Excursions in Modern Mathematics 10th edition Tannenbaum Test Bank

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INSTRUCTOR'S TESTING MANUAL

EXCURSIONS IN MODERN MATHEMATICS

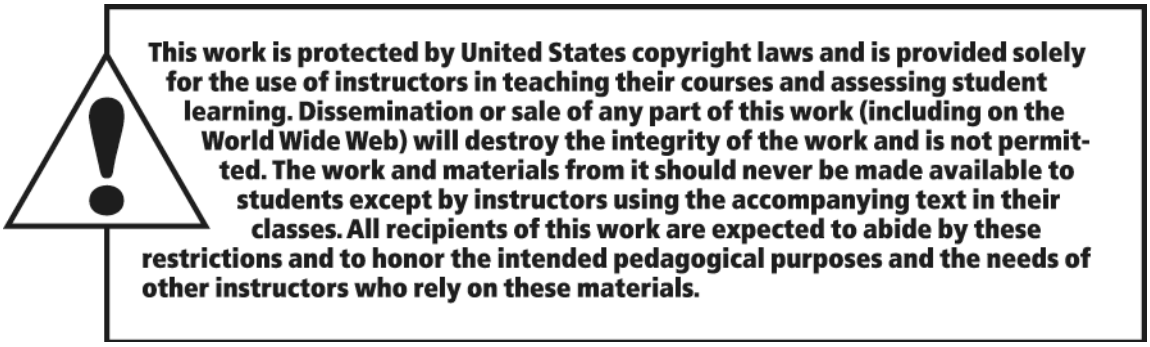
TENTH EDITION

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Excursions in Modern Mathematics 10th edition Tannenbaum Test Bank

Table of Contents

Chapter 1

Version 1

Version 2

Chapter 2

Version 1

Version 2

Chapter 3

Version 1

Version 2

Chapter 4

Version 1

Version 2

Chapter 5

Version 1

Version 2

Chapter 6

Version 1

Version 2

Chapter 7

Version 1

Version 2

Chapter 8

Version 1

Version 2

Chapter 9

Version 1

Version 2

Excursions in Modern Mathematics 10th edition Tannenbaum Test Bank

Chapter 10
Version 1
Version 2
Chapter 11
Version 1
Version 2
Chapter 12
Version 1
Version 2
Chapter 13
Version 1
Version 2
Chapter 14
Version 1
Version 2
Chapter 15
Version 1
Version 2
Chapter 16
Version 1
Version 2
Chapter 17
Version 1
Version 2

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Chapter 1

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

1) The student body at Hickory Middle School is voting for which new food item should be added to the school's cafeteria menu. The choices are Turkey Club (TC), Popcorn Shrimp (PS), BBQ Ribwich (BR), and Tofu Stir fry (TS). The following table gives the preference schedule for the results of the vote. 1) _____

Number of voters	**57**	**34**	**19**	**12**	**10**
1st choice	**PS**	**BR**	**TS**	**TC**	**TS**
2nd choice	**TC**	**PS**	**BR**	**BR**	**TC**
3rd choice	**BR**	**TS**	**TC**	**PS**	**BR**
4th choice	**TS**	**TC**	**PS**	**TS**	**PS**

Suppose that the voting rules are that when there is a food item with a majority of votes, it is the winner. Otherwise, all candidates with 20% or less of the first-place votes are eliminated and the votes are recounted. Find the preference schedule for the recount.

A)

	67	53	12
1st choice	TC	BR	TC
2nd choice	BR	TS	BR
3rd choice	TS	TC	TS

B)

	57	46	29
1st choice	PS	BR	TS
2nd choice	BR	PS	BR
3rd choice	TS	TS	PS

C)

	57	34	22	19
1st choice	PS	BR	TC	BR
2nd choice	TC	PS	BR	TC
3rd choice	BR	TC	PS	PS

D)

	57	44	31
1st choice	PS	BR	TC
2nd choice	TC	PS	BR
3rd choice	BR	TC	PS

E)

	57	46	29
1st choice	PS	BR	TS
2nd choice	BR	PS	PS
3rd choice	TS	TS	BR

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For an election with candidates (A, B, C, D, and E), we have the following preference schedule:

Number of voters	51	48	5
1st choice	A	D	E
2nd choice	B	C	C
3rd choice	C	B	D
4th choice	D	A	B
5th choice	E	E	A

2) Which candidate has the most second place votes? 2) _____

A) A B) B C) C D) D E) E

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of Voters	6	3	5	8
1st choice	D	D	A	C
2nd choice	B	A	C	A
3rd choice	A	B	B	D
4th choice	C	C	D	B

3) Using the plurality method, which candidate wins the election? 3) _____

A) A B) B C) C D) D

Solve the problem.

4) Consider an election with 769 voters and six candidates. What is the smallest number of votes that a plurality candidate could have? 4) _____

A) 128
B) 129
C) 385
D) 384
E) none of these

5) Consider an election with 456 voters and seven candidates. What is the smallest number of votes that a plurality candidate could have? 5) _____

A) 229
B) 66
C) 228
D) 65
E) none of these

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For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of voters	15	11	9	6	2
1st choice	A	C	D	B	C
2nd choice	B	B	C	D	D
3rd choice	C	D	B	C	B
4th choice	D	A	A	A	A

6) The ranking of the candidates using the plurality method is 6) _____

A) first: A; second: D; third: C; fourth: B.
B) first: A; second: B; third: C; fourth: D.
C) first: A; second: C; third: D; fourth: B.
D) first: A; second: D; third: B; fourth: C.
E) none of these

For an election with 4 candidates (A, B, C, and D), we have the following preference schedule:

Number of voters	20	14	8	7	2
1st choice	A	C	D	C	D
2nd choice	B	B	B	D	A
3rd choice	C	D	A	B	B
4th choice	D	A	C	A	C

7) Using the plurality ranking method, which candidate comes in last? 7) _____

A) A
B) B
C) C
D) D
E) none of these

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of voters	15	11	9	6	2
1st choice	A	C	D	B	C
2nd choice	B	B	C	D	D
3rd choice	C	D	B	C	B
4th choice	D	A	A	A	A

8) How many Borda points does candidate D earn in this election? 8) _____

A) 88
B) 121
C) 97
D) 124
E) none of these

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For an election with 4 candidates (A, B, C, and D), we have the following preference schedule:

Number of voters	20	14	8	7	2
1st choice	A	C	D	C	D
2nd choice	B	B	B	D	A
3rd choice	C	D	A	B	B
4th choice	D	A	C	A	C

9) How many Borda points does candidate D earn in this election? 9) _____

A) 109
B) 134
C) 144
D) 123
E) none of these

10) Using the Borda count method, the winner of the election is 10) _____

A) A.
B) B.
C) C.
D) E.
E) none of these

For an election with candidates A, B and C, we have the following preference schedule:

Number of voters	27	24	2
1st choice	A	B	C
2nd choice	C	C	B
3rd choice	B	A	A

11) Using the Borda count method, the winner of the election is 11) _____

A) A, B and C tie.
B) C.
C) A and B tie.
D) A.
E) B.

12) Using the Borda count method, which candidate wins the election if candidate B drops out of the race? 12) _____

A) A and C tie.
B) A
C) Cannot be determined from the information given.
D) C
E) none of these

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Solve the problem.

13) An election involving 5 candidates and 30 voters is held, and the results of the election are to be determined using the Borda count method. Assuming there isn't a five–way tie, the minimum number of points a winning candidate can receive is 13) _____

A) 51 points.
B) 91 points.
C) 151 points.
D) 31 points.
E) none of these

14) An election involving 6 candidates and 20 voters is held and the results of the election are to be determined using the Borda count method. The maximum number of points a candidate can receive is 14) _____

A) 15 points
B) 120 points.
C) 20 points
D) 60 points.
E) none of these

15) An election involving 6 candidates and 20 voters is held, and the results of the election are to be determined using the Borda count method. Assuming there isn't a six–way tie, the minimum number of points a winning candidate can receive is 15) _____

A) 71 points.
B) 91 points.
C) 81 points.
D) 61 points.
E) none of these

In a recent election involving three candidates, 20% of the voters preferred candidate A to C and C to B. Forty percent preferred candidate C the most and A the least. The other 900 voters preferred B the most and A the least.

16) How many Borda points would candidate C receive in this election? 16) _____

A) 5400
B) 1800
C) 4500
D) 900
E) none of these

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of Voters	6	3	5	8
1st choice	D	D	A	C
2nd choice	B	A	C	A
3rd choice	A	B	B	D
4th choice	C	C	D	B

17) The ranking of the candidates using the Borda count method is 17) _____

A) first: A; second: D; third: C; fourth: B.
B) first: D; second: A; third: C; fourth: B.
C) first: D; second: C; third: A; fourth: B.
D) first: A; second: C; third: D; fourth: B.
E) none of these

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For an election with 4 candidates (A, B, C, and D) we have the following preference schedule:

Number of Voters	27	19	8	15	2
1st Choice	B	A	D	C	A
2nd Choice	D	D	C	A	C
3rd Choice	A	C	A	D	D
4th Choice	C	B	B	B	B

18) Using the Borda count ranking method, which candidate comes in last? 18) _____

A) A
B) B
C) C
D) D
E) none of these

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of voters	15	11	9	6	2
1st choice	A	C	D	B	C
2nd choice	B	B	C	D	D
3rd choice	C	D	B	C	B
4th choice	D	A	A	A	A

19) Using the plurality–with–elimination method, which candidate is eliminated second? 19) _____

A) A
B) B
C) C
D) D
E) none of these

For an election with 4 candidates (A, B, C, and D), we have the following preference schedule:

Number of voters	20	14	8	7	2
1st choice	A	C	D	C	D
2nd choice	B	B	B	D	A
3rd choice	C	D	A	B	B
4th choice	D	A	C	A	C

20) Using the plurality–with–elimination method, which candidate is eliminated immediately before the winner of the election? 20) _____

A) A
B) B
C) C
D) D
E) none of these

21) Using the plurality–with–elimination method, the winner of the election is 21) _____

A) A.
B) B.
C) C.
D) D.
E) none of these

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Solve the problem.

22) Consider an election using the plurality with elimination method illustrated in the table below. 22) _____

	1st round	2nd round
A	4	4*
B	3	5
C	2*	

* Eliminated

Which of the following represent a possible preference schedule for this election?

A)

	4	3	2
1st choice	A	B	C
2nd choice	C	A	A
3rd choice	B	C	B

B)

	4	3	2
1st choice	A	B	C
2nd choice	B	C	B
3rd choice	C	A	A

C)

	4	3	2
1st choice	A	B	C
2nd choice	C	A	B
3rd choice	B	C	A

D) Both ballots in A) and B) are possible.

E) none of these

23) Consider an election using the plurality with elimination method illustrated in the table below. 23) _____

	1st round	2nd round	3rd round
A	5	5	5*
B	3	5	9
C	4	4*	
D	2*		

* Eliminated

Which of the following represents a possible preference table for this election?

A)

	5	4	3	2
1st choice	A	C	B	D
2nd choice	B	D	D	B
3rd choice	D	B	C	C
4th choice	C	A	A	A

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B)

	5	4	3	2
1st choice	A	C	B	D
2nd choice	B	D	A	B
3rd choice	C	B	C	C
4th choice	D	A	D	A

C)

	5	4	3	2
1st choice	A	C	B	D
2nd choice	B	D	C	B
3rd choice	C	B	A	A
4th choice	D	A	D	C

D)

	5	4	3	2
1st choice	A	C	B	D
2nd choice	C	D	A	B
3rd choice	B	B	D	A
4th choice	D	A	C	C

E) all of these

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of Voters	**6**	**3**	**5**	**8**
1st choice	**D**	**D**	**A**	**C**
2nd choice	**B**	**A**	**C**	**A**
3rd choice	**A**	**B**	**B**	**D**
4th choice	**C**	**C**	**D**	**B**

24) The ranking of the candidates using the plurality–with–elimination method is 24) _____

A) first: C; second: A; third: B; fourth: D.
B) first: D; second: C; third: A; fourth: B.
C) first: C; second: D; third: A; fourth: B.
D) first: C; second: A; third: D; fourth: B.
E) none of these

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of voters	**15**	**11**	**9**	**6**	**2**
1st choice	**A**	**C**	**D**	**B**	**C**
2nd choice	**B**	**B**	**C**	**D**	**D**
3rd choice	**C**	**D**	**B**	**C**	**B**
4th choice	**D**	**A**	**A**	**A**	**A**

25) The ranking of the candidates using the plurality–with–elimination method is 25) _____

A) first: C; second: D; third: A; fourth: B.
B) first: D; second: C; third: B; fourth: A.
C) first: D; second: A; third: C; fourth: B.
D) first: C; second: A; third: D; fourth: B.
E) none of these

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For an election with 4 candidates (A, B, C, and D), we have the following preference schedule:

Number of voters	20	14	8	7	2
1st choice	A	C	D	C	D
2nd choice	B	B	B	D	A
3rd choice	C	D	A	B	B
4th choice	D	A	C	A	C

26) Using the plurality–with–elimination ranking method, which candidate comes in second? 26) _____

A) A
B) B
C) C
D) D
E) none of these

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of Voters	6	3	5	8
1st choice	D	D	A	C
2nd choice	B	A	C	A
3rd choice	A	B	B	D
4th choice	C	C	D	B

27) Using the method of pairwise comparisons, which candidate wins the election? 27) _____

A) A
B) B
C) C
D) D
E) none of these

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of voters	15	11	9	6	2
1st choice	A	C	D	B	C
2nd choice	B	B	C	D	D
3rd choice	C	D	B	C	B
4th choice	D	A	A	A	A

28) How many pairwise comparisons does candidate B win? 28) _____

A) 0
B) 1
C) 2
D) 3
E) none of these

29) Using the method of pairwise comparisons, which candidate wins the election? 29) _____

A) A
B) B
C) C
D) D
E) none of these

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For an election with 4 candidates (A, B, C, and D), we have the following preference schedule:

Number of voters	20	14	8	7	2
1st choice	A	C	D	C	D
2nd choice	B	B	B	D	A
3rd choice	C	D	A	B	B
4th choice	D	A	C	A	C

30) Which candidate wins in the pairwise comparison between candidate A and candidate D? 30) _____

A) A
B) Neither – it is a tie.
C) Cannot be determined from the information given.
D) D
E) none of these

For an election with 6 candidates (A, B, C, D, E, and F), we have the following preference schedule:

Number of Voters	41	10	10	15	5
1st choice	B	F	A	A	E
2nd choice	A	A	E	F	F
3rd choice	D	E	F	E	A
4th choice	F	C	D	D	B
5th choice	E	D	C	B	D
6th choice	C	B	B	C	C

31) Using the method of pairwise comparisons, the winner of the election is 31) _____

A) A.
B) B.
C) C.
D) E.
E) none of these

For an election with candidates (A, B, C, D, and E), we have the following preference schedule:

Number of voters	51	48	5
1st choice	A	D	E
2nd choice	B	C	C
3rd choice	C	B	D
4th choice	D	A	B
5th choice	E	E	A

32) Using the method of pairwise comparisons, the winner of the election is 32) _____

A) A. B) B. C) C. D) D. E) E.

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Solve the problem.

33) An election is held among six candidates (A, B, C, D, E, and F). Using the method of pairwise comparisons, A gets 5 points; B gets 4 points; C gets 2 points; D gets $1\frac{1}{2}$ points, and E gets 0 points. 33) _____

How many points does F get?

A) 3

B) 2

C) $2\frac{1}{2}$

D) $1\frac{1}{2}$

E) none of these

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of voters	15	11	9	6	2
1st choice	A	C	D	B	C
2nd choice	B	B	C	D	D
3rd choice	C	D	B	C	B
4th choice	D	A	A	A	A

34) The ranking of the candidates using the pairwise comparisons method is 34) _____

A) first: B; second: C; third: A; fourth: D.

B) first: C; second: B; third: A; fourth: D.

C) first: C; second: B; third: D; fourth: A.

D) first: C; second: A; third: D; fourth: B.

E) none of these

For an election with 4 candidates (A, B, C, and D) we have the following preference schedule:

Number of Voters	27	19	8	15	2
1st Choice	B	A	D	C	A
2nd Choice	D	D	C	A	C
3rd Choice	A	C	A	D	D
4th Choice	C	B	B	B	B

35) Using the pairwise comparison ranking method, which candidate comes in third? 35) _____

A) A

B) B

C) C

D) D

E) none of these

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For an election with 4 candidates (A, B, C, and D), we have the following preference schedule:

Number of voters	20	14	8	7	2
1st choice	A	C	D	C	D
2nd choice	B	B	B	D	A
3rd choice	C	D	A	B	B
4th choice	D	A	C	A	C

36) Using the pairwise comparison ranking method, which candidates tie for second place? 36) _____

A) A and B
B) B and C
C) C and D
D) A, C, and D
E) none of these

Solve the problem.

37) An election is held among six candidates. What is the total number of pairwise comparisons in this election? 37) _____

A) 6^2 B) 6 C) 2×6 D) 2^6 E) $\frac{6 \times 5}{2}$

38) An election is held among 21 candidates. What is the total number of pairwise comparisons in this election? 38) _____

A) 21×2 B) 21 C) 21^2 D) $\frac{21 \times 20}{2}$ E) 2^{21}

39) In a round robin tennis tournament, every player plays against every other player. If 11 players are entered in a round robin tennis tournament, how many matches will be played? 39) _____

A) 11^2 B) $\frac{11 \times 10}{2}$ C) 11×2 D) 11×10 E) 2^{11}

40) In a round robin tennis tournament, every player plays against every other player. If 24 players are entered in a round robin tennis tournament, how many matches will be played? 40) _____

A) 24×2 B) 24×23 C) 24^2 D) 2^{24} E) $\frac{24 \times 23}{2}$

41) "If there is a choice that in a head–to–head comparison is preferred by the voters over every other choice, then that choice should be the winner of the election." This fairness criterion is called the 41) _____

A) mononocity criterion.
B) Condorcet criterion.
C) majority criterion.
D) independence of irrelevant alternatives criterion.
E) none of these

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42) "If choice X is a winner of an election and one (or more) of the other choices is removed and the ballots recounted, then X should still be a winner of the election." This fairness criterion is called the 42) _____

A) majority criterion.
B) independence of irrelevant alternatives criterion.
C) Condorcet criterion.
D) monotonicity criterion.
E) none of these

43) An election is held among four candidates (A, B, C, and D). Using a voting method we will call X, the winner of the election is candidate A. Due to an irregularity in the original vote count, a recount is required. Before the recount takes place, candidate B drops out of the race. In the recount, still using voting method X, candidate D wins the election. Based on this information, we can say that voting method X violates the 43) _____

A) majority criterion.
B) Condorcet criterion.
C) monotonicity criterion.
D) independence of irrelevant alternatives criterion.
E) none of these

44) An election is held among four candidates (A, B, C, and D). Using a voting method we will call X, the winner of the election is candidate A. Due to an irregularity in the original procedures, a new election is required. Before the new election takes place, one of the voters changes his mind and moves A from third choice to second choice on his ballot. All other voters vote the same way they did in the original election. In the new election, still using voting method X, candidate D wins the election. Based on this information, we can say that voting method X violates the 44) _____

A) Condorcet criterion.
B) majority criterion.
C) monotonicity criterion.
D) independence of irrelevant alternatives criterion.
E) none of these

45) An election is held among four candidates (A, B, C, and D). Using a voting method we will call X, the winner of the election is candidate A. However, candidate D beats each other candidate in a head to head, pairwise comparison. Based on this information, we can say that voting method X violates the 45) _____

A) monotonicity criterion.
B) Condorcet criterion.
C) majority criterion.
D) independence of irrelevant alternatives criterion.
E) none of these

46) An election is held among five candidates (A, B, C, D, and E). There are 37 voters. Using the method of pairwise comparisons, A, B, and C win one pairwise comparison each. D wins three pairwise comparisons, and E wins all the rest. In this election 46) _____

A) There is no Condorcet candidate.
B) D is a Condorcet candidate.
C) E is a Condorcet candidate.
D) Cannot be determined from the information given.
E) none of these

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47) Arrow's Impossibility Theorem implies 47) _____

A) that every voting method can potentially violate each one of the four fairness criteria.
B) that in every election, no matter what voting method we use, at least one of the four fairness criteria will be violated.
C) that it is impossible to have a voting method that satisfies all four of the fairness criteria.
D) that in every election, each of the voting methods must produce a different winner.
E) none of these

48) An election is held among five candidates (A, B, C, D, and E) and A gets a majority of the first place votes but B wins the election. Which of the following methods could have been the method used to decide this election? 48) _____

A) The Borda count method
B) The method of pairwise comparisons
C) The plurality–with–elimination method
D) all of these
E) none of these

49) An election is held among six candidates (A, B, C, D, E and F) and A gets a plurality of the first place votes but C wins the election. Which of the following methods could have been the method used to decide this election? 49) _____

A) The plurality–with–elimination method.
B) The Borda count method.
C) The method of pairwise comparisons.
D) all of these
E) none of these

50) The plurality method violates 50) _____

A) the Condorcet criterion.
B) the majority criterion.
C) the monotonicity criterion.
D) none of the four criteria.
E) none of these

51) The Borda count method satisfies 51) _____

A) the Condorcet criterion.
B) the majority criterion.
C) the monotonicity criterion.
D) All three of the above
E) none of these

52) The plurality with elimination method satisfies 52) _____

A) the majority criterion.
B) the monotonicity criterion.
C) the Condorcet criterion.
D) All three of the above
E) none of these

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1) B
2) C
3) D
4) B
5) B
6) C
7) B
8) C
9) A
10) A
11) B
12) B
13) B
14) B
15) A
16) A
17) A
18) B
19) C
20) C
21) A
22) D
23) E
24) C
25) C
26) C
27) A
28) C
29) C
30) D
31) B
32) C
33) C
34) C
35) C
36) D
37) E
38) D
39) B
40) E
41) B
42) B
43) D
44) C
45) B
46) C
47) C
48) A
49) D
50) A

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51) C
52) A

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Chapter 1

Name_____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Solve the problem.

1) The student body at Hickory Middle School is voting for which new food item should be added to the school's cafeteria menu. The choices are Turkey Club (TC), Popcorn Shrimp (PS), BBQ Ribwich (BR), and Tofu Stir fry (TS). The following table gives the preference schedule for the results of the vote. 1) _____

Number of voters	57	34	19	12	10
1st choice	PS	BR	TS	TC	TS
2nd choice	TC	PS	BR	BR	TC
3rd choice	BR	TS	TC	PS	BR
4th choice	TS	TC	PS	TS	PS

Suppose that the voting rules are that when there is a food item with a majority of votes, it is the winner. Otherwise, all candidates with 20% or less of the first–place votes are eliminated and the votes are recounted. Find the preference schedule for the recount.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of voters	15	11	9	6	2
1st choice	A	C	D	B	C
2nd choice	B	B	C	D	D
3rd choice	C	D	B	C	B
4th choice	D	A	A	A	A

1) How many first–place votes are needed for a majority in this election? 1) _____

A) 15
B) 20
C) 22
D) 43
E) none of these

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For an election with candidates (A, B, C, D, and E), we have the following preference schedule:

Number of voters	51	48	5
1st choice	A	D	E
2nd choice	B	C	C
3rd choice	C	B	D
4th choice	D	A	B
5th choice	E	E	A

2) How many people voted in the election? 2) _____

A) 3
B) 51
C) 104
D) 5
E) none of these

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of voters	15	11	9	6	2
1st choice	A	C	D	B	C
2nd choice	B	B	C	D	D
3rd choice	C	D	B	C	B
4th choice	D	A	A	A	A

3) Using the plurality method, which candidate wins the election? 3) _____

A) A
B) B
C) C
D) D
E) none of these

For an election with 4 candidates (A, B, C, and D), we have the following preference schedule:

Number of voters	20	14	8	7	2
1st choice	A	C	D	C	D
2nd choice	B	B	B	D	A
3rd choice	C	D	A	B	B
4th choice	D	A	C	A	C

4) Using the plurality method, the winner of the election is 4) _____

A) A.
B) B.
C) C.
D) D.
E) none of these

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For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of voters	15	11	9	6	2
1st choice	A	C	D	B	C
2nd choice	B	B	C	D	D
3rd choice	C	D	B	C	B
4th choice	D	A	A	A	A

5) The ranking of the candidates using the plurality method is 5) _____
A) first: A; second: D; third: B; fourth: C.
B) first: A; second: C; third: D; fourth: B.
C) first: A; second: B; third: C; fourth: D.
D) first: A; second: D; third: C; fourth: B.
E) none of these

6) How many Borda points does candidate D earn in this election? 6) _____
A) 124
B) 88
C) 97
D) 121
E) none of these

For an election with 4 candidates (A, B, C, and D) we have the following preference schedule:

Number of Voters	27	19	8	15	2
1st Choice	B	A	D	C	A
2nd Choice	D	D	C	A	C
3rd Choice	A	C	A	D	D
4th Choice	C	B	B	B	B

7) Using the Borda count method, the winner of the election is 7) _____
A) A.
B) B.
C) C.
D) D.
E) none of these

For an election with 4 candidates (A, B, C, and D), we have the following preference schedule:

Number of voters	20	14	8	7	2
1st choice	A	C	D	C	D
2nd choice	B	B	B	D	A
3rd choice	C	D	A	B	B
4th choice	D	A	C	A	C

8) Using the Borda count method, the winner of the election is 8) _____
A) A.
B) B.
C) C.
D) D.
E) none of these

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For an election with candidates (A, B, C, D, and E), we have the following preference schedule:

Number of voters	51	48	5
1st choice	A	D	E
2nd choice	B	C	C
3rd choice	C	B	D
4th choice	D	A	B
5th choice	E	E	A

9) Using the Borda count method, the winner of the election is 9) _____
A) A. B) B. C) C. D) D. E) E.

Solve the problem.

10) An election is held among four candidates (A, B, C, and D) using the Borda count method. There are 30 voters. If candidate A received 93 points and candidate B received 57 points, and candidates C and D tied, how many points did candidates C and D each receive? 10) _____
A) 75
B) 150
C) It is not possible to have ties using the Borda count.
D) Cannot be determined from the information given.
E) none of these

11) An election involving 5 candidates and 30 voters is held, and the results of the election are to be determined using the Borda count method. The minimum number of points a candidate can receive is 11) _____
A) 150 points.
B) 50 points.
C) 90 points.
D) 30 points.
E) none of these

12) An election involving 6 candidates and 20 voters is held and the results of the election are to be determined using the Borda count method. The maximum number of points a candidate can receive is 12) _____
A) 15 points
B) 120 points.
C) 20 points
D) 60 points.
E) none of these

13) An election involving 6 candidates and 20 voters is held, and the results of the election are to be determined using the Borda count method. Assuming there isn't a six–way tie, the minimum number of points a winning candidate can receive is 13) _____
A) 61 points.
B) 71 points.
C) 91 points.
D) 81 points.
E) none of these

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In a recent election involving three candidates, 20% of the voters preferred candidate A to C and C to B. Forty percent preferred candidate C the most and A the least. The other 900 voters preferred B the most and A the least.

14) How many people voted in this election? 14) _____

A) 2250
B) 4500
C) 1800
D) 900
E) none of these

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of Voters	6	3	5	8
1st choice	D	D	A	C
2nd choice	B	A	C	A
3rd choice	A	B	B	D
4th choice	C	C	D	B

15) The ranking of the candidates using the Borda count method is 15) _____

A) first: A; second: C; third: D; fourth: B.
B) first: D; second: A; third: C; fourth: B.
C) first: A; second: D; third: C; fourth: B.
D) first: D; second: C; third: A; fourth: B.
E) none of these

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of voters	15	11	9	6	2
1st choice	A	C	D	B	C
2nd choice	B	B	C	D	D
3rd choice	C	D	B	C	B
4th choice	D	A	A	A	A

16) The ranking of the candidates using the Borda count method is 16) _____

A) first: B; second: C; third: D; fourth: A.
B) first: B; second: A; third: C; fourth: D.
C) first: B; second: C; third: A; fourth: D.
D) first: C; second: A; third: D; fourth: B.
E) none of these

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For an election with 4 candidates (A, B, C, and D), we have the following preference schedule:

Number of voters	20	14	8	7	2
1st choice	A	C	D	C	D
2nd choice	B	B	B	D	A
3rd choice	C	D	A	B	B
4th choice	D	A	C	A	C

17) Using the Borda count ranking method, which candidate comes in last? 17) _____

A) A
B) B
C) C
D) D
E) none of these

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of Voters	6	3	5	8
1st choice	D	D	A	C
2nd choice	B	A	C	A
3rd choice	A	B	B	D
4th choice	C	C	D	B

18) Using the plurality–with–elimination method, which candidate wins the election? 18) _____

A) A
B) B
C) C
D) D
E) none of these

For an election with 4 candidates (A, B, C, and D) we have the following preference schedule:

Number of Voters	27	19	8	15	2
1st Choice	B	A	D	C	A
2nd Choice	D	D	C	A	C
3rd Choice	A	C	A	D	D
4th Choice	C	B	B	B	B

19) Using the plurality–with–elimination method, the winner of the election is 19) _____

A) A.
B) B.
C) C.
D) D.
E) none of these

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For an election with 4 candidates (A, B, C, and D), we have the following preference schedule:

Number of voters	20	14	8	7	2
1st choice	A	C	D	C	D
2nd choice	B	B	B	D	A
3rd choice	C	D	A	B	B
4th choice	D	A	C	A	C

20) Using the plurality–with–elimination method, which candidate is eliminated immediately before the winner of the election? 20) _____

A) A
B) B
C) C
D) D
E) none of these

For an election with 6 candidates (A, B, C, D, E, and F), we have the following preference schedule:

Number of Voters	41	10	10	15	5
1st choice	B	F	A	A	E
2nd choice	A	A	E	F	F
3rd choice	D	E	F	E	A
4th choice	F	C	D	D	B
5th choice	E	D	C	B	D
6th choice	C	B	B	C	C

21) Using the plurality–with–elimination method, the winner of the election is 21) _____

A) A.
B) B.
C) C.
D) E.
E) none of these

For an election with candidates (A, B, C, D, and E), we have the following preference schedule:

Number of voters	51	48	5
1st choice	A	D	E
2nd choice	B	C	C
3rd choice	C	B	D
4th choice	D	A	B
5th choice	E	E	A

22) Using the plurality–with–elimination method, the winner of the election is 22) _____

A) A. B) B. C) C. D) D. E) E.

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The cities of Beijing, Sydney, Manchester, Berlin, and Istanbul each vied to hold the 2000 Summer Olympics. There was an election using plurality with elimination. Four rounds worth of Olympic Committee voting are shown in the table below.

	1st round	2nd round	3rd round	4th round
Beijing	**32**	**37**	**40**	**43***
Sydney	**30**	**30**	**37**	**45**
Manchester	**11**	**13**	**11***	
Berlin	**9**	**9***		
Istanbul	**7***			

*** Eliminated**

23) How many members are on the Olympic Committee? 23) _____

A) 152
B) 354
C) 4
D) 89
E) none of these

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of Voters	6	3	5	8
1st choice	**D**	**D**	**A**	**C**
2nd choice	**B**	**A**	**C**	**A**
3rd choice	**A**	**B**	**B**	**D**
4th choice	**C**	**C**	**D**	**B**

24) The ranking of the candidates using the plurality–with–elimination method is 24) _____

A) first: C; second: A; third: D; fourth: B.
B) first: D; second: C; third: A; fourth: B.
C) first: C; second: D; third: A; fourth: B.
D) first: C; second: A; third: B; fourth: D.
E) none of these

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of voters	15	11	9	6	2
1st choice	**A**	**C**	**D**	**B**	**C**
2nd choice	**B**	**B**	**C**	**D**	**D**
3rd choice	**C**	**D**	**B**	**C**	**B**
4th choice	**D**	**A**	**A**	**A**	**A**

25) The ranking of the candidates using the plurality–with–elimination method is 25) _____

A) first: C; second: A; third: D; fourth: B.
B) first: C; second: D; third: A; fourth: B.
C) first: D; second: A; third: C; fourth: B.
D) first: D; second: C; third: B; fourth: A.
E) none of these

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For an election with 4 candidates (A, B, C, and D), we have the following preference schedule:

Number of voters	20	14	8	7	2
1st choice	A	C	D	C	D
2nd choice	B	B	B	D	A
3rd choice	C	D	A	B	B
4th choice	D	A	C	A	C

26) Using the plurality–with–elimination ranking method, which candidate comes in second? 26) _____

A) A
B) B
C) C
D) D
E) none of these

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of Voters	6	3	5	8
1st choice	D	D	A	C
2nd choice	B	A	C	A
3rd choice	A	B	B	D
4th choice	C	C	D	B

27) Using the method of pairwise comparisons, which candidate wins the election? 27) _____

A) A
B) B
C) C
D) D
E) none of these

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of voters	15	11	9	6	2
1st choice	A	C	D	B	C
2nd choice	B	B	C	D	D
3rd choice	C	D	B	C	B
4th choice	D	A	A	A	A

28) How many pairwise comparisons does candidate B win? 28) _____

A) 0
B) 1
C) 2
D) 3
E) none of these

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For an election with 4 candidates (A, B, C, and D), we have the following preference schedule:

Number of voters	20	14	8	7	2
1st choice	A	C	D	C	D
2nd choice	B	B	B	D	A
3rd choice	C	D	A	B	B
4th choice	D	A	C	A	C

29) How many pairwise comparisons does candidate A win? 29) _____

A) 0
B) 1
C) 2
D) 3
E) none of these

For an election with 6 candidates (A, B, C, D, E, and F), we have the following preference schedule:

Number of Voters	41	10	10	15	5
1st choice	B	F	A	A	E
2nd choice	A	A	E	F	F
3rd choice	D	E	F	E	A
4th choice	F	C	D	D	B
5th choice	E	D	C	B	D
6th choice	C	B	B	C	C

30) Using the method of pairwise comparisons, the winner of the election is 30) _____

A) A.
B) B.
C) C.
D) E.
E) none of these

Solve the problem.

31) An election is held among six candidates (A, B, C, D, E, and F). Using the method of pairwise comparisons, A gets 5 points; B gets 4 points; C gets 2 points; D gets $1\frac{1}{2}$ points, and E gets 0 points. 31) _____

How many points does F get?

A) 3
B) $1\frac{1}{2}$
C) $2\frac{1}{2}$
D) 2
E) none of these

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For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of Voters	6	3	5	8
1st choice	D	D	A	C
2nd choice	B	A	C	A
3rd choice	A	B	B	D
4th choice	C	C	D	B

32) The ranking of the candidates using the pairwise comparisons method is 32) _____

A) first: D; second: C; third: A; fourth: B.
B) first: D; second: A; third: C; fourth: B.
C) first: A; second: D; third: C; fourth: B.
D) first: A; second: C; third: D; fourth: B.
E) none of these

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of voters	15	11	9	6	2
1st choice	A	C	D	B	C
2nd choice	B	B	C	D	D
3rd choice	C	D	B	C	B
4th choice	D	A	A	A	A

33) The ranking of the candidates using the pairwise comparisons method is 33) _____

A) first: C; second: B; third: D; fourth: A.
B) first: B; second: C; third: A; fourth: D.
C) first: C; second: B; third: A; fourth: D.
D) first: C; second: A; third: D; fourth: B.
E) none of these

For an election with 4 candidates (A, B, C, and D) we have the following preference schedule:

Number of Voters	27	19	8	15	2
1st Choice	B	A	D	C	A
2nd Choice	D	D	C	A	C
3rd Choice	A	C	A	D	D
4th Choice	C	B	B	B	B

34) Using the pairwise comparison ranking method, which candidate comes in third? 34) _____

A) A
B) B
C) C
D) D
E) none of these

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For an election with 4 candidates (A, B, C, and D), we have the following preference schedule:

Number of voters	20	14	8	7	2
1st choice	A	C	D	C	D
2nd choice	B	B	B	D	A
3rd choice	C	D	A	B	B
4th choice	D	A	C	A	C

35) Using the pairwise comparison ranking method, which candidates tie for second place? 35) _____

A) A and B
B) B and C
C) C and D
D) A, C, and D
E) none of these

Solve the problem.

36) An election is held among 21 candidates. What is the total number of pairwise comparisons in this election? 36) _____

A) 2^{21} B) $\frac{21 \times 20}{2}$ C) 21×2 D) 21^2 E) 21

37) In a round robin tennis tournament, every player plays against every other player. If 11 players are entered in a round robin tennis tournament, how many matches will be played? 37) _____

A) 11×10 B) 11^2 C) 11×2 D) $\frac{11 \times 10}{2}$ E) 2^{11}

For an election with four candidates (A, B, C, and D) we have the following preference schedule:

Number of voters	15	11	9	6	2
1st choice	A	C	D	B	C
2nd choice	B	B	C	D	D
3rd choice	C	D	B	C	B
4th choice	D	A	A	A	A

38) In this election, 38) _____

A) C is a Condorcet candidate.
B) D is a Condorcet candidate.
C) every candidate is a Condorcet candidate.
D) there is no Condorcet candidate.
E) none of these

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For an election with 4 candidates (A, B, C, and D), we have the following preference schedule:

Number of voters	20	14	8	7	2
1st choice	A	C	D	C	D
2nd choice	B	B	B	D	A
3rd choice	C	D	A	B	B
4th choice	D	A	C	A	C

39) In this election, 39) _____

A) A is a Condorcet candidate.
B) B is a Condorcet candidate.
C) C is a Condorcet candidate.
D) D is a Condorcet candidate.
E) none of these

Solve the problem.

40) "If choice X is a winner of an election and, in a reelection, the only changes in the ballots are changes that only favor X, then X should remain a winner of the election." This fairness criterion is called the 40) _____

A) Condorcet criterion.
B) majority criterion.
C) monotonicity criterion.
D) independence of irrelevant alternatives criterion.
E) none of these

41) "If there is a choice that in a head–to–head comparison is preferred by the voters over every other choice, then that choice should be the winner of the election." This fairness criterion is called the 41) _____

A) Condorcet criterion.
B) independence of irrelevant alternatives criterion.
C) mononocity criterion.
D) majority criterion.
E) none of these

42) "If choice X is a winner of an election and one (or more) of the other choices is removed and the ballots recounted, then X should still be a winner of the election." This fairness criterion is called the 42) _____

A) monotonicity criterion.
B) majority criterion.
C) independence of irrelevant alternatives criterion.
D) Condorcet criterion.
E) none of these

43) "If there is a Condorcet candidate in an election, then such a candidate should be the winner of the election." This statement is another way to phrase the 43) _____

A) monotonicity criterion.
B) majority criterion.
C) Condorcet criterion.
D) independence of irrelevant alternatives criterion.
E) none of these

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44) An election is held among four candidates (A, B, C, and D). Using a voting method we will call X, the winner of the election is candidate A. Due to an irregularity in the original procedures, a new election is required. Before the new election takes place, one of the voters changes his mind and moves A from third choice to second choice on his ballot. All other voters vote the same way they did in the original election. In the new election, still using voting method X, candidate D wins the election. Based on this information, we can say that voting method X violates the _____ 44)

A) majority criterion.
B) independence of irrelevant alternatives criterion.
C) Condorcet criterion.
D) monotonicity criterion.
E) none of these

45) An election is held among four candidates (A, B, C, and D). Using a voting method we will call X, the winner of the election is candidate A. However, candidate D beats each other candidate in a head to head, pairwise comparison. Based on this information, we can say that voting method X violates the _____ 45)

A) Condorcet criterion.
B) independence of irrelevant alternatives criterion.
C) majority criterion.
D) monotonicity criterion.
E) none of these

46) An election is held among five candidates (A, B, C, D, and E). There are 37 voters. Using the method of pairwise comparisons, A, B, and C win one pairwise comparison each. D wins three pairwise comparisons, and E wins all the rest. In this election _____ 46)

A) There is no Condorcet candidate.
B) E is a Condorcet candidate.
C) D is a Condorcet candidate.
D) Cannot be determined from the information given.
E) none of these

47) An election is held among five candidates (A, B, C, D, and E) and A gets a majority of the first place votes but B wins the election. Which of the following methods could have been the method used to decide this election? _____ 47)

A) The method of pairwise comparisons
B) The plurality–with–elimination method
C) The Borda count method
D) all of these
E) none of these

48) An election is held among six candidates (A, B, C, D, E and F) and A gets a plurality of the first place votes but C wins the election. Which of the following methods could have been the method used to decide this election? _____ 48)

A) The Borda count method.
B) The method of pairwise comparisons.
C) The plurality–with–elimination method.
D) all of these
E) none of these

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49) The plurality method violates 49) _____

A) the majority criterion.
B) the monotonicity criterion.
C) the Condorcet criterion.
D) none of the four criteria.
E) none of these

50) The method of pairwise comparisons violates 50) _____

A) the independence of irrelevant alternatives criterion.
B) the majority criterion.
C) the monotonicity criterion.
D) the Condorcet criterion.
E) none of these

51) The plurality with elimination method satisfies 51) _____

A) the Condorcet criterion.
B) the monotonicity criterion.
C) the majority criterion.
D) All three of the above
E) none of these

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Answer Key
Testname:

1)

	57	46	29
1st choice	PS	BR	TS
2nd choice	BR	PS	BR
3rd choice	TS	TS	PS

1) C
2) C
3) A
4) C
5) B
6) C
7) D
8) B
9) C
10) A
11) D
12) B
13) B
14) A
15) C
16) A
17) D
18) C
19) C
20) C
21) B
22) D
23) D
24) C
25) C
26) C
27) A
28) C
29) B
30) B
31) C
32) D
33) A
34) C
35) D
36) B
37) D
38) A
39) B
40) C
41) A
42) C
43) C
44) D

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Answer Key
Testname:

45) A
46) B
47) C
48) D
49) C
50) A
51) C

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Chapter 2

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

1) How many players are there in the weighted voting system [20 : 7, 5, 4, 4, 2, 2, 2, 1, 1]? 1) _____
A) 10
B) 28
C) 9
D) 20
E) none of these

2) What is the quota in the weighted voting system [34 : 10, 7, 4, 4, 3, 3, 3, 1, 1]? 2) _____
A) 10
B) 34
C) 9
D) 36
E) none of these

3) The total number of votes in the weighted voting system [20 : 7, 5, 4, 4, 2, 2, 2, 1, 1] is 3) _____
A) 20.
B) 28.
C) 10.
D) 48.
E) none of these

4) In the weighted voting system [q : 10, 8, 4], a strict majority of the votes is needed to pass a motion. The value of the quota q is 4) _____
A) 12.
B) 10.
C) 11.
D) 13.
E) none of these

5) In the weighted voting system [q : 12, 10, 5, 1, 1], the largest possible value that the quota q can take is 5) _____
A) 22.
B) 30.
C) 29.
D) 15.
E) none of these

6) In the weighted voting system [q : 10, 8, 5], the smallest possible value that the quota q can take is 6) _____
A) 13.
B) 12.
C) 23.
D) 11.
E) none of these

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7) In the weighted voting system [q : 24, 12, 8, 4, 2], the largest value that the quota q can take is 7) _____

A) 36.
B) 24.
C) 25.
D) 50.
E) none of these

8) In the weighted voting system [30 : 24, 12, 8, 4, 2], the minimum percentage of votes needed to pass a motion is 8) _____

A) 30%. B) 51%. C) 50%. D) 61%. E) 60%.

9) In the weighted voting system [13 : 12, 7, 2], 9) _____

A) every player has veto power.
B) P_1 has veto power but is not a dictator.
C) no player has veto power.
D) P_1 is a dictator.
E) none of these

10) In the weighted voting system [14 : 7, 7, 6], 10) _____

A) P_1 and P_2 have equal power, P_3 is a dummy.
B) P_1 and P_2 have equal power, P_3 is not a dummy.
C) P_1 has all the power, P_2 and P_3 are dummies.
D) all three players have equal power.
E) none of these

11) In the weighted voting system [10 : 5, 4, 2], 11) _____

A) no player has veto power.
B) all three players have veto power.
C) P_1 and P_2 have veto power, P_3 is a dummy.
D) P_1 has veto power, P_3 is a dummy.
E) none of these

12) In the weighted voting system [11 : 5, 4, 2], 12) _____

A) all three players have veto power.
B) no player has veto power.
C) only P_1 has veto power.
D) P_1 and P_2 have veto power, P_3 is a dummy.
E) none of these

13) In the weighted voting system [q : 24, 12, 6, 3], what is the largest possible value of the quota q for which P_4 is a dummy? 13) _____

A) 41
B) 39
C) 42
D) 40
E) none of these

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14) In the weighted voting system $[q : 7, 5, 3, 2, 1]$, every player has veto power. The value of the quota q is 14) _____

A) 18.
B) 10.
C) 17.
D) 15.
E) none of these

15) In the weighted voting system $[q : 7, 5, 3, 2, 1]$, no player has veto power. The largest possible value that the quota q can take is 15) _____

A) 10.
B) 9.
C) 17.
D) 11.
E) none of these

16) A board is made up of two women (W) and three men (M). In order to pass a motion, three of the five including at least one woman must vote "yes". Which of the following weighted voting systems represent this situation? 16) _____

A) [8 : 3, 3, 2, 2, 2]
B) [3 : 1, 1, 1, 1, 1]
C) [7 : 3, 3, 2, 2, 2]
D) [6 : 3, 3, 2, 2, 2]
E) none of these

17) A player whose weight is bigger than the weight of every other player 17) _____

A) is a dictator.
B) is a critical player in every winning coalition.
C) is a dummy.
D) has veto power.
E) none of these

18) Consider the generic weighted voting system $[q : w_1, w_2, \ldots, w_N]$. Which of the following mathematical statements is equivalent to saying that P_1 is a dictator? 18) _____

A) $w_1 > q$
B) $w_2 + w_3 + \ldots + w_N < q$ and $w_1 < q$
C) $w_1 > w_2$
D) $w_1 \geq q$
E) none of these

Refer to the weighted voting system $[35 : 32, 15, 10, 3]$ and the Banzhaf definition of power. (The four players are P_1, P_2, P_3, and P_4.)

19) The winning coalitions are: 19) _____

A) all coalitions with three or more players.
B) all coalitions with two or more players, one of which is P_1.
C) all coalitions with two or more players.
D) all coalitions.
E) none of these

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20) The number of winning coalitions is 20) _____

A) 8.
B) 7.
C) 15.
D) 24.
E) none of these

21) Which players in the coalition $\{P_1, P_3\}$ are critical? 21) _____

A) P_1 and P_3
B) P_3 only
C) P_1 only
D) None of the players
E) none of these

22) The Banzhaf power distribution of the weighted voting system is 22) _____

A) P_1: 75%; P_2: $8\frac{1}{3}$%; P_3: $8\frac{1}{3}$%; P_4: $8\frac{1}{3}$%.
B) P_1: 40%; P_2: 20%; P_3: 20%; P_4: 20%.
C) P_1: 70%; P_2: 10%; P_3: 10%; P_4: 10%.
D) P_1: 60%; P_2: 20%; P_3: 10%; P_4: 10%.
E) none of these

Refer to the weighted voting system $[25 : 22, 12, 6, 3]$ and the Banzhaf definition of power. (The four players are P_1, P_2, P_3, and P_4.)

23) The weight of the coalition $\{P_2, P_3, P_4\}$ is 23) _____

A) 21.
B) 40.
C) 25.
D) 22.
E) none of these

24) The Banzhaf power distribution of the weighted voting system is 24) _____

A) P_1: 60%; P_2: 20%; P_3: 10%; P_4: 10%.
B) P_1: 25%; P_2: 25%; P_3: 25%; P_4: 25%.
C) P_1: 40%; P_2: 20%; P_3: 20%; P_4: 20%.
D) P_1: 70%; P_2: 10%; P_3: 10%; P_4: 10%.
E) none of these

Refer to the weighted voting system $[14 : 5, 5, 4, 4]$ and the Banzhaf definition of power. (The four players are P_1, P_2, P_3, and P_4.)

25) What is the weight of the coalition $\{P_2, P_3, P_4\}$? 25) _____

A) 13
B) 8
C) 12
D) 14
E) none of these

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26) What is the total number of winning coalitions? 26) _____

A) 1
B) 5
C) 15
D) 3
E) none of these

Refer to the weighted voting system $[12 : 5, 5, 2, 2]$ and the Banzhaf definition of power. (The four players are P_1, P_2, P_3, and P_4.)

27) What is the weight of the coalition $\{P_2, P_3, P_4\}$? 27) _____

A) 6
B) 10
C) 9
D) 12
E) none of these

28) What is the total number of winning coalitions? 28) _____

A) 15
B) 5
C) 3
D) 1
E) none of these

29) The Banzhaf power distribution of the weighted voting system is 29) _____

A) P_1: 25%; P_2: 25%; P_3: 25%; P_4: 25%.
B) P_1: 37.5%; P_2: 37.5%; P_3: 12.5%; P_4: 12.5%.
C) P_1: 40%; P_2: 30%; P_3: 20%; P_4: 10%.
D) P_1: 40%; P_2: 40%; P_3: 10%; P_4: 10%.
E) none of these

Refer to the weighted voting system $[25 : 16, 8, 6, 3]$ and the Banzhaf definition of power. (The four players are P_1, P_2, P_3 and P_4.)

30) Which players are critical in the coalition $\{P_1, P_2, P_3, P_4\}$? 30) _____

A) P_1 only
B) None of the players
C) P_1 and P_2 only
D) All of the players
E) none of these

31) The winning coalitions are 31) _____

A) all coalitions with three or more players, one of which is P_1.
B) all coalitions with three or more players.
C) all coalitions with two or more players.
D) all coalitions with P_1 in it.
E) none of these

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32) The number of winning coalitions is 32) _____

A) 5.
B) 3.
C) 4.
D) 15.
E) none of these

33) The Banzhaf power distribution of the weighted voting system is 33) _____

A) P_1: 25%; P_2: 25%; P_3: 25%; P_4: 25%.
B) P_1: 40%; P_2: 20%; P_3: 20%; P_4: 20%.
C) P_1: 50%; P_2: 30%; P_3: 10%; P_4: 10%.
D) P_1: 60%; P_2: 20%; P_3: 10%; P_4: 10%.
E) none of these

Refer to the weighted voting system $[25 : 16, 9, 9, 7]$ and the Banzhaf definition of power. (The four players are P_1, P_2, P_3 and P_4.)

34) Which players are critical in the coalition $\{P_1, P_3, P_4\}$? 34) _____

A) P_1 only
B) None of the players
C) P_1 and P_3 only
D) All three players
E) none of these

35) Which players are critical in the coalition $\{P_1, P_2, P_3, P_4\}$? 35) _____

A) P_1 and P_2 only
B) All of the players
C) P_1 only
D) P_1, P_2, and P_3 only
E) None of the players

36) The number of winning coalitions is 36) _____

A) 7.
B) 15.
C) 5.
D) 8.
E) none of these

37) The Banzhaf power distribution of the weighted voting system is 37) _____

A) P_1: $\frac{1}{2}$; P_2: $\frac{1}{5}$; P_3: $\frac{1}{5}$; P_4: $\frac{1}{10}$.
B) P_1: $\frac{5}{12}$; P_2: $\frac{1}{4}$; P_3: $\frac{1}{4}$; P_4: $\frac{1}{12}$.
C) P_1: $\frac{1}{3}$; P_2: $\frac{1}{4}$; P_3: $\frac{1}{4}$; P_4: $\frac{1}{6}$.
D) P_1: $\frac{7}{12}$; P_2: $\frac{1}{6}$; P_3: $\frac{1}{6}$; P_4: $\frac{1}{12}$.
E) none of these

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Refer to the weighted voting system $[26 : 16, 9, 9, 7]$ and the Banzhaf definition of power. (The four players are P_1, P_2, P_3 and P_4.)

38) Which players are critical in the coalition $\{P_1, P_3, P_4\}$? 38) _____

A) P_1 only
B) P_1 and P_3 only
C) None of the players
D) All three players
E) none of these

39) In this weighted voting system, which players have veto power? 39) _____

A) P_1 only
B) All of the players
C) P_1 and P_2 only
D) P_1, P_2 and P_3 only
E) None of the players

40) The number of losing coalitions is 40) _____

A) 11.
B) 4.
C) 1.
D) 14.
E) none of these

Refer to the weighted voting system $[22 : 10, 8, 6, 4, 2]$ and the Banzhaf definition of power. (The five players will be called P_1, P_2, P_3, P_4, and P_5.)

41) The number of winning coalitions having exactly two players is 41) _____

A) 1
B) 10
C) 5
D) 0
E) none of these

42) The number of coalitions having exactly three players is 42) _____

A) 10
B) 1
C) 5
D) 20
E) none of these

43) The number of winning coalitions having exactly three players is 43) _____

A) 10
B) 5
C) 1
D) 2
E) none of these

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44) The number of coalitions having exactly four players is 44) _____

A) 5
B) 20
C) 1
D) 10
E) none of these

Refer to the weighted voting system $[24 : 10, 8, 6, 4, 2]$ and the Banzhaf definition of power. (The five players will be called P_1, P_2, P_3, P_4, and P_5.)

45) The number of winning coalitions is 45) _____

A) 15.
B) 3.
C) 5.
D) 10.
E) none of these

46) In this voting system, 46) _____

A) P_3 has three times as much power as P_4.
B) P_3 has four times as much power as P_5.
C) P_3 and P_4 have the same power.
D) P_3 has twice as much power as P_4.
E) none of these

A committee consists of six members (A, B, C, D, E, and F). A has veto power; B, C, D, and E each have one vote. F is a nonvoting member. For a motion to pass it must have the support of A plus at least two additional voting members.

47) Which of the following is not a winning coalition? 47) _____

A) {A, C, D, E}
B) {A, B, C, D}
C) {A, B, E}
D) {B, C, D, E}
E) none of these

48) Which are the critical players in the coalition {A, B, D}? 48) _____

A) A only
B) D only
C) B only
D) A, B, and D
E) none of these

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Solve the problem.

49) Consider the generic weighted voting system {q: w_1, w_2, w_3, w_4, w_5}. Suppose that the winning coalitions are {P_1, P_2, P_3},{P_1, P_2, P_3, P_4},{P_1, P_2, P_3, P_5},and {P_1, P_2, P_3, P_4, P_5}.Find the Banzhaf power distribution. 49) _____

A) P_1: $\frac{1}{4}$, P_2: $\frac{1}{4}$, P_3: $\frac{1}{4}$, P_4: $\frac{1}{8}$, P_5: $\frac{1}{8}$

B) P_1: $\frac{5}{16}$, P_2: $\frac{5}{16}$, P_3: $\frac{1}{4}$, P_4: $\frac{1}{16}$, P_5: $\frac{1}{16}$

C) P_1: $\frac{1}{5}$, P_2: $\frac{1}{5}$, P_3: $\frac{1}{5}$, P_4: $\frac{1}{5}$, P_5: $\frac{1}{5}$

D) P_1: $\frac{1}{3}$, P_2: $\frac{1}{3}$, P_3: $\frac{1}{3}$, P_4: 0, P_5: 0

E) none of these

Refer to the weighted voting system $[10 : 7, 5, 4]$ and the Shapley–Shubik definition of power. (The three players are P_1, P_2, and P_3.)

50) Which player in the sequential coalition $\langle P_3, P_2, P_1 \rangle$ is pivotal? 50) _____

A) P_1

B) P_3

C) P_2

D) All three players

E) none of these

Refer to the weighted voting system $[8: 6, 3, 2]$ and the Shapley–Shubik definition of power. (The three players are P_1, P_2, and P_3.)

51) Which player in the sequential coalition $\langle P_3, P_2, P_1 \rangle$ is pivotal? 51) _____

A) P_3

B) P_1

C) P_2

D) All three players

E) none of these

52) The Shapley–Shubik power distribution of the weighted voting system is 52) _____

A) P_1: $\frac{1}{2}$; P_2: $\frac{1}{2}$; P_3: 0.

B) P_1: $\frac{1}{2}$; P_2: $\frac{1}{3}$; P_3: $\frac{1}{6}$.

C) P_1: $\frac{2}{3}$; P_2: $\frac{1}{6}$; P_3: $\frac{1}{6}$.

D) P_1: $\frac{1}{3}$; P_2: $\frac{1}{3}$; P_3: $\frac{1}{3}$.

E) none of these

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Refer to the weighted voting system $[10 : 7, 6, 4]$ and the Shapley–Shubik definition of power. (The three players are P_1, P_2, and P_3.)

53) Which player in the sequential coalition $\langle P_3, P_2, P_1 \rangle$ is pivotal? 53) _____

A) P_2
B) P_3
C) P_1
D) All three players
E) none of these

54) In how many sequential coalitions is P_2 the pivotal player? 54) _____

A) 0
B) 2
C) 1
D) 6
E) none of these

55) The Shapley–Shubik power distribution of the weighted voting system is 55) _____

A) P_1: $\frac{2}{3}$; P_2: $\frac{1}{6}$; P_3: $\frac{1}{6}$.

B) P_1: $\frac{1}{2}$; P_2: $\frac{1}{3}$; P_3: $\frac{1}{6}$.

C) P_1: $\frac{1}{2}$; P_2: $\frac{1}{2}$; P_3: 0.

D) P_1: $\frac{1}{3}$; P_2: $\frac{1}{3}$; P_3: $\frac{1}{3}$.

E) none of these

Refer to the weighted voting system $[9 : 4, 3, 2, 1]$ and the Shapley–Shubik definition of power. (The four players will be called P_1, P_2, P_3, and P_4.)

56) The number of sequential coalitions is 56) _____

A) 6.
B) 31.
C) 24.
D) 16.
E) none of these

57) The Shapley–Shubik power index of player P_4 is 57) _____

A) 0.

B) $\frac{1}{9}$.

C) $\frac{1}{4}$.

D) $\frac{1}{10}$.

E) none of these

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58) In how many sequential coalitions is player P_4 pivotal? 58) _____

A) 6
B) 2
C) 1
D) 0
E) none of these

Refer to the weighted voting system $[22 : 10, 8, 6, 4, 2]$ and the Shapley–Shubik definition of power. (The five players will be called P_1, P_2, P_3, P_4, and P_5.)

59) In how many sequential coalitions is player P_4 pivotal? 59) _____

A) 24
B) 16
C) 10
D) 4
E) none of these

Refer to the weighted voting system $[26 : 10, 8, 6, 4, 2]$ and the Shapley–Shubik definition of power. (The five players will be called P_1, P_2, P_3, P_4, and P_5.)

60) In how many sequential coalitions is player P_5 pivotal? 60) _____

A) 6
B) 12
C) 36
D) 24
E) none of these

61) In how many sequential coalitions is player P_1 pivotal? 61) _____

A) 36
B) 6
C) 12
D) 24
E) none of these

Solve the problem.

62) Which of the following is not a possible Shapley–Shubik power index for a player in a weighted voting system with three players? 62) _____

A) $\frac{1}{3}$
B) $\frac{1}{2}$
C) 0
D) $\frac{1}{4}$
E) none of these

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63) Which of the following is not a possible Shapley–Shubik power index for a player in a weighted voting system with four players? 63) _____

A) $\frac{1}{4}$

B) $\frac{1}{5}$

C) $\frac{1}{3}$

D) $\frac{1}{6}$

E) none of these

64) Consider the generic weighted voting system $[q : w_1, w_2, w_3, w_4]$. Suppose that $w_2 = w_3$, P_1 is a pivotal player 12 times and P_2 is pivotal 4 times. What is the Shapley–Shubik power index of P_4? 64) _____

A) $\frac{1}{6}$

B) $\frac{1}{2}$

C) $\frac{1}{3}$

D) 0

E) Can't be determined from the given information.

65) $\frac{200!}{198!} =$ 65) _____

A) 200

B) 2

C) 399

D) 39,800

E) none of these

66) $300! - 299! =$ 66) _____

A) $299 \times 299!$

B) $299^2 \times 298!$

C) $300 - 2 \times 299!$

D) 1

E) none of these

67) A, B, C, D, and E are the starting five players in a basketball team. The coach must choose a set of honorary "captains" for the last game of the season – it can be any number from one to all five. How many different possibilities are there? 67) _____

A) 24

B) 31

C) 120

D) 5

E) none of these

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68) A weighted voting system has 100 players. How many coalitions of size 99 are possible? 68) _____

A) 1
B) 100
C) 99
D) 50
E) none of these

69) A weighted voting system has 100 players. How many coalitions of size 98 are possible? 69) _____

A) 98
B) 4950
C) 4900
D) 8900
E) none of these

70) Consider the generic weighted voting system {q: w_1, w_2, w_3, w_4, w_5}. Suppose that the winning coalitions are {P_1, P_2, P_3}, {P_1, P_2, P_3, P_4}, {P_1, P_2, P_3, P_5}, and {P_1, P_2, P_3, P_4, P_5}. Which players have veto power? 70) _____

A) P_1, P_2, and P_3
B) P_1 only
C) P_1, P_2, P_3, and P_4
D) None of the players
E) All of the players

71) In any weighted voting system having N players, what is the minimum number of winning coalitions possible? 71) _____

A) 1
B) 0
C) N
D) N – 1
E) none of these

72) Two weighted voting systems are equivalent if they have the same number of players and exactly the same winning coalitions. Which of the following weighted voting systems are equivalent to [5 : 3, 2, 1, 1]? 72) _____

A) [9 : 5, 4, 3, 1]
B) [6 : 3, 2, 1, 1]
C) [7: 3, 2, 1, 1]
D) [8 : 4, 3, 2, 1]
E) [10 : 6, 5, 4, 2]

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1) C
2) B
3) B
4) A
5) C
6) B
7) D
8) E
9) B
10) A
11) B
12) A
13) C
14) A
15) D
16) C
17) E
18) D
19) B
20) B
21) A
22) C
23) A
24) D
25) A
26) D
27) C
28) C
29) B
30) A
31) A
32) C
33) B
34) C
35) E
36) A
37) B
38) D
39) A
40) A
41) D
42) A
43) D
44) A
45) C
46) A
47) D
48) D
49) D
50) A

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51) B
52) C
53) A
54) B
55) D
56) C
57) A
58) D
59) B
60) A
61) A
62) D
63) B
64) A
65) D
66) A
67) B
68) B
69) B
70) A
71) A
72) A

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Chapter 2

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

1) What is the quota in the weighted voting system [20 : 7, 5, 4, 4, 2, 2, 2, 1, 1]? 1) _____
A) 28
B) 9
C) 20
D) 10
E) none of these

2) The total number of votes in the weighted voting system [34 : 10, 7, 4, 4, 3, 3, 3, 1, 1] is 2) _____
A) 34.
B) 10.
C) 36.
D) 9.
E) none of these

3) The total number of votes in the weighted voting system [20 : 7, 5, 4, 4, 2, 2, 2, 1, 1] is 3) _____
A) 48.
B) 20.
C) 28.
D) 10.
E) none of these

4) In the weighted voting system [q : 10, 8, 4], a strict majority of the votes is needed to pass a motion. The value of the quota q is 4) _____
A) 10.
B) 13.
C) 12.
D) 11.
E) none of these

5) In the weighted voting system [q : 20, 19, 16, 2, 1, 1], a two–thirds majority of the votes is needed to pass a motion. The value of the quota q is 5) _____
A) 40.
B) 7.
C) 20.
D) 59.
E) none of these

6) In the weighted voting system [q : 12, 10, 5, 1, 1], the largest possible value that the quota q can take is 6) _____
A) 15.
B) 22.
C) 30.
D) 29.
E) none of these

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7) In the weighted voting system $[q : 10, 8, 5]$, the smallest possible value that the quota q can take is 7) _____

A) 13.
B) 23.
C) 12.
D) 11.
E) none of these

8) In the weighted voting system $[q : 24, 12, 8, 4, 2]$, the smallest possible value that the quota q can take is 8) _____

A) 36.
B) 24.
C) 50.
D) 25.
E) none of these

9) In the weighted voting system $[q : 22, 12, 8, 4]$, the smallest possible value that the quota q can take is 9) _____

A) 31.
B) 46.
C) 23.
D) 22.
E) none of these

10) In the weighted voting system $[9 : 11, 4, 2]$, 10) _____

A) P_1 has veto power but is not a dictator.
B) there are no dictators.
C) every player is a dictator.
D) P_1 is a dictator.
E) none of these

11) In the weighted voting system $[12 : 13, 7, 2]$, 11) _____

A) there are no dictators
B) P_1 has veto power but is not a dictator.
C) every player is a dictator.
D) P_1 is a dictator.
E) none of these

12) In the weighted voting system $[12 : 11, 5, 5]$, 12) _____

A) every player has veto power.
B) P_1 has veto power but is not a dictator.
C) no player has veto power.
D) P_1 is a dictator.
E) none of these

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13) In the weighted voting system $[14 : 7, 7, 6]$, 13) _____

A) P_1 and P_2 have equal power, P_3 is a dummy.

B) P_1 and P_2 have equal power, P_3 is not a dummy.

C) all three players have equal power.

D) P_1 has all the power, P_2 and P_3 are dummies.

E) none of these

14) In the weighted voting system $[10 : 5, 4, 2]$, 14) _____

A) all three players have veto power.

B) no player has veto power.

C) P_1 has veto power, P_3 is a dummy.

D) P_1 and P_2 have veto power, P_3 is a dummy.

E) none of these

15) In the weighted voting system [q : 24, 12, 8, 4, 2], what is the smallest possible value of the quota q for which P_5 is a dummy? 15) _____

A) 24

B) 29

C) 27

D) 30

E) none of these

16) What is the smallest value of w for which P_4 is not a dummy in the weighted voting system [30 : 24, 12, 6, w]? 16) _____

A) 3

B) 1

C) 6

D) 5

E) none of these

17) In the weighted voting system $[q : 7, 5, 3, 2, 1]$, every player has veto power. The value of the quota q is 17) _____

A) 10.

B) 18.

C) 15.

D) 17.

E) none of these

18) A player whose weight is bigger than the weight of every other player 18) _____

A) has veto power.

B) is a critical player in every winning coalition.

C) is a dictator.

D) is a dummy.

E) none of these

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19) Consider the generic weighted voting system $[q : w_1, w_2, \ldots, w_N]$. Which of the following mathematical statements is equivalent to saying that P_1 is a dictator? 19) _____

A) $w_1 \geq q$

B) $w_1 > w_2$

C) $w_2 + w_3 + \ldots + w_N < q$ and $w_1 < q$

D) $w_1 > q$

E) none of these

Refer to the weighted voting system $[35 : 32, 15, 10, 3]$ and the Banzhaf definition of power. (The four players are P_1, P_2, P_3, and P_4.)

20) The weight of the coalition $\{P_2, P_3, P_4\}$ is 20) _____

A) 25.

B) 57.

C) 28.

D) 60.

E) none of these

21) Which players in the coalition $\{P_1, P_3\}$ are critical? 21) _____

A) P_3 only

B) None of the players

C) P_1 only

D) P_1 and P_3

E) none of these

22) Which players in the coalition $\{P_1, P_3, P_4\}$ are critical? 22) _____

A) P_1 and P_3 only

B) All three players

C) None of the players

D) P_1 only

E) none of these

Refer to the weighted voting system $[25 : 22, 12, 6, 3]$ and the Banzhaf definition of power. (The four players are P_1, P_2, P_3, and P_4.)

23) Which players in the coalition $\{P_1, P_3, P_4\}$ are critical? 23) _____

A) P_1 and P_3 only

B) None of the players

C) All three players

D) P_1 only

E) none of these

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24) The Banzhaf power distribution of the weighted voting system is 24) _____

A) P_1: 60%; P_2: 20%; P_3: 10%; P_4: 10%.

B) P_1: 25%; P_2: 25%; P_3: 25%; P_4: 25%.

C) P_1: 40%; P_2: 20%; P_3: 20%; P_4: 20%.

D) P_1: 70%; P_2: 10%; P_3: 10%; P_4: 10%.

E) none of these

Refer to the weighted voting system $[14 : 5, 5, 4, 4]$ and the Banzhaf definition of power. (The four players are P_1, P_2, P_3, and P_4.)

25) What is the total number of winning coalitions? 25) _____

A) 1

B) 5

C) 15

D) 3

E) none of these

Refer to the weighted voting system $[12 : 5, 5, 2, 2]$ and the Banzhaf definition of power. (The four players are P_1, P_2, P_3, and P_4.)

26) What is the total number of winning coalitions? 26) _____

A) 5

B) 3

C) 15

D) 1

E) none of these

27) The Banzhaf power distribution of the weighted voting system is 27) _____

A) P_1: 25%; P_2: 25%; P_3: 25%; P_4: 25%.

B) P_1: 40%; P_2: 40%; P_3: 10%; P_4: 10%.

C) P_1: 40%; P_2: 30%; P_3: 20%; P_4: 10%.

D) P_1: 37.5%; P_2: 37.5%; P_3: 12.5%; P_4: 12.5%.

E) none of these

Refer to the weighted voting system $[25 : 16, 8, 6, 3]$ and the Banzhaf definition of power. (The four players are P_1, P_2, P_3 and P_4.)

28) Which players are critical in the coalition $\{P_1, P_3, P_4\}$? 28) _____

A) None of the players

B) All three players

C) P_1 and P_3 only

D) P_1 only

E) none of these

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29) Which players are critical in the coalition $\{P_1, P_2, P_3, P_4\}$? 29) _____

A) P_1 and P_2 only
B) P_1 only
C) All of the players
D) None of the players
E) none of these

30) The winning coalitions are 30) _____

A) all coalitions with three or more players.
B) all coalitions with three or more players, one of which is P_1.
C) all coalitions with two or more players.
D) all coalitions with P_1 in it.
E) none of these

31) The Banzhaf power distribution of the weighted voting system is 31) _____

A) P_1: 50%; P_2: 30%; P_3: 10%; P_4: 10%.
B) P_1: 25%; P_2: 25%; P_3: 25%; P_4: 25%.
C) P_1: 40%; P_2: 20%; P_3: 20%; P_4: 20%.
D) P_1: 60%; P_2: 20%; P_3: 10%; P_4: 10%.
E) none of these

Refer to the weighted voting system $[25 : 16, 9, 9, 7]$ and the Banzhaf definition of power. (The four players are P_1, P_2, P_3 and P_4.)

32) The weight of the coalition $\{P_1, P_3, P_4\}$ is 32) _____

A) 32.
B) 41.
C) 43.
D) 25.
E) none of these

33) Which players are critical in the coalition $\{P_1, P_3, P_4\}$? 33) _____

A) None of the players
B) All three players
C) P_1 only
D) P_1 and P_3 only
E) none of these

34) Which players are critical in the coalition $\{P_1, P_2, P_3, P_4\}$? 34) _____

A) All of the players
B) P_1, P_2, and P_3 only
C) P_1 only
D) P_1 and P_2 only
E) None of the players

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35) The winning coalitions are: 35) _____

A) $\{P_1, P_2\}$, $\{P_1, P_3\}$, and all coalitions with three or more players.

B) all coalitions with three or more players.

C) all coalitions with P_1 in it.

D) all coalitions with two or more players.

E) none of these

36) The Banzhaf power distribution of the weighted voting system is 36) _____

A) $P_1: \frac{1}{3}$; $P_2: \frac{1}{4}$; $P_3: \frac{1}{4}$; $P_4: \frac{1}{6}$.

B) $P_1: \frac{1}{2}$; $P_2: \frac{1}{5}$; $P_3: \frac{1}{5}$; $P_4: \frac{1}{10}$.

C) $P_1: \frac{7}{12}$; $P_2: \frac{1}{6}$; $P_3: \frac{1}{6}$; $P_4: \frac{1}{12}$.

D) $P_1: \frac{5}{12}$; $P_2: \frac{1}{4}$; $P_3: \frac{1}{4}$; $P_4: \frac{1}{12}$.

E) none of these

Refer to the weighted voting system $[26 : 16, 9, 9, 7]$ and the Banzhaf definition of power. (The four players are P_1, P_2, P_3 and P_4.)

37) Which players are critical in the coalition $\{P_1, P_3, P_4\}$? 37) _____

A) None of the players

B) P_1 only

C) All three players

D) P_1 and P_3 only

E) none of these

38) The winning coalitions are 38) _____

A) only the grand coalition.

B) all coalitions with two or more players except for $\{P_3, P_4\}$.

C) all coalitions with three or more players.

D) all coalitions with three or more players except for $\{P_2, P_3, P_4\}$.

E) none of these

39) The number of losing coalitions is 39) _____

A) 11.

B) 14.

C) 4.

D) 1.

E) none of these

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40) The Banzhaf power distribution of the weighted voting system is 40) _____

A) $P_1: \frac{1}{2}; P_2: \frac{3}{10}; P_3: \frac{1}{10}; P_4: \frac{1}{10}$.

B) $P_1: \frac{1}{2}; P_2: \frac{1}{6}; P_3: \frac{1}{6}; P_4: \frac{1}{6}$.

C) $P_1: \frac{5}{12}; P_2: \frac{1}{4}; P_3: \frac{1}{4}; P_4: \frac{1}{12}$.

D) $P_1: \frac{2}{5}; P_2: \frac{1}{5}; P_3: \frac{1}{5}; P_4: \frac{1}{5}$.

E) none of these

Refer to the weighted voting system $[22 : 10, 8, 6, 4, 2]$ and the Banzhaf definition of power. (The five players will be called P_1, P_2, P_3, P_4, and P_5.)

41) The number of winning coalitions having exactly three players is 41) _____

A) 5
B) 1
C) 10
D) 2
E) none of these

42) The number of coalitions having exactly four players is 42) _____

A) 20
B) 1
C) 5
D) 10
E) none of these

43) In this weighted voting system, 43) _____

A) P_3 and P_4 have the same power.

B) P_3 has three times as much power as P_4.

C) P_3 has twice as much power as P_4.

D) P_3 has four times as much power as P_5.

E) none of these

44) In this weighted voting system, giving any individual player one more vote has the effect of 44) _____

A) giving that player 1/19 more power.
B) giving that player 1/31 more power.
C) giving that player no more power.
D) giving that player 1/5 more power.
E) none of these

Refer to the weighted voting system $[24 : 10, 8, 6, 4, 2]$ and the Banzhaf definition of power. (The five players will be called P_1, P_2, P_3, P_4, and P_5.)

45) The number of coalitions is 45) _____

A) 63.
B) 31.
C) 15.
D) 120.
E) none of these

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A committee consists of six members (A, B, C, D, E, and F). A has veto power; B, C, D, and E each have one vote. F is a nonvoting member. For a motion to pass it must have the support of A plus at least two additional voting members.

46) Which are the critical players in the coalition {A, B, D}? 46) _____

A) B only
B) A, B, and D
C) A only
D) D only
E) none of these

A committee consists of five members (A, B, C, D, and E). A and B have veto power; C, D, and E each have one vote. For a motion to pass it must have the support of both A and B plus at least one additional member.

47) Which are the critical players in the coalition {A, B, D, E}? 47) _____

A) E only
B) A and B only
C) A, B, D and E
D) D only
E) none of these

Solve the problem.

48) In the weighted voting system $[21 : 12, 8, 6, 3, 2]$, the total number of possible coalitions is 48) _____

A) 32.
B) 23.
C) 63.
D) 31.
E) none of these

49) In the weighted voting system $[21 : 10, 8, 5, 3, 2]$, the total number of possible coalitions is 49) _____

A) 32.
B) 63.
C) 31.
D) 16.
E) none of these

Refer to the weighted voting system $[10 : 7, 5, 4]$ and the Shapley–Shubik definition of power. (The three players are P_1, P_2, and P_3.)

50) Which player in the sequential coalition $\langle P_1, P_2, P_3 \rangle$ is pivotal? 50) _____

A) P_2
B) P_1
C) P_3
D) All three players
E) none of these

51) Which player in the sequential coalition $\langle P_3, P_2, P_1 \rangle$ is pivotal? 51) _____

A) P_2
B) P_3
C) P_1
D) All three players
E) none of these

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52) The Shapley–Shubik power distribution of the weighted voting system is 52) _____

A) $P_1: \frac{1}{2}; P_2: \frac{1}{2}; P_3: 0.$

B) $P_1: \frac{1}{2}; P_2: \frac{1}{3}; P_3: \frac{1}{6}.$

C) $P_1: \frac{1}{3}; P_2: \frac{1}{3}; P_3: \frac{1}{3}.$

D) $P_1: \frac{2}{3}; P_2: \frac{1}{6}; P_3: \frac{1}{6}.$

E) none of these

Refer to the weighted voting system $[8: 6, 3, 2]$ and the Shapley–Shubik definition of power. (The three players are P_1, P_2, and P_3.)

53) In how many sequential coalitions is P_2 the pivotal player? 53) _____

A) 6
B) 2
C) 1
D) 0
E) none of these

54) The Shapley–Shubik power distribution of the weighted voting system is 54) _____

A) $P_1: \frac{1}{2}; P_2: \frac{1}{3}; P_3: \frac{1}{6}.$

B) $P_1: \frac{1}{3}; P_2: \frac{1}{3}; P_3: \frac{1}{3}.$

C) $P_1: \frac{2}{3}; P_2: \frac{1}{6}; P_3: \frac{1}{6}.$

D) $P_1: \frac{1}{2}; P_2: \frac{1}{2}; P_3: 0.$

E) none of these

Refer to the weighted voting system $[9 : 4, 3, 2, 1]$ and the Shapley–Shubik definition of power. (The four players will be called P_1, P_2, P_3, and P_4.)

55) The number of sequential coalitions is 55) _____

A) 16.
B) 6.
C) 24.
D) 32.
E) none of these

56) In how many sequential coalitions is player P_4 pivotal? 56) _____

A) 2
B) 1
C) 0
D) 6
E) none of these

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57) The Shapley–Shubik power distribution of the weighted voting system is 57) _____

A) P_1: $\frac{1}{4}$; P_2: $\frac{1}{4}$; P_3: $\frac{1}{4}$; P_4: $\frac{1}{4}$.

B) P_1: $\frac{5}{12}$; P_2: $\frac{1}{3}$; P_3: $\frac{5}{24}$; P_4: $\frac{1}{24}$.

C) P_1: $\frac{2}{3}$; P_2: $\frac{1}{6}$; P_3: $\frac{1}{6}$; P_4: 0.

D) P_1: $\frac{1}{3}$; P_2: $\frac{1}{3}$; P_3: $\frac{1}{3}$; P_4: 0.

E) none of these

Refer to the weighted voting system $[22 : 10, 8, 6, 4, 2]$ and the Shapley–Shubik definition of power. (The five players will be called P_1, P_2, P_3, P_4, and P_5.)

58) In how many sequential coalitions is player P_5 pivotal? 58) _____

A) 6
B) 12
C) 36
D) 24
E) none of these

59) If player P_5 is pivotal in a sequential coalition, which player does not appear before P_5? 59) _____

A) P_1
B) P_5 is never pivotal
C) P_4
D) P_2
E) P_3

60) In how many sequential coalitions is player P_4 pivotal? 60) _____

A) 16
B) 10
C) 4
D) 24
E) none of these

61) The Shapley–Shubik power index of player P_5 is 61) _____

A) $\frac{1}{20}$.

B) $\frac{1}{5}$.

C) $\frac{3}{10}$.

D) $\frac{1}{10}$.

E) none of these

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Refer to the weighted voting system $[26 : 10, 8, 6, 4, 2]$ and the Shapley–Shubik definition of power. (The five players will be called P_1, P_2, P_3, P_4, and P_5.)

62) In how many sequential coalitions is player P_1 pivotal? 62) _____

A) 24
B) 12
C) 36
D) 6
E) none of these

63) The Shapley–Shubik power index of player P_5 is 63) _____

A) $\frac{1}{5}$.

B) $\frac{1}{10}$.

C) $\frac{1}{20}$.

D) $\frac{3}{10}$.

E) none of these

Solve the problem.

64) The Shapley–Shubik power index of player P_4 in the weighted voting system [10 : 3, 3, 3, 2] is 64) _____

A) $\frac{1}{6}$

B) 0

C) $\frac{1}{12}$

D) $\frac{1}{4}$

E) none of these

65) $\frac{200!}{198!}$ = 65) _____

A) 200
B) 399
C) 39,800
D) 2
E) none of these

66) 300! – 299! = 66) _____

A) 1
B) $299^2 \times 298!$
C) $300 - 2 \times 299!$
D) $299 \times 299!$
E) none of these

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67) A, B, C, D, E and F are the starting six players on a hockey team. The coach must choose a set of honorary "captains" for the last game of the season – it can be any number from one to all six. How many different possibilities are there? 67) _____

A) 63
B) 35
C) 6
D) 720
E) none of these

68) A, B, C, D, and E are the starting five players in a basketball team. The coach must choose a set of honorary "captains" for the last game of the season – it can be any number from one to all five. How many different possibilities are there? 68) _____

A) 120
B) 5
C) 31
D) 24
E) none of these

69) A weighted voting system has 100 players. How many sequential coalitions in which P_{50} is listed first are possible? 69) _____

A) 100! – 1
B) 50!
C) $\frac{100!}{50}$
D) 99!
E) none of these

70) Consider the generic weighted voting system $[q : w_1, w_2, w_3, w_4, w_5]$. Suppose that the winning coalitions are exactly those having 3 or more players. Which players are critical in the coalition $\{P_1, P_2, P_4, P_5\}$? 70) _____

A) P_1, P_2, and P_4
B) P_1 only
C) P_1, P_2, P_4, P_5
D) None of the players
E) none of these

71) Consider the generic weighted voting system $\{q: w_1, w_2, w_3, w_4, w_5\}$. Suppose that the winning coalitions are $\{P_1, P_2, P_3\}$, $\{P_1, P_2, P_3, P_4\}$, $\{P_1, P_2, P_3, P_5\}$, and $\{P_1, P_2, P_3, P_4, P_5\}$. Which players are critical in the grand coalition $\{P_1, P_2, P_3, P_4, P_5\}$? 71) _____

A) P_1, P_2, and P_3
B) P_1 only
C) P_1, P_2, P_3, and P_4
D) None of the players
E) none of these

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72) In any weighted voting system having N players, what is the maximum number of players that can have veto power? 72) _____

A) N – 1
B) N
C) 1
D) 2
E) none of these

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1) C
2) C
3) C
4) C
5) A
6) D
7) C
8) E
9) E
10) D
11) D
12) B
13) A
14) A
15) C
16) C
17) B
18) E
19) A
20) C
21) D
22) D
23) D
24) D
25) D
26) B
27) D
28) B
29) B
30) B
31) C
32) A
33) D
34) E
35) A
36) D
37) C
38) D
39) A
40) D
41) D
42) C
43) A
44) C
45) B
46) B
47) B
48) D
49) C
50) A

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51) C
52) D
53) C
54) C
55) C
56) C
57) D
58) A
59) D
60) A
61) A
62) C
63) C
64) D
65) C
66) D
67) A
68) C
69) D
70) D
71) A
72) B

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Chapter 3

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Malia buys a chocolate–strawberry–vanilla cake in Figure(i) for $14.00 . She cuts the cake into six 60° wedges as shown in Figure (ii). Malia likes chocolate twice as much as vanilla and likes vanilla twice as much as strawberry.

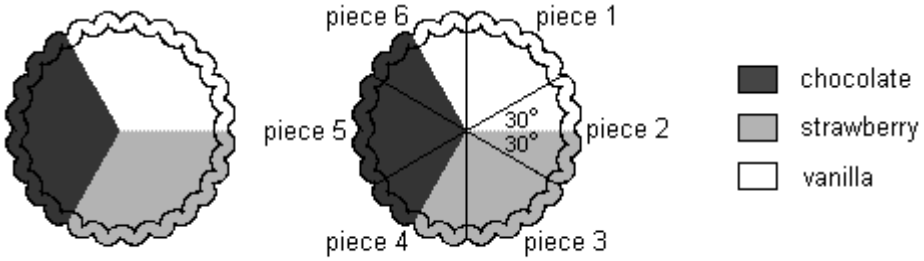


Figure (i) Figure (ii)

1) What is the value of piece 3 to Malia? 1) _____
A) $1.00
B) $3.00
C) $2.00
D) $4.00
E) none of these

2) What is the value of piece 5 to Malia? 2) _____
A) $3.00
B) $4.00
C) $2.00
D) $1.00
E) none of these

3) What is the value of piece 4 to Malia? 3) _____
A) $1.50
B) $2.00
C) $2.50
D) $1.00
E) none of these

4) What is the value of piece 6 to Malia? 4) _____
A) $1.00
B) $1.50
C) $2.50
D) $2.00
E) none of these

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Ned buys a chocolate–strawberry–vanilla cake in Figure (i) for $14.00. He cuts the cake into six 60° wedges as shown in Figure (ii). Ned values strawberry six times as much as chocolate. He does not value vanilla cake at all.

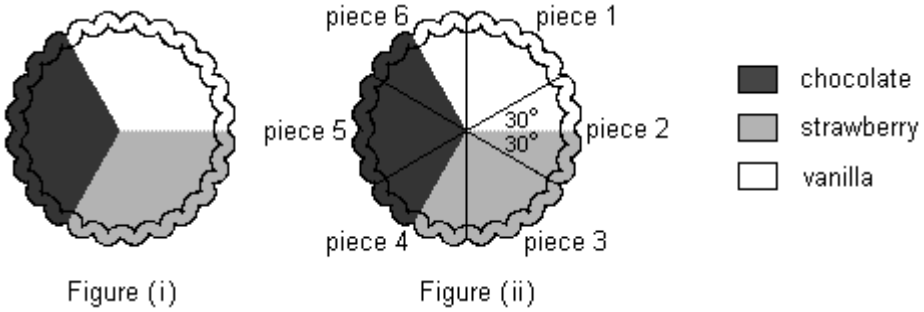
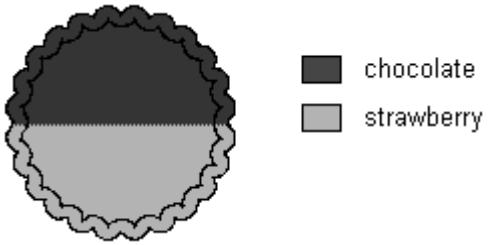


Figure (i) Figure (ii)

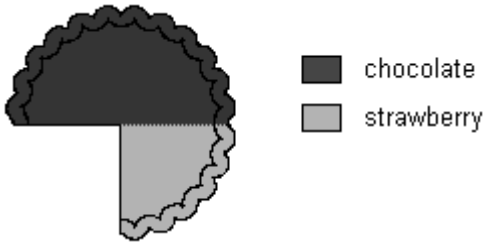
5) How much does Ned value piece 2? 5) _____

A) $4.00
B) $5.00
C) $3.00
D) $2.00
E) none of these

Angela and Ben want to divide fairly the chocolate–strawberry cake shown below. The total cost of the cake was $6.00. Angela values strawberry three times as much as she values chocolate, while Ben values chocolate twice as much as he values strawberry.



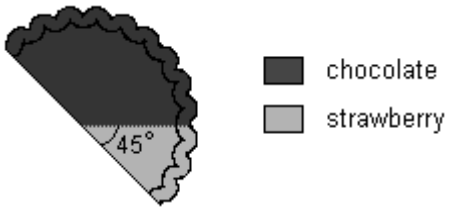
6) In Ben's eyes, the piece shown below is worth 6) _____



A) $5.00.
B) $4.00.
C) $4.75.
D) $4.50.
E) none of these

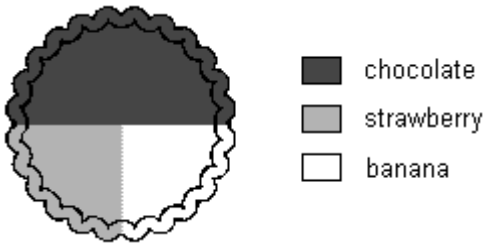
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7) In Angela's eyes, the piece shown below is worth 7) _____



A) $3.75.
B) $3.50.
C) $3.00.
D) $2.25.
E) none of these

Carli and Dale want to divide fairly the chocolate–strawberry cake shown below. The total cost of the cake was $18.00. Carli values strawberry and banana equally, but values chocolate twice as much as either of these put together. Dale values chocolate three times as much as he values strawberry. Further, he values strawberry twice as much as he values banana.



8) In Carli's eyes, the strawberry quarter of the cake is worth 8) _____
A) $3.50
B) $4.00
C) $3.00
D) $6.00
E) none of these

9) In Dale's eyes, the chocolate half of the cake is worth 9) _____
A) $12.00
B) $12.50
C) $15.00
D) $10.00
E) none of these

10) In Carli's eyes, the piece shown below is worth 10) _____



A) $2.50
B) $1.50
C) $3.00
D) $2.00
E) none of these

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Three players (Ady, Brenden, and Cara) are sharing a pie. Suppose that the pie is divided into three slices (s_1, s_2, and s_3). The following table gives the value of each slice in the eyes of each of the players.

	s_1	s_2	s_3
Ady	**$5.50**	**$4.50**	**$5.75**
Brenden	**$4.50**	**$4.25**	**$6.75**
Cara	**$4.00**	**$5.00**	**$4.75**

11) Find a fair division of cake using s_1, s_2, and s_3 as fair shares. 11) _____

A) Ady: s_2; Brenden: s_3; Cara: s_1

B) Ady: s_1; Brenden: s_2; Cara: s_3

C) Ady: s_1; Brenden: s_3; Cara: s_2

D) Ady: s_3; Brenden: s_2; Cara: s_1

E) Ady: s_2; Brenden: s_1; Cara: s_3

Four players (Alli, Blake, Corey, and Devin) are sharing a cake. Suppose that the cake is divided into four slices s_1, s_2, s_3, and s_4.

12) To Devin, s_1 is worth \$2.70, s_3 is worth \$3.90, s_2 and s_4 have equal value, and the entire cake is worth \$14.00. Determine which of the four slices are fair shares to Devin. 12) _____

A) s_3 and s_4

B) s_2, s_3, and s_4

C) s_2 and s_4

D) s_1, s_3, and s_4

E) s_1 and s_2

Alan, Boris, Cali, and Doris are dividing a cake among themselves. The cake is divided into four slices s_1, s_2, s_3, and s_4.

13) To Boris, the entire cake is worth \$18.00 and the value of s_4 is \$4.00. Boris values s_3 twice as much as s_1. He values s_2 as \$1.00 less than s_3. What are fair shares to Boris? 13) _____

A) $\{s_2, s_3\}$

B) $\{s_2\}$

C) $\{s_1, s_2, s_3\}$

D) $\{s_3\}$

E) none of these

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Solve the problem.

14) Alan, Brianna, Claire, and Doug wish to equally divide a half chocolate, half vanilla cake. Each player values chocolate three times as much as they value vanilla. What fraction of the chocolate half of the cake would be considered a fair share to each? 14) _____

A) $\frac{1}{2}$

B) $\frac{1}{4}$

C) $\frac{1}{5}$

D) $\frac{1}{3}$

E) none of these

15) Which of the following is a continuous fair division problem? 15) _____

A) Dividing a cream pie.
B) Dividing a house plus all the furniture in it.
C) Dividing an art collection.
D) Dividing the family jewels.
E) none of these

Ned buys a chocolate–strawberry–vanilla cake in Figure (i) for $14.00. He cuts the cake into six 60° wedges as shown in Figure (ii). Ned values strawberry six times as much as chocolate. He does not value vanilla cake at all.

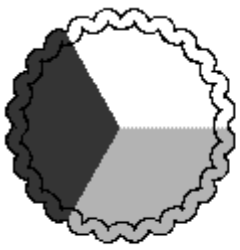


Figure (i)

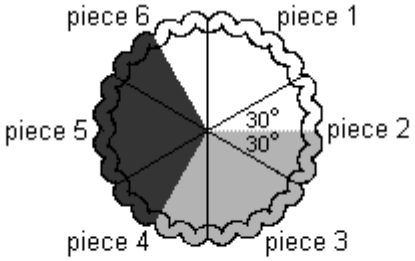
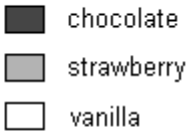


Figure (ii)

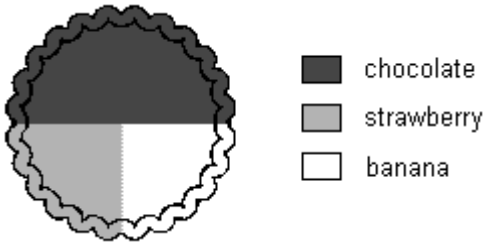


16) Ned is going to fairly divide the cake with his friend Omarosa using the divider–chooser method. If Ned were the divider, how might he divide the cake? 16) _____

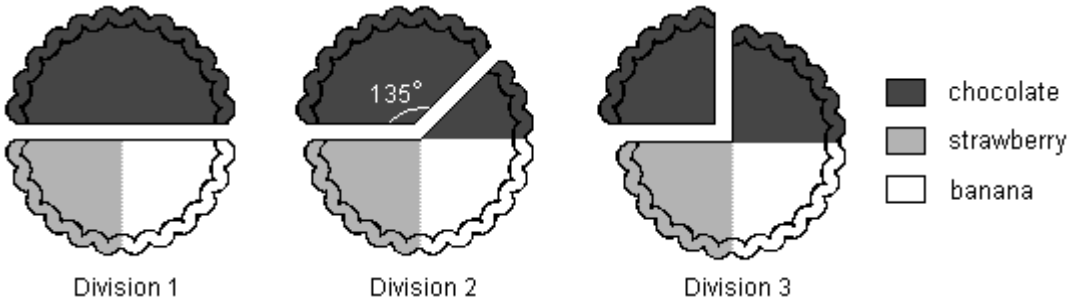
A) Share 1: Pieces 2 and 3; Share 2: Pieces 1, 4, 5, and 6
B) Share 1: Pieces 1, 2, and 3; Share 2: Pieces 4, 5, and 6
C) Share 1: Pieces 3, 4, and 5; Share 2: Pieces 1, 2, and 6
D) Share 1: Pieces 1, 3, and 5; Share 2: Pieces 2, 4, and 6
E) none of these

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Carli and Dale want to divide fairly the chocolate–strawberry cake shown below using the divider–chooser method. The total cost of the cake was $18.00. Carli values strawberry and banana equally, but values chocolate twice as much as either of these put together. Dale values chocolate three times as much as he values strawberry. Further, he values strawberry twice as much as he values banana.



17) If Dale is the divider, which of the divisions shown below is consistent with Dale's value system? 17) _____



A) Division 1
B) Division 2
C) Division 3
D) all of these
E) none of these

Solve the problem.

18) Joe and Bill want to divide a cake using the divider–chooser method. They draw straws, and it is determined that Bill will be the divider and Joe the chooser. Assuming that each plays the game correctly, which of the following statements [A), B), C) or D)] cannot be true? 18) _____

A) Joe believes that his share is worth 60% of the cake; Bill believes that his share is worth 50% of the cake.
B) Joe believes that his share is worth 50% of the cake; Bill believes that his share is worth 50% of the cake.
C) Bill believes that his share is worth 60% of the cake; Joe believes that his share is worth 50% of the cake.
D) Bill believes that Joe's share is worth 50% of the cake; Joe believes that his share is worth 60% of the cake.
E) none of these

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Three players (one divider and two choosers) are going to divide a cake fairly using the lone divider method. The divider cuts the cake into three slices (s_1, s_2, and s_3).

19) If the choosers' declarations are Chooser 1: {s_2} and Chooser 2: {s_3}, which of the following is a fair division of the cake? 19) _____

A) Chooser 1 gets s_2; Chooser 2 gets s_3; Divider gets s_1.

B) Chooser 1 gets s_3; Chooser 2 gets s_2; Divider gets s_1.

C) Chooser 1 gets s_1; Chooser 2 gets s_2; Divider gets s_3.

D) Chooser 1 gets s_2; Chooser 2 gets s_1; Divider gets s_3.

E) none of these

20) Suppose the choosers value the slices as follows: 20) _____

	s_1	s_2	s_3
Chooser 1	30%	40%	30%
Chooser 2	32%	32%	36%

Which of the following is a fair division of the cake?

A) Chooser 1 gets s_2; Chooser 2 gets s_3; Divider gets s_1.

B) Chooser 1 gets s_3; Chooser 2 gets s_2; Divider gets s_1.

C) Chooser 1 gets s_1; Chooser 2 gets s_2; Divider gets s_3.

D) Chooser 1 gets s_2; Chooser 2 gets s_1; Divider gets s_3.

E) none of these

21) Suppose the choosers value the slices as follows: 21) _____

	s_1	s_2	s_3
Chooser 1	35%	38%	27%
Chooser 2	34%	30%	36%

Which of the following is not a fair division of the cake?

A) Chooser 1 gets s_1; Chooser 2 gets s_3; Divider gets s_2.

B) Chooser 1 gets s_1; Chooser 2 gets s_2; Divider gets s_3.

C) Chooser 1 gets s_2; Chooser 2 gets s_1; Divider gets s_3.

D) Chooser 1 gets s_2; Chooser 2 gets s_3; Divider gets s_1.

E) none of these

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22) Suppose the choosers value the slices as follows: 22) _____

	s_1	s_2	s_3
Chooser 1	30%	40%	30%
Chooser 2	31%	37%	32%

Which of the following is a fair division of the cake?

A) Chooser 1 gets s_1; Chooser 2 gets s_2; Divider gets s_3.

B) Divider 1 gets s_2; Choosers 1 and 2 divide s_1 + s_3 using the divider–chooser method.

C) Chooser 1 gets s_2; Chooser 2 gets s_3; Divider gets s_1.

D) Divider 1 gets s_1; Choosers 1 and 2 divide s_2 + s_3 using the divider–chooser method.

E) none of these

Four players (A, B, C, and D) agree to divide a cake fairly using the lone divider method. The table below shows how each player values each of the four slices that have been cut by the divider.

	s_1	s_2	s_3	s_4
A	**20%**	**32%**	**28%**	**20%**
B	**25%**	**25%**	**25%**	**25%**
C	**15%**	**15%**	**30%**	**40%**
D	**24%**	**24%**	**24%**	**28%**

23) Using the lone–divider method, how many different fair divisions of this cake are possible? 23) _____

A) 0

B) 1

C) 2

D) 3

E) none of these

Five players (A, B, C, D, and E) agree to divide a cake fairly using the lone divider method. The table below shows how each player values each of the five slices that have been cut by the divider.

	s_1	s_2	s_3	s_4	s_5
A	**$1.00**	**$4.00**	**$3.00**	**$4.00**	**$3.00**
B	**$3.50**	**$4.50**	**$3.50**	**$3.50**	**$5.00**
C	**$1.25**	**$0.75**	**$0.75**	**$0.75**	**$1.50**
D	**$2.00**	**$2.00**	**$2.00**	**$2.00**	**$2.00**
E	**$1.00**	**$3.00**	**$1.00**	**$1.00**	**$4.00**

24) Assuming all players play honestly, which player was the divider? 24) _____

A) A B) B C) C D) D E) E

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Four partners (Alonzo, Brenda, Camille, and Donald) are dividing a parcel of land valued at $240,000 among themselves using the lone–divider method. Using a map, the divider divides the property into four parcels s_1, s_2, s_3, and s_4. The following table shows the value of the four parcels in the eyes of each partner, but some of the entries in the table are missing.

	s_1	s_2	s_3	s_4
Alonzo		**$50,000**	**$50,000**	**$70,000**
Brenda	**$40,000**	**$80,000**	**$55,000**	
Camille	**$110,000**	**$40,000**	**$30,000**	
Donald	**$60,000**			

25) Who was the divider? 25) _____

A) Alonzo
B) Brenda
C) Donald
D) Camille
E) none of these

26) Which of the following is a fair division of the property? 26) _____

A) Alonzo gets s_1, Brenda gets s_4, Camille gets s_2, Donald gets s_3
B) Alonzo gets s_1, Brenda gets s_2, Camille gets s_3, Donald gets s_4
C) Alonzo gets s_1, Brenda gets s_2, Camille gets s_4, Donald gets s_3
D) Alonzo gets s_2, Brenda gets s_1, Camille gets s_4, Donald gets s_3
E) none of these

Don, Dale, and Cam buy a carton of neopolitan ice cream that is one –third chocolate, one–third vanilla, and one–third strawberry as shown below. They wish to fairly divide the ice cream using the lone chooser method. Don likes chocolate twice as much as vanilla or strawberry. Dale likes strawberry but no other flavor. Cam, the chooser, likes chocolate and vanilla twice as much as strawberry. In the first division, Don cuts the chocolate piece off and lets Dale choose his favorite piece. Based on that, Dale chooses the vanilla and strawberry parts. Note: All cuts made to the ice cream shown below are vertical.



27) Which is a second division that Dale would make of his share of the ice cream? 27) _____

A) Part 1: the vanilla and $\frac{1}{3}$ of the strawberry, Part 2: $\frac{1}{3}$ of the strawberry, Part 3: $\frac{1}{3}$ of the strawberry
B) Part 1: the vanilla, Part 2: $\frac{1}{2}$ of the strawberry, Part 3: $\frac{1}{2}$ of the strawberry
C) Part 1: $\frac{2}{3}$ of the vanilla, Part 2: $\frac{2}{3}$ of the strawberry, Part 3: $\frac{1}{3}$ of the vanilla and $\frac{1}{3}$ of the strawberry
D) Part 1: the strawberry, Part 2: $\frac{1}{2}$ of the vanilla, Part 3: $\frac{1}{2}$ of the vanilla
E) none of these

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Solve the problem.

28) Sheila, Susan, and Rosie want to divide a cake fairly using the lone chooser method. The chooser, Rosie, was determined by drawing straws. Sheila and Susan agreed that Sheila would make the division of the cake. Assuming that each of them plays the game correctly, which of the following statements [A), B), C) or D)] cannot be true? 28) _____

A) Rosie believes that her share is worth 1/3 of the cake; Susan believes that her share is worth 1/3 of the cake; Sheila believes that her share is worth 2/3 of the cake.
B) Rosie believes that her share is worth 1/3 of the cake; Susan believes that her share is worth 1/2 of the cake; Sheila believes that her share is worth 1/3 of the cake.
C) Rosie believes that her share is worth 1/3 of the cake; Susan believes that her share is worth 1/3 of the cake; Sheila believes that her share is worth 1/3 of the cake.
D) Rosie believes that her share is worth 2/3 of the cake; Susan believes that her share is worth 1/2 of the cake; Sheila believes that her share is worth 1/3 of the cake.
E) none of these

29) Dave, Doug, and Cindy want to divide a cake fairly using the lone chooser method. After drawing straws, Cindy gets to be the chooser and Dave has to make the first division of the cake. Assuming that each of them plays the game correctly, which of the following statements is true? 29) _____

A) Dave, Doug, and Cindy may each believe that their share is worth more than 1/3 of the cake.
B) Doug may believe that the share he ends up with is worth more than 1/3 of the cake although he may also believe that the shares that Dave and Cindy end up with are worth more than his share.
C) Dave will believe that the share he ends up with is worth 1/3 of the cake although he may also believe that the shares that Doug and Cindy end up with are worth more than his share.
D) Cindy may believe that the share she ends up with is worth more than 1/3 of the cake and may also believe that the share that Dave ends up with is worth more than her share.
E) none of these

Three heirs (A, B, and C) must fairly divide an estate consisting of two items – a house and a boat – using the method of sealed bids. The players' bids (in dollars) are:

	A	B	C
House	**180,000**	**190,000**	**200,000**
Boat	**42,000**	**50,000**	**31,000**

30) After the initial allocations to each player are made, there is a surplus of 30) _____

A) $23,000.
B) $19,000.
C) $49,000.
D) $10,333.33.
E) none of these

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Four heirs (A, B, C, and D) must fairly divide an estate consisting of two items – a house and a cabin – using the method of sealed bids. The players' bids (in dollars) are:

	A	B	C	D
House	**195,000**	**212,000**	**201,000**	**182,000**
Cabin	**45,000**	**36,000**	**35,000**	**42,000**

31) The original fair share of player A is worth 31) _____
A) $80,000.
B) $240,000.
C) $60,000.
D) $120,000.
E) none of these

32) In the initial allocation, player A 32) _____
A) gets the house and pays the estate $135,000.
B) gets the house and an additional $55,000 from the estate.
C) gets the cabin and an additional $15,000 from the estate.
D) gets the cabin and pays the estate $15,000.
E) none of these

33) In the initial allocation, player B 33) _____
A) gets $62,000 from the estate.
B) gets the house and the cabin and pays the estate $186,000.
C) gets the house and pays the estate $274,000.
D) gets the house and pays the estate $150,000.
E) none of these

34) After all is said and done, the final allocation to player C is 34) _____
A) $64,000 in cash.
B) the cabin plus $29,000 in cash.
C) $54,000 in cash.
D) the cabin plus $24,000 in cash.
E) none of these

Four heirs (A, B, C, and D) must divide fairly an estate consisting of three items — a house, a cabin and a boat — using the method of sealed bids. The players' bids (in dollars) are:

	A	B	C	D
House	**180,000**	**200,000**	**190,000**	**185,000**
Cabin	**60,000**	**50,000**	**40,000**	**55,000**
Boat	**16,000**	**12,000**	**18,000**	**10,000**

35) In the initial allocation, player B 35) _____
A) gets $65,500 cash.
B) gets the house and pays the estate $134,500.
C) gets the cabin and an additional $15,500 from the estate.
D) gets the boat and an additional $53,500 from the estate.
E) none of these

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36) In the initial allocation, player C 36) _____

A) gets the boat and an additional $44,000 from the estate.
B) gets the house and pays the estate $128,000.
C) gets $62,000 cash.
D) gets the cabin and an additional $22,000 from the estate.
E) none of these

37) After all is said and done, the final allocation to player B is 37) _____

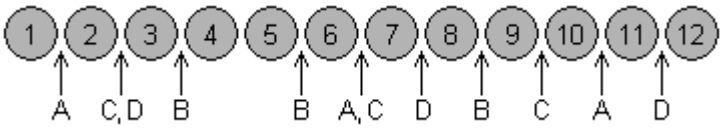
A) the house plus $6000 in cash.
B) the house minus $134,500 in cash.
C) $65,500 in cash.
D) the house minus $128,500 in cash.
E) none of these

Solve the problem.

38) Sue and Tom are getting a divorce. Except for the house, they own very little of value so they agree to divide the house fairly using the method of sealed bids. Sue bids 100,000 and Tom bids 90,000. After all is said and done, the final outcome is 38) _____

A) Sue gets the house and pays Tom $47,500.
B) Sue gets the house and pays Tom $45,000.
C) Sue gets the house and pays Tom $55,000.
D) Sue gets the house and pays Tom $50,000.
E) none of these

Four players (A, B, C, and D) agree to divide the 12 items below using the method of markers. The players' bids are as indicated.



39) Item 10 39) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

40) Item 11 40) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

41) Item 12 41) _____

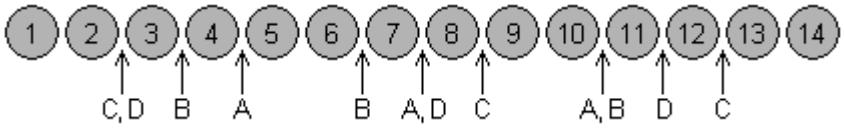
A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

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42) Item 4 42) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

Four players (A, B, C, and D) agree to divide the 14 items shown below by lining them up in order and using the method of markers. The players' bids are as indicated.



43) Item 3 43) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

44) Item 10 44) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

45) Item 13 45) _____

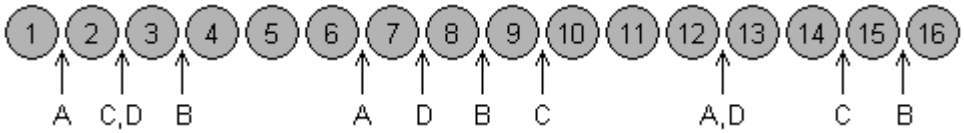
A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

46) Item 6 46) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

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Four players (A, B, C, and D) agree to divide the 16 items shown below by lining them up in order and using the method of markers. The players' bids are as indicated.



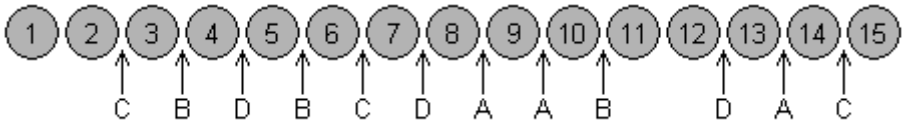
47) Item 11 47) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

48) Item 15 48) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

Four players (A, B, C, and D) agree to divide the 15 items shown below by lining them up in order and using the method of markers. The players' bids are as indicated.



49) Item 3 49) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

50) Item 7 50) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

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1) A
2) B
3) C
4) E
5) C
6) A
7) D
8) C
9) A
10) C
11) C
12) B
13) A
14) B
15) A
16) D
17) B
18) C
19) A
20) A
21) B
22) D
23) B
24) D
25) C
26) C
27) A
28) A
29) D
30) B
31) C
32) C
33) D
34) A
35) B
36) A
37) D
38) A
39) E
40) E
41) D
42) B
43) E
44) A
45) D
46) B
47) C
48) E
49) E
50) E

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Chapter 3

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Malia buys a chocolate–strawberry–vanilla cake in Figure(i) for $14.00 . She cuts the cake into six 60° wedges as shown in Figure (ii). Malia likes chocolate twice as much as vanilla and likes vanilla twice as much as strawberry.

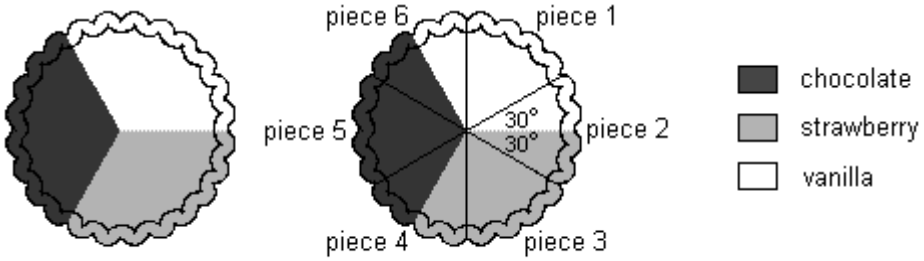


Figure (i) Figure (ii)

1) What is the value of piece 1 to Malia? 1) _____
A) $4.00
B) $2.00
C) $3.00
D) $1.00
E) none of these

2) What is the value of piece 2 to Malia? 2) _____
A) $1.00
B) $2.00
C) $1.50
D) $2.50
E) none of these

3) What is the value of piece 4 to Malia? 3) _____
A) $1.50
B) $1.00
C) $2.00
D) $2.50
E) none of these

4) What is the value of piece 6 to Malia? 4) _____
A) $2.50
B) $1.00
C) $1.50
D) $2.00
E) none of these

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Ned buys a chocolate–strawberry–vanilla cake in Figure (i) for $14.00. He cuts the cake into six 60° wedges as shown in Figure (ii). Ned values strawberry six times as much as chocolate. He does not value vanilla cake at all.

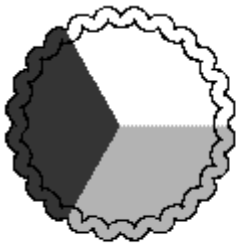


Figure (i)

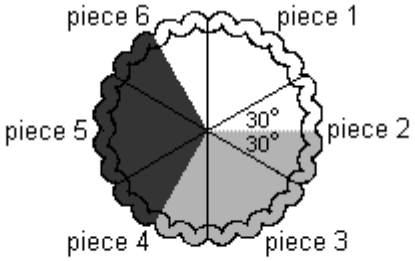
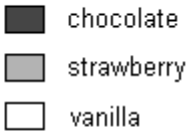


Figure (ii)



5) How much does Ned value piece 3? 5) _____

A) $12.00
B) $8.00
C) $4.00
D) $6.00
E) none of these

6) How much does Ned value piece 4? 6) _____

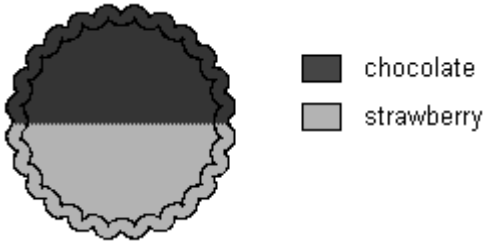
A) $3.00
B) $3.50
C) $2.50
D) $2.00
E) none of these

7) How much does Ned value piece 5? 7) _____

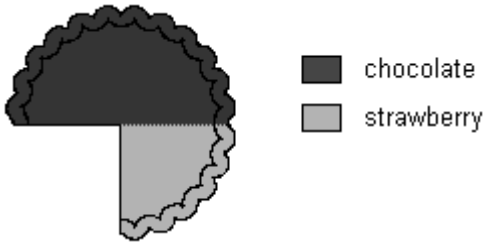
A) $2.50
B) $1.00
C) $1.50
D) $2.00
E) none of these

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Angela and Ben want to divide fairly the chocolate–strawberry cake shown below. The total cost of the cake was $6.00. Angela values strawberry three times as much as she values chocolate, while Ben values chocolate twice as much as he values strawberry.

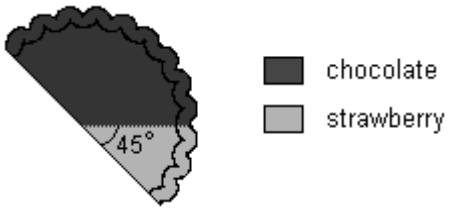


8) In Angela's eyes, the piece shown below is worth 8) _____



A) $4.50.
B) $3.75.
C) $2.25.
D) $5.00.
E) none of these

9) In Ben's eyes, the piece shown below is worth 9) _____



A) $3.00.
B) $2.50.
C) $4.00.
D) $3.50.
E) none of these

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Three players (Ady, Brenden, and Cara) are sharing a pie. Suppose that the pie is divided into three slices (s_1, s_2, and s_3). The following table gives the value of each slice in the eyes of each of the players.

	s_1	s_2	s_3
Ady	**$5.50**	**$4.50**	**$5.75**
Brenden	**$4.50**	**$4.25**	**$6.75**
Cara	**$4.00**	**$5.00**	**$4.75**

10) Find a fair division of cake using s_1, s_2, and s_3 as fair shares. 10) _____

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Four players (Alli, Blake, Corey, and Devin) are sharing a cake. Suppose that the cake is divided into four slices s_1, s_2, s_3, and s_4.

11) To Blake, s_1 and s_4 have equal value, s_2 is worth as much as s_1 and s_4 combined, and s_3 is worth \$2.40. The entire cake is worth \$14.00. Determine which of the four slices are fair shares to Blake. 11) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Alan, Boris, Cali, and Doris are dividing a cake among themselves. The cake is divided into four slices s_1, s_2, s_3, and s_4.

12) To Boris, the entire cake is worth \$18.00 and the value of s_4 is \$4.00. Boris values s_3 twice as much as s_1. He values s_2 as \$1.00 less than s_3. What are fair shares to Boris? 12) _____

A) $\{s_2\}$
B) $\{s_2, s_3\}$
C) $\{s_1, s_2, s_3\}$
D) $\{s_3\}$
E) none of these

Solve the problem.

13) Alan, Brianna, Claire, and Doug wish to equally divide a half chocolate, half vanilla cake. Each player values chocolate three times as much as they value vanilla. What fraction of the chocolate half of the cake would be considered a fair share to each? 13) _____

A) $\frac{1}{2}$
B) $\frac{1}{5}$
C) $\frac{1}{3}$
D) $\frac{1}{4}$
E) none of these

14) Consider a fair division problem involving five players. The phrase "a player receives a fair share" describes the fact that 14) _____

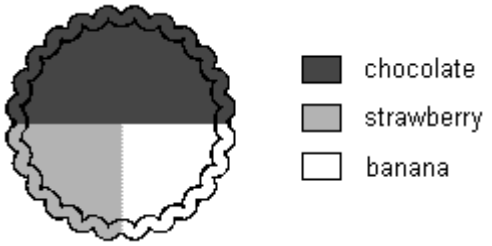
A) the player receives a share that, in that player's own opinion, has a value that is equal to 20% or more of the total.
B) the player receives a share that, in that player's own opinion, has a value that is exactly equal to 20% of the total.
C) the player receives a share that, in every player's opinion, has a value that is equal to 20% or more of the total.
D) the player receives a share that is at least as valuable as that of any other player.
E) none of these

15) Which of the following is a continuous fair division problem? 15) _____

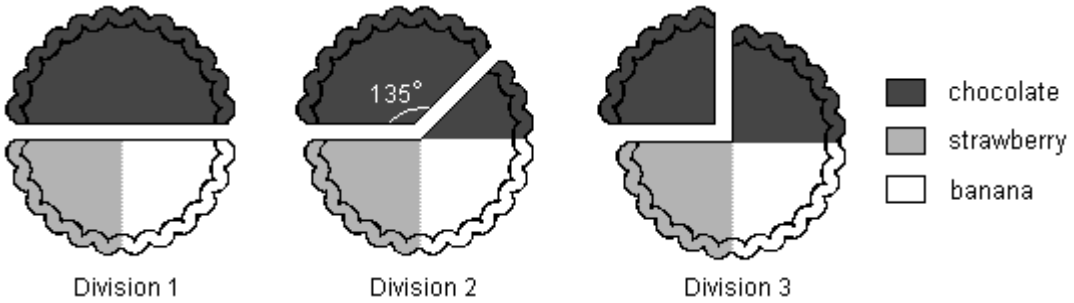
A) Dividing an art collection.
B) Dividing a cream pie.
C) Dividing a house plus all the furniture in it.
D) Dividing the family jewels.
E) none of these

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Carli and Dale want to divide fairly the chocolate–strawberry cake shown below using the divider–chooser method. The total cost of the cake was $18.00. Carli values strawberry and banana equally, but values chocolate twice as much as either of these put together. Dale values chocolate three times as much as he values strawberry. Further, he values strawberry twice as much as he values banana.

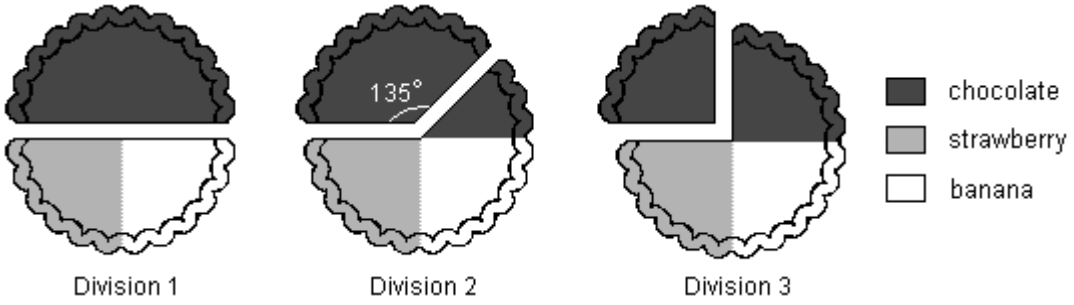


16) If Carli is the divider, which of the divisions shown below is consistent with Carli's value system? 16) _____



A) Division 1
B) Division 2
C) Division 3
D) all of these
E) none of these

17) If Dale is the divider, which of the divisions shown below is consistent with Dale's value system? 17) _____



A) Division 1
B) Division 2
C) Division 3
D) all of these
E) none of these

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Solve the problem.

18) Joe and Bill want to divide a cake using the divider–chooser method. They draw straws, and it is determined that Bill will be the divider and Joe the chooser. Assuming that each plays the game correctly, which of the following statements [A), B), C) or D)] cannot be true? 18) _____

A) Joe believes that his share is worth 50% of the cake; Bill believes that his share is worth 50% of the cake.

B) Bill believes that his share is worth 60% of the cake; Joe believes that his share is worth 50% of the cake.

C) Joe believes that his share is worth 60% of the cake; Bill believes that his share is worth 50% of the cake.

D) Bill believes that Joe's share is worth 50% of the cake; Joe believes that his share is worth 60% of the cake.

E) none of these

Three players (one divider and two choosers) are going to divide a cake fairly using the lone divider method. The divider cuts the cake into three slices (s_1, s_2, and s_3).

19) If the choosers' declarations are Chooser 1: {s_2 , s_3} and Chooser 2: {s_1 , s_3}, which of the following is not a fair division of the cake? 19) _____

A) Chooser 1 gets s_2; Chooser 2 gets s_3; Divider gets s_1.

B) Chooser 1 gets s_3; Chooser 2 gets s_1; Divider gets s_2.

C) Chooser 1 gets s_1; Chooser 2 gets s_3; Divider gets s_2.

D) Chooser 1 gets s_2; Chooser 2 gets s_1;Divider gets s_3.

E) none of these

20) If the chooser's declarations are Chooser 1: {s_2} and Chooser 2: {s_2}, which of the following is a fair division of the cake? 20) _____

A) Chooser 1 gets s_2; Chooser 2 gets s_3; Divider gets s_1.

B) Chooser 1 gets s_3; Chooser 2 gets s_1; Divider gets s_2.

C) Chooser 1 gets s_2; Chooser 2 gets s_1; Divider gets s_3.

D) Chooser 1 and Chooser 2 split s_2; Divider gets s_1 and s_3.

E) none of these

21) Suppose the choosers value the slices as follows: 21) _____

	s_1	s_2	s_3
Chooser 1	30%	40%	30%
Chooser 2	32%	32%	36%

Which of the following is a fair division of the cake?

A) Chooser 1 gets s_2; Chooser 2 gets s_3; Divider gets s_1.

B) Chooser 1 gets s_2; Chooser 2 gets s_1; Divider gets s_3.

C) Chooser 1 gets s_3; Chooser 2 gets s_2; Divider gets s_1.

D) Chooser 1 gets s_1; Chooser 2 gets s_2; Divider gets s_3.

E) none of these

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22) Suppose the choosers value the slices as follows: 22) _____

	s_1	s_2	s_3
Chooser 1	35%	38%	27%
Chooser 2	34%	30%	36%

Which of the following is not a fair division of the cake?

A) Chooser 1 gets s_2; Chooser 2 gets s_3; Divider gets s_1.

B) Chooser 1 gets s_1; Chooser 2 gets s_2; Divider gets s_3.

C) Chooser 1 gets s_1; Chooser 2 gets s_3; Divider gets s_2.

D) Chooser 1 gets s_2; Chooser 2 gets s_1; Divider gets s_3.

E) none of these

Four players (A, B, C, and D) agree to divide a cake fairly using the lone divider method. The table below shows how each player values each of the four slices that have been cut by the divider.

	s_1	s_2	s_3	s_4
A	**20%**	**32%**	**28%**	**20%**
B	**25%**	**25%**	**25%**	**25%**
C	**15%**	**15%**	**30%**	**40%**
D	**24%**	**24%**	**24%**	**28%**

23) Using the lone–divider method, how many different fair divisions of this cake are possible? 23) _____

A) 0

B) 1

C) 2

D) 3

E) none of these

Five players (A, B, C, D, and E) agree to divide a cake fairly using the lone divider method. The table below shows how each player values each of the five slices that have been cut by the divider.

	s_1	s_2	s_3	s_4	s_5
A	**$1.00**	**$4.00**	**$3.00**	**$4.00**	**$3.00**
B	**$3.50**	**$4.50**	**$3.50**	**$3.50**	**$5.00**
C	**$1.25**	**$0.75**	**$0.75**	**$0.75**	**$1.50**
D	**$2.00**	**$2.00**	**$2.00**	**$2.00**	**$2.00**
E	**$1.00**	**$3.00**	**$1.00**	**$1.00**	**$4.00**

24) Assuming all players play honestly, which player was the divider? 24) _____

A) A B) B C) C D) D E) E

25) Which of the following is a fair division of the cake? 25) _____

A) A gets s_4, B gets s_5, C gets s_1, D gets s_3, E gets s_2

B) A gets s_3, B gets s_2, C gets s_1, D gets s_4, E gets s_5

C) A gets s_4, B gets s_2, C gets s_1, D gets s_3, E gets s_5

D) All of these are fair divisions

E) none of these

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Four partners (Alonzo, Brenda, Camille, and Donald) are dividing a parcel of land valued at $240,000 among themselves using the lone–divider method. Using a map, the divider divides the property into four parcels s_1, s_2, s_3, and s_4. The following table shows the value of the four parcels in the eyes of each partner, but some of the entries in the table are missing.

	s_1	s_2	s_3	s_4
Alonzo		**$50,000**	**$50,000**	**$70,000**
Brenda	**$40,000**	**$80,000**	**$55,000**	
Camille	**$110,000**	**$40,000**	**$30,000**	
Donald	**$60,000**			

26) What was Brenda's bid list? 26) _____

A) $\{s_2, s_4\}$

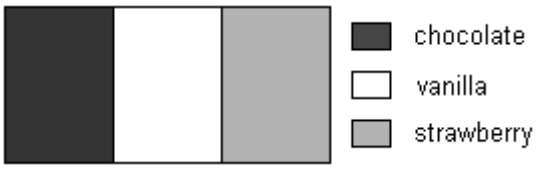
B) $\{s_2, s_3\}$

C) $\{s_2\}$

D) $\{s_2, s_3, s_4\}$

E) none of these

Don, Dale, and Cam buy a carton of neopolitan ice cream that is one –third chocolate, one–third vanilla, and one–third strawberry as shown below. They wish to fairly divide the ice cream using the lone chooser method. Don likes chocolate twice as much as vanilla or strawberry. Dale likes strawberry but no other flavor. Cam, the chooser, likes chocolate and vanilla twice as much as strawberry. In the first division, Don cuts the chocolate piece off and lets Dale choose his favorite piece. Based on that, Dale chooses the vanilla and strawberry parts. Note: All cuts made to the ice cream shown below are vertical.



27) Which is a second division that Dale would make of his share of the ice cream? 27) _____

A) Part 1: $\frac{2}{3}$ of the vanilla, Part 2: $\frac{2}{3}$ of the strawberry, Part 3: $\frac{1}{3}$ of the vanilla and $\frac{1}{3}$ of the strawberry

B) Part 1: the vanilla, Part 2: $\frac{1}{2}$ of the strawberry, Part 3: $\frac{1}{2}$ of the strawberry

C) Part 1: the strawberry, Part 2: $\frac{1}{2}$ of the vanilla, Part 3: $\frac{1}{2}$ of the vanilla

D) Part 1: the vanilla and $\frac{1}{3}$ of the strawberry, Part 2: $\frac{1}{3}$ of the strawberry, Part 3: $\frac{1}{3}$ of the strawberry

E) none of these

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Solve the problem.

28) Sheila, Susan, and Rosie want to divide a cake fairly using the lone chooser method. The chooser, Rosie, was determined by drawing straws. Sheila and Susan agreed that Sheila would make the division of the cake. Assuming that each of them plays the game correctly, which of the following statements [A), B), C) or D)] cannot be true? 28) _____

A) Rosie believes that her share is worth 1/3 of the cake; Susan believes that her share is worth 1/3 of the cake; Sheila believes that her share is worth 1/3 of the cake.
B) Rosie believes that her share is worth 2/3 of the cake; Susan believes that her share is worth 1/2 of the cake; Sheila believes that her share is worth 1/3 of the cake.
C) Rosie believes that her share is worth 1/3 of the cake; Susan believes that her share is worth 1/2 of the cake; Sheila believes that her share is worth 1/3 of the cake.
D) Rosie believes that her share is worth 1/3 of the cake; Susan believes that her share is worth 1/3 of the cake; Sheila believes that her share is worth 2/3 of the cake.
E) none of these

29) Dave, Doug, and Cindy want to divide a cake fairly using the lone chooser method. Cindy gets to be the chooser and Dave and Doug are the dividers, with Dave having to make the first division of the cake into two pieces. Suppose that x% represents the value of Dave's share (to Dave), y% represents the value of Doug's share (to Doug), and z% represents the value of Cindy's share (to Cindy). Assuming each player plays the game correctly, which of the following statements is true? 29) _____

A) x% + y% + z% = 100%
B) x% must be $33\frac{1}{3}$%; y% must be $33\frac{1}{3}$%; z% must be more than $33\frac{1}{3}$%.
C) y must be bigger than or equal to x; z must be bigger than or equal to y.
D) x% must be $33\frac{1}{3}$%; y must be bigger than x; z must be bigger than or equal to y.
E) none of these

Four heirs (A, B, C, and D) must fairly divide an estate consisting of two items – a house and a cabin – using the method of sealed bids. The players' bids (in dollars) are:

	A	B	C	D
House	**195,000**	**212,000**	**201,000**	**182,000**
Cabin	**45,000**	**36,000**	**35,000**	**42,000**

30) In the initial allocation, player A 30) _____

A) gets the cabin and an additional $15,000 from the estate.
B) gets the house and an additional $55,000 from the estate.
C) gets the cabin and pays the estate $15,000.
D) gets the house and pays the estate $135,000.
E) none of these

31) In the initial allocation, player B 31) _____

A) gets the house and the cabin and pays the estate $186,000.
B) gets $62,000 from the estate.
C) gets the house and pays the estate $150,000.
D) gets the house and pays the estate $274,000.
E) none of these

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32) After the initial allocation to each player is made, there is a surplus of 32) _____
A) $0.
B) $150,000.
C) $20,000.
D) $32,000.
E) none of these

33) After all is said and done, the final allocation to player C is 33) _____
A) the cabin plus $24,000 in cash.
B) the cabin plus $29,000 in cash.
C) $64,000 in cash.
D) $54,000 in cash.
E) none of these

Four heirs (A, B, C, and D) must divide fairly an estate consisting of three items — a house, a cabin and a boat — using the method of sealed bids. The players' bids (in dollars) are:

	A	B	C	D
House	**180,000**	**200,000**	**190,000**	**185,000**
Cabin	**60,000**	**50,000**	**40,000**	**55,000**
Boat	**16,000**	**12,000**	**18,000**	**10,000**

34) The original fair share of player B is worth 34) _____
A) $64,000.
B) $65,500.
C) $62,500.
D) $62,000.
E) none of these

35) In the initial allocation, player B 35) _____
A) gets the house and pays the estate $134,500.
B) gets $65,500 cash.
C) gets the boat and an additional $53,500 from the estate.
D) gets the cabin and an additional $15,500 from the estate.
E) none of these

36) In the initial allocation, player C 36) _____
A) gets the boat and an additional $44,000 from the estate.
B) gets the house and pays the estate $128,000.
C) gets the cabin and an additional $22,000 from the estate.
D) gets $62,000 cash.
E) none of these

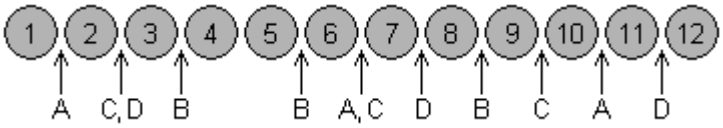
37) After the initial allocation to each player is made, there is a surplus of 37) _____
A) $12,000.
B) $24,000.
C) $6000.
D) $0.
E) none of these

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38) After all is said and done, the final allocation to player B is 38) _____

A) $65,500 in cash.
B) the house minus $134,500 in cash.
C) the house minus $128,500 in cash.
D) the house plus $6000 in cash.
E) none of these

Four players (A, B, C, and D) agree to divide the 12 items below using the method of markers. The players' bids are as indicated.



39) Item 5 39) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

40) Item 10 40) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

41) Item 11 41) _____

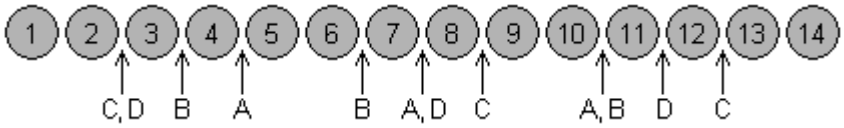
A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

42) Item 12 42) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

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Four players (A, B, C, and D) agree to divide the 14 items shown below by lining them up in order and using the method of markers. The players' bids are as indicated.



43) Item 5 43) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

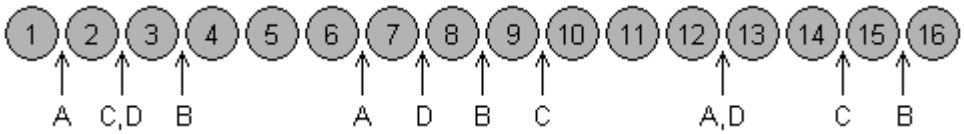
44) Item 13 44) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

45) Item 6 45) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

Four players (A, B, C, and D) agree to divide the 16 items shown below by lining them up in order and using the method of markers. The players' bids are as indicated.



46) Item 5 46) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

47) Item 11 47) _____

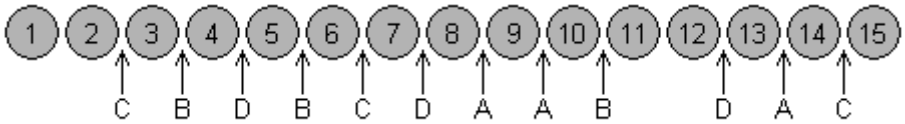
A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

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48) Item 16 48) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

Four players (A, B, C, and D) agree to divide the 15 items shown below by lining them up in order and using the method of markers. The players' bids are as indicated.



49) Item 7 49) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

50) Item 10 50) _____

A) goes to A.
B) goes to B.
C) goes to C.
D) goes to D.
E) is left over.

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Answer Key
Testname:

1) B
2) C
3) D
4) E
5) D
6) B
7) B
8) B
9) D
10) Ady: s_1; Brenden: s_3; Cara: s_2
11) s_2
12) B
13) D
14) A
15) B
16) B
17) B
18) B
19) C
20) E
21) A
22) B
23) B
24) D
25) D
26) A
27) D
28) D
29) E
30) A
31) C
32) C
33) C
34) B
35) A
36) A
37) B
38) C
39) B
40) E
41) E
42) D
43) B
44) D
45) B
46) D
47) C
48) B
49) E

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50) D

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Chapter 4

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

A small country consists of four states. The population of State A is 67,200, the population of State B is 78,300, the population of State C is 73,800, and the population of State D is 80,700. The total number of seats in the legislature is 100.

1) The standard divisor is 1) _____
A) 1000.
B) 10,000.
C) 3000.
D) 30,000.
E) none of these

2) The standard quota for State C is 2) _____
A) 26.1.
B) 25.7.
C) 26.9.
D) 24.6.
E) none of these

A small country consists of four states. The population of State A is 44,800, the population of State B is 52,200, the population of State C is 49,200, and the population of State D is 53,800. The total number of seats in the legislature is 100.

3) The standard quota for State C is 3) _____
A) 24.6.
B) 25.7.
C) 26.9.
D) 26.1.
E) none of these

The following question refers to a country with five states. There are 240 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E
Population (in thousands)	427	754	4389	3873	157

4) The standard divisor is 4) _____
A) 20,000.
B) 4000.
C) 9600.
D) 40,000.
E) none of these

5) The standard quota for State A is 5) _____
A) 11.
B) 427.
C) 0.148.
D) 10.675.
E) none of these

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6) The standard quota for State D is 6) _____

A) 96.
B) 97.
C) 96.825.
D) 97.825.
E) none of these

A small country consists of four states (State 1, State 2, State 3, and State 4). The total population of the country is 400,000. The standard quotas are $q_1 = 179.8$, $q_2 = 129.6$, $q_3 = 79.2$, and $q_4 = 11.4$ respectively.

7) The standard divisor is 7) _____

A) 4000.
B) 100.
C) 1000.
D) 400.
E) none of these

A bus company operates four bus routes (A, B, C, and D) and 50 buses. The buses are apportioned among the routes on the basis of average number of daily passengers per route which is given in the following table.

Route	A	B	C	D
Daily average number of passengers	3194	9066	4548	8192

8) The standard divisor represents 8) _____

A) the daily average number of passengers per bus.
B) the daily average number of passengers per 50 buses.
C) the number of passengers that one bus is able to transport per day.
D) the number of buses required for 25,000 passengers.
E) none of these

9) The standard quota of Route A (to 2 decimal places) is 9) _____

A) 6.39.
B) 12.78.
C) 63.88.
D) 7.14.
E) none of these

A small country consists of four states (State 1, State 2, State 3, and State 4). The total population of the country is 200,000. The standard quotas are $q_1 = 64.8$, $q_2 = 89.9$, $q_3 = 39.6$, and $q_4 = 5.7$ respectively.

10) The population of State 1 is 10) _____

A) 32,400.
B) 89,900.
C) 64,800.
D) 129,600.
E) none of these

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The following question refers to a school district with three high schools. The total number of students in the district is 3000. The teachers within the district are apportioned to the high schools based on the schools' respective enrollments. The standard quota for each school is given in the following table.

School	North High	Central High	South High
Standard Quota	$18\frac{1}{3}$	$51\frac{2}{3}$	30

11) Find the number of teachers in the school district. 11) _____

A) 10
B) 30
C) 300
D) 100
E) none of these

12) Find the standard divisor for this apportionment problem. 12) _____

A) 100
B) 10
C) 30
D) 300
E) none of these

13) What does the standard divisor represent in this apportionment problem? 13) _____

A) the number of teachers per 100 students
B) the number of teachers required for 3000 students
C) the number of students per teacher
D) the number of students per 100 teachers
E) none of these

A small country consists of four states. The population of State A is 67,200, the population of State B is 78,300, the population of State C is 73,800, and the population of State D is 80,700. The total number of seats in the legislature is 100.

14) Under Hamilton's method, the apportionments to each state are 14) _____

A) State A: 22 seats; State B: 26 seats; State C: 25 seats; State D: 27 seats.
B) State A: 23 seats; State B: 26 seats; State C: 24 seats; State D: 27 seats.
C) State A: 22 seats; State B: 26 seats; State C: 24 seats; State D: 28 seats.
D) State A: 22 seats; State B: 26 seats; State C: 24 seats; State D: 26 seats.
E) none of these

A small country consists of four states. The population of State A is 44,800, the population of State B is 52,200, the population of State C is 49,200, and the population of State D is 53,800. The total number of seats in the legislature is 100.

15) Under Hamilton's method, the apportionments to each state are 15) _____

A) State A: 22 seats; State B: 26 seats; State C: 24 seats; State D: 26 seats.
B) State A: 23 seats; State B: 26 seats; State C: 24 seats; State D: 27 seats.
C) State A: 22 seats; State B: 26 seats; State C: 24 seats; State D: 28 seats.
D) State A: 22 seats; State B: 26 seats; State C: 25 seats; State D: 27 seats.
E) none of these

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The following question refers to a country with five states. There are 250 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E
Population (in thousands)	250	875	4700	3825	350

16) Under Hamilton's method, the apportionments to each state are 16) _____

A) State A: 6; State B: 22; State C: 118; State D: 96; State E: 8.
B) State A: 6; State B: 23; State C: 116; State D: 96; State E: 9.
C) State A: 6; State B: 22; State C: 117; State D: 96; State E: 9.
D) State A: 7; State B: 22; State C: 117; State D: 95; State E: 9.
E) none of these

The following question refers to a country with six states. There are 250 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E	F
Population (in thousands)	1456	6733	557	2081	685	988

17) Find each state's apportionment under Hamilton's method. 17) _____

A) State A: 29; State B: 133; State C: 12; State D: 42; State E: 14; State F: 20
B) State A: 29; State B: 136; State C: 11; State D: 42; State E: 13; State F: 19
C) State A: 29; State B: 134; State C: 11; State D: 42; State E: 14; State F: 20
D) State A: 29; State B: 135; State C: 11; State D: 41; State E: 14; State F: 20
E) none of these

The following question refers to a country with six states. There are 300 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E	F
Population (in thousands)	1856	5922	602	2076	626	918

18) Find each state's apportionment under Hamilton's method. 18) _____

A) State A: 47; State B: 147; State C: 15; State D: 52; State E: 16; State F: 23
B) State A: 46; State B: 148; State C: 15; State D: 52; State E: 16; State F: 23
C) State A: 46; State B: 149; State C: 15; State D: 52; State E: 15; State F: 23
D) State A: 47; State B: 148; State C: 15; State D: 52; State E: 15; State F: 23
E) none of these

A small country consists of four states (State 1, State 2, State 3, and State 4). The total population of the country is 400,000. The standard quotas are $q_1 = 179.8$, $q_2 = 129.6$, $q_3 = 79.2$, and $q_4 = 11.4$ respectively.

19) The final apportionment to each state under Hamilton's method is 19) _____

A) State 1: 180 seats; State 2: 129 seats; State 3: 80 seats; State 4: 11 seats.
B) State 1: 180 seats; State 2: 130 seats; State 3: 79 seats; State 4: 11 seats.
C) State 1: 179 seats; State 2: 130 seats; State 3: 79 seats; State 4: 12 seats.
D) State 1: 179 seats; State 2: 131 seats; State 3: 79 seats; State 4: 11 seats.
E) none of these

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A bus company operates four bus routes (A, B, C, and D) and 50 buses. The buses are apportioned among the routes on the basis of average number of daily passengers per route which is given in the following table.

Route	A	B	C	D
Daily average number of passengers	3194	9066	4548	8192

20) In process of applying Hamilton's method, the route receiving the "extra" bus is 20) _____
A) Route D.
B) Route C.
C) Route B.
D) Route A.
E) none of these

Solve the problem.

21) A mother wishes to distribute 16 pieces of candy using Hamilton's method among her 3 children (Abe, Betty, and Cindy) based on the number of hours each child spends doing chores around the house. The only information we have is that Cindy's standard quota is 3.59. Which of the following is possible? 21) _____
A) Cindy could receive 4 pieces of candy.
B) Cindy could receive 3 or 4 pieces of candy.
C) Cindy could receive 3 pieces of candy.
D) Cindy could receive 5 pieces of candy.
E) none of these

A small country consists of four states. The population of State A is 67,200, the population of State B is 78,300, the population of State C is 73,800, and the population of State D is 80,700. The total number of seats in the legislature is 100.

22) Using a divisor of D = 2925, the modified quotas (to two decimal places) are 22) _____
A) State A: 22.40; State B: 26.10; State C: 24.60; State D: 26.90.
B) State A: 22.74; State B: 26.86; State C: 25.12; State D: 27.43.
C) State A: 22.97; State B: 26.77; State C: 25.23; State D: 27.59.
D) State A: 22.58; State B: 26.67; State C: 24.93; State D: 27.28.
E) none of these

The following question refers to a country with five states. There are 250 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E
Population (in thousands)	250	875	4700	3825	350

23) Under Jefferson's method, the apportionments to each state are 23) _____
A) State A: 7; State B: 22; State C: 117; State D: 95; State E: 9.
B) State A: 6; State B: 23; State C: 116; State D: 96; State E: 9.
C) State A: 6; State B: 22; State C: 117; State D: 96; State E: 9.
D) State A: 6; State B: 22; State C: 118; State D: 96; State E: 8.
E) none of these

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The following question refers to a country with six states. There are 250 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E	F
Population (in thousands)	1456	6733	557	2081	685	988

24) Find each state's apportionment under Jefferson's method. 24) _____

A) State A: 29; State B: 136; State C: 11; State D: 42; State E: 13; State F: 19
B) State A: 29; State B: 135; State C: 11; State D: 41; State E: 14; State F: 20
C) State A: 29; State B: 134; State C: 11; State D: 42; State E: 14; State F: 20
D) State A: 29; State B: 133; State C: 12; State D: 42; State E: 14; State F: 20
E) none of these

A small country consists of four states (State 1, State 2, State 3, and State 4). The total population of the country is 200,000. The standard quotas are $q_1 = 64.8$, $q_2 = 89.9$, $q_3 = 39.6$, and $q_4 = 5.7$ respectively.

25) Which of the following numbers can be used as a modified divisor under Jefferson's method? 25) _____

A) 990
B) 1004
C) 1000
D) 1001
E) none of these

A bus company operates four bus routes (A, B, C, and D) and 50 buses. The buses are apportioned among the routes on the basis of average number of daily passengers per route which is given in the following table.

Route	A	B	C	D
Daily average number of passengers	3194	9066	4548	8192

26) Find the apportionment of the buses among the routes using Jefferson's method. 26) _____

A) Route A: 6; Route B: 18; Route C: 9; Route D: 17
B) Route A: 7; Route B: 18; Route C: 10; Route D: 16
C) Route A: 7; Route B: 17; Route C: 9; Route D: 17
D) Route A: 7; Route B: 18; Route C: 9; Route D: 16
E) none of these

A bus company operates four bus routes (A, B, C, and D) and 100 buses. The buses are apportioned among the routes on the basis of average number of daily passengers per route which is given in the following table.

Route	A	B	C	D
Daily average number of passengers	12,444	36,503	19,581	31,472

27) Find the apportionment of the buses among the routes using Jefferson's method. 27) _____

A) Route A: 13; Route B: 36; Route C: 20; Route D: 31
B) Route A: 12; Route B: 37; Route C: 19; Route D: 32
C) Route A: 13; Route B: 36; Route C: 19; Route D: 32
D) Route A: 12; Route B: 37; Route C: 20; Route D: 31
E) none of these

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The following question refers to a school district with three high schools. The total number of students in the district is 3000. The teachers within the district are apportioned to the high schools based on the schools' respective enrollments. The standard quota for each school is given in the following table.

School	North High	Central High	South High
Standard Quota	$18\frac{1}{3}$	$51\frac{2}{3}$	30

28) Which of the following will work as a modified divisor for Jefferson's method? 28) _____

A) 29.1
B) 29.5
C) 28.7
D) 29.9
E) none of these

The following question refers to a country with six states. There are 300 seats in the legislature and the percent of the population in each state is given in the table below.

State	A	B	C	D	E	F
Percent of Population	14.25%	53.75%	5.35%	16.5%	6.25%	3.9%

29) Find each state's apportionment under Jefferson's method. 29) _____

A) A: 43; B: 162; C: 16; D: 50; E: 18; F: 11
B) A: 43; B: 161; C: 16; D: 49; E: 19; F: 12
C) A: 44; B: 160; C: 16; D: 49; E: 19; F: 12
D) A: 43; B: 160; C: 16; D: 50; E: 19; F: 12
E) none of these

The following question refers to a country with five states. There are 250 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E
Population (in thousands)	250	875	4700	3825	350

30) Using a divisor of D = 40,500, the modified quotas (to 3 decimal places) are 30) _____

A) State A: 6.242; State B: 21.848; State C: 117.353; State D: 95.506; State E: 8.739.
B) State A: 6.329; State B: 22.152; State C: 118.987; State D: 96.835; State E: 8.861.
C) State A: 6.173; State B: 21.605; State C: 116.049; State D: 94.444; State E: 8.642.
D) State A: 6.250; State B: 21.875; State C: 117.500; State D: 95.625; State E: 8.750.
E) none of these

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The following question refers to a country with five states. There are 240 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E
Population (in thousands)	427	754	4389	3873	157

31) Under Adams's method, the apportionments to each state are 31) _____

A) State A: 10; State B: 19; State C: 110; State D: 97; State E: 4.
B) State A: 10; State B: 19; State C: 111; State D: 97; State E: 3.
C) State A: 10; State B: 18; State C: 110; State D: 98; State E: 4.
D) State A: 11; State B: 19; State C: 109; State D: 97; State E: 4.
E) none of these

The following question refers to a country with six states. There are 250 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E	F
Population (in thousands)	1456	6733	557	2081	685	988

32) Find each state's apportionment under Adams's method. 32) _____

A) State A: 29; State B: 134; State C: 11; State D: 42; State E: 14; State F: 20
B) State A: 29; State B: 136; State C: 11; State D: 42; State E: 13; State F: 19
C) State A: 29; State B: 135; State C: 11; State D: 41; State E: 14; State F: 20
D) State A: 29; State B: 133; State C: 12; State D: 42; State E: 14; State F: 20
E) none of these

The following question refers to a country with six states. There are 300 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E	F
Population (in thousands)	1856	5922	602	2076	626	918

33) Find each state's apportionment under Adams's method. 33) _____

A) State A: 47; State B: 148; State C: 15; State D: 52; State E: 15; State F: 23
B) State A: 46; State B: 149; State C: 15; State D: 52; State E: 15; State F: 23
C) State A: 46; State B: 148; State C: 15; State D: 52; State E: 16; State F: 23
D) State A: 47; State B: 147; State C: 15; State D: 52; State E: 16; State F: 23
E) none of these

A small country consists of four states (State 1, State 2, State 3, and State 4). The total population of the country is 200,000. The standard quotas are $q_1 = 64.8$, $q_2 = 89.9$, $q_3 = 39.6$, and $q_4 = 5.7$ respectively.

34) Which of the following numbers can be used as a modified divisor under Adams's method? 34) _____

A) 1011
B) 990
C) 1004
D) 1000
E) none of these

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A bus company operates four bus routes (A, B, C, and D) and 50 buses. The buses are apportioned among the routes on the basis of average number of daily passengers per route which is given in the following table.

Route	A	B	C	D
Daily average number of passengers	3194	9066	4548	8192

35) Find the apportionment of the buses among the routes using Adams's method. 35) _____

A) Route A: 7; Route B: 18; Route C: 9; Route D: 16
B) Route A: 7; Route B: 18; Route C: 10; Route D: 16
C) Route A: 7; Route B: 17; Route C: 9; Route D: 17
D) Route A: 6; Route B: 18; Route C: 9; Route D: 17
E) none of these

A bus company operates four bus routes (A, B, C, and D) and 100 buses. The buses are apportioned among the routes on the basis of average number of daily passengers per route which is given in the following table.

Route	A	B	C	D
Daily average number of passengers	12,444	36,503	19,581	31,472

36) Find the apportionment of the buses among the routes using Adams's method. 36) _____

A) Route A: 12; Route B: 37; Route C: 19; Route D: 32
B) Route A: 12; Route B: 37; Route C: 20; Route D: 31
C) Route A: 13; Route B: 36; Route C: 20; Route D: 31
D) Route A: 13; Route B: 36; Route C: 19; Route D: 32
E) none of these

The following question refers to a country with six states. There are 300 seats in the legislature and the percent of the population in each state is given in the table below.

State	A	B	C	D	E	F
Percent of Population	14.25%	53.75%	5.35%	16.5%	6.25%	3.9%

37) Find each state's apportionment under Adams's method. 37) _____

A) A: 43; B: 161; C: 16; D: 49; E: 19; F: 12
B) A: 43; B: 162; C: 16; D: 50; E: 18; F: 11
C) A: 43; B: 160; C: 16; D: 50; E: 19; F: 12
D) A: 44; B: 160; C: 16; D: 49; E: 19; F: 12
E) none of these

A small country consists of four states. The population of State A is 67,200, the population of State B is 78,300, the population of State C is 73,800, and the population of State D is 80,700. The total number of seats in the legislature is 100.

38) Under Webster's method the apportionments to each state are 38) _____

A) State A: 22 seats; State B: 26 seats; State C: 25 seats; State D: 27 seats.
B) State A: 22 seats; State B: 26 seats; State C: 24 seats; State D: 26 seats.
C) State A: 22 seats; State B: 26 seats; State C: 24 seats; State D: 28 seats.
D) State A: 23 seats; State B: 26 seats; State C: 24 seats; State D: 27 seats.
E) none of these

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The following question refers to a country with five states. There are 250 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E
Population (in thousands)	250	875	4700	3825	350

39) Using a divisor of D = 40,050, the modified quotas (to 3 decimal places) are 39) _____

A) State A: 6.329; State B: 22.152; State C: 118.987; State D: 96.835; State E: 8.861.
B) State A: 6.250; State B: 21.875; State C: 117.500; State D: 95.625; State E: 8.750.
C) State A: 6.173; State B: 21.605; State C: 116.049; State D: 94.444; State E: 8.642.
D) State A: 6.242; State B: 21.848; State C: 117.353; State D: 95.506; State E: 8.739.
E) none of these

The following question refers to a country with six states. There are 250 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E	F
Population (in thousands)	1456	6733	557	2081	685	988

40) Find each state's apportionment under Webster's method. 40) _____

A) State A: 29; State B: 134; State C: 11; State D: 42; State E: 14; State F: 20
B) State A: 29; State B: 136; State C: 11; State D: 42; State E: 13; State F: 19
C) State A: 29; State B: 133; State C: 12; State D: 42; State E: 14; State F: 20
D) State A: 29; State B: 135; State C: 11; State D: 41; State E: 14; State F: 20
E) none of these

The following question refers to a country with six states. There are 300 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E	F
Population (in thousands)	1856	5922	602	2076	626	918

41) Find each state's apportionment under Webster's method. 41) _____

A) State A: 46; State B: 149; State C: 15; State D: 52; State E: 15; State F: 23
B) State A: 47; State B: 147; State C: 15; State D: 52; State E: 16; State F: 23
C) State A: 47; State B: 148; State C: 15; State D: 52; State E: 15; State F: 23
D) State A: 46; State B: 148; State C: 15; State D: 52; State E: 16; State F: 23
E) none of these

A bus company operates four bus routes (A, B, C, and D) and 100 buses. The buses are apportioned among the routes on the basis of average number of daily passengers per route which is given in the following table.

Route	A	B	C	D
Daily average number of passengers	12,444	36,503	19,581	31,472

42) Find the apportionment of the buses among the routes using Webster's method. 42) _____

A) Route A: 13; Route B: 36; Route C: 20; Route D: 31
B) Route A: 12; Route B: 37; Route C: 20; Route D: 31
C) Route A: 13; Route B: 36; Route C: 19; Route D: 32
D) Route A: 12; Route B: 37; Route C: 19; Route D: 32
E) none of these

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The following question refers to a school district with three high schools. The total number of students in the district is 3000. The teachers within the district are apportioned to the high schools based on the schools' respective enrollments. The standard quota for each school is given in the following table.

School	North High	Central High	South High
Standard Quota	$18\frac{1}{3}$	$51\frac{2}{3}$	30

43) Find each school's apportionment of teachers under Webster's method. 43) _____

A) North: 19; Central: 51; South: 30
B) North: 17; Central: 52; South: 31
C) North: 18; Central: 52; South: 30
D) North: 18; Central: 51; South: 31
E) none of these

The following question refers to a country with six states. There are 300 seats in the legislature and the percent of the population in each state is given in the table below.

State	A	B	C	D	E	F
Percent of Population	14.25%	53.75%	5.35%	16.5%	6.25%	3.9%

44) Find each state's apportionment under Webster's method. 44) _____

A) A: 43; B: 162; C: 16; D: 50; E: 18; F: 11
B) A: 43; B: 160; C: 16; D: 50; E: 19; F: 12
C) A: 44; B: 160; C: 16; D: 49; E: 19; F: 12
D) A: 43; B: 161; C: 16; D: 49; E: 19; F: 12
E) none of these

Solve the problem.

45) Without using a calculator, find the geometric mean of 4 and 9. 45) _____

A) 36 B) 13 C) 6 D) 6.5 E) 5

46) Without using a calculator, find the geometric mean of $\frac{1}{40}$ and $\frac{1}{90}$. 46) _____

A) $\frac{1}{65}$ B) $\frac{1}{3600}$ C) $\frac{1}{50}$ D) $\frac{1}{60}$ E) 60

47) Without using a calculator, find the geometric mean of $12^3 \cdot 14^6 \cdot 16^6 \cdot 18$ and $12^7 \cdot 14^8 \cdot 18$ 47) _____

A) $12^5 \cdot 14^7 \cdot 16^3 \cdot 18^2$
B) $12^5 \cdot 14^7 \cdot 16^3 \cdot 18$
C) $12^5 \cdot 14^7 \cdot 16^3$
D) $12^{10} \cdot 14^{14} \cdot 16^6 \cdot 18^2$
E) $12^2 \cdot 14 \cdot 16^3$

48) Let a and b be positive numbers, and let G be their geometric mean. Express the geometric mean of 4.95a and 4.95b in terms of G. 48) _____

A) 24.5025G B) $\sqrt{4.95G}$ C) $G\sqrt{4.95}$ D) $4.95\sqrt{G}$ E) 4.95G

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49) Round the quota q = 6.481 using the Huntington–Hill rounding rules. 49) _____

A) 8 B) 6 C) 7 D) 42 E) 5

50) A country consists of six states, with the state's populations given in the following table. The number of seats to be apportioned is M = 100. Find the apportionment under the Huntington–Hill method. 50) _____

State	A	B	C	D	E	F
Population	321,980	204,950	189,670	133,800	53,702	95,898

A) A:32; B:21; C:20; D:12; E: 5; F: 10
B) A:33; B:21; C:19; D:13; E: 5; F: 9
C) A:32; B:21; C:19; D:13; E: 6; F: 9
D) A:32; B:21; C:19; D:13; E: 5; F: 10
E) A:32; B:22; C:18; D:13; E: 5; F: 10

A country has four states. Suppose the population of State 1 is P_1, the population of State 2 is P_2, the population of State 3 is P_3, and the population of State 4 is P_4. Suppose also that the total number of seats in the legislature is M and the standard divisor is D.

51) The value of D is 51) _____

A) $\dfrac{M}{P_1 + P_2 + P_3 + P_4}$.

B) $\dfrac{P_1 \times P_2 \times P_3 \times P_4}{M}$.

C) $\dfrac{P_1 + P_2 + P_3 + P_4}{M}$.

D) $P_1 + P_2 + P_3 + P_4$.

E) none of these

52) If q_1, q_2, q_3, and q_4 are the respective standard quotas for the four states, then $q_1 + q_2 + q_3 + q_4$ equals 52) _____

A) 0.
B) the number of seats in the legislature M.
C) the standard divisor D.
D) the total population $P_1 + P_2 + P_3 + P_4$.
E) none of these

Solve the problem.

53) Which of the following apportionment methods does not violate the quota rule? 53) _____

A) Jefferson's method
B) Adams's method
C) Hamilton's method
D) Webster's method
E) none of these

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54) In a certain apportionment problem, State X has a standard quota of 73.9. The final apportionment to State X is 75 seats. Which of the following apportionment methods could have produced this result? 54) _____

A) Adams's method
B) Hamilton's method
C) Jefferson's method
D) all of these
E) none of these

55) Which of the following apportionment methods can produce the Population paradox? 55) _____

A) Webster's method
B) Hamilton's method
C) Jefferson's method
D) Adams's method
E) none of these

56) Which apportionment method does not violate the quota rule and does not suffer from any of the paradoxes? 56) _____

A) Jefferson's method
B) Adams's method
C) Webster's method
D) Hamilton's method
E) There is no such method.

57) In a certain apportionment problem, State X has a standard quota of 48.9. The final apportionment to State X is 50 seats. This is called 57) _____

A) the population paradox.
B) a lower–quota violation.
C) an upper–quota violation.
D) the Alabama paradox.
E) none of these

58) In a certain apportionment problem, State X has a standard quota of 73.9. The final apportionment to State X is 75 seats. This is called 58) _____

A) a lower–quota violation.
B) the population paradox.
C) an upper–quota violation.
D) the Alabama paradox.
E) none of these

59) In a certain apportionment problem, State X has a standard quota of 48.9. The final apportionment to State X is 47 seats. Which of the following apportionment methods could have produced this result? 59) _____

A) Adams's method
B) Jefferson's method
C) Hamilton's method
D) all of these
E) none of these

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60) In a certain apportionment problem, State X has a standard quota of 48.9. The final apportionment to State X is 50 seats. Which of the following apportionment methods could have produced this result? 60) _____

A) Adams's method
B) Hamilton's method
C) Jefferson's method
D) all of these
E) none of these

61) Which apportionment method does not violate the quota rule, and does not suffer from any of the paradoxes? 61) _____

A) Jefferson's method
B) Adam's method
C) Hamilton's method
D) Webster's method
E) There is no such method.

62) A mother wishes to distribute 16 pieces of candy among her three children (Abe, Betty, and Cindy) based on the number of hours each child spends doing chores around the house. Using a certain apportionment method, she has determined that Abe is to get 9 pieces of the candy, Betty is to get 4 pieces, and Cindy is to get 3 pieces. However, just before she hands out the candy, she discovers that a neighbor (Dave) has been helping her children with the household chores. Since Dave has worked the same number of hours as Cindy, the mother decides to add 3 more pieces of candy and distribute 19 pieces. When she apportions the 19 pieces using the same apportionment method, Abe ends up with 10 pieces, Betty with 3 pieces, Cindy with 3 pieces, and Dave with 3 pieces. This is an example of 62) _____

A) a violation of the quota rule.
B) the Alabama paradox.
C) the new states paradox.
D) the population paradox.
E) none of these

63) Consider a country consisting of three states whose populations are given in the table below. 63) _____

State	A	B	C
Population	39	70	270

Using Hamilton's method with M = 24 and M = 25 seats yields the apportionments shown in the following table.

State	A	B	C
M = 24 seats	3	4	17
M = 25 seats	2	5	18

This is called

A) a violation of the quota rule.
B) the Alabama paradox.
C) the new states paradox.
D) the population paradox.
E) none of these

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64) Consider a country whose populations in the years 2005 and 2006 are given in the table below. 64) _____

State	A	B	C
2005 Population	41	73	274
2006 Population	41	75	275

Using Hamilton's with M = 25 seats yields the apportionments shown in the following table

State	A	B	C
2005 Apportionment	2	5	18
2006 Apportionment	3	5	17

This is called

A) the new states paradox.
B) a violation of the quota rule.
C) the Alabama paradox.
D) the population paradox.
E) none of these

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1) C
2) D
3) A
4) D
5) D
6) C
7) C
8) A
9) A
10) C
11) D
12) C
13) C
14) A
15) D
16) C
17) D
18) B
19) B
20) D
21) B
22) C
23) D
24) A
25) A
26) A
27) B
28) B
29) A
30) C
31) D
32) D
33) D
34) A
35) A
36) C
37) C
38) A
39) D
40) A
41) D
42) B
43) C
44) D
45) C
46) D
47) B
48) E
49) C
50) D

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51) C
52) B
53) C
54) C
55) B
56) E
57) C
58) C
59) A
60) C
61) E
62) C
63) B
64) D

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Chapter 4

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

1) According to the 2000 U. S. Census, 6.753% of the U.S. population lived in the state of New York. Rounded to two decimal places, what was New York's standard quota in 2000? (Use the fact that the House of Representatives has 435 seats.) 1) _____

A) 2937.55
B) 6441.58
C) 29.38
D) 293.76
E) none of these

A small country consists of four states. The population of State A is 67,200, the population of State B is 78,300, the population of State C is 73,800, and the population of State D is 80,700. The total number of seats in the legislature is 100.

2) The standard quota for State C is 2) _____

A) 26.9.
B) 25.7.
C) 24.6.
D) 26.1.
E) none of these

A small country consists of four states. The population of State A is 44,800, the population of State B is 52,200, the population of State C is 49,200, and the population of State D is 53,800. The total number of seats in the legislature is 100.

3) The standard quota for State B is 3) _____

A) 25.7.
B) 26.1.
C) 24.6.
D) 26.9.
E) none of these

The following question refers to a country with five states. There are 250 seats in the legislature, and the populations of the states are given in the table below.

State	**A**	**B**	**C**	**D**	**E**
Population (in thousands)	**250**	**875**	**4700**	**3825**	**350**

4) The standard divisor is 4) _____

A) 25,000.
B) 40,000.
C) 10,000.
D) 4000.
E) none of these

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The following question refers to a country with five states. There are 240 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E
Population (in thousands)	427	754	4389	3873	157

5) The standard divisor is 5) _____
A) 40,000.
B) 20,000.
C) 9600.
D) 4000.
E) none of these

A small country consists of four states (State 1, State 2, State 3, and State 4). The total population of the country is 200,000. The standard quotas are $q_1 = 64.8$, $q_2 = 89.9$, $q_3 = 39.6$, and $q_4 = 5.7$ respectively.

6) The standard divisor is 6) _____
A) 200.
B) 2000.
C) 100.
D) 1000.
E) none of these

A bus company operates four bus routes (A, B, C, and D) and 50 buses. The buses are apportioned among the routes on the basis of average number of daily passengers per route which is given in the following table.

Route	A	B	C	D
Daily average number of passengers	3194	9066	4548	8192

7) The standard divisor represents 7) _____
A) the number of buses required for 25,000 passengers.
B) the number of passengers that one bus is able to transport per day.
C) the daily average number of passengers per bus.
D) the daily average number of passengers per 50 buses.
E) none of these

A bus company operates four bus routes (A, B, C, and D) and 100 buses. The buses are apportioned among the routes on the basis of average number of daily passengers per route which is given in the following table.

Route	A	B	C	D
Daily average number of passengers	12,444	36,503	19,581	31,472

8) The standard divisor is 8) _____
A) 100.
B) 1000.
C) 100,000.
D) 10,000.
E) none of these

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9) The standard divisor represents 9) _____

A) the number of passengers that one bus is able to transport per day.
B) the number of buses required for 100,000 passengers.
C) the daily average number of passengers per 100 buses.
D) the daily average number of passengers per bus.
E) none of these

A small country consists of four states (State 1, State 2, State 3, and State 4). The total population of the country is 200,000. The standard quotas are $q_1 = 64.8$, $q_2 = 89.9$, $q_3 = 39.6$, and $q_4 = 5.7$ respectively.

10) The population of State 1 is 10) _____

A) 89,900.
B) 64,800.
C) 129,600.
D) 32,400.
E) none of these

A small country consists of four states (State 1, State 2, State 3, and State 4). The total population of the country is 400,000. The standard quotas are $q_1 = 179.8$, $q_2 = 129.6$, $q_3 = 79.2$, and $q_4 = 11.4$ respectively.

11) The population of State 1 is 11) _____

A) 129,600.
B) 259,200.
C) 64,800.
D) 179,800.
E) none of these

The following question refers to a school district with three high schools. The total number of students in the district is 3000. The teachers within the district are apportioned to the high schools based on the schools' respective enrollments. The standard quota for each school is given in the following table.

School	North High	Central High	South High
Standard Quota	$18\frac{1}{3}$	$51\frac{2}{3}$	30

12) How many students are enrolled in Central High? 12) _____

A) 1500
B) 1550
C) 1400
D) 1450
E) none of these

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Solve the problem.

13) Consider a country consisting of three states (A, B, and C) and 20 seats in its Congress. This country is in the process of admitting a fourth state (D). The populations of these states are shown in the table below. 13) _____

State	A	B	C	D
Population (in thousands)	45	65	280	60

How many seats should be created in order to give state D its "fair share" of seats in the new Congress?

A) 3
B) 2
C) 4
D) 5
E) none of these

A small country consists of four states. The population of State A is 67,200, the population of State B is 78,300, the population of State C is 73,800, and the population of State D is 80,700. The total number of seats in the legislature is 100.

14) Under Hamilton's method, the apportionments to each state are 14) _____

A) State A: 22 seats; State B: 26 seats; State C: 24 seats; State D: 26 seats.
B) State A: 22 seats; State B: 26 seats; State C: 25 seats; State D: 27 seats.
C) State A: 22 seats; State B: 26 seats; State C: 24 seats; State D: 28 seats.
D) State A: 23 seats; State B: 26 seats; State C: 24 seats; State D: 27 seats.
E) none of these

The following question refers to a country with five states. There are 250 seats in the legislature, and the populations of the states are given in the table below.

State	**A**	**B**	**C**	**D**	**E**
Population (in thousands)	**250**	**875**	**4700**	**3825**	**350**

15) Under Hamilton's method, the apportionments to each state are 15) _____

A) State A: 6; State B: 23; State C: 116; State D: 96; State E: 9.
B) State A: 6; State B: 22; State C: 117; State D: 96; State E: 9.
C) State A: 7; State B: 22; State C: 117; State D: 95; State E: 9.
D) State A: 6; State B: 22; State C: 118; State D: 96; State E: 8.
E) none of these

The following question refers to a country with six states. There are 250 seats in the legislature, and the populations of the states are given in the table below.

State	**A**	**B**	**C**	**D**	**E**	**F**
Population (in thousands)	**1456**	**6733**	**557**	**2081**	**685**	**988**

16) Find each state's apportionment under Hamilton's method. 16) _____

A) State A: 29; State B: 133; State C: 12; State D: 42; State E: 14; State F: 20
B) State A: 29; State B: 134; State C: 11; State D: 42; State E: 14; State F: 20
C) State A: 29; State B: 135; State C: 11; State D: 41; State E: 14; State F: 20
D) State A: 29; State B: 136; State C: 11; State D: 42; State E: 13; State F: 19
E) none of these

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The following question refers to a country with six states. There are 300 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E	F
Population (in thousands)	1856	5922	602	2076	626	918

17) Find each state's apportionment under Hamilton's method. 17) _____

A) State A: 46; State B: 148; State C: 15; State D: 52; State E: 16; State F: 23
B) State A: 47; State B: 147; State C: 15; State D: 52; State E: 16; State F: 23
C) State A: 46; State B: 149; State C: 15; State D: 52; State E: 15; State F: 23
D) State A: 47; State B: 148; State C: 15; State D: 52; State E: 15; State F: 23
E) none of these

18) Determine the number of "extra" seats under Hamilton's method. 18) _____

A) 1 B) 4 C) 3 D) 5 E) 2

A bus company operates four bus routes (A, B, C, and D) and 50 buses. The buses are apportioned among the routes on the basis of average number of daily passengers per route which is given in the following table.

Route	A	B	C	D
Daily average number of passengers	3194	9066	4548	8192

19) In process of applying Hamilton's method, the route receiving the "extra" bus is 19) _____

A) Route D.
B) Route C.
C) Route A.
D) Route B.
E) none of these

20) Find the apportionment of the buses among the routes using Hamilton's method. 20) _____

A) Route A: 7; Route B: 18; Route C: 9; Route D: 16
B) Route A: 7; Route B: 17; Route C: 9; Route D: 17
C) Route A: 7; Route B: 18; Route C: 10; Route D: 16
D) Route A: 6; Route B: 18; Route C: 9; Route D: 17
E) none of these

The following question refers to a country with six states. There are 300 seats in the legislature and the percent of the population in each state is given in the table below.

State	A	B	C	D	E	F
Percent of Population	14.25%	53.75%	5.35%	16.5%	6.25%	3.9%

21) Determine the number of "extra" seats under Hamilton's method. 21) _____

A) 5 B) 4 C) 2 D) 3 E) 1

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A small country consists of four states. The population of State A is 44,800, the population of State B is 52,200, the population of State C is 49,200, and the population of State D is 53,800. The total number of seats in the legislature is 100.

22) Under Jefferson's method, the apportionments to each state are 22) _____

A) State A: 23 seats; State B: 26 seats; State C: 24 seats; State D: 27 seats.
B) State A: 22 seats; State B: 26 seats; State C: 25 seats; State D: 27 seats.
C) State A: 22 seats; State B: 26 seats; State C: 24 seats; State D: 26 seats.
D) State A: 22 seats; State B: 26 seats; State C: 24 seats; State D: 28 seats.
E) none of these

The following question refers to a country with five states. There are 250 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E
Population (in thousands)	250	875	4700	3825	350

23) Under Jefferson's method, the apportionments to each state are 23) _____

A) State A: 6; State B: 22; State C: 118; State D: 96; State E: 8.
B) State A: 6; State B: 23; State C: 116; State D: 96; State E: 9.
C) State A: 6; State B: 22; State C: 117; State D: 96; State E: 9.
D) State A: 7; State B: 22; State C: 117; State D: 95; State E: 9.
E) none of these

The following question refers to a country with five states. There are 240 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E
Population (in thousands)	427	754	4389	3873	157

24) Using a divisor of D = 39,540, the modified quotas (to 3 decimal places) are 24) _____

A) State A: 10.675; State B: 18.850; State C: 109.725; State D: 96.825; State E: 3.925.
B) State A: 10.799; State B: 19.069; State C: 111.002; State D: 97.951; State E: 3.971.
C) State A: 10.648; State B: 18.803; State C: 109.451; State D: 96.584; State E: 3.915.
D) State A: 10.596; State B: 18.710; State C: 108.908; State D: 96.104; State E: 3.896.
E) none of these

25) Under Jefferson's method, the apportionments to each state are 25) _____

A) State A: 11; State B: 19; State C: 109; State D: 97; State E: 4.
B) State A: 10; State B: 19; State C: 111; State D: 97; State E: 3.
C) State A: 10; State B: 18; State C: 110; State D: 98; State E: 4.
D) State A: 10; State B: 19; State C: 110; State D: 97; State E: 4.
E) none of these

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The following question refers to a country with six states. There are 300 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E	F
Population (in thousands)	1856	5922	602	2076	626	918

26) Find each state's apportionment under Jefferson's method. 26) _____

A) State A: 47; State B: 147; State C: 15; State D: 52; State E: 16; State F: 23
B) State A: 46; State B: 149; State C: 15; State D: 52; State E: 15; State F: 23
C) State A: 46; State B: 148; State C: 15; State D: 52; State E: 16; State F: 23
D) State A: 47; State B: 148; State C: 15; State D: 52; State E: 15; State F: 23
E) none of these

A bus company operates four bus routes (A, B, C, and D) and 100 buses. The buses are apportioned among the routes on the basis of average number of daily passengers per route which is given in the following table.

Route	A	B	C	D
Daily average number of passengers	12,444	36,503	19,581	31,472

27) Find the apportionment of the buses among the routes using Jefferson's method. 27) _____

A) Route A: 13; Route B: 36; Route C: 19; Route D: 32
B) Route A: 12; Route B: 37; Route C: 19; Route D: 32
C) Route A: 12; Route B: 37; Route C: 20; Route D: 31
D) Route A: 13; Route B: 36; Route C: 20; Route D: 31
E) none of these

The following question refers to a school district with three high schools. The total number of students in the district is 3000. The teachers within the district are apportioned to the high schools based on the schools' respective enrollments. The standard quota for each school is given in the following table.

School	North High	Central High	South High
Standard Quota	$18\frac{1}{3}$	$51\frac{2}{3}$	30

28) Which of the following will work as a modified divisor for Jefferson's method? 28) _____

A) 29.5
B) 29.9
C) 28.7
D) 29.1
E) none of these

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The following question refers to a country with six states. There are 300 seats in the legislature and the percent of the population in each state is given in the table below.

State	A	B	C	D	E	F
Percent of Population	14.25%	53.75%	5.35%	16.5%	6.25%	3.9%

29) Find each state's apportionment under Jefferson's method. 29) _____

A) A: 43; B: 160; C: 16; D: 50; E: 19; F: 12
B) A: 43; B: 162; C: 16; D: 50; E: 18; F: 11
C) A: 44; B: 160; C: 16; D: 49; E: 19; F: 12
D) A: 43; B: 161; C: 16; D: 49; E: 19; F: 12
E) none of these

A small country consists of four states. The population of State A is 67,200, the population of State B is 78,300, the population of State C is 73,800, and the population of State D is 80,700. The total number of seats in the legislature is 100.

30) Under Adams's method the apportionments to each state are 30) _____

A) State A: 22 seats; State B: 26 seats; State C: 24 seats; State D: 26 seats.
B) State A: 23 seats; State B: 26 seats; State C: 24 seats; State D: 27 seats.
C) State A: 22 seats; State B: 26 seats; State C: 24 seats; State D: 28 seats.
D) State A: 22 seats; State B: 26 seats; State C: 25 seats; State D: 27 seats.
E) none of these

The following question refers to a country with five states. There are 250 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E
Population (in thousands)	250	875	4700	3825	350

31) Under Adams's method, the apportionments to each state are 31) _____

A) State A: 6; State B: 23; State C: 116; State D: 96; State E: 9.
B) State A: 6; State B: 22; State C: 118; State D: 96; State E: 8.
C) State A: 6; State B: 22; State C: 117; State D: 96; State E: 9.
D) State A: 7; State B: 22; State C: 117; State D: 95; State E: 9.
E) none of these

The following question refers to a country with five states. There are 240 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E
Population (in thousands)	427	754	4389	3873	157

32) Under Adams's method, the apportionments to each state are 32) _____

A) State A: 10; State B: 18; State C: 110; State D: 98; State E: 4.
B) State A: 10; State B: 19; State C: 111; State D: 97; State E: 3.
C) State A: 10; State B: 19; State C: 110; State D: 97; State E: 4.
D) State A: 11; State B: 19; State C: 109; State D: 97; State E: 4.
E) none of these

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The following question refers to a country with six states. There are 250 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E	F
Population (in thousands)	1456	6733	557	2081	685	988

33) Find each state's apportionment under Adams's method. 33) _____

A) State A: 29; State B: 134; State C: 11; State D: 42; State E: 14; State F: 20
B) State A: 29; State B: 133; State C: 12; State D: 42; State E: 14; State F: 20
C) State A: 29; State B: 135; State C: 11; State D: 41; State E: 14; State F: 20
D) State A: 29; State B: 136; State C: 11; State D: 42; State E: 13; State F: 19
E) none of these

The following question refers to a country with six states. There are 300 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E	F
Population (in thousands)	1856	5922	602	2076	626	918

34) Find each state's apportionment under Adams's method. 34) _____

A) State A: 47; State B: 147; State C: 15; State D: 52; State E: 16; State F: 23
B) State A: 46; State B: 149; State C: 15; State D: 52; State E: 15; State F: 23
C) State A: 47; State B: 148; State C: 15; State D: 52; State E: 15; State F: 23
D) State A: 46; State B: 148; State C: 15; State D: 52; State E: 16; State F: 23
E) none of these

A bus company operates four bus routes (A, B, C, and D) and 100 buses. The buses are apportioned among the routes on the basis of average number of daily passengers per route which is given in the following table.

Route	A	B	C	D
Daily average number of passengers	12,444	36,503	19,581	31,472

35) Find the apportionment of the buses among the routes using Adams's method. 35) _____

A) Route A: 12; Route B: 37; Route C: 20; Route D: 31
B) Route A: 13; Route B: 36; Route C: 19; Route D: 32
C) Route A: 13; Route B: 36; Route C: 20; Route D: 31
D) Route A: 12; Route B: 37; Route C: 19; Route D: 32
E) none of these

The following question refers to a country with six states. There are 300 seats in the legislature and the percent of the population in each state is given in the table below.

State	A	B	C	D	E	F
Percent of Population	14.25%	53.75%	5.35%	16.5%	6.25%	3.9%

36) Find each state's apportionment under Adams's method. 36) _____

A) A: 43; B: 162; C: 16; D: 50; E: 18; F: 11
B) A: 43; B: 160; C: 16; D: 50; E: 19; F: 12
C) A: 44; B: 160; C: 16; D: 49; E: 19; F: 12
D) A: 43; B: 161; C: 16; D: 49; E: 19; F: 12
E) none of these

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A country has four states. Suppose the population of State 1 is P_1, the population of State 2 is P_2, the population of State 3 is P_3, and the population of State 4 is P_4. Suppose also that the total number of seats in the legislature is M and the standard divisor is D.

37) If A is the modified divisor used for Adams's method, then 37) _____
A) A is always less than or equal to D.
B) A can be less than, equal to, or greater than D.
C) A is always greater than or equal to D.
D) A is always equal to D.
E) none of these

The following question refers to a country with five states. There are 250 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E
Population (in thousands)	250	875	4700	3825	350

38) Using a divisor of D = 40,050, the modified quotas (to 3 decimal places) are 38) _____
A) State A: 6.250; State B: 21.875; State C: 117.500; State D: 95.625; State E: 8.750.
B) State A: 6.329; State B: 22.152; State C: 118.987; State D: 96.835; State E: 8.861.
C) State A: 6.173; State B: 21.605; State C: 116.049; State D: 94.444; State E: 8.642.
D) State A: 6.242; State B: 21.848; State C: 117.353; State D: 95.506; State E: 8.739.
E) none of these

The following question refers to a country with five states. There are 240 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E
Population (in thousands)	427	754	4389	3873	157

39) Using a divisor of D = 40,100, the modified quotas (to 3 decimal places) are 39) _____
A) State A: 10.675; State B: 18.850; State C: 109.725; State D: 96.825; State E: 3.925.
B) State A: 10.596; State B: 18.710; State C: 108.908; State D: 96.104; State E: 3.896.
C) State A: 10.648; State B: 18.803; State C: 109.451; State D: 96.584; State E: 3.915.
D) State A: 10.799; State B: 19.069; State C: 111.002; State D: 97.951; State E: 3.971.
E) none of these

40) Under Webster's method, the apportionments to each state are 40) _____
A) State A: 10; State B: 19; State C: 110; State D: 97; State E: 4.
B) State A: 10; State B: 18; State C: 110; State D: 98; State E: 4.
C) State A: 11; State B: 19; State C: 109; State D: 97; State E: 4.
D) State A: 10; State B: 19; State C: 111; State D: 97; State E: 3.
E) none of these

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The following question refers to a country with six states. There are 300 seats in the legislature, and the populations of the states are given in the table below.

State	A	B	C	D	E	F
Population (in thousands)	1856	5922	602	2076	626	918

41) Find each state's apportionment under Webster's method. 41) _____

A) State A: 46; State B: 148; State C: 15; State D: 52; State E: 16; State F: 23
B) State A: 47; State B: 148; State C: 15; State D: 52; State E: 15; State F: 23
C) State A: 46; State B: 149; State C: 15; State D: 52; State E: 15; State F: 23
D) State A: 47; State B: 147; State C: 15; State D: 52; State E: 16; State F: 23
E) none of these

A small country consists of four states (State 1, State 2, State 3, and State 4). The total population of the country is 200,000. The standard quotas are $q_1 = 64.8$, $q_2 = 89.9$, $q_3 = 39.6$, and $q_4 = 5.7$ respectively.

42) Which of the following numbers can be used as a modified divisor under Webster's method? 42) _____

A) 1004
B) 1001
C) 990
D) 1000
E) none of these

The following question refers to a country with six states. There are 300 seats in the legislature and the percent of the population in each state is given in the table below.

State	A	B	C	D	E	F
Percent of Population	14.25%	53.75%	5.35%	16.5%	6.25%	3.9%

43) Find each state's apportionment under Webster's method. 43) _____

A) A: 43; B: 161; C: 16; D: 49; E: 19; F: 12
B) A: 44; B: 160; C: 16; D: 49; E: 19; F: 12
C) A: 43; B: 160; C: 16; D: 50; E: 19; F: 12
D) A: 43; B: 162; C: 16; D: 50; E: 18; F: 11
E) none of these

A country has four states. Suppose the population of State 1 is P_1, the population of State 2 is P_2, the population of State 3 is P_3, and the population of State 4 is P_4. Suppose also that the total number of seats in the legislature is M and the standard divisor is D.

44) If W is the modified divisor used for Webster's method, then 44) _____

A) W can be less than, equal to, or greater than D.
B) W is always greater than or equal to D.
C) W is always equal to D.
D) W is always less than or equal to D.
E) none of these

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SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Solve the problem.

45) A country consists of six states, with the state's populations given in the following table. The number of seats to be apportioned is M = 100. Find the apportionment under Webster's method. 45) _____

State	A	B	C	D	E	F
Population	321,980	201,050	187,670	135,800	53,700	99,800

46) Without using a calculator, find the geometric mean of $\frac{1}{40}$ and $\frac{1}{90}$. 46) _____

47) Without using a calculator, find the geometric mean of $12^3 \cdot 14^6 \cdot 16^6 \cdot 18$ and $12^7 \cdot 14^8 \cdot 18$ 47) _____

48) Let a and b be positive numbers, and let G be their geometric mean. Express the geometric mean of 4.95a and 4.95b in terms of G. 48) _____

49) Let a and b be positive numbers, and let G be their geometric mean. Express the geometric mean of 20a and 5b in terms of G. 49) _____

50) Let a and b be positive numbers, and let G be their geometric mean. Express the geometric mean of a^4 and b^4 in terms of G. 50) _____

51) A country consists of six states, with the state's populations given in the following table. The number of seats to be apportioned is M = 100. Find the apportionment under the Huntington–Hill method. 51) _____

State	A	B	C	D	E	F
Population	321,980	204,950	189,670	133,800	53,702	95,898

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

A country has four states. Suppose the population of State 1 is P_1, the population of State 2 is P_2, the population of State 3 is P_3, and the population of State 4 is P_4. Suppose also that the total number of seats in the legislature is M and the standard divisor is D.

52) The standard quota for State 1 is 52) _____

A) $\frac{D}{P_1}$.

B) $\frac{P_1}{D}$.

C) $P_1 \times D$.

D) $P_1 + D$.

E) none of these

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Solve the problem.

53) Which of the following apportionment methods does not violate the quota rule? 53) _____

A) Webster's method
B) Adams's method
C) Hamilton's method
D) Jefferson's method
E) none of these

54) In a certain apportionment problem, State X has a standard quota of 73.9. The final apportionment to State X is 75 seats. Which of the following apportionment methods could have produced this result? 54) _____

A) Adams's method
B) Jefferson's method
C) Hamilton's method
D) all of these
E) none of these

55) Which apportionment method does not violate the quota rule and does not suffer from any of the paradoxes? 55) _____

A) Hamilton's method
B) Jefferson's method
C) Webster's method
D) Adams's method
E) There is no such method.

56) In a certain apportionment problem, State X has a standard quota of 73.9. The final apportionment to State X is 75 seats. This is called 56) _____

A) the Alabama paradox.
B) a lower–quota violation.
C) the population paradox.
D) an upper–quota violation.
E) none of these

57) In a certain apportionment problem, State X has a standard quota of 73.9. The final apportionment to State X is 72 seats. This is called 57) _____

A) an upper–quota violation.
B) the population paradox.
C) the Alabama paradox.
D) a lower–quota violation.
E) none of these

58) In a certain apportionment problem, State X has a standard quota of 48.9. The final apportionment to State X is 50 seats. Which of the following apportionment methods could have produced this result? 58) _____

A) Jefferson's method
B) Hamilton's method
C) Adams's method
D) all of these
E) none of these

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59) Under a certain apportionment method, a state receives an apportionment of 52 seats when the total number of seats in the legislature is 334 but only 51 seats when the total number of seats in the legislature is 335. This is called 59) _____

A) a violation of the quota rule.
B) the Alabama paradox.
C) the new states paradox.
D) the population paradox.
E) none of these

60) Under a certain apportionment method, a state receives an apportionment of 42 seats when the total number of seats in the legislature is 234 but only 41 seats when the total number of seats in the legislature is 235. This is called 60) _____

A) the new states paradox.
B) the population paradox.
C) the Alabama paradox.
D) a violation of the quota rule.
E) none of these

61) Under a certain apportionment method State X receives 51 seats and State Y receives 19 seats. Ten years later, the population of State X has increased by 3%, while the population of State Y remains unchanged. Under the same apportionment method, State X now receives 50 seats and State Y receives 20 seats. This is called 61) _____

A) the new states paradox.
B) the population paradox.
C) a violation of the quota rule.
D) the Alabama paradox.
E) none of these

62) A father wishes to distribute 16 pieces of candy among his 3 children (Abe, Betty, and Cindy) based on the number of hours each child spends doing chores around the house. Using a certain apportionment method, he has determined that Abe is to get 9 pieces of candy, Betty is to get 4 pieces, and Cindy is to get 3 pieces. However, just before he hands out the candy, he discovers that he has 17 pieces (not 16) of candy. When he apportions the 17 pieces of candy using the same apportionment method, Abe ends up with 10 pieces, Betty with 5 pieces, and Cindy with 2 pieces. This is an example of 62) _____

A) the Alabama paradox.
B) the new states paradox.
C) the population paradox.
D) a violation of the quota rule.
E) none of these

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63) A father wishes to distribute 19 pieces of candy among his 4 children (Abe, Betty, Cindy, and Dale) based on the number of hours each child spends doing chores around the house. Using a certain apportionment method, he has determined that Abe is to get 9 pieces of candy, Betty is to get 4 pieces, Cindy is to get 3 pieces, and Dale is to get 3 pieces. However, just before he hands out the candy, he discovers that he has 20 pieces (not 19) of candy. When he apportions the 20 pieces of candy using the same apportionment method, Abe ends up with 10 pieces, Betty with 5 pieces, Cindy with 3 pieces, and Dale with 2 pieces. This is an example of 63) _____

A) the population paradox.
B) the Alabama paradox.
C) the new states paradox.
D) a violation of the quota rule.
E) none of these

64) A mother wishes to distribute 16 pieces of candy among her three children (Abe, Betty, and Cindy) based on the number of hours each child spends doing chores around the house. Based on the time each child spent doing chores, Abe deserves 7.8 pieces of candy, Betty deserves 4.8 pieces, and Cindy deserves 3.4 pieces. Using a certain apportionment method, Abe ends up with 9 pieces of the candy, Betty ends up with 4 pieces, and Cindy ends up with 3 pieces. This is an example of 64) _____

A) the Alabama paradox.
B) the new states paradox.
C) a violation of the quota rule.
D) the population paradox.
E) none of these

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1) C
2) C
3) B
4) B
5) A
6) D
7) C
8) B
9) D
10) B
11) D
12) B
13) A
14) B
15) B
16) C
17) A
18) C
19) C
20) A
21) D
22) B
23) A
24) B
25) B
26) B
27) B
28) A
29) B
30) D
31) D
32) D
33) B
34) A
35) C
36) B
37) C
38) D
39) C
40) C
41) A
42) A
43) A
44) A
45) A:32; B:20; C:19; D:14; E: 5; F: 10
46) $\frac{1}{60}$
47) $12^5 \cdot 14^7 \cdot 16^3 \cdot 18$
48) 4.95G

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49) 10G
50) G^4
51) A:32; B:21; C:19; D:13; E: 5; F: 10
52) B
53) C
54) B
55) E
56) D
57) D
58) A
59) B
60) C
61) B
62) A
63) B
64) C

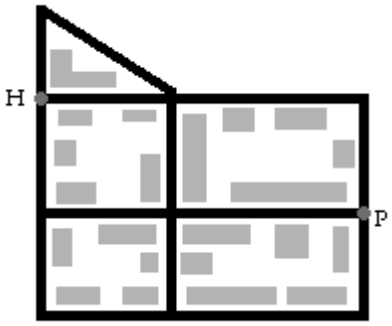
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Chapter 5

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

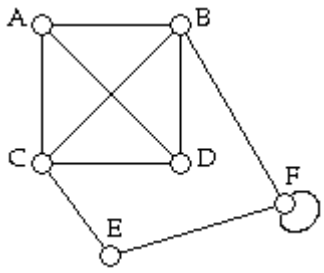
Use the following diagram of the streets in a residential neighborhood to answer the question.



1) A neighborhood watchman patrols the neighborhood each evening. His patrol must cover each street in the neighborhood, beginning and ending at the marked starting point, P. Describe his "optimal route". 1) _____

A) the route that require the least amount of walking, while still covering the whole neighborhood, but not necessarily returning to P
B) the route that requires the least amount of walking, by covering most streets in the neighborhood but not retracing any steps and returning to P
C) the route that requires the least amount of walking, along which he is least likely to come across crime
D) the route that requires the least amount of walking, while still covering the whole neighborhood and returning to P.
E) the route along which he is least likely to come across crime

Use the figure below to answer the following question(s).

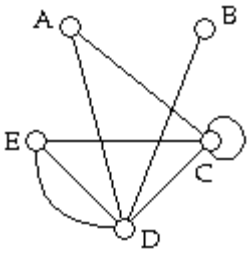


2) Edge BD is adjacent to edge 2) _____

A) AD.
B) BF.
C) CD.
D) all of these.
E) none of these

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Use the figure below to answer the following question(s).



3) The degree of vertex D is 3) _____

A) 4.

B) $4\frac{1}{2}$.

C) 5.

D) 3.

E) none of these

4) The degree of vertex C is 4) _____

A) 4.

B) 2.

C) 3.

D) 5.

E) none of these

Assume you have a graph with vertex set V = {A, B, C, D, E} and edge set E = {CD, CB, DA, DB, EA, AA}.

5) The degree of vertex A is 5) _____

A) 1.

B) 4.

C) 3.

D) 2.

E) none of these

Assume you have a graph with vertex set V = {A, B, C, D, E} and edge set E = {AB, AE, BD, BE, CD, and DD}.

6) The degree of vertex D is 6) _____

A) 3.

B) 4.

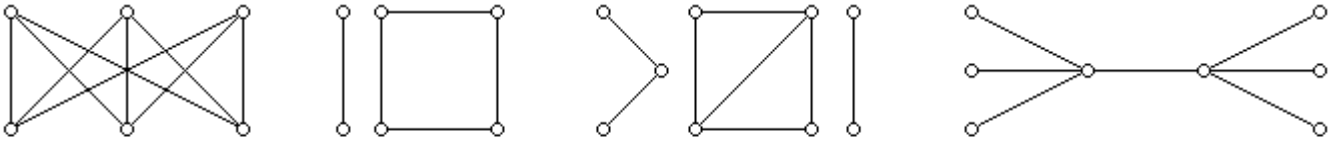
C) 2.

D) 1.

E) none of these

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Use the figure below to answer the following question(s).



Graph 1 Graph 2 Graph 3 Graph 4

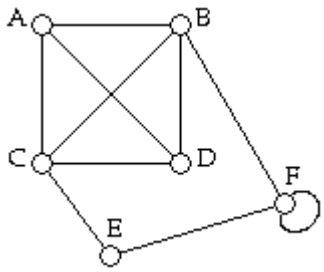
7) In which graph does each vertex have the same degree? 7) _____

A) Graph 1
B) Graph 3
C) Graph 2
D) Graph 4
E) none of these

8) Which graphs are disconnected? 8) _____

A) Graph 3 only
B) Graph 1 and Graph 4
C) Graph 2 and Graph 3
D) Graph 2 only
E) none of these

Use the figure below to answer the following question(s).



9) Which of the following is a bridge of the graph? 9) _____

A) BF
B) BC
C) FF
D) AD
E) none of these

10) Which of the following statements is true? 10) _____

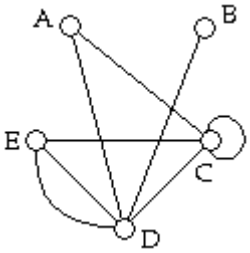
A) The graph has two components.
B) The graph is connected.
C) The graph has 16 components.
D) All of these are true.
E) None of these are true.

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11) Which of the following statements is true? 11) _____

A) The graph has an Euler circuit.
B) The graph has an Euler path from vertex A to vertex F.
C) The graph has an Euler path from vertex A to vertex D.
D) All of these are true.
E) None of these are true.

Use the figure below to answer the following question(s).



12) Which of the following [A), B), C) or D)] is not a circuit in the graph? 12) _____

A) A, D, E, C, A
B) E, D, C, C, E
C) A, D, C, D, E, D, A
D) C, A, D, C
E) All of these are circuits in the graph.

13) Which of the following is a bridge of the graph? 13) _____

A) BD
B) AD
C) CC
D) EC
E) none of these

Assume you have a graph with vertex set V = {A, B, C, D, E} and edge set E = {CD, CB, DA, DB, EA, AA}.

14) How many paths are there from B to A? 14) _____

A) 4
B) 1
C) 2
D) 0
E) None of these are true.

Assume you have a graph with vertex set V = {A, B, C, D, E} and edge set E = {AB, AE, BD, BE, CD, and DD}.

15) The bridges of the graph are 15) _____

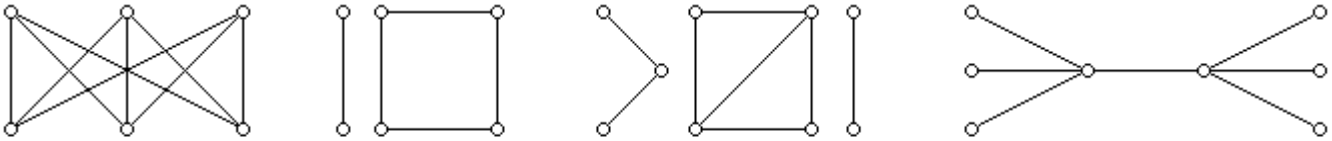
A) BD only.
B) BD, CD, and DD.
C) BD and CD.
D) AB, BD, and CD.
E) none of these

16) Which of the following [A), B), C) or D)] is not a circuit of the graph? 16) _____

A) D, D
B) E, B, A, E
C) A, B, D, D, B, E, A
D) A, B, E, A
E) none of these

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Use the figure below to answer the following question(s).



Graph 1 Graph 2 Graph 3 Graph 4

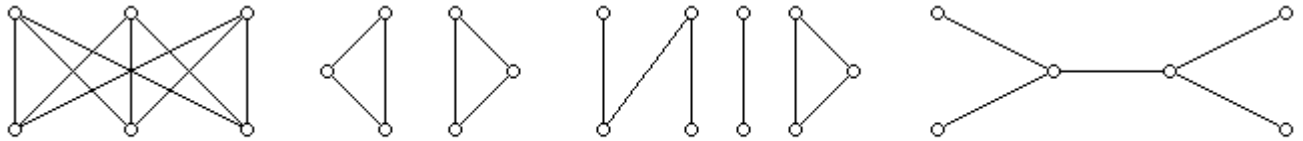
17) Which graph has no circuits? 17) _____

A) Graph 3
B) Graph 1
C) Graph 4
D) Graph 2
E) none of these

18) In which graph is it true that every edge is a bridge? 18) _____

A) Graph 1
B) Graph 2
C) Graph 4
D) Graph 3
E) none of these

Use the figure below to answer the following question(s).



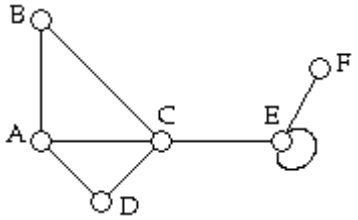
Graph 1 Graph 2 Graph 3 Graph 4

19) In which graph is it true that every edge is a bridge? 19) _____

A) Graph 2
B) Graph 3
C) Graph 4
D) Graph 1
E) none of these

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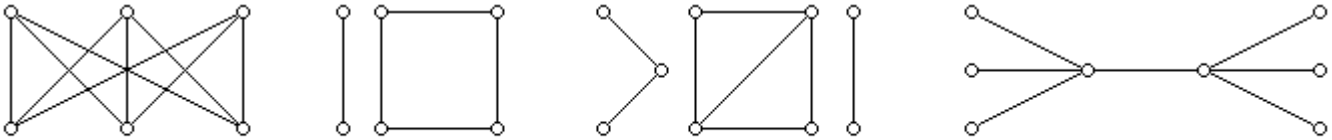
Use the figure below to answer the following question(s).



20) The number of paths from A to C is 20) _____

A) 3.
B) 0.
C) 5.
D) 1.
E) none of these

Use the figure below to answer the following question(s).

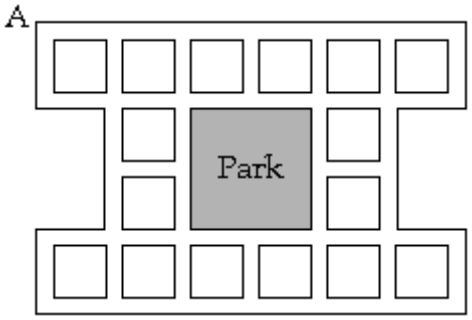


Graph 1 **Graph 2** **Graph 3** **Graph 4**

21) Which graph describes the following situation: 3 boys and 3 girls go to a dance and every boy dances with every girl. 21) _____

A) Graph 4
B) Graph 1
C) Graph 3
D) Graph 2
E) none of these

A city crew must paint the median divider along each of the 48 streets in the neighborhood shown below (starting and ending at A). The foreman wants to organize the route in the most efficient possible way.

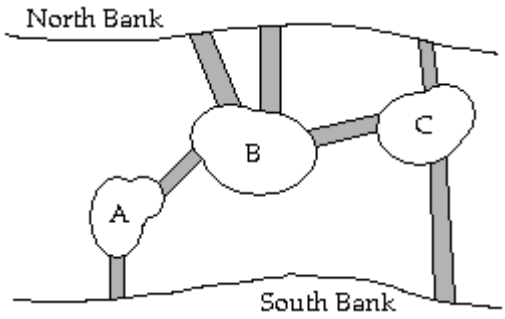


22) The number of vertices of odd degree in the graph that models this problem is 22) _____

A) 4.
B) 12.
C) 8.
D) 16.
E) none of these

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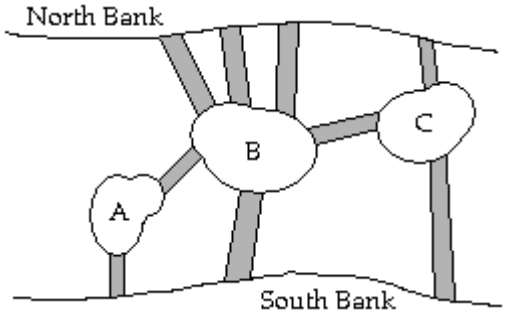
In a certain city there is a river running through the middle of the city. There are three islands and seven bridges as shown in the figure below.



23) A graph that appropriately models this situation would have 23) _____
A) 7 vertices and 7 edges.
B) 5 vertices and 3 edges.
C) 3 vertices and 7 edges.
D) 5 vertices and 7 edges.
E) none of above

24) In the graph that models this situation, the degree of the vertex that represents island A is 24) _____
A) 4.
B) 3.
C) 1.
D) 2.
E) none of these

In a certain city there is a river running through the middle of the city. There are three islands and nine bridges as shown in the figure below.



25) A graph that appropriately models this situation would have 25) _____
A) 3 vertices and 9 edges.
B) 5 vertices and 9 edges.
C) 9 vertices and 5 edges.
D) 9 vertices and 3 edges.
E) none of these

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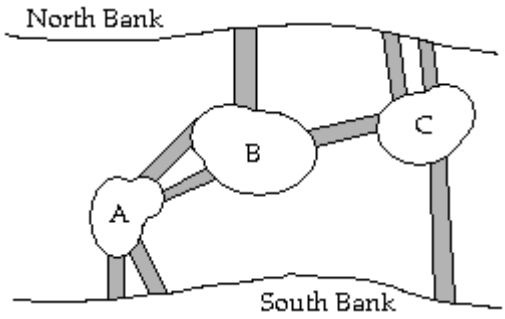
26) In the graph that models this situation, the degree of the vertex that represents island A is 26) _____

A) 4.
B) 3.
C) 2.
D) 1.
E) none of these

27) In the graph that models this situation, the degree of the vertex that represents the South Bank is 27) _____

A) 4.
B) 2.
C) 1.
D) 3.
E) none of these

In a certain city there is a river running through the middle of the city. There are three islands and nine bridges as shown in the figure below.

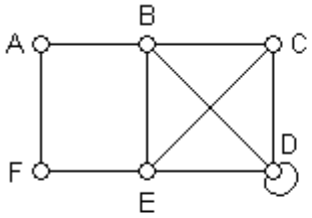


28) In the graph that models this situation, the degree of the vertex that represents the North Bank is 28) _____

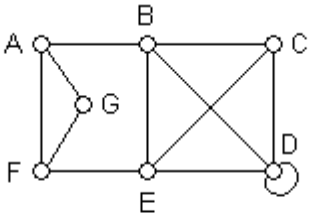
A) 1.
B) 4.
C) 3.
D) 2.
E) none of these

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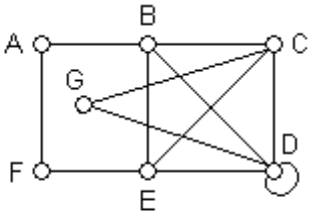
Use the figure below to answer the following question(s).



Graph 1



Graph 2



Graph 3

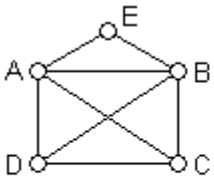
29) Which of the graphs has an Euler circuit? 29) _____

A) Graphs 1 and 3
B) Graph 1 only
C) Graph 3 only
D) Graph 2 only
E) none of these

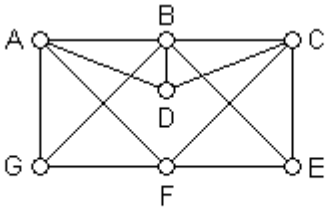
30) Which of the graphs has an Euler path but no Euler circuits? 30) _____

A) Graph 3 only
B) Graph 2 only
C) Graph 1 only
D) Graphs 1 and 2
E) none of these

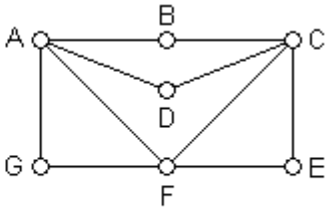
Use the figure below to answer the following question(s).



Graph 1



Graph 2



Graph 3

31) Which of the graphs has an Euler circuit? 31) _____

A) Graphs 1 and 3
B) Graph 1 only
C) Graph 2 only
D) Graph 3 only
E) none of these

32) Which of the graphs has an Euler path but no Euler circuit? 32) _____

A) Graph 1 only
B) Graphs 1 and 2
C) Graph 2 only
D) Graph 3 only
E) none of these

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Solve the problem.

33) A graph has an Euler circuit if 33) _____

A) it is connected and has an even number of edges.
B) it is connected and every vertex has even degree.
C) every vertex has even degree.
D) it is connected and has an even number of vertices.
E) none of these

34) A graph with 9 vertices has an Euler path but no Euler circuit. The graph must have 34) _____

A) 2 vertices of even degree and 7 vertices of odd degree.
B) 9 vertices of even degree.
C) 2 vertices of odd degree and 7 vertices of even degree.
D) 9 vertices of odd degree.
E) none of these

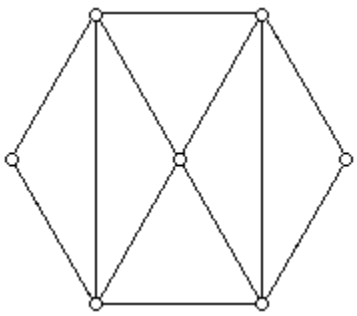
35) A graph has 13 edges. The sum of the degrees of all the vertices of this graph is 35) _____

A) 13.
B) 52.
C) 26.
D) not possible to determine from the information given.
E) none of these

36) A graph has twelve vertices—two vertices of degree 4, four vertices of degree 3, and six vertices of degree 2. The number of edges in the graph is 36) _____

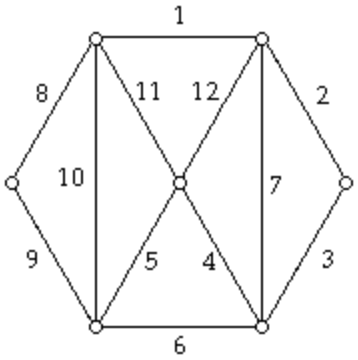
A) 16.
B) 14.
C) 9.
D) 12.
E) none of these

37) Find an Euler circuit for the following graph by labeling the edges 1, 2, 3, and so on in the order in which they can be traveled. 37) _____

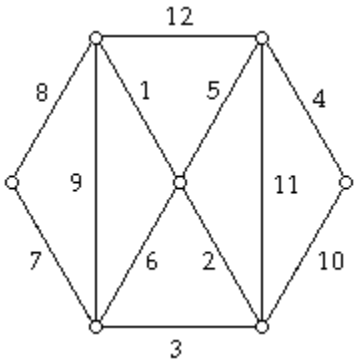


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A)

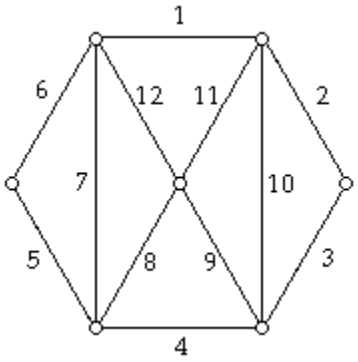


B)

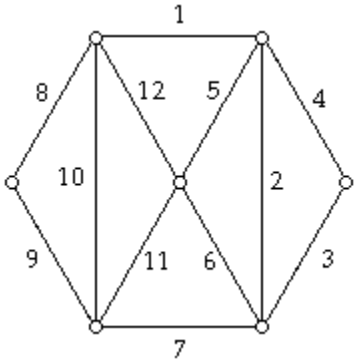


C) none of these

D)

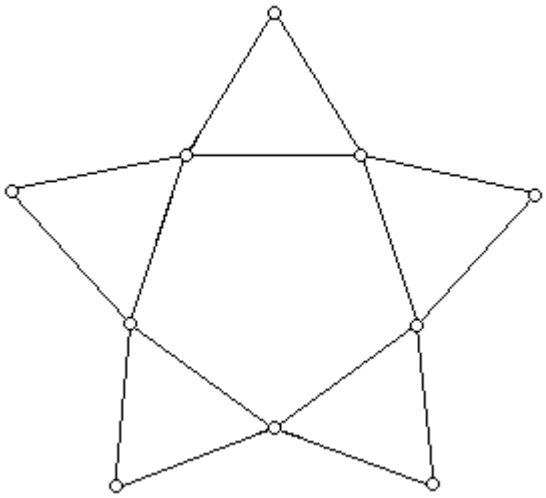


E)



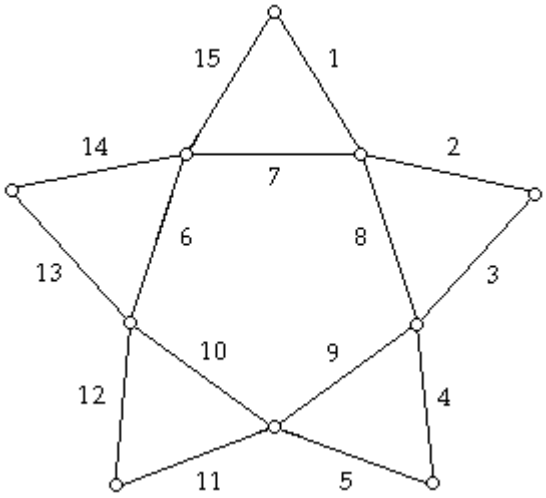
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38) Find an Euler circuit for the following graph by labeling the edges 1, 2, 3, and so on in the order in which they can be traveled. 38) _____

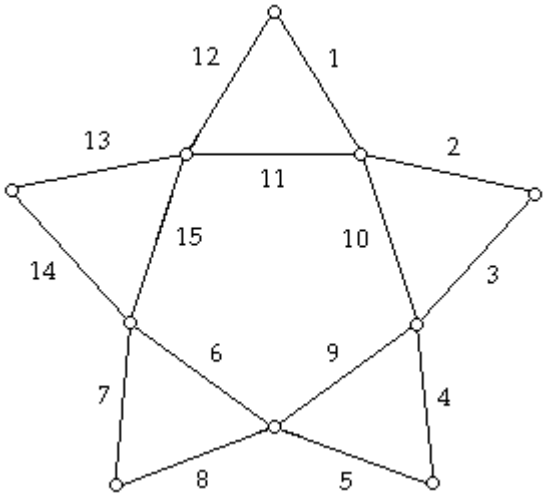


A) none of these

B)

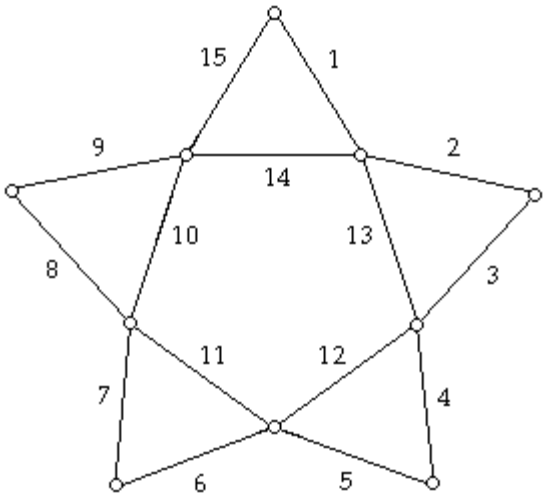


C)

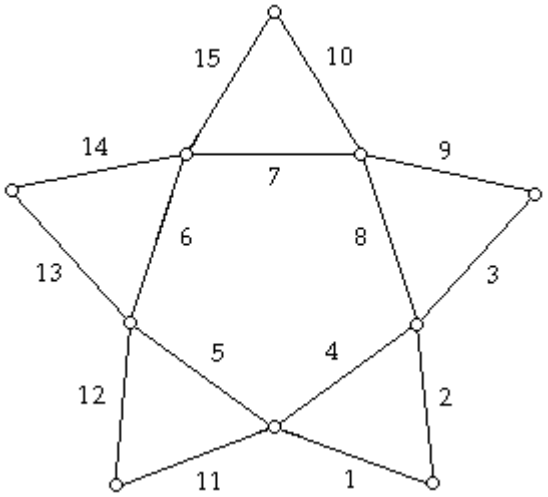


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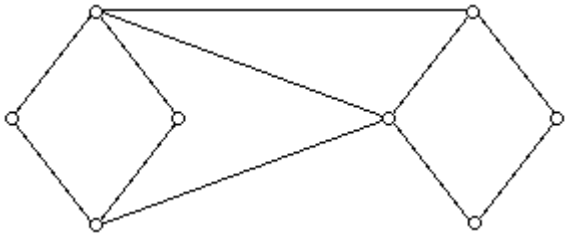
D)



E)

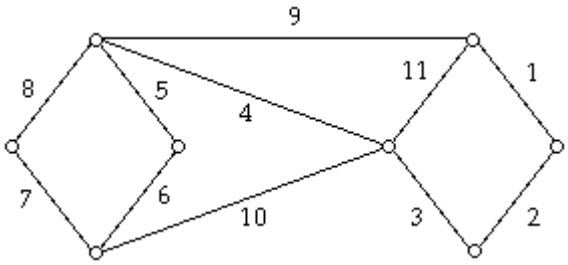


39) Find an Euler path for the following graph by labeling the edges 1, 2, 3, and so on in the order in which they can be traveled. 39) _____



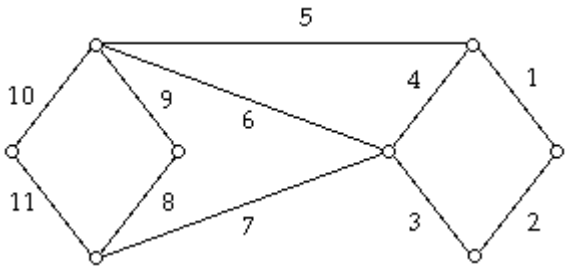
A) none of these

B)

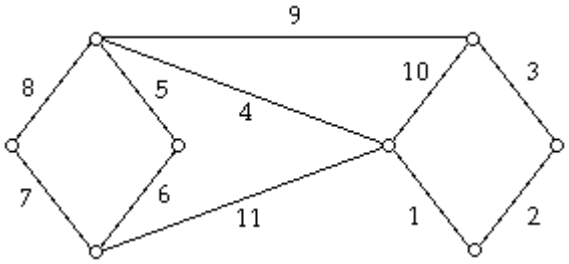


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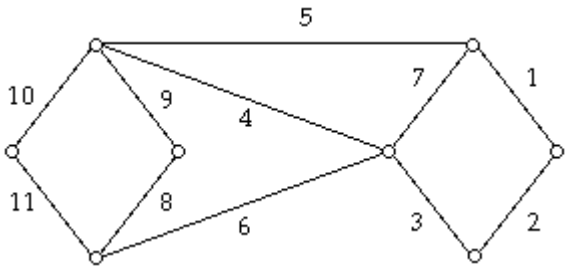
C)



D)



E)



Assume you have a graph with vertex set V = {A, B, C, D, E} and edge set E = {CD, CB, DA, DB, EA, AA}.

40) Which of the following statements is true? 40) _____

A) The graph has an Euler path from vertex E to vertex D.
B) The graph has a closed unicursal tracing.
C) The graph has an Euler circuit.
D) All of these are true.
E) None of these are true.

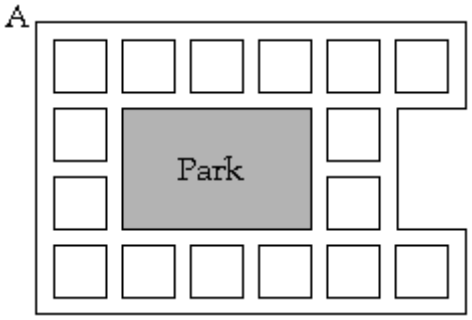
Solve the problem.

41) The basic rule in Fleury's algorithm is 41) _____

A) never travel across a bridge of the original graph.
B) never travel across a bridge of the untraveled part of the graph.
C) only travel across a bridge on the original graph if there is no other alternative.
D) only travel across a bridge of the untraveled part of the graph if there is no other alternative.
E) none of these

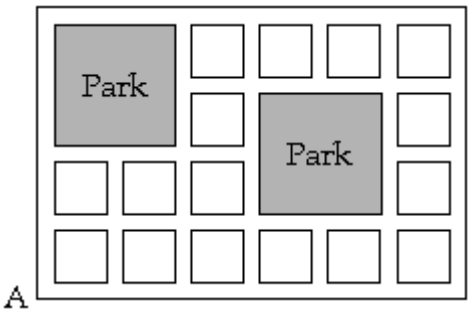
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An undercover police officer is assigned the job of once a night walking each of the 48 blocks of a certain section of town described by the street grid shown below. The walk starts and ends at A. The officer wants to minimize the total number of blocks he has to walk each night.



42) An optimal eulerization of the graph representing this problem can be obtained by adding 42) _____
A) 12 edges.
B) 10 edges.
C) 11 edges.
D) 9 edges
E) none of these

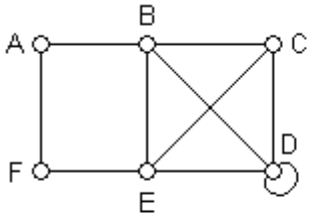
A city crew must paint the median divider along each of the 48 streets in the neighborhood shown below (starting and ending at A). The foreman wants to organize the route in the most efficient possible way.



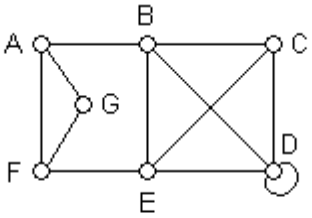
43) An optimal eulerization of the graph that models this problem can be obtained by adding 43) _____
A) 16 edges.
B) 10 edges.
C) 12 edges.
D) 14 edges.
E) none of these

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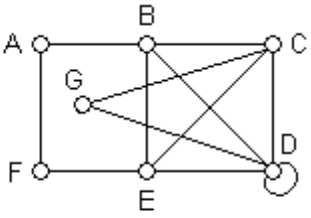
Use the figure below to answer the following question(s).



Graph 1



Graph 2



Graph 3

44) Which graphs can be eulerized by adding the single edge CD? 44) _____

A) Graphs 1 and 2
B) Graph 2 only
C) Graph 1 only
D) Graph 3 only
E) none of these

Solve the problem.

45) After the eulerization of a graph, the number of odd vertices is 45) _____

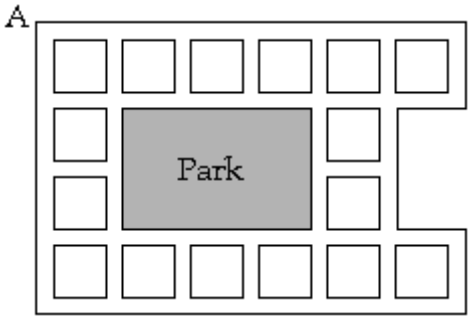
A) the same as the number of even vertices of the graph.
B) not possible to determine without knowing the specific graph.
C) 0.
D) the same as the number of odd vertices before the eulerization.
E) 2.

46) After the semi–eulerization of a graph, the number of odd vertices is 46) _____

A) 2.
B) 0.
C) the same as the number of odd vertices before the semi–eulerization.
D) the same as the number of even vertices of the graph.
E) not possible to determine without knowing the specific graph.

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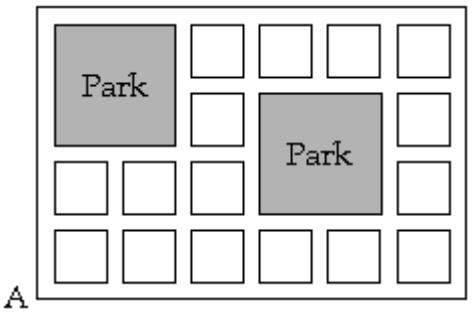
An undercover police officer is assigned the job of once a night walking each of the 48 blocks of a certain section of town described by the street grid shown below. The walk starts and ends at A. The officer wants to minimize the total number of blocks he has to walk each night.



47) Suppose that it takes the officer 5 minutes to walk a block. In an optimal trip, the officer will cover the entire neighborhood in 47) _____

A) 5 hours and 10 minutes.
B) 4 hours and 50 minutes.
C) 5 hours.
D) 4 hours and 45 minutes.
E) none of these

A city crew must paint the median divider along each of the 48 streets in the neighborhood shown below (starting and ending at A). The foreman wants to organize the route in the most efficient possible way.

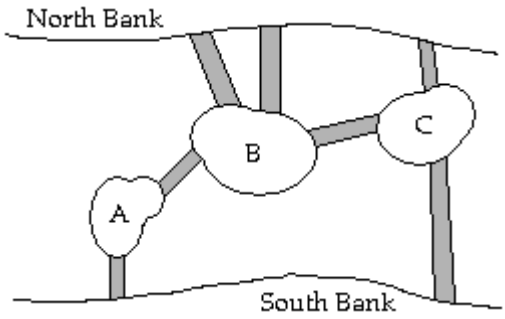


48) In an optimal trip through the neighborhood, the crew will travel a total of 48) _____

A) 62 blocks.
B) 64 blocks.
C) 66 blocks.
D) 60 blocks.
E) none of these

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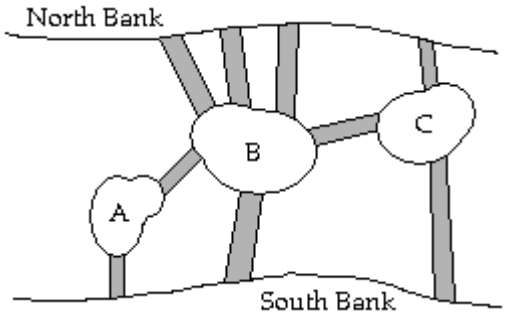
In a certain city there is a river running through the middle of the city. There are three islands and seven bridges as shown in the figure below.



49) It is possible to take a walk through this town, starting on the North Bank, crossing each bridge once (and only once) and ending 49) _____

A) on island C.
B) back on the North Bank.
C) on the South Bank.
D) on island B.
E) none of these

In a certain city there is a river running through the middle of the city. There are three islands and nine bridges as shown in the figure below.



50) It is possible to take a walk through this town, starting on the South Bank, crossing each bridge once (and only once) and ending 50) _____

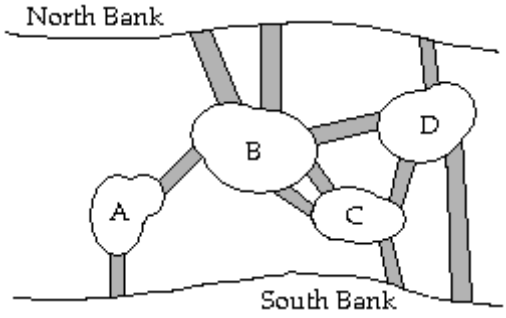
A) on the North Bank.
B) on island C.
C) back on the South Bank.
D) on island B.
E) none of these

51) Suppose there is a crossing charge of $1.00 every time one crosses a bridge. A tourist wants to start on the South Bank, stroll across each of the bridges at least once, and return to her hotel on the South Bank at the end of the trip. What is the cheapest possible cost of such a trip? 51) _____

A) $9
B) Such a trip is impossible.
C) $18
D) $10
E) none of these

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In a certain city there is a river running through the middle of the city. There are four islands and eleven bridges as shown in the figure below.



52) Suppose that there is a crossing charge of $1.00 every time one crosses a bridge. A tourist wants to start on the South Bank, stroll across each of the bridges at least once, and return to her hotel on the South Bank at the end of the trip. What is the cheapest possible cost of such a trip? 52) _____

A) $13
B) $14
C) $11
D) $12
E) none of these

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1) D
2) D
3) C
4) D
5) B
6) B
7) A
8) C
9) E
10) B
11) C
12) C
13) A
14) A
15) C
16) C
17) C
18) C
19) C
20) A
21) B
22) D
23) D
24) D
25) B
26) C
27) D
28) C
29) C
30) C
31) D
32) A
33) B
34) C
35) C
36) A
37) D
38) D
39) C
40) A
41) D
42) A
43) D
44) C
45) C
46) A
47) C
48) A
49) A
50) B

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51) D
52) A

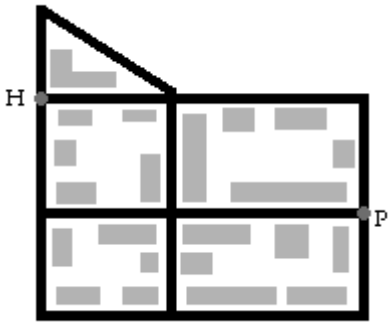
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Chapter 5

Name_____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use the following diagram of the streets in a residential neighborhood to answer the question.



1) A woman walks her dog around the neighborhood each morning. Beginning at her home, point H, is it possible for her to walk along each block of the neighborhood just once and end up back home? 1) _____

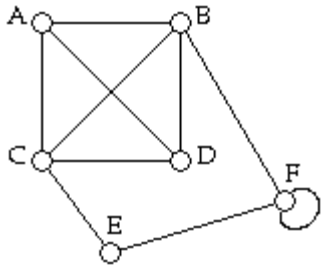
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

2) A neighborhood watchman patrols the neighborhood each evening. His patrol must cover each street in the neighborhood, beginning and ending at the marked starting point, P. Describe his "optimal route". 2) _____

A) the route that require the least amount of walking, while still covering the whole neighborhood, but not necessarily returning to P
B) the route along which he is least likely to come across crime
C) the route that requires the least amount of walking, while still covering the whole neighborhood and returning to P.
D) the route that requires the least amount of walking, along which he is least likely to come across crime
E) the route that requires the least amount of walking, by covering most streets in the neighborhood but not retracing any steps and returning to P

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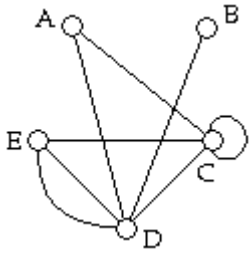
Use the figure below to answer the following question(s).



3) Edge BD is adjacent to edge 3) _____
A) CD.
B) BF.
C) AD.
D) all of these.
E) none of these

4) The degree of vertex F is 4) _____
A) 2.
B) 4.
C) 3.
D) 5.
E) none of these

Use the figure below to answer the following question(s).



5) The degree of vertex D is 5) _____
A) 5.
B) 3.
C) 4.
D) $4\frac{1}{2}$.
E) none of these

Assume you have a graph with vertex set V = {A, B, C, D, E} and edge set E = {CD, CB, DA, DB, EA, AA}.

6) The degree of vertex B is 6) _____
A) 1.
B) 0.
C) 3.
D) 2.
E) none of these

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7) The degree of vertex A is 7) _____

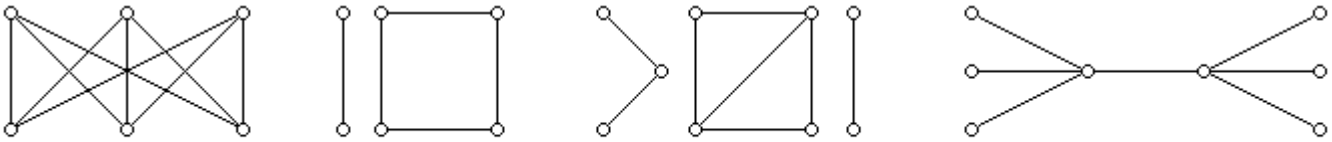
A) 2.
B) 4.
C) 1.
D) 3.
E) none of these

Assume you have a graph with vertex set V = {A, B, C, D, E} and edge set E = {AB, AE, BD, BE, CD, and DD}.

8) The degree of vertex D is 8) _____

A) 1.
B) 2.
C) 4.
D) 3.
E) none of these

Use the figure below to answer the following question(s).



Graph 1 **Graph 2** **Graph 3** **Graph 4**

9) Which graphs are disconnected? 9) _____

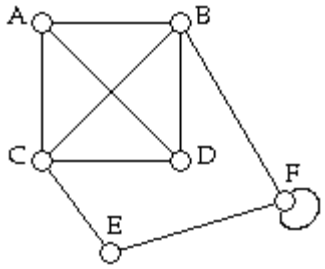
A) Graph 3 only
B) Graph 1 and Graph 4
C) Graph 2 and Graph 3
D) Graph 2 only
E) none of these

10) Which graph has 3 components? 10) _____

A) Graph 4
B) Graph 2
C) Graph 1
D) Graph 3
E) none of these

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Use the figure below to answer the following question(s).



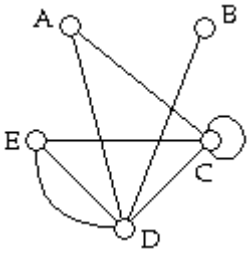
11) Which of the following, [A), B), C) or D)] is not a path from vertex E to vertex A? 11) _____

A) E, C, A
B) E, F, B, A
C) E, C, D, B, C, A
D) E, F, F B, A
E) All of these are paths from E to A.

12) Which of the following statements is true? 12) _____

A) The graph has an Euler circuit.
B) The graph has an Euler path from vertex A to vertex F.
C) The graph has an Euler path from vertex A to vertex D.
D) All of these are true.
E) None of these are true.

Use the figure below to answer the following question(s).



13) Which of the following [A), B), C) or D)] is not a circuit in the graph? 13) _____

A) C, A, D, C
B) E, D, C, C, E
C) A, D, E, C, A
D) A, D, C, D, E, D, A
E) All of these are circuits in the graph.

14) Which of the following is a bridge of the graph? 14) _____

A) CC
B) BD
C) EC
D) AD
E) none of these

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Assume you have a graph with vertex set V = {A, B, C, D, E} and edge set E = {CD, CB, DA, DB, EA, AA}.

15) The bridges of the graph are 15) _____

A) DA and EA.
B) DA only.
C) DA, EA, and AA.
D) CD, DA, and EA.
E) none of these

16) Which of the following [A), B), C), or D)] is not a circuit of the graph? 16) _____

A) C, D, B, C
B) B, D, C, B
C) C, D, A, A, D, B, C
D) A, A
E) none of these

17) Suppose that edge AE is removed from the graph. Which of the following statements regarding the resulting graph is true? 17) _____

A) The resulting graph has two components.
B) The resulting graph is connected.
C) The resulting graph has 10 components.
D) All of these are true.
E) None of these are true.

Assume you have a graph with vertex set V = {A, B, C, D, E} and edge set E = {AB, AE, BD, BE, CD, and DD}.

18) The bridges of the graph are 18) _____

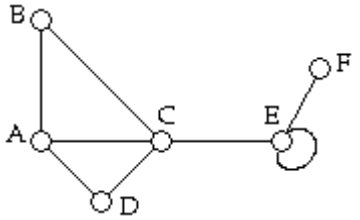
A) AB, BD, and CD.
B) BD, CD, and DD.
C) BD and CD.
D) BD only.
E) none of these

19) Which of the following [A), B), C) or D)] is not a circuit of the graph? 19) _____

A) A, B, D, D, B, E, A
B) D, D
C) E, B, A, E
D) A, B, E, A
E) none of these

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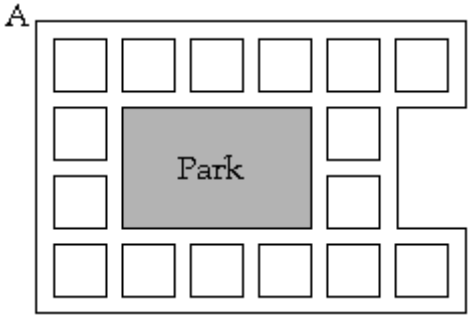
Use the figure below to answer the following question(s).



20) The number of paths from A to C is 20) _____

A) 1.
B) 0.
C) 5.
D) 3.
E) none of these

An undercover police officer is assigned the job of once a night walking each of the 48 blocks of a certain section of town described by the street grid shown below. The walk starts and ends at A. The officer wants to minimize the total number of blocks he has to walk each night.

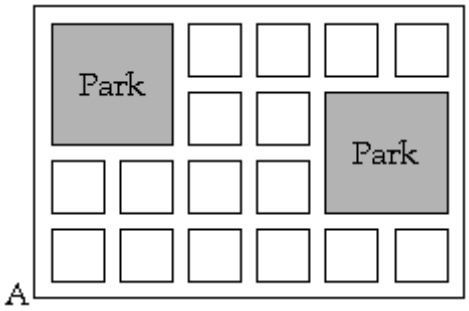


21) How many vertices of odd degree are there in the graph representing this problem? 21) _____

A) 20
B) 24
C) 18
D) 22
E) none of these

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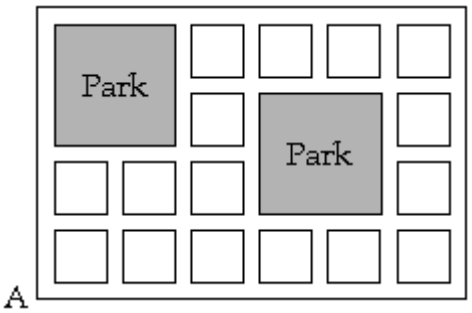
A city crew must paint the median divider along each of the 47 streets in the neighborhood shown below (starting and ending at A). The foreman wants to organize the route in the most efficient possible way.



22) The number of vertices of odd degree in the graph that models this problem is 22) _____

A) 18.
B) 20.
C) 14.
D) 16.
E) none of these

A city crew must paint the median divider along each of the 48 streets in the neighborhood shown below (starting and ending at A). The foreman wants to organize the route in the most efficient possible way.

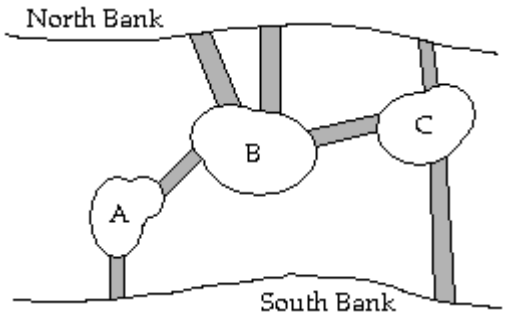


23) The number of vertices of odd degree in the graph that models this problem is 23) _____

A) 16.
B) 20.
C) 14.
D) 18.
E) none of these

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In a certain city there is a river running through the middle of the city. There are three islands and seven bridges as shown in the figure below.



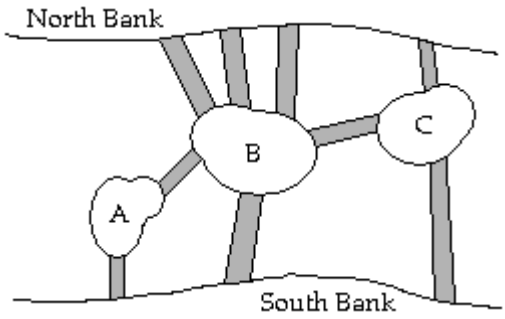
24) A graph that appropriately models this situation would have 24) _____
A) 7 vertices and 7 edges.
B) 3 vertices and 7 edges.
C) 5 vertices and 3 edges.
D) 5 vertices and 7 edges.
E) none of above

25) In the graph that models this situation, the degree of the vertex that represents island A is 25) _____
A) 3.
B) 4.
C) 1.
D) 2.
E) none of these

26) In the graph that models this situation, the degree of the vertex that represents the North Bank is 26) _____
A) 4.
B) 1.
C) 3.
D) 2.
E) none of these

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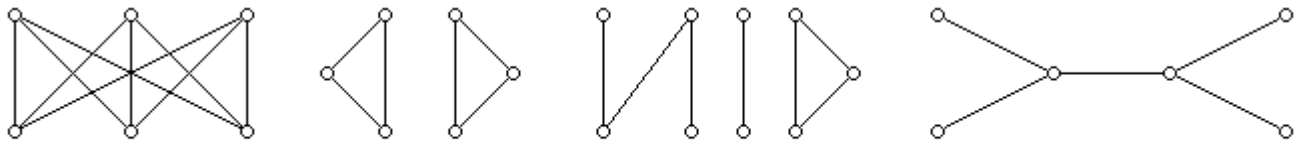
In a certain city there is a river running through the middle of the city. There are three islands and nine bridges as shown in the figure below.



27) A graph that appropriately models this situation would have 27) _____
A) 3 vertices and 9 edges.
B) 9 vertices and 5 edges.
C) 9 vertices and 3 edges.
D) 5 vertices and 9 edges.
E) none of these

28) In the graph that models this situation, the degree of the vertex that represents island B is 28) _____
A) 6.
B) 4.
C) 3.
D) 5.
E) none of these

Use the figure below to answer the following question(s).

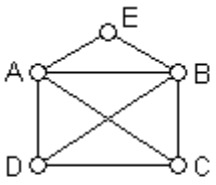


Graph 1 **Graph 2** **Graph 3** **Graph 4**

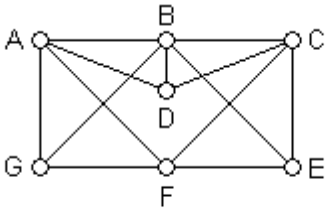
29) Which graph has an Euler circuit? 29) _____
A) Graph 1
B) Graph 4
C) Graph 3
D) Graph 2
E) none of these

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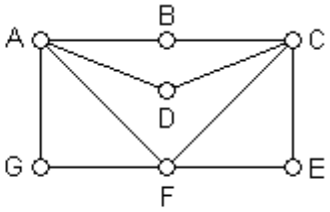
Use the figure below to answer the following question(s).



Graph 1



Graph 2



Graph 3

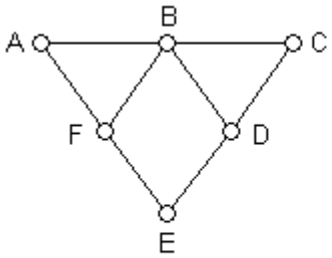
30) Which of the graphs has an Euler circuit? 30) _____

A) Graph 3 only
B) Graphs 1 and 3
C) Graph 2 only
D) Graph 1 only
E) none of these

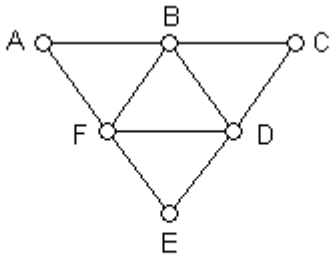
31) Which of the graphs has an Euler path but no Euler circuit? 31) _____

A) Graphs 1 and 2
B) Graph 3 only
C) Graph 1 only
D) Graph 2 only
E) none of these

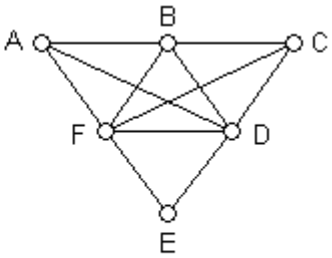
Use the figure below to answer the following question(s).



Graph 1



Graph 2



Graph 3

32) Which of the graphs has an Euler circuit? 32) _____

A) Graph 2 only
B) Graph 3 only
C) Graph 1 only
D) Graphs 1 and 3
E) none of these

33) Which of the graphs has an Euler path but no Euler circuit? 33) _____

A) Graph 3 only
B) Graphs 1 and 2
C) Graph 2 only
D) Graph 1 only
E) none of these

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Solve the problem.

34) A graph has an Euler circuit if 34) _____
A) every vertex has even degree.
B) it is connected and every vertex has even degree.
C) it is connected and has an even number of edges.
D) it is connected and has an even number of vertices.
E) none of these

35) A graph with 9 vertices has an Euler path but no Euler circuit. The graph must have 35) _____
A) 9 vertices of odd degree.
B) 9 vertices of even degree.
C) 2 vertices of even degree and 7 vertices of odd degree.
D) 2 vertices of odd degree and 7 vertices of even degree.
E) none of these

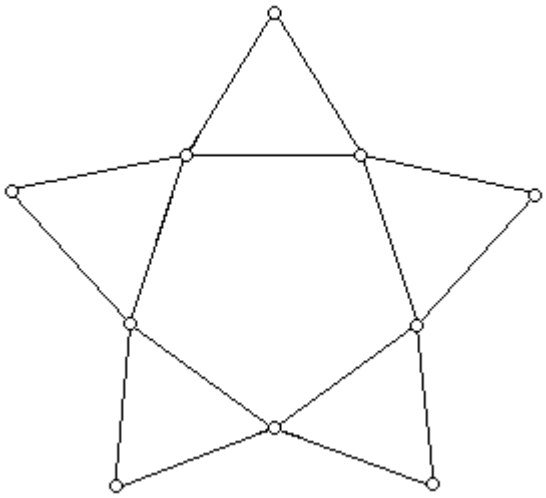
36) A graph has twelve vertices—two vertices of degree 4, four vertices of degree 3, and six vertices of degree 2. The number of edges in the graph is 36) _____
A) 14.
B) 16.
C) 9.
D) 12.
E) none of these

37) If a graph has 7 vertices and M is the number of vertices of odd degree, then M cannot be 37) _____
A) 0.
B) 4.
C) 7.
D) 3.
E) none of these

38) Let G be a graph with 7 vertices such that every vertex is adjacent to every other vertex, and having no multiple loops or edges. Which of the following is true? 38) _____
A) G has an Euler path, but not an Euler circuit.
B) G has an Euler circuit.
C) G has a bridge.
D) All of these are true.
E) None of these are true.

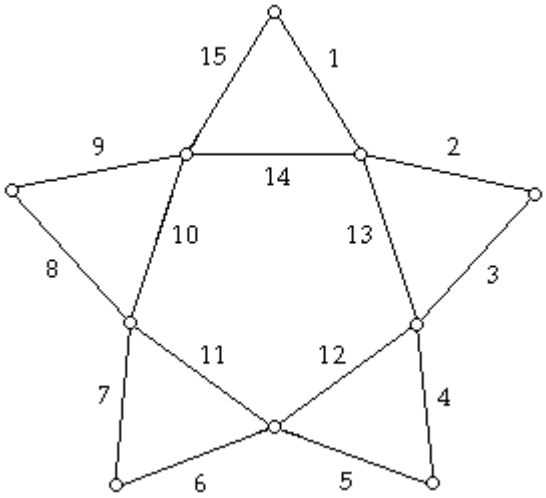
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39) Find an Euler circuit for the following graph by labeling the edges 1, 2, 3, and so on in the order in which they can be traveled. 39) _____

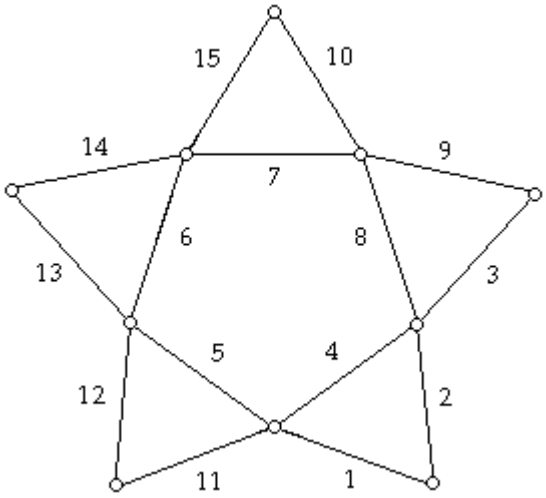


A) none of these

B)

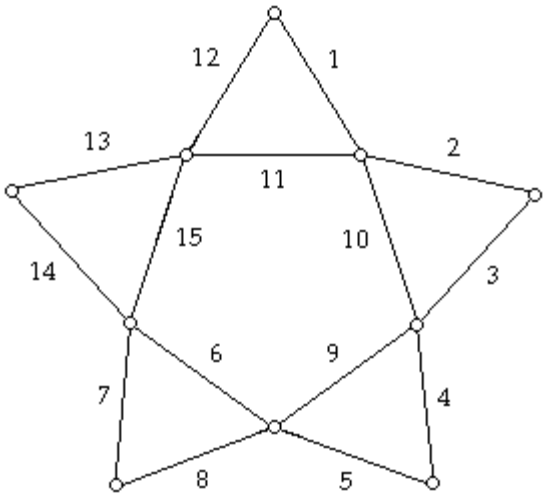


C)

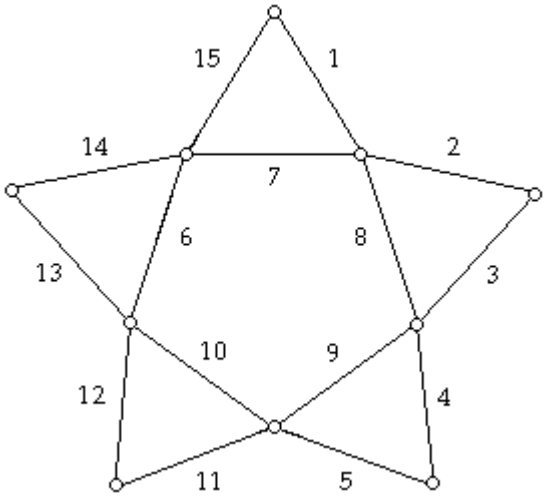


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D)



E)

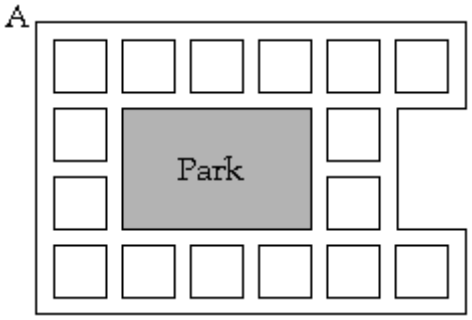


40) The basic rule in Fleury's algorithm is 40) _____

A) only travel across a bridge of the untraveled part of the graph if there is no other alternative.
B) never travel across a bridge of the untraveled part of the graph.
C) never travel across a bridge of the original graph.
D) only travel across a bridge on the original graph if there is no other alternative.
E) none of these

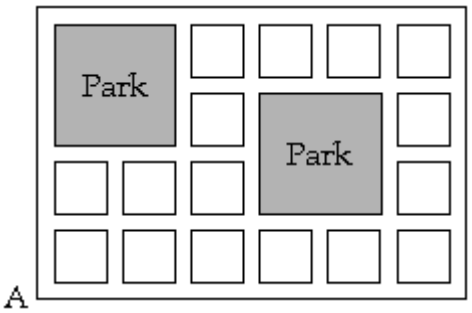
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An undercover police officer is assigned the job of once a night walking each of the 48 blocks of a certain section of town described by the street grid shown below. The walk starts and ends at A. The officer wants to minimize the total number of blocks he has to walk each night.



41) An optimal eulerization of the graph representing this problem can be obtained by adding 41) _____
A) 11 edges.
B) 10 edges.
C) 9 edges
D) 12 edges.
E) none of these

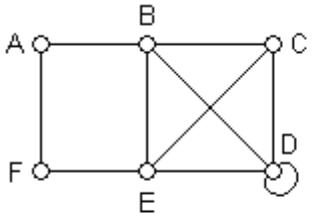
A city crew must paint the median divider along each of the 48 streets in the neighborhood shown below (starting and ending at A). The foreman wants to organize the route in the most efficient possible way.



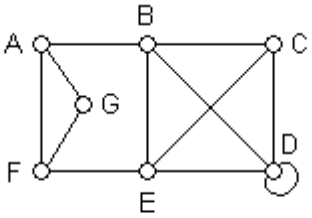
42) An optimal eulerization of the graph that models this problem can be obtained by adding 42) _____
A) 16 edges.
B) 10 edges.
C) 14 edges.
D) 12 edges.
E) none of these

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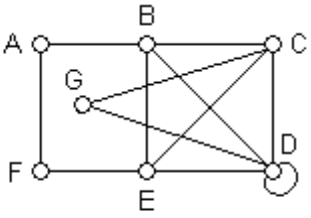
Use the figure below to answer the following question(s).



Graph 1



Graph 2



Graph 3

43) Which graphs can be eulerized by adding the single edge CD? 43) _____

A) Graph 1 only
B) Graphs 1 and 2
C) Graph 3 only
D) Graph 2 only
E) none of these

Solve the problem.

44) After the eulerization of a graph, the number of odd vertices is 44) _____

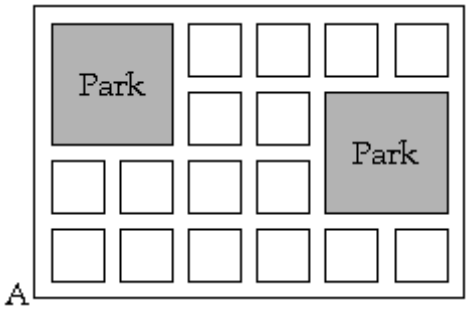
A) 2.
B) the same as the number of even vertices of the graph.
C) not possible to determine without knowing the specific graph.
D) 0.
E) the same as the number of odd vertices before the eulerization.

45) After the semi–eulerization of a graph, the number of odd vertices is 45) _____

A) the same as the number of odd vertices before the semi–eulerization.
B) the same as the number of even vertices of the graph.
C) 2.
D) not possible to determine without knowing the specific graph.
E) 0.

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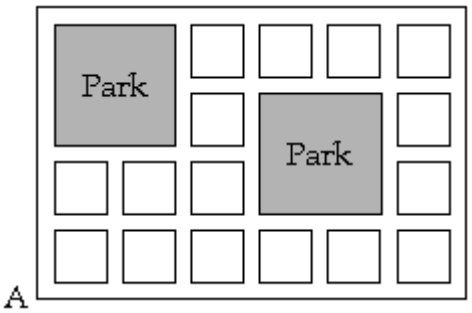
A city crew must paint the median divider along each of the 47 streets in the neighborhood shown below (starting and ending at A). The foreman wants to organize the route in the most efficient possible way.



46) In an optimal trip through the neighborhood the crew will travel a total of 46) _____

A) 66 blocks.
B) 59 blocks.
C) 62 blocks.
D) 52 blocks.
E) none of these

A city crew must paint the median divider along each of the 48 streets in the neighborhood shown below (starting and ending at A). The foreman wants to organize the route in the most efficient possible way.

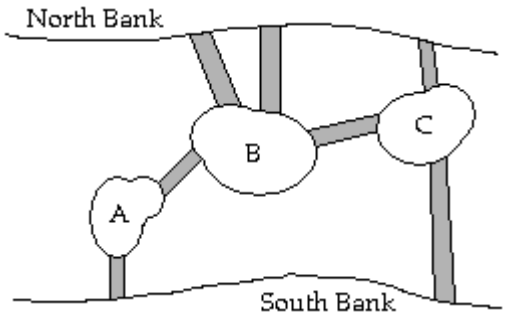


47) In an optimal trip through the neighborhood, the crew will travel a total of 47) _____

A) 64 blocks.
B) 60 blocks.
C) 62 blocks.
D) 66 blocks.
E) none of these

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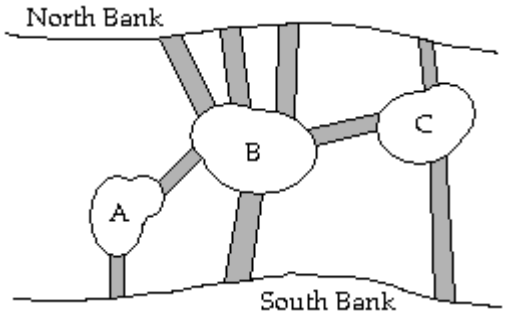
In a certain city there is a river running through the middle of the city. There are three islands and seven bridges as shown in the figure below.



48) Which of the following statements is true? 48) _____

A) The graph that models this situation has an Euler path starting on the South Bank and ending on the North Bank.
B) No edge in the graph that models this situation is actually a bridge.
C) The graph that models this situation has an Euler circuit.
D) All of these are true.
E) None of these are true.

In a certain city there is a river running through the middle of the city. There are three islands and nine bridges as shown in the figure below.

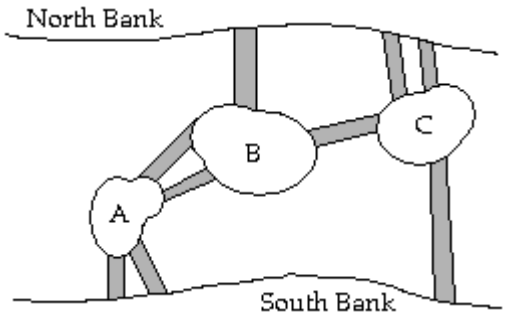


49) It is possible to take a walk through this town, starting on the South Bank, crossing each bridge once (and only once) and ending 49) _____

A) on the North Bank.
B) on island C.
C) on island B.
D) back on the South Bank.
E) none of these

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In a certain city there is a river running through the middle of the city. There are three islands and nine bridges as shown in the figure below.



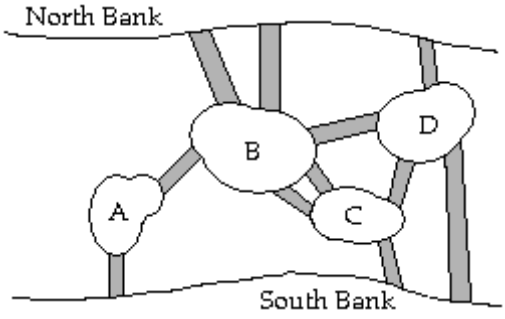
50) It is possible to take a walk though this town, starting on the South Bank, crossing each bridge once (and only once) and ending 50) _____

A) back on the South Bank.
B) on island B.
C) on the North Bank.
D) on island C.
E) none of these

51) Suppose there is a crossing charge of $1.00 every time one crosses a bridge. A tourist wants to start on the South Bank, stroll across each of the bridges at least once, and return to her hotel on the South Bank at the end of the trip. What is the cheapest possible cost of such a trip? 51) _____

A) $10
B) $9
C) $11
D) $12
E) none of these

In a certain city there is a river running through the middle of the city. There are four islands and eleven bridges as shown in the figure below.



52) It is possible to take a walk through this town, starting on the South Bank, crossing each bridge one (and only once) and ending 52) _____

A) on island C.
B) on the North Bank.
C) back on the South Bank.
D) on island B.
E) none of these

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1) No
2) C
3) D
4) B
5) A
6) D
7) B
8) C
9) C
10) D
11) E
12) C
13) D
14) B
15) A
16) C
17) A
18) C
19) A
20) D
21) A
22) A
23) B
24) D
25) D
26) C
27) D
28) A
29) E
30) A
31) C
32) A
33) D
34) B
35) D
36) B
37) D
38) B
39) B
40) A
41) D
42) C
43) A
44) D
45) C
46) B
47) C
48) B
49) B
50) C

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51) C
52) B

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Chapter 6

Name_____

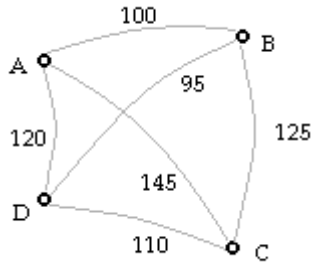
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Answer the question about traveling salesman problems.

1) Which of these is not an element common to all traveling salesman problems? 1) _____

A) a traveler
B) a set of goods
C) a set of sites
D) a set of costs
E) All of these are elements common to traveling salesman problems.

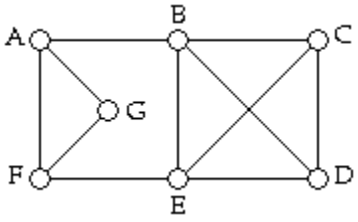
2) The diagram below shows the distances, in miles, between four cities: A, B, C, and D. A businessman must travel between all four cities, starting and ending in his home city, A. He wants to find the optimal tour. In this case, what is the "cost variable"? 2) _____



A) size of the planes
B) number of cities to go to
C) travel time
D) distance traveled
E) price to travel between cities

Solve the problem.

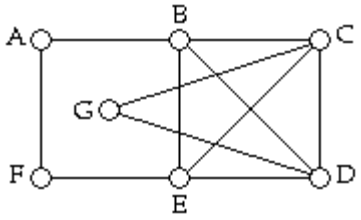
3) The following graph 3) _____



A) has no Hamilton circuit.
B) has several Hamilton circuits, all of which contain the edge AG.
C) has a single Hamilton circuit (and its mirror–image circuit).
D) has several Hamilton circuits, none of which contain the edge BD.
E) none of these

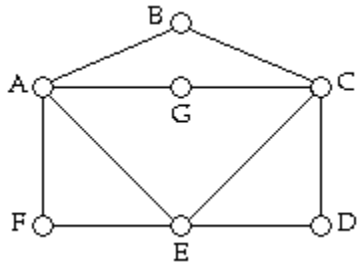
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4) The following graph 4) _____



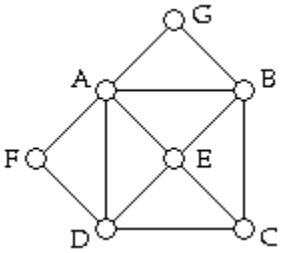
A) has several Hamilton circuits, all of which contain the edge CG.
B) has a single Hamilton circuit (and its mirror-image circuit).
C) has several Hamilton circuits, none of which contain the edge BD.
D) has no Hamilton circuit.
E) none of these

5) The following graph 5) _____



A) has several Hamilton circuits, none of which contain the edge BC.
B) has a single Hamilton circuit (and its mirror-image circuit).
C) has several Hamilton circuits, all of which contain the edge GC.
D) has no Hamilton circuit.
E) none of these

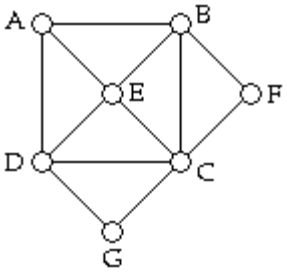
6) The following graph 6) _____



A) has several Hamilton circuits, none of which contain the edge BC.
B) has a single Hamilton circuit (and its mirror-image circuit).
C) has several Hamilton circuits, all of which contain the edge AD.
D) has no Hamilton circuit.
E) none of these

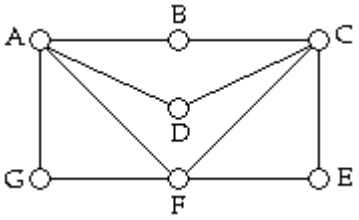
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7) The following graph 7) _____



A) has several Hamilton circuits (none of which contain the edge BC or CD).
B) has several Hamilton circuits, all of which contain the edge AD.
C) has a single Hamilton circuit (and its mirror–image circuit).
D) has no Hamilton circuit.
E) none of these

8) The following graph 8) _____



A) has a Hamilton path that starts at D and ends at G.
B) has no Hamilton path.
C) has a Hamilton path that starts at G and ends at F.
D) has a Hamilton path that starts at G and ends at E.
E) none of these

9) n! = 9) _____

A) n + (n – 1)!
B) n! + (n – 1)!
C) n! × (n – 1)!
D) n × (n – 1)!
E) none of these

10) $\frac{50!}{49!}$ = 10) _____

A) 1
B) 51
C) 39
D) 50
E) none of these

11) $\frac{75!}{74!}$ = 11) _____

A) 75
B) 1
C) 76
D) 74
E) none of these

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12) If $100! \approx 10^{158}$, which of the following numbers most closely approximates 99!? 12) _____

A) $10^{158} - 100$

B) $10^{158} - 1$

C) 10^{157}

D) 10^{156}

E) none of these

13) $\frac{26! + 24!}{25!} =$ 13) _____

A) $\frac{50!}{25!}$

B) 26.04

C) 25

D) 2

E) none of these

14) The number of Hamilton circuits in K_{11} is 14) _____

A) $\frac{11 \times 10}{2}$.

B) 11!.

C) 11.

D) 10!.

E) none of these

15) The number of Hamilton circuits in the complete graph with 12 vertices is 15) _____

A) in the hundreds of thousands.

B) in the millions.

C) in the hundreds.

D) more than a billion.

E) none of these

16) The number of Hamilton circuits in the complete graph with 100 vertices is 16) _____

A) in the hundreds.

B) in the millions.

C) in the thousands.

D) more than a billion.

E) none of these

17) The number of edges in K_{12} is 17) _____

A) 132.

B) 12!.

C) 66.

D) 12.

E) none of these

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18) If the number of edges in K_{500} is x, and the number of edges in K_{502} is y, what is the value of y – x? 18) _____

A) 500
B) 501! – 499!
C) 2
D) 1001
E) none of these

19) In a complete graph with 720 distinct Hamilton circuits, there is a total of 19) _____

A) 7 vertices.
B) 6 vertices.
C) 9 vertices.
D) 5 vertices.
E) none of these

20) In a complete graph with 16 vertices (A through P), the total number of Hamilton circuits (including mirror–image circuits) that start at vertex A is 20) _____

A) 17!.
B) 14!.
C) 15!.
D) 16!.
E) none of these

21) In a complete graph with 16 vertices (A through P), the total number of Hamilton paths that start at vertex A and end at vertex P is 21) _____

A) 16!.
B) 15!.
C) 17!.
D) 14!.
E) none of these

22) In a complete graph with 16 vertices (A through P), the total number of Hamilton paths that start at vertex A, pass through vertex D after traversing exactly three edges, and end at vertex P is 22) _____

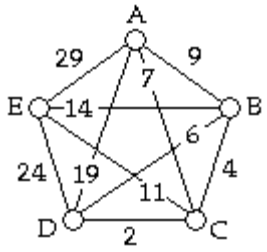
A) 3! × 12!
B) 16!
C) 13!
D) 14!
E) none of these

23) In a complete graph with n vertices there is a total of 23) _____

A) $\frac{1}{2}n(n-1)$ edges.
B) $n(n+1)$ edges.
C) $\frac{1}{2}n(n+1)$ edges.
D) $n(n-1)$ edges.
E) none of these

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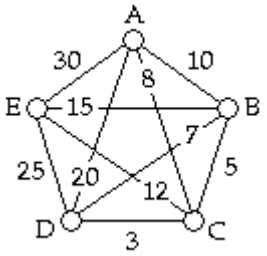
A mail truck must deliver packages to 5 different homes (A, B, C, D, and E). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



24) How many different Hamilton circuits would we have to check if we use the brute-force algorithm? (Do not count the same circuit traveled backward.) 24) _____

A) 12
B) 30
C) 4
D) 60
E) none of these

A mail truck must deliver packages to 5 different homes (A, B, C, D, and E). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



25) How many different Hamilton circuits would we have to check if we use the brute-force algorithm? (Do not count the same circuit traveled backward.) 25) _____

A) 60
B) 12
C) 4
D) 30
E) none of these

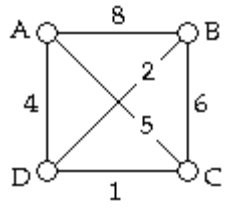
Solve the problem.

26) In applying the brute-force algorithm to solve a traveling salesman problem on a graph with 20 vertices, you use a supercomputer that computes 1 billion (that's 10^9) circuits per second. There are 31,536,000 seconds in a year. Roughly how long would it take for the supercomputer to solve this problem? 26) _____

A) approximately 77 years
B) approximately 4 years
C) approximately 15 years
D) approximately 1.5 years
E) approximately 31 years

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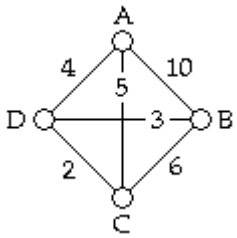
A delivery truck must deliver furniture to 4 different locations (A, B, C, and D). The trip must start and end at A. The graph below shows the distances (in miles) between location. We want to minimize the total distance traveled.



27) The nearest–neighbor tour starting with vertex A is given by: 27) _____

A) A, C, B, D, A.
B) A, B, D, C, A.
C) A, D, B, C, A.
D) A, D, C, B, A.
E) none of these

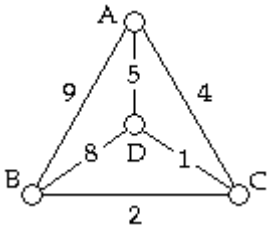
A delivery truck must deliver furniture to 4 different locations (A, B, C, and D). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



28) An optimal tour is given by: 28) _____

A) A, D, C, B, A.
B) A, B, D, C, A.
C) A, C, D, B, A.
D) A, C, B, D, A.
E) none of these

A truck must drop off furniture at 4 different homes (A, B, C, and D) as shown in the graph below, starting and ending at A. The numbers on the edges represent distances (in miles) between locations. The truck driver wants to minimize the total length of the trip.

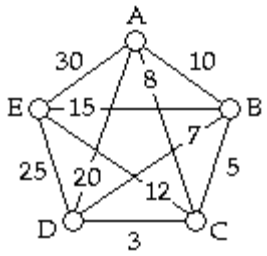


29) An optimal tour is given by: 29) _____

A) A, D, B, C, A.
B) A, B, C, D, A.
C) A, C, D, B, A.
D) A, B, D, C, A.
E) none of these

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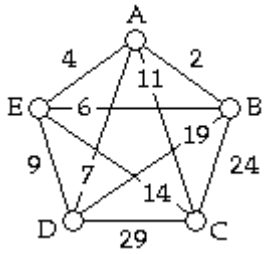
A mail truck must deliver packages to 5 different homes (A, B, C, D, and E). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



30) The nearest–neighbor tour starting with vertex A is given by: 30) _____

A) A, C, D, B, E, A.
B) A, D, B, E, C, A.
C) A, E, C, D, B, A.
D) A, B, C, D, E, A.
E) none of these

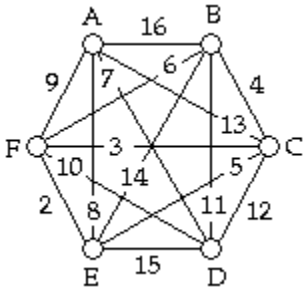
A delivery truck must deliver packages to 5 different store locations (A, B, C, D, and E). The trip must start and end at D. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



31) The nearest–neighbor tour starting with vertex D is given by: 31) _____

A) D, A, B, E, C, D.
B) D, C, A, B, E, D.
C) D, B, E, C, A, D.
D) D, E, A, B, C, D.
E) none of these

A delivery truck must deliver packages to 6 different store locations (A, B, C, D, E, and F). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.

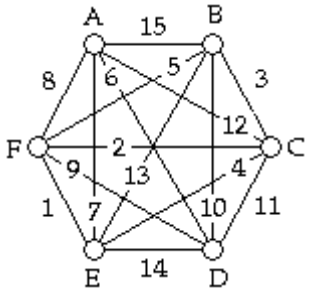


32) The nearest–neighbor tour starting with vertex A is given by: 32) _____

A) A, B, C, D, E, F, A.
B) A, D, F, E, C, B, A.
C) A, C, D, B, E, F, A.
D) A, E, F, C, B, D, A.
E) none of these

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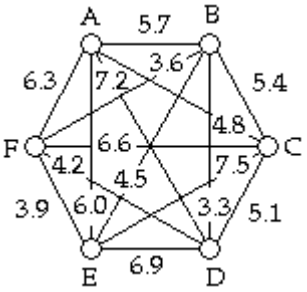
A delivery truck must deliver packages to 6 different store locations (A, B, C, D, E, and F). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



33) The nearest–neighbor tour starting with vertex A is given by: 33) _____

A) A, B, C, D, E, F, A.
B) A, D, F, E, C, B, A.
C) A, E, F, C, B, D, A.
D) A, C, D, B, E, F, A.
E) none of these

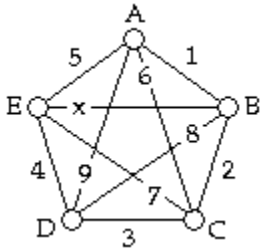
A delivery truck must deliver packages to 6 different store locations (A, B, C, D, E, and F). The trip must start and end at C. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



34) The nearest–neighbor tour starting with vertex C is given by: 34) _____

A) C, A, B, D, F, E, C.
B) C, A, E, F, B, D, C.
C) C, B, D, F, E, A, C.
D) C, D, E, F, A, B, C.
E) none of these

Use the figure below to answer the following question(s).



35) The nearest–neighbor tour with starting vertex B is uniquely B, C, D, E, A, B 35) _____

A) only if $x > 5$.
B) only if $x > 2$.
C) only if $x > 1$.
D) only if $x > 3$.
E) regardless of the value of x.

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36) The nearest–neighbor tour with starting vertex D is uniquely D, E, A, B, C, D 36) _____

A) only if x > 4.
B) only if x > 5.
C) only if x > 9.
D) only if x > 1.
E) regardless of the value of x.

37) The nearest–neighbor tour with starting vertex E is uniquely E, A, B, C, D, E 37) _____

A) only if x > 9.
B) only if x > 1.
C) only if x > 4.
D) only if x > 5.
E) regardless of the value of x.

A traveling saleswoman's territory consists of the 6 cities shown on the following mileage chart. The saleswoman must organize a round trip that starts and ends at Memphis (her hometown) and will pass through each of the other five cities exactly once.

Mileage Chart

	Atlanta	Dallas	Denver	Houston	Kansas City	Memphis
Atlanta	*	795	1398	789	798	371
Dallas	795	*	781	243	489	452
Denver	1398	781	*	1019	600	1040
Houston	789	243	1019	*	710	561
Kansas City	798	489	600	710	*	451
Memphis	371	452	1040	561	451	*

38) The nearest–neighbor tour starting from Memphis is given by: 38) _____

A) Memphis, Atlanta, Houston, Dallas, Kansas City, Denver, Memphis.
B) Memphis, Dallas, Houston, Denver, Atlanta, Kansas City, Memphis.
C) Memphis, Atlanta, Denver, Kansas City, Houston, Dallas, Memphis.
D) Memphis, Atlanta, Denver, Houston, Dallas, Kansas City, Memphis.
E) none of these

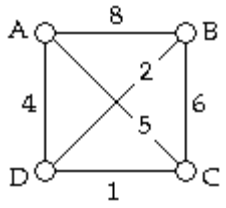
Solve the problem.

39) The nearest–neighbor algorithm for solving the Traveling Salesman Problem is 39) _____

A) an optimal and inefficient algorithm.
B) an optimal and efficient algorithm.
C) an approximate and efficient algorithm.
D) an approximate and inefficient algorithm.
E) none of these

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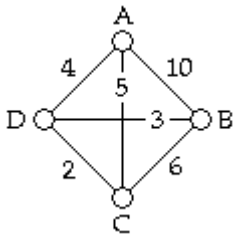
A delivery truck must deliver furniture to 4 different locations (A, B, C, and D). The trip must start and end at A. The graph below shows the distances (in miles) between location. We want to minimize the total distance traveled.



40) The repetitive nearest–neighbor tour starting with vertex A is given by: 40) _____

A) A, B, D, C, A
B) A, C, B, D, A.
C) A, D, B, C, A.
D) A, D, C, B, A.
E) none of these

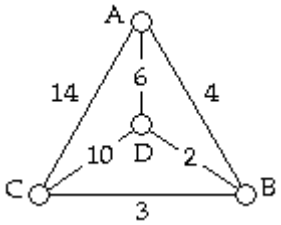
A delivery truck must deliver furniture to 4 different locations (A, B, C, and D). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



41) The repetitive nearest–neighbor tour starting with vertex A is given by: 41) _____

A) A, C, B, D, A.
B) A, D, B, C, A.
C) A, D, C, B, A.
D) A, B, D, C, A.
E) none of these

A garbage truck must pick up garbage at 4 different dump sites (A, B, C, and D) as shown in the graph below, starting and ending at A. The numbers on the edges represent distances (in miles) between locations. The truck driver wants to minimize the total length of the trip.

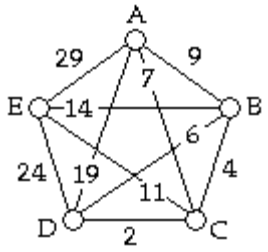


42) The repetitive nearest–neighbor tour starting with vertex A is given by: 42) _____

A) A, D, C, B, A.
B) A, B, D, C, A.
C) A, C, B, D, A.
D) A, B, C, D, A.
E) none of these

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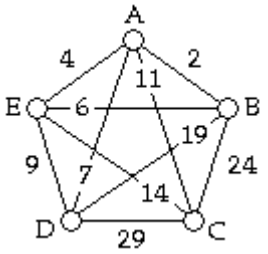
A mail truck must deliver packages to 5 different homes (A, B, C, D, and E). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



43) The repetitive nearest–neighbor tour starting with vertex A is given by: 43) _____

A) A, B, C, D, E, A.
B) A, E, C, D, B, A.
C) A, D, B, E, C, A.
D) A, C, D, B, E, A.
E) none of these

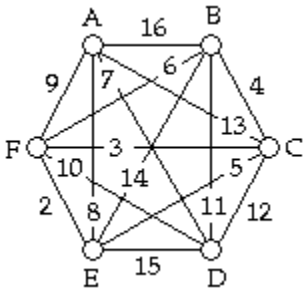
A delivery truck must deliver packages to 5 different store locations (A, B, C, D, and E). The trip must start and end at D. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



44) The repetitive nearest–neighbor tour starting with vertex D is given by: 44) _____

A) D, C, A, B, E, D.
B) D, E, A, B, C, D.
C) D, B, E, C, A, D.
D) D, A, B, E, C, D.
E) none of these

A delivery truck must deliver packages to 6 different store locations (A, B, C, D, E, and F). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.

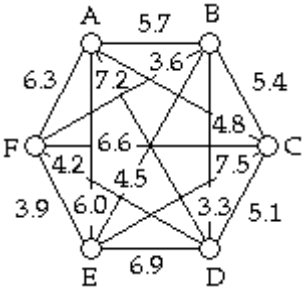


45) The repetitive nearest–neighbor tour starting with vertex A is given by: 45) _____

A) A, E, F, C, B, D, A.
B) A, D, F, E, C, B, A.
C) A, B, C, D, E, F, A.
D) A, C, D, B, E, F, A.
E) none of these

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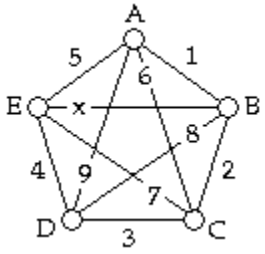
A delivery truck must deliver packages to 6 different store locations (A, B, C, D, E, and F). The trip must start and end at C. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



46) The repetitive nearest–neighbor tour starting with vertex C is given by: 46) _____

A) C, B, D, F, E, A, C.
B) C, A, E, F, B, D, C.
C) C, D, E, F, A, B, C.
D) C, A, B, D, F, E, C.
E) none of these

Use the figure below to answer the following question(s).



47) The repetitive nearest–neighbor tour starting with vertex A is A, B, C, D, E, A 47) _____

A) only if $x > 9$.
B) only if $x > 1$.
C) only if $x > 4$.
D) only if $x > 5$.
E) regardless of the value of x.

Solve the problem.

48) The Future Laureates is a rock band planning to go on tour across the U.S. using their newly acquired platinum coach tour bus. It turns out their lead guitarist has car sickness. Having already set the dates and venues for the tour, the band wants to minimize their time on the road. A nearest–neighbor tour is found with a total travel time of 126 hours. Suppose that they later find out that the travel time of an optimal tour is 109 hours. What was the relative error of the nearest–neighbor tour? Express your answer as a percentage, rounded to the nearest tenth of a percent. 48) _____

A) 15.6% B) 13.5% C) 24.8% D) 17% E) 5.6%

49) In trying to solve a certain Traveling Salesman Problem, you find a solution with a total length of 2500 miles. If the length of the optimal solution is 2000 miles, then the relative error of your solution is 49) _____

A) 25%.
B) 20%.
C) 400%.
D) 125%.
E) none of these

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50) In trying to solve a certain Traveling Salesman Problem, you find a solution with a total length of X miles. If the length of the optimal solution is L miles, then the relative error of your solution is 50) _____

A) $\frac{X - L}{L}$.

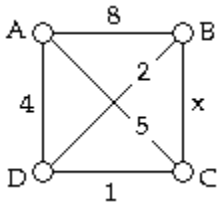
B) $\frac{X - L}{X}$.

C) $\frac{X}{L}$.

D) X – L.

E) none of these

Use the figure below to answer the following question(s).



51) The cheapest–link tour starting with vertex A is uniquely A, B, D, C, A 51) _____

A) only if $x > 5$.

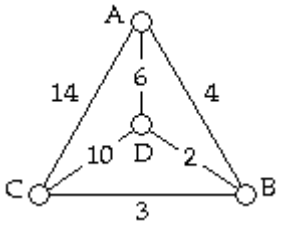
B) only if $0 < x < 1$.

C) only if $x > 2$.

D) only if $1 < x < 2$.

E) regardless of the value of x.

A garbage truck must pick up garbage at 4 different dump sites (A, B, C, and D) as shown in the graph below, starting and ending at A. The numbers on the edges represent distances (in miles) between locations. The truck driver wants to minimize the total length of the trip.



52) The cheapest–link tour starting with vertex A is given by: 52) _____

A) A, B, D, C, A.

B) A, B, C, D, A.

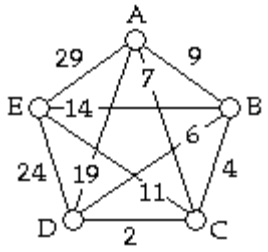
C) A, C, B, D, A.

D) A, D, C, B, A.

E) none of these

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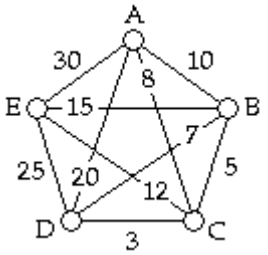
A mail truck must deliver packages to 5 different homes (A, B, C, D, and E). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



53) The cheapest–link tour starting with vertex A is given by: 53) _____

A) A, B, C, D, E, A.
B) A, D, B, E, C, A.
C) A, E, C, D, B, A.
D) A, C, D, B, E, A.
E) none of these

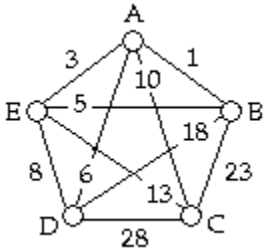
A mail truck must deliver packages to 5 different homes (A, B, C, D, and E). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



54) The cheapest–link tour starting with vertex A is given by: 54) _____

A) A, E, C, D, B, A.
B) A, C, D, B, E, A.
C) A, D, B, E, C, A.
D) A, B, C, D, E, A.
E) none of these

A delivery truck must deliver packages to five different store locations (A, B, C, D, and E). The trip must start and end at D. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.

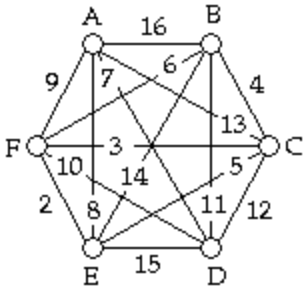


55) The cheapest–link tour starting with vertex D is given by: 55) _____

A) D, E, A, B, C, D.
B) D, A, B, E, C, D.
C) D, B, E, C, A, D.
D) D, C, A, B, E, D.
E) none of these

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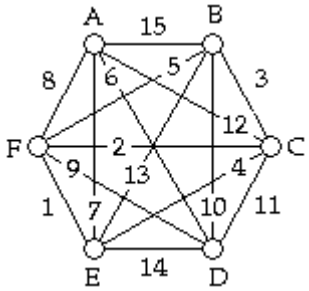
A delivery truck must deliver packages to 6 different store locations (A, B, C, D, E, and F). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



56) In applying the cheapest-link algorithm to this graph, the fourth edge added to the circuit is: 56) _____

A) BC.
B) BF.
C) AD.
D) CE.
E) none of these

A delivery truck must deliver packages to 6 different store locations (A, B, C, D, E, and F). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.

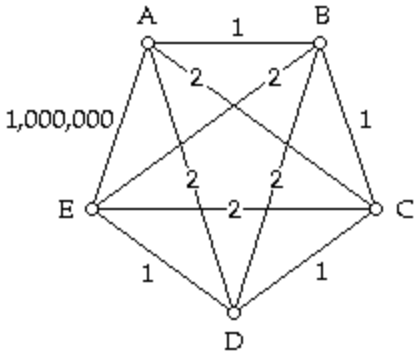


57) The cheapest-link tour starting with vertex A is given by: 57) _____

A) A, B, C, D, E, F, A.
B) A, D, F, E, C, B, A.
C) A, C, D, B, E, F, A.
D) A, E, F, C, B, D, A.
E) none of these

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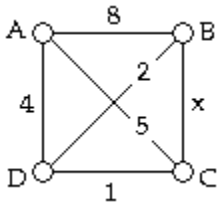
Use the figure below to answer the following question(s).



58) Applying the cheapest–link algorithm produces a Hamilton circuit with weight 58) _____

A) 1,000,004.
B) 7.
C) 6.
D) 10.
E) none of these

Use the figure below to answer the following question(s).



59) The cheapest–link tour starting with vertex A is A, B, D, C, A 59) _____

A) only if $x > 5$.
B) only if $0 < x < 1$.
C) only if $1 < x < 2$.
D) only if $x > 2$.
E) regardless of the value of x.

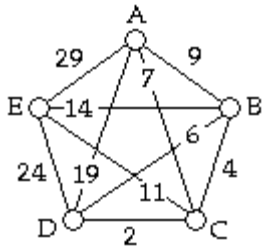
Solve the problem.

60) Sam is a sales representative whose territory consists of eleven major cities in the midwest. He wants to visit customers in each of the cities, and he wants to minimize travel cost. Sam uses the cheapest–link algorithm to find a cheapest–link tour with a total cost of $1894. Suppose that he later finds out the cost of an optimal tour is $1760. What was the relative error of the cheapest–link tour? Express your answer as a percentage, rounded to the nearest tenth of a percent. 60) _____

A) 13.3% B) 3.8% C) 7.6% D) 15.2% E) 7.1%

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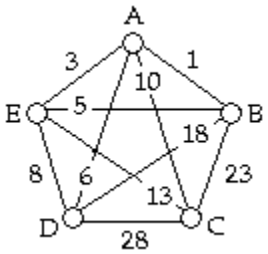
A mail truck must deliver packages to 5 different homes (A, B, C, D, and E). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



61) The shortest trip in this situation can be found using 61) _____
A) the repetitive nearest–neighbor algorithm.
B) both the nearest–neighbor and the cheapest–link algorithms.
C) the cheapest–link algorithm.
D) the nearest–neighbor algorithm.
E) all of these algorithms give the shortest trip in this situation.

62) Using both the cheapest–link and the repetitive nearest–neighbor algorithm, the length of the shortest trip we can find (without using brute force) is: 62) _____
A) 57 miles.
B) 28 miles.
C) 68 miles.
D) 58 miles.
E) none of these

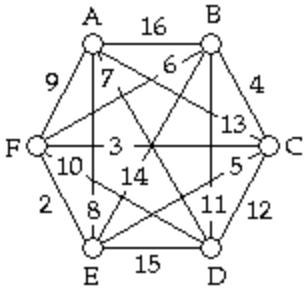
A delivery truck must deliver packages to five different store locations (A, B, C, D, and E). The trip must start and end at D. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



63) Using both the cheapest–link and the repetitive nearest–neighbor algorithm, the length of the shortest trip we can find (without using brute force) is: 63) _____
A) 52 miles.
B) 58 miles.
C) 63 miles.
D) 50 miles.
E) none of these

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A delivery truck must deliver packages to 6 different store locations (A, B, C, D, E, and F). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



64) Using both the cheapest–link and the repetitive nearest–neighbor algorithm, the length of the shortest trip we can find (without using brute force) is: 64) _____

A) 44 miles.
B) 35 miles.
C) 58 miles.
D) 27 miles.
E) none of these

65) Using only the nearest–neighbor, repetitive nearest–neighbor, and cheapest–link algorithms (not brute force) on this graph, 65) _____

A) the cheapest–link algorithm yields the shortest trip.
B) the cheapest–link and the repetitive nearest–neighbor algorithms both yield the shortest trip.
C) the nearest–neighbor algorithm yields the shortest trip.
D) the nearest–neighbor and the repetitive nearest–neighbor algorithms both yield the shortest trip.
E) the repetitive nearest–neighbor algorithm yields the shortest trip.

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A traveling saleswoman's territory consists of the 6 cities shown on the following mileage chart. The saleswoman must organize a round trip that starts and ends at Memphis (her hometown) and will pass through each of the other five cities exactly once.

Mileage Chart

	Atlanta	Dallas	Denver	Houston	Kansas City	Memphis
Atlanta	*	795	1398	789	798	371
Dallas	795	*	781	243	489	452
Denver	1398	781	*	1019	600	1040
Houston	789	243	1019	*	710	561
Kansas City	798	489	600	710	*	451
Memphis	371	452	1040	561	451	*

66) At an average cost of 10 cents per mile, the cheapest trip, that the saleswoman can find that starts at Memphis and passes through each of the other cities exactly once using either the nearest–neighbor or cheapest–link algorithm would cost 66) _____
A) $397.10.
B) $353.20.
C) $415.10.
D) $436.10.
E) none of these

A hypothetical management science problem requires us to find the cheapest "supercircuit" in a graph. Three algorithms are available: Algorithm 1, Algorithm 2, and Algorithm 3.

67) Algorithm 3 never produces a supercircuit that is off by more than 10% from the cheapest supercircuit. The amount of time that it takes to carry out Algorithm 3 is: 1 second for a graph with 5 or less vertices, 30 seconds for a graph with 6 vertices, 40 seconds for a graph with 7 vertices, and so on, increasing by 10 seconds every time we add a vertex (from 7 vertices on). Algorithm 3 is 67) _____
A) an approximate and efficient algorithm.
B) an optimal and inefficient algorithm.
C) an approximate and inefficient algorithm.
D) an optimal and efficient algorithm.
E) none of these

Solve the problem.

68) An example of an optimal and efficient algorithm for solving the Traveling Salesman Problem 68) _____
A) is the cheapest–link algorithm
B) is the brute–force algorithm
C) is the repetitive nearest–neighbor algorithm
D) is the nearest–neighbor algorithm
E) has not yet been discovered

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1) B
2) D
3) B
4) A
5) D
6) A
7) A
8) A
9) D
10) D
11) A
12) D
13) B
14) D
15) B
16) D
17) C
18) D
19) A
20) C
21) D
22) C
23) A
24) A
25) B
26) B
27) D
28) D
29) B
30) A
31) A
32) B
33) B
34) A
35) C
36) D
37) C
38) A
39) C
40) A
41) D
42) C
43) B
44) A
45) A
46) B
47) B
48) A
49) A
50) A

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51) C
52) C
53) A
54) D
55) A
56) C
57) D
58) A
59) D
60) C
61) A
62) A
63) A
64) B
65) B
66) B
67) A
68) E

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Chapter 6

Name_____

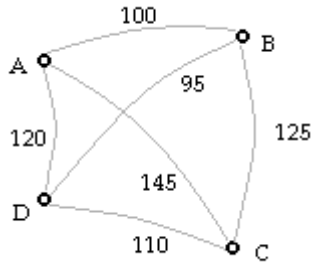
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Answer the question about traveling salesman problems.

1) Which of these is not an element common to all traveling salesman problems? 1) _____

A) a set of costs
B) a set of goods
C) a traveler
D) a set of sites
E) All of these are elements common to traveling salesman problems.

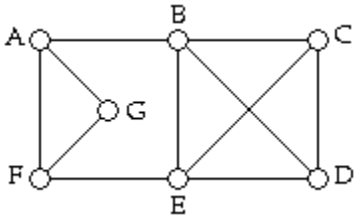
2) The diagram below shows the distances, in miles, between four cities: A, B, C, and D. A businessman must travel between all four cities, starting and ending in his home city, A. He wants to find the optimal tour. In this case, what is the "cost variable"? 2) _____



A) travel time
B) number of cities to go to
C) size of the planes
D) distance traveled
E) price to travel between cities

Solve the problem.

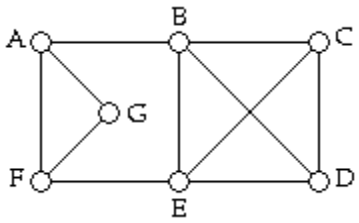
3) The following graph 3) _____



A) has no Hamilton circuit.
B) has several Hamilton circuits, all of which contain the edge AG.
C) has several Hamilton circuits, none of which contain the edge BD.
D) has a single Hamilton circuit (and its mirror–image circuit).
E) none of these

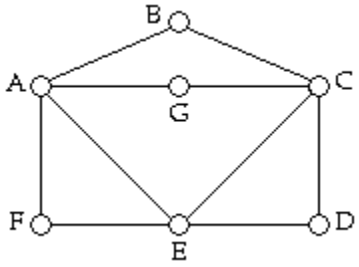
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4) A Hamilton circuit for the following graph 4) _____



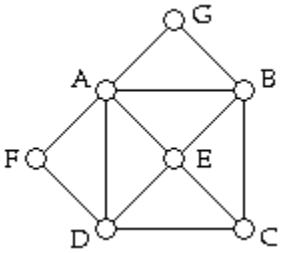
A) must contain the edge FE.
B) must contain the edge AB.
C) must contain the edge CD.
D) all of these
E) none of these

5) The following graph 5) _____



A) has no Hamilton circuit.
B) has several Hamilton circuits, all of which contain the edge GC.
C) has a single Hamilton circuit (and its mirror–image circuit).
D) has several Hamilton circuits, none of which contain the edge BC.
E) none of these

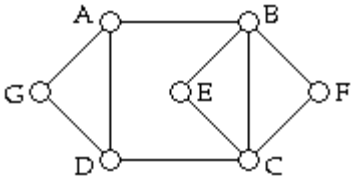
6) The following graph 6) _____



A) has several Hamilton circuits, none of which contain the edge BC.
B) has a single Hamilton circuit (and its mirror–image circuit).
C) has several Hamilton circuits, all of which contain the edge AD.
D) has no Hamilton circuit.
E) none of these

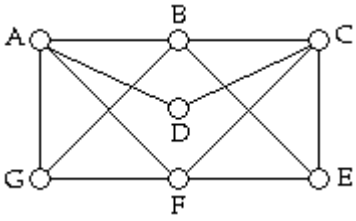
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7) The following graph 7) _____



A) has a Hamilton path that starts at D and ends at G.
B) has no Hamilton path.
C) has a Hamilton path that starts at A and ends at B.
D) has a Hamilton path that starts at G and ends at F.
E) none of these

8) The following graph 8) _____



A) has no Hamilton circuit.
B) has a single Hamilton circuit (and its mirror–image circuit).
C) has several Hamilton circuits, all of which contain the edge AD.
D) has several Hamilton circuits, none of which contain the edge BC.
E) none of these

9) $\frac{50!}{49!}$ = 9) _____

A) 39
B) 51
C) 50
D) 1
E) none of these

10) $\frac{101!}{100!}$ = 10) _____

A) 1
B) 1.01
C) 10,100
D) 101
E) none of these

11) If $999! \approx 4 \times 10^{2564}$, which of the following numbers most closely approximates 1000!? 11) _____

A) $4 \times 10^{2564} + 1$
B) 4×10^{2567}
C) $4 \times 10^{2564} + 1000$
D) 4×10^{2566}
E) none of these

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12) $\frac{26! + 24!}{25!} =$ 12) _____

A) 25
B) $\frac{50!}{25!}$
C) 2
D) 26.04
E) none of these

13) Which of the following is closest to the value of $\frac{501! + 499!}{500!}$? 13) _____

A) 500! B) 2 C) $\frac{1000!}{500!}$ D) 1000 E) 500

14) The number of Hamilton circuits in K_{12} is 14) _____

A) 11!.
B) 12!.
C) 12.
D) $\frac{12 \times 11}{2}$.
E) none of these

15) The number of Hamilton circuits in K_{11} is 15) _____

A) $\frac{11 \times 10}{2}$.
B) 10!.
C) 11.
D) 11!.
E) none of these

16) The number of Hamilton circuits in the complete graph with 12 vertices is 16) _____

A) in the hundreds.
B) more than a billion.
C) in the hundreds of thousands.
D) in the millions.
E) none of these

17) The number of Hamilton circuits in the complete graph with 100 vertices is 17) _____

A) in the millions.
B) in the hundreds.
C) more than a billion.
D) in the thousands.
E) none of these

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18) If the number of edges in K_{500} is x, and the number of edges in K_{502} is y, what is the value of y – x? 18) _____

A) 500
B) 501! – 499!
C) 2
D) 1001
E) none of these

19) In a complete graph with 720 distinct Hamilton circuits, there is a total of 19) _____

A) 9 vertices.
B) 5 vertices.
C) 6 vertices.
D) 7 vertices.
E) none of these

20) In a complete graph with 16 vertices (A through P), the total number of Hamilton circuits (including mirror–image circuits) that start at vertex A is 20) _____

A) 16!.
B) 17!.
C) 15!.
D) 14!.
E) none of these

21) In a complete graph with 16 vertices (A through P), the total number of Hamilton paths that start at vertex A and end at vertex P is 21) _____

A) 16!.
B) 17!.
C) 15!.
D) 14!.
E) none of these

22) The number of edges in the complete graph with 50 vertices is 22) _____

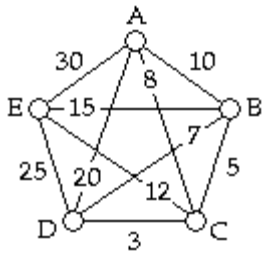
A) 49.
B) 50!.
C) $\frac{50 \times 51}{2}$.
D) $\frac{49 \times 50}{2}$.
E) none of these

23) The number of edges in the complete graph with 100 vertices is 23) _____

A) 100!.
B) 99.
C) $\frac{100 \times 101}{2}$.
D) $\frac{99 \times 100}{2}$.
E) none of these

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A mail truck must deliver packages to 5 different homes (A, B, C, D, and E). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



24) How many different Hamilton circuits would we have to check if we use the brute–force algorithm? (Do not count the same circuit traveled backward.) 24) _____

A) 30
B) 12
C) 60
D) 4
E) none of these

Solve the problem.

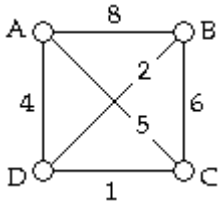
25) The brute–force algorithm for solving the Traveling Salesman Problem is 25) _____

A) an approximate and efficient algorithm.
B) an approximate and inefficient algorithm.
C) an optimal and efficient algorithm.
D) an optimal and inefficient algorithm.
E) none of these

26) In applying the brute–force algorithm to solve a traveling salesman problem on a graph with 20 vertices, you use a supercomputer that computes 1 billion (that's 10^9) circuits per second. There are 31,536,000 seconds in a year. Roughly how long would it take for the supercomputer to solve this problem? 26) _____

A) approximately 1.5 years
B) approximately 15 years
C) approximately 31 years
D) approximately 4 years
E) approximately 77 years

A delivery truck must deliver furniture to 4 different locations (A, B, C, and D). The trip must start and end at A. The graph below shows the distances (in miles) between location. We want to minimize the total distance traveled.

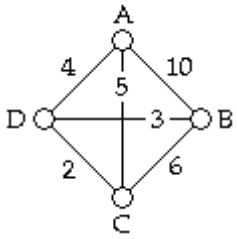


27) An optimal tour is given by: 27) _____

A) A, C, B, D, A.
B) A, B, D, C, A.
C) A, B, C, D, A.
D) A, D, C, B, A.
E) none of these

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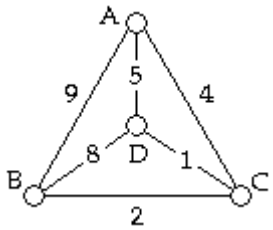
A delivery truck must deliver furniture to 4 different locations (A, B, C, and D). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



28) The nearest–neighbor tour starting with vertex A is given by: 28) _____

A) A, D, C, B, A.
B) A, D, B, C, A.
C) A, C, B, D, A.
D) A, B, D, C, A.
E) none of these

A truck must drop off furniture at 4 different homes (A, B, C, and D) as shown in the graph below, starting and ending at A. The numbers on the edges represent distances (in miles) between locations. The truck driver wants to minimize the total length of the trip.



29) The nearest–neighbor tour starting with vertex A is given by: 29) _____

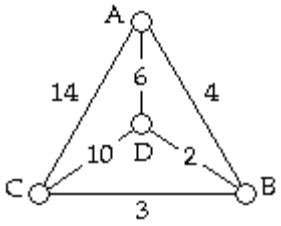
A) A, B, C, D, A.
B) A, D, C, B, A.
C) A, B, D, C, A.
D) A, C, B, D, A.
E) none of these

30) An optimal tour is given by: 30) _____

A) A, D, B, C, A.
B) A, C, D, B, A.
C) A, B, D, C, A.
D) A, B, C, D, A.
E) none of these

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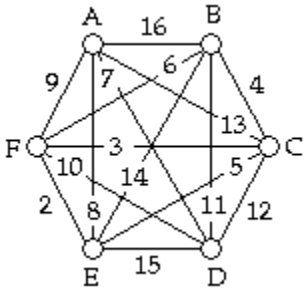
A garbage truck must pick up garbage at 4 different dump sites (A, B, C, and D) as shown in the graph below, starting and ending at A. The numbers on the edges represent distances (in miles) between locations. The truck driver wants to minimize the total length of the trip.



31) An optimal tour is given by: 31) _____

A) A, B, D, C, A.
B) A, D, C, B, A.
C) A, C, B, D, A.
D) A, D, B, C, A.
E) none of these

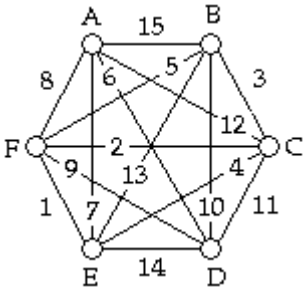
A delivery truck must deliver packages to 6 different store locations (A, B, C, D, E, and F). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



32) The nearest–neighbor tour starting with vertex A is given by: 32) _____

A) A, C, D, B, E, F, A.
B) A, D, F, E, C, B, A.
C) A, E, F, C, B, D, A.
D) A, B, C, D, E, F, A.
E) none of these

A delivery truck must deliver packages to 6 different store locations (A, B, C, D, E, and F). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.

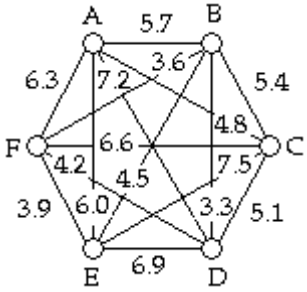


33) The nearest–neighbor tour starting with vertex A is given by: 33) _____

A) A, C, D, B, E, F, A.
B) A, D, F, E, C, B, A.
C) A, B, C, D, E, F, A.
D) A, E, F, C, B, D, A.
E) none of these

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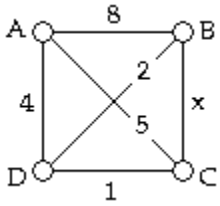
A delivery truck must deliver packages to 6 different store locations (A, B, C, D, E, and F). The trip must start and end at C. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



34) The nearest–neighbor tour starting with vertex C is given by: 34) _____

A) C, A, E, F, B, D, C.
B) C, A, B, D, F, E, C.
C) C, B, D, F, E, A, C.
D) C, D, E, F, A, B, C.
E) none of these

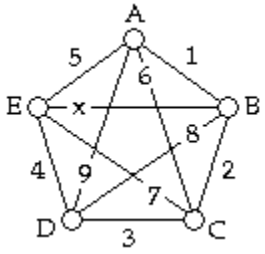
Use the figure below to answer the following question(s).



35) The nearest–neighbor tour with starting vertex A is A, B, C, D, A 35) _____

A) only if $1 \le x \le 8$.
B) only if $x < 5$.
C) only if $x = 1$.
D) only if $2 < x < 8$.
E) regardless of the value of x.

Use the figure below to answer the following question(s).



36) The nearest–neighbor tour with starting vertex D is uniquely D, E, A, B, C, D 36) _____

A) only if $x > 1$.
B) only if $x > 5$.
C) only if $x > 4$.
D) only if $x > 9$.
E) regardless of the value of x.

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37) The nearest–neighbor tour with starting vertex A is uniquely A, B, C, D, E, A 37) _____

A) only if $x > 2$.
B) only if $x > 3$.
C) only if $x > 5$.
D) only if $x > 1$.
E) regardless of the value of x.

38) The nearest–neighbor tour with starting vertex E is uniquely E, A, B, C, D, E 38) _____

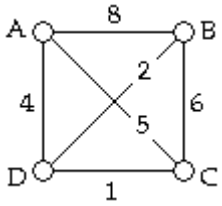
A) only if $x > 1$.
B) only if $x > 4$.
C) only if $x > 5$.
D) only if $x > 9$.
E) regardless of the value of x.

Solve the problem.

39) The nearest–neighbor algorithm for solving the Traveling Salesman Problem is 39) _____

A) an optimal and efficient algorithm.
B) an optimal and inefficient algorithm.
C) an approximate and inefficient algorithm.
D) an approximate and efficient algorithm.
E) none of these

A delivery truck must deliver furniture to 4 different locations (A, B, C, and D). The trip must start and end at A. The graph below shows the distances (in miles) between location. We want to minimize the total distance traveled.

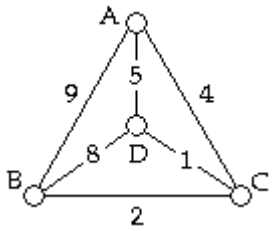


40) The repetitive nearest–neighbor tour starting with vertex A is given by: 40) _____

A) A, C, B, D, A.
B) A, D, B, C, A.
C) A, B, D, C, A
D) A, D, C, B, A.
E) none of these

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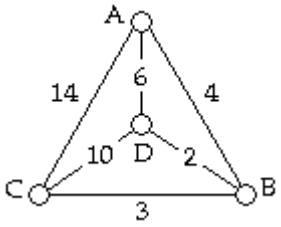
A truck must drop off furniture at 4 different homes (A, B, C, and D) as shown in the graph below, starting and ending at A. The numbers on the edges represent distances (in miles) between locations. The truck driver wants to minimize the total length of the trip.



41) The repetitive nearest–neighbor tour starting with vertex A is given by: 41) _____

A) A, C, B, D, A.
B) A, B, D, C, A.
C) A, D, C, B, A.
D) A, C, D, B, A.
E) none of these

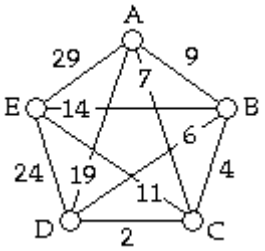
A garbage truck must pick up garbage at 4 different dump sites (A, B, C, and D) as shown in the graph below, starting and ending at A. The numbers on the edges represent distances (in miles) between locations. The truck driver wants to minimize the total length of the trip.



42) The repetitive nearest–neighbor tour starting with vertex A is given by: 42) _____

A) A, D, C, B, A.
B) A, B, D, C, A.
C) A, B, C, D, A.
D) A, C, B, D, A.
E) none of these

A mail truck must deliver packages to 5 different homes (A, B, C, D, and E). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.

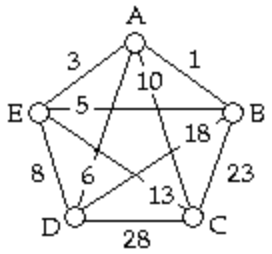


43) The repetitive nearest–neighbor tour starting with vertex A is given by: 43) _____

A) A, D, B, E, C, A.
B) A, B, C, D, E, A.
C) A, E, C, D, B, A.
D) A, C, D, B, E, A.
E) none of these

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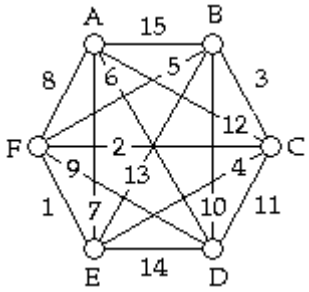
A delivery truck must deliver packages to five different store locations (A, B, C, D, and E). The trip must start and end at D. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



44) The repetitive nearest–neighbor tour starting with vertex D is given by: 44) _____

A) D, C, A, B, E, D.
B) D, E, A, B, C, D.
C) D, C, E, A, B, D.
D) D, A, B, E, C, D.
E) none of these

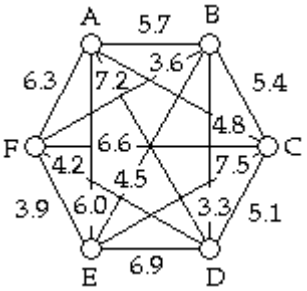
A delivery truck must deliver packages to 6 different store locations (A, B, C, D, E, and F). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



45) The repetitive nearest–neighbor tour starting with vertex A is given by: 45) _____

A) A, C, D, B, E, F, A.
B) A, B, C, D, E, F, A.
C) A, E, F, C, B, D, A.
D) A, D, F, E, C, B, A.
E) none of these

A delivery truck must deliver packages to 6 different store locations (A, B, C, D, E, and F). The trip must start and end at C. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



46) The repetitive nearest–neighbor tour starting with vertex C is given by: 46) _____

A) C, A, E, F, B, D, C.
B) C, D, E, F, A, B, C.
C) C, B, D, F, E, A, C.
D) C, A, B, D, F, E, C.
E) none of these

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Solve the problem.

47) The repetitive nearest–neighbor algorithm for solving the Traveling Salesman Problem is 47) _____

A) an approximate and efficient algorithm.
B) an approximate and inefficient algorithm.
C) an optimal and efficient algorithm.
D) an optimal and inefficient algorithm.
E) none of these

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

48) The Future Laureates is a rock band planning to go on tour across the U.S. using their newly acquired platinum coach tour bus. It turns out their lead guitarist has car sickness. Having already set the dates and venues for the tour, the band wants to minimize their time on the road. A nearest–neighbor tour is found with a total travel time of 126 hours. Suppose that they later find out that the travel time of an optimal tour is 109 hours. What was the relative error of the nearest–neighbor tour? Express your answer as a percentage, rounded to the nearest tenth of a percent. 48) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

49) In trying to solve a certain Traveling Salesman Problem, you find a solution with a total length of 2500 miles. If the length of the optimal solution is 2000 miles, then the relative error of your solution is 49) _____

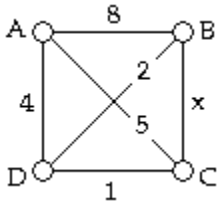
A) 25%.
B) 20%.
C) 400%.
D) 125%.
E) none of these

50) In trying to solve a certain Traveling Salesman Problem, you find a solution with a total length of X miles. If the length of the optimal solution is L miles, then the relative error of your solution is 50) _____

A) X – L.
B) $\frac{X - L}{L}$.
C) $\frac{X}{L}$.
D) $\frac{X - L}{X}$.
E) none of these

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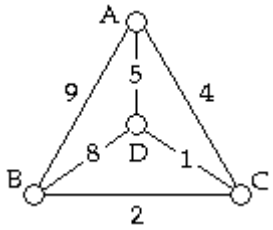
Use the figure below to answer the following question(s).



51) The cheapest–link tour starting with vertex A is uniquely A, B, C, D, A 51) _____

A) if $2 < x < 5$.
B) if $5 < x < 8$.
C) if $x < 2$.
D) if $1 \le x \le 8$.
E) regardless of the value of x.

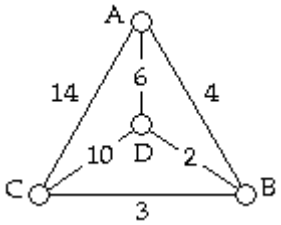
A truck must drop off furniture at 4 different homes (A, B, C, and D) as shown in the graph below, starting and ending at A. The numbers on the edges represent distances (in miles) between locations. The truck driver wants to minimize the total length of the trip.



52) The length of the trip of the circuit found using the cheapest–link algorithm is 52) _____

A) 29 miles.
B) 22 miles.
C) 19 miles.
D) 17 miles.
E) none of these

A garbage truck must pick up garbage at 4 different dump sites (A, B, C, and D) as shown in the graph below, starting and ending at A. The numbers on the edges represent distances (in miles) between locations. The truck driver wants to minimize the total length of the trip.

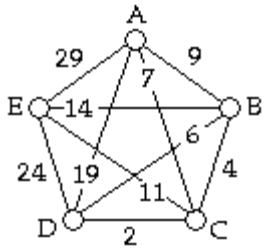


53) The cheapest–link tour starting with vertex A is given by: 53) _____

A) A, D, C, B, A.
B) A, B, D, C, A.
C) A, B, C, D, A.
D) A, C, B, D, A.
E) none of these

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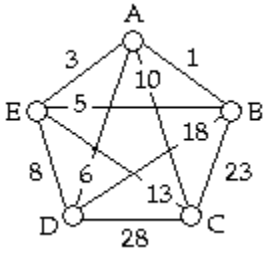
A mail truck must deliver packages to 5 different homes (A, B, C, D, and E). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



54) The cheapest–link tour starting with vertex A is given by: 54) _____

A) A, B, C, D, E, A.
B) A, E, C, D, B, A.
C) A, D, B, E, C, A.
D) A, C, D, B, E, A.
E) none of these

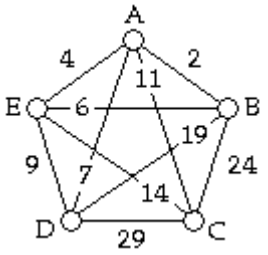
A delivery truck must deliver packages to five different store locations (A, B, C, D, and E). The trip must start and end at D. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



55) The cheapest–link tour starting with vertex D is given by: 55) _____

A) D, B, E, C, A, D.
B) D, A, B, E, C, D.
C) D, E, A, B, C, D.
D) D, C, A, B, E, D.
E) none of these

A delivery truck must deliver packages to 5 different store locations (A, B, C, D, and E). The trip must start and end at D. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.

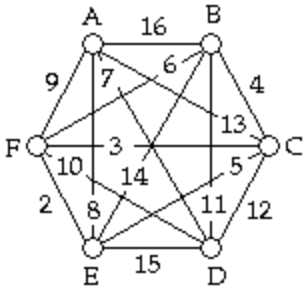


56) The cheapest–link tour starting with vertex D is given by: 56) _____

A) D, C, A, B, E, D.
B) D, B, E, C, A, D.
C) D, E, A, B, C, D.
D) D, A, B, E, C, D.
E) none of these

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A delivery truck must deliver packages to 6 different store locations (A, B, C, D, E, and F). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



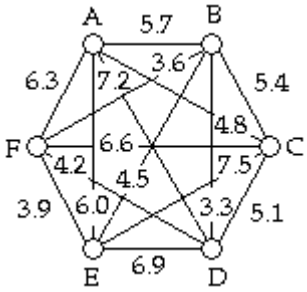
57) In applying the cheapest-link algorithm to this graph, the fourth edge added to the circuit is: 57) _____

A) BF.
B) AD.
C) BC.
D) CE.
E) none of these

58) The cheapest-link tour starting with vertex A is given by: 58) _____

A) A, C, D, B, E, F, A.
B) A, D, F, E, C, B, A.
C) A, B, C, D, E, F, A.
D) A, E, F, C, B, D, A.
E) none of these

A delivery truck must deliver packages to 6 different store locations (A, B, C, D, E, and F). The trip must start and end at C. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



59) In applying the cheapest-link algorithm to this graph, the fourth edge added to the circuit is: 59) _____

A) BE.
B) CD.
C) AC.
D) DF.
E) none of these

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A traveling salesman's territory consists of the 5 cities shown on the following mileage chart. The salesman must organize a round trip that starts and ends at Louisville (his hometown) and will pass through each of the other four cities exactly once.

Mileage Chart

	Boston	Buffalo	Chicago	Columbus	Louisville
Boston	*	446	963	735	941
Buffalo	446	*	522	326	532
Chicago	963	522	*	308	292
Columbus	735	326	308	*	209
Louisville	941	532	292	209	*

60) The cheapest–link tour starting from Louisville is given by: 60) _____

A) Louisville, Columbus, Chicago, Buffalo, Boston, Louisville.
B) Louisville, Chicago, Buffalo, Boston, Columbus, Louisville.
C) Louisville, Boston, Buffalo, Chicago, Columbus, Louisville.
D) Louisville, Columbus, Buffalo, Boston, Chicago, Louisville.
E) none of these

A traveling saleswoman's territory consists of the 6 cities shown on the following mileage chart. The saleswoman must organize a round trip that starts and ends at Memphis (her hometown) and will pass through each of the other five cities exactly once.

Mileage Chart

	Atlanta	Dallas	Denver	Houston	Kansas City	Memphis
Atlanta	*	795	1398	789	798	371
Dallas	795	*	781	243	489	452
Denver	1398	781	*	1019	600	1040
Houston	789	243	1019	*	710	561
Kansas City	798	489	600	710	*	451
Memphis	371	452	1040	561	451	*

61) The cheapest–link tour starting from Memphis is given by: 61) _____

A) Memphis, Atlanta, Denver, Kansas City, Houston, Dallas, Memphis.
B) Memphis, Dallas, Houston, Denver, Atlanta, Kansas City, Memphis.
C) Memphis, Atlanta, Houston, Dallas, Kansas City, Denver, Memphis.
D) Memphis, Atlanta, Denver, Houston, Dallas, Kansas City, Memphis.
E) none of these

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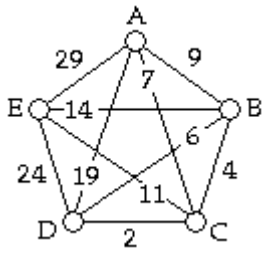
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Solve the problem.

62) Sam is a sales representative whose territory consists of eleven major cities in the midwest. He wants to visit customers in each of the cities, and he wants to minimize travel cost. Sam uses the cheapest–link algorithm to find a cheapest–link tour with a total cost of $1894. Suppose that he later finds out the cost of an optimal tour is $1760. What was the relative error of the cheapest–link tour? Express your answer as a percentage, rounded to the nearest tenth of a percent. 62) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

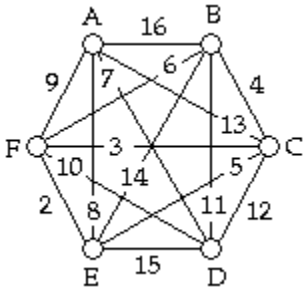
A mail truck must deliver packages to 5 different homes (A, B, C, D, and E). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



63) Using both the cheapest–link and the repetitive nearest–neighbor algorithm, the length of the shortest trip we can find (without using brute force) is: 63) _____

A) 58 miles.
B) 68 miles.
C) 57 miles.
D) 28 miles.
E) none of these

A delivery truck must deliver packages to 6 different store locations (A, B, C, D, E, and F). The trip must start and end at A. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



64) Using both the cheapest–link and the repetitive nearest–neighbor algorithm, the length of the shortest trip we can find (without using brute force) is: 64) _____

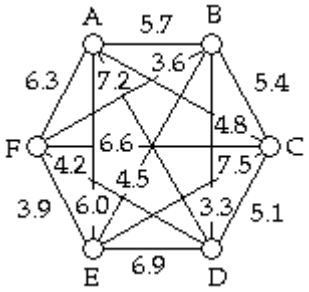
A) 27 miles.
B) 58 miles.
C) 35 miles.
D) 44 miles.
E) none of these

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65) Using only the nearest–neighbor, repetitive nearest–neighbor, and cheapest–link algorithms (not brute force) on this graph, 65) _____

A) the repetitive nearest–neighbor algorithm yields the shortest trip.
B) the nearest–neighbor algorithm yields the shortest trip.
C) the cheapest–link algorithm yields the shortest trip.
D) the nearest–neighbor and the repetitive nearest–neighbor algorithms both yield the shortest trip.
E) the cheapest–link and the repetitive nearest–neighbor algorithms both yield the shortest trip.

A delivery truck must deliver packages to 6 different store locations (A, B, C, D, E, and F). The trip must start and end at C. The graph below shows the distances (in miles) between locations. We want to minimize the total distance traveled.



66) Using only the nearest–neighbor, repetitive nearest–neighbor, and cheapest–link algorithms (not brute force) on this graph, 66) _____

A) the nearest–neighbor and the repetitive nearest–neighbor algorithms both yield the shortest trip.
B) the cheapest–link and the repetitive nearest–neighbor algorithms both yield the shortest trip.
C) the nearest–neighbor algorithm yields the shortest trip.
D) the cheapest–link algorithm yields the shortest trip.
E) the repetitive nearest–neighbor algorithm yields the shortest trip.

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A traveling saleswoman's territory consists of the 6 cities shown on the following mileage chart. The saleswoman must organize a round trip that starts and ends at Memphis (her hometown) and will pass through each of the other five cities exactly once.

Mileage Chart

	Atlanta	Dallas	Denver	Houston	Kansas City	Memphis
Atlanta	*	795	1398	789	798	371
Dallas	795	*	781	243	489	452
Denver	1398	781	*	1019	600	1040
Houston	789	243	1019	*	710	561
Kansas City	798	489	600	710	*	451
Memphis	371	452	1040	561	451	*

67) At an average cost of 10 cents per mile, the cheapest trip, that the saleswoman can find that starts at Memphis and passes through each of the other cities exactly once using either the nearest–neighbor or cheapest–link algorithm would cost 67) _____

A) $353.20.
B) $436.10.
C) $397.10.
D) $415.10.
E) none of these

A hypothetical management science problem requires us to find the cheapest "supercircuit" in a graph. Three algorithms are available: Algorithm 1, Algorithm 2, and Algorithm 3.

68) Algorithm 3 never produces a supercircuit that is off by more than 10% from the cheapest supercircuit. The amount of time that it takes to carry out Algorithm 3 is: 1 second for a graph with 5 or less vertices, 30 seconds for a graph with 6 vertices, 40 seconds for a graph with 7 vertices, and so on, increasing by 10 seconds every time we add a vertex (from 7 vertices on). Algorithm 3 is 68) _____

A) an optimal and inefficient algorithm.
B) an approximate and inefficient algorithm.
C) an approximate and efficient algorithm.
D) an optimal and efficient algorithm.
E) none of these

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1) B
2) D
3) B
4) D
5) A
6) A
7) D
8) C
9) C
10) D
11) B
12) D
13) E
14) A
15) B
16) D
17) C
18) D
19) D
20) C
21) D
22) D
23) D
24) B
25) D
26) D
27) B
28) A
29) C
30) D
31) B
32) B
33) B
34) B
35) E
36) A
37) A
38) B
39) D
40) C
41) C
42) D
43) C
44) A
45) C
46) A
47) A
48) 15.6%
49) A
50) B

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51) C
52) D
53) D
54) A
55) C
56) C
57) B
58) D
59) C
60) D
61) D
62) 7.6%
63) C
64) C
65) E
66) B
67) A
68) C

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Chapter 7

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

1) Which of the following four graphs is a tree? 1) _____



Graph 1 Graph 2 Graph 3 Graph 4

A) Graph 2 and Graph 4
B) Graph 2 and Graph 3
C) Graph 1 and Graph 4
D) Graph 1 and Graph 3
E) none of these

2) The number of edges in a tree with 49 vertices is 2) _____

A) 50.
B) 48.
C) 49.
D) 2^{49}.
E) none of these

3) The number of vertices in a tree with 49 edges is 3) _____

A) 50.
B) 49.
C) 48.
D) 2^{49}.
E) none of these

4) Assume that G is a graph with no loops or multiple edges. Which of the following graphs G are definitely trees? 4) _____

A) G has 14 vertices and there is exactly one path from any vertex to any other vertex.
B) G has 14 vertices, is connected, and every edge in G is a bridge.
C) G has 14 vertices, 13 edges, and no circuits.
D) all of these are trees.
E) none of these are trees.

5) Assume that G is a graph with no loops or multiple edges. It is known that G has 5 vertices, 4 edges, and that the degree of each vertex is either 1 or 2. What can be said about G? 5) _____

A) G is a tree.
B) G has 4 bridges.
C) G is not a tree.
D) G could be a tree.
E) none of these

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6) Suppose T is a tree with 21 vertices. Then 6) _____
A) T has one bridge.
B) T can have any number of bridges.
C) T has 20 bridges.
D) T has no bridges.
E) none of these

7) Suppose G is a graph with 39 vertices and 38 edges. Then 7) _____
A) G cannot have any circuits.
B) G must be a tree.
C) G cannot have more than one path joining any two vertices.
D) G is either a tree or it is not connected.
E) none of these

8) Suppose G is a graph with 51 vertices and 50 edges. Then 8) _____
A) G cannot have any circuits.
B) G is either a tree or is not connected.
C) G cannot have more than one path joining any two vertices.
D) G must be a tree.
E) none of these

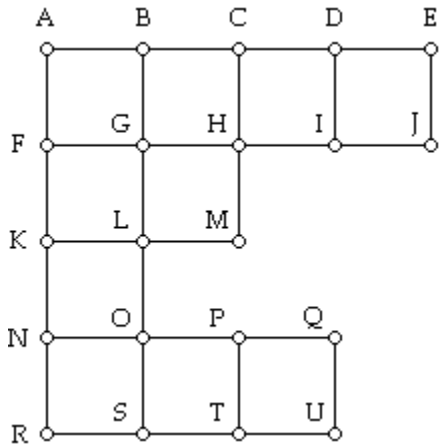
9) A graph G has 42 vertices and has the property that there is one and only one path joining any two vertices of the graph. Which of the following statements [A), B), C), or D)] is not true? 9) _____
A) G must be connected.
B) Every edge of the graph must be a bridge.
C) G cannot have any circuits.
D) G must have 41 edges.
E) all of these statements are true.

10) A vertex of degree 1 in a tree is often called a leaf. What is the smallest number of leaves that a tree on 100 vertices can have? 10) _____
A) 0 B) 1 C) 99 D) 100 E) 2

11) A vertex of degree 1 in a tree is often called a leaf. What is the largest number of leaves that a tree on 100 vertices can have? 11) _____
A) 0 B) 100 C) 1 D) 99 E) 2

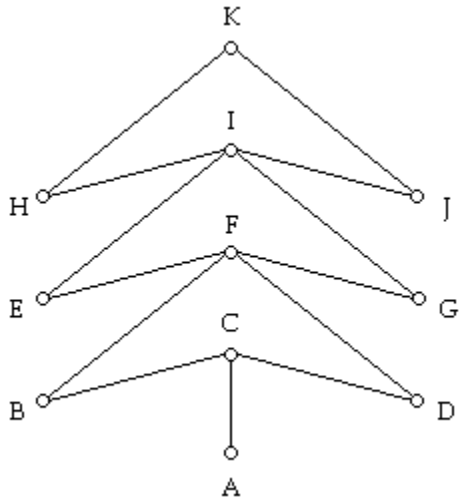
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12) Calculate the redundancy of the following network. 12) _____



A) 4 B) 8 C) 12 D) 10 E) 7

13) Calculate the redundancy of the following network. 13) _____



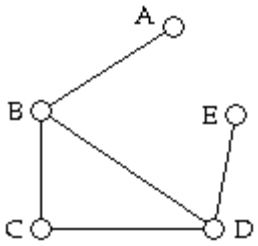
A) 2 B) 6 C) 4 D) 7 E) 3

14) The difference in length between the minimum spanning tree and the shortest network is 14) _____

A) 0.
B) always less than 5%.
C) always greater than 0.
D) always less than 13.4%.
E) none of these

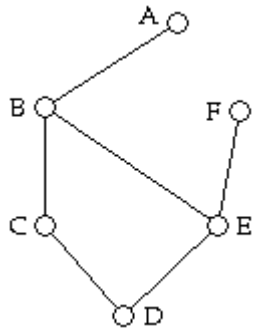
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15) Any spanning tree of the following network contains 15) _____



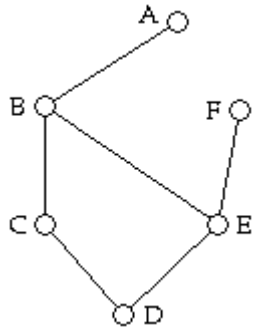
A) edges AB, BC, CD, and DE.
B) edge BD.
C) each edge of the graph.
D) edges AB and DE.
E) none of these

16) Every spanning tree of the following network contains edge 16) _____



A) BC
B) DE
C) CD
D) BE
E) none of these

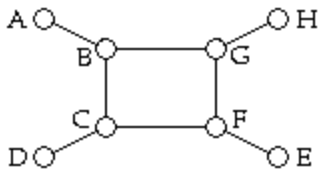
17) How many spanning trees does the following network have? 17) _____



A) 8
B) 3
C) 5
D) 4
E) none of these

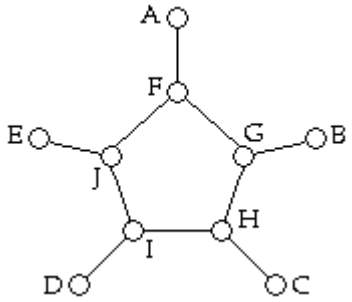
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18) How many spanning trees does the following network have? 18) _____



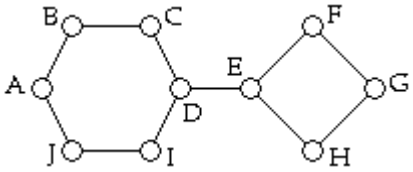
A) 2
B) 4
C) 3
D) 1
E) none of these

19) How many spanning trees does the following network have? 19) _____



A) 5
B) 4
C) 6
D) 7
E) none of these

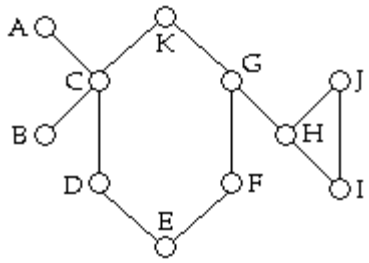
20) How many spanning trees does the following network have? 20) _____



A) 24
B) 25
C) 15
D) 23
E) none of these

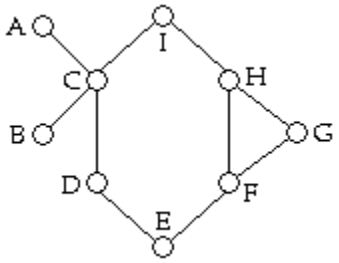
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21) How many spanning trees does the following network have? 21) _____



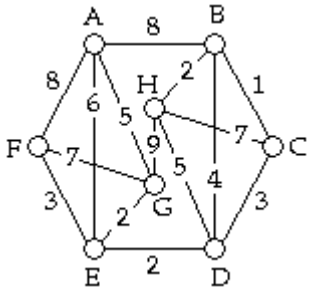
A) 17
B) 19
C) 10
D) 18
E) none of these

22) How many spanning trees does the following network have? 22) _____



A) 19
B) 17
C) 10
D) 18
E) none of these

New telephone lines must be installed to connect 8 cities (A, B, C, D, E, F, G, and H). Due to government regulations, the only possible connections that are allowed are shown by the edges on the network below. The numbers on the edges indicate the cost (in millions of dollars) of each possible connection. The telephone company wishes to connect the cities in the cheapest possible way.



23) The degree of vertex E in the minimal spanning tree is 23) _____

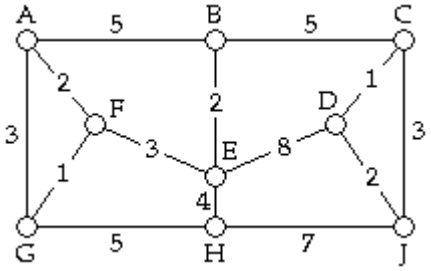
A) 2.
B) 4.
C) 1.
D) 3.
E) all of these will be directly connected.

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24) The total cost of the optimal solution to this problem is 24) _____

A) 18 million.
B) 24 million.
C) 21 million.
D) 22 million.
E) none of these

New telephone lines must be installed to connect 9 cities (A, B, C, D, E, F, G, H and J). Due to government regulations, the only possible connections that are allowed are shown by the edges on the network below. The numbers on the edges indicate the cost (in millions of dollars) of each possible connection. The telephone company wishes to connect the cities in the cheapest possible way.



25) In an optimal solution to this problem there will not be a direct connection between 25) _____

A) B and C.
B) C and J.
C) E and H.
D) E and F.
E) all of these will be directly connected.

26) The total cost of the optimal solution to this problem is 26) _____

A) 19 million.
B) 20 million.
C) 21 million.
D) 18 million.
E) none of these

27) The number of bridges in the optimal solution to this problem is 27) _____

A) 9.
B) 8.
C) 10.
D) 0.
E) none of these

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Use the mileage chart shown below to find the minimum spanning tree for the 6 cities of Atlanta, Dallas, Denver, Houston, Kansas City, and Memphis.

	Atlanta	Dallas	Denver	Houston	Kansas City	Memphis
Atlanta	*	795	1398	789	798	371
Dallas	795	*	781	243	489	452
Denver	1398	781	*	1019	600	1040
Houston	789	243	1019	*	710	561
Kansas City	798	489	600	710	*	451
Memphis	371	452	1040	561	451	*

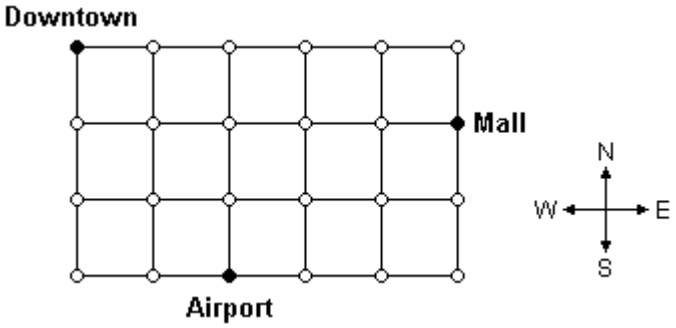
28) Using Kruskal's algorithm which edge is chosen third? 28) _____

A) Kansas City – Denver.
B) Memphis – Atlanta.
C) Memphis – Dallas.
D) Kansas City – Memphis.
E) none of these

29) The length of the minimum spanning tree connecting the 6 cities is 29) _____

A) 2227 miles.
B) 2134 miles.
C) 2117 miles.
D) 2573 miles.
E) none of these

Middletown is designing a new high–speed rail system to connect Downtown, the Airport, and the Mall. The elevated tracks for the rail system will run along the existing roads, that run on a grid as shown below. In addition, a central switching station must be located at one of the intersections.

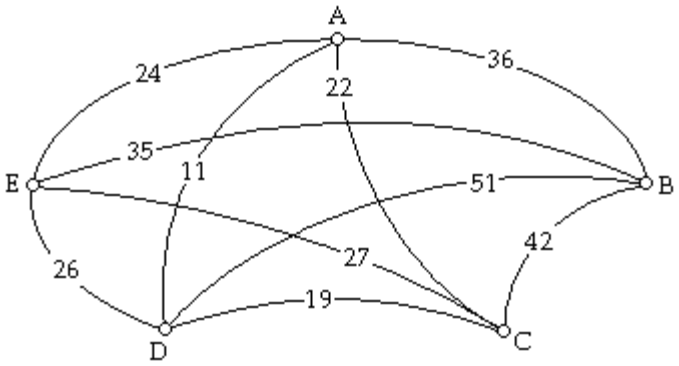


30) Where is the optimal location for the switching station? 30) _____

A) One block north of the Mall.
B) Two blocks north of the Airport.
C) Two blocks east of Downtown.
D) One block north and one block east of the Airport.
E) none of these

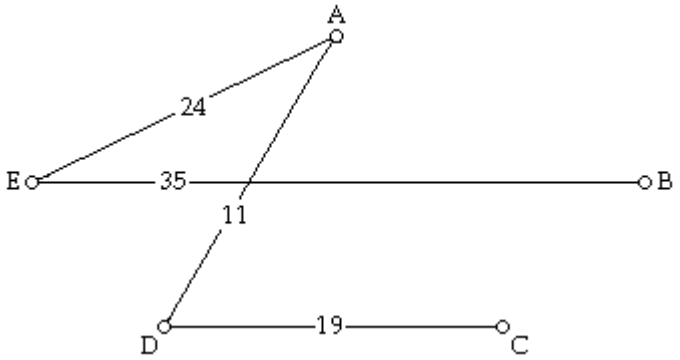
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The question(s) that follow refer to the problem of finding the minimum spanning tree for the weighted network shown below.

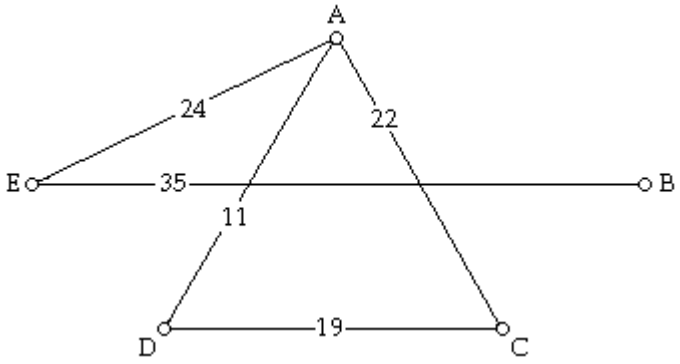


31) Find the MST of the network using Kruskal's algorithm. 31) _____

A)

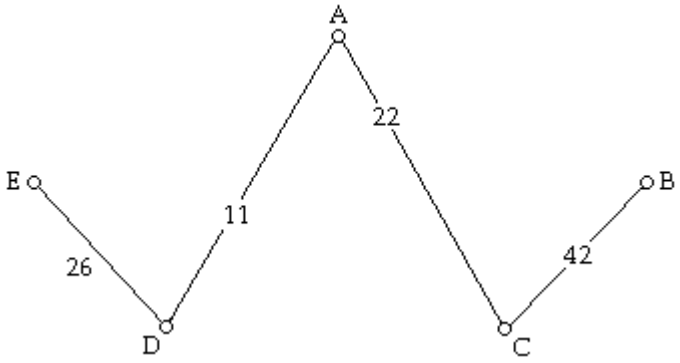


B)



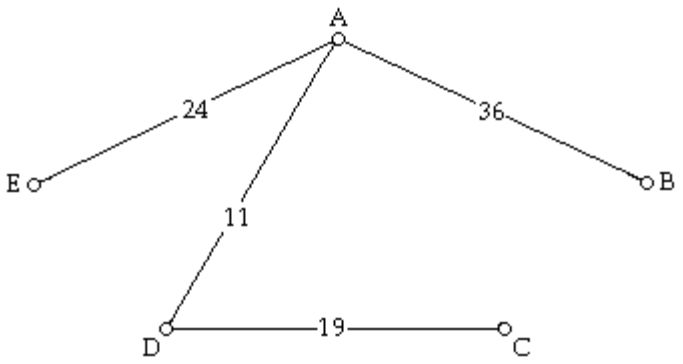
C) none of these

D)

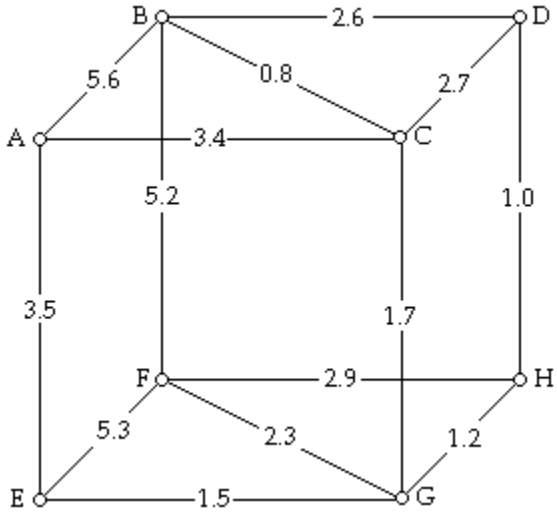


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E)



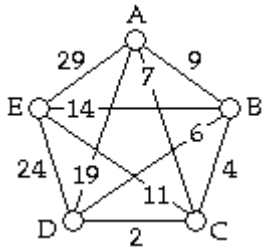
The question(s) that follow refer to the problem of finding the minimum spanning tree for the weighted network shown below.



32) Give the weight of the MST. 32) _____

A) 12.5 B) 11.9 C) 12.8 D) 11.3 E) 10.8

The question(s) that follow refer to the problem of finding the minimum spanning tree for the weighted network shown below.



33) Using Kruskal's algorithm, which edge should we choose third? 33) _____

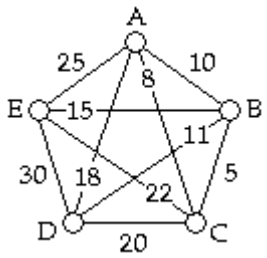
A) BD
B) CD
C) BC
D) AC
E) none of these

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34) Which of the following edges of the given network are not part of the minimum spanning tree? 34) _____

A) CD
B) AC
C) BD
D) BC
E) none of these

The question(s) that follow refer to the problem of finding the minimum spanning tree for the weighted network shown below.



35) Using Kruskal's algorithm, which edge should we choose first? 35) _____

A) EA
B) AC
C) ED
D) BC
E) none of these

36) Using Kruskal's algorithm, which edge should we choose second? 36) _____

A) CD
B) BD
C) AC
D) AB
E) none of these

37) Using Kruskal's algorithm, which edge should we choose third? 37) _____

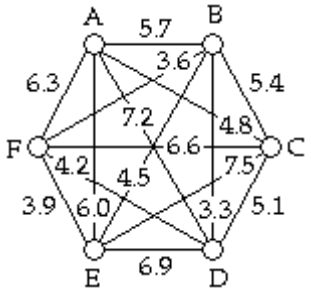
A) BD
B) AC
C) AB
D) CD
E) none of these

38) The total weight of the minimum spanning tree is 38) _____

A) 34.
B) 60.
C) 49.
D) 39.
E) none of these

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The question(s) that follow refer to the problem of finding the minimum spanning tree for the weighted network shown below.



39) Using Kruskal's algorithm, which edge should we choose second? 39) _____

A) EF
B) BF
C) DF
D) BD
E) none of these

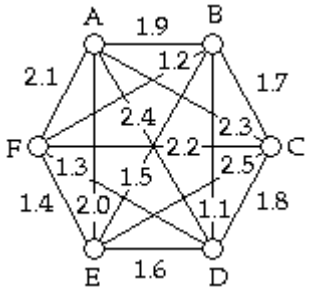
40) Using Kruskal's algorithm, which edge should we choose third? 40) _____

A) EF
B) BD
C) BF
D) DF
E) none of these

41) Which of the following edges of the given network are not part of the minimum spanning tree? 41) _____

A) EF
B) DF
C) CD
D) AC
E) none of these

The question(s) that follow refer to the problem of finding the minimum spanning tree for the weighted network shown below.



42) Using Kruskal's algorithm, which edge should we choose first? 42) _____

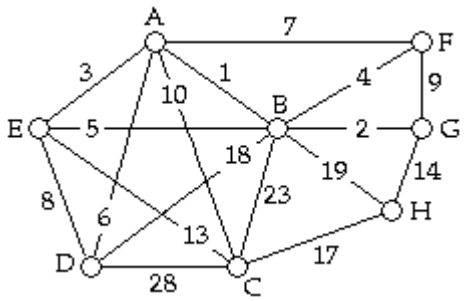
A) AB
B) BD
C) BF
D) AE
E) none of these

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43) What is the total weight of the minimum spanning tree? 43) _____

A) 7.7
B) 8.2
C) 10.5
D) 7.3
E) none of these

The question(s) that follow refer to the problem of finding the minimum spanning tree for the weighted network shown below.



44) Using Kruskal's algorithm, which edge should we choose first? 44) _____

A) BG
B) AE
C) GH
D) AB
E) none of these

45) Using Kruskal's algorithm, which edge should we choose third? 45) _____

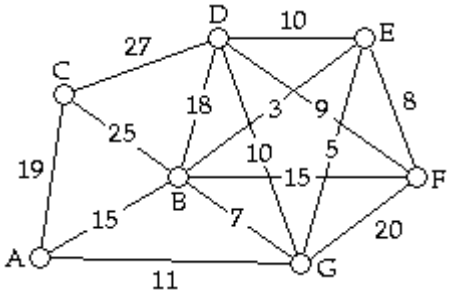
A) BG
B) AB
C) GH
D) AE
E) none of these

46) The total weight of the minimum spanning tree is 46) _____

A) 74.
B) 44.
C) 36.
D) 80.
E) none of these

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The question(s) that follow refer to the problem of finding the minimum spanning tree for the weighted network shown below.



47) Using Kruskal's algorithm, which edge should we choose first? 47) _____

A) EG
B) AG
C) AB
D) BE
E) none of these

48) The total weight of the minimum spanning tree is 48) _____

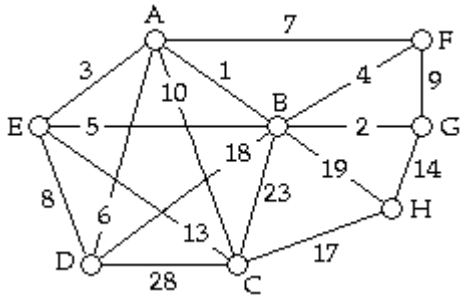
A) 55.
B) 36.
C) 95.
D) 42.
E) none of these

Solve the problem.

49) Which of the following statements is true about Kruskal's algorithm. 49) _____

A) It is an efficient algorithm, but it doesn't always give the minimum spanning tree.
B) It is an efficient algorithm, and it always gives the minimum spanning tree.
C) It is an inefficient algorithm, and it never gives the minimum spanning tree.
D) It is an inefficient algorithm, but it always gives the minimum spanning tree.
E) none of these

The question(s) that follow refer to the problem of finding the minimum spanning tree for the weighted network shown below.



50) The total weight of the maximum spanning tree is 50) _____

A) 132.
B) 124.
C) 40.
D) 116.
E) none of these

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1) D
2) B
3) A
4) D
5) D
6) C
7) D
8) B
9) E
10) E
11) D
12) D
13) E
14) D
15) D
16) E
17) D
18) B
19) A
20) A
21) D
22) B
23) D
24) A
25) B
26) B
27) B
28) D
29) C
30) B
31) A
32) B
33) D
34) C
35) D
36) C
37) A
38) D
39) B
40) A
41) B
42) B
43) D
44) D
45) D
46) B
47) D
48) A
49) B
50) D

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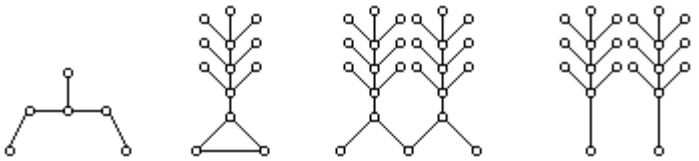
Chapter 7

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

1) Which of the following four graphs is a tree? 1) _____



Graph 1 Graph 2 Graph 3 Graph 4

A) Graph 2 and Graph 3
B) Graph 1 and Graph 3
C) Graph 2 and Graph 4
D) Graph 1 and Graph 4
E) none of these

2) A tree is 2) _____

A) any graph with one component.
B) any graph that is connected and has no circuits.
C) any graph that has no bridges.
D) any graph that has no circuits.
E) none of these

3) The number of edges in a tree with 49 vertices is 3) _____

A) 2^{49}.
B) 50.
C) 49.
D) 48.
E) none of these

4) The number of edges in a tree with 57 vertices is 4) _____

A) 2^{57}.
B) 57.
C) 56.
D) 58.
E) none of these

5) The number of vertices in a tree with 49 edges is 5) _____

A) 48.
B) 2^{49}.
C) 49.
D) 50.
E) none of these

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6) Assume that G is a graph with no loops or multiple edges. Which of the following graphs G are definitely trees? 6) _____

A) G has 14 vertices and there is exactly one path from any vertex to any other vertex.
B) G has 14 vertices, is connected, and every edge in G is a bridge.
C) G has 14 vertices, 13 edges, and no circuits.
D) all of these are trees.
E) none of these are trees.

7) Assume that G is a graph with no loops or multiple edges. It is known that G has 5 vertices, 4 edges, and that the degree of each vertex is either 1 or 2. What can be said about G? 7) _____

A) G is not a tree.
B) G could be a tree.
C) G is a tree.
D) G has 4 bridges.
E) none of these

8) Suppose G is a graph with 39 vertices and 38 edges. Then 8) _____

A) G cannot have more than one path joining any two vertices.
B) G must be a tree.
C) G cannot have any circuits.
D) G is either a tree or it is not connected.
E) none of these

9) A graph has 37 vertices and has the property that there is one and only one path joining any two vertices of the graph. Which of the statements [A), B), C), or D)] is not true? 9) _____

A) G must be connected.
B) Every edge of the graph must be a bridge.
C) G must have 36 edges.
D) G cannot have any circuits.
E) all of these statements are true.

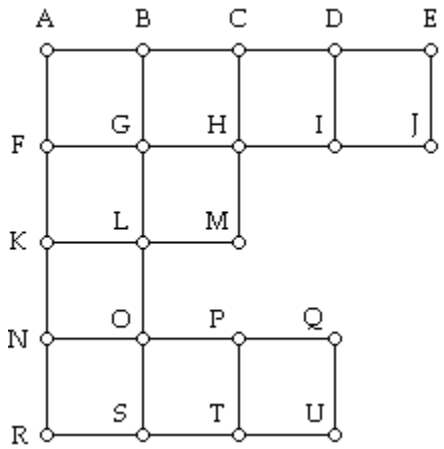
10) A graph G has 42 vertices and has the property that there is one and only one path joining any two vertices of the graph. Which of the following statements [A), B), C), or D)] is not true? 10) _____

A) G must have 41 edges.
B) Every edge of the graph must be a bridge.
C) G cannot have any circuits.
D) G must be connected.
E) all of these statements are true.

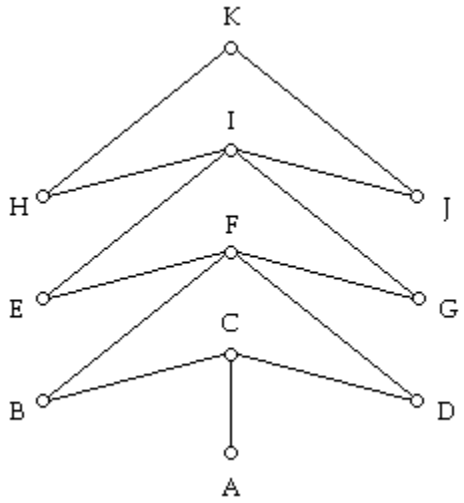
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SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

11) Calculate the redundancy of the following network. 11) _____



12) Calculate the redundancy of the following network. 12) _____



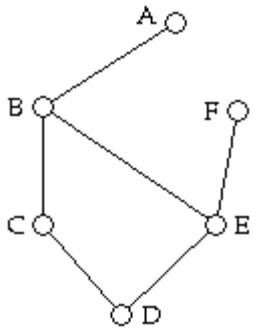
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

13) The difference in length between the minimum spanning tree and the shortest network is 13) _____

A) 0.
B) always less than 5%.
C) always greater than 0.
D) always less than 13.4%.
E) none of these

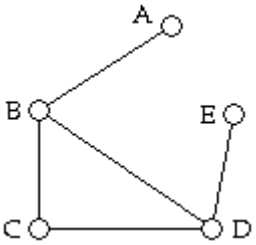
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14) Every spanning tree of the following network contains edge 14) _____



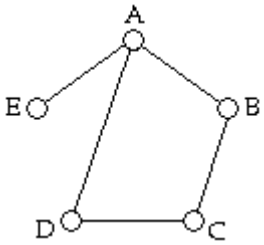
A) DE
B) BE
C) CD
D) BC
E) none of these

15) How many spanning trees does the following network have? 15) _____



A) 8
B) 4
C) 3
D) 5
E) none of these

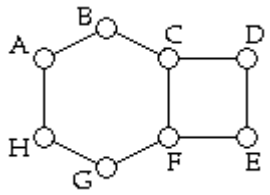
16) How many spanning trees does the following network have? 16) _____



A) 5
B) 4
C) 8
D) 3
E) none of these

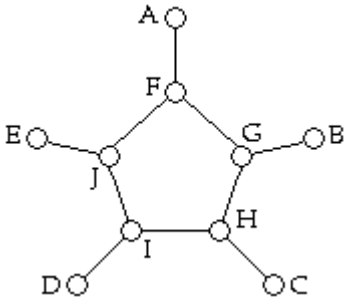
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17) How many spanning trees does the following network have? 17) _____



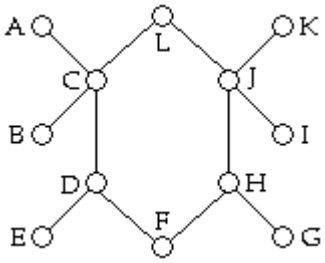
A) 25
B) 15
C) 23
D) 24
E) none of these

18) How many spanning trees does the following network have? 18) _____



A) 6
B) 4
C) 5
D) 7
E) none of these

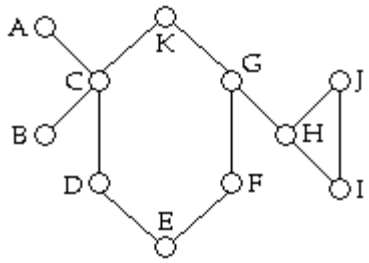
19) How many spanning trees does the following network have? 19) _____



A) 4
B) 7
C) 6
D) 5
E) none of these

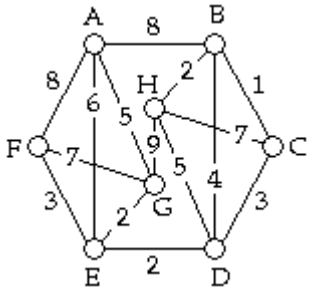
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20) How many spanning trees does the following network have? 20) _____



A) 18
B) 17
C) 19
D) 10
E) none of these

New telephone lines must be installed to connect 8 cities (A, B, C, D, E, F, G, and H). Due to government regulations, the only possible connections that are allowed are shown by the edges on the network below. The numbers on the edges indicate the cost (in millions of dollars) of each possible connection. The telephone company wishes to connect the cities in the cheapest possible way.



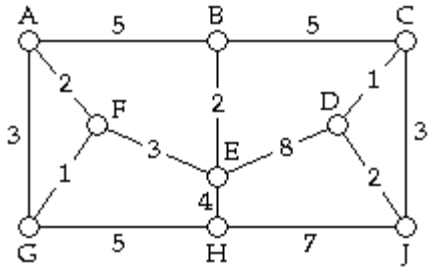
21) The degree of vertex E in the minimal spanning tree is 21) _____
A) 4.
B) 1.
C) 3.
D) 2.
E) all of these will be directly connected.

22) The total cost of the optimal solution to this problem is 22) _____
A) 18 million.
B) 22 million.
C) 24 million.
D) 21 million.
E) none of these

23) The number of bridges in the optimal solution to this problem is 23) _____
A) 8.
B) 0.
C) 9.
D) 7.
E) none of these

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New telephone lines must be installed to connect 9 cities (A, B, C, D, E, F, G, H and J). Due to government regulations, the only possible connections that are allowed are shown by the edges on the network below. The numbers on the edges indicate the cost (in millions of dollars) of each possible connection. The telephone company wishes to connect the cities in the cheapest possible way.



24) Using Kruskal's algorithm, which edge is chosen last? 24) _____

A) BC
B) AB
C) EH
D) DE
E) none of these

25) Using Kruskal's algorithm, which edge is chosen second to last? 25) _____

A) DE
B) EH
C) BC
D) AB
E) none of these

26) In an optimal solution to this problem there will not be a direct connection between 26) _____

A) E and H.
B) E and F.
C) C and J.
D) B and C.
E) all of these will be directly connected.

27) The number of bridges in the optimal solution to this problem is 27) _____

A) 0.
B) 10.
C) 9.
D) 8.
E) none of these

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Use the mileage chart shown below to find the minimum spanning tree for the 5 cities of Boston, Buffalo, Chicago, Columbus, and Louisville.

	Boston	Buffalo	Chicago	Columbus	Louisville
Boston	*	446	963	735	941
Buffalo	446	*	522	326	532
Chicago	963	522	*	308	292
Columbus	735	326	308	*	209
Louisville	941	532	292	209	*

28) The length of the minimum spanning tree connecting the cities of Boston, Buffalo, Chicago, Columbus, and Louisville is 28) _____

A) 2236 miles.
B) 1135 miles.
C) 1795 miles.
D) 1273 miles.
E) none of these

Use the mileage chart shown below to find the minimum spanning tree for the 6 cities of Atlanta, Dallas, Denver, Houston, Kansas City, and Memphis.

	Atlanta	Dallas	Denver	Houston	Kansas City	Memphis
Atlanta	*	795	1398	789	798	371
Dallas	795	*	781	243	489	452
Denver	1398	781	*	1019	600	1040
Houston	789	243	1019	*	710	561
Kansas City	798	489	600	710	*	451
Memphis	371	452	1040	561	451	*

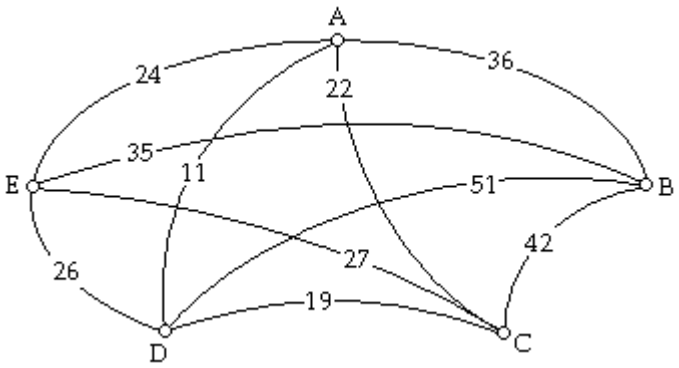
29) Using Kruskal's algorithm which edge is chosen last? 29) _____

A) Kansas City – Memphis.
B) Kansas City – Denver.
C) Memphis – Dallas.
D) Memphis – Denver.
E) none of these

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SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

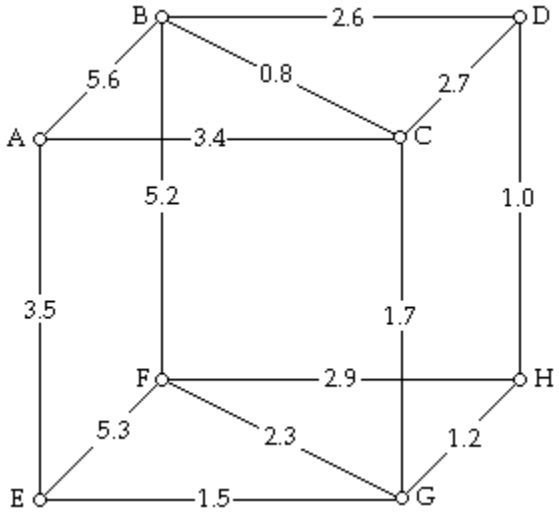
The question(s) that follow refer to the problem of finding the minimum spanning tree for the weighted network shown below.



30) Give the weight of the MST. 30) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

The question(s) that follow refer to the problem of finding the minimum spanning tree for the weighted network shown below.

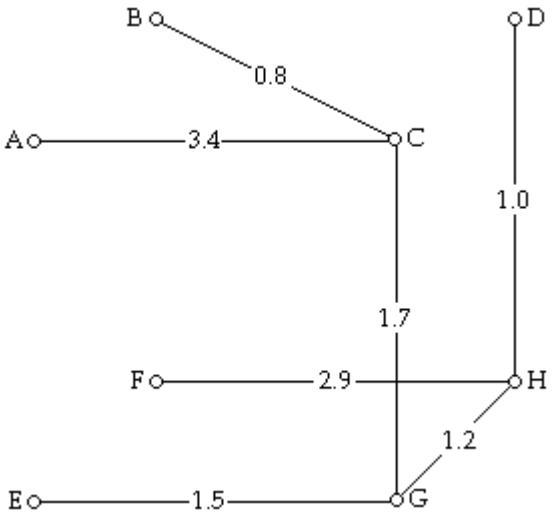


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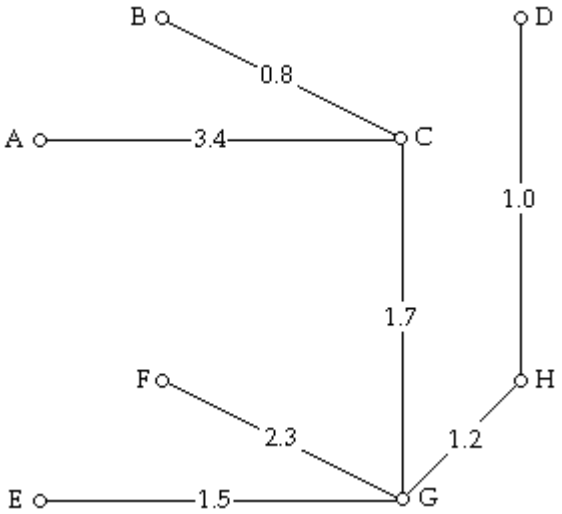
31) Find the MST of the network using Kruskal's algorithm. 31) _____

A) none of these

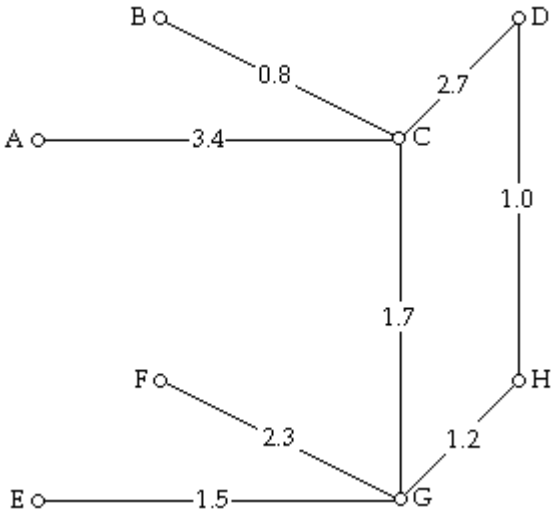
B)



C)

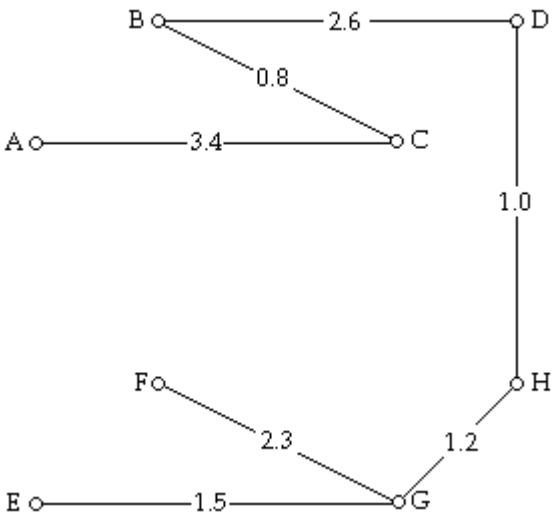


D)

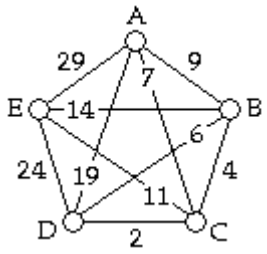


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E)



The question(s) that follow refer to the problem of finding the minimum spanning tree for the weighted network shown below.



32) Using Kruskal's algorithm, which edge should we choose first? 32) _____

A) CD
B) BD
C) BC
D) AC
E) none of these

33) Using Kruskal's algorithm, which edge should we choose second? 33) _____

A) BC
B) CD
C) BD
D) AC
E) none of these

34) Using Kruskal's algorithm, which edge should we choose third? 34) _____

A) BC
B) AC
C) BD
D) CD
E) none of these

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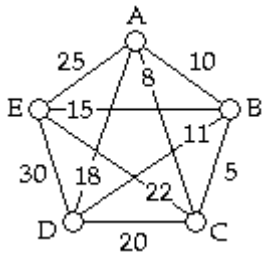
35) Which of the following edges of the given network are not part of the minimum spanning tree? 35) _____

A) AC
B) BD
C) BC
D) CD
E) none of these

36) The total weight of the minimum spanning tree is 36) _____

A) 26.
B) 68.
C) 24.
D) 125.
E) none of these

The question(s) that follow refer to the problem of finding the minimum spanning tree for the weighted network shown below.



37) Using Kruskal's algorithm, which edge should we choose first? 37) _____

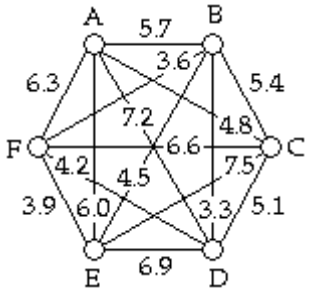
A) BC
B) ED
C) AC
D) EA
E) none of these

38) Which of the following edges of the given network are not part of the minimum spanning tree? 38) _____

A) EB
B) AC
C) AB
D) BD
E) none of these

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The question(s) that follow refer to the problem of finding the minimum spanning tree for the weighted network shown below.



39) Using Kruskal's algorithm, which edge should we choose third? 39) _____

A) DF
B) BF
C) BD
D) EF
E) none of these

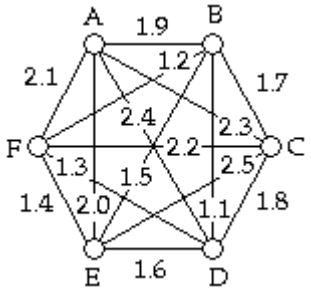
40) Using Kruskal's algorithm which edge should we choose fourth? 40) _____

A) BE
B) DF
C) BF
D) AC
E) none of these

41) What is the total weight of the minimum spanning tree? 41) _____

A) 20.7
B) 21.0
C) 20.1
D) 20.4
E) none of these

The question(s) that follow refer to the problem of finding the minimum spanning tree for the weighted network shown below.



42) Using Kruskal's algorithm, which edge should we choose second? 42) _____

A) AB
B) BF
C) BD
D) AE
E) none of these

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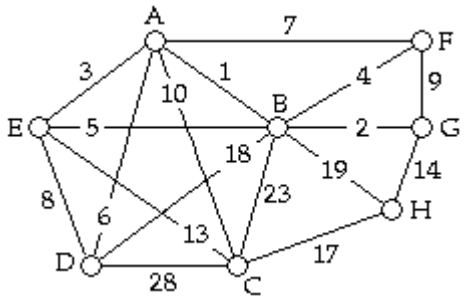
43) Which of the following edges of the given network are not part of the minimum spanning tree? 43) _____

A) BC
B) DF
C) AB
D) EF
E) none of these

44) What is the total weight of the minimum spanning tree? 44) _____

A) 7.7
B) 10.5
C) 7.3
D) 8.2
E) none of these

The question(s) that follow refer to the problem of finding the minimum spanning tree for the weighted network shown below.



45) Using Kruskal's algorithm, which edge should we choose first? 45) _____

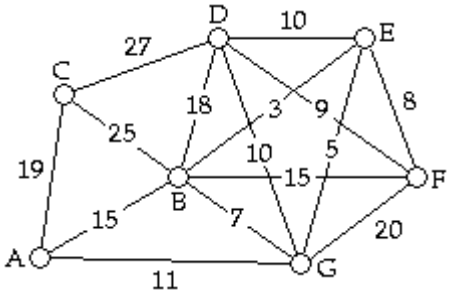
A) AB
B) GH
C) AE
D) BG
E) none of these

46) The total weight of the minimum spanning tree is 46) _____

A) 80.
B) 44.
C) 36.
D) 74.
E) none of these

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The question(s) that follow refer to the problem of finding the minimum spanning tree for the weighted network shown below.



47) Using Kruskal's algorithm, which edge should we choose last? 47) _____

A) CD
B) AC
C) BC
D) none of these
E) AB

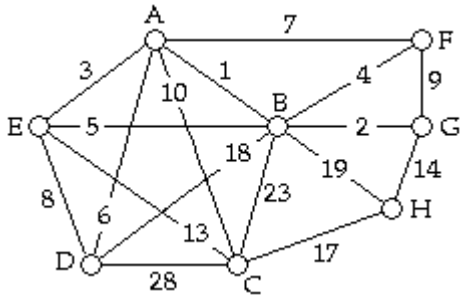
48) Which of the following edges of the given network are not part of the minimum spanning tree? 48) _____

A) AC
B) AG
C) BG
D) EF
E) none of these

49) The total weight of the minimum spanning tree is 49) _____

A) 36.
B) 95.
C) 42.
D) 55.
E) none of these

The question(s) that follow refer to the problem of finding the minimum spanning tree for the weighted network shown below.



50) The total weight of the maximum spanning tree is 50) _____

A) 40.
B) 132.
C) 124.
D) 116.
E) none of these

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1) B
2) B
3) D
4) C
5) D
6) D
7) B
8) D
9) E
10) E
11) 10
12) 3
13) D
14) E
15) C
16) B
17) C
18) C
19) C
20) A
21) C
22) A
23) D
24) A
25) B
26) C
27) D
28) D
29) B
30) 89
31) C
32) A
33) A
34) B
35) B
36) C
37) A
38) C
39) D
40) D
41) A
42) B
43) B
44) C
45) A
46) B
47) B
48) C
49) D
50) D

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Chapter 8

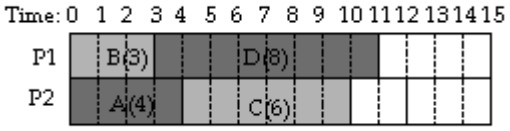
Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

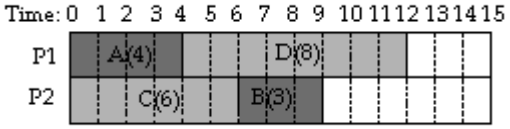
Answer the question about scheduling.

1) Two coworkers are working on a project that can be broken down into 4 tasks: Task A takes 4 hours, task B takes 3 hours, task C takes 6 hours, and task D takes 8 hours. The only precedence relation is that task B must be completed before starting task C. If the coworkers can work on separate tasks, what is the optimal schedule for these tasks? 1) _____

A)



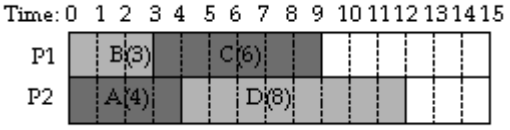
B)



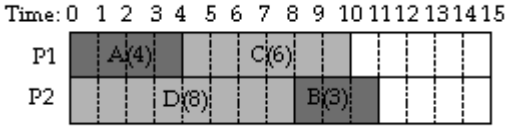
C)



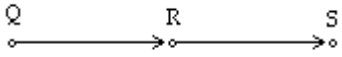
D)



E)



2) Describe the following precedence relation in words. 2) _____



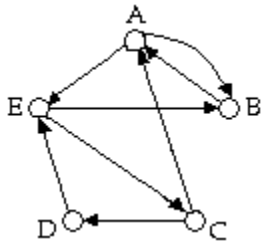
A) Task S precedes task R, which precedes task Q.
B) Task Q precedes task R, task R precedes task S, and tasks Q and S are independent.
C) Task Q precedes task R, which precedes task S.
D) Task S precedes task Q.
E) Tast R precedes task Q.

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3) A prerequisite indicating that a task cannot be started before another task is complete is called a _____ . 3) _____

A) optimal schedule
B) processing time
C) precedence relation
D) processor
E) independent task

For the following question(s), refer to the digraph below.



4) Which of the following is not a path from vertex C to vertex E in the digraph? 4) _____

A) C, D, E
B) C, A, B, E
C) all of these are paths from C to E.
D) C, A, E
E) none of these are paths from C to E.

5) Suppose that the vertices of the digraph represent individuals and there is an arc going from vertex X to vertex Y if and only if X "likes" Y. Which of the following statements [A), B), C), or D)] is not true? 5) _____

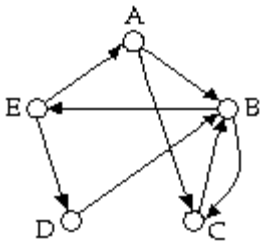
A) B likes E but E does not like B.
B) B and C do not like each other.
C) A likes B and E but does not like C or D.
D) A and B like each other.
E) all of these statements are true.

6) Suppose that the vertices of the digraph represent golfers playing in a tournament and the arcs represent Matches already played. An arc going from vertex X to vertex Y means that team X beat golfer Y. (No ties are possible in golf matches.) Which of the following statements [A), B), C), or D)] is not true? 6) _____

A) E defeated B and C but lost to A and D.
B) A and B were the only two players that played each other twice.
C) B and C were the only two players that did not play each other.
D) A played a total of 4 matches, winning 2 and losing 2.
E) all of these statements are true.

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For the following question(s), refer to the digraph below.



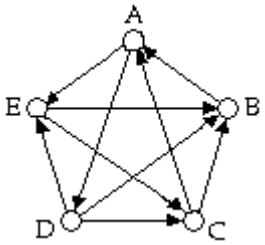
7) Vertex A has 7) _____
A) indegree 2, outdegree 1.
B) indegree 3, outdegree 0.
C) indegree 1, outdegree 2.
D) indegree 0, outdegree 3.
E) none of these

8) Vertex D is 8) _____
A) incident from vertex B only.
B) incident from vertex E only.
C) incident from vertices E and B.
D) incident from vertex C only.
E) none of these

9) Which of the following is not a path from vertex A to vertex E in the digraph? 9) _____
A) A, B, E
B) A, B, D, E
C) A, B, C, B, E
D) A, C, B, E
E) all of these are paths from A to E.

10) Suppose that the vertices of the digraph represent individuals and there is an arc going from vertex X to vertex Y if and only if X "likes" Y. Which of the following statements [A), B), C), or D)] is not true? 10) _____
A) B and C like each other.
B) C and D do not like each other.
C) E likes B but B does not like E.
D) E likes A and D but does not like B or C.
E) all of these statements are true.

For the following question(s), refer to the tournament digraph below. The vertices of the digraph represent five tennis players in a round–robin tournament. An arc XY represents the fact that X defeated Y in the tournament.



11) Which player won the tournament? 11) _____
A) A B) B C) C D) D E) E

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12) How many games were played in the tournament? 12) _____

A) 5!
B) 10
C) 32
D) 5
E) none of these

Assume you have a digraph with 5 vertices (A, B, C, D, and E) and 9 arcs. B is incident from D, E, and A; C is incident to E and A and incident from D; E is incident to D and incident from A.

13) Which of the following is not a path from vertex C to vertex B in the digraph? 13) _____

A) C, D, E, B
B) C, A, B
C) C, E, D, B
D) C, E, B
E) all of these are paths from C to B.

14) How many cycles are there in the digraph that start and end at B? 14) _____

A) 1
B) 2
C) 0
D) 3
E) none of these

15) How many cycles are there in the digraph that start and end at C? 15) _____

A) 0
B) 1
C) 3
D) 2
E) none of these

Assume you have a digraph with 5 vertices (A, B, C, D, and E) and 9 arcs. A is incident from C, D, and E; B is incident to D and E and incident from C; D is incident to C and incident from E.

16) Vertex A has 16) _____

A) indegree 3, outdegree 0.
B) indegree 0, outdegree 3.
C) indegree 2, outdegree 1.
D) indegree 1, outdegree 2.
E) none of these

17) Vertex B has 17) _____

A) indegree 0, outdegree 3.
B) indegree 2, outdegree 1.
C) indegree 1, outdegree 2.
D) indegree 3, outdegree 0.
E) none of these

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18) Which of the following is not a path from vertex B to vertex A in the digraph? 18) _____

A) B, D, C, A
B) B, C, D, A
C) B, E, A
D) B, D, A
E) all of these are paths from A to E.

19) How many cycles are there in the digraph that start and end at B? 19) _____

A) 3
B) 0
C) 1
D) 2
E) none of these

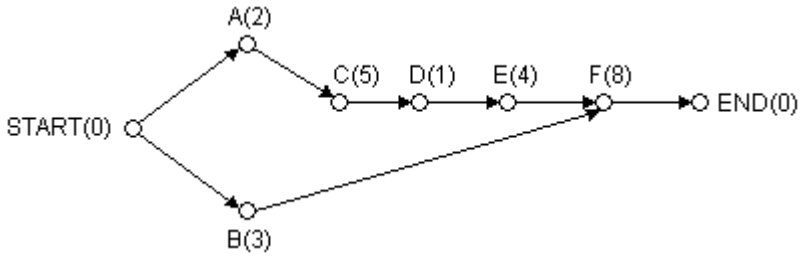
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Suppose you have the project consisting of the six tasks described in the following table.

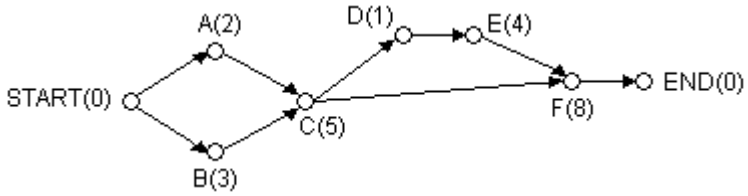
Task	Length of task (hours)	Prior tasks that must be completed
A	2	
B	3	
C	5	A, B
D	1	C
E	4	D
F	8	B

20) Which project digraph below models the project described? 20) _____

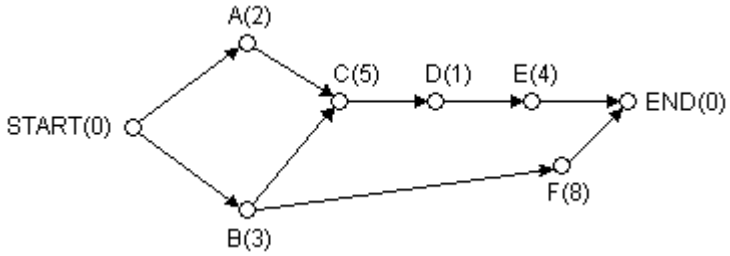
A)



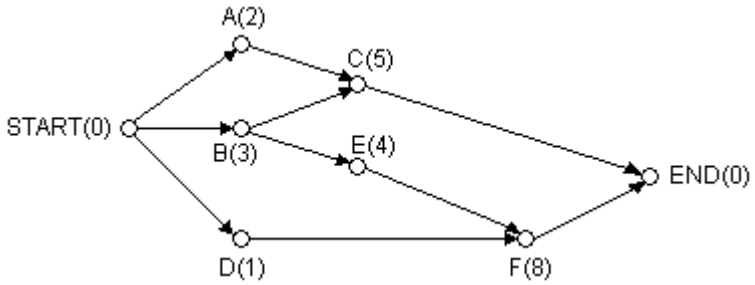
B)



C)



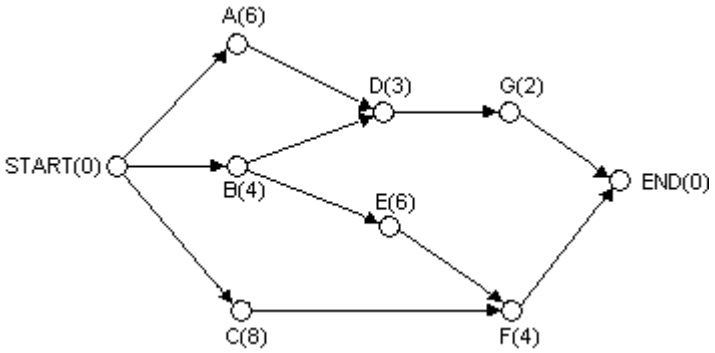
D)



E) none of these

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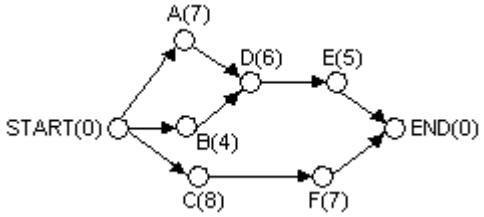
Suppose you have the following project digraph. (The numbers in parentheses represent hours.)



21) What is the number of tasks in this project? 21) _____

A) 9
B) 11
C) 7
D) 6
E) none of these

Suppose you have the following project digraph. (The numbers in parentheses represent hours.)

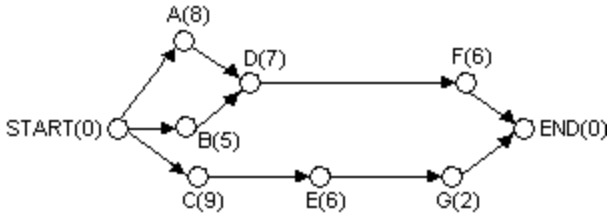


22) Using the priority list, C, F, E, B, A, D and the priority–list model to schedule this project with two processors results in a finishing time of 22) _____

A) 23 hours.
B) 18 hours.
C) 19 hours.
D) 22 hours.
E) none of these

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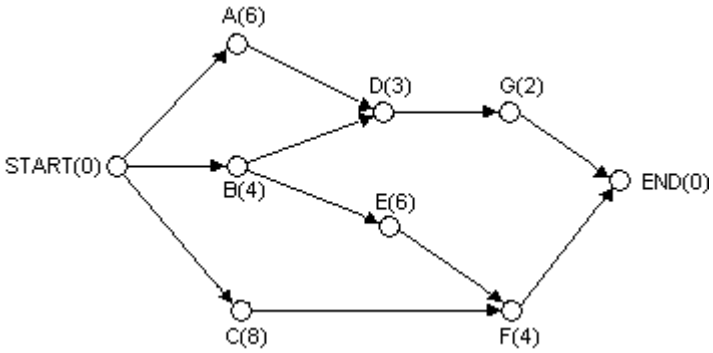
Suppose you have the following project digraph. (The numbers in parentheses represent hours.)



23) Using the priority list, C, E, G, F, B, A, D and the priority–list model to schedule this project with two processors results in a finishing time of 23) _____

A) 21 hours.
B) 22 hours.
C) 26 hours.
D) 24 hours.
E) none of these

Suppose you have the following project digraph. (The numbers in parentheses represent hours.)

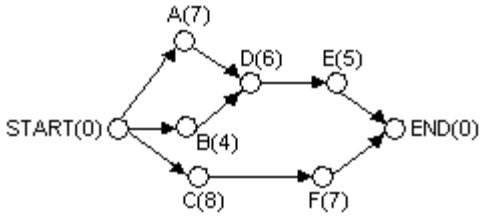


24) Using the priority list F, E, A, D, B, G, C and the priority–list model to schedule this project with two processors, the project finishing time is 24) _____

A) 22 hours.
B) 21 hours.
C) 18 hours.
D) 17 hours.
E) none of these

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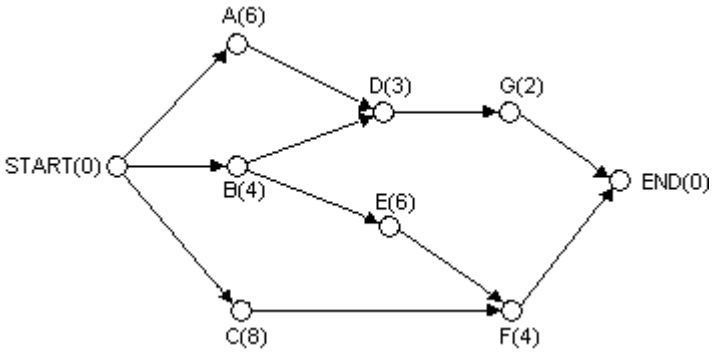
Suppose you have the following project digraph. (The numbers in parentheses represent hours.)



25) Scheduling this project with two processors results in a finishing time shorter than 22 hours using the priority list 25) _____

A) C, D, B, E, A, F.
B) C, B, A, F, E, D.
C) C, F, E, B, A, D.
D) C, F, A, B, D, E.
E) none of these

Suppose you have the following project digraph. (The numbers in parentheses represent hours.)



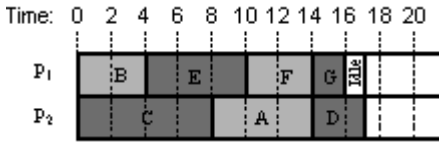
26) If we use the priority list F, E, A, D, B, G, C and the priority-list model to schedule this project with two processors, we should start by assigning 26) _____

A) task B to one processor, task E to the other one.
B) task A to one processor, task C to the other one.
C) task A to one processor, task B to the other one.
D) task B to one processor, task C to the other one.
E) none of these

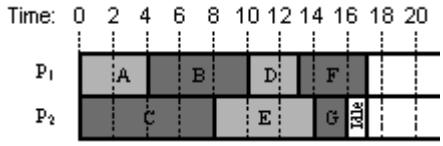
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27) If we use the priority list F, E, A, D, B, G, C and the priority-list model to schedule this project with two processors, the project timeline is 27) _____

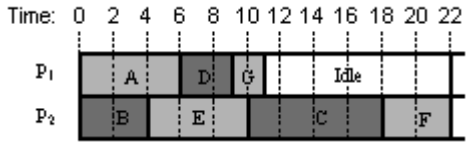
A)



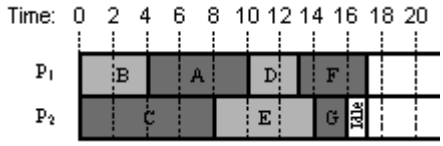
B)



C)

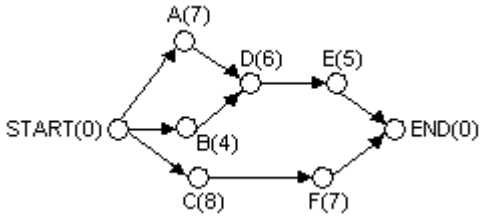


D)



E) none of these

Suppose you have the following project digraph. (The numbers in parentheses represent hours.)

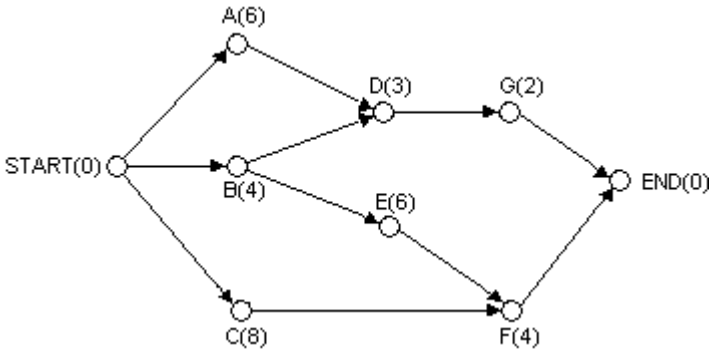


28) Using the decreasing-time algorithm to schedule this project with two processors results in a completion time of 28) _____

A) 23 hours.
B) 22 hours.
C) 19 hours.
D) 18 hours.
E) none of these

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Suppose you have the following project digraph. (The numbers in parentheses represent hours.)



29) If we use decreasing–time algorithm to schedule this project with two processors, we should start by assigning 29) _____

A) task B to one processor, task E to the other one.
B) task A to one processor, task B to the other one.
C) task A to one processor, task C to the other one.
D) task B to one processor, task C to the other one.
E) none of these

Solve the problem.

30) Use the decreasing–time algorithm to schedule 8 independent tasks having lengths 1, 3, 4, 7, 11, 18, 29, and 47 hours using two processors. How much idle time is in the resulting schedule? 30) _____

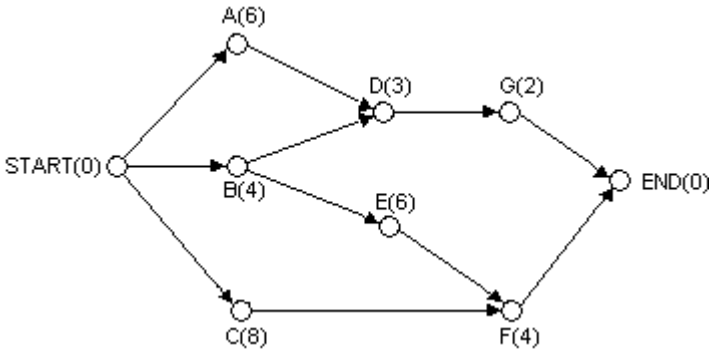
A) 1 hour
B) 2 hours
C) 0 hours
D) 3 hours
E) none of these

31) The decreasing–time algorithm is 31) _____

A) an approximate and efficient algorithm.
B) an optimal and inefficient algorithm.
C) an approximate and inefficient algorithm.
D) an optimal and efficient algorithm.
E) none of these

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Suppose you have the following project digraph. (The numbers in parentheses represent hours.)

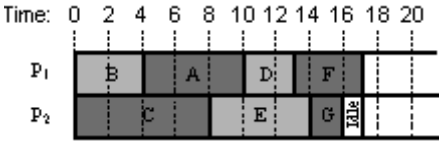


32) Consider the following timeline using three processors. 32) _____



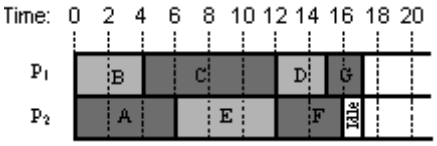
A) This timeline is not an optimal schedule because the project can be scheduled with a finishing time of 11 hours.
B) This timeline is an optimal schedule for three processors.
C) This timeline is an illegal schedule because task E was started before task C was completed.
D) This timeline is an illegal schedule because task F was started before task E was completed.
E) none of these

33) Consider the following timeline using two processors. 33) _____



A) This timeline is an illegal schedule.
B) This is the timeline one gets using the critical-path algorithm.
C) This is the timeline one gets using the decreasing-time algorithm.
D) This timeline is an optimal schedule.
E) none of these

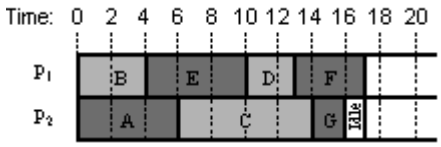
34) Consider the following timeline using two processors. 34) _____



A) This timeline is an optimal schedule.
B) This is the timeline one gets using the decreasing-time algorithm.
C) This timeline is an illegal schedule.
D) This is the timeline one gets using the critical-path algorithm.
E) none of these

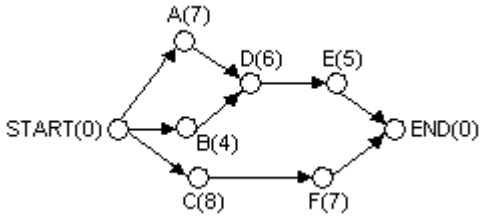
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35) Consider the following timeline using two processors. 35) _____



A) This timeline is an optimal schedule.
B) This is the timeline one gets using the critical–path algorithm.
C) This timeline is an illegal schedule.
D) This is the timeline one gets using the decreasing–time algorithm.
E) none of these

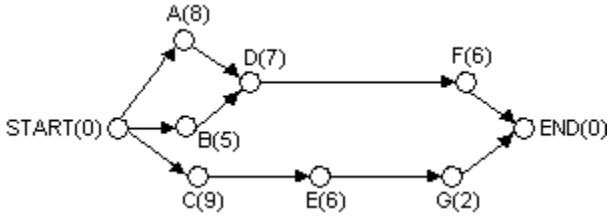
Suppose you have the following project digraph. (The numbers in parentheses represent hours.)



36) The length of the critical path from C is 36) _____
A) 12 hours.
B) 15 hours.
C) 20 hours.
D) 7 hours.
E) none of these

37) Using the critical–path algorithm to schedule this project with six processors results in a finishing time of 37) _____
A) 23 hours.
B) 22 hours.
C) 19 hours.
D) 18 hours.
E) none of these

Suppose you have the following project digraph. (The numbers in parentheses represent hours.)



38) The length of the critical path from B is 38) _____
A) 18 hours.
B) 13 hours.
C) 21 hours.
D) 5 hours.
E) none of these

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39) The length of the critical path for the entire project is 39) _____

A) 18 hours.
B) 26 hours.
C) 17 hours.
D) 21 hours.
E) none of these

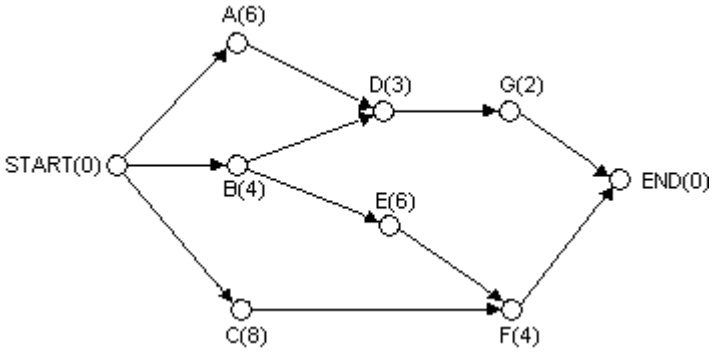
Suppose you have the project consisting of the six tasks described in the following table.

Task	Length of task (hours)	Prior tasks that must be completed
A	2	
B	3	
C	5	A, B
D	1	C
E	4	D
F	8	B

40) The critical path list for this project is given by 40) _____

A) F[8], E[12], D[13], C[18], B[21], A[23]
B) A[2], B[3], C[5], F[8], D[1], E[4]
C) A[23], B[21], C[18], D[13], E[12], F[8]
D) A[12], B[11], C[10], F[8], D[5], E[4]
E) none of these

Suppose you have the following project digraph. (The numbers in parentheses represent hours.)



41) If we use the critical–path algorithm to schedule this project with two processors, we should start by assigning 41) _____

A) task B to one processor, task C to the other one.
B) task A to one processor, task B to the other one.
C) task A to one processor, task C to the other one.
D) task B to one processor, task E to the other one.
E) none of these

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42) Using the critical–path algorithm to schedule this project with two processors, the project finishing time is 42) _____
A) 18 hours.
B) 20 hours.
C) 19 hours.
D) 17 hours.
E) none of these

43) Using the critical–path algorithm to schedule this project with two processors, the total combined idle time of the two processors is 43) _____
A) 1 hour.
B) 3 hours.
C) 7 hours.
D) 5 hours.
E) none of these

Solve the problem.

44) Consider a project consisting of nine tasks (A through I) with the following processing times (in hours): A(10), B(7), C(5), D(3), E(6), F(4), G(8), H(7), and I(4). If a schedule with three processors has a finishing time of 22 hours, what is the total idle time in the schedule? 44) _____
A) 16 hours.
B) 10 hours.
C) 12 hours.
D) 14 hours.
E) none of these

45) Which of the following always produces an optimal schedule to the general scheduling problem? 45) _____
A) The decreasing–time algorithm.
B) The backflow algorithm.
C) The brute–force algorithm.
D) The critical–path algorithm.
E) none of these

A project consists of seven independent tasks with processing times (in hours) given by 4, 5, 6, 7, 8, 9, and 12.

46) Find the project finishing time Fin for N = 2 processors using the critical–path algorithm. 46) _____
A) Fin = 28 hours
B) Fin = 21 hours
C) Fin = 27 hours
D) Fin = 25 hours
E) Fin = 26 hours

47) Find the optimal finishing time Opt for N = 2 processors. 47) _____
A) Opt = 23 hours
B) Opt = 26 hours
C) Opt = 27 hours
D) Opt = 25 hours
E) Opt = 24 hours

48) Compute the relative error of the critical–path schedule expressed as a percent. 48) _____
A) 4.4% B) 3.8% C) 5% D) 2.5% E) 5.3%

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A project consists of seven independent tasks with processing times (in hours) given by 3, 4, 4, 5, 7, 7, and 11.

49) Find the finishing time Fin for N = 3 processors using the critical–path algorithm. 49) _____

A) Fin = 14 hours
B) Fin = 15 hours
C) Fin = 12 hours
D) Fin = 11 hours
E) Fin = 16 hours

Solve the problem.

50) The following nine tasks (with completion times given in hours) are all independent: A(4), B(7), C(5), D(3), E(6), F(4), G(1), H(2), and I(4). Using the critical–path algorithm to schedule this project with four processors results in a finishing time of 50) _____

A) 8 hours.
B) 10 hours.
C) 9 hours.
D) 12 hours.
E) none of these

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1) A
2) C
3) C
4) B
5) A
6) C
7) C
8) B
9) B
10) C
11) D
12) B
13) A
14) C
15) D
16) A
17) C
18) B
19) D
20) C
21) C
22) D
23) C
24) A
25) E
26) C
27) C
28) B
29) C
30) B
31) A
32) D
33) A
34) A
35) C
36) B
37) D
38) A
39) D
40) D
41) A
42) A
43) B
44) C
45) C
46) C
47) B
48) B
49) B
50) C

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Chapter 8

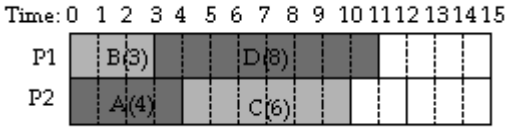
Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

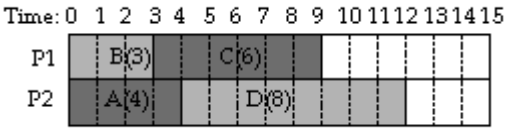
Answer the question about scheduling.

1) Two coworkers are working on a project that can be broken down into 4 tasks: Task A takes 4 hours, task B takes 3 hours, task C takes 6 hours, and task D takes 8 hours. The only precedence relation is that task B must be completed before starting task C. If the coworkers can work on separate tasks, what is the optimal schedule for these tasks? 1) _____

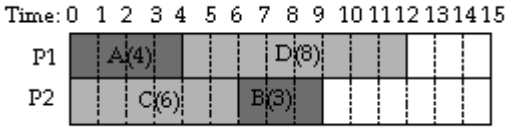
A)



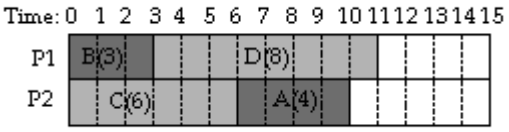
B)



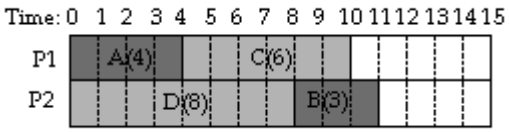
C)



D)

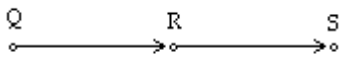


E)



SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

2) Describe the following precedence relation in words. 2) _____

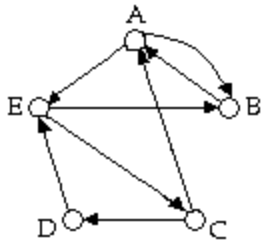


3) A prerequisite indicating that a task cannot be started before another task is complete is called a _____ . 3) _____

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MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

For the following question(s), refer to the digraph below.



4) Vertex D is 4) _____
A) incident to vertices C and E.
B) incident to vertex A, B, C, and E.
C) incident to vertex E only.
D) incident to vertex C only.
E) none of these

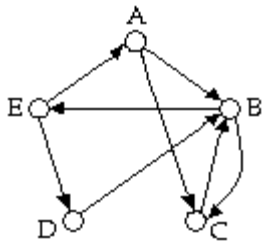
5) Which of the following is not a path from vertex C to vertex E in the digraph? 5) _____
A) C, D, E
B) C, A, B, E
C) all of these are paths from C to E.
D) C, A, E
E) none of these are paths from C to E.

6) Suppose that the vertices of the digraph represent individuals and there is an arc going from vertex X to vertex Y if and only if X "likes" Y. Which of the following statements [A), B), C), or D)] is not true? 6) _____
A) B and C do not like each other.
B) A and B like each other.
C) A likes B and E but does not like C or D.
D) B likes E but E does not like B.
E) all of these statements are true.

7) Suppose that the vertices of the digraph represent golfers playing in a tournament and the arcs represent Matches already played. An arc going from vertex X to vertex Y means that team X beat golfer Y. (No ties are possible in golf matches.) Which of the following statements [A), B), C), or D)] is not true? 7) _____
A) B and C were the only two players that did not play each other.
B) A played a total of 4 matches, winning 2 and losing 2.
C) E defeated B and C but lost to A and D.
D) A and B were the only two players that played each other twice.
E) all of these statements are true.

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For the following question(s), refer to the digraph below.

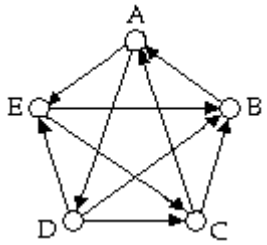


8) Vertex A has 8) _____
A) indegree 3, outdegree 0.
B) indegree 0, outdegree 3.
C) indegree 2, outdegree 1.
D) indegree 1, outdegree 2.
E) none of these

9) Vertex D is 9) _____
A) incident to vertex C only.
B) incident to vertex B only.
C) incident to vertices E and B.
D) incident to vertex E only.
E) none of these

10) Vertex D is 10) _____
A) incident from vertices E and B.
B) incident from vertex E only.
C) incident from vertex B only.
D) incident from vertex C only.
E) none of these

For the following question(s), refer to the tournament digraph below. The vertices of the digraph represent five tennis players in a round–robin tournament. An arc XY represents the fact that X defeated Y in the tournament.



11) Which player won the tournament? 11) _____
A) A B) B C) C D) D E) E

Assume you have a digraph with 5 vertices (A, B, C, D, and E) and 9 arcs. B is incident from D, E, and A; C is incident to E and A and incident from D; E is incident to D and incident from A.

12) Vertex A has 12) _____
A) indegree 1, outdegree 2.
B) indegree 3, outdegree 0.
C) indegree 0, outdegree 3.
D) indegree 2, outdegree 1.
E) none of these

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13) How many cycles are there in the digraph that start and end at B? 13) _____

A) 3
B) 1
C) 2
D) 0
E) none of these

Assume you have a digraph with 5 vertices (A, B, C, D, and E) and 9 arcs. A is incident from C, D, and E; B is incident to D and E and incident from C; D is incident to C and incident from E.

14) Vertex A has 14) _____

A) indegree 2, outdegree 1.
B) indegree 0, outdegree 3.
C) indegree 1, outdegree 2.
D) indegree 3, outdegree 0.
E) none of these

15) Vertex B has 15) _____

A) indegree 1, outdegree 2.
B) indegree 2, outdegree 1.
C) indegree 3, outdegree 0.
D) indegree 0, outdegree 3.
E) none of these

16) Vertex D is 16) _____

A) incident to vertex A only.
B) incident to vertices A and C.
C) incident to vertex B only.
D) incident to vertex E only.
E) none of these

17) How many cycles are there in the digraph that start and end at A? 17) _____

A) 2
B) 1
C) 3
D) 0
E) none of these

18) How many cycles are there in the digraph that start and end at B? 18) _____

A) 2
B) 0
C) 1
D) 3
E) none of these

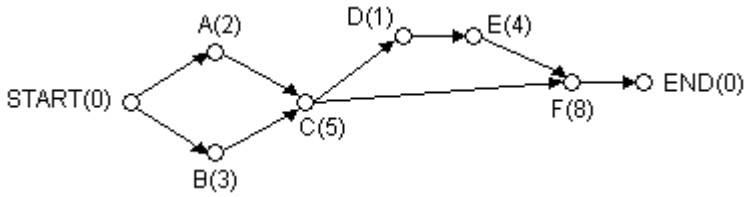
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Suppose you have the project consisting of the six tasks described in the following table.

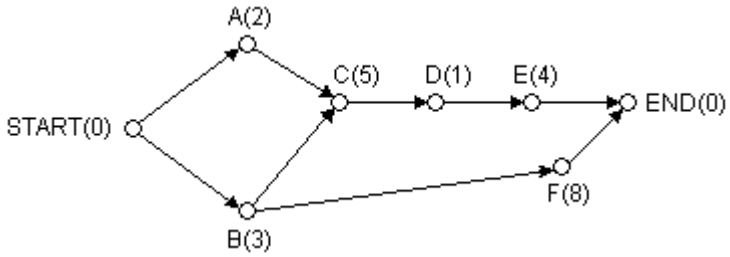
Task	Length of task (hours)	Prior tasks that must be completed
A	2	
B	3	
C	5	A, B
D	1	C
E	4	D
F	8	B

19) Which project digraph below models the project described? 19) _____

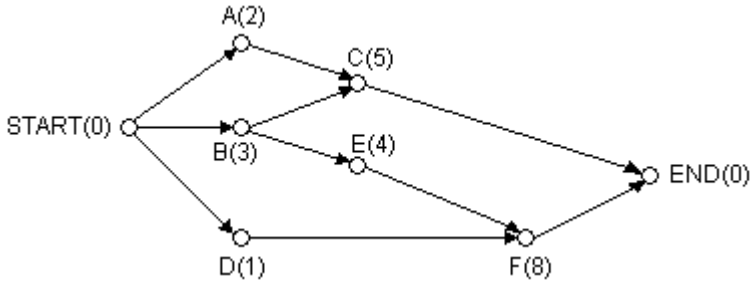
A)



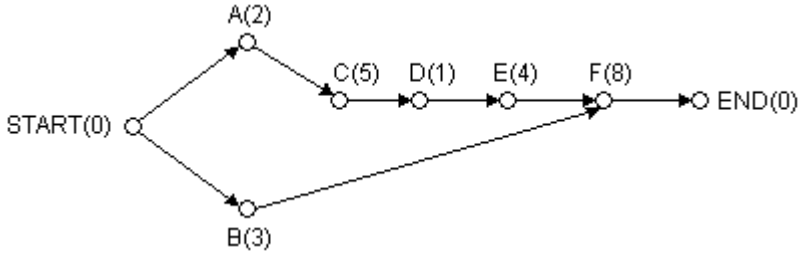
B)



C)



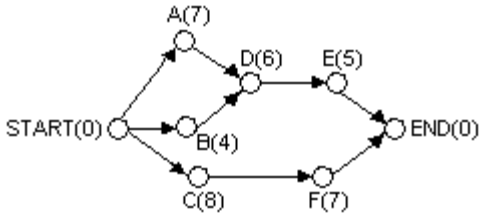
D)



E) none of these

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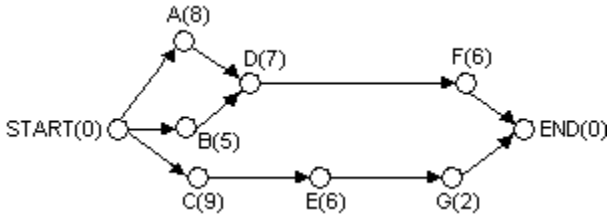
Suppose you have the following project digraph. (The numbers in parentheses represent hours.)



20) The number of tasks in the project is 20) _____
A) 7.
B) 9.
C) 8.
D) 6.
E) none of these

21) Using the priority list, C, F, E, B, A, D and the priority–list model to schedule this project with two processors results in a finishing time of 21) _____
A) 18 hours.
B) 22 hours.
C) 19 hours.
D) 23 hours.
E) none of these

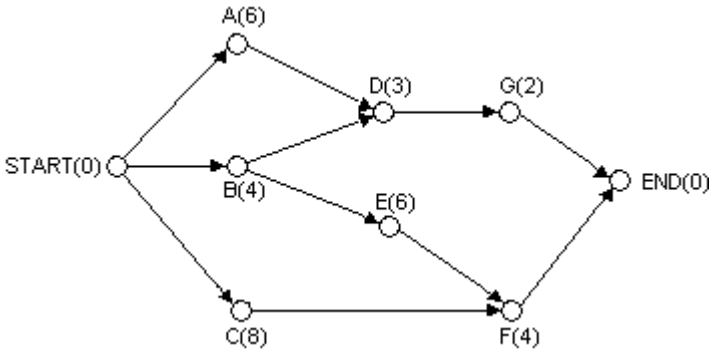
Suppose you have the following project digraph. (The numbers in parentheses represent hours.)



22) Using the priority list, C, E, G, F, B, A, D and the priority–list model to schedule this project with two processors results in a finishing time of 22) _____
A) 22 hours.
B) 21 hours.
C) 24 hours.
D) 26 hours.
E) none of these

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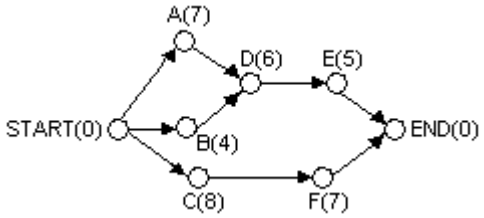
Suppose you have the following project digraph. (The numbers in parentheses represent hours.)



23) Using the priority list F, E, A, D, B, G, C and the priority–list model to schedule this project with two processors, the project finishing time is 23) _____

A) 17 hours.
B) 21 hours.
C) 22 hours.
D) 18 hours.
E) none of these

Suppose you have the following project digraph. (The numbers in parentheses represent hours.)

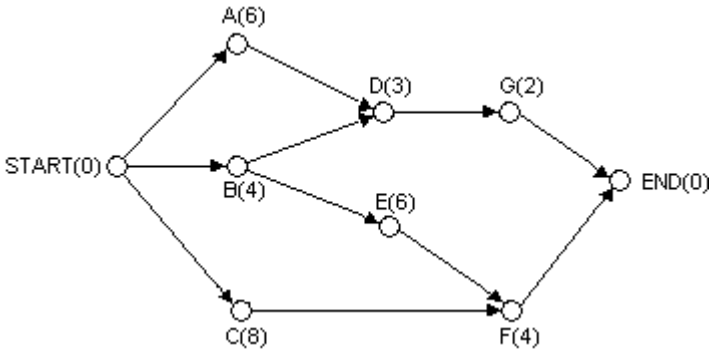


24) Scheduling this project with two processors results in a finishing time shorter than 22 hours using the priority list 24) _____

A) C, F, E, B, A, D.
B) C, D, B, E, A, F.
C) C, F, A, B, D, E.
D) C, B, A, F, E, D.
E) none of these

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Suppose you have the following project digraph. (The numbers in parentheses represent hours.)

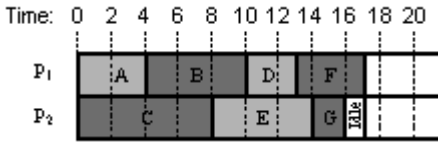


25) If we use the priority list F, E, A, D, B, G, C and the priority-list model to schedule this project with two processors, we should start by assigning 25) _____

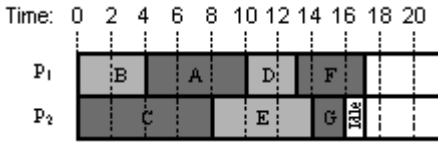
A) task A to one processor, task C to the other one.
B) task B to one processor, task C to the other one.
C) task A to one processor, task B to the other one.
D) task B to one processor, task E to the other one.
E) none of these

26) If we use the priority list F, E, A, D, B, G, C and the priority-list model to schedule this project with two processors, the project timeline is 26) _____

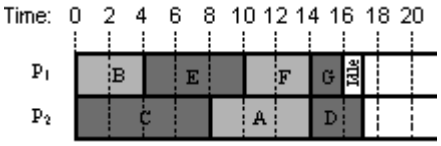
A)



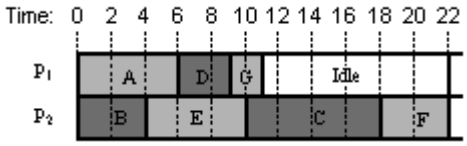
B)



C)



D)



E) none of these

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27) If we use decreasing–time algorithm to schedule this project with two processors, we should start by assigning 27) _____

A) task B to one processor, task E to the other one.
B) task A to one processor, task B to the other one.
C) task B to one processor, task C to the other one.
D) task A to one processor, task C to the other one.
E) none of these

Solve the problem.

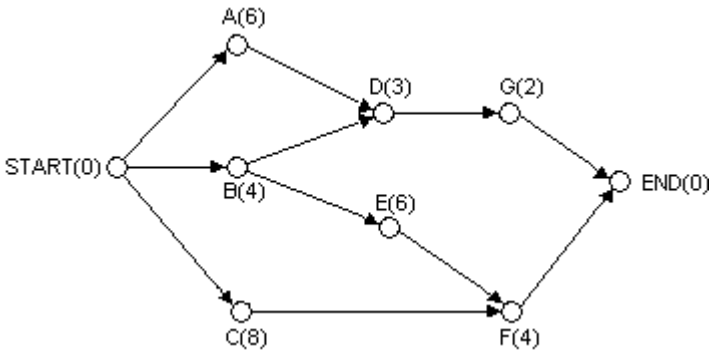
28) Use the decreasing–time algorithm to schedule 8 independent tasks having lengths 1, 3, 4, 7, 11, 18, 29, and 47 hours using two processors. How much idle time is in the resulting schedule? 28) _____

A) 0 hours
B) 2 hours
C) 3 hours
D) 1 hour
E) none of these

29) The decreasing–time algorithm is 29) _____

A) an optimal and inefficient algorithm.
B) an approximate and inefficient algorithm.
C) an approximate and efficient algorithm.
D) an optimal and efficient algorithm.
E) none of these

Suppose you have the following project digraph. (The numbers in parentheses represent hours.)



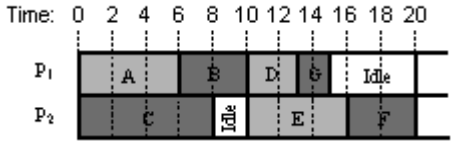
30) Consider the following timeline using three processors. 30) _____



A) This timeline is not optimal because task F was started after processor 3 was idle for 2 hours.
B) This timeline is an illegal schedule because task E was started before task C was completed.
C) This timeline is not an optimal schedule because the project can be scheduled with a finishing time of 12 hours.
D) This timeline is an optimal schedule for three processors.
E) none of these

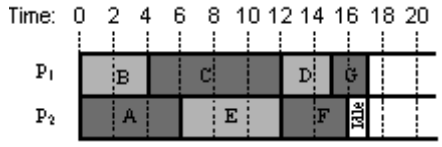
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31) Consider the following timeline using two processors. 31) _____



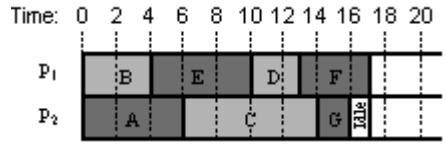
A) This is the timeline one gets using the critical-path algorithm.
B) This timeline is an optimal schedule.
C) This timeline is an illegal schedule.
D) This is the timeline one gets using the decreasing-time algorithm.
E) none of these

32) Consider the following timeline using two processors. 32) _____



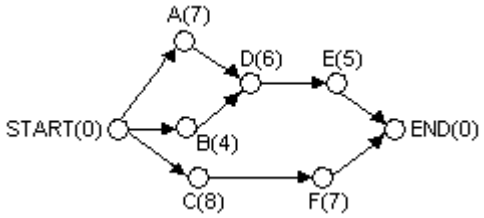
A) This timeline is an optimal schedule.
B) This is the timeline one gets using the decreasing-time algorithm.
C) This is the timeline one gets using the critical-path algorithm.
D) This timeline is an illegal schedule.
E) none of these

33) Consider the following timeline using two processors. 33) _____



A) This timeline is an optimal schedule.
B) This timeline is an illegal schedule.
C) This is the timeline one gets using the critical-path algorithm.
D) This is the timeline one gets using the decreasing-time algorithm.
E) none of these

Suppose you have the following project digraph. (The numbers in parentheses represent hours.)



34) The length of the critical path for the entire project is 34) _____

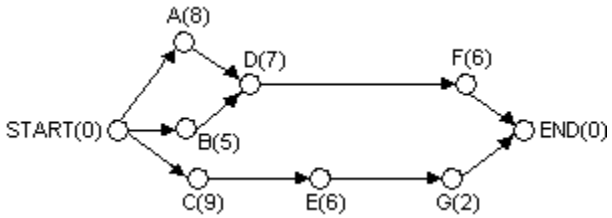
A) 30 hours.
B) 37 hours.
C) 15 hours.
D) 18 hours.
E) none of these

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35) Using the critical-path algorithm to schedule this project with three processors results in a finishing time of 35) _____

A) 23 hours.
B) 19 hours.
C) 22 hours.
D) 18 hours.
E) none of these

Suppose you have the following project digraph. (The numbers in parentheses represent hours.)



36) The length of the critical path from E is 36) _____

A) 6 hours.
B) 8 hours.
C) 2 hours.
D) 9 hours.
E) none of these

37) The length of the critical path from B is 37) _____

A) 21 hours.
B) 18 hours.
C) 5 hours.
D) 13 hours.
E) none of these

38) The length of the critical path for the entire project is 38) _____

A) 18 hours.
B) 26 hours.
C) 21 hours.
D) 17 hours.
E) none of these

39) Using the critical-path algorithm to schedule this project with three processors results in a finishing time of 39) _____

A) 24 hours.
B) 22 hours.
C) 21 hours.
D) 20 hours.
E) none of these

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40) Using the critical-path algorithm to schedule this project with five processors results in a finishing time of 40) _____

A) 22 hours.
B) 20 hours.
C) 24 hours.
D) 21 hours.
E) none of these

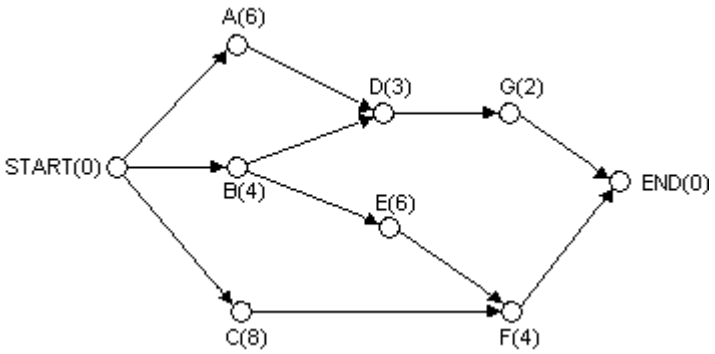
Suppose you have the project consisting of the six tasks described in the following table.

Task	Length of task (hours)	Prior tasks that must be completed
A	2	
B	3	
C	5	A, B
D	1	C
E	4	D
F	8	B

41) The critical path list for this project is given by 41) _____

A) A[12], B[11], C[10], F[8], D[5], E[4]
B) A[2], B[3], C[5], F[8], D[1], E[4]
C) A[23], B[21], C[18], D[13], E[12], F[8]
D) F[8], E[12], D[13], C[18], B[21], A[23]
E) none of these

Suppose you have the following project digraph. (The numbers in parentheses represent hours.)



42) The length of the critical path of this project digraph is 42) _____

A) 16 hours.
B) 12 hours.
C) 14 hours.
D) 11 hours.
E) none of these

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43) If we use the critical–path algorithm to schedule this project with two processors, we should start by assigning 43) _____

A) task B to one processor, task C to the other one.
B) task A to one processor, task C to the other one.
C) task A to one processor, task B to the other one.
D) task B to one processor, task E to the other one.
E) none of these

44) Using the critical–path algorithm to schedule this project with two processors, the project finishing time is 44) _____

A) 19 hours.
B) 17 hours.
C) 18 hours.
D) 20 hours.
E) none of these

A project consists of five tasks. The lengths of the tasks (in hours) are 5, 4, 4, 3, and 3. The tasks are all independent (i.e., there are no precedence relations).

45) Using the critical–path algorithm to schedule the project with two processors, the finishing time is 45) _____

A) 12 hours.
B) 11 hours.
C) 9 hours.
D) 10 hours.
E) none of these

Solve the problem.

46) Consider a project consisting of nine tasks (A through I) with the following processing times (in hours): A(10), B(7), C(5), D(3), E(6), F(4), G(8), H(7), and I(4). If a schedule with three processors has a finishing time of 22 hours, what is the total idle time in the schedule? 46) _____

A) 16 hours.
B) 14 hours.
C) 10 hours.
D) 12 hours.
E) none of these

47) Which of the following always produces an optimal schedule to the general scheduling problem? 47) _____

A) The decreasing–time algorithm.
B) The backflow algorithm.
C) The critical–path algorithm.
D) The brute–force algorithm.
E) none of these

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

A project consists of seven independent tasks with processing times (in hours) given by 3, 4, 4, 5, 7, 7, and 11.

48) Find the finishing time Fin for N = 3 processors using the critical–path algorithm. 48) _____

49) Find the optimal finishing time Opt for N = 3 processors. 49) _____

50) Compute the relative error of the critical–path schedule expressed as a percent. 50) _____

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1) A
2) Task Q precedes task R, which precedes task S.
3) precedence relation
4) C
5) B
6) D
7) A
8) D
9) B
10) B
11) D
12) A
13) D
14) D
15) A
16) B
17) D
18) A
19) B
20) D
21) B
22) D
23) C
24) E
25) C
26) D
27) D
28) B
29) C
30) D
31) D
32) A
33) B
34) D
35) D
36) B
37) B
38) C
39) C
40) D
41) A
42) C
43) A
44) C
45) B
46) D
47) D
48) Fin = 15 hours
49) Opt = 14 hours
50) 7.1%

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Chapter 9

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

1) The 100th term in the arithmetic sequence 3, 7, 11, 15, . . . is 1) _____

A) 403.
B) 103.
C) 407.
D) 399.
E) none of these

2) $\underbrace{3 + 7 + 11 + 15 + \ldots}_{100 \text{ terms}} =$ 2) _____

A) 39,798
B) 19,899
C) 20,100
D) 40,200
E) none of these

3) The 100th term in the arithmetic sequence 15, 11, 7, 3, . . . is 3) _____

A) –336.
B) –385.
C) –340.
D) –381.
E) none of these

4) $\underbrace{5 + 8 + 11 + 14 + \ldots + 299 + 302}_{100 \text{ terms}} =$ 4) _____

A) 30,200
B) 15,350
C) 15,100
D) 30,700
E) none of these

5) In an arithmetic sequence with first term P_0 and common difference d, the value of P_N is given by 5) _____

A) $P_0 + (N - 1)d$.
B) $d + (N - 1)P_0$.
C) $d + NP_0$.
D) $P_0 + Nd$.
E) none of these

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6) In an arithmetic sequence with first term P_1 and common difference d, the (N + 2)nd term is given by 6) _____

A) $P_1 + (N + 2)d$.
B) $P_1 + (N + 1)d$.
C) $d + (N + 1)P_1$.
D) $d + (N + 2)P_1$.
E) none of these

7) In an arithmetic sequence with first term P_0 and common difference d, the sum of the first 400 terms is given by 7) _____

A) $200(2P_0 + 200d)$.
B) $200(2P_0 + 400d)$.
C) $100(2P_0 + 200d)$.
D) $100(2P_0 + 399d)$.
E) none of these

8) An arithmetic sequence has a 35th term of 214. The 37th term is 222. Find the first term of this sequence. 8) _____

A) 78
B) –62
C) 74
D) –58
E) none of these

9) If $P_N = P_{N-1} + 2$ and $P_0 = 3$, then $P_3 =$ 9) _____

A) 5. B) 9. C) 3. D) 2. E) 7.

10) If $P_N = P_{N-1} + 2$ and $P_0 = 3$, then $P_{100} =$ 10) _____

A) 103.
B) 202.
C) 102.
D) 203.
E) none of these

11) If $P_N = P_{N-1} + 2$ and $P_0 = 3$, an explicit description of P_N is given by the expression 11) _____

A) $P_N = 3 + 2N$
B) $P_N = 3 + 2(N - 1)$
C) $P_N = 2 + 3(N - 1)$
D) $P_N = 2 + 3N$
E) none of these

12) If $P_N = P_{N-1} + 4$ and $P_{17} = 74$, then $P_3 =$ 12) _____

A) 14. B) 17. C) 2. D) 10. E) 18.

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13) An arithmetic sequence has first term 17 and second term 20. Which term is the number 344 in this sequence? 13) _____

A) 109
B) 110
C) 327
D) 108
E) none of these

14) $5 + 8 + 11 + \ldots + 755 =$ 14) _____

A) $\frac{760 \times 747}{2}$

B) $\frac{760 \times 750}{2}$

C) $\frac{760 \times 251}{2}$

D) $\frac{760 \times 250}{2}$

E) none of these

15) Consider a population that grows according to a linear growth model. The population in the fifth generation is $P_5 = 43$ and the population in the ninth generation is $P_9 = 71$. The common difference is d = 15) _____

A) 7.
B) 14.
C) 28.
D) 4.
E) none of these

16) Fred currently weighs 175 pounds. He joins the dessert of the month club and gains 1.5 pounds per month. Fred is also a member of Weight Watchers where his monthly charge is $2 per pound of his own weight. How much does Fred pay in dues over the course of three years? 16) _____

A) $612.50
B) $14,544
C) none of these
D) $7272
E) $22,050

Starting in the year 2000, the number of crimes committed each year in Middletown is predicted to grow according to a linear growth model. During the year 2000, Middletown recorded 2 crimes ($P_0 = 2$). During the year 2001, Middletown recorded 6 crimes ($P_1 = 6$).

17) According to the model, how many crimes are likely to be committed in Middletown during 2002? 17) _____

A) 12
B) 24
C) 18
D) 10
E) none of these

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18) According to the model, how many crimes are likely to be committed in Middletown during 2050? 18) _____

A) 202
B) 206
C) 104
D) 106
E) none of these

19) If P_N denotes the predicted number of crimes during the year 2000 + N, then 19) _____

A) $P_N = 2N + 4$.
B) $P_N = 4N - 2$.
C) $P_N = N^2 + N$.
D) $P_N = 4N + 2$.
E) none of these

The number of cars sold weekly by a new automobile dealership grows according to a linear growth model. The first week the dealership sold two cars ($P_0 = 2$). The second week the dealership sold six cars ($P_1 = 6$).

20) How many cars were sold in the third week? 20) _____

A) 10
B) 18
C) 12
D) 24
E) none of these

Starting in the year 2000, the number of crimes committed each year in Middletown is predicted to grow according to a linear growth model. During the year 2000, Middletown recorded 2 crimes ($P_0 = 2$). During the year 2001, Middletown recorded 6 crimes ($P_1 = 6$).

21) During the 50 years 2000–2049, the total number of crimes recorded in Middletown predicted by the model is 21) _____

A) 5000.
B) 2000.
C) 4996.
D) 5004.
E) none of these

The number of cars sold weekly by a new automobile dealership grows according to a linear growth model. The first week the dealership sold two cars ($P_0 = 2$). The second week the dealership sold six cars ($P_1 = 6$).

22) If the manager gets a $100 bonus for every car sold, how much total bonus money did the manager make in the first four weeks? 22) _____

A) $8000
B) $3200
C) $5600
D) $1400
E) none of these

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Starting in the year 2000, the number of speeding tickets issued each year in Middletown is predicted to grow according to an exponential growth model. During the year 2000, Middletown issued 200 speeding tickets ($P_0 = 200$). Every year thereafter, the number of speeding tickets issued is predicted to grow by 10%.

23) According to the model, how many speeding tickets are likely to be issued in Middletown during 2002? 23) _____

A) 242
B) 222
C) 220
D) 240
E) none of these

24) According to the model, in what year will approximately 354 speeding tickets be issued in Middletown? 24) _____

A) 2035
B) 2055
C) 2005
D) 2006
E) none of these

Solve the problem.

25) Consider a population that decays according to an exponential model. The initial population is $P_0 = 46{,}875$ and the common ratio is $r = 0.8$. How many generations will it take for the population to fall below 10,000? 25) _____

A) 7
B) 6
C) 5
D) 4
E) none of these

26) The number of arrests in Smallville during the year 2000 was 50. It is predicted that in each of the next 25 years the number of arrests will increase by 5%. Using this prediction, approximate how many arrests will be made in Smallville during the 26 years from 2000 to 2025. 26) _____

A) 2847 B) 2556 C) 1365 D) 178 E) 169

Starting in the year 2000, the number of speeding tickets issued each year in Middletown is predicted to grow according to an exponential growth model. During the year 2000, Middletown issued 200 speeding tickets ($P_0 = 200$). Every year thereafter, the number of speeding tickets issued is predicted to grow by 10%.

27) If P_N denotes the predicted number of speeding tickets issued during the year 2000 + N, then 27) _____

A) $P_N = P_{N-1} + 20$.
B) $P_N = 1.1 \times P_{N-1}$.
C) $P_N = P_{N-1} + 0.1$.
D) $P_N = 0.1 \times P_{N-1}$.
E) none of these

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28) If P_N denotes the predicted number of speeding tickets issued during the year 2000 + N, then 28) _____

A) $P_N = 200 \times (0.1)^N$.

B) $P_N = 200 \times (0.1)^{N-1}$.

C) $P_N = 200 \times (1.1)^{N-1}$

D) $P_N = 200 \times (1.1)^N$.

E) none of these

Solve the problem.

29) In a geometric sequence with the first term P_0 and common ratio r, the 100th term of the sequence is given by 29) _____

A) $P_0 \times r^{100}$.

B) $P_0 + r^{99}$.

C) $P_0 \times r^{99}$.

D) $P_0 + r^{100}$.

E) none of these

30) Consider a population that grows according to the recursive rule $P_N = 5 \times P_{N-1}$, with initial population $P_0 = 6$. Which of the following is an explicit description of this population sequence? 30) _____

A) $P_N = 6 \times 5^{N-1}$

B) $P_N = 5 \times 6^N$

C) $P_N = 6 \times 5^N$

D) $P_N = 5 \times 6^{N-1}$

E) none of these

Consider a geometric sequence that has initial term $G_0 = 75$ and a common ratio c = 2.2.

31) Find G_1. 31) _____

A) 165 B) 155 C) 144 D) 35 E) 150

32) Find G_4. 32) _____

A) 2250.32 B) 1650.52 C) 7522.30 D) 1756.92 E) 798.60

Recent studies show that the number of three–legged frogs in a particular area is increasing due to exposure to chemical pollutants. The first set of data reported in 2000 estimates a population of 5000 three –legged frogs. Statistics show an annual increase of 15%. Let G_N denote the number of three–legged frogs projected to inhabit this area in the year 2000 + N.

33) How many three–legged frogs are projected to inhabit this area by 2009? Round to the nearest whole number. 33) _____

A) 7532 B) 15,295 C) 6750 D) 10,000 E) 17,589

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Solve the problem.

34) $1 + 4 + 4^2 + 4^3 + \ldots + 4^{217} =$ 34) _____

A) $\frac{4^{216} - 1}{3}$

B) $\frac{4^{218}}{3} - 1$

C) $\frac{4^{218} - 1}{3}$

D) 4^{218}

E) none of these

35) $1 + 5 + 5^2 + 5^3 + \ldots + 5^{207} =$ 35) _____

A) $\frac{5^{206} - 1}{4}$

B) $\frac{5^{208}}{4} - 1$

C) 5^{208}

D) $\frac{5^{208} - 1}{4}$

E) none of these

36) $5 + 5 \times 3 + 5 \times 3^2 + 5 \times 3^3 + \ldots + 5 \times 3^{78} =$ 36) _____

A) $2.5 \times (3^{79} - 1)$

B) $5 \times (3^{79} - 1)$

C) $2.5 \times (3^{78} - 1)$

D) $5 \times (3^{78} - 1)$

E) none of these

37) $\frac{\$22}{(1.025)} + \frac{\$22}{(1.025)^2} + \frac{\$22}{(1.025)^3} + \ldots + \frac{\$22}{(1.025)^{50}}$ 37) _____

A) \$623.97 B) \$611.01 C) \$655.23 D) \$617.57 E) \$671.92

Assume there is a certain population of fish in a pond whose growth is described by the logistic equation. The growth parameter for this type of fish is r = 3.0.

38) If originally the pond is stocked to 50% of its carrying capacity, then the population of the pond after the second breeding season is 38) _____

A) 56.25% of the pond's carrying capacity.

B) 75% of the pond's carrying capacity.

C) 50% of the pond's carrying capacity.

D) 25% of the pond's carrying capacity.

E) none of these

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Solve the problem.

39) Suppose that we have a confined colony of squirrels growing according to the logistic growth model. Suppose that the growth parameter for this type of squirrel is $r = \frac{29}{10}$. Suppose also that the starting population is $p_0 = \frac{20}{29}$. Then $p_2 =$ 39) _____

A) $\frac{10}{29}$.

B) $\frac{107}{145}$.

C) $\frac{99}{145}$.

D) $\frac{18}{29}$.

E) none of these

40) Suppose that we have a confined colony of squirrels growing according to the logistic growth model. Suppose that the growth parameter for this type of squirrel is $r = \frac{29}{10}$. Suppose also that the starting population is $p_0 = \frac{4}{29}$. Then $p_2 =$ 40) _____

A) $\frac{19}{29}$.

B) $\frac{10}{29}$.

C) 0.

D) $\frac{4}{29}$.

E) none of these

41) Suppose that in a population growing according to the logistic growth model we have $p_5 = \frac{10}{31}$ and $p_6 = \frac{20}{31}$. Then $r =$ 41) _____

A) $\frac{62}{21}$.

B) 2.

C) $\frac{10}{31}$.

D) $\frac{31}{10}$.

E) none of these

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42) Suppose that in a population growing according to the logistic growth model we have $p_5 = \frac{5}{14}$ and $p_6 = \frac{5}{7}$. Then r = 42) _____

A) $\frac{28}{9}$.

B) $\frac{5}{14}$.

C) $\frac{14}{5}$.

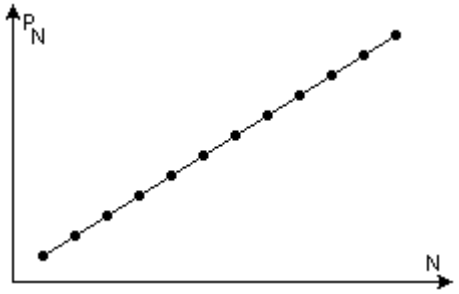
D) 2.

E) none of these

43) Which phrase best describes the growth model represented by $P_N = 100\left(1 + \frac{0.08}{12}\right)^{12N}$? 43) _____

A) explicit linear growth
B) recursive exponential growth
C) logistic growth
D) recursive linear growth
E) explicit exponential growth

44) The plot best represents which type of growth? 44) _____



A) linear growth
B) geometric growth
C) logistic growth
D) none of these
E) exponential growth

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Answer Key
Testname: CHAPTER 9

1) D
2) C
3) D
4) B
5) D
6) B
7) D
8) A
9) B
10) D
11) A
12) E
13) B
14) C
15) A
16) B
17) D
18) A
19) D
20) A
21) A
22) B
23) A
24) D
25) A
26) B
27) B
28) D
29) C
30) C
31) A
32) D
33) E
34) C
35) D
36) A
37) A
38) A
39) C
40) A
41) A
42) A
43) E
44) A

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Chapter 9

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

1) The 100th term in the arithmetic sequence 3, 7, 11, 15, . . . is 1) _____
A) 399.
B) 103.
C) 403.
D) 407.
E) none of these

2) $\underbrace{15 + 11 + 7 + 3 + \ldots}_{100 \text{ terms}} =$ 2) _____
A) –20,100
B) –19,899
C) –18,500
D) –18,300
E) none of these

3) $\underbrace{5 + 8 + 11 + 14 + \ldots + 299 + 302}_{100 \text{ terms}} =$ 3) _____
A) 30,200
B) 30,700
C) 15,350
D) 15,100
E) none of these

4) $\underbrace{2 + 12 + 22 + 32 + \ldots}_{151 \text{ terms}} =$ 4) _____
A) 113,552
B) 114,156
C) 114,307
D) 113,401
E) none of these

5) The 412th term in the arithmetic sequence –4, 1, 6, 11, . . . is 5) _____
A) 2056.
B) 2051.
C) 408.
D) 2060.
E) none of these

6) The 315th term in the arithmetic sequence 17, 12, 7, 2, . . . is 6) _____
A) –1553.
B) –308.
C) –303.
D) –298.
E) none of these

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7) In an arithmetic sequence with first term P_0 and common difference d, the value of P_N is given by 7) _____

A) $d + NP_0$.

B) $d + (N - 1)P_0$.

C) $P_0 + (N - 1)d$.

D) $P_0 + Nd$.

E) none of these

8) An arithmetic sequence has a 35th term of 214. The 37th term is 222. Find the 100th term of this sequence. 8) _____

A) 470 B) 474 C) 464 D) 78 E) 478

9) If $P_N = P_{N-1} + 2$ and $P_0 = 3$, then $P_3 =$ 9) _____

A) 5. B) 3. C) 9. D) 2. E) 7.

10) If $P_N = P_{N-1} + 2$ and $P_0 = 3$, then $P_{100} =$ 10) _____

A) 202.

B) 203.

C) 102.

D) 103.

E) none of these

11) If $P_N = P_{N-1} + 2$ and $P_0 = 3$, an explicit description of P_N is given by the expression 11) _____

A) $P_N = 2 + 3(N - 1)$

B) $P_N = 2 + 3N$

C) $P_N = 3 + 2N$

D) $P_N = 3 + 2(N - 1)$

E) none of these

12) An arithmetic sequence has first term 17 and second term 20. Which term is the number 344 in this sequence? 12) _____

A) 108

B) 109

C) 327

D) 110

E) none of these

13) $5 + 8 + 11 + \ldots + 755 =$ 13) _____

A) $\frac{760 \times 750}{2}$

B) $\frac{760 \times 251}{2}$

C) $\frac{760 \times 747}{2}$

D) $\frac{760 \times 250}{2}$

E) none of these

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14) $7 + 11 + 15 + \ldots + 223 =$ 14) _____

A) $\frac{230 \times 55}{2}$

B) $\frac{230 \times 54}{2}$

C) $\frac{223 \times 55}{2}$

D) $\frac{223 \times 54}{2}$

E) none of these

15) Consider a population that grows according to a linear growth model. The population in the fifth generation is $P_5 = 43$ and the population in the ninth generation is $P_9 = 71$. The common difference is d = 15) _____

A) 28.
B) 4.
C) 14.
D) 7.
E) none of these

16) Fred currently weighs 175 pounds. He joins the dessert of the month club and gains 1.5 pounds per month. Fred is also a member of Weight Watchers where his monthly charge is $2 per pound of his own weight. How much does Fred pay in dues over the course of three years? 16) _____

A) none of these
B) $612.50
C) $7272
D) $14,544
E) $22,050

Starting in the year 2000, the number of crimes committed each year in Middletown is predicted to grow according to a linear growth model. During the year 2000, Middletown recorded 2 crimes ($P_0 = 2$). During the year 2001, Middletown recorded 6 crimes ($P_1 = 6$).

17) According to the model, how many crimes are likely to be committed in Middletown during 2002? 17) _____

A) 18
B) 10
C) 24
D) 12
E) none of these

18) According to the model, how many crimes are likely to be committed in Middletown during 2050? 18) _____

A) 202
B) 104
C) 206
D) 106
E) none of these

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The number of cars sold weekly by a new automobile dealership grows according to a linear growth model. The first week the dealership sold two cars ($P_0 = 2$). The second week the dealership sold six cars ($P_1 = 6$).

19) How many cars were sold in the third week? 19) _____

A) 12
B) 10
C) 24
D) 18
E) none of these

20) If P_N denotes the number of cars sold in the Nth week, then 20) _____

A) $P_N = 4N - 2$.
B) $P_N = 4N + 2$.
C) $P_N = 2N + 4$.
D) $P_N = N^2 + N$.
E) none of these

Starting in the year 2000, the number of crimes committed each year in Middletown is predicted to grow according to a linear growth model. During the year 2000, Middletown recorded 2 crimes ($P_0 = 2$). During the year 2001, Middletown recorded 6 crimes ($P_1 = 6$).

21) During the 50 years 2000–2049, the total number of crimes recorded in Middletown predicted by the model is 21) _____

A) 5000.
B) 5004.
C) 4996.
D) 2000.
E) none of these

The number of cars sold weekly by a new automobile dealership grows according to a linear growth model. The first week the dealership sold two cars ($P_0 = 2$). The second week the dealership sold six cars ($P_1 = 6$).

22) In the first 50 weeks the dealership sold a total of 22) _____

A) 4996 cars.
B) 5000 cars.
C) 2000 cars.
D) 5004 cars.
E) none of these

Starting in the year 2000, the number of speeding tickets issued each year in Middletown is predicted to grow according to an exponential growth model. During the year 2000, Middletown issued 200 speeding tickets ($P_0 = 200$). Every year thereafter, the number of speeding tickets issued is predicted to grow by 10%.

23) According to the model, approximately how many speeding tickets are likely to be issued in Middletown during 2025? 23) _____

A) 450
B) 2167
C) 700
D) 1970
E) none of these

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24) For each speeding ticket issued, Middletown charges $50. Approximately how much money did Middletown earn from speeding tickets during the time period 2000–2025? 24) _____

A) $300 B) $1,091,800 C) $541,750 D) $21,850 E) $108,350

Solve the problem.

25) A population grows according to an exponential growth model. The initial population is $P_0 = 12$ and the population after 2 generations is $P_2 = 27$. Find the common ratio r. 25) _____

A) 1.25
B) 2.25
C) 7.5
D) 1.5
E) none of these

26) Consider a population that decays according to an exponential model. The initial population is $P_0 = 46{,}875$ and the common ratio is r = 0.8. How many generations will it take for the population to fall below 10,000? 26) _____

A) 7
B) 5
C) 6
D) 4
E) none of these

Starting in the year 2000, the number of speeding tickets issued each year in Middletown is predicted to grow according to an exponential growth model. During the year 2000, Middletown issued 200 speeding tickets ($P_0 = 200$). Every year thereafter, the number of speeding tickets issued is predicted to grow by 10%.

27) If P_N denotes the predicted number of speeding tickets issued during the year 2000 + N, then 27) _____

A) $P_N = 0.1 \times P_{N-1}$.
B) $P_N = P_{N-1} + 20$.
C) $P_N = P_{N-1} + 0.1$.
D) $P_N = 1.1 \times P_{N-1}$.
E) none of these

28) If P_N denotes the predicted number of speeding tickets issued during the year 2000 + N, then 28) _____

A) $P_N = 200 \times (1.1)^{N-1}$
B) $P_N = 200 \times (0.1)^{N-1}$.
C) $P_N = 200 \times (1.1)^{N}$.
D) $P_N = 200 \times (0.1)^{N}$.
E) none of these

Solve the problem.

29) If $P_N = 3P_{N-1}$ and $P_4 = 108$, then $P_1 =$ 29) _____

A) 12. B) 4. C) 324. D) 3. E) 2916.

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30) If $P_N = P_0\left(\frac{1}{3}\right)^N$ and $P_5 = 2916$, then $P_6 =$ 30) _____

A) 4860.
B) 8748.
C) 972.
D) 324.
E) none of these

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

The first two terms of a geometric sequence are $G_0 = 1260$ and $G_1 = 882$.

31) Find the common ratio c. 31) _____

32) Find G_3. 32) _____

As summer approaches the size of Matt's wardrobe increases weekly by 6%. Assume that Matt's wardrobe contained 112 pieces in March, and let G_N denote the number of pieces in his wardrobe N months after March.

33) How many pieces does Matt have in his wardrobe in July (N = 5)? Round to the nearest whole number. 33) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

34) Give an explicit formula for G_N. 34) _____

A) $G_N = 112 \cdot (1.6)^N$
B) $G_N = N \cdot (112)^{1.6}$
C) $G_N = 112 \cdot (N)^{1.06}$
D) $G_N = N \cdot (1.06)^{112}$
E) $G_N = 112 \cdot (1.06)^N$

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Recent studies show that the number of three–legged frogs in a particular area is increasing due to exposure to chemical pollutants. The first set of data reported in 2000 estimates a population of 5000 three–legged frogs. Statistics show an annual increase of 15%. Let G_N denote the number of three–legged frogs projected to inhabit this area in the year 2000 + N.

35) How many three–legged frogs are projected to inhabit this area by 2009? Round to the nearest whole number. 35) _____

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MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

36) $1 + 4 + 4^2 + 4^3 + \ldots + 4^{217} =$ 36) _____

A) 4^{218}

B) $\frac{4^{218} - 1}{3}$

C) $\frac{4^{218}}{3} - 1$

D) $\frac{4^{216} - 1}{3}$

E) none of these

37) $5 + 5 \times 3 + 5 \times 3^2 + 5 \times 3^3 + \ldots + 5 \times 3^{78} =$ 37) _____

A) $2.5 \times (3^{79} - 1)$

B) $5 \times (3^{79} - 1)$

C) $2.5 \times (3^{78} - 1)$

D) $5 \times (3^{78} - 1)$

E) none of these

38) Suppose that we have a confined colony of squirrels growing according to the logistic growth model. Suppose that the growth parameter for this type of squirrel is $r = \frac{29}{10}$. Suppose also that the starting population is $p_0 = \frac{20}{29}$. Then $p_2 =$ 38) _____

A) $\frac{99}{145}$.

B) $\frac{18}{29}$.

C) $\frac{107}{145}$.

D) $\frac{10}{29}$.

E) none of these

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39) Suppose that in a population growing according to the logistic growth model we have $p_5 = \frac{10}{31}$ and $p_6 = \frac{20}{31}$. Then r = 39) _____

A) 2.

B) $\frac{31}{10}$.

C) $\frac{10}{31}$.

D) $\frac{62}{21}$.

E) none of these

40) A population grows according to the logistic growth model, with growth parameter r = 0.9 and initial population given by $p_0 = 0.2$. What does the logistic growth model predict in the long term for this population? 40) _____

A) unlimited growth

B) The population settles into a two–period cycle alternating between a high–population period at 14.4% and a low–population period at 3% of the habitat's carrying capacity.

C) It stabilizes at 3% of the habitat's carrying capacity.

D) extinction

E) The population settles into a four–period cycle with the following approximate percentages of the habitat's carrying capacity: 14.4%, 8.8%, 11.1%, 7.2%.

41) A population grows according to the logistic growth model, with growth parameter r = 1.6 and initial population given by $p_0 = 0.5$. What does the logistic growth model predict in the long term for this population? 41) _____

A) extinction

B) unlimited growth

C) It stabilizes at 37.5% of the habitat's carrying capacity.

D) The population settles into a two–period cycle alternating between a high–population period at 50% and a low–population period at 37.5% of the habitat's carrying capacity.

E) The population settles into a four–period cycle with the following approximate percentages of the habitat's carrying capacity: 50%, 37.9%, 38.4%, 37.5%.

42) Which phrase best describes the growth model represented by $P_N = 100\left(1 + \frac{0.08}{12}\right)^{12N}$? 42) _____

A) explicit linear growth

B) explicit exponential growth

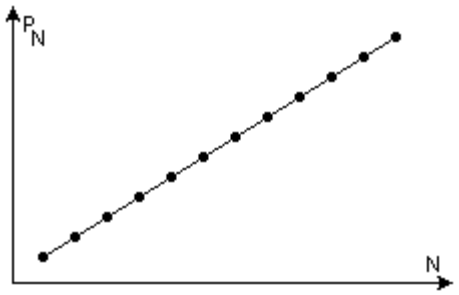
C) recursive exponential growth

D) recursive linear growth

E) logistic growth

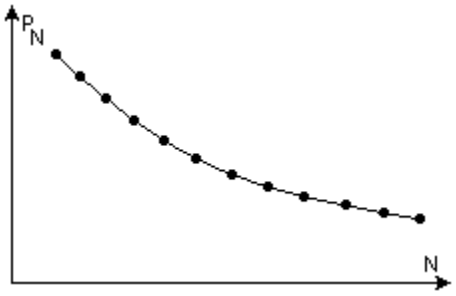
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43) The plot best represents which type of growth? 43) _____



A) linear growth
B) logistic growth
C) exponential growth
D) none of these
E) geometric growth

44) The plot best represents which type of growth? 44) _____



A) none of these
B) logistic growth
C) No growth
D) linear growth
E) exponential growth

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Answer Key
Testname: CHAPTER 9 VERSION 2

1) A
2) D
3) C
4) A
5) B
6) A
7) D
8) B
9) C
10) B
11) C
12) D
13) B
14) A
15) D
16) D
17) B
18) A
19) B
20) A
21) A
22) B
23) B
24) B
25) D
26) A
27) D
28) C
29) B
30) C
31) 0.70
32) 432.18
33) 150
34) E
35) 17,589
36) B
37) A
38) A
39) D
40) D
41) C
42) B
43) A
44) E

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Chapter 10

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Express the percentage as a decimal.

1) 4.25% 1) _____
A) 42.5 B) 0.0425 C) 0.00425 D) 0.000425 E) 425.0

2) 41.3% 2) _____
A) 413.05 B) 0.413 C) 0.00413 D) 41.30 E) 0.0413

3) 67.6% 3) _____
A) 0.000676 B) 67.6 C) 0.676 D) 676.0 E) 0.0676

4) 0.024% 4) _____
A) 0.240 B) 0.024 C) 0.00024 D) 0.0024 E) 240.0

5) 135.5% 5) _____
A) 135.5 B) 0.1355 C) 1355.0 D) 13.55 E) 1.355

Solve the problem.

6) Kate decides to replace all the lights in her college apartment with energy saving light bulbs beginning this month. The packaging says the new bulbs will use 75% less electricity. If Kate's electric bill last month was $7.29 from bulb use alone, project how much Kate's electric bill will be this month for bulb use. 6) _____
A) $2.55 B) $0.80 C) $5.47 D) $1.82 E) $6.54

7) Since the enactment of a smoking ban in a particular city, the number of smokers has slowly declined. Statistics show that the number of smokers in this city has decreased for four consecutive months by 3%, 2%, 5% and 2%. What was the overall percentage decrease in the number of smokers during this four month period? 7) _____
A) 12% B) 88.5% C) 11.5% D) 3% E) 12.5%

8) Suppose that your lab scores in a biology class were 29 out of 40 points in Lab 1, 15 out of 20 points in Lab 2, and 72 out of 85 in Lab 3. Compare your lab scores and rank them in order, from best to last. 8) _____
A) Lab 3 (84.7%), Lab 2 (75%), Lab 1 (72.5%)
B) Lab 1 (72.5%), Lab2 (75%), Lab 3 (84.7%)
C) Lab2 (75%), Lab 3 (84.7%), Lab 1 (72.5%)
D) Lab 1 (72.5%), Lab 3 (84.7%), Lab2 (75%)
E) Lab2 (75%), Lab 1 (72.5%), Lab 3 (84.7%)

9) A 450–piece puzzle is missing 18% of its pieces from its box. How many pieces are in the box? 9) _____
A) 531 B) 81 C) 288 D) 468 E) 369

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10) Home values in Park Lawn have declined 2% per year for each of the past five years. What was the total percentage decrease in home values during the five-year period? Round your answer to the nearest tenth of a percentage point. 10) _____

A) 9.8% B) 9.6% C) 3.9% D) 98.0% E) 90.4%

11) Suppose you borrow \$825 for a term of six years at simple interest and $4\frac{3}{4}$% APR. How much interest must you pay on the loan? 11) _____

A) \$107.42 B) \$11.76 C) \$390.19 D) \$117.56 E) \$235.13

12) Suppose you borrow \$5400 for a term of eight years at simple interest and 3.78% APR. How much interest must you pay on the loan? 12) _____

A) \$163.30 B) \$5604.12 C) \$204.13 D) \$1632.96 E) \$7032.960

13) Suppose you borrow \$3300 for a term of four years at simple interest and 12.5% APR. How much is the total (principal plus interest) you must pay back on the loan? 13) _____

A) \$4950.00 B) \$346.50 C) \$1650.00 D) \$495.00 E) \$3465.00

14) Suppose you borrow \$8050 for a term of nine years at simple interest and $3\frac{3}{5}$% APR. How much is the total (principal plus interest) you must pay back on the loan? 14) _____

A) \$2608.20 B) \$260.82 C) \$8078.98 D) \$8310.82 E) \$10,658.20

15) Suppose you buy a \$9000 savings bond that pays 4.75% annual simple interest. When you cash in the bond, you have to pay 16% federal taxes on the interest you earned. How much money would you net if you cash in the bond after six years? 15) _____

A) \$10,440.70 B) \$11,565.60 C) \$13,275.30 D) \$11,154.60 E) \$10,915.20

16) A savings bond currently worth \$7600 collects 5.5% annual simple interest each year. If the bond was purchased seven years ago, how much was it bought for? 16) _____

A) \$1381.81 B) \$5487.36 C) \$11,780.00 D) \$4903.23 E) \$2673.21

17) Suppose you purchase a five-year bond with an APR of 3.78%. The face value of the bond is \$8917.50. Find the purchase price of the bond. 17) _____

A) \$7509.47 B) \$8917.50 C) \$7440.86 D) \$7500 E) \$7431.25

18) Suppose you purchase a eight-year bond with an APR of $4\frac{3}{4}$%. The face value of the bond is \$6210. Find the purchase price of the bond. 18) _____

A) \$3465.99 B) \$4713.75 C) \$3445.41 D) \$3366.96 E) \$4500

19) Suppose you purchase a 15-year U.S. savings bond with an APR of 3.5%. The face value of the bond is \$10,000. Find the purchase price of the bond. 19) _____

A) \$6722.69 B) \$6400 C) \$6633.50 D) \$6482.98 E) \$6557.38

20) Suppose you purchase a 15-year U.S. savings bond with an APR of $3\frac{1}{4}$%. The face value of the bond is \$6000. Find the purchase price of the bond. 20) _____

A) \$4137.93 B) \$4078.16 C) \$3990.02 D) \$3934.43 E) \$4033.61

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21) Suppose you purchase an six–year bond for $7200. The face value of the bond when it matures is $9144. Find the APR. 21) _____

A) 4.75% B) 4.25% C) 4% D) 5% E) 4.5%

22) Suppose you purchase a 10–year muni bond for $8000. The face value of the bond when it matures is $12,300. Find the APR. 22) _____

A) 5.5% B) $4\frac{7}{8}$ C) 5% D) 5.375% E) $5\frac{1}{4}\%$

23) Find the APR of a bond that doubles its value in 10 years. Round your answer to the nearest hundredth of a percent. 23) _____

A) 15% B) 5% C) 7.5% D) 12.5% E) 10%

24) BCD Loans is a payday loan company that offers quick, short–term loans using the borrower's future paychecks as collateral. BCD Loans charges $20 for each $100 loaned for a term of 14 days. Find the APR charged by BCD Loans. Round your answer to the nearest hundredth of a percent. 24) _____

A) 152.14% B) 52.14% C) 521.43% D) 5.21% E) 214.33%

25) Budget Credit is a payday loan company that offers quick, short–term loans using the borrower's future paychecks as collateral. Budget Credit charges $28 for each $100 loaned for a term of 21 days. Find the APR charged by Budget Credit. Round your answer to the nearest hundredth of a percent. 25) _____

A) 486.67% B) 4.87% C) 148.67% D) 48.67% E) 248.67%

26) A bank offers a 3% annual interest rate compounded monthly. The periodic interest rate is 26) _____

A) 0.025%.
B) 0.05%.
C) 0.25%.
D) 0.0025%.
E) none of these

27) A bank offers a 4.2% annual interest rate compounded monthly. The periodic interest rate is 27) _____

A) 0.007%.
B) 0.0035%.
C) 0.07%.
D) 0.35%.
E) none of these

28) Find the future value of an investment of P = $5000 compounded annually with a 4% APR for a term of five years. Round your answer to the nearest cent. 28) _____

A) $5849.29 B) $6077.53 C) $6083.26 D) $6230.91 E) $6038.26

29) Find the future value of an investment of P = $4575.50 compounded annually with a 7.25% APR for a term of three years. Round your answer to the nearest cent. 29) _____

A) $5489.74 B) $5684.13 C) $5643.95 D) $5644.56 E) $5568.25

30) Find the future value of a CD paying a 4% APR compounded monthly if you invest $2000 for a term of four years. Round your answer to the nearest cent. 30) _____

A) $2026.80 B) $2339.72 C) $2346.40 D) $3224.45 E) $2422.41

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31) Find the salary in 2005 dollars that would be equivalent to a $50,000 salary in 2016. Assume an average annual inflation rate of 2% between 2005 and 2016. Round your answer to the nearest cent. 31) _____

A) $40,213.15 B) $41,017.41 C) $42,025.50 D) $38,107.24 E) $39,568.35

32) Find the salary in 2010 dollars that would be equivalent to a $67,750 salary in 2018. Assume an average annual inflation rate of 3% between 2010 and 2018. Round your answer to the nearest cent. 32) _____

A) $50,510.36 B) $52,863.44 C) $50,412.36 D) $56,082.98 E) $53,482.48

33) Find the salary in 2014 dollars that would be equivalent to a $70,000 salary in 2018. Assume an average annual inflation rate of 3.25% between 2014 and 2018. Round your answer to the nearest cent. 33) _____

A) $61,953.15 B) $63,789.13 C) $63,595.72 D) $61,593.91 E) $59,510.89

34) Find the salary in 2006 dollars that would be equivalent to a $100,000 salary in 2018. Assume an average annual inflation rate of 3.75% between 2006 and 2018. Round your answer to the nearest cent. 34) _____

A) $66,179.00 B) $66,778.33 C) $68,127.00 D) $64,289.90 E) $69,202.05

35) Which of the following options would you choose to invest your money in: 35) _____

I. 6% APR compounded yearly
II. 5.25% APR compounded monthly
III. 4.75% APR compounded continuously?

A) I
B) I and III
C) none of these
D) II
E) III

36) Find the future value of a CD paying a 3% APR compounded continuously if you invest $3000 for a term of four years. Round your answer to the nearest cent. 36) _____

A) $3409.43 B) $3382.49 C) $3282.52 D) $3376.53 E) $3278.18

37) Find the future value of a CD paying a 3.65% APR compounded continuously if you invest $2500 for a term of 250 days. Round your answer to the nearest dollar. 37) _____

A) $2564 B) $2562 C) $2560 D) $2563 E) $2565

38) Find the future value of a CD paying a 3.6% APR compounded continuously if you invest $3000 for a term of 1000 days. Round your answer to the nearest dollar. 38) _____

A) $3325 B) $3305 C) $3318 D) $3316 E) $3311

39) Suppose you invest $P on a CD paying 3% interest compounded continuously for a term of five years. At the end of the term you get $3485.50 from the bank. Find the value of the original principal P. Round your answer to the nearest dollar. 39) _____

A) $3000 B) $3025 C) $3005 D) $2775 E) $2995

40) Suppose you invest $P on a CD paying 3.5% interest compounded continuously for a term of three years. At the end of the term you get $4998.20 from the bank. Find the value of the original principal P. Round your answer to the nearest dollar. 40) _____

A) $4525 B) $4500 C) $4495 D) $4450 E) $4555

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41) Suppose you invest $P on a CD paying 3.75% interest compounded continuously for a term of 3.75 years. At the end of the term you get 4028.48 from the bank. Find the value of the original principal P. Round your answer to the nearest dollar. 41) _____

A) $3495 B) $3575 C) $3500 D) $3600 E) $3550

42) Suppose you invest $P on a CD paying 2.875% interest compounded continuously for a term of 1.5 years. At the end of the term you get $2610.17 from the bank. Find the value of the original principal P. Round your answer to the nearest dollar. 42) _____

A) $2525 B) $2475 C) $2495 D) $2505 E) $2500

43) Suppose you invest $P on a CD paying 4.15% interest compounded continuously for a term of 250 days. At the end of the term you get $8230.66 from the bank. Find the value of the original principal P. Round your answer to the nearest dollar. 43) _____

A) $7975 B) $8065 C) $8000 D) $7995 E) $8025

44) You buy a $500 certificate of deposit (CD) and the end of two years you cash it for $551.25. What is the annual yield on this investment? 44) _____

A) 6%
B) 0.05%
C) 5%
D) 2.5%
E) none of these

45) Find the APY for an APR of 2.5% compounded semi-annually. 45) _____

A) 2.5156% B) 2.5235% C) 2.5288% D) 2.5000% E) 2.5315%

46) A bank offers a 3.75% annual interest rate compounded monthly. The APY is approximately. 46) _____

A) 3.7500% B) 3.8031% C) 3.8151% D) 3.7852% E) 3.8212%

47) Find the APY for an APR of 4.5% compounded continuously. 47) _____

A) 4.5765% B) 4.5506% C) 4.5940% D) 4.6028% E) 4.5000%

48) Find the APY for an APR of 4.75% compounded continuously. 48) _____

A) 4.8064% B) 4.7500$ C) 4.8646% D) 4.8353% E) 4.8548

49) How many years will it take you to double an investment of $800 that has a 7% APY? 49) _____

A) 11 years
B) 15 years
C) 12 years
D) 13 years
E) none of these

50) For an investment having an APY of 3%, estimate the number of years needed to double the principal. 50) _____

A) 6 years
B) 24 years
C) 12 years
D) 10 years
E) none of these

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51) For an investment having an APY of 9%, estimate the number of years needed to double the principal. 51) _____

A) 10 years
B) 5 years
C) none of these
D) 8 years
E) 9 years

52) For an investment having an APY of 5%, estimate the number of years needed to double the principal. 52) _____

A) 6 years
B) 10 years
C) 15 years
D) 9 years
E) none of these

53) Find the value of a retirement savings account paying an APR of 5.8% after 45 years (contributions made at the end of each year, including the last year) when the annual contribution is $2040. Round your answer to the nearest cent. 53) _____

A) $399,480.24
B) $435,309.45
C) $409,517.44
D) $385,139.35
E) $364,998.51

54) Find the value of a retirement savings account paying an APR of 6.2% after 40 years (contributions made at the end of each year, including the last year) when the annual contribution is $2700. Round your answer to the nearest cent. 54) _____

A) $486,451.91
B) $439,457.86
C) $469,404.24
D) $434,574.99
E) $411,259.75

55) The value of a retirement savings account with an annual contribution of $1800 (contributions made at the end of each year, including the last year), and an APR of 5.4% after 40 years is $239,880.81. 55) _____
Find the value of this retirement savings account after 45 years. Round your answer to the nearest cent.

A) $312,992.88
B) $303,849.63
C) $322,057.51
D) $331,414.49
E) $341,248.61

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56) Find the value of a retirement savings account with an annual contribution of $1800 (contributions made at the end of each year, including the last year), and an APR of 6.6% after 35 years. Round your answer to the nearest cent. 56) _____

A) $233,121.77
B) $212,319.94
C) $228,133.06
D) $223,262.44
E) $244,989.84

57) Find the value of a retirement savings account with an annual contribution of $600 (contributions made at the end of each year, including the last year), and an APR of 6.6% after 40 years. Round your answer to the nearest cent. 57) _____

A) $100,844.67
B) $110,898.96
C) $105,379.14
D) $108,100.43
E) $115,835.05

58) Find the value of a retirement savings account paying an APR of 6.6% (compounded monthly) after 40 years of monthly contributions (contributions made at the end of each month, including the last month) when the monthly contribution is $100. Round your answer to the nearest cent. 58) _____

A) $216,200.85
B) $218,654.54
C) $251,976.40
D) $241,375.18
E) $234,767.36

59) Find the value of a retirement savings account paying an APR of 6.6% (compounded monthly) after 40 years of monthly contributions (contributions made at the end of each month, including the last month) when the monthly contribution is $170. Round your answer to the nearest cent. 59) _____

A) $410,337.81
B) $371,712.72
C) $367,541.45
D) $428,359.87
E) $399,104.52

60) The value of a retirement savings account with a monthly contribution of $150 (contributions made at the end of each month, including the last month), and an APR of 6.0% (compounded monthly) after 40 years is $298,723.61. Find the value of this retirement savings account after 45 years. Round your answer to the nearest cent. 60) _____

A) $413,398.89
B) $400,660.01
C) $382,938.32
D) $426,593.02
E) $400,326.64

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61) The value of a retirement savings account with a monthly contribution of $150 (contributions made at the end of each month, including the last month), and an APR of 4.8% (compounded monthly) after 40 years is $217,308.21. Find the value of this retirement savings account after 50 years. Round your answer to the nearest cent. 61) _____

A) $364,158.24
B) $361,438.09
C) $373,894.95
D) $353,426.76
E) $386,841.38

62) Find the value of a retirement savings account with a monthly contribution of $50 (contributions made at the end of each month, including the last month), and an APR of 4.8% (compounded monthly) after $52\frac{1}{2}$ years. Round your answer to the nearest cent. 62) _____

A) $147,307.35
B) $134,013.40
C) $142,078.50
D) $138,420.00
E) $137,058.22

63) Richard plans to retire 35 years from now, and has a goal to have $650,000 in his retirement savings account by that time. What should he contribute monthly, assuming the APR is 6.6% compounded monthly. Contributions are made at the end of the month, including the last month. Round your answer to the nearest cent. 63) _____

A) $368.86 B) $396.74 C) $426.96 D) $406.17 E) $357.11

64) Sarah plans to contribute monthly to a savings account for her daughter's college education. Her goal is $300,000 in 20 years. Assume the APR is 5.4% compounded monthly and contributions are made monthly at the end of each month, including the last month. What amount does Sarah need to contribute each month? Round your answer to the nearest cent. 64) _____

A) $696.75 B) $688.66 C) $459.57 D) $642.81 E) $756.95

65) What monthly contribution should you make if your goal is to have $600,000 in your retirement savings account after 45 years? Assume the APR is 6.0% compounded monthly and that contributions are made at the end of each month, including the last month. Round your answer to the nearest cent. 65) _____

A) $202.98 B) $210.97 C) $217.71 D) $232.17 E) $204.20

66) What should your monthly contribution be if your goal is to have $400,000 in your retirement savings account after 35 years? Assume the APR is 4.8% compounded monthly and that contributions are made at the end of each month, including the last month. Round your answer to the nearest cent. 66) _____

A) $376.21 B) $368.02 C) $390.48 D) $347.07 E) $299.20

67) Jackie decided to save for retirement and wants to have $575,000 in her retirement savings account at the end of 25 years. The APR is 6.0% compounded monthly and contributions to the account are made at the end of each month, including the last month. What does Jackie need to contribute monthly? 67) _____

A) $923.49 B) $855.59 C) $829.73 D) $793.75 E) $868.76

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68) Consider a retirement savings account where the monthly contribution is $125 for the first 10 years, is increased to $225 for the next 25 years, and then is increased once again to $400 for the last 5 years. The APR is always 6.6% compounded monthly. What is the value of the account at the end of 40 years? 68) _____

Round your answer to the nearest cent.

A) $359,959.20
B) $409,863.08
C) $418,651.04
D) $421,601.45
E) $406,912.67

69) Consider a retirement savings account where the monthly contribution is $150 for the first 15 years, is increased to $225 for the next 15 years, and then is increased once again to $300 for the last 15 years. The APR is always 4.8% compounded monthly. What is the value of the account at the end of 45 years? 69) _____

Round your answer to the nearest cent.

A) $369,963.02
B) $363,368.08
C) $366,146.09
D) $367,185.01
E) $356,603.76

70) Consider a retirement savings account where the monthly contribution is $100 for the first 10 years, is increased to $250 for the next 15 years, and then is increased once again to $300 for the last 10 years. The APR is always 5.4% compounded monthly. What is the value of the account at the end of 35 years? 70) _____

Round your answer to the nearest cent.

A) $223,825.32
B) $227,043.78
C) $220,831.15
D) $233,256.41
E) $230,037.95

71) Consider a retirement savings account where the monthly contribution is $150 for the first 15 years, is increased to $200 for the next 20 years, and then is increased once again to $250 for the last 10 years. The APR is always 5.1% compounded monthly. What is the value of the account at the end of 45 years? 71) _____

Round your answer to the nearest cent.

A) $368,558.63
B) $367,654.61
C) $359,300.45
D) $364,381.55
E) $363,477.53

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72) Consider a retirement savings account where the monthly contribution is $150 for the first 10 years, is increased to $200 for the next 20 years, and then is increased once again to $250 for the last 15 years. The APR is always 5.1% compounded monthly. What is the value of the account at the end of 45 years? 72) _____

Round your answer to the nearest cent.

A) $380,662.67
B) $389,016.83
C) $391,468.51
D) $384,840.75
E) $387,291.43

73) Suppose you purchase a car and you are going to finance $18,000 for 60 months at an APR of 7.2% compounded monthly. Find the monthly payments on the loan. Round your answer to the nearest cent. 73) _____

A) 398.39 B) $378.47 C) $338.63 D) $433.13 E) $358.12

74) Suppose you purchase a car and you are going to finance $15,000 for 60 months at an APR of 7.5% compounded monthly. Find the monthly payments on the loan. Round your answer to the nearest cent. 74) _____

A) $300.57 B) $292.09 C) $354.34 D) $352.28 E) $289.99

75) Suppose you want to buy a car. The dealer offers a financing package consisting of a 3.6% APR compounded monthly for a term of four years. Suppose that you want your monthly payments to be at most $500. What is the maximum amount that you should finance? Round your answer to the nearest dollar. 75) _____

A) $23,000 B) $22,321 C) $22,330 D) $23,525 E) $22,500

76) Suppose you want to buy a car. The dealer offers a financing package consisting of a 5.4% APR compounded monthly for a term of 4.5 years. Suppose that you want your monthly payments to be at most $800. What is the maximum amount that you should finance? Round your answer to the nearest dollar. 76) _____

A) $38,276 B) $38,200 C) $37,080 D) $37,000 E) $38,515

77) You want to purchase a new car. The price of the car is $27,425. The dealer is offering two promotions: You can take a $2000 instant rebate and 5.5% financing (Deal 1) or you can choose 4.5% financing on your entire loan (Deal 2). Calculate the monthly payment of both deals over 60 months and identify which is the better deal. 77) _____

A) Deal 1; $495; Deal 2: $483; Deal 2 is a better deal
B) Deal 1: $486; Deal 2: $511; Deal 1 is a better deal
C) Deal 1: $489; Deal 2: $513; Deal 1 is a better deal
D) none of these
E) Deal 1: $502; Deal 2: $514; Deal 2 is a better deal

78) Kayla and Sean are planning to purchase a new home. They will need to take out a 30 –year home mortgage loan of $150,000. The annual interest rate for a 30 –year mortgage at their bank is 6% compounded monthly. Compute their monthly mortgage payment under this loan. Round your answer to the nearest cent. 78) _____

A) $899.33 B) $881.34 C) $869.36 D) $893.33 E) $900.00

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79) Dan has a 30–year mortgage loan of $120,000 with an interest rate of 6.6%. How much interest will he pay over the life of the loan? Round your answer to the nearest dollar. 79) _____

A) $15,990 B) $16,000 C) $160,000 D) $155,000 E) $155,900

80) John just bought a house. He made a $20,000 down payment and financed the balance with a 22–year home mortgage loan with an interest rate of 6% compounded monthly. His monthly mortgage payment is $875. What was the selling price of the house? Round your answer to the nearest dollar. 80) _____

A) $148,737 B) $148,097 C) $127,078 D) $147,445 E) $128,242

81) Emily just bought a house. She made a $30,000 down payment and financed the balance with a 35–year home mortgage loan with an interest rate of 5% compounded monthly. Her monthly mortgage payment is $960. What was the selling price of the house? Round your answer to the nearest dollar. 81) _____

A) $241,348 B) $250,217 C) $219,303 D) $260,783 E) $220,217

82) You are purchasing a home for $220,000 and are shopping for a loan. You have a total of $40,000 to put down. In addition, there are $800 in closing costs loan and any loan fee that might be charged. Bank A offers a 10% APR amortized over 20 years with 240 equal monthly payments. There is no loan fee. Bank B offers an 8.5% APR amortized over 20 years with 240 equal monthly payments. There is a 4% loan fee (i.e., a one–time up–front charge of 4% of the loan). Calculate the monthly mortgage payment of both loans and identify which is the better loan. 82) _____

A) Bank A: $1737; Bank B: $1562; Bank B offers a better loan
B) Bank A: $1745; Bank B: $1569; Bank B offers a better loan
C) Bank A: $2123; Bank B: $1909; Bank B offers a better loan
D) Bank A: $1737; Bank B: $1562; Bank A offers a better loan
E) Bank A: $1745; Bank B: $1569; Bank A offers a better loan

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1) B
2) B
3) C
4) C
5) E
6) D
7) C
8) A
9) E
10) B
11) E
12) D
13) A
14) E
15) D
16) B
17) D
18) E
19) E
20) E
21) E
22) D
23) E
24) C
25) A
26) C
27) D
28) C
29) D
30) C
31) A
32) E
33) D
34) D
35) A
36) B
37) D
38) E
39) A
40) B
41) C
42) E
43) C
44) C
45) A
46) C
47) D
48) C
49) A
50) B

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51) D
52) C
53) C
54) B
55) C
56) C
57) D
58) E
59) E
60) A
61) C
62) C
63) B
64) A
65) C
66) B
67) C
68) C
69) C
70) B
71) E
72) D
73) E
74) A
75) B
76) A
77) B
78) A
79) E
80) B
81) E
82) A

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Chapter 10

Name_____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Express the percentage as a decimal.

1) 12.5% 1) _____

2) 4.25% 2) _____

3) 67.6% 3) _____

4) $\frac{1}{8}$% 4) _____

5) 0.0078% 5) _____

Solve the problem.

6) Enrollment at Kamp Krazy Kids is up 20% from last summer because more parents are working longer hours during the day. If last year's total enrollment was 260, how many kids are expected to attend camp this summer? 6) _____

7) Kate decides to replace all the lights in her college apartment with energy saving light bulbs beginning this month. The packaging says the new bulbs will use 75% less electricity. If Kate's electric bill last month was $7.29 from bulb use alone, project how much Kate's electric bill will be this month for bulb use. 7) _____

8) Since the enactment of a smoking ban in a particular city, the number of smokers has slowly declined. Statistics show that the number of smokers in this city has decreased for four consecutive months by 3%, 2%, 5% and 2%. What was the overall percentage decrease in the number of smokers during this four month period? 8) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

9) A bond mutual fund grows by 5% in 2014 and by 10% in 2016. By approximately how much did the fund grow in 2015 so as to increase by a total of 40% during the three year period? 9) _____

A) Too little information is given.
B) 26%
C) 16%
D) 25%
E) 21%

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

10) Home values in Park Lawn have declined 2% per year for each of the past five years. What was the total percentage decrease in home values during the five–year period? Round your answer to the nearest tenth of a percentage point. 10) _____

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11) Suppose you borrow \$1250 for a term of 12 years at simple interest and 2.15% APR. How much interest must you pay on the loan? 11) _____

12) Suppose you borrow \$2225 for a term of seven years at simple interest and 3.36% APR. How much is the total (principal plus interest) you must pay back on the loan? 12) _____

13) Suppose you borrow \$7500 for a term of five years at simple interest and $8\frac{1}{4}$% APR. How much is the total (principal plus interest) you must pay back on the loan? 13) _____

14) Suppose you borrow \$8050 for a term of nine years at simple interest and $3\frac{3}{5}$% APR. How much is the total (principal plus interest) you must pay back on the loan? 14) _____

15) Suppose you buy a \$9000 savings bond that pays 4.75% annual simple interest. When you cash in the bond, you have to pay 16% federal taxes on the interest you earned. How much money would you net if you cash in the bond after six years? 15) _____

16) Suppose you purchase a three–year bond with an APR of 2.5%. The face value of the bond is \$6450. Find the purchase price of the bond. 16) _____

17) Suppose you purchase a five–year bond with an APR of 3.78%. The face value of the bond is \$8917.50. Find the purchase price of the bond. 17) _____

18) Suppose you purchase a 10–year U.S. savings bond with an APR of 2.5%. The face value of the bond is \$9000. Find the purchase price of the bond. 18) _____

19) Suppose you purchase a 30–year U.S. savings bond with an APR of 4.5%. The face value of the bond is \$12,000. Find the purchase price of the bond. 19) _____

20) Suppose you purchase a 15–year U.S. savings bond with an APR of $3\frac{1}{4}$%. The face value of the bond is \$6000. Find the purchase price of the bond. 20) _____

21) Suppose you purchase an eight–year bond for \$5000. The face value of the bond when it matures is \$6550. Find the APR. 21) _____

22) Suppose you purchase a seven–year muni bond for \$9600. The face value of the bond when it matures is \$13,128. Find the APR. 22) _____

23) Find the APR of a bond that doubles its value in 10 years. Round your answer to the nearest hundredth of a percent. 23) _____

24) Find the APR of a bond that doubles its value in eight years. Round your answer to the nearest hundredth of a percent. 24) _____

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25) BCD Loans is a payday loan company that offers quick, short–term loans using the borrower's future paychecks as collateral. BCD Loans charges $20 for each $100 loaned for a term of 14 days. Find the APR charged by BCD Loans. Round your answer to the nearest hundredth of a percent. 25) _____

26) A bank offers a 4.2% annual interest rate compounded monthly. The periodic interest rate is 26) _____

27) A bank offers a 4.75% annual interest rate compounded daily. The periodic interest rate is approximately 27) _____

28) Find the future value of an investment of P = $4575.50 compounded annually with a 7.25% APR for a term of three years. Round your answer to the nearest cent. 28) _____

29) Find the future value of a CD paying a 4% APR compounded monthly if you invest $2000 for a term of four years. Round your answer to the nearest cent. 29) _____

30) Find the future value of a CD paying a 4.15% APR compounded daily if you invest $3800 for a term of three years. Round your answer to the nearest cent. 30) _____

31) Find the salary in 2005 dollars that would be equivalent to a $50,000 salary in 2016. Assume an average annual inflation rate of 2% between 2005 and 2016. Round your answer to the nearest cent. 31) _____

32) Find the salary in 2010 dollars that would be equivalent to a $67,750 salary in 2018. Assume an average annual inflation rate of 3% between 2010 and 2018. Round your answer to the nearest cent. 32) _____

33) Find the salary in 2014 dollars that would be equivalent to a $70,000 salary in 2018. Assume an average annual inflation rate of 3.25% between 2014 and 2018. Round your answer to the nearest cent. 33) _____

34) Find the salary in 2006 dollars that would be equivalent to a $100,000 salary in 2018. Assume an average annual inflation rate of 3.75% between 2006 and 2018. Round your answer to the nearest cent. 34) _____

35) Find the future value of a CD paying a 3% APR compounded continuously if you invest $3000
for a term of four years. Round your answer to the nearest cent. 35) _____

36) Find the future value of a CD paying a 3.5% APR compounded continuously if you invest $4000
for a term of five years. Round your answer to the nearest cent. 36) _____

37) Find the future value of a CD paying a 3.6% APR compounded continuously if you invest $3000
for a term of 1000 days. Round your answer to the nearest dollar. 37) _____

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38) Find the future value of a CD paying a 3.75% APR compounded continuously if you invest $5000
for a term of 750 days. Round your answer to the nearest dollar. 38) _____

39) Suppose you invest $P on a CD paying 2.75% interest compounded continuously for a term of four years. At the end of the term you get $2232.56 from the bank. Find the value of the original principal P. Round your answer to the nearest dollar. 39) _____

40) Suppose you invest $P on a CD paying 3.5% interest compounded continuously for a term of three years. At the end of the term you get $4998.20 from the bank. Find the value of the original principal P. Round your answer to the nearest dollar. 40) _____

41) Suppose you invest $P on a CD paying 4% interest compounded continuously for a term of 2.5 years. At the end of the term you get $8288.78 from the bank. Find the value of the original principal P. Round your answer to the nearest dollar. 41) _____

42) Suppose you invest $P on a CD paying 3.375% interest compounded continuously for a term of 100 days. At the end of the term you get $10,092.89 from the bank. Find the value of the original principal P. Round your answer to the nearest dollar. 42) _____

43) Suppose you invest $P on a CD paying 4.15% interest compounded continuously for a term of 250 days. At the end of the term you get $8230.66 from the bank. Find the value of the original principal P. Round your answer to the nearest dollar. 43) _____

44) You invest $3000 and after one year it has grown to $3200. What is the APY on your investment? 44) _____

45) You buy a $500 certificate of deposit (CD) and the end of two years you cash it for $551.25. What is the annual yield on this investment? 45) _____

46) Find the APY for an APR of 1.5% compounded quarterly. 46) _____

47) A bank offers a 3.75% annual interest rate compounded monthly. The APY is approximately. 47) _____

48) Find the APY for an APR of 4.75% compounded continuously. 48) _____

49) How many years will it take you to double an investment of $800 that has a 7% APY? 49) _____

50) For an investment having an APY of 8%, estimate the number of years needed to double the principal. 50) _____

51) For an investment having an APY of 9%, estimate the number of years needed to double the principal. 51) _____

52) For an investment having an APY of 5%, estimate the number of years needed to double the principal. 52) _____

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53) Find the value of a retirement savings account paying an APR of 5.8% after 45 years (contributions made at the end of each year, including the last year) when the annual contribution is $1200. Round your answer to the nearest cent. 53) _____

54) Find the value of a retirement savings account paying an APR of 6.2% after 40 years (contributions made at the end of each year, including the last year) when the annual contribution is $1680. Round your answer to the nearest cent. 54) _____

55) Find the value of a retirement savings account paying an APR of 6.2% after 40 years (contributions made at the end of each year, including the last year) when the annual contribution is $900. Round your answer to the nearest cent. 55) _____

56) The value of a retirement savings account with an annual contribution of $600 (contributions made at the end of each year, including the last year), and an APR of 5.4% after 40 years is $79,960.27.
Find the value of this retirement savings account after 52 years. Round your answer to the nearest cent. 56) _____

57) Find the value of a retirement savings account with an annual contribution of $600 (contributions made at the end of each year, including the last year), and an APR of 6.6% after 40 years. Round your answer to the nearest cent. 57) _____

58) Find the value of a retirement savings account paying an APR of 6.6% (compounded monthly) after 40 years of monthly contributions (contributions made at the end of each month, including the last month) when the monthly contribution is $100. Round your answer to the nearest cent. 58) _____

59) The value of a retirement savings account with a monthly contribution of $150 (contributions made at the end of each month, including the last month), and an APR of 6.0% (compounded monthly) after 40 years is $298,723.61. Find the value of this retirement savings account after 45 years. Round your answer to the nearest cent. 59) _____

60) The value of a retirement savings account with a monthly contribution of $150 (contributions made at the end of each month, including the last month), and an APR of 4.8% (compounded monthly) after 40 years is $217,308.21. Find the value of this retirement savings account after 50 years. Round your answer to the nearest cent. 60) _____

61) Find the value of a retirement savings account with a monthly contribution of $50 (contributions made at the end of each month, including the last month), and an APR of 6.0% (compounded monthly) after $49\frac{1}{2}$ years. Round your answer to the nearest cent. 61) _____

62) Find the value of a retirement savings account with a monthly contribution of $50 (contributions made at the end of each month, including the last month), and an APR of 4.8% (compounded monthly) after $52\frac{1}{2}$ years. Round your answer to the nearest cent. 62) _____

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63) Richard plans to retire 35 years from now, and has a goal to have $650,000 in his retirement savings account by that time. What should he contribute monthly, assuming the APR is 6.6% compounded monthly. Contributions are made at the end of the month, including the last month. Round your answer to the nearest cent. 63) _____

64) Sarah plans to contribute monthly to a savings account for her daughter's college education. Her goal is $300,000 in 20 years. Assume the APR is 5.4% compounded monthly and contributions are made monthly at the end of each month, including the last month. What amount does Sarah need to contribute each month? Round your answer to the nearest cent. 64) _____

65) What monthly contribution should you make if your goal is to have $600,000 in your retirement savings account after 45 years? Assume the APR is 6.0% compounded monthly and that contributions are made at the end of each month, including the last month. Round your answer to the nearest cent. 65) _____

66) What should your monthly contribution be if your goal is to have $400,000 in your retirement savings account after 35 years? Assume the APR is 4.8% compounded monthly and that contributions are made at the end of each month, including the last month. Round your answer to the nearest cent. 66) _____

67) What monthly contribution should you make if your goal is to have $600,000 in your retirement savings account after 45 years? Assume the APR is 6.6% compounded monthly and that contributions are made at the end of each month, including the last month. Round your answer to the nearest cent. 67) _____

68) Consider a retirement savings account where the monthly contribution is $150 for the first 15 years, is increased to $225 for the next 15 years, and then is increased once again to $300 for the last 15 years. The APR is always 4.8% compounded monthly. What is the value of the account at the end of 45 years?
Round your answer to the nearest cent. 68) _____

69) Consider a retirement savings account where the monthly contribution is $125 for the first 10 years, is increased to $225 for the next 10 years, and then is increased once again to $400 for the last 15 years. The APR is always 6.6% compounded monthly. What is the value of the account at the end of 35 years?
Round your answer to the nearest cent. 69) _____

70) Consider a retirement savings account where the monthly contribution is $100 for the first 10 years, is increased to $250 for the next 15 years, and then is increased once again to $300 for the last 10 years. The APR is always 5.4% compounded monthly. What is the value of the account at the end of 35 years?
Round your answer to the nearest cent. 70) _____

71) Consider a retirement savings account where the monthly contribution is $150 for the first 15 years, is increased to $200 for the next 20 years, and then is increased once again to $250 for the last 10 years. The APR is always 5.1% compounded monthly. What is the value of the account at the end of 45 years?
Round your answer to the nearest cent. 71) _____

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72) Consider a retirement savings account where the monthly contribution is $150 for the first 10 years, is increased to $200 for the next 20 years, and then is increased once again to $250 for the last 15 years. The APR is always 5.1% compounded monthly. What is the value of the account at the end of 45 years?
Round your answer to the nearest cent. 72) _____

73) Suppose you purchase a car and you are going to finance $16,000 for 36 months at an APR of 5.1% compounded monthly. Find the monthly payments on the loan. Round your answer to the nearest cent. 73) _____

74) Suppose you purchase a car and you are going to finance $15,000 for 60 months at an APR of 7.5% compounded monthly. Find the monthly payments on the loan. Round your answer to the nearest cent. 74) _____

75) Suppose you want to buy a car. The dealer offers a financing package consisting of a 3.6% APR compounded monthly for a term of four years. Suppose that you want your monthly payments to be at most $500. What is the maximum amount that you should finance?
Round your answer to the nearest dollar. 75) _____

76) Suppose you want to buy a car. The dealer offers a financing package consisting of a 4.8% APR compounded monthly for a term of five years. Suppose that you want your monthly payments to be at most $600. What is the maximum amount that you should finance?
Round your answer to the nearest dollar. 76) _____

77) Suppose you want to buy a car. The dealer offers a financing package consisting of a 7.2% APR compounded monthly for a term of 4.25 years. Suppose that you want your monthly payments to be at most $750. What is the maximum amount that you should finance?
Round your answer to the nearest dollar. 77) _____

78) Kayla and Sean are planning to purchase a new home. They will need to take out a 30–year home mortgage loan of $150,000. The annual interest rate for a 30–year mortgage at their bank is 6% compounded monthly. Compute their monthly mortgage payment under this loan. Round your answer to the nearest cent. 78) _____

79) Corrine has a 15–year mortgage loan of $60,000 with an interest rate of 7.2%. How much interest will she pay over the life of the loan? Round your answer to the nearest dollar. 79) _____

80) Dan has a 30–year mortgage loan of $120,000 with an interest rate of 6.6%. How much interest will he pay over the life of the loan? Round your answer to the nearest dollar. 80) _____

81) Willie just bought a house. He made a $50,000 down payment and financed the balance with a 30–year home mortgage loan with an interest rate of 5.4% compounded monthly. His monthly mortgage payment is $505.38. What was the selling price of the house?
Round your answer to the nearest dollar. 81) _____

82) You just bought a house. You made a $60,000 down payment and financed the balance with a 15–year home mortgage loan with an interest rate of 4.8% compounded monthly. Your monthly mortgage payment is $780.41. What was the selling price of the house?
Round your answer to the nearest dollar. 82) _____

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1) 0.125
2) 0.0425
3) 0.676
4) 0.00125
5) 0.000078
6) 312
7) $1.82
8) 11.5%
9) E
10) 9.6%
11) $322.50
12) $2748.32
13) $10,593.75
14) $10,658.20
15) $11,154.60
16) $6000
17) $7500
18) $7200
19) $5106.38
20) $4033.61
21) $3\frac{7}{8}\%$
22) $5\frac{1}{4}\%$
23) 10%
24) 12.5%
25) 521.43%
26) 0.35%.
27) 0.013%.
28) $5644.56
29) $2346.40
30) $4303.78
31) $40,213.15
32) $53,482.48
33) $61,593.91
34) $64,289.90
35) $3382.49
36) $4764.98
37) $3311
38) $5401
39) $2000
40) $4500
41) $7500
42) $10,000
43) $8000
44) 6.7%
45) 5%
46) 1.5085%
47) 3.8151%

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48) 4.8646%
49) 11 years
50) 9 years
51) 8 years
52) 15 years
53) $240,892.61
54) $273,440.44
55) $146,485.95
56) $160,075.29
57) $108,100.43
58) $234,767.36
59) $413,398.89
60) $373,894.95
61) $183,482.05
62) $142,078.50
63) $396.74
64) $696.75
65) $217.71
66) $368.02
67) $179.99
68) $366,146.09
69) $334,435.86
70) $227,043.78
71) $363,477.53
72) $384,840.75
73) $480.25
74) $300.57
75) $22,321
76) $31,949
77) $32,867
78) $899.33
79) $38,285
80) $155,900
81) $140,000
82) $159,999

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Chapter 11

Name_____

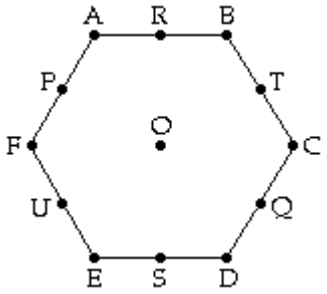
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Answer the question about rigid motions.

1) For two–dimensional objects moving in a plane, there are four possible rigid motions. Reflections and rotations are two of the possibilities. What are the other two types of rigid motions? 1) _____
   A) translations and glide reflections
   B) glide reflections and rotary reflections
   C) glide reflections and screw displacements
   D) translations and rotary reflections
   E) translations and screw displacements

2) If a point P is moved back to itself under a rigid motion *M*, P is called a ____ of the rigid motion *M*. 2) _____
   A) fixed point
   B) basic rigid motion
   C) image
   D) rigid point
   E) equivalent rigid motion

The figure below is a regular hexagon ABCDEF with center O. (P, Q, R, S, T, and U are the midpoints of the sides.)



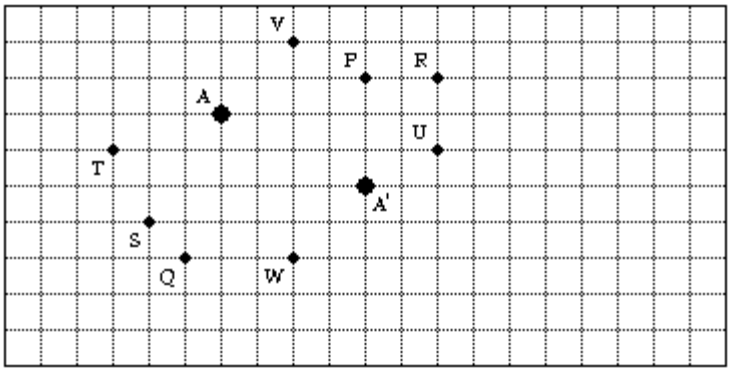
3) The image of A under the reflection with axis the line passing through B and E is 3) _____
   A) C.
   B) Q.
   C) T.
   D) D.
   E) none of these

4) The image of P under the reflection with axis the line passing through A and D is 4) _____
   A) R.
   B) Q.
   C) U.
   D) T.
   E) none of these

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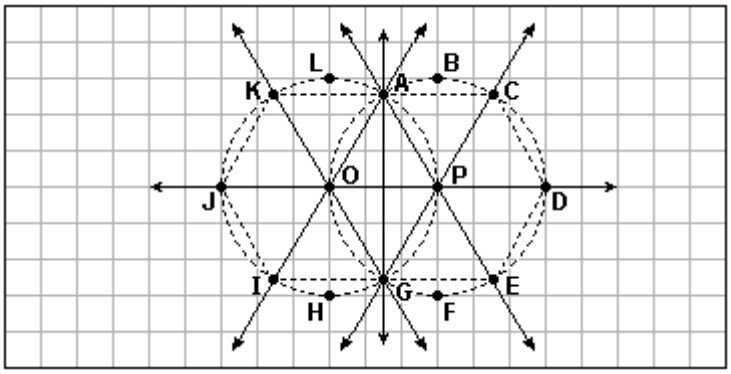
Solve the problem.

5) Given that A' is the image of point A under a reflection (shown below), the axis of reflection passes through points 5) _____



A) V and W.
B) P and Q.
C) T and U.
D) R and S.
E) none of these

Use the figure shown below to answer the question(s).

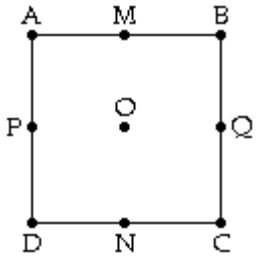


6) Point K is reflected about the line passing through points A and I. The result is then reflected about the line through G and K. The image is located at point 6) _____

A) O.
B) J.
C) K.
D) I.
E) none of these

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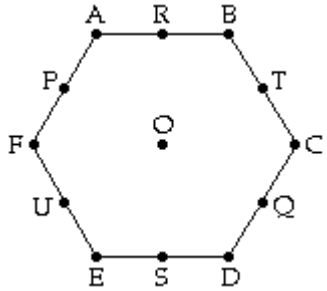
The figure below is a square ABCD with center O. (M, N, P, and Q are the midpoints of the sides.)



7) The image of A under a 90° clockwise rotation with center O is 7) _____

A) B.
B) C.
C) M.
D) D.
E) none of these

The figure below is a regular hexagon ABCDEF with center O. (P, Q, R, S, T, and U are the midpoints of the sides.)



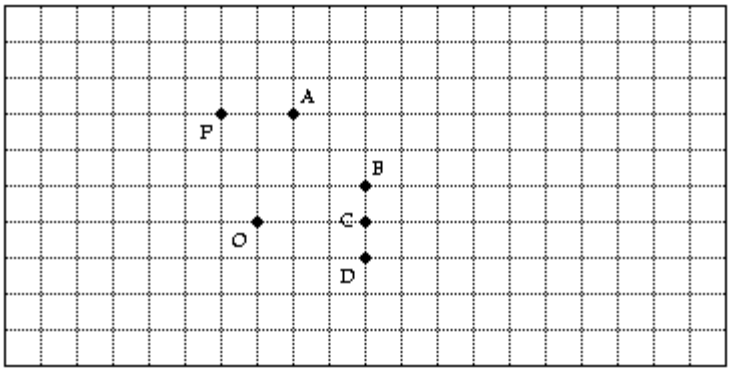
8) The image of A under a 300° counterclockwise rotation with center O is 8) _____

A) C.
B) E.
C) F.
D) B.
E) none of these

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Solve the problem.

9) In the figure shown below, the image of point P under a 90° clockwise rotation having rotocenter O is 9) _____



A) A.
B) B.
C) C.
D) D.
E) none of these

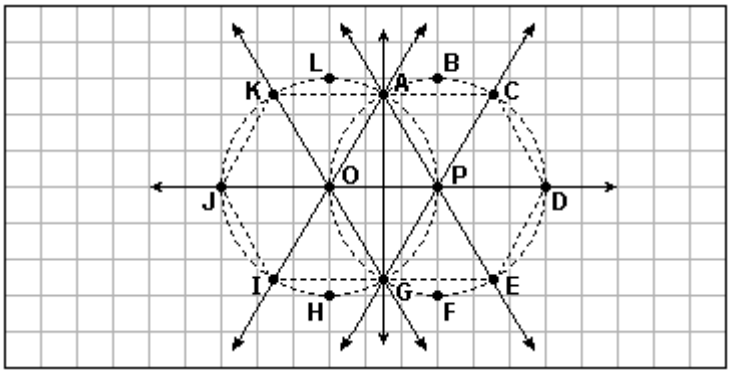
10) The result of applying a 50° clockwise rotation followed by a 50° counterclockwise rotation with the same center is 10) _____
A) a 100° counterclockwise rotation.
B) the identity motion.
C) a reflection.
D) a 100° clockwise rotation.
E) none of these

11) If an object has a 120° clockwise rotation as one of its symmetries, then it must also have as a symmetry 11) _____
A) a 180° rotation.
B) a 60° counterclockwise rotation.
C) a 120° counterclockwise rotation.
D) a 60° clockwise rotation.
E) none of these

12) The result of applying 12 consecutive 90° clockwise rotations with the same center is 12) _____
A) a reflection.
B) the identity motion.
C) a 90° counterclockwise rotation.
D) a 90° clockwise rotation.
E) none of these

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Use the figure shown below to answer the question(s).



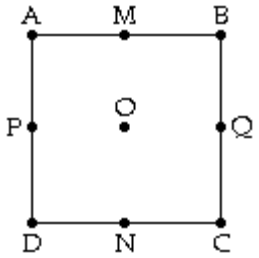
13) Triangle OJK is rotated 60° clockwise about rotocenter O. The result is translated 3 units to the right. The product of this rotation and this translation is 13) _____
A) a translation 6 units to the right
B) a 120° clockwise rotation having rotocenter O.
C) a reflection about the vertical line passing through A and G.
D) a 60° clockwise rotation having rotocenter G.
E) none of these

14) A rotation is formed by taking the product of a reflection about the line passing through A and I and a reflection about the line passing through A and G. The angle of this rotation is 14) _____
A) 60°.
B) 90°.
C) 45°.
D) 30°.
E) none of these

15) Triangle PAC is rotated 120° counterclockwise about the rotocenter P. The image is 15) _____
A) triangle PDE.
B) triangle POA.
C) triangle PGO.
D) triangle PCD.
E) none of these

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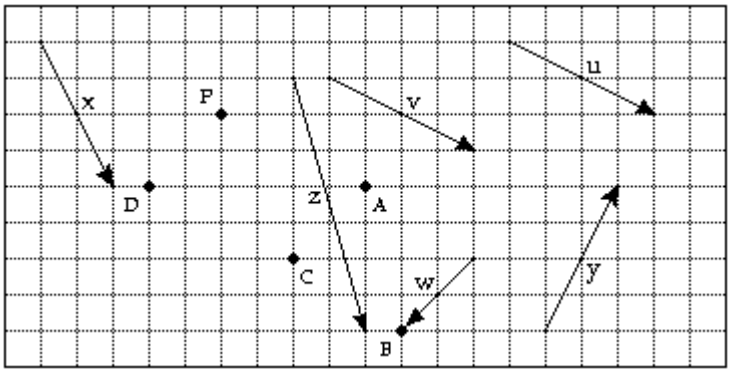
The figure below is a square ABCD with center O. (M, N, P, and Q are the midpoints of the sides.)



16) A translation sends the point A to the point Q. The image of P under this translation is 16) _____

A) B.
B) O.
C) C.
D) N.
E) none of these

Translation T_1 is determined by vector v and translation T_2 is determined by vector w as shown below.

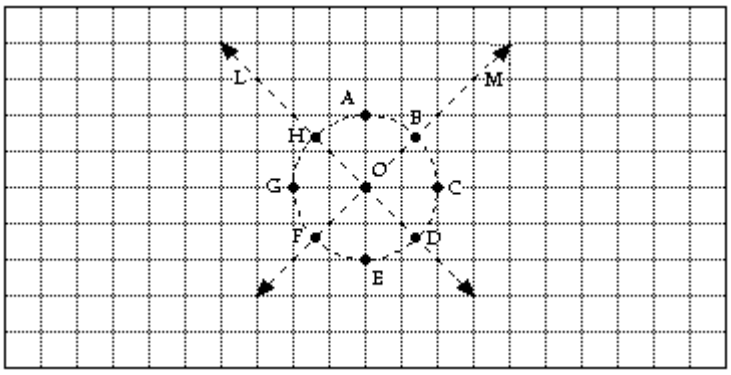


17) The image of point P under T_1 followed by T_2 is point 17) _____

A) A
B) B
C) C
D) D
E) none of these

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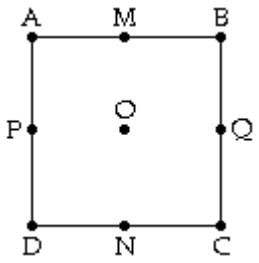
Use the figure shown below to answer the question(s).



18) If the image of point B under a translation is point D, then the image of point H is 18) _____

A) C.
B) F.
C) G.
D) B.
E) none of these

The figure below is a square ABCD with center O. (M, N, P, and Q are the midpoints of the sides.)

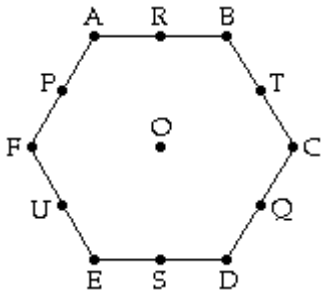


19) A glide reflection sends the point A to the point Q and the point P to the point C. The image of B under this glide reflection is 19) _____

A) P.
B) A.
C) N.
D) D.
E) none of these

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The figure below is a regular hexagon ABCDEF with center O. (P, Q, R, S, T, and U are the midpoints of the sides.)



20) A glide reflection sends the point A to the point Q and the point P to the point D. The image of U under this glide reflection is 20) _____
A) R.
B) C.
C) P.
D) B.
E) none of these

21) A glide reflection sends the point P to the point Q and the point U to the point T. The axis of reflection for this glide reflection is 21) _____
A) the line through P and Q.
B) the line through C and F.
C) the line through R and S.
D) the line through T and U.
E) none of these

Solve the problem.

22) The result of applying the same glide reflection twice is equivalent to a single 22) _____
A) reflection.
B) translation.
C) glide reflection.
D) rotation.
E) none of these

23) Which of the following is a symmetry of the letter C? 23) _____
A) a 90° rotation
B) a reflection with axis a vertical line
C) a 180° rotation
D) a reflection with axis a horizontal line
E) none of these

24) Which of the following are symmetries of the letter Z? 24) _____
A) a reflection with axis a diagonal line
B) a reflection with axis a vertical line
C) a 180° rotation
D) a reflection with axis a horizontal line
E) none of these

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25) What are the symmetries of the symbol $\oint$? 25) _____

A) a reflection with axis a vertical line
B) a 180° rotation
C) a reflection with axis a horizontal line
D) all of these
E) none of these

26) The letter B has symmetry type 26) _____

A) Z_1.
B) Z_2.
C) D_1.
D) D_2.
E) none of these

27) The letter C has a symmetry type 27) _____

A) Z_2.
B) D_1.
C) Z_1.
D) D_2.
E) none of these

28) The letter Z has a symmetry type 28) _____

A) Z_2.
B) D_2.
C) D_1.
D) Z_1.
E) none of these

29) The greek letter Γ (gamma) has symmetry type 29) _____

A) Z_2.
B) D_1.
C) D_2.
D) Z_1.
E) none of these

30) The symbol $\S$ has symmetry type 30) _____

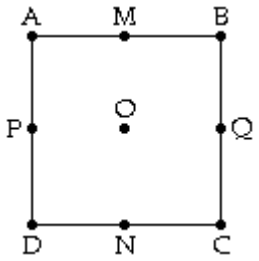
A) Z_1.
B) Z_2.
C) D_1.
D) D_2.
E) none of these

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31) Which of the following letters has the same symmetry type as the letter X? 31) _____

A) E
B) M
C) U
D) H
E) none of these

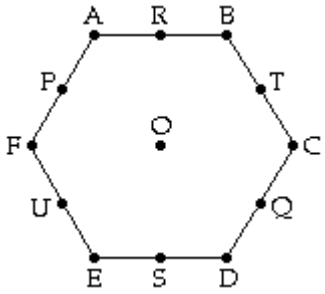
The figure below is a square ABCD with center O. (M, N, P, and Q are the midpoints of the sides.)



32) Which of the following reflections is not a symmetry of the square? 32) _____

A) the reflection with axis the line passing through A and B
B) the reflection with axis the line passing through A and C
C) the reflection with axis the line passing through M and N
D) the reflection with axis the line passing through P and Q
E) all of these are symmetries of the square.

The figure below is a regular hexagon ABCDEF with center O. (P, Q, R, S, T, and U are the midpoints of the sides.)



33) Which of the following reflections is not a symmetry of the regular hexagon? 33) _____

A) the reflection with axis the line passing through A and B
B) the reflection with axis the line passing through R and S
C) the reflection with axis the line passing through A and D
D) the reflection with axis the line passing through P and Q
E) all of these are symmetries of the regular hexagon.

34) Which of the following rotations is not a symmetry of the regular hexagon? 34) _____

A) a 180° clockwise rotation with center O
B) a 90° clockwise rotation with center O
C) a 120° counterclockwise rotation with center O
D) a 60° clockwise rotation with center O
E) none of these

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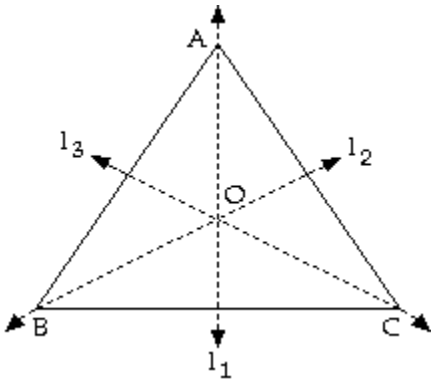
Solve the problem.

35) Which of the following has symmetry type D_∞? 35) _____

A) sand dollar
B) wedding band
C) octopus
D) human face
E) piece of blank paper

Refer to the equilateral triangle shown below and its six symmetries:

- **r_1 : reflection with axis l_1**
- **r_2 : reflection with axis l_2**
- **r_3 : reflection with axis l_3**
- **R_1 : 120° clockwise rotation with rotocenter O**
- **R_2 : 240° clockwise rotation with rotocenter O**
- **I : the identity symmetry**



36) Which symmetry results when applying the symmetry R_2 followed by r_1 ? 36) _____

A) r_2 B) R_1 C) r_3 D) r_1 E) R_2

Solve the problem.

37) The symmetry type of the border pattern . . . Z Z Z Z Z Z . . . is 37) _____

A) 1g.
B) 12.
C) 11.
D) 1m.
E) none of these

38) The kind of symmetries found in the border pattern . . . p b q d p b q d p b q d . . . are the identity and 38) _____

A) translations, glide reflections, and half–turns only.
B) translations and half–turns only.
C) translations and glide reflections only.
D) translations only.
E) none of these

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39) The symmetry type of the border pattern . . . p b q d p b q d p b q d . . . is 39) _____

A) 1m.
B) 12.
C) mg.
D) 1g.
E) none of these

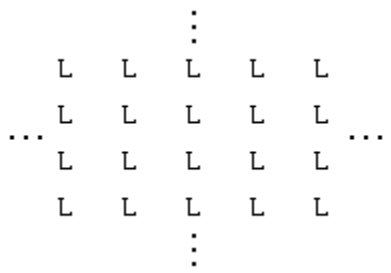
40) The kind of symmetries found in the border pattern . . . p b p b p b . . . are the identity and 40) _____

A) translations and half–turns only.
B) translations, glide reflections, and half–turns only.
C) translations and glide reflections only.
D) translations only.
E) none of these

41) In a wallpaper pattern, 41) _____

A) there is translation symmetry in exactly one direction.
B) there may or may not be translation symmetry.
C) there is translation symmetry in at least two different directions.
D) there is translation symmetry in at least four different directions.
E) none of these

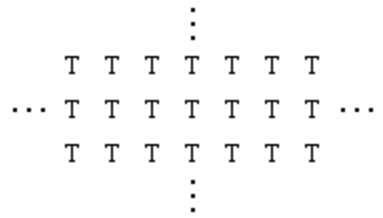
42) The kind of symmetries found in the wallpaper pattern shown below are the identity and 42) _____



A) translations and horizontal reflections only.
B) translations and 180° rotations only.
C) translations only.
D) translations and vertical reflections only.
E) none of these

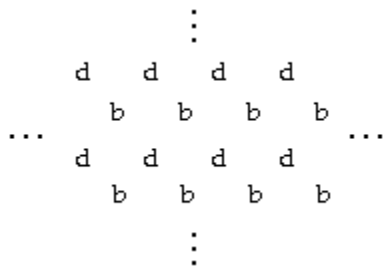
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43) The kind of symmetries found in the wallpaper pattern shown below are the identity and 43) _____



A) translations and 180° rotations only.
B) translations and vertical reflections only.
C) translations and horizontal reflections only.
D) translations only.
E) none of these

44) The kind of symmetries found in the wallpaper pattern shown below are the identity and 44) _____



A) translations and vertical reflections only.
B) translations and glide reflections only.
C) translations, reflections and rotations only.
D) translations only.
E) none of these

45) The identity motion is 45) _____
A) not a symmetry.
B) a symmetry of finite objects only.
C) a symmetry of borders and wallpapers only.
D) a symmetry of every object.
E) none of these

46) Which of the following statements is not true? 46) _____
A) There are exactly seven different types of border patterns.
B) There are seventeen different types of wallpaper patterns.
C) Every border pattern must have translation symmetry in the direction of the pattern.
D) Every wallpaper pattern must have translation symmetries in at least two different directions.
E) All of these statements are true.

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Answer Key
Testname: CHAPTER 11

1) A
2) A
3) A
4) A
5) E
6) D
7) A
8) D
9) B
10) B
11) C
12) B
13) D
14) D
15) C
16) C
17) C
18) B
19) A
20) E
21) B
22) B
23) D
24) C
25) B
26) C
27) B
28) A
29) D
30) B
31) D
32) A
33) A
34) B
35) B
36) A
37) B
38) B
39) B
40) C
41) C
42) C
43) B
44) B
45) D
46) E

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Chapter 11

Name_____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

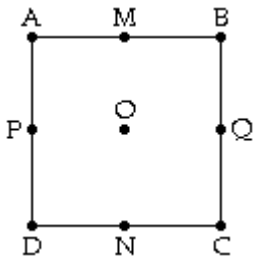
Answer the question about rigid motions.

1) For two–dimensional objects moving in a plane, there are four possible rigid motions. Reflections and rotations are two of the possibilities. What are the other two types of rigid motions? 1) _____

2) If a point P is moved back to itself under a rigid motion *M*, P is called a ____ of the rigid motion *M*. 2) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

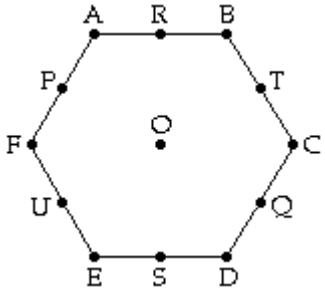
The figure below is a square ABCD with center O. (M, N, P, and Q are the midpoints of the sides.)



3) The image of A under the reflection with axis the line passing through M and P is 3) _____

A) D.
B) O.
C) C.
D) B.
E) none of these

The figure below is a regular hexagon ABCDEF with center O. (P, Q, R, S, T, and U are the midpoints of the sides.)



4) The image of A under the reflection with axis the line passing through B and E is 4) _____

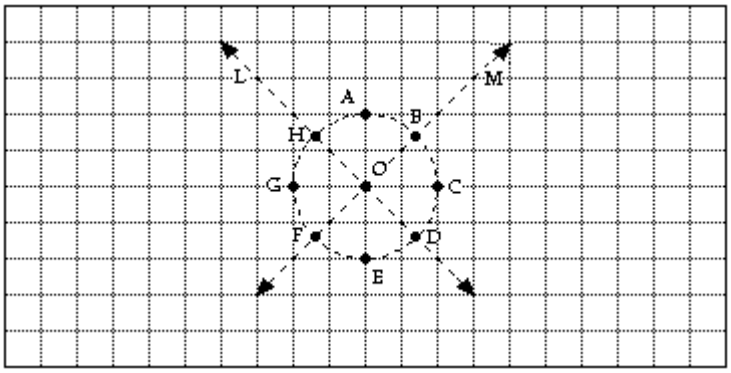
A) D.
B) T.
C) C.
D) Q.
E) none of these

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5) The image of P under the reflection with axis the line passing through A and D is 5) _____

A) T.
B) U.
C) R.
D) Q.
E) none of these

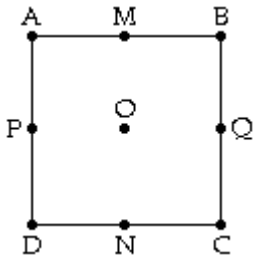
Use the figure shown below to answer the question(s).



6) The image of point A under a reflection about the line L followed by a 90° clockwise rotation having rotocenter O is 6) _____

A) A.
B) G.
C) C.
D) E.
E) none of these

The figure below is a square ABCD with center O. (M, N, P, and Q are the midpoints of the sides.)



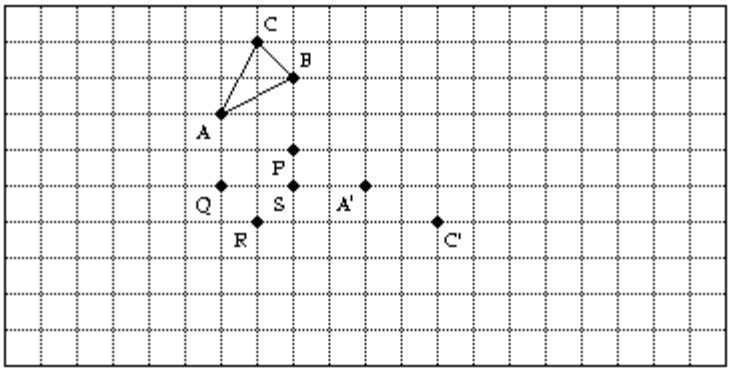
7) The image of A under a 90° clockwise rotation with center O is 7) _____

A) M.
B) D.
C) C.
D) B.
E) none of these

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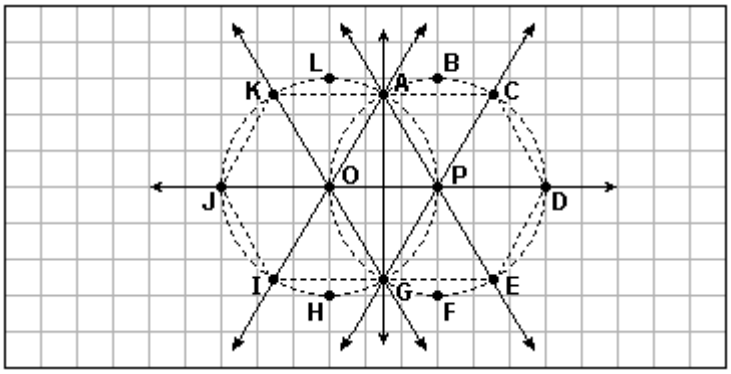
Solve the problem.

8) In the figure shown below, A' is the image of A and C' is the image of C under a rotation having a rotocenter located at point 8) _____



A) S.
B) P.
C) R.
D) Q.
E) none of these

Use the figure shown below to answer the question(s).



9) Find the image of point K under a 7590° clockwise rotation about the rotocenter O. 9) _____

A) G
B) P
C) A
D) L
E) none of these

Solve the problem.

10) A 7216° clockwise rotation is equivalent to 10) _____

A) a 344° counterclockwise rotation.
B) a 16° clockwise rotation.
C) a 376° clockwise rotation.
D) all of these
E) none of these

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11) If an object has a 30° clockwise rotation as one of its symmetries, then it must also have as a symmetry 11) _____

A) a 90° clockwise rotation.
B) a reflection.
C) a translation.
D) a 45° clockwise rotation.
E) none of these

12) If an object has a 120° clockwise rotation as one of its symmetries, then it must also have as a symmetry 12) _____

A) a 180° rotation.
B) a 120° counterclockwise rotation.
C) a 60° clockwise rotation.
D) a 60° counterclockwise rotation.
E) none of these

13) If an object has a 240° clockwise rotation as one of its symmetries, then it must also have as a symmetry 13) _____

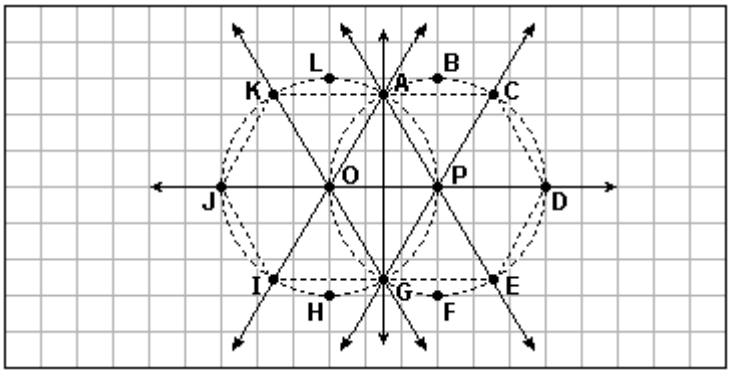
A) a 90° counterclockwise rotation.
B) a 120° clockwise rotation.
C) a 180° rotation.
D) a 90° clockwise rotation.
E) none of these

14) The result of applying 12 consecutive 90° clockwise rotations with the same center is 14) _____

A) a reflection.
B) a 90° clockwise rotation.
C) a 90° counterclockwise rotation.
D) the identity motion.
E) none of these

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Use the figure shown below to answer the question(s).



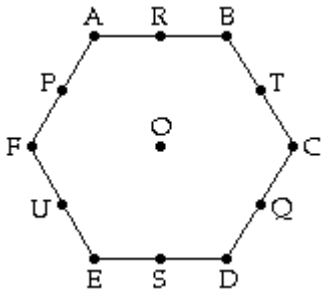
15) Reflecting any point A through H on the circle about the line L and then about the line M is equivalent to 15) _____

A) a reflection about the horizontal line through C and G.
B) a 180° rotation about the rotocenter O.
C) a reflection about the vertical line through A and E.
D) the identity motion.
E) none of these

16) Triangle PAC is rotated 120° counterclockwise about the rotocenter P. The image is 16) _____

A) triangle PDE.
B) triangle POA.
C) triangle PGO.
D) triangle PCD.
E) none of these

The figure below is a regular hexagon ABCDEF with center O. (P, Q, R, S, T, and U are the midpoints of the sides.)

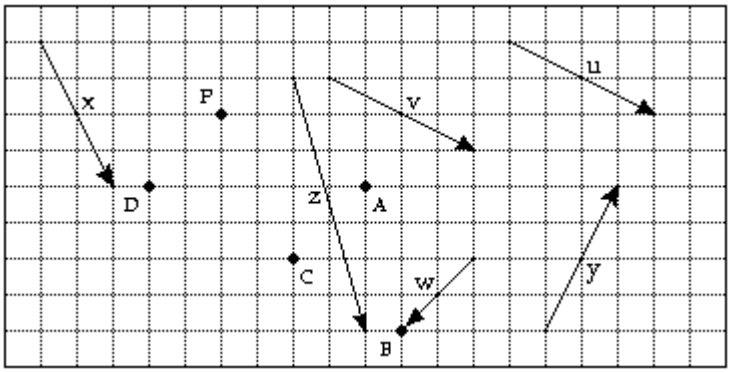


17) A translation sends the point A to the point C. The image of F under this translation is 17) _____

A) D.
B) B.
C) S.
D) Q.
E) none of these

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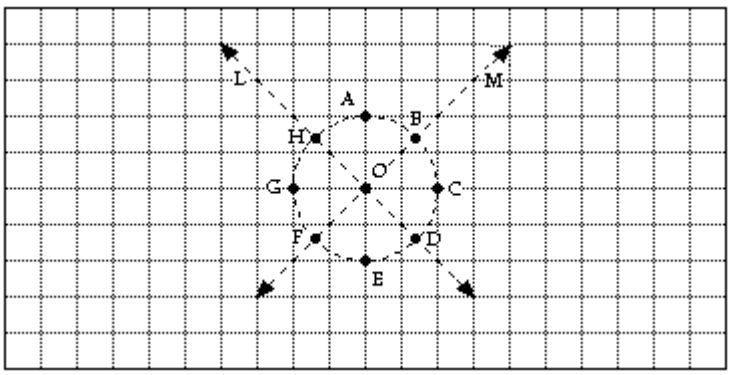
Translation T_1 is determined by vector v and translation T_2 is determined by vector w as shown below.



18) The image of point P under T_1 followed by T_2 is point 18) _____

A) A
B) B
C) C
D) D
E) none of these

Use the figure shown below to answer the question(s).



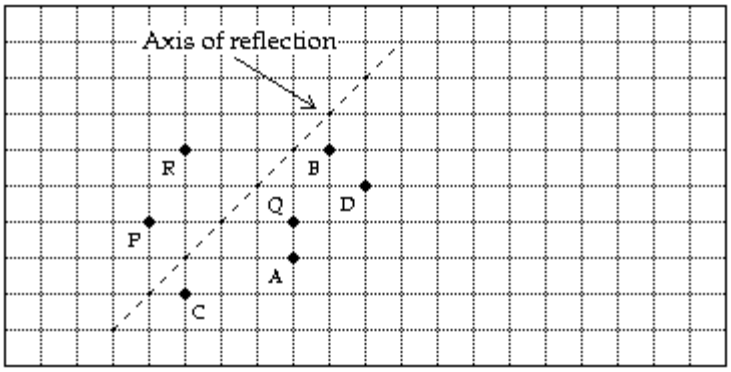
19) If the image of point B under a translation is point D, then the image of point H is 19) _____

A) F.
B) C.
C) B.
D) G.
E) none of these

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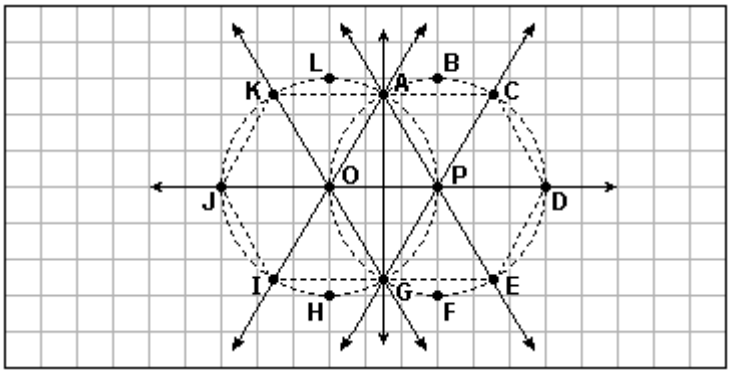
Solve the problem.

20) A glide reflection having axis of reflection as shown below sends point P to point Q. The image of point R under this same glide reflection is 20) _____



A) A
B) B
C) C
D) D
E) none of these

Use the figure shown below to answer the question(s).



21) The image of triangle OKA under a glide reflection is triangle PGE. The image of triangle OIJ under this glide reflection is 21) _____

A) triangle PAO.
B) triangle OKA.
C) triangle DCP.
D) triangle PAC.
E) none of these

Solve the problem.

22) The result of applying the same glide reflection twice is equivalent to a single 22) _____

A) translation.
B) rotation.
C) glide reflection.
D) reflection.
E) none of these

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23) What are the symmetries of the letter B? 23) _____

A) a 90° rotation
B) a reflection with axis a horizontal line
C) a reflection with axis a vertical line
D) all of these
E) none of these

24) Which of the following are symmetries of the letter D? 24) _____

A) a reflection with axis a diagonal line
B) a 90° rotation
C) a reflection with axis a horizontal line
D) a reflection with axis a vertical line
E) none of these

25) Which of the following are symmetries of the letter Z? 25) _____

A) a 180° rotation
B) a reflection with axis a diagonal line
C) a reflection with axis a vertical line
D) a reflection with axis a horizontal line
E) none of these

26) The greek letter Γ (gamma) has symmetry type 26) _____

A) Z_1.
B) D_1.
C) D_2.
D) Z_2.
E) none of these

27) 27) _____

The symbol  has symmetry type

A) Z_1.
B) Z_2.
C) D_1.
D) D_2.
E) none of these

28) Which of the following letters has the same symmetry type as the letter X? 28) _____

A) M
B) E
C) U
D) H
E) none of these

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29) The symmetry type of an equilateral triangle is 29) _____

A) D_3.

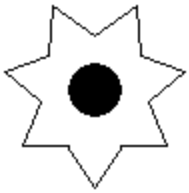
B) D_2.

C) Z_3.

D) Z_2.

E) none of these

30) Determine the symmetry type of the object shown below. 30) _____



A) Z_7

B) Z_{14}

C) D_7

D) D_{14}

E) none of these

31) Determine the symmetry type of the object shown below. 31) _____



A) Z_7

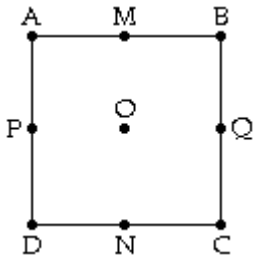
B) Z_{14}

C) D_7

D) D_{14}

E) none of these

The figure below is a square ABCD with center O. (M, N, P, and Q are the midpoints of the sides.)



32) Which of the following reflections is not a symmetry of the square? 32) _____

A) the reflection with axis the line passing through M and N

B) the reflection with axis the line passing through P and Q

C) the reflection with axis the line passing through A and C

D) the reflection with axis the line passing through A and B

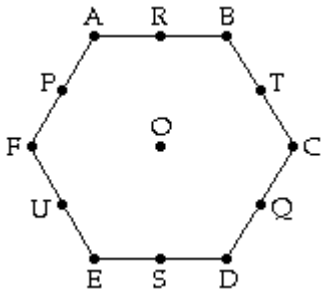
E) all of these are symmetries of the square.

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33) Which of the following translations is a symmetry of the square? 33) _____

A) a translation that sends A to B
B) a translation that sends A to C
C) a translation that sends P to Q
D) a translation that sends A to O
E) none of these

The figure below is a regular hexagon ABCDEF with center O. (P, Q, R, S, T, and U are the midpoints of the sides.)



34) Which of the following reflections is not a symmetry of the regular hexagon? 34) _____

A) the reflection with axis the line passing through A and D
B) the reflection with axis the line passing through R and S
C) the reflection with axis the line passing through A and B
D) the reflection with axis the line passing through P and Q
E) all of these are symmetries of the regular hexagon.

Solve the problem.

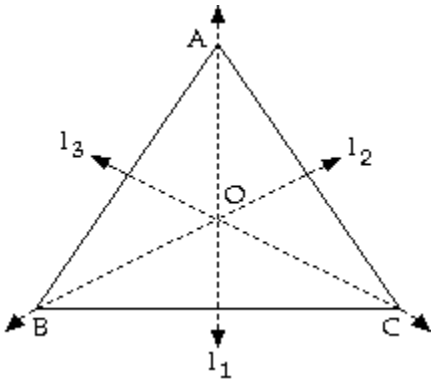
35) Which of the following has symmetry type Z_1? 35) _____

A) sand dollar
B) hex nut
C) basketball
D) calculator
E) starfish

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Refer to the equilateral triangle shown below and its six symmetries:

- **r_1 : reflection with axis l_1**
- **r_2 : reflection with axis l_2**
- **r_3 : reflection with axis l_3**
- **R_1 : 120° clockwise rotation with rotocenter O**
- **R_2 : 240° clockwise rotation with rotocenter O**
- **I : the identity symmetry**



36) Which symmetry results when applying the symmetry r_1 followed by R_2 ? 36) _____

A) r_3 B) r_2 C) R_2 D) R_1 E) r_1

Solve the problem.

37) The kind of symmetries found in the border pattern . . . Z Z Z Z Z Z . . . are the identity and 37) _____

A) translations only.
B) translations and horizontal reflections only.
C) translations and vertical reflections only.
D) translations and half–turns only.
E) none of these

38) The symmetry type of the border pattern . . . Z Z Z Z Z Z . . . is 38) _____

A) 12.
B) 11.
C) 1m.
D) 1g.
E) none of these

39) The symmetry type of the border pattern . . . p b q d p b q d p b q d . . . is 39) _____

A) 1m.
B) mg.
C) 1g.
D) 12.
E) none of these

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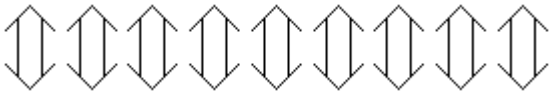
40) The kind of symmetries found in the border pattern . . . p b p b p b . . . are the identity and 40) _____

A) translations, glide reflections, and half–turns only.
B) translations only.
C) translations and half–turns only.
D) translations and glide reflections only.
E) none of these

41) The symmetry type of the border pattern . . . Ψ Ψ Ψ Ψ Ψ . . . is 41) _____

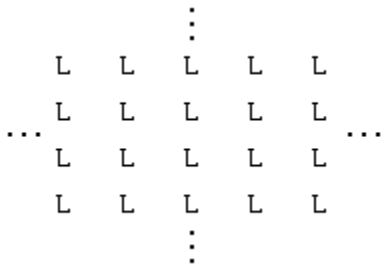
A) mg.
B) m1.
C) mm.
D) 1m.
E) none of these

42) The border pattern shown below is of type 42) _____



A) mg.
B) m1.
C) 1m.
D) mm.
E) none of these

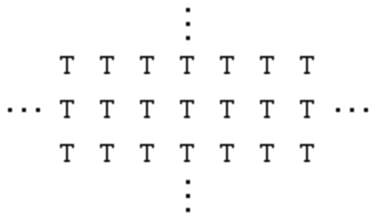
43) The kind of symmetries found in the wallpaper pattern shown below are the identity and 43) _____



A) translations and horizontal reflections only.
B) translations only.
C) translations and 180° rotations only.
D) translations and vertical reflections only.
E) none of these

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44) The kind of symmetries found in the wallpaper pattern shown below are the identity and 44) _____



A) translations and vertical reflections only.
B) translations only.
C) translations and horizontal reflections only.
D) translations and 180° rotations only.
E) none of these

45) The identity motion is 45) _____
A) a symmetry of finite objects only.
B) a symmetry of every object.
C) a symmetry of borders and wallpapers only.
D) not a symmetry.
E) none of these

46) Which of the following statements is not true? 46) _____
A) Every border pattern must have translation symmetry in the direction of the pattern.
B) There are seventeen different types of wallpaper patterns.
C) Every wallpaper pattern must have translation symmetries in at least two different directions.
D) There are exactly seven different types of border patterns.
E) All of these statements are true.

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1) translations and glide reflections
2) fixed point
3) B
4) C
5) C
6) A
7) D
8) C
9) D
10) D
11) A
12) B
13) B
14) D
15) B
16) C
17) A
18) C
19) A
20) D
21) A
22) A
23) B
24) C
25) A
26) A
27) B
28) D
29) A
30) C
31) A
32) D
33) E
34) C
35) D
36) A
37) D
38) A
39) D
40) D
41) B
42) D
43) B
44) A
45) B
46) E

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Chapter 12

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

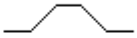
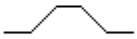
Solve the problem.

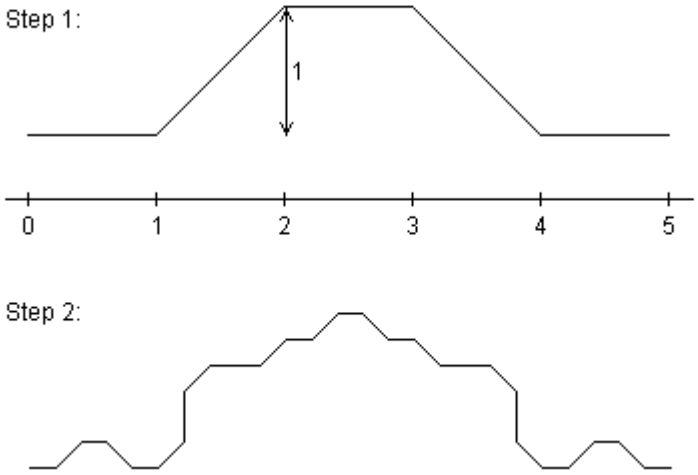
1) If the area of the seed triangle in the construction of the Koch snowflake is 10, then the area of the Koch snowflake is 1) _____
   A) 0.
   B) infinite.
   C) 16.
   D) 20.
   E) none of these

2) The Koch snowflake is a geometric shape with 2) _____
   A) infinite area and infinite perimeter.
   B) infinite area and finite perimeter.
   C) finite area and infinite perimeter.
   D) finite area and finite perimeter.
   E) none of these

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The following question(s) refer to a fractal defined by the recursive procedure :

- **Start with a line segment of length 5.**
- **Step 1: Replace the line segment with**  **(see figure below).**
- **Step 2: Replace each line segment in the previous figure with**  **(see figure below).**
- **Step 3, 4, 5, etc.: Replace each line segment in the previous figure with**  **.**



3) What is the length of the figure at step 1 of the construction? 3) _____

A) $5\sqrt{2}$
B) $7 + 2\sqrt{2}$
C) $3 + 2\sqrt{2}$
D) 5
E) none of these

4) How many line segments appear in step 2 of the construction? 4) _____

A) 2^5
B) 5×2
C) 5
D) 5^2
E) none of these

5) How many line segments appear in step 4 of the construction? 5) _____

A) 5
B) 5^4
C) 4^5
D) 5×4
E) none of these

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6) How many line segments appear in step N of the construction? 6) _____

A) $5 \times N$

B) N

C) N^5

D) 5^N

E) none of these

7) What is the length of the leftmost line segment in step 3 of the construction? 7) _____

A) $\left(\frac{1}{3}\right)^5$

B) $\left(\frac{1}{5}\right)^2$

C) $\frac{1}{3}$

D) $\left(\frac{1}{5}\right)^3$

E) none of these

8) What is the length of the figure at step N of the construction? 8) _____

A) $3N + 2N\sqrt{2}$

B) $\frac{(3 + 2\sqrt{2})^N}{5^{N-1}}$

C) $N \times \frac{3 + \sqrt{2}}{5}$

D) $N^{(3 + \sqrt{2})/5}$

E) none of these

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Refer to the figures and recursive rules below to answer the following question(s).



Figure 1



Figure 2



Figure 3

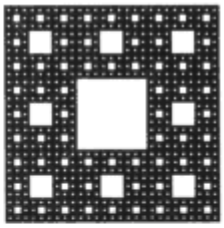


Figure 4

Rule A: • Start with a solid black equilateral triangle. • Whenever you see an edge $\frac{\text{white}}{\text{black}}$ replace it with .
Rule B: • Start with a solid black triangle. • Whenever you see a  replace it with a .
Rule C: • Start with a solid black square. • Whenever you see an edge $\frac{\text{white}}{\text{black}}$ replace it with .
Rule D: • Start with a solid black square. • Whenever you see a square, subdivide the square into nine equal subsquares and remove the central subsquare.
Rule E: • Start with a solid black equilateral triangle. • Whenever you see an edge $\frac{\text{white}}{\text{black}}$ replace it with .

9) Which of the figures above best approximates the Koch snowflake? 9) _____

A) Figure 4
B) Figure 2
C) Figure 1
D) Figure 3
E) none of these

Solve the problem.

10) Of the following objects in nature, which one could never have self–similarity? 10) _____

A) a soap bubble
B) a coastline
C) a mountain
D) a cloud
E) all of these could have self–similarity

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11) At step 1 in the construction of the Sierpinski gasket, there is 1 hole. At step 2 in the construction, there are 4 holes. How many holes are there at step 4 of the construction? 11) _____

A) 10.
B) 13.
C) 121.
D) 40.
E) none of these

12) Assume that the seed square of the Sierpinski carpet has area A = 8. Find the area of the "carpet" obtained in Step 2 of the construction. 12) _____

A) $\frac{81}{64}$ B) $\frac{64}{9}$ C) $\frac{4096}{81}$ D) $\frac{4096}{729}$ E) $\frac{512}{81}$

13) Assume that the seed triangle of the Sierpinski ternary gasket has area A = 2. Find the area of the "ternary gasket" obtained in Step 3 of the construction. 13) _____

A) $\frac{32}{81}$ B) $\frac{8}{27}$ C) $\frac{16}{9}$ D) $\frac{8}{9}$ E) $\frac{16}{27}$

14) Assume that the seed square of the Sierpinski L has area A = 4. Find the area of the shape obtained in Step 4 of the construction. 14) _____

A) $\frac{27}{16}$ B) $\frac{81}{256}$ C) $\frac{81}{64}$ D) $\frac{64}{81}$ E) $\frac{27}{64}$

15) Assume that the seed square of the Sierpinski L has perimeter P = 8. Find the length of the boundary of the shape obtained in Step 3 of the construction. 15) _____

A) 10 B) 56 C) 40 D) 12 E) 14

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Refer to the figures and recursive rules below to answer the following question(s).



Figure 1



Figure 2



Figure 3

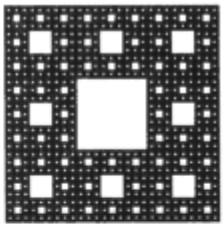


Figure 4

Rule A: • Start with a solid black equilateral triangle. • Whenever you see an edge $\frac{\text{white}}{\text{black}}$ replace it with ▲.
Rule B: • Start with a solid black triangle. • Whenever you see a ▲ replace it with a ▲▲.
Rule C: • Start with a solid black square. • Whenever you see an edge $\frac{\text{white}}{\text{black}}$ replace it with ■.
Rule D: • Start with a solid black square. • Whenever you see a square, subdivide the square into nine equal subsquares and remove the central subsquare.
Rule E: • Start with a solid black equilateral triangle. • Whenever you see an edge $\frac{\text{white}}{\text{black}}$ replace it with $\frac{\text{white}}{\text{black}\quad\text{black}}$.

16) Which of the figures above approximates the result of recursively applying Rule B infinitely many times? 16) _____

A) Figure 1
B) Figure 3
C) Figure 4
D) Figure 2
E) none of these

17) Which of the figures above approximates the result of recursively applying Rule C infinitely many times? 17) _____

A) Figure 1
B) Figure 3
C) Figure 2
D) Figure 4
E) none of these

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18) Which of the figures above approximates the result of recursively applying Rule D infinitely many times? 18) _____

A) Figure 3
B) Figure 2
C) Figure 1
D) Figure 4
E) none of these

19) Which of the figures above approximates the result of recursively applying Rule E infinitely many times? 19) _____

A) Figure 2
B) Figure 3
C) Figure 4
D) Figure 1
E) none of these

Refer to the following Chaos game to answer the question(s): Start with a square ABCD in which A is located at (0, 0), B is located at (27, 0), C is located at (27, 27), and D is located at (0, 27). Then, roll a fair die. We will say that A is the "winner" if we roll a 1, B is if we roll a 2, C is if we roll a 3, and D is if we roll a 4. If we roll a 5 or 6, we disregard the roll and roll again. Each roll of the die generates a point inside or on the boundary of the square according to the following rules.

• Start: Roll the die. Mark the "winning" vertex and call it P_1.

• Step 1: Roll the die again. From P_1 move two–thirds of the way straight toward the next winning vertex. Mark this point and call it P_2.

• Steps 2, 3, etc.: Continue rolling the die, each time moving to a point two –thirds of the way from the last position to the winning vertex.

20) Determine the coordinates of the point P_2 corresponding to the sequence of rolls 4, 3, 2, 1. 20) _____

A) (27, 27)
B) (8, 3)
C) (18, 27)
D) (24, 9)
E) none of these

21) Determine the coordinates of the point P_3 corresponding to the sequence of rolls 4, 3, 2, 1. 21) _____

A) (27, 27)
B) (24, 9)
C) (8, 3)
D) (18, 27)
E) none of these

22) Determine the coordinates of the point P_2 corresponding to the sequence of rolls 1, 2, 2, 1. 22) _____

A) (18, 0)
B) (8, 0)
C) (0, 0)
D) (24, 0)
E) none of these

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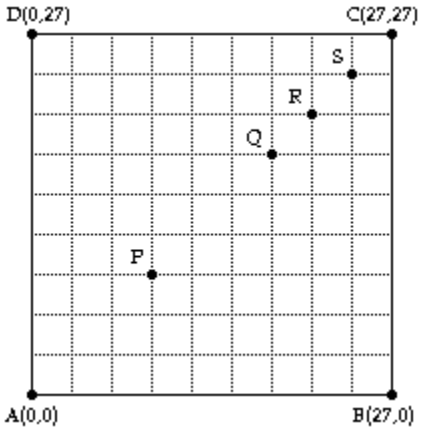
23) Determine the coordinates of the point P_3 corresponding to the sequence of rolls 1, 2, 2, 1. 23) _____

A) (0, 0)
B) (24, 0)
C) (8, 0)
D) (18, 0)
E) none of these

24) Determine the coordinates of the point P_4 corresponding to the sequence of rolls 1, 2, 2, 1. 24) _____

A) (18, 0)
B) (24, 0)
C) (8, 0)
D) (0, 0)
E) none of these

25) Refer to the following figure to answer the question. 25) _____



Point R is determined by which of the following sequence of rolls?

A) 1, 3, 3
B) 3, 3, 1
C) 1, 1, 3
D) 3, 1, 3
E) none of these

Answer the question about the twisted Sierpinski gasket.

26) Which of the following statements about the twisted Sierpinski gasket is/are true? 26) _____

I. The boundary is infinitely long.
II. The area is infinitely large.
III. The self–similarity is exact, infinite, and universal.

A) I only
B) III only
C) I, II, and III
D) II and III
E) I and II

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27) The following properties describe the Sierpinski gasket and/or the twisted Sierpinski gasket. Which properties apply ONLY to the twisted Sierpinski gasket? 27) _____

I. Infinitely long boundary
II. Infinitely small area
III. Exact, infinite, and universal self–similarity
IV. Approximate, infinite, and universal self–similarity

A) I, II, and IV
B) I, III, and IV
C) I and II
D) III only
E) IV only

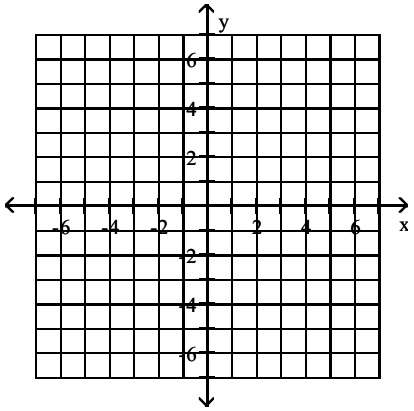
Simplify the expression.

28) $i(1 + i)$ 28) _____

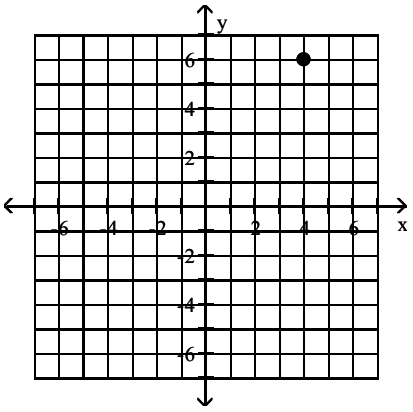
A) 2.
B) $1 + i$.
C) $-1 + i$.
D) 0.
E) none of these

Solve the problem.

29) Plot the point corresponding to the complex number $(6 + 4i)$. 29) _____

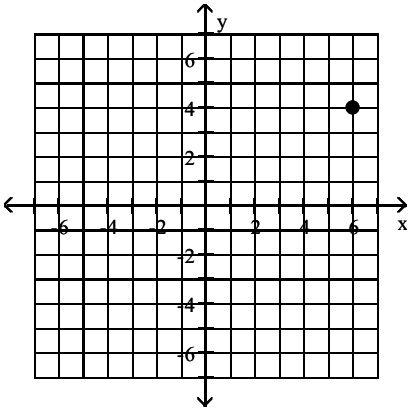


A)

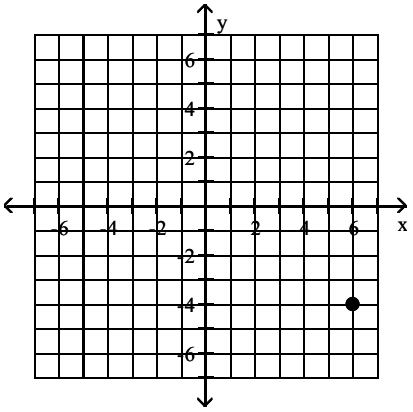


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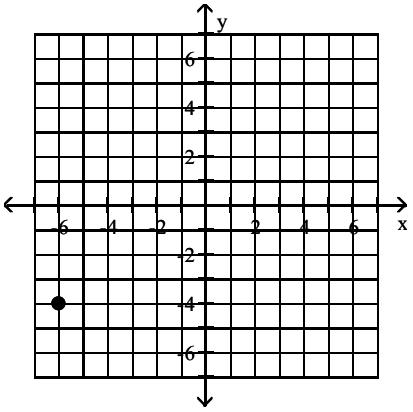
B)



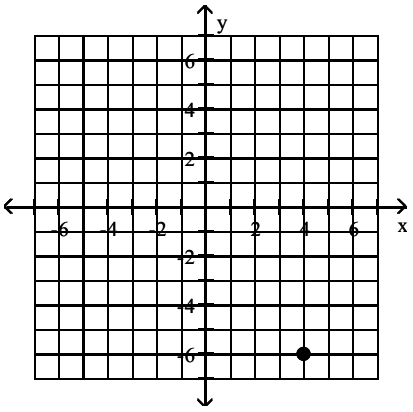
C)



D)

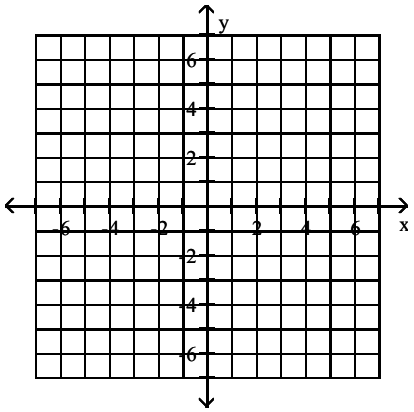


E)

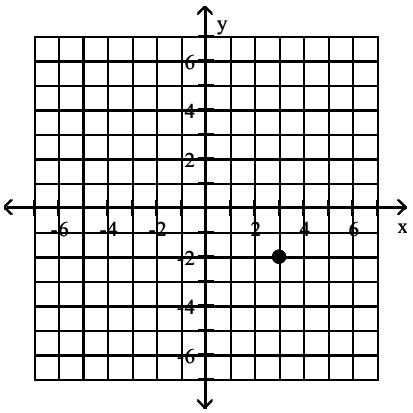


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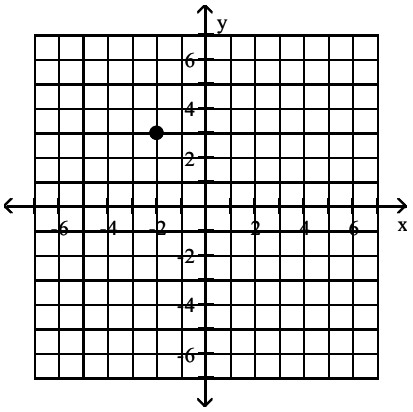
30) Plot the point corresponding to the complex number $(-i)^2(2 - 3i)$. 30) _____



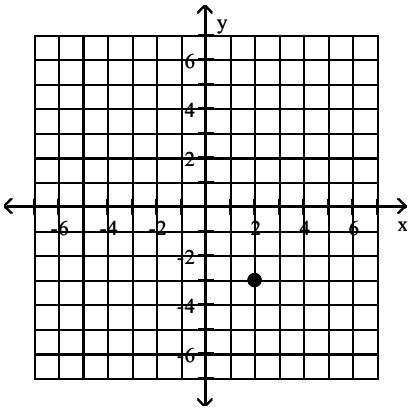
A)



B)

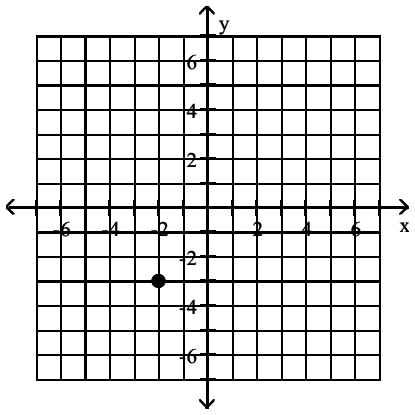


C)

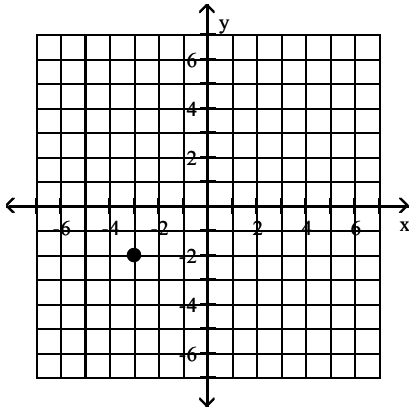


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D)



E)



To answer the following question(s), refer to the Mandelbrot replacement process described by:

• Start: Choose an arbitrary complex number s, called the seed of the Mandelbrot sequence. Set the seed s to be the initial term of the sequence ($s_0 = s$).

• Procedure M: To find the next term in the sequence, square the preceding term and add the seed ($s_{N+1} = s_N^2 + s$).

31) For the seed s = 2, the second and third values of the sequence (s_1 and s_2) are given by 31) _____

A) 2 and 2.
B) 6 and 38.
C) 6 and 42.
D) 4 and 16.
E) none of these

32) For the seed s = 3, the second and third values of the sequence (s_1 and s_2) are given by 32) _____

A) 3 and 6.
B) 3 and 3.
C) 12 and 147.
D) 6 and 142.
E) none of these

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33) For the seed s = –1, the second, third, and fourth values of the sequence (s_1, s_2, and s_3) are given by 33) _____

A) 2, 3, and 7.
B) 0, –1, and 0.
C) 0, 1, and 0.
D) 0, 0, and 0.
E) none of these

34) For the seed s = –3, the Mandelbrot replacement process 34) _____

A) is periodic.
B) gives values that have no pattern.
C) gives values that get closer and closer to –1.
D) goes off to infinity.
E) none of these

35) Suppose that when we apply the Mandelbrot replacement process we get $s_6 = 2$ and $s_7 = 2$. Then the seed s is 35) _____

A) s = –1.
B) s = –2.
C) s = 2.
D) s = 1.
E) none of these

36) If we apply the Mandelbrot replacement process to the seed s = 2i, then s_1 = 36) _____

A) –4 + 2i.
B) 4i.
C) –4.
D) –2i.
E) none of these

37) If we apply the Mandelbrot replacement process to the seed s = 1 – i, then s_1 = 37) _____

A) –1 + i.
B) 2 – 2i.
C) 1 – 3i.
D) 3 – 3i.
E) none of these

38) Suppose that at a certain step, the Mandelbrot replacement process produces the value $s_N = 5$ and at the next step it produces the value $s_{N+1} = 26$. Then the seed s equals 38) _____

A) 1.
B) $\sqrt{2}$.
C) 2.
D) 21.
E) none of these

Solve the problem.

39) Assume that the seed cube of the Menger sponge has volume 1. Find the volume of each removed cube in Step 6 of the construction. 39) _____

A) $\left(\frac{1}{27}\right)^5$ B) $\left(\frac{20}{27}\right)^6$ C) $\frac{20}{27}$ D) $\left(\frac{1}{27}\right)^6$ E) $\frac{1}{27}$

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40) Consider the Mandelbrot sequence with seed s = –i. Is it escaping, periodic, or attracted? 40) _____

A) attracted to 0
B) periodic
C) attracted to 1
D) escaping
E) attracted to –1– i

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1) C
2) C
3) C
4) D
5) B
6) D
7) B
8) B
9) D
10) A
11) D
12) E
13) E
14) C
15) E
16) A
17) C
18) D
19) E
20) C
21) B
22) A
23) B
24) C
25) D
26) A
27) E
28) C
29) B
30) B
31) B
32) C
33) B
34) D
35) B
36) A
37) C
38) A
39) D
40) B

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Chapter 12

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

1) If the area of the seed triangle in the construction of the Koch snowflake is 5, then the area of the Koch snowflake is 1) _____
   A) infinite.
   B) 8.
   C) 10.
   D) 0.
   E) none of these

2) Suppose that the perimeter of the seed triangle in the construction of the Koch snowflake is 5. Then the length of the boundary of the Koch snowflake is 2) _____
   A) 10.
   B) infinite.
   C) 8.
   D) 0.
   E) none of these

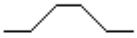
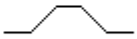
3) Suppose that the perimeter of the seed triangle in the construction of the Koch snowflake is 10. Then the length of the boundary of the Koch snowflake is 3) _____
   A) infinite.
   B) 16.
   C) 20.
   D) 0.
   E) none of these

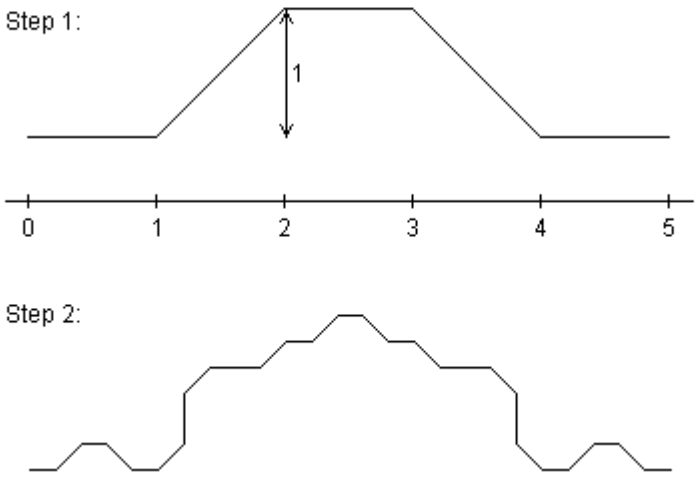
4) If the area of the region at step 1 in the construction of the Koch snowflake is 36, then the area of the seed equilateral triangle in the construction is 4) _____
   A) 45.
   B) 36.
   C) 9.
   D) 27.
   E) none of these

5) The Koch snowflake is a geometric shape with 5) _____
   A) finite area and finite perimeter.
   B) infinite area and infinite perimeter.
   C) finite area and infinite perimeter.
   D) infinite area and finite perimeter.
   E) none of these

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The following question(s) refer to a fractal defined by the recursive procedure :

- **Start with a line segment of length 5.**
- **Step 1: Replace the line segment with**  **(see figure below).**
- **Step 2: Replace each line segment in the previous figure with**  **(see figure below).**
- **Step 3, 4, 5, etc.: Replace each line segment in the previous figure with**  **.**



6) How many line segments appear in step 2 of the construction? 6) _____

A) 2^5
B) 5
C) 5^2
D) 5×2
E) none of these

7) How many line segments appear in step N of the construction? 7) _____

A) N^5
B) N
C) 5^N
D) $5 \times N$
E) none of these

8) What is the length of the leftmost line segment in step 3 of the construction? 8) _____

A) $\left(\frac{1}{3}\right)^5$
B) $\frac{1}{3}$
C) $\left(\frac{1}{5}\right)^2$
D) $\left(\frac{1}{5}\right)^3$
E) none of these

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9) What is the length of the figure at step N of the construction? 9) _____

A) $\frac{(3 + 2\sqrt{2})^N}{5^{N-1}}$

B) $N^{(3 + \sqrt{2})/5}$

C) $N \times \frac{3 + \sqrt{2}}{5}$

D) $3N + 2N\sqrt{2}$

E) none of these

Refer to the figures and recursive rules below to answer the following question(s).



Figure 1



Figure 2



Figure 3

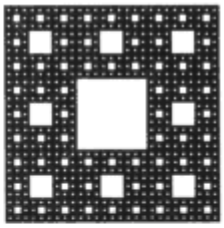


Figure 4

Rule A:
- Start with a solid black equilateral triangle.
- Whenever you see an edge $\frac{\text{white}}{\text{black}}$ replace it with .

Rule B:
- Start with a solid black triangle.
- Whenever you see a  replace it with a .

Rule C:
- Start with a solid black square.
- Whenever you see an edge $\frac{\text{white}}{\text{black}}$ replace it with .

Rule D:
- Start with a solid black square.
- Whenever you see a square, subdivide the square into nine equal subsquares and remove the central subsquare.

Rule E:
- Start with a solid black equilateral triangle.
- Whenever you see an edge $\frac{\text{white}}{\text{black}}$ replace it with .

10) Which of the figures above best approximates the Sierpinski gasket? 10) _____

A) Figure 4
B) Figure 3
C) Figure 1
D) Figure 2
E) none of these

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11) What is the area of the figure obtained when we recursively apply Rule E infinitely many times, given that the area of the starting equilateral triangle is 10? 11) _____

A) 4
B) 16
C) 0
D) infinite
E) none of these

Solve the problem.

12) Of the following objects in nature, which one could never have self–similarity? 12) _____

A) a soap bubble
B) a mountain
C) a coastline
D) a cloud
E) all of these could have self–similarity

13) If the area of the region at step 4 in the construction of the Sierpinski gasket is 8, then the area of the region in step 5 of the construction of the Sierpinski gasket is 13) _____

A) 6.
B) 0.
C) 10.
D) 8.
E) none of these

14) At step 1 in the construction of the Sierpinski gasket, there is 1 hole. At step 2 in the construction, there are 4 holes. How many holes are there at step 4 of the construction? 14) _____

A) 121.
B) 13.
C) 10.
D) 40.
E) none of these

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

15) Assume that the seed square of the Sierpinski carpet has area $A = 8$. Find the area of the "carpet" obtained in Step 2 of the construction. 15) _____

16) Assume that the seed triangle of the Sierpinski ternary gasket has area $A = 2$. Find the area of the "ternary gasket" obtained in Step 3 of the construction. 16) _____

17) Assume that the seed square of the Sierpinski L has perimeter $P = 8$. Find the length of the boundary of the shape obtained in Step 3 of the construction. 17) _____

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MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Refer to the figures and recursive rules below to answer the following question(s).



Figure 1



Figure 2



Figure 3

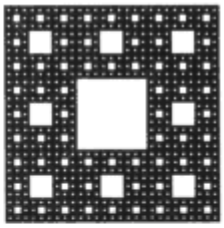


Figure 4

Rule A: • Start with a solid black equilateral triangle. • Whenever you see an edge $\frac{\text{white}}{\text{black}}$ replace it with  .
Rule B: • Start with a solid black triangle. • Whenever you see a  replace it with a  .
Rule C: • Start with a solid black square. • Whenever you see an edge $\frac{\text{white}}{\text{black}}$ replace it with  .
Rule D: • Start with a solid black square. • Whenever you see a square, subdivide the square into nine equal subsquares and remove the central subsquare.
Rule E: • Start with a solid black equilateral triangle. • Whenever you see an edge $\frac{\text{white}}{\text{black}}$ replace it with  .

18) Which of the figures above approximates the result of recursively applying Rule C infinitely many times? 18) _____

A) Figure 3
B) Figure 4
C) Figure 2
D) Figure 1
E) none of these

19) Which of the figures above approximates the result of recursively applying Rule D infinitely many times? 19) _____

A) Figure 3
B) Figure 4
C) Figure 2
D) Figure 1
E) none of these

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Refer to the following Chaos game to answer the question(s): Start with a square ABCD in which A is located at (0, 0), B is located at (27, 0), C is located at (27, 27), and D is located at (0, 27). Then, roll a fair die. We will say that A is the "winner" if we roll a 1, B is if we roll a 2, C is if we roll a 3, and D is if we roll a 4. If we roll a 5 or 6, we disregard the roll and roll again. Each roll of the die generates a point inside or on the boundary of the square according to the following rules.

• Start: Roll the die. Mark the "winning" vertex and call it P_1.

• Step 1: Roll the die again. From P_1 move two–thirds of the way straight toward the next winning vertex. Mark this point and call it P_2.

• Steps 2, 3, etc.: Continue rolling the die, each time moving to a point two –thirds of the way from the last position to the winning vertex.

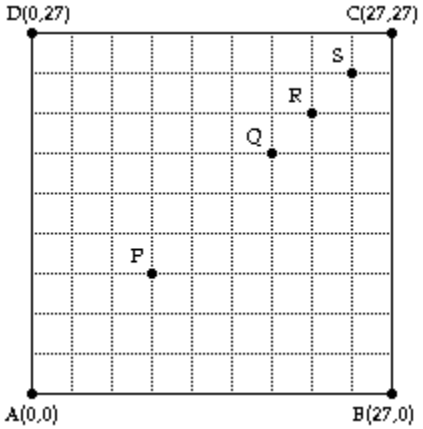
20) Determine the coordinates of the point P_2 corresponding to the sequence of rolls 4, 3, 2, 1. 20) _____

A) (8, 3)
B) (24, 9)
C) (18, 27)
D) (27, 27)
E) none of these

21) Determine the coordinates of the point P_4 corresponding to the sequence of rolls 4, 3, 2, 1. 21) _____

A) (8, 3)
B) (24, 9)
C) (27, 27)
D) (18, 27)
E) none of these

22) Refer to the following figure to answer the question. 22) _____

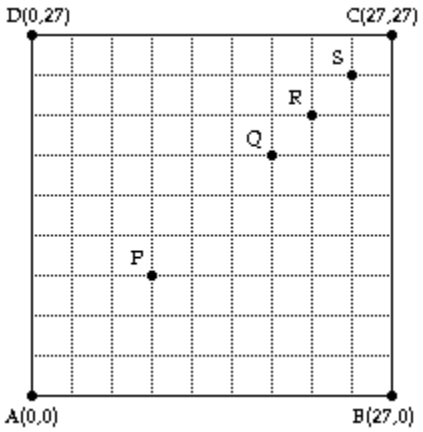


Point S is determined by which of the following sequence of rolls?

A) 3, 3, 1
B) 1, 1, 3
C) 1, 3, 3
D) 3, 1, 3
E) none of these

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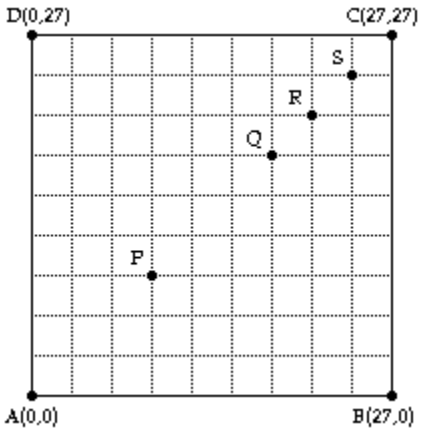
23) Refer to the following figure to answer the question. 23) _____



Point P is determined by which of the following sequence of rolls?

A) 1, 1, 3
B) 3, 1, 3
C) 3, 3, 1
D) 1, 3, 3
E) none of these

24) Refer to the following figure to answer the question. 24) _____



Which point is determined by the sequence of rolls 1, 1, 3?

A) R
B) Q
C) P
D) S
E) none of these

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SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Answer the question about the twisted Sierpinski gasket.

25) Which of the following statements about the twisted Sierpinski gasket is/are true? 25) _____

I. The boundary is infinitely long.
II. The area is infinitely large.
III. The self–similarity is exact, infinite, and universal.

26) The following properties describe the Sierpinski gasket and/or the twisted Sierpinski gasket. Which properties apply ONLY to the twisted Sierpinski gasket? 26) _____

I. Infinitely long boundary
II. Infinitely small area
III. Exact, infinite, and universal self–similarity
IV. Approximate, infinite, and universal self–similarity

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Simplify the expression.

27) $i(1 + i)$ 27) _____

A) $1 + i$.
B) $-1 + i$.
C) 0.
D) 2.
E) none of these

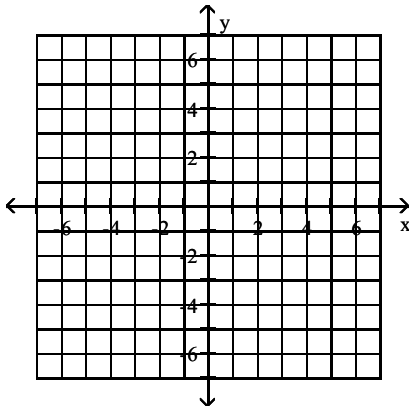
28) $(1 + i)^2 + (1 + i)$ 28) _____

A) $1 + 3i$.
B) $3i$.
C) $3 + 3i$.
D) $2 + 4i$.
E) none of these

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Solve the problem.

29) Plot the point corresponding to the complex number $(-i)^2(2 - 3i)$. 29) _____



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MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

To answer the following question(s), refer to the Mandelbrot replacement process described by:

• Start: Choose an arbitrary complex number s, called the seed of the Mandelbrot sequence. Set the seed s to be the initial term of the sequence ($s_0 = s$).

• Procedure M: To find the next term in the sequence, square the preceding term and add the seed ($s_{N+1} = s_N^2 + s$).

30) For the seed s = 2, the second and third values of the sequence (s_1 and s_2) are given by 30) _____

A) 6 and 38.
B) 4 and 16.
C) 6 and 42.
D) 2 and 2.
E) none of these

31) For the seed s = 3, the second and third values of the sequence (s_1 and s_2) are given by 31) _____

A) 3 and 3.
B) 12 and 147.
C) 3 and 6.
D) 6 and 142.
E) none of these

32) For the seed s = –1, the second, third, and fourth values of the sequence (s_1, s_2, and s_3) are given by 32) _____

A) 0, 1, and 0.
B) 2, 3, and 7.
C) 0, –1, and 0.
D) 0, 0, and 0.
E) none of these

33) If we apply the Mandelbrot replacement process to the seed s = 2i, then s_1 = 33) _____

A) 4i.
B) –4 + 2i.
C) –4.
D) –2i.
E) none of these

34) If we apply the Mandelbrot replacement process to the seed s = 1 + i, then s_2 = 34) _____

A) –1 – i.
B) 3 – 3i.
C) –7 + 7i.
D) 1 + 3i.
E) none of these

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35) Suppose that at a certain step, the Mandelbrot replacement process produces the value $s_N = 5$ and at the next step it produces the value $s_{N+1} = 26$. Then the seed s equals 35) _____

A) 21.
B) 1.
C) $\sqrt{2}$.
D) 2.
E) none of these

36) Suppose that when we apply the Mandelbrot replacement process we get: $s_8 = a$; $s_9 = b$; $s_{10} = -a$. Then s_{11} 36) _____

A) $-b$
B) b
C) a^2
D) $a^2 + b$
E) none of these

Solve the problem.

37) Which of the following geometric objects has exact self–similarity? 37) _____

A) a triangle
B) a sphere
C) the Mandelbrot set
D) a circle
E) none of these

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

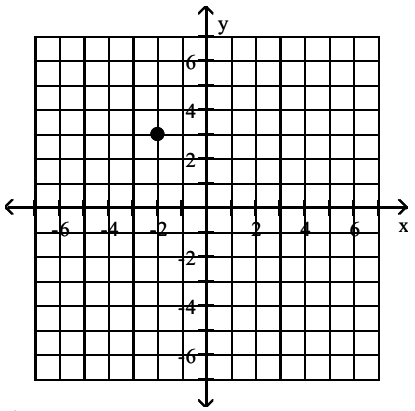
38) Assume that the seed cube of the Menger sponge has volume 1. Find the volume of each removed cube in Step 6 of the construction. 38) _____

39) Assume that the seed cube of the Menger sponge has volume 1. Find the volume of the sponge obtained in Step 5 of the construction. 39) _____

40) Consider the Mandelbrot sequence with seed $s = -i$. Is it escaping, periodic, or attracted? 40) _____

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1) B
2) B
3) A
4) D
5) C
6) C
7) C
8) C
9) A
10) C
11) A
12) A
13) A
14) D
15) $\frac{512}{81}$
16) $\frac{16}{27}$
17) 14
18) C
19) B
20) C
21) A
22) C
23) C
24) B
25) I only
26) IV only
27) B
28) A
29)



30) A
31) B
32) C
33) B
34) C
35) B

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36) B
37) E
38) $\left(\frac{1}{27}\right)^6$
39) $\left(\frac{20}{27}\right)^5$
40) periodic

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Chapter 13

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

In the following question(s), F_N represents the Nth Fibonacci number.

1) F_{11} = 1) _____

A) 55
B) 34
C) 89
D) 11
E) none of these

2) F_{10} = 2) _____

A) 55
B) 10
C) 34
D) 21
E) none of these

3) F_9 = 3) _____

A) 21
B) 55
C) 34
D) 10
E) none of these

4) $F_{3 \times 5}$ = 4) _____

A) 10
B) 15
C) 8
D) 610
E) none of these

5) $F_{12/6}$ = 5) _____

A) 1
B) 24
C) 8
D) 2
E) none of these

6) $F_9 - 5$ = 6) _____

A) 29
B) 3
C) 50
D) 4
E) none of these

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7) F_{F_6} = 7) _____

A) 21
B) 6
C) 8
D) 13
E) none of these

8) If F_{500} = a and F_{501} = b, then F_{502} = 8) _____

A) a + b.
B) a + 2a.
C) b – a.
D) 2a – b.
E) none of these

9) If F_{1000} = a and F_{1001} = b, then F_{1002} = 9) _____

A) a + 2a.
B) b – a.
C) a + b.
D) 2a – b.
E) none of these

10) If F_{500} = a and F_{501} = b, then F_{503} = 10) _____

A) a + 2b.
B) b – a.
C) a + b.
D) 2a – b.
E) none of these

11) If F_{1000} = a and F_{1001} = b, then F_{1003} = 11) _____

A) a + b.
B) 2a – b.
C) a + 2b.
D) b – a.
E) none of these

12) If F_{1000} = a and F_{1001} = b, then F_{999} = 12) _____

A) a + b.
B) 2a – b.
C) b – a.
D) a + 2a.
E) none of these

13) If F_{500} = a and F_{501} = b, then F_{504} = 13) _____

A) 3a + 5b.
B) a + 2b.
C) 2a + 3b.
D) a + b.
E) none of these

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14) $F_{25} = 75{,}025$ and $F_{26} = 121{,}393$. Find the value of F_{23}. 14) _____

A) 196,418
B) 28,657
C) 17,711
D) 46,368
E) none of these

15) Using scientific notation, the value of F_{32} is approximately 15) _____

A) 1.62×10^{32}.
B) 0.618×10^{32}.
C) 2.18×10^{6}.
D) 3.52×10^{6}.
E) 1.35×10^{6}.

16) If $F_N = a$ and $F_{N+1} = b$, then $F_{N+M} =$ 16) _____

A) $F_N a + F_{N+1} b$.
B) $F_{M-1} a + F_M b$.
C) $a + b$.
D) $F_M a + F_{M+1} b$.
E) none of these

Solve the problem.

17) Note that 17) _____

$$1^2 + 1^2 = 1 \times 2$$
$$1^2 + 1^2 + 2^2 = 2 \times 3$$
$$1^2 + 1^2 + 2^2 + 3^2 = 3 \times 5$$
$$1^2 + 1^2 + 2^2 + 3^2 + 5^2 = 5 \times 8$$

From this, we might conjecture that $1^2 + 1^2 + 2^2 + \ldots + F_N^2 = F_N \times y$ where $y =$

A) 13.
B) F_N.
C) F_{N-1}.
D) F_{N+1}.
E) none of these

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18) According to Binet's formula, F_{12} = 18) _____

A) $\left(\frac{1+\sqrt{5}}{2}\right)^{12}$.

B) $\frac{\left(\frac{1+\sqrt{5}}{2}\right)^{12} - \left(\frac{1-\sqrt{5}}{2}\right)^{12}}{\sqrt{5}}$.

C) $\frac{(1+\sqrt{5})^{12} - (1+\sqrt{5})^{12}}{5}$.

D) $\frac{\left(\frac{1+\sqrt{5}}{2}\right)^{12} - \left(\frac{1-\sqrt{5}}{2}\right)^{12}}{\sqrt{12}}$.

E) none of these

19) According to Binet's formula, F_{13} = 19) _____

A) $\left(\frac{1+\sqrt{5}}{2}\right)^{13}$.

B) $\frac{(1+\sqrt{5})^{13} - (1-\sqrt{5})^{13}}{\sqrt{5}}$.

C) $\frac{\left(\frac{1+\sqrt{5}}{2}\right)^{13} - \left(\frac{1-\sqrt{5}}{2}\right)^{13}}{\sqrt{5}}$.

D) $\frac{\left(\frac{1+\sqrt{5}}{2}\right)^{13} + \left(\frac{1-\sqrt{5}}{2}\right)^{13}}{\sqrt{5}}$.

E) none of these

20) 20) _____

$\frac{\left(\frac{1+\sqrt{5}}{2}\right)^{9} - \left(\frac{1-\sqrt{5}}{2}\right)^{9}}{\sqrt{5}}$ =

A) 34
B) 21
C) 55
D) 10
E) none of these

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21) $\dfrac{\left(\dfrac{1+\sqrt{5}}{2}\right)^{11}-\left(\dfrac{1-\sqrt{5}}{2}\right)^{11}}{\sqrt{5}}=$ 21) _____

A) 11
B) 144
C) 55
D) 89
E) none of these

22) $\left(\dfrac{1+\sqrt{5}}{2}\right)^{7}=$ 22) _____

A) $13\left(\dfrac{1+\sqrt{5}}{2}\right)+8$

B) $13\left(\dfrac{1+\sqrt{5}}{2}\right)+8\left(\dfrac{1-\sqrt{5}}{2}\right)$

C) $13\left(\dfrac{1+\sqrt{5}}{2}\right)-8$

D) 13
E) none of these

In the following question(s), F_N represents the Nth Fibonacci number.

23) F_{1001}/F_{1000} rounded to three decimal places gives 23) _____

A) 1.618.
B) 1.001.
C) 1.414.
D) 0.618.
E) none of these

24) F_{2001}/F_{2000} rounded to three decimal places gives 24) _____

A) 0.618.
B) 1.618.
C) 1.414.
D) 1.001.
E) none of these

25) F_{2000}/F_{2001} rounded to three decimal places gives 25) _____

A) 1.618.
B) 0.999.
C) 0.618.
D) 1.414.
E) none of these

26) F_{32} is what percentage of F_{30}? 26) _____

A) 261.8% B) 161.8% C) 61.8% D) 19% E) 1.05%

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Solve the problem.

27) Rounded to three decimal places, the two solutions of $x^2 = x + 1$ are 27) _____

A) 1.618 and 0.618.
B) 1.618 and –1.618.
C) 1.618 and –0.618.
D) 1.618 and 2.236.
E) none of these

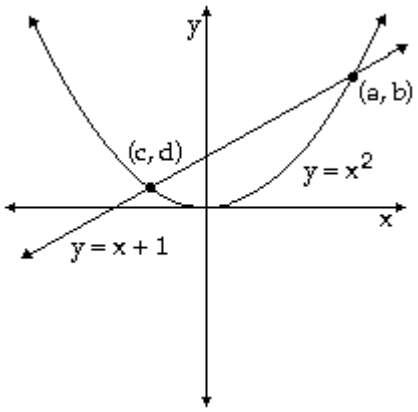
28) The two solutions of the equation $x^2 = x + 1$ are 28) _____

A) ϕ and $-\phi$.
B) ϕ and $-1/\phi$.
C) ϕ and ϕ^2.
D) 1 and ϕ.
E) none of these

29) The two solutions of the equation $3x^2 = 4x + 7$ are 29) _____

A) –1 and $\frac{7}{3}$.
B) –1 and ϕ.
C) 1 and $\frac{4}{7}$.
D) –1 and $\frac{7}{4}$.
E) none of these

The following question refers to the graph below.



30) The ordered pair (a, b) is given by 30) _____

A) (1, ϕ).
B) (ϕ, ϕ).
C) (ϕ, $\phi + 1$).
D) ($\frac{1}{\phi}$, $\frac{1}{\phi} + 1$).
E) ($\frac{1}{\phi}$, ϕ).

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31) The ordered pair (c, d) is given by 31) _____

A) $(-\phi, \phi^2)$.
B) $(-\phi, \phi + 1)$.
C) $(\frac{1}{\phi}, \phi^2 + 1)$.
D) $(-\frac{1}{\phi}, -\frac{1}{\phi} + 1)$.
E) $(-1, \phi)$.

Solve the problem.

32) The golden ratio ϕ is the positive solution of the equation 32) _____

A) $x = 1 + x^2$.
B) $x^2 = 1 - x$.
C) $x^2 = 1 + x$.
D) $x^2 = \frac{1}{x}$.
E) none of these

33) Rounded to three decimal places, $\frac{1}{\phi}$ (where ϕ is the golden ratio) equals 33) _____

A) 1.618.
B) –0.618.
C) 2.142.
D) 0.618.
E) none of these

34) If ϕ is the golden ratio and F_N is the N^{th} Fibonacci number, then ϕ^N = 34) _____

A) $F_N\phi$.
B) $F_N\phi - F_{N-1}$.
C) F_N.
D) $F_N\phi + F_{N-1}$.
E) none of these

35) If ϕ is the golden ratio, then ϕ^8 = 35) _____

A) $21\phi + 13$.
B) $21\phi - 13$.
C) 21ϕ.
D) 21.
E) none of these

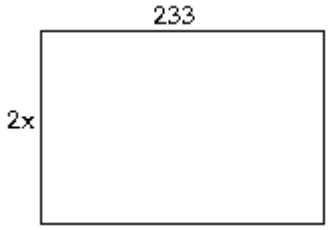
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36) If the rectangle below is a golden rectangle (with x as the shorter side), then the approximate value of x is 36) _____



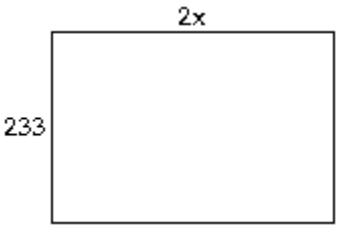
A) 89.
B) $89\left(\frac{1+\sqrt{5}}{2}\right)$.
C) 55.
D) 34.
E) none of these

37) If the rectangle below is a golden rectangle(with 2x as the shorter side), then the approximate value of x is 37) _____



A) 72.
B) 144.
C) 116.5.
D) 161.8.
E) none of these

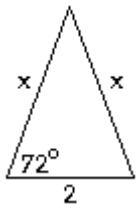
38) If the rectangle below is a golden rectangle(with 2x as the shorter side), then the approximate value of x is 38) _____



A) 377.
B) 261.8.
C) 161.8.
D) 188.5.
E) none of these

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39) The value of x in the triangle shown is approximately 39) _____



A) 2.618.
B) 1.618.
C) 3.236.
D) 3.618.
E) none of these

In the following question(s), F_N represents the Nth Fibonacci number.

40) Using scientific notation, the value of F_{210} is approximately 3.45×10^{45}. Use the fact that $F_N \approx \phi F_{N-1}$ to approximate the value of F_{211}. 40) _____

A) 5.58×10^{45}
B) 2.11×10^{46}
C) 2.13×10^{45}
D) 1.618×10^{45}
E) 1.618×10^{46}

41) Using scientific notation, the value of F_{500} is approximately 1.394×10^{104}. Use the fact that $F_N \approx \phi F_{N-1}$ to approximate the value of F_{499}. 41) _____

A) 8.616×10^{103}
B) 2.618×10^{104}
C) 2.255×10^{104}
D) 1.618×10^{104}
E) 6.956×10^{103}

42) Using scientific notation, the value of F_{500} is approximately 1.394×10^{104}. Use the fact that $F_N \approx \phi F_{N-1}$ to approximate the value of F_{503}. 42) _____

A) 1.618×10^{106}
B) 5.905×10^{104}
C) 9.556×10^{105}
D) 2.255×10^{104}
E) 1.618×10^{105}

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Solve the problem.

43) Consider the sequence A_N defined by $A_1 = 3$, $A_2 = 3$, $A_N = A_{N-1} + A_{N-2}$. The relation between A_N and F_N is given by 43) _____

A) $A_N = 3F_N$.
B) $A_N = F_{N+2}$.
C) $A_N = F_N + 2$.
D) $A_N = F_N$.
E) none of these

44) Consider the sequence A_N defined by $A_1 = 3$, $A_2 = 3$, $A_N = A_{N-1} + A_{N-2}$. As the values of N get large, the ratios A_N/A_{N-1} approach 44) _____

A) $\phi + 2$.
B) 3ϕ.
C) 1.
D) ϕ.
E) none of these

45) The Lucas sequence L_N is given by 1, 3, 4, 7, 11, 18, 29, 47, 76, 123, ... 45) _____

Note that

$$\phi - \frac{1}{\phi} = 1$$

$$\phi^2 + \frac{1}{\phi^2} = 3$$

$$\phi^3 - \frac{1}{\phi^3} = 4$$

$$\phi^4 + \frac{1}{\phi^4} = 7$$

$$\phi^5 - \frac{1}{\phi^5} = 11$$

From this, we might conjecture that the value of L_N =

A) $\phi^N - \frac{1}{\phi^N}$

B) $\phi^N + \frac{1}{(-\phi)^N}$

C) $\phi^N + \frac{1}{\phi^N}$

D) $\phi^{N+1} + \frac{1}{\phi^{N+1}}$

E) none of these

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46) The Lucas sequence L_N is given by 1, 3, 4, 7, 11, 18, 29, 47, 76, 123, ... 46) _____

Note that

$$1 \times 7 = 4^2 - 3^2$$
$$3 \times 11 = 7^2 - 4^2$$
$$4 \times 18 = 11^2 - 7^2$$

From this, we might conjecture that $L_N \times L_{N+3} = L_{N+2}^2 - y$ where y =

A) L_N^2.

B) L_{N-1}^2.

C) $18^2 - 11^2$.

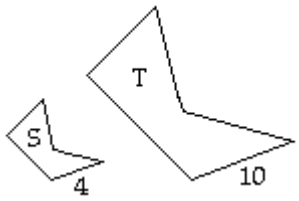
D) L_{N+1}^2.

E) none of these

47) T and T' are similar triangles. Suppose that the base of T' is 5 times longer than the base of T. If the area of T' is 100 sq. in., what is the area of T? 47) _____

A) 4 sq. in.
B) 20 sq. in.
C) 5 sq. in.
D) 500 sq. in.
E) none of these

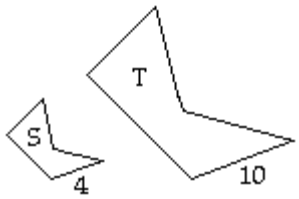
48) S and T are similar polygons. If the perimeter of S is 16, what is the perimeter of T? 48) _____



A) 50
B) 80
C) 64
D) 40
E) none of these

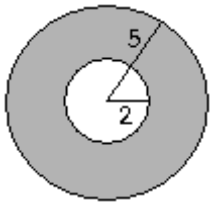
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49) S and T are similar polygons. If the area of T is 300, what is the area of S? 49) _____



A) 96
B) 48
C) 30
D) 120
E) none of these

The circular ring has an inner radius of 2 and outer radius of 5.



50) An object similar to the circular ring shown is 50) _____

A) a circle of radius 5.
B) another circular ring with inner radius 5 and outer radius 12.5.
C) another circular ring with inner radius 4 and outer radius 7.
D) a circle of radius 2.
E) none of these

Refer to the figures below to answer the following question.

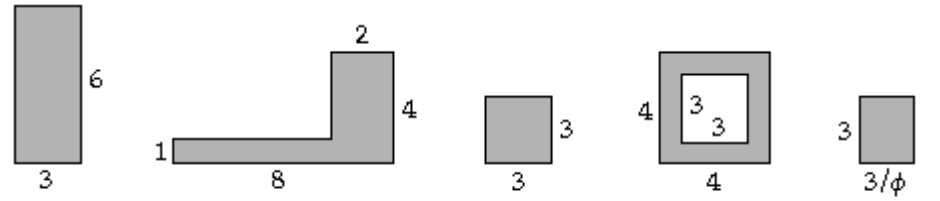


Figure A Figure B Figure C Figure D Figure E

51) Which of the figures is a gnomon to Figure C? 51) _____

A) Figure E
B) Figure B
C) Figure D
D) Figure A
E) none of these

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52) Which of the figures is a gnomon to Figure D? 52) _____

A) Figure D is its own gnomon.
B) Figure D does not have a gnomon.
C) Figure C
D) Figure E
E) none of these

53) Which of the figures is a gnomon to Figure E? 53) _____

A) Figure B
B) Figure A
C) Figure D
D) Figure C
E) none of these

Refer to the figures below to answer the following question.

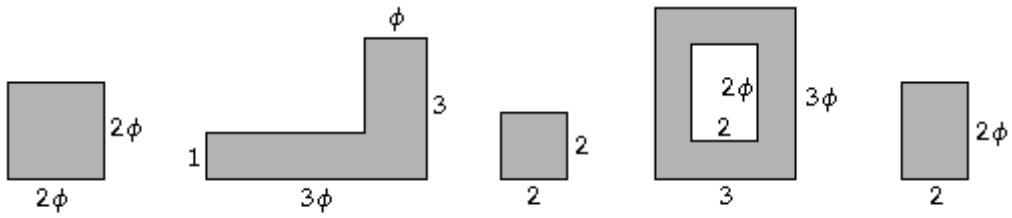


Figure A Figure B Figure C Figure D Figure E

54) For which of the figures is Figure A a gnomon? 54) _____

A) Figure E
B) Figure B
C) Figure D
D) Figure C
E) none of these

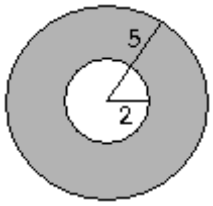
Solve the problem.

55) Which of the following is a gnomon to a disk of radius 5? 55) _____

A) A circular disk of radius 10
B) A circular ring with inner radius 5 and outer radius 10
C) Circular disks of radius 5 do not have gnomons
D) A circular disk of radius 5
E) A circular ring with inner radius 1 and outer radius 5

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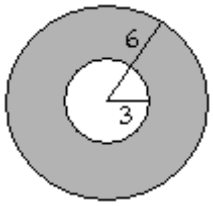
The circular ring has an inner radius of 2 and outer radius of 5.



56) The circular ring shown is a gnomon to 56) _____

A) another circular ring with inner radius 2 and outer radius 5.
B) a circular disk of radius 5.
C) a circular disk of radius 2.
D) another circular ring with inner radius 5 and outer radius 12.5.
E) none of these

The circular ring has an inner radius of 3 and outer radius of 6.

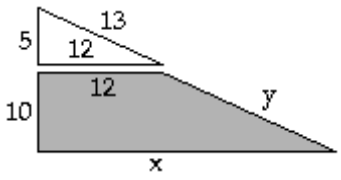


57) The circular ring shown is a gnomon to 57) _____

A) another circular ring with inner radius 6 and outer radius 9.
B) another circular ring with inner radius 6 and outer radius 12.
C) a circular disk of radius 6.
D) a circular disk of radius 3.
E) none of these

Solve the problem.

58) Find the value of y so that the shaded figure is a gnomon to the white triangle. 58) _____



A) 24
B) 26
C) 39
D) 36
E) none of these

59) If A is a golden rectangle, a gnomon to A is 59) _____

A) another golden rectangle whose longer side equals the shorter side of A.
B) another golden rectangle whose shorter side equals the longer side of A.
C) a square of sides equal to the shorter side of A.
D) a square of sides equal to the longer side of A.
E) none of these

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60) Rectangle A is 25 by 50. Rectangle B is a gnomon to rectangle A. The dimensions of rectangle B are 60) _____

A) 50 by 100.
B) 25 by 50.
C) 50 by 75.
D) 50 by 50.
E) none of these

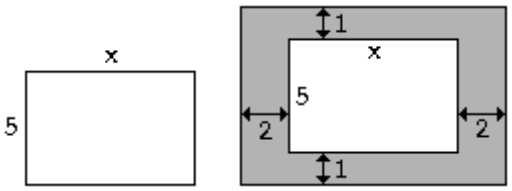
61) Rectangle A is 20 by 50. Rectangle B is a gnomon to rectangle A. The dimensions of rectangle B are 61) _____

A) 20 by 50.
B) 50 by 105.
C) 40 by 50.
D) 50 by 125.
E) none of these

62) Rectangle A is 20 by 30. Rectangle B is a gnomon to rectangle A. The dimensions of rectangle B are 62) _____

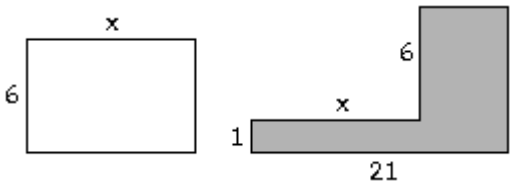
A) 30 by 30.
B) 30 by 60.
C) 30 by 45.
D) 25 by 30.
E) none of these

63) If the shaded "rectangular ring" is a gnomon to the white rectangle, then x = 63) _____



A) 10.
B) 12.
C) 8.
D) 6.
E) none of these

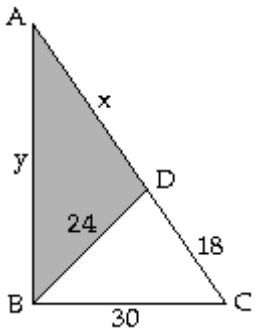
64) If the shaded figure is a gnomon to the white rectangle, then x = 64) _____



A) 8.
B) 18.
C) 12.
D) 6.
E) none of these

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65) If the shaded triangle ABD shown is a gnomon to triangle BCD, then x = 65) _____



A) 18.
B) 32.
C) 40.
D) 30.
E) none of these

66) Which of the following statements [A), B), C), or D)] is not true? 66) _____
A) If G is a gnomon to A, then A must be a gnomon to G.
B) There are figures that have no gnomons.
C) There are figures that are gnomons to themselves.
D) There are figures that have more than one gnomon.
E) all of these statements are true.

Answer the question about spiral growth in nature.

67) The cross section of a tree trunk is an example of: 67) _____
I. Logarithmic spiral
II. One–sided or asymmetric growth
III. Gnomonic growth
A) II and III
B) I, II and III
C) I and II
D) III only
E) II only

68) A spiral obtained by forming a series of Fibonacci rectangles by adding squares and then connecting opposite corners of the squares in a continuous arc is called a ____ . 68) _____
A) golden rectangle
B) Fibonnacci spiral
C) chambered Fibonnacci rectangle
D) gnomonic spiral
E) logarithmic spiral

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1) C
2) A
3) C
4) D
5) A
6) A
7) A
8) A
9) C
10) A
11) C
12) C
13) C
14) B
15) C
16) B
17) D
18) B
19) C
20) A
21) D
22) A
23) A
24) B
25) C
26) A
27) C
28) B
29) A
30) C
31) D
32) C
33) D
34) D
35) A
36) C
37) A
38) D
39) C
40) A
41) A
42) B
43) A
44) D
45) B
46) D
47) A
48) D
49) B
50) B

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51) C
52) B
53) E
54) A
55) B
56) C
57) D
58) B
59) D
60) C
61) B
62) D
63) A
64) B
65) B
66) A
67) A
68) B

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Chapter 13

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

In the following question(s), F_N represents the Nth Fibonacci number.

1) F_{11} = 1) _____

A) 89
B) 11
C) 34
D) 55
E) none of these

2) $2F_{9-3}$ = 2) _____

A) 12
B) 65
C) 6
D) 16
E) none of these

3) $\frac{F_{12}}{F_6}$ = 3) _____

A) 4
B) 18
C) 2
D) 1
E) none of these

4) $F_{12/4}$ = 4) _____

A) 48
B) 21
C) 2
D) 3
E) none of these

5) F_{9-5} = 5) _____

A) 3
B) 29
C) 50
D) 4
E) none of these

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6) F_{F_5} = 6) _____

A) F_5
B) F_{F_5}
C) 5
D) all of these
E) none of these

7) $F_{82} - F_{80}$ = 7) _____

A) F_2
B) 2
C) F_{81}
D) F_{79}
E) none of these

8) $F_{92} - F_{90}$ = 8) _____

A) F_{89}
B) F_{91}
C) F_2
D) 2
E) none of these

9) If $F_{500} = a$ and $F_{501} = b$, then F_{502} = 9) _____

A) 2a – b.
B) a + b.
C) b – a.
D) a + 2a.
E) none of these

10) If $F_{1000} = a$ and $F_{1001} = b$, then F_{1002} = 10) _____

A) a + 2a.
B) 2a – b.
C) a + b.
D) b – a.
E) none of these

11) If $F_{500} = a$ and $F_{501} = b$, then F_{503} = 11) _____

A) 2a – b.
B) a + 2b.
C) b – a.
D) a + b.
E) none of these

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12) If $F_{1000} = a$ and $F_{1001} = b$, then $F_{999} =$ 12) _____

A) $a + 2a$.
B) $a + b$.
C) $b - a$.
D) $2a - b$.
E) none of these

13) If $F_{500} = a$ and $F_{501} = b$, then $F_{504} =$ 13) _____

A) $3a + 5b$.
B) $a + 2b$.
C) $2a + 3b$.
D) $a + b$.
E) none of these

14) $F_{21} = 10{,}946$ and $F_{24} = 46{,}368$. Find the value of F_{22}. 14) _____

A) 17,711
B) 196,418
C) 28,657
D) 46,368
E) none of these

15) Using scientific notation, the value of F_{32} is approximately 15) _____

A) 1.62×10^{32}.
B) 3.52×10^{6}.
C) 2.18×10^{6}.
D) 0.618×10^{32}.
E) 1.35×10^{6}.

16) If $F_N = a$ and $F_{N+1} = b$, then $F_{N+M} =$ 16) _____

A) $F_{M-1}a + F_M b$.
B) $F_M a + F_{M+1} b$.
C) $a + b$.
D) $F_N a + F_{N+1} b$.
E) none of these

17) $F_{487} - F_{484} =$ 17) _____

A) $2F_{485}$
B) 3
C) F_{481}
D) F_3
E) none of these

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Solve the problem.

18) According to Binet's formula, F_{12} = 18) _____

A) $\dfrac{\left(\dfrac{1+\sqrt{5}}{2}\right)^{12}-\left(\dfrac{1-\sqrt{5}}{2}\right)^{12}}{\sqrt{5}}$.

B) $\dfrac{\left(\dfrac{1+\sqrt{5}}{2}\right)^{12}-\left(\dfrac{1-\sqrt{5}}{2}\right)^{12}}{\sqrt{12}}$.

C) $\dfrac{(1+\sqrt{5})^{12}-(1+\sqrt{5})^{12}}{5}$.

D) $\left(\dfrac{1+\sqrt{5}}{2}\right)^{12}$.

E) none of these

19) According to Binet's formula, F_{13} = 19) _____

A) $\left(\dfrac{1+\sqrt{5}}{2}\right)^{13}$.

B) $\dfrac{\left(\dfrac{1+\sqrt{5}}{2}\right)^{13}-\left(\dfrac{1-\sqrt{5}}{2}\right)^{13}}{\sqrt{5}}$.

C) $\dfrac{(1+\sqrt{5})^{13}-(1-\sqrt{5})^{13}}{\sqrt{5}}$.

D) $\dfrac{\left(\dfrac{1+\sqrt{5}}{2}\right)^{13}+\left(\dfrac{1-\sqrt{5}}{2}\right)^{13}}{\sqrt{5}}$.

E) none of these

20) 20) _____

$\dfrac{\left(\dfrac{1+\sqrt{5}}{2}\right)^{10}-\left(\dfrac{1-\sqrt{5}}{2}\right)^{10}}{\sqrt{5}}$ =

A) 21
B) 34
C) 55
D) 10
E) none of these

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21) $\dfrac{\left(\dfrac{1+\sqrt{5}}{2}\right)^{11}-\left(\dfrac{1-\sqrt{5}}{2}\right)^{11}}{\sqrt{5}}=$ 21) _____

A) 55
B) 89
C) 11
D) 144
E) none of these

22) $\left(\dfrac{1+\sqrt{5}}{2}\right)^{7}=$ 22) _____

A) $13\left(\dfrac{1+\sqrt{5}}{2}\right)+8$

B) 13
C) $13\left(\dfrac{1+\sqrt{5}}{2}\right)+8\left(\dfrac{1-\sqrt{5}}{2}\right)$
D) $13\left(\dfrac{1+\sqrt{5}}{2}\right)-8$

E) none of these

In the following question(s), F_N represents the Nth Fibonacci number.

23) F_{1001}/F_{1000} rounded to three decimal places gives 23) _____

A) 0.618.
B) 1.618.
C) 1.414.
D) 1.001.
E) none of these

24) F_{1000}/F_{1001} rounded to three decimal places gives 24) _____

A) 0.999.
B) 0.618.
C) 1.618.
D) 1.414.
E) none of these

25) F_{2000}/F_{2001} rounded to three decimal places gives 25) _____

A) 0.618.
B) 1.414.
C) 0.999.
D) 1.618.
E) none of these

26) F_{20} is what percentage of F_{19}? 26) _____

A) 161.8% B) 61.8% C) 19% D) 261.8% E) 1.05%

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Solve the problem.

27) The two solutions of the equation $x^2 = x + 1$ are 27) _____

A) ϕ and $-\phi$.

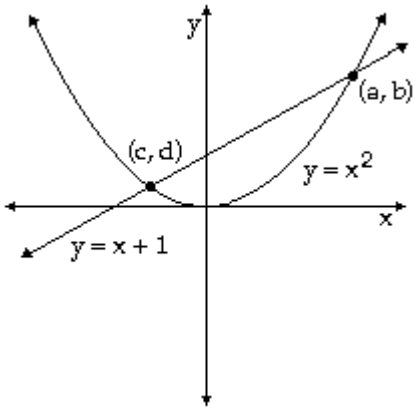
B) ϕ and ϕ^2.

C) ϕ and $-1/\phi$.

D) 1 and ϕ.

E) none of these

The following question refers to the graph below.



28) The ordered pair (a, b) is given by 28) _____

A) $(\frac{1}{\phi}, \phi)$.

B) $(\frac{1}{\phi}, \frac{1}{\phi} + 1)$.

C) $(\phi, \phi + 1)$.

D) (1, ϕ).

E) (ϕ, ϕ).

29) The ordered pair (c, d) is given by 29) _____

A) $(-\phi, \phi + 1)$.

B) $(\frac{1}{\phi}, \phi^2 + 1)$.

C) $(-\frac{1}{\phi}, -\frac{1}{\phi} + 1)$.

D) $(-\phi, \phi^2)$.

E) $(-1, \phi)$.

Solve the problem.

30) The golden ratio ϕ is the positive solution of the equation 30) _____

A) $x = 1 + x^2$.

B) $x^2 = \frac{1}{x}$.

C) $x^2 = 1 - x$.

D) $x^2 = 1 + x$.

E) none of these

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31) Rounded to three decimal places, the golden ratio ϕ equals 31) _____

A) 2.618.
B) 0.618.
C) 3.142.
D) 1.618.
E) none of these

32) Rounded to three decimal places, $\frac{1}{\phi}$ (where ϕ is the golden ratio) equals 32) _____

A) 0.618.
B) 1.618.
C) 2.142.
D) –0.618.
E) none of these

33) If ϕ is the golden ratio, then ϕ^8 = 33) _____

A) $21\phi + 13$.
B) 21ϕ.
C) 21.
D) $21\phi - 13$.
E) none of these

34) $\phi^{10} = a\sqrt{5} + b$ for a pair of positive integers a and b. The value of b for which this happens is 34) _____

A) 10.
B) 61.5.
C) 34.
D) 55.
E) none of these

35) A golden rectangle has a shorter side of length 100 ft. Which of the following numbers most closely represents the length of the longer side of the rectangle? 35) _____

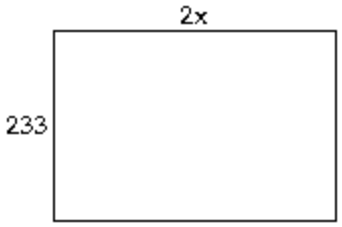
A) 210 ft
B) 323.6 ft
C) 161.8 ft
D) 200 ft
E) none of these

36) A golden rectangle has a shorter side of length 600 ft. Which of the following numbers most closely represents the length of the longer side of the rectangle? 36) _____

A) 761.8 ft
B) 670.8 ft
C) 1570.8 ft
D) 970.8 ft
E) none of these

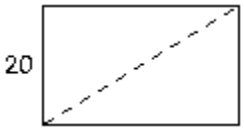
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37) If the rectangle below is a golden rectangle(with 2x as the shorter side), then the approximate value of x is 37) _____



A) 188.5.
B) 261.8.
C) 161.8.
D) 377.
E) none of these

38) The rectangle shown is golden with short side of length 20. Estimate the length of the diagonal. 38) _____



A) 38.04
B) 323.61
C) 32.36
D) 52.36
E) none of these

In the following question(s), F_N represents the Nth Fibonacci number.

39) Using scientific notation, the value of F_{210} is approximately 3.45×10^{45}. Use the fact that $F_N \approx \phi F_{N-1}$ to approximate the value of F_{211}. 39) _____

A) 2.11×10^{46}
B) 2.13×10^{45}
C) 1.618×10^{46}
D) 1.618×10^{45}
E) 5.58×10^{45}

40) Using scientific notation, the value of F_{500} is approximately 1.394×10^{104}. Use the fact that $F_N \approx \phi F_{N-1}$ to approximate the value of F_{499}. 40) _____

A) 1.618×10^{104}
B) 2.618×10^{104}
C) 8.616×10^{103}
D) 2.255×10^{104}
E) 6.956×10^{103}

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41) Using scientific notation, the value of F_{500} is approximately 1.394×10^{104}. Use the fact that $F_N \approx \phi F_{N-1}$ to approximate the value of F_{503}. 41) _____

A) 5.905×10^{104}
B) 9.556×10^{105}
C) 1.618×10^{105}
D) 2.255×10^{104}
E) 1.618×10^{106}

Solve the problem.

42) Consider the sequence A_N defined by $A_1 = 3$, $A_2 = 3$, $A_N = A_{N-1} + A_{N-2}$. The relation between A_N and F_N is given by 42) _____

A) $A_N = 3F_N$.
B) $A_N = F_N$.
C) $A_N = F_{N+2}$.
D) $A_N = F_N + 2$.
E) none of these

43) Consider the sequence A_N defined by $A_1 = 5$, $A_2 = 5$, $A_N = A_{N-1} + A_{N-2}$. The relation between A_N and F_N is given by 43) _____

A) $A_N = F_{N+4}$.
B) $A_N = F_N + 4$.
C) $A_N = 5F_N$.
D) $A_N = F_N$.
E) none of these

44) The Lucas numbers are defined recursively by $L_1 = 1$, $L_2 = 3$, $L_N = L_{N-1} + L_{N-2}$. $L_5 =$ 44) _____

A) 18 B) 7 C) 9 D) 11 E) 5

45) The Lucas numbers are defined recursively by $L_1 = 1$, $L_2 = 3$, $L_N = L_{N-1} + L_{N-2}$. The value of L_7/L_6 is approximately 45) _____

A) 0.618. B) 4.584. C) 1.17. D) 6. E) 1.611.

46) For $N \geq 1$, the Lucas numbers are defined explicitly by the formula $L_N = \left(\frac{1+\sqrt{5}}{2}\right)^N + \left(\frac{1-\sqrt{5}}{2}\right)^N$. 46) _____

$L_{30} =$

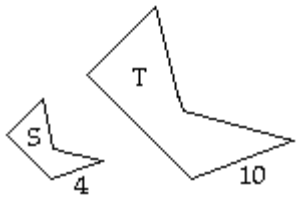
A) 1,618,034 B) 3,010,349 C) 30 D) 618,034 E) 1,860,498

47) R and R' are similar rectangles. Suppose that the width of R is a and the width of R' is 4a. If the area of R is 50 sq. in., what is the area of R' ? 47) _____

A) 400 sq. in.
B) 800 sq. in.
C) 200 sq. in.
D) 200a sq. in.
E) none of these

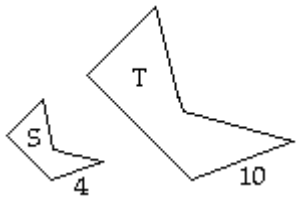
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48) S and T are similar polygons. If the perimeter of S is 16, what is the perimeter of T? 48) _____



A) 80
B) 40
C) 50
D) 64
E) none of these

49) S and T are similar polygons. If the area of T is 300, what is the area of S? 49) _____



A) 120
B) 96
C) 30
D) 48
E) none of these

50) R is a 5 by x rectangle. R' is an 8 by 13 – x rectangle. There are two values of x that make these rectangles similar. What is the ratio of the larger of these values to the smaller of these values? 50) _____

A) 1.618
B) 2
C) 0.618
D) 1.6
E) none of these

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Refer to the figures below to answer the following question.

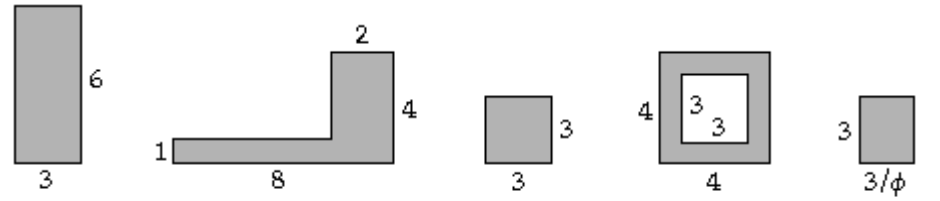


Figure A Figure B Figure C Figure D Figure E

51) Which of the figures is a gnomon to Figure A? 51) _____

A) Figure C
B) Figure B
C) Figure E
D) Figure D
E) none of these

52) Which of the figures is a gnomon to Figure C? 52) _____

A) Figure A
B) Figure B
C) Figure E
D) Figure D
E) none of these

53) Which of the figures is a gnomon to Figure D? 53) _____

A) Figure C
B) Figure D does not have a gnomon.
C) Figure E
D) Figure D is its own gnomon.
E) none of these

54) Which of the figures is a gnomon to Figure E? 54) _____

A) Figure B
B) Figure D
C) Figure A
D) Figure C
E) none of these

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Refer to the figures below to answer the following question.

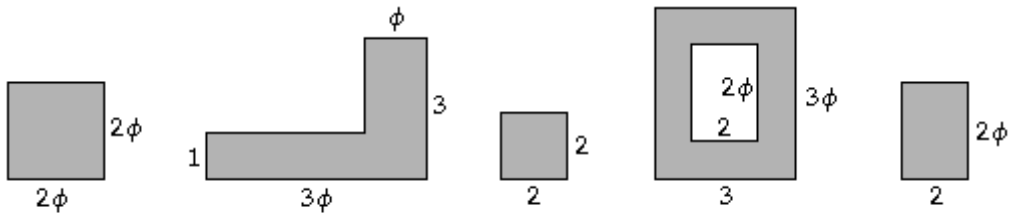


Figure A Figure B Figure C Figure D Figure E

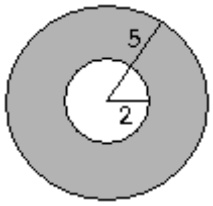
55) Which of the figures is a gnomon to Figure D? 55) _____

A) Figure B
B) Figure C
C) Figure E
D) Figure A
E) none of these

56) Which of the figures is a gnomon to Figure E? 56) _____

A) Figure B, Figure D, Figure E
B) Figure A, Figure B, Figure D
C) Figure B, Figure C, Figure D
D) Figure B, Figure C
E) none of these

The circular ring has an inner radius of 2 and outer radius of 5.

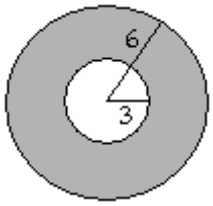


57) The circular ring shown is a gnomon to 57) _____

A) another circular ring with inner radius 2 and outer radius 5.
B) another circular ring with inner radius 5 and outer radius 12.5.
C) a circular disk of radius 5.
D) a circular disk of radius 2.
E) none of these

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The circular ring has an inner radius of 3 and outer radius of 6.



58) The circular ring shown is a gnomon to 58) _____

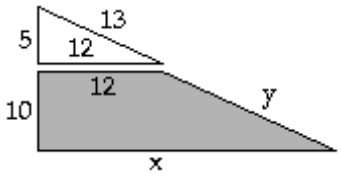
A) another circular ring with inner radius 6 and outer radius 9.
B) a circular disk of radius 3.
C) a circular disk of radius 6.
D) another circular ring with inner radius 6 and outer radius 12.
E) none of these

59) A gnomon to the circular ring shown is 59) _____

A) another circular ring with inner radius 6 and outer radius 12.
B) a circle of radius 3.
C) another circular ring with inner radius 6 and outer radius 9.
D) a circle of radius 6.
E) none of these

Solve the problem.

60) Find the value of x so that the shaded figure is a gnomon to the white triangle. 60) _____



A) 26
B) 39
C) 24
D) 36
E) none of these

61) If A is a golden rectangle, a gnomon to A is 61) _____

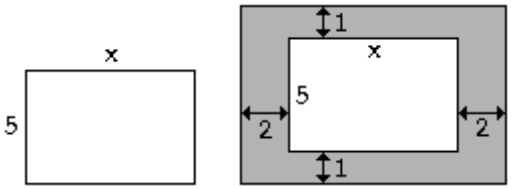
A) another golden rectangle whose longer side equals the shorter side of A.
B) a square of sides equal to the shorter side of A.
C) a square of sides equal to the longer side of A.
D) another golden rectangle whose shorter side equals the longer side of A.
E) none of these

62) Which of the following statements is true? 62) _____

A) A rectangle with dimensions $\sqrt{10}$ by $\sqrt{5}$ is its own gnomon.
B) A rectangle with dimensions ϕ by $\frac{1}{\phi}$ (where ϕ is the golden ratio) is its own gnomon.
C) A rectangle with dimensions 20 by ϕ (where ϕ is the golden ratio) is its own gnomon.
D) A rectangle with dimensions 4 by $\sqrt{2}$ is its own gnomon.
E) none of these

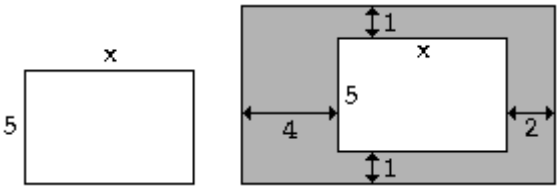
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63) If the shaded "rectangular ring" is a gnomon to the white rectangle, then x = 63) _____



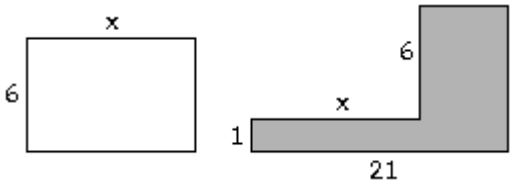
A) 12.
B) 6.
C) 10.
D) 8.
E) none of these

64) If the shaded "rectangular ring" is a gnomon to the white rectangle, then x = 64) _____



A) 3.
B) 15.
C) 10.
D) 20.
E) none of these

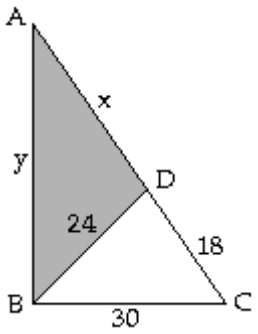
65) If the shaded figure is a gnomon to the white rectangle, then x = 65) _____



A) 12.
B) 6.
C) 8.
D) 18.
E) none of these

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66) If the shaded triangle ABD shown is a gnomon to triangle BCD, then x = 66) _____



A) 18.
B) 30.
C) 40.
D) 32.
E) none of these

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Answer the question about spiral growth in nature.

67) The cross section of a tree trunk is an example of: 67) _____
I. Logarithmic spiral
II. One–sided or asymmetric growth
III. Gnomonic growth

68) A spiral obtained by forming a series of Fibonacci rectangles by adding squares and then connecting opposite corners of the squares in a continuous arc is called a ____ . 68) _____

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1) A
2) D
3) B
4) C
5) B
6) D
7) C
8) B
9) B
10) C
11) B
12) C
13) C
14) A
15) C
16) A
17) A
18) A
19) B
20) C
21) B
22) A
23) B
24) B
25) A
26) A
27) C
28) C
29) C
30) D
31) D
32) A
33) A
34) B
35) C
36) D
37) A
38) A
39) E
40) C
41) A
42) A
43) C
44) D
45) E
46) E
47) B
48) B
49) D
50) D

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51) B
52) D
53) B
54) E
55) E
56) B
57) D
58) B
59) E
60) D
61) C
62) A
63) C
64) B
65) D
66) D
67) II and III
68) Fibonnacci spiral

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Chapter 14

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

As part of a statistics project, a 6th grade teacher brings to class a container with 300 red marbles and 500 white marbles which are thoroughly mixed. To figure out how many marbles in the container are red without actually counting them all, a student randomly draws 40 marbles from the container. Of the 40 marbles drawn, 16 are red.

1) The N–value for this population is 1) _____
   A) 300.
   B) 16.
   C) 800.
   D) 40.
   E) none of these

2) Suppose that the student is given the N–value. What is a reasonable estimate for the number of white marbles in the container? 2) _____
   A) 107
   B) 320
   C) 300
   D) 480
   E) none of these

As part of a statistics project, a 6th grade teacher brings to class a container with 200 red marbles and 800 white marbles which are thoroughly mixed. To figure out how many marbles in the container are red without actually counting them all, a student randomly draws 150 marbles from the container. Of the 150 marbles drawn, 33 are red.

3) The N–value for this population is 3) _____
   A) 200.
   B) 150.
   C) 33.
   D) 1000.
   E) none of these

4) Suppose that the student is given the N–value. What is a reasonable estimate for the number of red marbles in the container? 4) _____
   A) 33
   B) 183
   C) 220
   D) 150
   E) none of these

A child has an enormous jar in which she has been saving all of her spare change. In order to determine exactly how much money she has in the jar, she dumps all of the coins on the floor and counts them. Under the watchful eye of her mother, she counts 180 pennies, 120 nickels, 100 dimes, and 80 quarters.

5) The N–value of the target population in this study is 5) _____
   A) 80.
   B) 120.
   C) 180.
   D) 100.
   E) none of these

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A container contains a large unspecified number of ping–pong balls. A student takes 80 balls from the container, marks them with a blue dot, returns the marked balls to the container, and thoroughly mixes the balls. She then takes 80 balls again from the container. Of these, 16 have blue dots. She now wants to use this data to estimate the total number of ping–pong balls in the container.

6) The best estimate for the percentage of ping–pong balls in the container that are marked is 6) _____

A) 15%.
B) 10%.
C) 20%.
D) 5%.
E) none of these

7) An estimate for the number of ping–pong balls in the container is 7) _____

A) 480.
B) 160.
C) 576.
D) 400.
E) none of these

The following question(s) refer(s) to the capture–recapture method: n_1 denotes the size of the tagged (captured) sample, n_2 denotes the size of the second (recaptured) sample, and k denotes the number of tagged individuals in the second sample.

8) If $n_1 = 500$, $n_2 = 300$, and $k = 25$, an estimate for the size of the population is 8) _____

A) 1500.
B) 4500.
C) 6000.
D) 15.
E) none of these

9) If $n_1 = 250$, $n_2 = 150$, and $k = 25$, an estimate for the size of the population is 9) _____

A) 3000.
B) 2500.
C) 1500.
D) 15.
E) none of these

10) If $n_1 = 150$, $k = 15$, and the estimated size of the population is approximately 1060, then the value of n_2 is 10) _____

A) 10,600.
B) 15,900.
C) 150.
D) 106.
E) none of these

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As part of a statistics project, a 6th grade teacher brings to class a container with 300 red marbles and 500 white marbles which are thoroughly mixed. To figure out how many marbles in the container are red without actually counting them all, a student randomly draws 40 marbles from the container. Of the 40 marbles drawn, 16 are red.

11) The target population consists of 11) _____

A) the 40 marbles drawn by the student.
B) the 300 red marbles in the container.
C) the 800 marbles in the container.
D) the 16 marbles drawn by the student.
E) none of these

12) The sampling error is most likely a result of 12) _____

A) a confounding variable.
B) sampling bias.
C) sampling variability.
D) nonresponse bias.
E) none of these

As part of a statistics project, a 6th grade teacher brings to class a container with 200 red marbles and 800 white marbles which are thoroughly mixed. To figure out how many marbles in the container are red without actually counting them all, a student randomly draws 150 marbles from the container. Of the 150 marbles drawn, 33 are red.

13) The target population consists of 13) _____

A) the 200 red marbles in the container.
B) the 33 marbles drawn by the student.
C) the 150 marbles drawn by the student.
D) the 1000 marbles in the container.
E) none of these

14) The sampling method used in this example is called 14) _____

A) stratified sampling.
B) quota sampling.
C) random sampling, but not simple random sampling.
D) simple random sampling.
E) none of these

In order to determine how American undergraduate college students feel about eliminating spring break in order to finish spring term a week early, a survey was conducted. Two hundred undergraduate students from the University of Miami (FL) were interviewed. Both of the interviewers hired to conduct the survey were told to interview 25 freshmen, 25 sophomores, 25 juniors, and 25 seniors. Of the 200 students interviewed, 20% were in favor of the elimination of spring break, 70% were opposed, and 10% had no opinion.

15) The target population for this survey is 15) _____

A) the 200 students that were interviewed.
B) all American undergraduate college students.
C) all undergraduates at the University of Miami.
D) the 180 students that had an opinion.
E) none of these

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16) The sampling frame for this survey 16) _____

A) is the same as the target population.
B) does not overlap the target population.
C) is larger than the target population.
D) is smaller than the target population.
E) none of these

17) The sample for this survey is 17) _____

A) all American undergraduate college students.
B) the 180 students that had an opinion.
C) the 200 students that were interviewed.
D) all undergraduates at the University of Miami.
E) none of these

18) Based on the fact that 20% of the students interviewed were in favor of the elimination of spring break, the value 20% is 18) _____

A) a parameter.
B) a statistic.
C) a population.
D) a sample.
E) none of these

19) Which of the following best describes the parameter in this situation? 19) _____

A) The percentage of American college students that undergraduates at the University of Miami (FL) represent.
B) The 20% of students interviewed that favored the elimination of spring break.
C) The actual percentage of students at the University of Miami (FL) that favor the elimination of spring break.
D) The actual percentage of American college students that favor the elimination of spring break.
E) none of these

20) The sampling proportion in this survey is 20) _____

A) 20%.
B) 200/(the number of American college students).
C) 100%.
D) 200/(the number of University of Miami, FL undergraduates).
E) none of these

21) The sampling method used for the survey is called 21) _____

A) random sampling.
B) stratified sampling.
C) quota sampling.
D) simple random sampling.
E) none of these

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A child has an enormous jar in which she has been saving all of her spare change. In order to determine exactly how much money she has in the jar, she dumps all of the coins on the floor and counts them. Under the watchful eye of her mother, she counts 180 pennies, 120 nickels, 100 dimes, and 80 quarters.

22) If the child were to grab a handful of 48 coins at random from the jar, how much money should she expect it to be worth? 22) _____

A) $4.92
B) $3.78
C) $39.60
D) $4.80
E) none of these

Solve the problem.

23) Any data collection process in which the data are collected from each and every member of the population is called 23) _____

A) a survey.
B) a public opinion poll.
C) a census.
D) a parameter.
E) none of these

24) Any data collection process in which the data are collected from a selected subgroup of the population is called 24) _____

A) a survey.
B) a census.
C) a parameter.
D) a statistic.
E) none of these

As part of a statistics project, a 6th grade teacher brings to class a container with 300 red marbles and 500 white marbles which are thoroughly mixed. To figure out how many marbles in the container are red without actually counting them all, a student randomly draws 40 marbles from the container. Of the 40 marbles drawn, 16 are red.

25) The data collection method can best be described as 25) _____

A) a controlled study.
B) a census.
C) a survey.
D) a clinical study.
E) none of these

As part of a statistics project, a 6th grade teacher brings to class a container with 200 red marbles and 800 white marbles which are thoroughly mixed. To figure out how many marbles in the container are red without actually counting them all, a student randomly draws 150 marbles from the container. Of the 150 marbles drawn, 33 are red.

26) The data collection method can best be described as 26) _____

A) a survey.
B) a controlled study.
C) a census.
D) a clinical study.
E) none of these

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A child has an enormous jar in which she has been saving all of her spare change. In order to determine exactly how much money she has in the jar, she dumps all of the coins on the floor and counts them. Under the watchful eye of her mother, she counts 180 pennies, 120 nickels, 100 dimes, and 80 quarters.

27) The data collection method used in this example is called 27) _____
A) a census.
B) random sampling.
C) a controlled study.
D) a survey.
E) none of these

A farmer wishes to work out the average milk yield in his herd that consists of an equal number of Ayrshire, Friesian, Galloway, and Jersey cows.

28) Suppose the farmer divides up his herd into the four sub–groups and randomly samples 3 cows from each subgroup. What type of sampling is being used? 28) _____
A) simple random sampling
B) quota sampling
C) stratified sampling
D) convenience sampling
E) capture–recapture

29) Suppose the farmer selects 12 cows in the following fashion: The first cow to be born in January, February, March etc. is included in the sample. What type of sampling is being used? 29) _____
A) simple random sampling
B) stratified sampling
C) convenience sampling
D) quota sampling
E) capture–recapture

30) Suppose the farmer samples the 12 cows in his barn that are closest to where he enters the barn. What type of sampling is being used? 30) _____
A) simple random sampling
B) stratified sampling
C) capture–recapture
D) convenience sampling
E) quota sampling

Solve the problem.

31) A method of sampling in which the population is broken up into categories and the members of the sample are chosen randomly from within some group of randomly selected categories is called 31) _____
A) simple random sampling.
B) stratified sampling.
C) quota sampling.
D) randomized controlled sampling.
E) none of these

32) Which of the following is unavoidable in a survey using random sampling? 32) _____
A) nonresponse bias
B) sampling variability
C) confounding variables
D) sampling bias
E) none of these

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A tamoxifen study claims that a combination of chemotherapy and the hormone therapy tamoxifen is more effective than tamoxifen alone in preventing breast cancer. In the study, a group of researchers from the U.S. and Canada studied 1477 postmenopausal women with early–stage breast cancer. The women were randomly assigned to one of three study groups. Group A (361 patients) received tamoxifen alone on a daily basis for five years. Group B (566 patients) received chemotherapy and tamoxifen for six months, and then completed five years of tamoxifen treatment. Group C (550 patients) received chemotherapy alone for six months followed by five years of tamoxifen treatment. All 1477 patients knew which treatment they were receiving.

33) This study is 33) _____

A) not blind.
B) blind, but not double–blind.
C) not an experiment.
D) double–blind.
E) none of these

34) Which of the following is the most likely confounding variable in this study? 34) _____

A) Only women were in the study.
B) Only 1477 women were involved in the study.
C) The three groups in the study were of different sizes.
D) Only postmenopausal women were in the study.
E) The doctors running the study were only from the U.S. and Canada.

In order to determine the effects of a new high carbohydrate diet intended to treat depression, a researcher conducts a study. Five hundred inmates in the Middletown prison are selected to participate in the study. The researcher puts the 400 inmates not in solitary confinement on the new diet. The 100 inmates in solitary confinement are given their regular meals. The 400 inmates on the new diet are not aware that they being studied or that their diet has been modified, but have many fewer reported cases of depression after 30 days.

35) Which of the following is not true? 35) _____

A) This is a controlled experiment.
B) The control group consists of 100 inmates.
C) This is a clinical study.
D) This is a randomized controlled experiment.
E) All of these statements are true.

36) Which of the following statements is true? 36) _____

A) The study is a double–blind experiment, but not a blind experiment.
B) The study is a double–blind experiment.
C) The study is a blind experiment, but not a double–blind experiment.
D) The study is not blind experiment.
E) All of these statements are true.

37) In this study, which is the control group? 37) _____

A) the 400 inmates not in solitary confinement
B) the 100 inmates in solitary confinement
C) the subjects that responded to the treatment
D) There is no control group.
E) none of these

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In order to determine the effects of a new pill that is supposed to reduce hair loss, a researcher conducts a study. Five hundred volunteer subjects (300 men and 200 women) all of which suffer some degree of hair loss are selected to participate in the study. The researcher gives the women the real pill and the men a sugar pill, but only the researcher knows this.

38) In the experiment, which is the placebo group? 38) _____

A) the 300 men
B) the subjects that responded to the treatment
C) the 200 women
D) There is no placebo group.
E) none of these

In order to determine the effectiveness of a new vaccine that is alleged to cure "math anxiety," a study was conducted. One thousand volunteer college students enrolled in math courses across the U.S. were chosen. The 1000 students were broken up into two groups. Those enrolled in calculus courses were given the real vaccine. The students in developmental (remedial) math courses were given a fake vaccine consisting of sugared water. None of the students knew whether they were being given the real or the fake vaccine, but the researcher conducting the study knew. At the end of the semester the students were given a test that measured their level of math anxiety. The students in the treatment group showed significantly lower levels of math anxiety than those in the control group. On the basis of this experiment the vaccine was advertised as being highly effective in fighting math anxiety.

39) This study can best be described as a 39) _____

A) double–blind randomized controlled experiment.
B) blind randomized controlled experiment.
C) double–blind controlled placebo experiment.
D) blind controlled placebo experiment.
E) none of these

40) The control group in this study consists of 40) _____

A) the students chosen from developmental math courses.
B) the 1000 volunteer college students used for the study.
C) the students chosen from calculus courses.
D) This study has no control group because it used volunteers.
E) none of these

41) Which of the following is the most likely confounding variable for the study? 41) _____

A) the students' grade level (freshman, sophomore, junior, senior)
B) the students' background in mathematics
C) the type of college attended (two year, four year, public, private university)
D) the student's sex (male, female)
E) none of these

Solve the problem.

42) The primary reason for having a control group and a treatment group in a clinical study is 42) _____

A) to eliminate confounding variables.
B) to save money.
C) to make it easier to collect data.
D) to combat the placebo effect.
E) none of these

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A tamoxifen study claims that a combination of chemotherapy and the hormone therapy tamoxifen is more effective than tamoxifen alone in preventing breast cancer. In the study, a group of researchers from the U.S. and Canada studied 1477 postmenopausal women with early–stage breast cancer. The women were randomly assigned to one of three study groups. Group A (361 patients) received tamoxifen alone on a daily basis for five years. Group B (566 patients) received chemotherapy and tamoxifen for six months, and then completed five years of tamoxifen treatment. Group C (550 patients) received chemotherapy alone for six months followed by five years of tamoxifen treatment. All 1477 patients knew which treatment they were receiving.

43) This study can best be described as a 43) _____

A) census.
B) randomized controlled experiment.
C) survey using stratified sampling.
D) survey using simple random sampling.
E) survey using quota sampling.

In order to determine the effectiveness of a new vaccine that is alleged to cure "math anxiety," a study was conducted. One thousand volunteer college students enrolled in math courses across the U.S. were chosen. The 1000 students were broken up into two groups. Those enrolled in calculus courses were given the real vaccine. The students in developmental (remedial) math courses were given a fake vaccine consisting of sugared water. None of the students knew whether they were being given the real or the fake vaccine, but the researcher conducting the study knew. At the end of the semester the students were given a test that measured their level of math anxiety. The students in the treatment group showed significantly lower levels of math anxiety than those in the control group. On the basis of this experiment the vaccine was advertised as being highly effective in fighting math anxiety.

44) This study can best be described as a 44) _____

A) survey using stratified sampling.
B) survey using quota sampling.
C) randomized controlled experiment.
D) census.
E) controlled placebo experiment.

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Answer Key
Testname: CHAPTER 14

1) C
2) D
3) D
4) C
5) E
6) C
7) D
8) C
9) C
10) D
11) C
12) C
13) D
14) D
15) B
16) D
17) C
18) B
19) D
20) B
21) C
22) B
23) C
24) A
25) C
26) A
27) A
28) C
29) A
30) D
31) B
32) B
33) A
34) D
35) D
36) C
37) B
38) A
39) D
40) A
41) B
42) A
43) B
44) E

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Chapter 14

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

As part of a statistics project, a 6th grade teacher brings to class a container with 200 red marbles and 800 white marbles which are thoroughly mixed. To figure out how many marbles in the container are red without actually counting them all, a student randomly draws 150 marbles from the container. Of the 150 marbles drawn, 33 are red.

1) The sample consists of 1) _____
   A) the 1000 marbles in the container.
   B) the 33 red marbles drawn by the student.
   C) the 200 red marbles in the container.
   D) the 150 marbles drawn by the student.
   E) none of these

As part of a statistics project, a 6th grade teacher brings to class a container with 300 red marbles and 500 white marbles which are thoroughly mixed. To figure out how many marbles in the container are red without actually counting them all, a student randomly draws 40 marbles from the container. Of the 40 marbles drawn, 16 are red.

2) The sample consists of 2) _____
   A) the 16 red marbles drawn by the student.
   B) the 300 red marbles in the container.
   C) the 40 marbles drawn by the student.
   D) the 800 marbles in the container.
   E) none of these

As part of a statistics project, a 6th grade teacher brings to class a container with 200 red marbles and 800 white marbles which are thoroughly mixed. To figure out how many marbles in the container are red without actually counting them all, a student randomly draws 150 marbles from the container. Of the 150 marbles drawn, 33 are red.

3) Suppose that the student is given the N–value. What is a reasonable estimate for the number of red marbles in the container? 3) _____
   A) 183
   B) 220
   C) 33
   D) 150
   E) none of these

4) The N–value for this population is 4) _____
   A) 150.
   B) 1000.
   C) 33.
   D) 200.
   E) none of these

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A container contains a large unspecified number of ping–pong balls. A student takes 80 balls from the container, marks them with a blue dot, returns the marked balls to the container, and thoroughly mixes the balls. She then takes 80 balls again from the container. Of these, 16 have blue dots. She now wants to use this data to estimate the total number of ping–pong balls in the container.

5) An estimate for the number of ping–pong balls in the container is 5) _____

A) 576.
B) 400.
C) 480.
D) 160.
E) none of these

6) The best estimate for the percentage of ping–pong balls in the container that are marked is 6) _____

A) 20%.
B) 10%.
C) 5%.
D) 15%.
E) none of these

The following question(s) refer(s) to the capture–recapture method: n_1 denotes the size of the tagged (captured) sample, n_2 denotes the size of the second (recaptured) sample, and k denotes the number of tagged individuals in the second sample.

7) If $n_1 = 250$, $n_2 = 150$, and $k = 25$, an estimate for the size of the population is 7) _____

A) 15.
B) 2500.
C) 3000.
D) 1500.
E) none of these

8) If $n_1 = 150$, $k = 15$, and the estimated size of the population is approximately 1060, then the value of n_2 is 8) _____

A) 10,600.
B) 150.
C) 15,900.
D) 106.
E) none of these

9) If $n_1 = 500$, $n_2 = 300$, and $k = 25$, an estimate for the size of the population is 9) _____

A) 6000.
B) 15.
C) 1500.
D) 4500.
E) none of these

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Solve the problem.

10) A researcher interested in Cleansburg citizens' attitudes toward a revitalized downtown area surveys a randomly selected group of 200 downtown office workers. 66% of those surveyed indicated they are in favor of revitalizing the downtown area. The researcher concluded that "about two thirds of the people in Cleansburg are in favor of revitalizing the downtown area." This conclusion might be invalid because 10) _____

A) 66% is not exactly two thirds.
B) the size of the sample is too small.
C) the sample is not representative of the population.
D) there was no control group.
E) none of these

In order to determine how American undergraduate college students feel about eliminating spring break in order to finish spring term a week early, a survey was conducted. Two hundred undergraduate students from the University of Miami (FL) were interviewed. Both of the interviewers hired to conduct the survey were told to interview 25 freshmen, 25 sophomores, 25 juniors, and 25 seniors. Of the 200 students interviewed, 20% were in favor of the elimination of spring break, 70% were opposed, and 10% had no opinion.

11) Which of the following best describes the parameter in this situation? 11) _____

A) The actual percentage of students at the University of Miami (FL) that favor the elimination of spring break.
B) The percentage of American college students that undergraduates at the University of Miami (FL) represent.
C) The actual percentage of American college students that favor the elimination of spring break.
D) The 20% of students interviewed that favored the elimination of spring break.
E) none of these

Solve the problem.

12) Any data collection process in which the data are collected from a selected subgroup of the population is called 12) _____

A) a survey.
B) a statistic.
C) a parameter.
D) a census.
E) none of these

A child has an enormous jar in which she has been saving all of her spare change. In order to determine exactly how much money she has in the jar, she dumps all of the coins on the floor and counts them. Under the watchful eye of her mother, she counts 180 pennies, 120 nickels, 100 dimes, and 80 quarters.

13) If the child were to grab a handful of 48 coins at random from the jar, how much money should she expect it to be worth? 13) _____

A) $39.60
B) $3.78
C) $4.92
D) $4.80
E) none of these

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In order to determine the effectiveness of a new vaccine that is alleged to cure "math anxiety," a study was conducted. One thousand volunteer college students enrolled in math courses across the U.S. were chosen. The 1000 students were broken up into two groups. Those enrolled in calculus courses were given the real vaccine. The students in developmental (remedial) math courses were given a fake vaccine consisting of sugared water. None of the students knew whether they were being given the real or the fake vaccine, but the researcher conducting the study knew. At the end of the semester the students were given a test that measured their level of math anxiety. The students in the treatment group showed significantly lower levels of math anxiety than those in the control group. On the basis of this experiment the vaccine was advertised as being highly effective in fighting math anxiety.

14) The sampling frame in this study consists of 14) _____

A) all U.S. college students enrolled in math classes.
B) the treatment and control groups.
C) all U.S. college students.
D) all students that suffer from "math anxiety."
E) none of these

In order to determine how American undergraduate college students feel about eliminating spring break in order to finish spring term a week early, a survey was conducted. Two hundred undergraduate students from the University of Miami (FL) were interviewed. Both of the interviewers hired to conduct the survey were told to interview 25 freshmen, 25 sophomores, 25 juniors, and 25 seniors. Of the 200 students interviewed, 20% were in favor of the elimination of spring break, 70% were opposed, and 10% had no opinion.

15) The target population for this survey is 15) _____

A) all American undergraduate college students.
B) all undergraduates at the University of Miami.
C) the 200 students that were interviewed.
D) the 180 students that had an opinion.
E) none of these

Solve the problem.

16) Any type of numerical information about a population obtained from a sample is called 16) _____

A) a controlled study.
B) a statistic.
C) a parameter.
D) a clinical study.
E) none of these

As part of a statistics project, a 6th grade teacher brings to class a container with 300 red marbles and 500 white marbles which are thoroughly mixed. To figure out how many marbles in the container are red without actually counting them all, a student randomly draws 40 marbles from the container. Of the 40 marbles drawn, 16 are red.

17) The value 16/40 is 17) _____

A) a parameter.
B) a statistic.
C) the response rate.
D) the sampling error.
E) the sampling proportion.

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Solve the problem.

18) A method of sampling in which the population is broken up into categories and the members of the sample are chosen randomly from within some group of randomly selected categories is called 18) _____
A) simple random sampling.
B) stratified sampling.
C) randomized controlled sampling.
D) quota sampling.
E) none of these

19) Which of the following will most likely make an instant, online poll (such as one found at CNN.com or ESPN.com) unscientific? 19) _____
A) quota sampling
B) voluntary response
C) small sample size
D) leading question bias
E) the placebo effect

A farmer wishes to work out the average milk yield in his herd that consists of an equal number of Ayrshire, Friesian, Galloway, and Jersey cows.

20) Suppose the farmer selects 12 cows in the following fashion: The first cow to be born in January, February, March etc. is included in the sample. What type of sampling is being used? 20) _____
A) stratified sampling
B) quota sampling
C) capture–recapture
D) simple random sampling
E) convenience sampling

Solve the problem.

21) Simple random sampling means that 21) _____
A) every member of the population has a chance of being in the sample.
B) any two groups of members of the population of equal size have the same chance of being in the sample.
C) all members of the population have an equal chance of being in the sample.
D) every member of the population is automatically a member of the sample.
E) none of these

In order to determine how American undergraduate college students feel about eliminating spring break in order to finish spring term a week early, a survey was conducted. Two hundred undergraduate students from the University of Miami (FL) were interviewed. Both of the interviewers hired to conduct the survey were told to interview 25 freshmen, 25 sophomores, 25 juniors, and 25 seniors. Of the 200 students interviewed, 20% were in favor of the elimination of spring break, 70% were opposed, and 10% had no opinion.

22) The sampling proportion in this survey is 22) _____
A) 200/(the number of University of Miami, FL undergraduates).
B) 100%.
C) 20%.
D) 200/(the number of American college students).
E) none of these

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A farmer wishes to work out the average milk yield in his herd that consists of an equal number of Ayrshire, Friesian, Galloway, and Jersey cows.

23) Suppose the farmer samples the 12 cows in his barn that are closest to where he enters the barn. What type of sampling is being used? 23) _____

A) simple random sampling
B) quota sampling
C) capture–recapture
D) convenience sampling
E) stratified sampling

24) Suppose the farmer selects the first 3 cows of each type that he milks to be in his sample. What type of sampling is being used? 24) _____

A) convenience sampling
B) stratified sampling
C) simple random sampling
D) capture–recapture
E) quota sampling

Solve the problem.

25) A census is taken of the 35 gasoline stations in the Middletown area. The mean price of a gallon of gas from this study is $1.24. The value $1.24 is 25) _____

A) a parameter.
B) a statistic.
C) an N–value.
D) a population.
E) none of these

As part of a statistics project, a 6th grade teacher brings to class a container with 300 red marbles and 500 white marbles which are thoroughly mixed. To figure out how many marbles in the container are red without actually counting them all, a student randomly draws 40 marbles from the container. Of the 40 marbles drawn, 16 are red.

26) The data collection method can best be described as 26) _____

A) a census.
B) a controlled study.
C) a survey.
D) a clinical study.
E) none of these

A child has an enormous jar in which she has been saving all of her spare change. In order to determine exactly how much money she has in the jar, she dumps all of the coins on the floor and counts them. Under the watchful eye of her mother, she counts 180 pennies, 120 nickels, 100 dimes, and 80 quarters.

27) The "80 quarters in the jar" describes 27) _____

A) a strata.
B) a parameter.
C) a statistic.
D) a sample.
E) none of these

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Solve the problem.

28) Which of the following is unavoidable in a survey using random sampling? 28) _____

A) sampling bias
B) sampling variability
C) confounding variables
D) nonresponse bias
E) none of these

In order to determine how American undergraduate college students feel about eliminating spring break in order to finish spring term a week early, a survey was conducted. Two hundred undergraduate students from the University of Miami (FL) were interviewed. Both of the interviewers hired to conduct the survey were told to interview 25 freshmen, 25 sophomores, 25 juniors, and 25 seniors. Of the 200 students interviewed, 20% were in favor of the elimination of spring break, 70% were opposed, and 10% had no opinion.

29) The sampling method used for the survey is called 29) _____

A) simple random sampling.
B) quota sampling.
C) random sampling.
D) stratified sampling.
E) none of these

A container contains a large unspecified number of ping–pong balls. A student takes 80 balls from the container, marks them with a blue dot, returns the marked balls to the container, and thoroughly mixes the balls. She then takes 80 balls again from the container. Of these, 16 have blue dots. She now wants to use this data to estimate the total number of ping–pong balls in the container.

30) The statistical method described in this example is called 30) _____

A) a census.
B) a survey.
C) a controlled study.
D) capture–recapture.
E) none of these

As part of a statistics project, a 6th grade teacher brings to class a container with 200 red marbles and 800 white marbles which are thoroughly mixed. To figure out how many marbles in the container are red without actually counting them all, a student randomly draws 150 marbles from the container. Of the 150 marbles drawn, 33 are red.

31) The sampling method used in this example is called 31) _____

A) stratified sampling.
B) quota sampling.
C) random sampling, but not simple random sampling.
D) simple random sampling.
E) none of these

32) The target population consists of 32) _____

A) the 200 red marbles in the container.
B) the 33 marbles drawn by the student.
C) the 150 marbles drawn by the student.
D) the 1000 marbles in the container.
E) none of these

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In order to determine the effects of a new high carbohydrate diet intended to treat depression, a researcher conducts a study. Five hundred inmates in the Middletown prison are selected to participate in the study. The researcher puts the 400 inmates not in solitary confinement on the new diet. The 100 inmates in solitary confinement are given their regular meals. The 400 inmates on the new diet are not aware that they being studied or that their diet has been modified, but have many fewer reported cases of depression after 30 days.

33) In this study, which is the control group? 33) _____

A) the 400 inmates not in solitary confinement
B) the subjects that responded to the treatment
C) the 100 inmates in solitary confinement
D) There is no control group.
E) none of these

34) Which of the following statements is true? 34) _____

A) The study is not blind experiment.
B) The study is a double–blind experiment.
C) The study is a blind experiment, but not a double–blind experiment.
D) The study is a double–blind experiment, but not a blind experiment.
E) All of these statements are true.

Solve the problem.

35) In a study of 135 women, roughly half took estrogen as well as calcium and vitamin D supplements and received regular dental checkups. The remaining women received the supplements and the checkups but substituted a sugar pill for the estrogen. Those who received the estrogen had an average 3.6 percent gain in bone density compared to a 0.2 percent bone density improvement in those taking the sugar pill. This study can best be described as 35) _____

A) a controlled placebo experiment.
B) the placebo effect.
C) a survey using simple random sampling.
D) a survey using quota sampling.
E) a census.

36) A controlled placebo experiment is said to be blind when 36) _____

A) neither the members of the control group nor the members of the treatment group know to which of the two groups they belong.
B) none of the scientists conducting the study know which patients are in the control group and which patients are in the treatment group.
C) the members of the control group are told they are in the treatment group.
D) the members of the treatment group are told they are in the control group.
E) none of these

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In order to determine the effectiveness of a new vaccine that is alleged to cure "math anxiety," a study was conducted. One thousand volunteer college students enrolled in math courses across the U.S. were chosen. The 1000 students were broken up into two groups. Those enrolled in calculus courses were given the real vaccine. The students in developmental (remedial) math courses were given a fake vaccine consisting of sugared water. None of the students knew whether they were being given the real or the fake vaccine, but the researcher conducting the study knew. At the end of the semester the students were given a test that measured their level of math anxiety. The students in the treatment group showed significantly lower levels of math anxiety than those in the control group. On the basis of this experiment the vaccine was advertised as being highly effective in fighting math anxiety.

37) Which of the following is the most likely confounding variable for the study? 37) _____

A) the students' background in mathematics
B) the type of college attended (two year, four year, public, private university)
C) the students' grade level (freshman, sophomore, junior, senior)
D) the student's sex (male, female)
E) none of these

38) The control group in this study consists of 38) _____

A) the 1000 volunteer college students used for the study.
B) the students chosen from developmental math courses.
C) the students chosen from calculus courses.
D) This study has no control group because it used volunteers.
E) none of these

39) This study can best be described as a 39) _____

A) double–blind randomized controlled experiment.
B) double–blind controlled placebo experiment.
C) blind controlled placebo experiment.
D) blind randomized controlled experiment.
E) none of these

A tamoxifen study claims that a combination of chemotherapy and the hormone therapy tamoxifen is more effective than tamoxifen alone in preventing breast cancer. In the study, a group of researchers from the U.S. and Canada studied 1477 postmenopausal women with early–stage breast cancer. The women were randomly assigned to one of three study groups. Group A (361 patients) received tamoxifen alone on a daily basis for five years. Group B (566 patients) received chemotherapy and tamoxifen for six months, and then completed five years of tamoxifen treatment. Group C (550 patients) received chemotherapy alone for six months followed by five years of tamoxifen treatment. All 1477 patients knew which treatment they were receiving.

40) This study can best be described as a 40) _____

A) survey using quota sampling.
B) randomized controlled experiment.
C) census.
D) survey using stratified sampling.
E) survey using simple random sampling.

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In order to determine the effectiveness of a new vaccine that is alleged to cure "math anxiety," a study was conducted. One thousand volunteer college students enrolled in math courses across the U.S. were chosen. The 1000 students were broken up into two groups. Those enrolled in calculus courses were given the real vaccine. The students in developmental (remedial) math courses were given a fake vaccine consisting of sugared water. None of the students knew whether they were being given the real or the fake vaccine, but the researcher conducting the study knew. At the end of the semester the students were given a test that measured their level of math anxiety. The students in the treatment group showed significantly lower levels of math anxiety than those in the control group. On the basis of this experiment the vaccine was advertised as being highly effective in fighting math anxiety.

41) The results of this study should be considered unreliable because 41) _____

A) the sample was too small.
B) the treatment and control groups were not the same size.
C) only college students were used.
D) the treatment and control groups represented two very different segments of the population.
E) none of these

Solve the problem.

42) A controlled placebo experiment is said to be double–blind when 42) _____

A) neither the subject nor the scientists conducting the study know which individuals are in the treatment group and which are in the control group.
B) none of the scientists conducting the study know which patients are in the control group and which patients are in the treatment group.
C) the members of the control group are told they are in the treatment group and vice versa.
D) neither the members of the control group or the members of the treatment group know to which of the two groups they belong.
E) none of these

43) The primary reason for having a control group and a treatment group in a clinical study is 43) _____

A) to save money.
B) to make it easier to collect data.
C) to eliminate confounding variables.
D) to combat the placebo effect.
E) none of these

44) Which of the following is not required in a double–blind placebo experiment? 44) _____

A) Neither the members of the control group nor the members of the treatment group know to which of the two groups they belong.
B) The size of the control group and treatment group are the same.
C) There is a control group and a treatment group.
D) The scientists conducting the study do not know which individuals are in the treatment group and which are in the control group.
E) none of these

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Answer Key
Testname: CHAPTER 14 VERSION 2

1) D
2) C
3) B
4) B
5) B
6) A
7) D
8) D
9) A
10) C
11) C
12) A
13) B
14) A
15) A
16) B
17) B
18) B
19) B
20) D
21) B
22) D
23) D
24) E
25) A
26) C
27) C
28) B
29) B
30) D
31) D
32) D
33) C
34) C
35) A
36) A
37) A
38) B
39) C
40) B
41) D
42) A
43) C
44) B

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Chapter 15

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

1) The data below gives the eye colors of 20 students in a Statistics class. Make a frequency table for the data. 1) _____

green	blue	brown	blue	blue
brown	blue	blue	blue	green
blue	brown	blue	brown	brown
blue	brown	blue	blue	blue

A)

Color	Green	Brown	Blue
Percent	10%	30%	70%

B)

Color	Green	Brown	Blue
Frequency	2	6	12

C)

Color	Green	Brown	Blue
Frequency	2	8	20

D)

Color	Green	Brown	Blue
Frequency	6	12	2

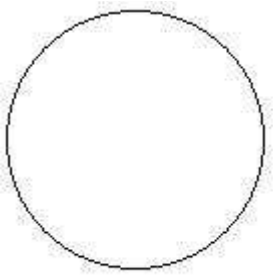
E)

Color	Green	Brown	Blue
Frequency	6	2	12

Construct a pie chart illustrating the given data set.

2) A cereal manufacturer wants to introduce their new cereal breakfast bar. The marketing team traveled to various states and asked 900 people to sample the breakfast bar and rate it as excellent, good, or fair. The following data give the rating distribution. 2) _____

Excellent	Good	Fair
180	450	270



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A)



B)



C)



D)



E)



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SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Solve the problem.

3) The data below show the types of medals won by 25 State University students participating in the statewide science fair. Make a bar chart for the data. 3) _____

gold	gold	silver	gold	bronze	silver	silver
bronze	gold	silver	silver	bronze	silver	gold
gold	silver	silver	bronze	bronze	gold	silver
gold	gold	bronze	bronze			

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

4) When the possible values of a numerical variable change by minimum increments, the variable is called 4) _____

A) categorical.
B) continuous.
C) discrete.
D) qualitative.
E) none of these

The table below shows the scores of a group of students on a 10 point multiple choice placement test.

Exam Score	Frequency
3	5
4	3
5	5
6	2
7	7
8	6
9	1
10	1

5) The total number of students taking the test is 5) _____

A) 8.
B) 180.
C) 30.
D) 52.
E) none of these

6) What kind of variable is the test score? 6) _____

A) quantitative and discrete
B) qualitative and continuous
C) qualitative and discrete
D) quantitative and continuous
E) none of these

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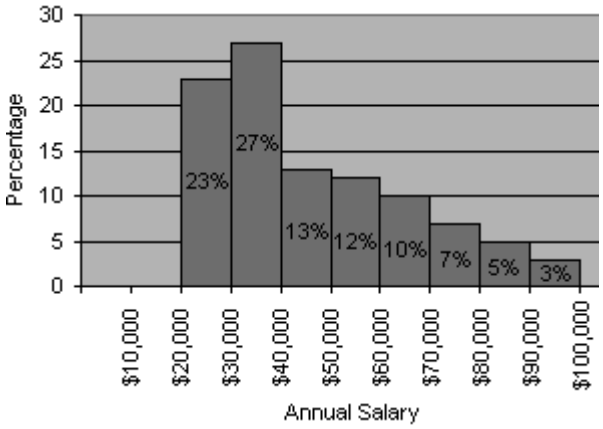
The data in the figure below represents the annual salaries of 120 professional mathematicians.



7) The kind of graph shown above is called 7) _____

A) a frequency table.
B) a histogram.
C) a box plot.
D) a bar graph.
E) none of these

The data in the figure below represents the annual salaries of 200 professional musicians.



8) Approximately how many musicians make $40,000 or less? 8) _____

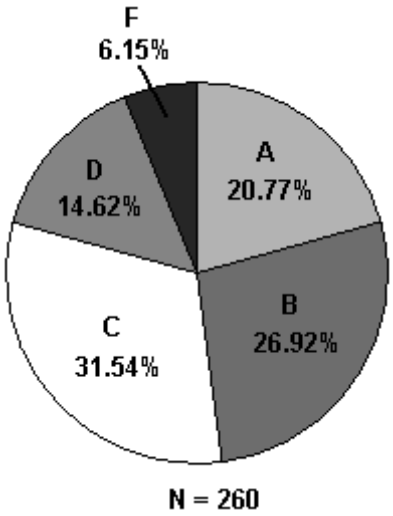
A) 50
B) 100
C) 54
D) 27
E) none of these

9) Give the length of of each class interval in the bar graph (in dollars). 9) _____

A) $20,000 B) $5 C) $9999 D) $90,000 E) $10,000

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The pie chart shown below represents the grades of 260 students in Professor Blackbeard's Stat 101 class.



10) A good estimate for the number of degrees in the 'B' slice of the pie is 10) _____

A) 27°.
B) 13°.
C) 104°.
D) 97°.
E) none of these

The table below shows Joe's golf scores from Saturday.

Golf Score	Frequency
2	5
3	8
4	11
5	5
6	3
7	1
8	2
9	1

11) Joe's average golf score on Saturday was 11) _____

A) 4.
B) 4.5.
C) 3.75.
D) 4.25.
E) none of these

12) Joe's median golf score on Saturday was 12) _____

A) 3.75.
B) 4.25.
C) 4.5.
D) 4.
E) none of these

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The table below shows the scores of a group of students on a 10 point multiple choice placement test.

Exam Score	Frequency
3	5
4	3
5	5
6	2
7	7
8	6
9	1
10	1

13) The median score on the test is 13) _____

A) 6.
B) 5.5.
C) 5.
D) 6.5.
E) none of these

The scores on a 30–point multiple–choice exam are given in the following frequency table:

Exam Score	Frequency
23	6
24	4
25	3
26	1
27	5
28	4
29	4
30	1

14) The mean score on the exam is 14) _____

A) 25.
B) 26.5.
C) 25.5.
D) 26.
E) none of these

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The scores on a 30–point multiple–choice exam are given in the following frequency table:

Exam Score	Frequency
23	6
24	6
25	4
26	1
27	6
28	6
29	4
30	1

15) The average score on the exam is 15) _____
A) 25.
B) 26.5.
C) 25.5.
D) 26.
E) none of these

16) The median score on the exam is 16) _____
A) 25.
B) 26.5.
C) 25.5.
D) 26.
E) none of these

Use the data set {–100, –99, –98, ..., –2, –1} to answer the following question(s).

17) The data set has a median of 17) _____
A) –50.5.
B) –49.5.
C) –51.
D) –50.
E) none of these

Use the data set {–100, –99, –98, ..., –2, –1, 0} to answer the following question(s).

18) The data set has a mean of 18) _____
A) –50.
B) –50.5.
C) –51.
D) –49.5.
E) none of these

19) The data set has a median of 19) _____
A) –51.
B) –50.5.
C) –50.
D) –49.5.
E) none of these

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Use the data set {–2, –3, 1, 8} to answer the following question(s).

20) The mean of the data set is 20) _____

A) 3.5.
B) 1.
C) 0.25.
D) 4.
E) none of these

Use the data set {–1, –3, –5, 9} to answer the following question(s).

21) The mean of the data set is 21) _____

A) 0.25.
B) 0.
C) –1.
D) 1.
E) none of these

22) The median of the data set is 22) _____

A) 0.
B) –4.
C) –2.
D) 1.
E) none of these

Use the data set {0, 4, 4, 8, 4, 16} to answer the following question(s).

23) The mean of the data set is 23) _____

A) 2.
B) $\sqrt{152}$.
C) 6.
D) 4.
E) none of these

Use the data set {0, –1, –3, 3, 3, –5, –7, 10} to answer the following question(s).

24) The mean of the data set is 24) _____

A) 0.
B) 3.
C) 0.25.
D) –0.5.
E) none of these

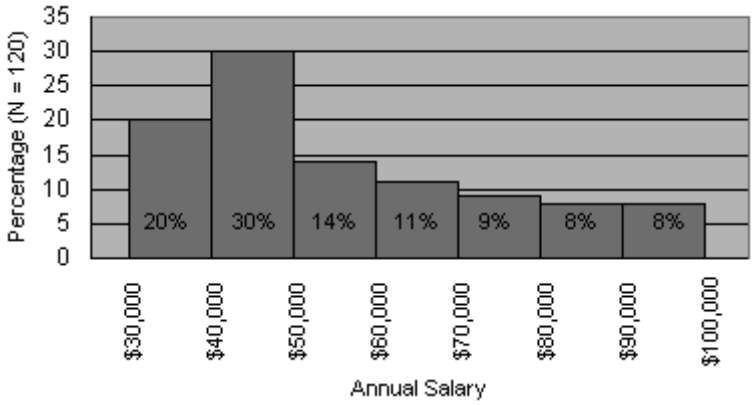
Use the data set $\{d_1, d_2, d_3, ..., d_{251}\}$ consisting of 251 numbers to answer the following question(s).

25) After sorting the data set (in increasing order from left to right), the median is 25) _____

A) the sum of all the numbers divided by 251.
B) the average of the numbers in the 125th and 126th positions.
C) the number in the 125th position.
D) the number in the 126th position.
E) none of these

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The data in the figure below represents the annual salaries of 120 professional mathematicians.



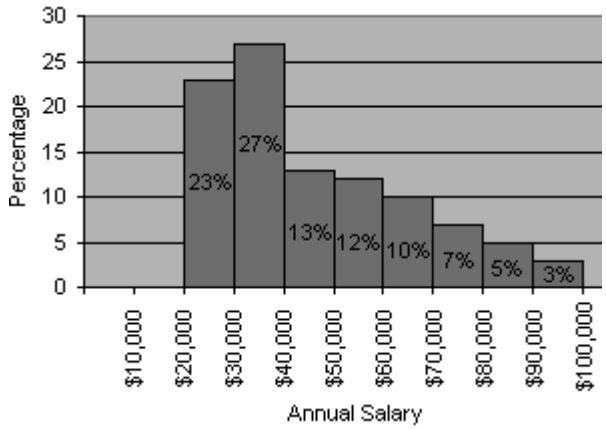
26) The median salary of this group of mathematicians is approximately 26) _____

A) $70,000.
B) $50,000.
C) $60,000.
D) $40,000.
E) none of these

27) The mean salary for this group of mathematicians is 27) _____

A) greater than the median.
B) $50,000.
C) the same as the median.
D) less than the median.
E) none of these

The data in the figure below represents the annual salaries of 200 professional musicians.

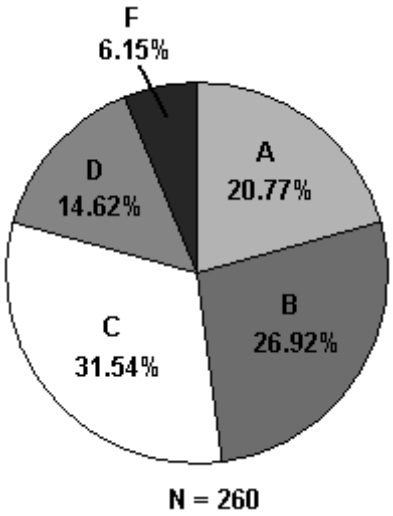


28) The median salary of this group of musicians is approximately 28) _____

A) $40,000.
B) $50,000.
C) $60,000.
D) $80,000.
E) none of these

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The pie chart shown below represents the grades of 260 students in Professor Blackbeard's Stat 101 class.



29) Suppose the following grade point scale is used: A = 4.0, B = 3.0, C = 2.0, D = 1.0, F = 0.0. Which number best estimates the grade point average in Professor Blackbeard's Stat 101 class? 29) _____

A) 2 B) 2.5 C) 2.4 D) 2.1 E) 2.6

Use the frequency table below to answer the following question(s).

Data Value	Frequency
2	4
3	5
5	x
7	1
8	20

30) If the mean of the data set is 6, then x satisfies 30) _____

A) $12 \le x$ B) $3 \le x < 6$ C) $0 \le x < 3$ D) $9 \le x < 12$ E) $6 \le x < 9$

The table below shows Joe's golf scores from Saturday.

Golf Score	Frequency
2	5
3	8
4	11
5	5
6	3
7	1
8	2
9	1

31) The third quartile of golf scores is 31) _____

A) 6.
B) 5.5.
C) 6.5.
D) 5.
E) none of these

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32) The 95th percentile of golf scores is 32) _____

A) 8.
B) 8.2.
C) 34.2
D) 8.5.
E) none of these

33) The locator for the 20th percentile is 33) _____

A) 3.
B) 7.2.
C) 7.
D) 8.
E) none of these

The table below shows the scores of a group of students on a 10 point multiple choice placement test.

Exam Score	Frequency
3	5
4	3
5	5
6	2
7	7
8	6
9	1
10	1

34) The first quartile on the test is 34) _____

A) 5.
B) 5.5.
C) 4.
D) 4.5.
E) none of these

35) The third quartile on the test is 35) _____

A) 8.
B) 7.
C) 6.5.
D) 7.5.
E) none of these

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The scores on a 30–point multiple–choice exam are given in the following frequency table:

Exam Score	Frequency
23	6
24	4
25	3
26	1
27	5
28	4
29	4
30	1

36) The first quartile on the exam is 36) _____
A) 24.
B) 25.5.
C) 24.5.
D) 25.
E) none of these

37) The third quartile on the exam is 37) _____
A) 28.
B) 26.5.
C) 27.
D) 27.5.
E) none of these

38) The 35th percentile on the exam is 38) _____
A) 9.8.
B) 25.
C) 23.
D) 24.
E) none of these

39) The locator for the 80th percentile is 39) _____
A) 22.5.
B) 23.
C) 22.4.
D) 22.2.
E) none of these

Use the data set {–100, –99, –98, ..., –2, –1, 0} to answer the following question(s).

40) The data set has a first quartile of 40) _____
A) –75.5.
B) –75.
C) –76.
D) –74.4.
E) none of these

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Use the data set {0, –1, –3, 3, 3, –5, –7, 10} to answer the following question(s).

41) The 15th percentile of the data set is 41) _____

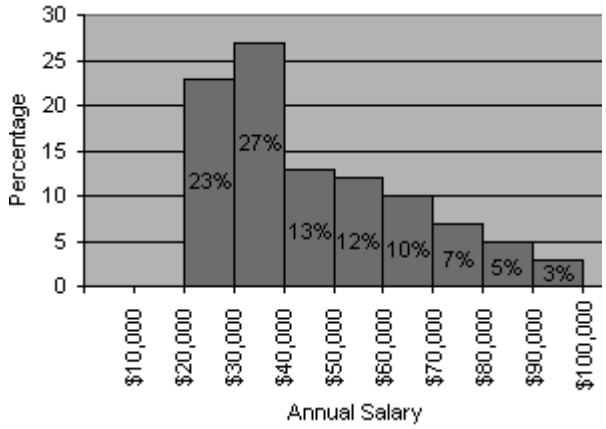
A) –3.
B) –5.
C) –2.
D) –4.
E) none of these.

Use the data set $\{d_1, d_2, d_3, ..., d_{251}\}$ consisting of 251 numbers to answer the following question(s).

42) After sorting the data set (in increasing order from left to right) the first quartile is 42) _____

A) the number in the 64th position.
B) the number in the 63rd position.
C) the average of the numbers in the 63rd and 64th positions.
D) the average of the numbers in the 62nd and 63rd positions.
E) none of these

The data in the figure below represents the annual salaries of 200 professional musicians.



43) The third quartile of the salaries of this group of musicians is approximately 43) _____

A) $80,000.
B) $70,000.
C) $75,000.
D) $60,000.
E) none of these

Solve the problem.

44) A class consisting of 160 students is given an exam. The first quartile for the scores on the exam is 42. This means that 44) _____

A) 40 students scored 42 or higher.
B) 120 students scored 42 or higher.
C) 80 students scored 42 or higher.
D) 25 students scored 42 or higher.
E) none of these

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45) A class consisting of 80 students is given an exam. The third quartile for the scores on the exam is 67. This means that 45) _____

A) 20 students scored 67 or higher.
B) 75 students scored 67 or higher.
C) 67 students scored 75 or higher.
D) 60 students scored 67 or higher.
E) none of these

46) Find the five–number summary for the data set {5, –2, 8, 4, 7, 1, 7, –2, –5}. 46) _____

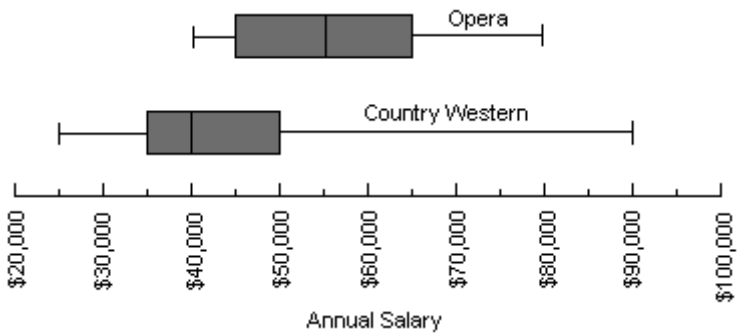
A) Min = –5, Q_1 = 1, M = 4, Q_3 = 7, Max = 8
B) Min = –5, Q_1 = –2, M = 4, Q_3 = 5, Max = 8
C) Min = –5, Q_1 = –2, M = 4, Q_3 = 7, Max = 8
D) Min = –5, Q_1 = –2, M = 5, Q_3 = 7, Max = 8
E) Min = –5, Q_1 = –2, M = 2.6, Q_3 = 7, Max = 8

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

47) Draw a box plot for the data set {5, –2, 8, 4, 7, 1, 7, –2, –5}. 47) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

The box plots represent a comparison of the annual salaries of a group of opera and a group of country western singers respectively.



48) Reba is a country western singer whose annual salary is twice the median salary of the group of country western singers. Sylvia is the highest paid among the group of opera singers. Which of the following statements is true? 48) _____

A) Reba and Sylvia have the same annual salary.
B) The information provided is not sufficient to determine which of the two salaries is higher.
C) Reba's annual salary is higher than Sylvia's.
D) Sylvia's annual salary is higher than Reba's.
E) none of these

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Solve the problem.

49) The average of a data set consisting of 11 numbers is 6. The smallest of the numbers is Min = 2. If Max is the largest of the numbers in the data set, which of the following could be a possible value of Max? 49) _____

A) 6.5
B) 6.3
C) 47
D) 6.25
E) none of these

50) The average of a data set consisting of 11 numbers is 6. The smallest of the numbers is Min = 1. If Max is the largest of the numbers in the data set, which of the following could be a possible value of Max? 50) _____

A) 6.6
B) 6
C) 6.4
D) 65
E) none of these

51) Which of the following [A), B), C), or D)] is not part of the five–number summary of a data set? 51) _____

A) the median of the data set
B) the average of the data set
C) the smallest value in the data set
D) the first quartile of the data set
E) all of these are given in the five–number summary.

The table below shows the scores of a group of students on a 10 point multiple choice placement test.

Exam Score	Frequency
3	5
4	3
5	5
6	2
7	7
8	6
9	1
10	1

52) The range on the test is 52) _____

A) 7.
B) 10.
C) 8.
D) 9.
E) none of these

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The scores on a 30–point multiple–choice exam are given in the following frequency table:

Exam Score	Frequency
23	6
24	6
25	4
26	1
27	6
28	6
29	4
30	1

53) The range on the exam is 53) _____

A) 10.
B) 7.
C) 9.
D) 8.
E) none of these

54) The interquartile range on the exam is 54) _____

A) 3.
B) 2.5.
C) 3.5.
D) 2.
E) none of these

Use the frequency table below to answer the following question(s).

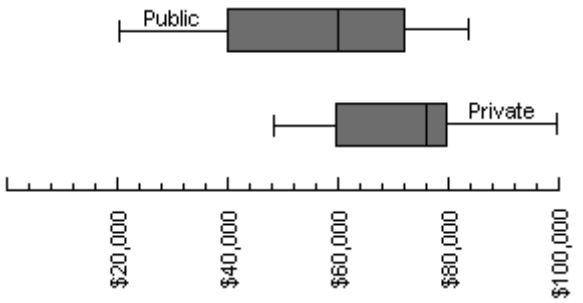
Data Value	Frequency
2	5
3	5
5	45
7	5
8	5

55) The interquartile range of this data set is 55) _____

A) 0.
B) 4.
C) 6.
D) 2.
E) none of these

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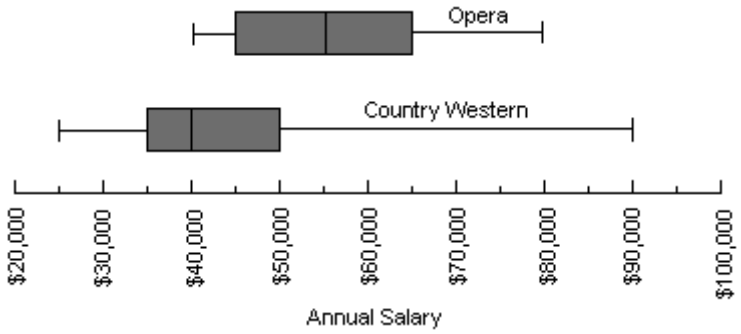
The box plots represent a comparison of the annual salaries of a group of public and private employees



56) The interquartile range of salaries for the group of public employees is 56) _____

A) $64,000.
B) $20,000.
C) $12,000.
D) $32,000.
E) none of these

The box plots represent a comparison of the annual salaries of a group of opera and a group of country western singers respectively.



57) The range of salaries for the group of country western singers is approximately 57) _____

A) $65,000.
B) $90,000.
C) $40,000.
D) $15,000.
E) none of these

Solve the problem.

58) The average of a data set consisting of 8 numbers is 5. The smallest of the numbers is Min = 1. The largest of the numbers is Max = 9. Which of the following is the smallest possible value of the interquartile range of this data set? 58) _____

A) 2
B) 1
C) 0
D) 4
E) none of these

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59) Suppose that the data set $\{x_1, x_2, x_3, ..., x_N\}$ has median M and interquartile range IQR. If M' and IQR' are the median and interquartile range of the data set $\{x_1 + c, x_2 + c, x_3 + c, ..., x_N + c\}$, respectively, then 59) _____

A) M' = M + c, and IQR' = IQR + c.
B) M' = M, and IQR' = IQR.
C) M' = M, and IQR' = IQR + c.
D) M' = M + c, and IQR' = IQR.
E) none of these

Use the frequency table below to answer the following question(s).

Data Value	Frequency
2	5
3	5
5	45
7	5
8	5

60) An outlier of a data set is defined as any data point more than 1.5 times the interquartile range above the third quartile or below the first quartile. The number of outliers in this data set is 60) _____

A) 20.
B) 0.
C) 5.
D) 10.
E) none of these

Use the data set {–2, –3, 1, 8} to answer the following question(s).

61) The standard deviation of the data set is 61) _____

A) 4.301.
B) 18.5.
C) 4.33.
D) 3.905.
E) none of these

Use the data set {0, 4, 4, 8, 4, 16} to answer the following question(s).

62) The standard deviation of the data set is 62) _____

A) 13.266.
B) 152.
C) 25.333.
D) 12.329.
E) none of these

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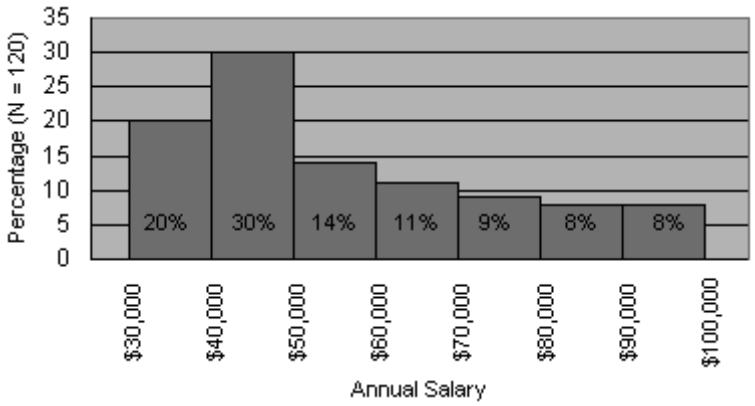
Use the frequency table below to answer the following question(s).

Data Value	Frequency
2	5
3	5
5	45
7	5
8	5

63) The standard deviation of this data set is 63) _____

A) 1.414.
B) 1.225.
C) 1.732.
D) 1.581.
E) none of these

The data in the figure below represents the annual salaries of 120 professional mathematicians.



64) Which of the following values is the best estimate of the standard deviation of this data? 64) _____

A) $70,000 B) $5000 C) $40,000 D) $490,000 E) $20,000

Solve the problem.

65) What is the size relationship between the interquartile range and the standard deviation of a data set? 65) _____

A) The interquartile range is always more than the standard deviation.
B) The interquartile range is always less than the standard deviation.
C) The interquartile range can be smaller than, equal to, or bigger than the standard deviation.
D) The interquartile range is always equal to the standard deviation.
E) none of these

66) Which of the following [A), B), C), or D)] can be a negative number? 66) _____

A) the range of a data set
B) the standard deviation of a data set
C) the interquartile range of a data set
D) the variance of a data set
E) none of these can be negative numbers.

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67) Suppose that the data set $\{x_1, x_2, x_3, \ldots, x_N\}$ has average A and standard deviation s. If A' and s' are the average and standard deviation of the data set $\{x_1 + c, x_2 + c, x_3 + c, \ldots, x_N + c\}$, respectively, then 67) _____

A) A' = A + c and s' = s.
B) A' = A and s' = s + c.
C) A' = A and s' = s.
D) A' = A + c and s' = s + c.
E) none of these

68) Suppose that every element in the data set $\{x_1, x_2, x_3, \ldots, x_N\}$ is positive and increases in value by 10%. Which of the following is not true? 68) _____

A) The range of the data set increases by 10%.
B) The median of the data set increases by 10%.
C) The mean of the data set increases by 10%.
D) The standard deviation of the data set increases by 10%.
E) all of these are true.

69) Suppose that every element in the data set $\{x_1, x_2, x_3, \ldots, x_N\}$ is positive. Further, suppose each element is first increased in value by 10% and then 1 is added to each of the resulting values. Which of the following is not true? 69) _____

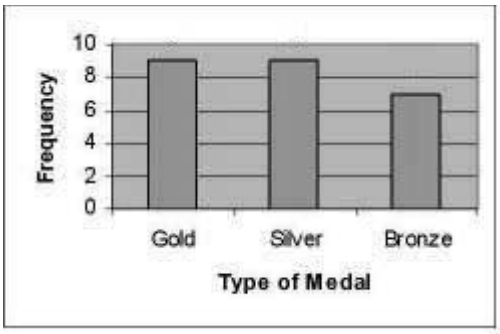
A) The range of the data set increases by 10%.
B) The median of the data set increases by 10%.
C) The variance of the data set increases by 10%.
D) The standard deviation of the data set increases by 10%.
E) all of these are true.

70) Using Chebyshev's theorem, how many standard deviations on each side of the mean must we take to be assured of including 95% of the data? 70) _____

A) 6 B) 4 C) 5 D) 3 E) 2

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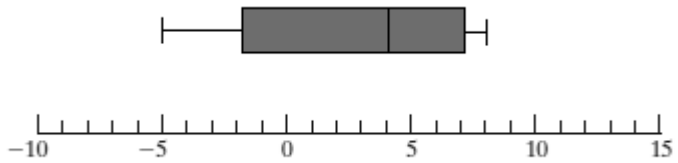
1) B
2) E
3)



4) C
5) C
6) A
7) B
8) B
9) E
10) D
11) D
12) D
13) D
14) D
15) D
16) B
17) A
18) A
19) C
20) B
21) B
22) C
23) C
24) A
25) D
26) B
27) A
28) A
29) C
30) D
31) D
32) A
33) B
34) C
35) A
36) A
37) A
38) D
39) C
40) B

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41) B
42) C
43) D
44) B
45) A
46) C
47)



48) A
49) A
50) A
51) B
52) A
53) B
54) E
55) A
56) D
57) A
58) C
59) D
60) A
61) A
62) E
63) A
64) E
65) C
66) E
67) A
68) E
69) B
70) C

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Chapter 15

Name_____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Solve the problem.

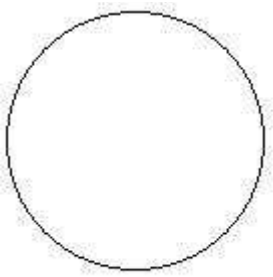
1) The data below gives the eye colors of 20 students in a Statistics class. Make a frequency table for the data. 1) _____

green	blue	brown	blue	blue
brown	blue	blue	blue	green
blue	brown	blue	brown	brown
blue	brown	blue	blue	blue

Construct a pie chart illustrating the given data set.

2) A cereal manufacturer wants to introduce their new cereal breakfast bar. The marketing team traveled to various states and asked 900 people to sample the breakfast bar and rate it as excellent, good, or fair. The following data give the rating distribution. 2) _____

Excellent	Good	Fair
180	450	270



Solve the problem.

3) The data below show the types of medals won by 25 State University students participating in the statewide science fair. Make a bar chart for the data. 3) _____

gold	gold	silver	gold	bronze	silver	silver
bronze	gold	silver	silver	bronze	silver	gold
gold	silver	silver	bronze	bronze	gold	silver
gold	gold	bronze	bronze			

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

4) When the possible values of a numerical variable change by minimum increments, the variable is called 4) _____

A) categorical.
B) continuous.
C) discrete.
D) qualitative.
E) none of these

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The table below shows Joe's golf scores from Saturday.

Golf Score	Frequency
2	5
3	8
4	11
5	5
6	3
7	1
8	2
9	1

5) What kind of variable is a golf score? 5) _____

A) qualitative and continuous
B) quantitative and discrete
C) quantitative and continuous
D) qualitative and discrete
E) none of these

The table below shows the scores of a group of students on a 10 point multiple choice placement test.

Exam Score	Frequency
3	5
4	3
5	5
6	2
7	7
8	6
9	1
10	1

6) The total number of students taking the test is 6) _____

A) 180.
B) 52.
C) 8.
D) 30.
E) none of these

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The data in the figure below represents the annual salaries of 120 professional mathematicians.



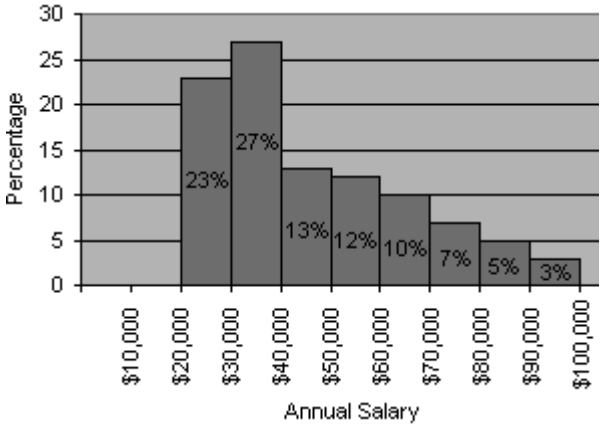
7) The kind of graph shown above is called 7) _____

A) a frequency table.
B) a bar graph.
C) a box plot.
D) a histogram.
E) none of these

8) Approximately how many mathematicians make $50,000 or more? 8) _____

A) 40
B) 60
C) 14
D) 50
E) none of these

The data in the figure below represents the annual salaries of 200 professional musicians.

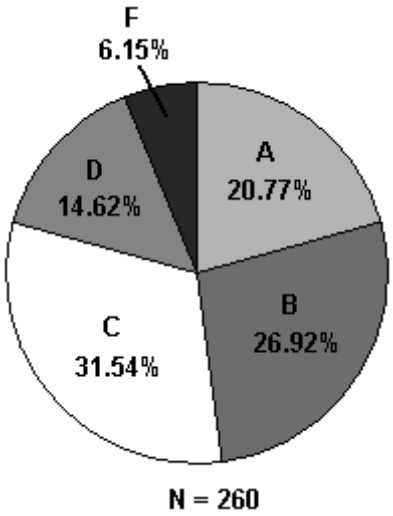


9) Approximately how many musicians make $40,000 or less? 9) _____

A) 54
B) 100
C) 27
D) 50
E) none of these

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The pie chart shown below represents the grades of 260 students in Professor Blackbeard's Stat 101 class.



10) According to the chart, approximately how many students passed with a grade of 'C' or better? 10) _____

A) 32
B) 82
C) 79
D) 206
E) none of these

The table below shows Joe's golf scores from Saturday.

Golf Score	Frequency
2	5
3	8
4	11
5	5
6	3
7	1
8	2
9	1

11) Joe's median golf score on Saturday was 11) _____

A) 4.25.
B) 4.5.
C) 3.75.
D) 4.
E) none of these

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The table below shows the scores of a group of students on a 10 point multiple choice placement test.

Exam Score	Frequency
3	5
4	3
5	5
6	2
7	7
8	6
9	1
10	1

12) The average score on the test is 12) _____

A) 6.5.
B) 5.5.
C) 5.
D) 6.
E) none of these

The scores on a 30–point multiple–choice exam are given in the following frequency table:

Exam Score	Frequency
23	6
24	6
25	4
26	1
27	6
28	6
29	4
30	1

13) The average score on the exam is 13) _____

A) 25.5.
B) 25.
C) 26.5.
D) 26.
E) none of these

Use the data set {–100, –99, –98, ..., –2, –1} to answer the following question(s).

14) The data set has a mean of 14) _____

A) –49.5.
B) –50.5.
C) –51.
D) –50.
E) none of these

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Use the data set {–2, –3, 1, 8} to answer the following question(s).

15) The median of the data set is 15) _____

A) –1.
B) 0.
C) 2.
D) –0.5.
E) none of these

Use the data set {–1, –3, –5, 9} to answer the following question(s).

16) The median of the data set is 16) _____

A) –2.
B) 1.
C) –4.
D) 0.
E) none of these

Use the data set {0, –1, –3, 3, 3, –5, –7, 10} to answer the following question(s).

17) The mean of the data set is 17) _____

A) –0.5.
B) 0.25.
C) 3.
D) 0.
E) none of these

Use the data set $\{d_1, d_2, d_3, ..., d_{251}\}$ consisting of 251 numbers to answer the following question(s).

18) After sorting the data set (in increasing order from left to right), the median is 18) _____

A) the number in the 125th position.
B) the sum of all the numbers divided by 251.
C) the average of the numbers in the 125th and 126th positions.
D) the number in the 126th position.
E) none of these

Use the data set $\{d_1, d_2, d_3, ..., d_{255}\}$ consisting of 255 numbers to answer the following question(s).

19) After sorting the data set (in increasing order from left to right), the median is 19) _____

A) the number in the 128th position.
B) the number in the 127th position.
C) the average of the numbers in the 127th and 128th positions.
D) the sum of all the numbers divided by 255.
E) none of these

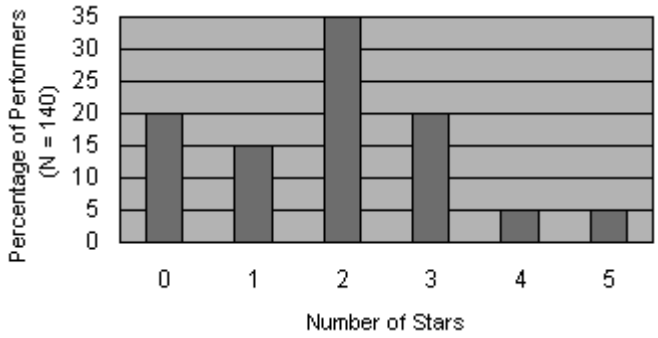
Use the data set $\{d_1, d_2, d_3, ..., d_{256}\}$ consisting of 256 numbers to answer the following question(s).

20) After sorting the data set (in increasing order from left to right), the median is 20) _____

A) the number in the 129th position.
B) the average of the numbers in the 128th and 129th positions.
C) the sum of all the numbers divided by 255.
D) the number in the 128th position.
E) none of these

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The data in the figure below represents the number of stars earned by 140 performers in a talent competition.



21) How many performers earned more than the median number of stars? 21) _____

A) 49
B) 30
C) 42
D) 91
E) none of these

The data in the figure below represents the annual salaries of 120 professional mathematicians.

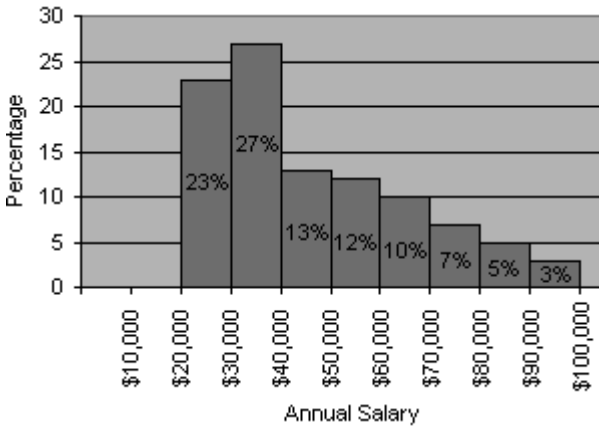


22) The median salary of this group of mathematicians is approximately 22) _____

A) $40,000.
B) $50,000.
C) $70,000.
D) $60,000.
E) none of these

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The data in the figure below represents the annual salaries of 200 professional musicians.



23) The median salary of this group of musicians is approximately 23) _____

A) $50,000.
B) $80,000.
C) $60,000.
D) $40,000.
E) none of these

Solve the problem.

24) What is the size relationship between the mean and the median of a data set? 24) _____

A) The mean is always more than the median.
B) The mean is always equal to the median.
C) The mean is always less than the median.
D) The mean can be smaller than, equal to, or larger than the median.
E) none of these

25) During a seven game playoff series, Kobe averaged 30 points per game. He scored 25 points in the first 4 games and 35 points in the next 2 games. How many points did he score in game 7? 25) _____

A) 35
B) 40
C) 45
D) 30
E) none of these

26) Jill scored a 78 on the first of five 100–point exams in Stat 101. How many points must she average on the next four exams in order to raise her overall average to 90%? 26) _____

A) 93 points
B) 97 points
C) 102 points
D) 92 points
E) none of these

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Use the frequency table below to answer the following question(s).

Data Value	Frequency
2	4
3	5
5	x
7	1
8	20

27) If the mean of the data set is 6, then x satisfies 27) _____

A) $9 \le x < 12$ B) $6 \le x < 9$ C) $3 \le x < 6$ D) $12 \le x$ E) $0 \le x < 3$

28) If the median of the data set is 6, then x satisfies 28) _____

A) $0 \le x < 3$ B) $12 \le x$ C) $6 \le x < 9$ D) $9 \le x < 12$ E) $3 \le x < 6$

Use the data set {0, 4, 4, 8, 4, 16} to answer the following question(s).

29) The mode of the data set is 29) _____

A) $\sqrt{152}$.
B) 4.
C) 6.
D) 2.
E) none of these

Use the data set {0, –1, –3, 3, 3, –5, –7, 10} to answer the following question(s).

30) The mode of the data set is 30) _____

A) 0.
B) –3.5.
C) –0.5.
D) 3.
E) none of these

The table below shows Joe's golf scores from Saturday.

Golf Score	Frequency
2	5
3	8
4	11
5	5
6	3
7	1
8	2
9	1

31) The first quartile of golf scores is 31) _____

A) 3.
B) 4.
C) 2.5.
D) 3.5.
E) none of these

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32) The third quartile of golf scores is 32) _____

A) 5.5.
B) 5.
C) 6.
D) 6.5.
E) none of these

The table below shows the scores of a group of students on a 10 point multiple choice placement test.

Exam Score	Frequency
3	5
4	3
5	5
6	2
7	7
8	6
9	1
10	1

33) The first quartile on the test is 33) _____

A) 4.
B) 4.5.
C) 5.5.
D) 5.
E) none of these

34) The third quartile on the test is 34) _____

A) 8.
B) 6.5.
C) 7.5.
D) 7.
E) none of these

The scores on a 30–point multiple–choice exam are given in the following frequency table:

Exam Score	Frequency
23	6
24	4
25	3
26	1
27	5
28	4
29	4
30	1

35) The first quartile on the exam is 35) _____

A) 25.
B) 24.5.
C) 24.
D) 25.5.
E) none of these

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36) The locator for the 80th percentile is 36) _____

A) 22.4.
B) 22.5.
C) 23.
D) 22.2.
E) none of these

The scores on a 30–point multiple–choice exam are given in the following frequency table:

Exam Score	Frequency
23	6
24	6
25	4
26	1
27	6
28	6
29	4
30	1

37) The first quartile on the exam is 37) _____

A) 24.5.
B) 25.5.
C) 25.
D) 24.
E) none of these

38) The third quartile on the exam is 38) _____

A) 27.
B) 28.
C) 27.5.
D) 26.5.
E) none of these

Use the data set {–100, –99, –98, ..., –2, –1} to answer the following question(s).

39) The data set has a first quartile of 39) _____

A) –75.5.
B) –76.
C) –75.
D) –74.4.
E) none of these

Use the data set {–100, –99, –98, ..., –2, –1, 0} to answer the following question(s).

40) The data set has a first quartile of 40) _____

A) –76.
B) –75.
C) –75.5.
D) –74.4.
E) none of these

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Use the data set $\{d_1, d_2, d_3, ..., d_{251}\}$ consisting of 251 numbers to answer the following question(s).

41) After sorting the data set (in increasing order from left to right) the first quartile is 41) _____
A) the number in the 64th position.
B) the average of the numbers in the 63rd and 64th positions.
C) the number in the 63rd position.
D) the average of the numbers in the 62nd and 63rd positions.
E) none of these

42) After sorting the data set (in increasing order from left to right), the third quartile is 42) _____
A) the sum of the median plus the first quartile.
B) the number in the 188th position.
C) the average of the numbers in the 188th and 189th positions.
D) the number in the 189th position.
E) none of these

Use the data set $\{d_1, d_2, d_3, ..., d_{256}\}$ consisting of 256 numbers to answer the following question(s).

43) After sorting the data set (in increasing order from left to right), the third quartile is 43) _____
A) the average of the numbers in the 191st and 192nd positions from the right.
B) the average of the numbers in the 192nd and 193rd positions from the right.
C) the number in the 193rd position from the right.
D) the number in the 192nd position from the right.
E) none of these

The data in the figure below represents the annual salaries of 120 professional mathematicians.



44) Sue, a professional mathematician, makes $80,000 per year. In what percentile does this place her? 44) _____
A) 80th percentile
B) 92nd percentile
C) 71st percentile
D) 84th percentile
E) none of these

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Solve the problem.

45) A class consisting of 160 students is given an exam. The first quartile for the scores on the exam is 42. This means that 45) _____

A) 120 students scored 42 or higher.
B) 25 students scored 42 or higher.
C) 40 students scored 42 or higher.
D) 80 students scored 42 or higher.
E) none of these

46) A class consisting of 80 students is given an exam. The third quartile for the scores on the exam is 67. This means that 46) _____

A) 20 students scored 67 or higher.
B) 67 students scored 75 or higher.
C) 60 students scored 67 or higher.
D) 75 students scored 67 or higher.
E) none of these

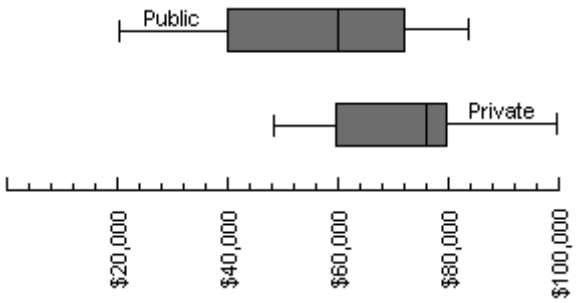
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

47) Find the five–number summary for the data set {5, –2, 8, 4, 7, 1, 7, –2, –5}. 47) _____

48) Draw a box plot for the data set {5, –2, 8, 4, 7, 1, 7, –2, –5}. 48) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

The box plots represent a comparison of the annual salaries of a group of public and private employees



49) Which of the following represents the five number summary for the salaries of the public employees? 49) _____

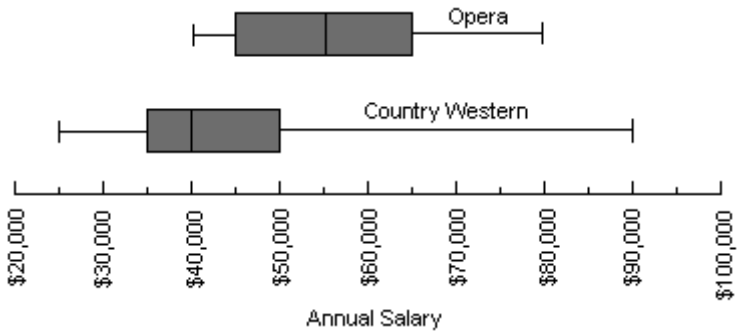
A) Min = \$20,000, Q_1 = \$40,000, Q_2 = \$60,000, Q_3 = \$72,000, Max = \$84,000
B) Min = \$20,000, Q_1 = \$40,000, Q_2 = \$60,000, Q_3 = \$66,000, Max = \$82,000
C) Min = \$48,000, Q_1 = \$60,000, Q_2 = \$76,000, Q_3 = \$80,000, Max = \$100,000
D) Min = \$40,000, Q_1 = \$48,000, Q_2 = \$60,000, Q_3 = \$72,000, Max = \$80,000
E) none of these

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50) Cathy, a private employee, has an annual salary that is twice the minimum salary of the group of private employees. Dale is the highest paid among the group of public employees. Which of the following statements is true? 50) _____

A) Cathy's annual salary is higher than Dale's.
B) The information provided is not sufficient to determine which of the two salaries is higher.
C) Dale's annual salary is higher than Cathy's.
D) Cathy and Dale have the same annual salary.
E) none of these

The box plots represent a comparison of the annual salaries of a group of opera and a group of country western singers respectively.



51) Which of the following represents the five number summary for the salaries of the opera singers? 51) _____

A) Min = \$0, Q_1 = \$40,000, Q_2 = \$45,000, Q_3 = \$55,000, Max = \$65,000
B) Min = \$20,000, Q_1 = \$40,000, Q_2 = \$55,000, Q_3 = \$80,000, Max = \$100,000
C) Min = \$45,000, Q_1 = \$55,000, Q_2 = \$55,000, Q_3 = \$55,000, Max = \$65,000
D) Min = \$40,000, Q_1 = \$45,000, Q_2 = \$55,000, Q_3 = \$65,000, Max = \$80,000
E) none of these

Solve the problem.

52) Which of the following [A), B), C), or D)] is not part of the five–number summary of a data set? 52) _____

A) the median of the data set
B) the first quartile of the data set
C) the average of the data set
D) the smallest value in the data set
E) all of these are given in the five–number summary.

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The table below shows Joe's golf scores from Saturday.

Golf Score	Frequency
2	5
3	8
4	11
5	5
6	3
7	1
8	2
9	1

53) The range of golf scores was 53) _____

A) 8.
B) 10.
C) 7.
D) 9.
E) none of these

The scores on a 30–point multiple–choice exam are given in the following frequency table:

Exam Score	Frequency
23	6
24	4
25	3
26	1
27	5
28	4
29	4
30	1

54) The interquartile range on the exam is 54) _____

A) 3.5.
B) 2.5.
C) 3.
D) 4.
E) none of these

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The scores on a 30–point multiple–choice exam are given in the following frequency table:

Exam Score	Frequency
23	6
24	6
25	4
26	1
27	6
28	6
29	4
30	1

55) The range on the exam is 55) _____

A) 8.
B) 7.
C) 9.
D) 10.
E) none of these

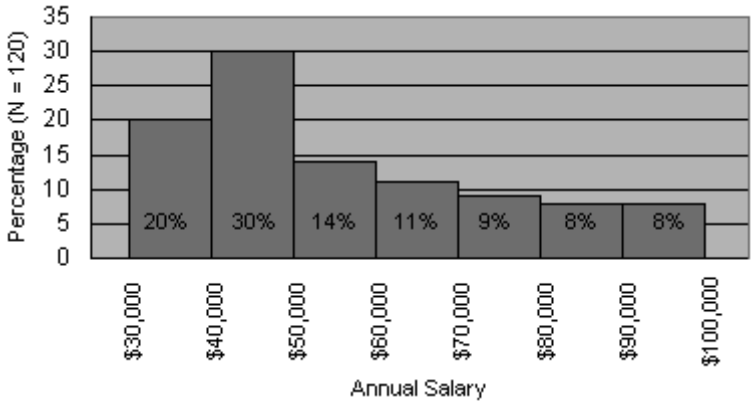
Use the frequency table below to answer the following question(s).

Data Value	Frequency
2	5
3	5
5	45
7	5
8	5

56) The interquartile range of this data set is 56) _____

A) 2.
B) 0.
C) 6.
D) 4.
E) none of these

The data in the figure below represents the annual salaries of 120 professional mathematicians.

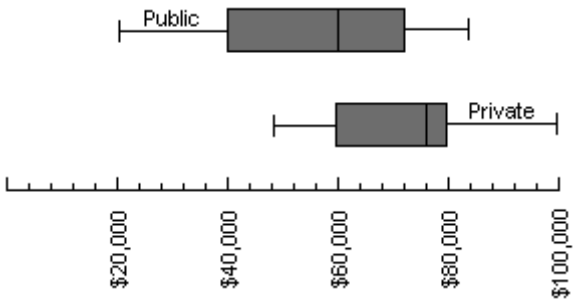


57) An approximate value for the interquartile range of the salary data is 57) _____

A) $28,500. B) $70,000. C) $32,500. D) $21,500. E) $10,000.

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The box plots represent a comparison of the annual salaries of a group of public and private employees



58) The interquartile range of salaries for the group of public employees is 58) _____

A) $32,000.
B) $64,000.
C) $20,000.
D) $12,000.
E) none of these

Solve the problem.

59) The average of a data set consisting of 8 numbers is 5. The smallest of the numbers is Min = 1. The largest of the numbers is Max = 9. Which of the following is the smallest possible value of the interquartile range of this data set? 59) _____

A) 4
B) 0
C) 2
D) 1
E) none of these

Use the frequency table below to answer the following question(s).

Data Value	Frequency
2	5
3	5
5	45
7	5
8	5

60) An outlier of a data set is defined as any data point more than 1.5 times the interquartile range above the third quartile or below the first quartile. The number of outliers in this data set is 60) _____

A) 0.
B) 10.
C) 5.
D) 20.
E) none of these

61) The standard deviation of this data set is 61) _____

A) 1.414.
B) 1.225.
C) 1.581.
D) 1.732.
E) none of these

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Solve the problem.

62) Which data set given below has the largest standard deviation? 62) _____

A) {3, 4, 5, 6, 7}
B) {1, 1, 5, 9, 9}
C) {2, 4, 5, 6, 8}
D) {3, 4, 6, 6, 6}
E) {3, 3, 5, 7, 7}

63) The average of a data set consisting of 8 numbers is 5. The smallest of the numbers is Min = 1. The largest of the numbers is Max = 9. Which of the following is the smallest possible value of the standard deviation of this data set? 63) _____

A) 4
B) 0
C) 2
D) 1
E) none of these

64) The standard deviation of a set of 1000 numbers is 0. Which of the following statements must be true about the set of numbers? 64) _____

A) Half of the numbers must be positive or zero and half of the numbers must be negative or zero.
B) All of the numbers must be 0.
C) All of the numbers must be positive or zero.
D) All of the numbers must be equal.
E) none of these

65) What is the size relationship between the interquartile range and the standard deviation of a data set? 65) _____

A) The interquartile range can be smaller than, equal to, or bigger than the standard deviation.
B) The interquartile range is always equal to the standard deviation.
C) The interquartile range is always less than the standard deviation.
D) The interquartile range is always more than the standard deviation.
E) none of these

66) Which of the following [A), B), C), or D)] can never be a negative number? 66) _____

A) the mean of a data set
B) the maximum value of a data set
C) the median of a data set
D) the standard deviation of a data set
E) all of these can be negative numbers.

67) Which of the following [A), B), C), or D)] is not a measure of spread? 67) _____

A) the standard deviation
B) the interquartile range
C) the range
D) the median
E) all of these are measures of spread.

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68) Suppose that the data set $\{x_1, x_2, x_3, \ldots, x_N\}$ has average A and standard deviation s. If A' and s' are the average and standard deviation of the data set $\{x_1 + c, x_2 + c, x_3 + c, \ldots, x_N + c\}$, respectively, then 68) _____

A) A' = A and s' = s.
B) A' = A and s' = s + c.
C) A' = A + c and s' = s + c.
D) A' = A + c and s' = s.
E) none of these

69) Suppose that every element in the data set $\{x_1, x_2, x_3, \ldots, x_N\}$ is positive and increases in value by 10%. Which of the following is not true? 69) _____

A) The mean of the data set increases by 10%.
B) The standard deviation of the data set increases by 10%.
C) The range of the data set increases by 10%.
D) The median of the data set increases by 10%.
E) all of these are true.

70) Suppose that every element in the data set $\{x_1, x_2, x_3, \ldots, x_N\}$ is positive. Further, suppose each element is first increased in value by 10% and then 1 is added to each of the resulting values. Which of the following is not true? 70) _____

A) The range of the data set increases by 10%.
B) The variance of the data set increases by 10%.
C) The standard deviation of the data set increases by 10%.
D) The median of the data set increases by 10%.
E) all of these are true.

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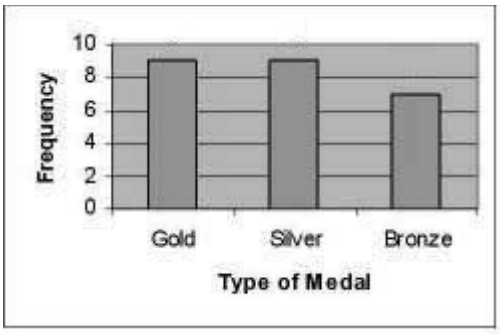
1)

Color	Green	Brown	Blue
Frequency	2	6	12

2)



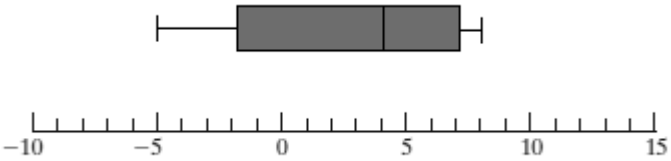
3)



4) C
5) B
6) D
7) D
8) B
9) B
10) D
11) D
12) D
13) D
14) B
15) D
16) A
17) D
18) D
19) A
20) B
21) C
22) B
23) D
24) D
25) B
26) A
27) A
28) B

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29) B
30) D
31) A
32) B
33) A
34) A
35) C
36) A
37) D
38) B
39) A
40) B
41) B
42) C
43) B
44) D
45) A
46) A
47) Min = −5, Q_1 = −2, M = 4, Q_3 = 7, Max = 8
48)



49) A
50) A
51) D
52) C
53) C
54) D
55) B
56) B
57) A
58) A
59) B
60) D
61) A
62) B
63) C
64) D
65) A
66) D
67) D
68) D
69) E
70) D

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Chapter 16

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

1) Suppose we roll a regular six–sided die twice and note whether it lands as an even number (E) or an odd number (O) on each roll. The sample space for this random experiment is 1) _____
   A) {EE, EO, OE, OO}.
   B) {E, O}.
   C) {E, E, O, O}.
   D) {EE, EO, OO}.
   E) none of these

2) Suppose we roll a regular six–sided die three times and note whether it lands as an even number (E) or an odd number (O) on each roll. Which of the following describes the sample space for this random experiment? 2) _____
   A) {EEE, OOO}
   B) {E, O}
   C) {EEE, EEO, OEO, OEE, EOO, EOE, OOE, OOO}
   D) {3 E's, 2 O's and 1 E, 1 E and 2 O's, 3 O's}
   E) none of these

3) A coin is tossed twice. The sample space for this random experiment is 3) _____
   A) {H, T}.
   B) {HH, HT, TH, TT}.
   C) {H, H, T, T}.
   D) {HH, HT, TT}.
   E) none of these

4) A fair coin is tossed three times. Which of the following describes the sample space for this random experiment? 4) _____
   A) {3 H's, 2 H's and 1 T, 1 H and 2 T's, 3 T's}
   B) {HHH, TTT}
   C) {HHH, HHT, HTH, THH, HTT, THT, TTH, TTT}
   D) {H, T}
   E) none of these

A pair of honest dice is rolled, and the number on each die is noted.

5) Which of the following [A), B), C), or D)] is not an outcome in the sample space? 5) _____
   A) (1,1)
   B) (6,6)
   C) (4,5)
   D) (5,2)
   E) all of these are outcomes in the sample space.

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Solve the problem.

6) Which of the following [A), B), C), or D)] is not a random experiment? 6) _____
   A) drawing a card from a deck of cards
   B) rolling a pair of dice
   C) predicting the winner of next year's world series
   D) tossing a coin
   E) all of these are random experiments.

7) A person shoots ten consecutive free throws and on each toss we observe either a success or a failure. How many different outcomes are there in the sample space? 7) _____
   A) 10
   B) 20
   C) 10^2
   D) 2^{10}
   E) none of these

8) A person shoots ten consecutive free throws and the total number of successes is observed. How many different outcomes are there in the sample space? 8) _____
   A) 11
   B) 2^{10}
   C) 5
   D) 10^2
   E) none of these

9) A pair of six–sided dice are rolled. The observation is the number that comes up on each die. The event described by E: "both dice will come up as even numbers" is 9) _____
   A) {(1, 2), (1, 4), (1, 6), (2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6), (3, 2), (3, 4), (3, 6), (4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6), (5, 2), (5, 4), (5, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)}.
   B) {(1, 1), (2, 2), (2, 4), (2, 6), (3, 3), (4, 2), (4, 4), (4, 6), (5, 5), (6, 2), (6, 4), (6, 6)}.
   C) {(2, 4), (2, 6), (4, 2), (4, 6), (6, 2), (6, 4)}.
   D) {(2, 2), (2, 4), (2, 6), (4, 2), (4, 4), (4, 6), (6, 2), (6, 4), (6, 6)}.
   E) none of these

10) A pair of six–sided dice are rolled. The observation is the number that comes up on each die. The event described by E: "at least one die will come up as an even number" is 10) _____
   A) {(1, 2), (1, 4), (1, 6), (2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6), (3, 2), (3, 4), (3, 6), (4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6), (5, 2), (5, 4), (5, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)}.
   B) {(1, 2), (1, 4), (1, 6), (2, 1), (2, 3), (2, 4), (2, 5), (2, 6), (3, 2), (3, 4), (3, 6), (4, 1), (4, 2), (4, 3), (4, 5), (4, 6), (5, 2), (5, 4), (5, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5)}.
   C) {(1, 2), (1, 4), (1, 6), (2, 1), (2, 3), (2, 5), (3, 2), (3, 4), (3, 6), (4, 1), (4, 3), (4, 5), (5, 2), (5, 4), (5, 6), (6, 1), (6, 3), (6, 5)}.
   D) {(2, 2), (2, 4), (2, 6), (4, 2), (4, 4), (4, 6), (6, 2), (6, 4), (6, 6)}.
   E) none of these

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11) A pair of six-sided dice are rolled. The observation is the number that comes up on each die. The event described by E: "both dice come up with the same parity" (i.e., both numbers rolled are even or both numbers rolled are odd) is 11) _____

A) {(1, 1), (1, 3), (1, 5), (2, 2), (2, 4), (2, 6), (3, 1), (3, 3), (3, 5), (4, 2), (4, 4), (4, 6), (5, 1), (5, 3), (5, 5), (6, 2), (6, 4), (6, 6)}.
B) {(1, 3), (1, 5), (2, 4), (2, 6), (3, 1), (3, 5), (4, 2), (4, 6), (5, 1), (5, 3), (6, 2), (6, 4)}.
C) {(2, 2), (2, 4), (2, 6), (4, 2), (4, 4), (4, 6), (6, 2), (6, 4), (6, 6)}.
D) {(1, 1), (1, 3), (1, 5), (3, 1), (3, 3), (3, 5), (5, 1), (5, 3), (5, 5)}.
E) none of these

12) In the game of Yahtzee, a set of five dice is rolled at once, and the number on each die is observed. What is the size N of the sample space? 12) _____

A) 5^6
B) 6!
C) ${}_6P_5$
D) 6^5
E) none of these

A computer password consists of any five capital letters from the ordinary English alphabet (A through Z).

13) How many different passwords start with the letter Z? 13) _____

A) 26^4
B) 25^4
C) $26^5 - 1$
D) 26×25
E) none of these

14) How many different passwords start with the letter Z and end with the letter W? 14) _____

A) 24^3
B) 26^3
C) 24^5
D) $26 \times 25 \times 24^3$.
E) none of these

A license plate consists of any five capital letters from the ordinary English alphabet (A through Z) except for the letters O, I, and Q.

15) How many of the license plates start with the letter Z and end with the letter W? 15) _____

A) 23^3
B) $23 \times 22 \times 21^3$
C) 21^3
D) 21^5
E) none of these

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16) How many of the license plates begin with the word MATH? 16) _____

A) $23^4 \times 22$

B) 23×22^4

C) 23

D) 22^4

E) none of these

A computer password is made up of five characters. Each character can be a capital letter (A through Z) or a digit (0 through 9).

17) How many passwords do not start with the digit 0? 17) _____

A) $36^5 - 1$

B) 36^4

C) 35^5

D) 35×36^4

E) none of these

18) How many passwords have four letters and only one digit? 18) _____

A) $4 \times 26 \times 10$

B) $26^4 \times 10$

C) $26 \times 25 \times 24 \times 23 \times 10$

D) $5 \times 26^4 \times 10$

E) none of these

Tasmanian automobile licence plates consist of three capital letters (A through Z) followed by three digits (0 through 9).

19) How many Tasmanian license plates end with a 1? 19) _____

A) $26^2 \times 10^3$

B) $26^3 \times 10^3 - 1$

C) $26^3 \times 10^3$

D) $26^3 \times 10^2$

E) none of these

20) How many Tasmanian license plates start with the word ZOO? 20) _____

A) 100

B) 10

C) 1

D) 1000

E) none of these

Tasmanian automobile license plates consist of four capital letters (A through Z) followed by three digits (0 through 9).

21) How many Tasmanian license plates end with '66'? 21) _____

A) $26^2 \times 10^3$

B) $26^4 \times 10^3$

C) $26^4 \times 10^3 - 1$

D) $26^4 \times 10$

E) none of these

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22) How many Tasmanian license plates start with the word ADD? 22) _____

A) 26,000
B) 2600
C) 1
D) 1000
E) none of these

A computer password is made up of four characters. Each character can be a capital letter (A through Z), a lowercase letter (a through z) or a digit (0 through 9).

23) How many different such computer passwords are there? 23) _____

A) 62^4
B) 62×4
C) $2 \times 26^4 + 10^4$
D) 4^{62}
E) none of these

24) How many passwords do not start with the digit 0? 24) _____

A) 61×62^3
B) $62^4 - 1$
C) 61^4
D) 62^3
E) none of these

25) How many passwords have 3 letters (uppercase or lowercase) and only one digit? 25) _____

A) $52^3 \times 10$
B) $52 \times 51 \times 50 \times 10$
C) $4 \times 52^3 \times 10$
D) $4 \times 52 \times 10$
E) none of these

26) How many passwords do not contain the uppercase letter O, the lowercase o, or the number 0? 26) _____

A) $62 \times 25 \times 25 \times 9$
B) $62^4 - 3$
C) $59 \times 58 \times 57 \times 56$
D) 59^4
E) none of these

A French restaurant offers a menu consisting of 5 different appetizers, 3 different salads, 2 different soups, 7 different main courses, and 3 different desserts. The restaurant offers different combinations of "fixed price dinners" on different days of the week.

27) On Fridays and Saturdays, the "fixed price dinner" consists of a choice of appetizer, a choice of either soup or salad, a main course, and a dessert. Assuming you don't pass on any of these, how many different "fixed price dinners" are possible on Fridays and Saturdays? 27) _____

A) 21
B) 525
C) 20
D) 630
E) none of these

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28) On Sundays, the "fixed price dinner" consists of a main course, a dessert, and any two of the other three types of items (i.e., appetizer and soup, or appetizer and salad, or soup and salad). Assuming you don't pass on any of these, how many "fixed price dinners" are possible on Sundays? 28) _____

A) 30
B) 5880
C) 651
D) 420
E) none of these

Solve the problem.

29) How many 6–digit numbers (i.e. between 100,000 and 999,999) are divisible by 20? 29) _____

A) 50,000
B) 45,000
C) 27,907,200
D) 90,000
E) none of these

30) ${}_{10}P_{10}$ = 30) _____

A) 1
B) 10!
C) 10^2
D) $\frac{10!}{10!\ 0!}$
E) none of these

31) ${}_5C_3$ = 31) _____

A) 20
B) 10
C) 60
D) 30
E) none of these

32) ${}_{15}C_{15}$ = 32) _____

A) 15
B) 0
C) 1
D) 15!
E) none of these

33) ${}_{100}C_{100}$ = 33) _____

A) 100
B) 100!
C) 0
D) 1
E) none of these

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34) $\dfrac{1000^{\mathrm{P}}500}{1000^{\mathrm{P}}501} =$ 34) _____

A) 501 B) $\dfrac{500}{501}$ C) 500 D) $\dfrac{1}{501}$ E) $\dfrac{1}{500}$

35) Three cards are drawn in order from a well shuffled deck of 52 cards. The probability that all three cards are clubs is given by 35) _____

A) $\dfrac{52^{\mathrm{C}}3}{13^{\mathrm{C}}3}$.

B) $\dfrac{13^{\mathrm{P}}3}{52^{\mathrm{P}}3}$.

C) $\dfrac{3 \times 13^{\mathrm{P}}1}{52^{\mathrm{P}}3}$.

D) $\dfrac{3 \times 52^{\mathrm{C}}3}{13^{\mathrm{C}}1}$.

E) none of these

A license plate consists of any five capital letters from the ordinary English alphabet (A through Z) except for the letters O, I, and Q.

36) How many different license plates are possible? 36) _____

A) $23^{\mathrm{C}}5$

B) 23^5

C) $23^{\mathrm{P}}5$

D) 23×5

E) none of these

Tasmanian automobile license plates consist of four capital letters (A through Z) followed by three digits (0 through 9).

37) How many Tasmanian license plates have no repeated symbols (different letters and different digits)? 37) _____

A) $26^{\mathrm{P}}4 \times 10^{\mathrm{P}}3$

B) 25^7

C) $(26^4 - 1) \times (10^3 - 1)$

D) $26^{\mathrm{C}}4 \times 10^{\mathrm{C}}3$

E) none of these

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Solve the problem.

38) A student downloaded five music files to a portable MP3 player. In how many different orders can the songs be played? 38) _____

A) ${}_5C_5$
B) 120
C) 5
D) 15
E) none of these

39) Six Republicans and six Democrats orally cast their vote in the U.S. Senate. In how many orders can they vote if they must alternate Republican, Democrat, Republican, Democrat, and so on and if a Republican must always be the first to vote? 39) _____

A) 12!
B) $6! \times 6!$
C) $6 \times 11!$
D) ${}_{12}P_6$
E) none of these

40) The Tasmanian House of Representatives has 435 members (235 Demublicans and 200 Republicrats). A set of 3 leaders – a Speaker, a Whip, and a Secretary – must be selected. How many different sets of leaders can be selected if the leaders cannot all be of the same political party? 40) _____

A) ${}_{435}P_3 - {}_{235}P_3 - {}_{200}P_3$
B) $\dfrac{{}_{435}C_3}{{}_{235}C_3 \cdot {}_{200}C_3}$
C) ${}_{235}P_3 + {}_{200}P_3$
D) $435^3 - 235^3 - 200^3$
E) none of these

41) A Tasmanian lottery ticket consists of choosing 7 different numbers between 1 and 56. The number of possible lottery tickets is given by 41) _____

A) $\dfrac{56}{7}$.
B) $\dfrac{56!}{7!\,49!}$.
C) $\dfrac{56!}{49!}$.
D) $\dfrac{56!}{7!}$.
E) none of these

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42) A Tasmanian lottery ticket consists of choosing 7 different numbers between (and including) 10 and 52. The number of possible lottery tickets is given by 42) _____

A) $\frac{52!}{45!\,7!}$

B) 43×7

C) $\frac{43!}{36!}$

D) $\frac{43!}{7!\,36!}$

E) none of these

43) The Tasmanian House of Representatives has 435 members. A set of 3 leaders – a Speaker, a Whip, and a Secretary – must be selected. How many different sets of leaders can be selected? 43) _____

A) 435^3

B) $435 \times 434 \times 433$

C) $\frac{435 \times 434 \times 433}{3 \times 2 \times 1}$

D) 3^{435}

E) none of these

44) In a probability space, which of the following statements is not true? 44) _____

A) All outcomes are equally likely.

B) The probability of the sample space is always equal to 1.

C) The impossible event always has probability equal to 0.

D) All probabilities are between 0 and 1 (0 and 1 included).

E) All of these statements are true.

45) Consider the sample space $S = \{o_1, o_2, o_3, o_4, o_5\}$. Suppose you are given $Pr(o_1) = 0.25$ and $Pr(o_2) = 0.15$. Find the probability assignment for the probability space when o_3, o_4, and o_5 all have the same probability. 45) _____

A) $Pr(o_1) = 0.25,\ Pr(o_2) = 0.15,\ Pr(o_3) = 0.3,\ Pr(o_4) = 0.15,\ Pr(o_5) = 0.15$

B) $Pr(o_1) = 0.2,\ Pr(o_2) = 0.2,\ Pr(o_3) = 0.2,\ Pr(o_4) = 0.2,\ Pr(o_5) = 0.2$

C) $Pr(o_1) = 0.25,\ Pr(o_2) = 0.15,\ Pr(o_3) = 0.15,\ Pr(o_4) = 0.3,\ Pr(o_5) = 0.15$

D) $Pr(o_1) = 0.25,\ Pr(o_2) = 0.15,\ Pr(o_3) = 0.15,\ Pr(o_4) = 0.15,\ Pr(o_5) = 0.15$

E) $Pr(o_1) = 0.25,\ Pr(o_2) = 0.15,\ Pr(o_3) = 0.2,\ Pr(o_4) = 0.2,\ Pr(o_5) = 0.2$

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46) Five horses (A, B, C, D, and E) are racing at the local track. According to the oddsmakers, A has a "one in four" probability of winning [i.e. $\Pr(A) = \frac{1}{4}$], B has a "one in ten" probability of winning, and C has a "one in twenty" probability of winning. The remaining two horses both have the same probability of winning. Find the probability assignment for the probability space. 46) _____

A) $\Pr(A) = \frac{1}{4}, \Pr(B) = \frac{1}{10}, \Pr(C) = \frac{1}{20}, \Pr(D) = \frac{3}{20}, \Pr(E) = \frac{3}{20}$

B) $\Pr(A) = \frac{1}{4}, \Pr(B) = \frac{1}{10}, \Pr(C) = \frac{1}{20}, \Pr(D) = \frac{3}{10}, \Pr(E) = \frac{3}{10}$

C) $\Pr(A) = \frac{1}{4}, \Pr(B) = \frac{1}{10}, \Pr(C) = \frac{1}{20}, \Pr(D) = \frac{3}{20}, \Pr(E) = \frac{7}{20}$

D) $\Pr(A) = \frac{1}{4}, \Pr(B) = \frac{1}{10}, \Pr(C) = \frac{1}{20}, \Pr(D) = \frac{1}{20}, \Pr(E) = \frac{1}{20}$

E) $\Pr(A) = \frac{1}{4}, \Pr(B) = \frac{1}{10}, \Pr(C) = \frac{1}{20}, \Pr(D) = \frac{3}{40}, \Pr(E) = \frac{3}{40}$

47) Consider the sample space $S = \{o_1, o_2, o_3, o_4\}$. Suppose you are given $\Pr(o_1) = 0.35$ and $\Pr(o_2) = 0.25$. If o_3 and o_4 have the same probability, find $\Pr(o_3)$. 47) _____

A) 0.1
B) 0.3
C) 0.2
D) 0.4
E) none of these

Four basketball teams called A, B, C, and D are entered in a tournament. According to the odds makers, the probability that team A will win the tournament is Pr(A) = 0.1, and the other three teams all have an equal probability of winning the tournament.

48) What is the probability that team A will not win the tournament? 48) _____

A) 0.4
B) 0.3
C) 0.9
D) cannot be determined from the information given
E) none of these

A pair of honest dice is rolled, and the number on each die is noted.

49) What is the probability of rolling a total of 2? 49) _____

A) $\frac{1}{18}$

B) $\frac{1}{6}$

C) $\frac{1}{3}$

D) $\frac{1}{36}$

E) none of these

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50) What is the probability of rolling a total of 7? 50) _____

A) $\frac{7}{36}$

B) $\frac{1}{36}$

C) $\frac{1}{3}$

D) $\frac{1}{6}$

E) none of these

51) What is the probability of rolling a total of either 7 or 11? 51) _____

A) $\frac{1}{6}$

B) $\frac{1}{4}$

C) $\frac{1}{18}$

D) $\frac{1}{36}$

E) none of these

52) What is the probability of rolling a total that is neither 7 nor 11? 52) _____

A) $\frac{5}{6}$

B) $\frac{17}{18}$

C) $\frac{7}{9}$

D) $\frac{1}{2}$

E) none of these

Four drivers called A, B, C, and D are entered in a race. According to the odds makers, the probability that the driver A will win the race is Pr(A) = 0.4, and the other three drivers all have an equal probability of winning the race.

53) What is the probability that the driver B will not win the race? 53) _____

A) 0.4

B) 0.6

C) 0.8

D) cannot be determined from the information given

E) none of these

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Solve the problem.

54) If a fair coin is tossed twice, the probability that both tosses will come up heads is 54) _____

A) $\frac{1}{3}$.

B) $\frac{1}{2}$.

C) $\frac{1}{4}$.

D) $\frac{3}{4}$.

E) none of these

55) If a fair coin is tossed twice, the probability that at least one of the tosses will come up heads is 55) _____

A) $\frac{1}{3}$.

B) $\frac{3}{4}$.

C) $\frac{1}{4}$.

D) $\frac{1}{2}$.

E) none of these

56) If a fair coin is tossed twice, the probability of both tosses coming up the same is 56) _____

A) $\frac{1}{3}$.

B) $\frac{3}{4}$.

C) $\frac{1}{4}$.

D) $\frac{1}{2}$.

E) none of these

57) If a fair coin is tossed three times, the probability of tossing three heads is 57) _____

A) $\frac{1}{8}$.

B) $\frac{1}{4}$.

C) $\frac{3}{8}$.

D) $\frac{1}{2}$.

E) none of these

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58) An honest coin is tossed ten times. The probability of tossing one head and nine tails is 58) _____

A) $\frac{1}{1024}$.

B) $\frac{1}{9}$.

C) $\frac{5}{512}$.

D) $\frac{1}{10}$.

E) none of these

59) An honest coin is tossed ten times . The probability of tossing two heads and eight tails is 59) _____

A) $\frac{1}{5}$.

B) $\frac{5}{512}$.

C) $\frac{1}{512}$.

D) $\frac{45}{1024}$.

E) none of these

A pitching machine throws 70% strikes and 30% balls. Five pitches will be thrown by the machine.

60) What is the probability the machine will throw one ball and four strikes? 60) _____

A) $\frac{1}{5}$

B) $0.3 + 4 \times 0.7$

C) 0.3×0.7^4

D) $5 \times 0.3 \times 0.7^4$

E) none of these

61) What is the probability that the machine will throw three balls and two strikes? 61) _____

A) 0.01323

B) 0.1323

C) 0.2

D) 0.06615

E) none of these

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Solve the problem.

62) There are 1000 tickets sold in a raffle. If you have 4 of these tickets and 10 prizes are to be given, what is the probability that each of your tickets will win a prize? 62) _____

A) $\frac{{}_{10}C_4}{{}_{1000}C_4}$

B) $\frac{{}_{10}C_4}{1000}$

C) $\frac{10 \times 4}{1000}$

D) $\frac{4}{10} \times \frac{1}{1000}$

E) none of these

A couple is planning to have four children. Suppose that for this couple the probability of a boy is 46% and the probability of a girl is 54%. (Assume the gender of each child is independent from that of the other children.)

63) What is the probability that they will have an equal number of boys and girls? 63) _____

A) $4 \times 0.46^2 \times 0.54^2$

B) $0.46^2 + 0.54^2$

C) $6 \times 0.46^2 \times 0.54^2$

D) $0.46^2 \times 0.54^2$

E) none of these

Solve the problem.

64) If the chances of rain tomorrow are 30%, then the odds of rain tomorrow can be given as 64) _____

A) 3 to 13.

B) 3 to 1.

C) 3 to 7.

D) 3 to 10.

E) none of these

65) If the probability of snow on Tuesday is 0.125, then the odds of snow on Tuesday can be given as 65) _____

A) 1 to 8.

B) 125 to 1.

C) 1 to 7.

D) 1 to 12.5.

E) none of these

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66) Suppose that the odds against winning the grand prize in the lottery are 80,000,000 to 1. What is the probability if winning the lottery? 66) _____

A) $\frac{79,999,999}{80,000,000}$

B) $\frac{1}{79,999,999}$

C) $\frac{1}{80,000,001}$

D) $\frac{1}{80,000,000}$

E) none of these

Four drivers called A, B, C, and D are entered in a race. According to the odds makers, the probability that the driver A will win the race is Pr(A) = 0.4, and the other three drivers all have an equal probability of winning the race.

67) What are the odds that driver D will win the race? 67) _____

A) 4 to 6
B) 1 to 4
C) 1 to 6
D) 1 to 3
E) none of these

Solve the problem.

68) An amateur golfer had the following distribution of scores one weekend at her local country club. What was her average score per hole that weekend? 68) _____

Score	2	3	4	5	6
Percentage of holes	5.6%	16.7%	22.2%	44.4%	11.1%

A) 4.258 B) 4.752 C) 5.0 D) 4.5 E) 4.387

69) In 2008 an outdoor mall was open throughout the year. The number of shoppers averaged 5000 on sunny days, 4000 on cloudy days, 1200 on rainy days, and 3000 on snowy days. The percentage of days of each type in 2008 is given in the following table. Find the average number of average shoppers per day at the mall for 2008. 69) _____

Weather condition	Sunny	Cloudy	Rainy	Snowy
Percentage of days	42%	31%	18%	9%

A) 3300 B) 3826 C) 2100 D) 3943 E) 1240

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70) A football player kicks two consecutive field goals from approximately the same distance. Each field goal is worth three points and has probability of success $p = \frac{3}{5}$. Let X denote the number of points scored. Find the probability distribution of X. 70) _____

A)

Outcome	0 points	3 points	6 points
Probability	0.36	0.48	0.16

B)

Outcome	0 points	3 points	6 points
Probability	0.33	0.33	0.33

C)

Outcome	0 points	3 points	6 points
Probability	0.16	0.48	0.36

D)

Outcome	0 points	3 points	6 points
Probability	0.16	0.24	0.36

E)

Outcome	0 points	3 points	6 points
Probability	0	1.44	2.16

71) A football player kicks two consecutive field goals from approximately the same distance. Each field goal is worth three points and has probability of success $p = \frac{3}{5}$. Let X denote the number of points scored. Find the expected value of X. 71) _____

A) 2.4 points
B) 2.88 points
C) 2.97 points
D) 3.0 points
E) 3.6 points

72) Suppose that you roll a pair of honest dice. If you roll a total of 6, you win $18; if you roll a total of 11, you win $72; if you roll any other total, you lose $9. Let X denote the payoff in a single play of this game. Find the expected value of a play of this game. Round your answer to the nearest penny. 72) _____

A) $0 B) $–1.00 C) $–0.50 D) $–0.75 E) $0.75

73) In one state's Multi–Million Lottery you choose 5 numbers between 1 and 56 plus a Mega number between 1 and 36. Suppose that a winning ticket pays $60 million (assume that the prize will not be split among several winners). Find the expected value of a $1 lottery ticket. Round your answer to the nearest penny. 73) _____

A) $–0.44 B) $0.44 C) $0.56 D) $–1.00 E) $–0.56

74) An insurance company plans to sell a $200,000 one–year term life insurance policy to a 60–year–old female. Of 2.5 million females having similar risk factors, the company estimates that 5000 of them will die in the next year. What is the premium that the insurance company should charge if it would like to make a profit of $150 on each policy? 74) _____

A) $40 per policy
B) $400 per policy
C) $190 per policy
D) $250 per policy
E) $550 per policy

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1) A
2) C
3) B
4) C
5) E
6) E
7) D
8) A
9) D
10) A
11) A
12) D
13) A
14) B
15) A
16) C
17) D
18) D
19) D
20) D
21) D
22) A
23) A
24) A
25) C
26) D
27) B
28) C
29) B
30) B
31) B
32) C
33) D
34) E
35) B
36) B
37) A
38) B
39) B
40) A
41) B
42) D
43) B
44) A
45) E
46) B
47) C
48) C
49) D
50) D

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51) E
52) C
53) C
54) C
55) B
56) D
57) A
58) C
59) D
60) D
61) B
62) A
63) C
64) C
65) C
66) C
67) B
68) E
69) B
70) C
71) E
72) D
73) E
74) E

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Chapter 16

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

1) Suppose we roll a regular six–sided die twice and note whether it lands as an even number (E) or an odd number (O) on each roll. The sample space for this random experiment is 1) _____
   A) {EE, EO, OO}.
   B) {E, O}.
   C) {EE, EO, OE, OO}.
   D) {E, E, O, O}.
   E) none of these

2) Suppose we roll a regular six–sided die three times and note whether it lands as an even number (E) or an odd number (O) on each roll. Which of the following describes the sample space for this random experiment? 2) _____
   A) {EEE, EEO, OEO, OEE, EOO, EOE, OOE, OOO}
   B) {EEE, OOO}
   C) {E, O}
   D) {3 E's, 2 O's and 1 E, 1 E and 2 O's, 3 O's}
   E) none of these

3) A coin is tossed twice. The sample space for this random experiment is 3) _____
   A) {H, T}.
   B) {HH, HT, TH, TT}.
   C) {HH, HT, TT}.
   D) {H, H, T, T}.
   E) none of these

4) A fair coin is tossed three times. Which of the following describes the sample space for this random experiment? 4) _____
   A) {HHH, HHT, HTH, THH, HTT, THT, TTH, TTT}
   B) {HHH, TTT}
   C) {3 H's, 2 H's and 1 T, 1 H and 2 T's, 3 T's}
   D) {H, T}
   E) none of these

A pair of honest dice is rolled, and the number on each die is noted.

5) Which of the following [A), B), C), or D)] is not an outcome in the sample space? 5) _____
   A) (1,1)
   B) (6,6)
   C) (5,2)
   D) (4,5)
   E) all of these are outcomes in the sample space.

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6) How many different outcomes are there in the sample space? 6) _____

A) 12
B) 6
C) 64
D) 30
E) none of these

Solve the problem.

7) Which of the following [A), B), C), or D)] is not a random experiment? 7) _____

A) drawing a card form a deck of cards
B) selecting the numbers in the lottery
C) rolling a pair of dice
D) tossing a coin
E) all of these are random experiments.

8) A pair of six-sided dice are rolled. The observation is the number that comes up on each die. The event described by E: "at least one die will come up as an even number" is 8) _____

A) {(1, 2), (1, 4), (1, 6), (2, 1), (2, 3), (2, 5), (3, 2), (3, 4), (3, 6), (4, 1), (4, 3), (4, 5), (5, 2), (5, 4), (5, 6), (6, 1), (6, 3), (6, 5)}.
B) {(1, 2), (1, 4), (1, 6), (2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6), (3, 2), (3, 4), (3, 6), (4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6), (5, 2), (5, 4), (5, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)}.
C) {(2, 2), (2, 4), (2, 6), (4, 2), (4, 4), (4, 6), (6, 2), (6, 4), (6, 6)}.
D) {(1, 2), (1, 4), (1, 6), (2, 1), (2, 3), (2, 4), (2, 5), (2, 6), (3, 2), (3, 4), (3, 6), (4, 1), (4, 2), (4, 3), (4, 5), (4, 6), (5, 2), (5, 4), (5, 6), (6, 1), (6, 2), (6, 3), (6, 4), (6, 5)}.
E) none of these

9) A pair of six-sided dice are rolled. The observation is the number that comes up on each die. The event described by E: "both dice come up with the same parity" (i.e., both numbers rolled are even or both numbers rolled are odd) is 9) _____

A) {(1, 1), (1, 3), (1, 5), (3, 1), (3, 3), (3, 5), (5, 1), (5, 3), (5, 5)}.
B) {(1, 3), (1, 5), (2, 4), (2, 6), (3, 1), (3, 5), (4, 2), (4, 6), (5, 1), (5, 3), (6, 2), (6, 4)}.
C) {(1, 1), (1, 3), (1, 5), (2, 2), (2, 4), (2, 6), (3, 1), (3, 3), (3, 5), (4, 2), (4, 4), (4, 6), (5, 1), (5, 3), (5, 5), (6, 2), (6, 4), (6, 6)}.
D) {(2, 2), (2, 4), (2, 6), (4, 2), (4, 4), (4, 6), (6, 2), (6, 4), (6, 6)}.
E) none of these

10) In the game of Yahtzee, a set of five dice is rolled at once, and the number on each die is observed. What is the size N of the sample space? 10) _____

A) ${}_6P_5$
B) 6!
C) 5^6
D) 6^5
E) none of these

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A computer password consists of any five capital letters from the ordinary English alphabet (A through Z).

11) How many different passwords have no repeated letters? 11) _____

A) 26^5
B) $26 \times 25 \times 24 \times 23 \times 22$
C) 26×5
D) 25
E) none of these

A license plate consists of any five capital letters from the ordinary English alphabet (A through Z) except for the letters O, I, and Q.

12) How many of the license plates begin with the word MATH? 12) _____

A) 23×22^4
B) $23^4 \times 22$
C) 23
D) 22^4
E) none of these

A computer password is made up of five characters. Each character can be a capital letter (A through Z) or a digit (0 through 9).

13) How many different such computer passwords are there? 13) _____

A) 36^5
B) 36×5
C) $26^5 + 10^5$
D) 5^{36}
E) none of these

14) How many passwords start with a digit? 14) _____

A) 10×26^4
B) 10×35^4
C) 36^4
D) 10×36^4
E) none of these

15) How many passwords have three letters and two digits? 15) _____

A) $26^3 \times 10^2$
B) $26 \times 25 \times 24 \times 10 \times 9$
C) $10 \times 26^3 \times 10^2$
D) $3 \times 26^3 \times 10^2$
E) none of these

Tasmanian automobile licence plates consist of three capital letters (A through Z) followed by three digits (0 through 9).

16) How many Tasmanian license plates end with a 1? 16) _____

A) $26^3 \times 10^3$
B) $26^3 \times 10^2$
C) $26^2 \times 10^3$
D) $26^3 \times 10^3 - 1$
E) none of these

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17) How many Tasmanian license plates start with the word ZOO? 17) _____

A) 1000
B) 10
C) 1
D) 100
E) none of these

Tasmanian automobile license plates consist of four capital letters (A through Z) followed by three digits (0 through 9).

18) How many different Tasmanian license plates are possible? 18) _____

A) $(26 \times 4) + (10 \times 3)$
B) 36^7
C) $26^4 \times 10^3$
D) $26^4 + 10^3$
E) none of these

19) How many Tasmanian license plates start with the word ADD? 19) _____

A) 1
B) 2600
C) 1000
D) 26,000
E) none of these

A computer password is made up of four characters. Each character can be a capital letter (A through Z), a lowercase letter (a through z) or a digit (0 through 9).

20) How many passwords do not start with the digit 0? 20) _____

A) 61×62^3
B) 62^3
C) 61^4
D) $62^4 - 1$
E) none of these

21) How many passwords start with a lowercase letter? 21) _____

A) 26×36^4
B) 26×62^3
C) 26×36^3
D) 36^3
E) none of these

22) How many passwords consist entirely of letters? 22) _____

A) 52×4
B) 52^4
C) 4^{52}
D) $52 \times 51 \times 50 \times 49$
E) none of these

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23) How many passwords do not contain the uppercase letter O, the lowercase o, or the number 0? 23) _____

A) $59 \times 58 \times 57 \times 56$

B) $62 \times 25 \times 25 \times 9$

C) $62^4 - 3$

D) 59^4

E) none of these

24) How many passwords have 2 letters (uppercase or lowercase) and 2 digits? 24) _____

A) $2 \times 52^2 \times 10^2$

B) $52^2 \times 10^2$

C) $6 \times 52^2 \times 10^2$

D) $52 \times 51 \times 10 \times 9$

E) none of these

A French restaurant offers a menu consisting of 5 different appetizers, 3 different salads, 2 different soups, 7 different main courses, and 3 different desserts. The restaurant offers different combinations of "fixed price dinners" on different days of the week.

25) On Monday through Thursday, the "fixed price dinner" consists of a choice of appetizer, a soup, a main course, and a dessert. Assuming you don't pass on any of these, how many different "fixed price dinners" are possible on these days? 25) _____

A) 70

B) 42

C) 210

D) 17

E) none of these

A French restaurant offers a menu consisting of 4 different appetizers, 5 different salads, 3 different soups, 7 different main courses, and 8 different desserts. The restaurant offers different combinations of "fixed price dinners" on different days of the week.

26) On Monday through Thursday, the "fixed price dinner" consists of a choice of appetizer, a soup, a main course, and a dessert. Assuming you don't pass on any of these, how many different "fixed price dinners" are possible on these days? 26) _____

A) 392

B) 672

C) 22

D) 68

E) none of these

27) On Sundays, the "fixed price dinner" consists of a main course, a dessert, and any two of the other three types of items (i.e., appetizer and soup, or appetizer and salad, or soup and salad). Assuming you don't pass on any of these, how many "fixed price dinners" are possible on Sundays? 27) _____

A) 2688

B) 3360

C) 1344

D) 2632

E) none of these

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Solve the problem.

28) ${}_{10}P_3$ = 28) _____

A) 720
B) 120
C) 360
D) 30
E) none of these

29) ${}_{10}P_{10}$ = 29) _____

A) 10!
B) 10^2
C) $\frac{10!}{10!\ 0!}$
D) 1
E) none of these

30) ${}_5C_3$ = 30) _____

A) 20
B) 30
C) 10
D) 60
E) none of these

31) ${}_8C_5$ = 31) _____

A) 6720
B) 336
C) 26
D) 56
E) none of these

32) ${}_{15}C_{15}$ = 32) _____

A) 15
B) 1
C) 15!
D) 0
E) none of these

33) ${}_{100}C_{100}$ = 33) _____

A) 100!
B) 0
C) 1
D) 100
E) none of these

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

34) Given that ${}_{120}P_{20} \approx 7.17 \times 10^{40}$, find an approximate value for ${}_{120}P_{21}$. 34) _____

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MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

35) $\dfrac{{}_{1000}C_{500}}{{}_{1000}C_{501}} =$ 35) _____

A) $\dfrac{501}{500}$ B) $\dfrac{1}{500}$ C) 500 D) 501 E) $\dfrac{500}{501}$

A license plate consists of any five capital letters from the ordinary English alphabet (A through Z) except for the letters O, I, and Q.

36) How many of the license plates have no repeated letters? 36) _____

A) 23^5

B) ${}_{23}P_5$

C) ${}_{23}C_5$

D) 23×5

E) none of these

Tasmanian automobile license plates consist of four capital letters (A through Z) followed by three digits (0 through 9).

37) How many Tasmanian license plates have no repeated symbols (different letters and different digits)? 37) _____

A) ${}_{26}P_4 \times {}_{10}P_3$

B) ${}_{26}C_4 \times {}_{10}C_3$

C) $(26^4 - 1) \times (10^3 - 1)$

D) 25^7

E) none of these

Solve the problem.

38) A student downloaded five music files to a portable MP3 player. In how many different orders can the songs be played? 38) _____

A) 120

B) 15

C) 5

D) ${}_5C_5$

E) none of these

39) Six Republicans and six Democrats orally cast their vote in the U.S. Senate. In how many orders can they vote if the first person to vote must be a Democrat? 39) _____

A) ${}_{12}P_6$

B) $6! \times 6!$

C) $6 \times 11!$

D) $12!$

E) none of these

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40) A Tasmanian lottery ticket consists of choosing 7 different numbers between (and including) 10 and 52. The number of possible lottery tickets is given by 40) _____

A) $\frac{43!}{7!\,36!}$

B) $\frac{52!}{45!\,7!}$

C) $\frac{43!}{36!}$

D) 43×7

E) none of these

41) Forty–three drivers start a race. Assuming all the drivers are equally skilled, how many top ten finishes are possible? 41) _____

A) ${}_{43}C_{10}$

B) 33!

C) ${}_{43}P_{10}$

D) 33

E) none of these

42) The Tasmanian House of Representatives has 435 members (235 Demublicans and 200 Republicrats). A set of 3 leaders – a Speaker, a Whip, and a Secretary – must be selected. How many different sets of leaders can be selected if the Speaker must be a Demublican? 42) _____

A) $235 \times 230 \times 229$

B) $235 \times 434 \times 433$

C) $235 \times 435 \times 434$

D) $435 \times 434 \times 433$

E) none of these

43) In a probability space, which of the following statements is not true? 43) _____

A) All outcomes are equally likely.

B) All probabilities are between 0 and 1 (0 and 1 included).

C) The probability of the sample space is always equal to 1.

D) The impossible event always has probability equal to 0.

E) All of these statements are true.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

44) Consider the sample space $S = \{o_1, o_2, o_3, o_4, o_5\}$. Suppose you are given $Pr(o_1) = 0.25$ and $Pr(o_2) = 0.15$. Find the probability assignment for the probability space when o_3, o_4, and o_5 all have the same probability. 44) _____

45) Five horses (A, B, C, D, and E) are racing at the local track. According to the oddsmakers, A has a "one in four" probability of winning [i.e. $Pr(A) = \frac{1}{4}$], B has a "one in ten" probability of winning, and C has a "one in twenty" probability of winning. The remaining two horses both have the same probability of winning. Find the probability assignment for the probability space. 45) _____

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MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

46) Consider the sample space S = {o_1, o_2, o_3, o_4}. Suppose you are given Pr(o_1) = 0.35 and Pr(o_2) = 0.25. If o_3 and o_4 have the same probability, find Pr(o_3). 46) _____

A) 0.4
B) 0.2
C) 0.3
D) 0.1
E) none of these

Four basketball teams called A, B, C, and D are entered in a tournament. According to the odds makers, the probability that team A will win the tournament is Pr(A) = 0.1, and the other three teams all have an equal probability of winning the tournament.

47) What is the probability that team A will not win the tournament? 47) _____

A) 0.3
B) 0.4
C) 0.9
D) cannot be determined from the information given
E) none of these

48) What is the probability that team D will win the tournament? 48) _____

A) 0.45
B) 0.9
C) 0.25
D) 0.3
E) none of these

A pair of honest dice is rolled, and the number on each die is noted.

49) What is the probability of rolling a total of 7? 49) _____

A) $\frac{7}{36}$

B) $\frac{1}{36}$

C) $\frac{1}{6}$

D) $\frac{1}{3}$

E) none of these

50) What is the probability of rolling a total of either 7 or 11? 50) _____

A) $\frac{1}{4}$

B) $\frac{1}{18}$

C) $\frac{1}{36}$

D) $\frac{1}{6}$

E) none of these

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Four drivers called A, B, C, and D are entered in a race. According to the odds makers, the probability that the driver A will win the race is Pr(A) = 0.4, and the other three drivers all have an equal probability of winning the race.

51) What is the probability that the driver B will not win the race? 51) _____

A) 0.8
B) 0.4
C) 0.6
D) cannot be determined from the information given
E) none of these

Solve the problem.

52) If a fair coin is tossed twice, the probability that both tosses will come up heads is 52) _____

A) $\frac{3}{4}$.

B) $\frac{1}{4}$.

C) $\frac{1}{2}$.

D) $\frac{1}{3}$.

E) none of these

53) An honest coin is tossed ten times. The probability of tossing one head and nine tails is 53) _____

A) $\frac{5}{512}$.

B) $\frac{1}{1024}$.

C) $\frac{1}{9}$.

D) $\frac{1}{10}$.

E) none of these

54) An honest coin is tossed ten times . The probability of tossing two heads and eight tails is 54) _____

A) $\frac{1}{5}$.

B) $\frac{5}{512}$.

C) $\frac{45}{1024}$.

D) $\frac{1}{512}$.

E) none of these

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55) An honest coin is tossed ten times. The probability that the number of heads is double the number of tails is 55) _____

A) $\frac{1}{3}$.

B) 0.

C) $\frac{2}{3}$.

D) $\frac{1}{2}$.

E) none of these

56) An honest coin is tossed ten times. The probability that the number of heads is triple the number of tails is 56) _____

A) $\frac{1}{2}$.

B) $\frac{2}{3}$.

C) 0.

D) $\frac{1}{3}$.

E) none of these

57) Suppose that an honest coin is tossed ten times. What is the probability that it will come up heads at least once? 57) _____

A) $\frac{10}{9}$

B) $\frac{9}{10}$

C) $\frac{1}{2}$

D) $\frac{1023}{1024}$

E) none of these

A pitching machine throws 70% strikes and 30% balls. Five pitches will be thrown by the machine.

58) What is the probability the machine will throw one ball and four strikes? 58) _____

A) $5 \times 0.3 \times 0.7^4$

B) $0.3 + 4 \times 0.7$

C) 0.3×0.7^4

D) $\frac{1}{5}$

E) none of these

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A couple is planning to have four children. Suppose that for this couple the probability of a boy is 46% and the probability of a girl is 54%. (Assume the gender of each child is independent from that of the other children.)

59) What is the probability that they will have four boys? 59) _____

A) 0.46^4

B) $0.46^3 \times 0.54$

C) $\frac{1}{4}$

D) $0.46 + 0.46 + 0.46 + 0.46$

E) none of these

60) What is the probability that they will have an equal number of boys and girls? 60) _____

A) $6 \times 0.46^2 \times 0.54^2$

B) $0.46^2 \times 0.54^2$

C) $0.46^2 + 0.54^2$

D) $4 \times 0.46^2 \times 0.54^2$

E) none of these

Solve the problem.

61) Two cards are drawn in order from a well shuffled deck of 52 cards. The probability that both cards are hearts is given by 61) _____

A) $\left(\frac{13}{52}\right)$.

B) $\left(\frac{13}{52}\right) \times \left(\frac{12}{52}\right)$.

C) $\left(\frac{13}{52}\right) \times \left(\frac{12}{51}\right)$.

D) $\left(\frac{13}{52}\right) \times \left(\frac{13}{51}\right)$.

E) none of these

62) Two cards are drawn in order from a well shuffled deck of 52 cards. The probability that both cards are 10's is given by 62) _____

A) $\left(\frac{4}{52}\right) \times \left(\frac{3}{52}\right)$.

B) $\left(\frac{4}{52}\right) \times \left(\frac{3}{51}\right)$.

C) $\left(\frac{4}{52}\right)^{12}$.

D) $\left(\frac{4}{52}\right) \times \left(\frac{4}{51}\right)$.

E) none of these

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63) Three cards are drawn in order from a well shuffled deck of 52 cards. The probability that all three cards are clubs is given by 63) _____

A) $\left(\frac{13}{52}\right) \times \left(\frac{13}{51}\right) \times \left(\frac{13}{50}\right)$.

B) $\left(\frac{13}{52}\right) \times \left(\frac{12}{51}\right)$.

C) $\left(\frac{13}{52}\right) \times \left(\frac{12}{51}\right) \times \left(\frac{11}{50}\right)$.

D) $\left(\frac{13}{52}\right) \times \left(\frac{12}{52}\right) \times \left(\frac{11}{52}\right)$.

E) none of these

64) If the chances of rain tomorrow are 20%, then the odds of rain tomorrow can be given as 64) _____

A) 2 to 12.
B) 2 to 10.
C) 2 to 8.
D) 2 to 1.
E) none of these

65) If the chances of rain tomorrow are 30%, then the odds of rain tomorrow can be given as 65) _____

A) 3 to 7.
B) 3 to 1.
C) 3 to 13.
D) 3 to 10.
E) none of these

66) Suppose that the odds of winning the grand prize in a raffle are 1 to 7. What is the probability of winning the grand prize? 66) _____

A) $\frac{1}{7}$

B) $\frac{1}{8}$

C) $\frac{6}{7}$

D) $\frac{1}{6}$

E) none of these

Four drivers called A, B, C, and D are entered in a race. According to the odds makers, the probability that the driver A will win the race is Pr(A) = 0.4, and the other three drivers all have an equal probability of winning the race.

67) What are the odds that driver D will win the race? 67) _____

A) 1 to 3
B) 1 to 6
C) 1 to 4
D) 4 to 6
E) none of these

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SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Solve the problem.

68) An amateur golfer had the following distribution of scores one weekend at her local country club. What was her average score per hole that weekend? 68) _____

Score	2	3	4	5	6
Percentage of holes	5.6%	16.7%	22.2%	44.4%	11.1%

69) In 2008 an outdoor mall was open throughout the year. The number of shoppers averaged 5000 on sunny days, 4000 on cloudy days, 1200 on rainy days, and 3000 on snowy days. The percentage of days of each type in 2008 is given in the following table. Find the average number of average shoppers per day at the mall for 2008. 69) _____

Weather condition	Sunny	Cloudy	Rainy	Snowy
Percentage of days	42%	31%	18%	9%

70) Find the expected value of the random variable with outcomes and associated probability distribution shown in the following table. 70) _____

Outcome	20	40	60	80
Probability	0.1	0.3	0.2	?

71) A football player kicks two consecutive field goals from approximately the same distance. Each field goal is worth three points and has probability of success $p = \frac{3}{5}$. Let X denote the number of points scored. Find the probability distribution of X. 71) _____

72) A football player kicks two consecutive field goals from approximately the same distance. Each field goal is worth three points and has probability of success $p = \frac{3}{5}$. Let X denote the number of points scored. Find the expected value of X. 72) _____

73) In one state's Multi–Million Lottery you choose 5 numbers between 1 and 56 plus a Mega number between 1 and 36. Suppose that a winning ticket pays $60 million (assume that the prize will not be split among several winners). Find the expected value of a $1 lottery ticket. Round your answer to the nearest penny. 73) _____

74) An insurance company plans to sell a $200,000 one–year term life insurance policy to a 60–year–old female. Of 2.5 million females having similar risk factors, the company estimates that 5000 of them will die in the next year. What is the premium that the insurance company should charge if it would like to make a profit of $150 on each policy? 74) _____

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1) C
2) A
3) B
4) A
5) E
6) E
7) E
8) B
9) C
10) D
11) B
12) C
13) A
14) D
15) C
16) B
17) A
18) C
19) D
20) A
21) B
22) B
23) D
24) C
25) C
26) B
27) D
28) A
29) A
30) C
31) D
32) B
33) C
34) 7.17×10^{42}
35) A
36) B
37) A
38) A
39) C
40) A
41) C
42) B
43) A
44) $\Pr(o_1) = 0.25,\ \Pr(o_2) = 0.15,\ \Pr(o_3) = 0.2,\ \Pr(o_4) = 0.2,\ \Pr(o_5) = 0.2$
45) $\Pr(A) = \frac{1}{4}, \Pr(B) = \frac{1}{10}, \Pr(C) = \frac{1}{20}, \Pr(D) = \frac{3}{10}, \Pr(E) = \frac{3}{10}$
46) B
47) C
48) D

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49) C
50) E
51) A
52) B
53) A
54) C
55) B
56) C
57) D
58) A
59) A
60) A
61) C
62) B
63) C
64) C
65) A
66) B
67) C
68) 4.387
69) 3826
70) 58
71)

Outcome	0 points	3 points	6 points
Probability	0.16	0.48	0.36

72) 3.6 points
73) $–0.56
74) $550 per policy

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Chapter 17

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

150 students in a math class take the final exam. The scores on the exam have an approximately normal distribution with mean $\mu = 65$ and standard deviation $\sigma = 10$.

1) Peter's score on the exam places him in the 16th percentile of the class. Peter's score on the exam is approximately 1) _____
   A) 45.
   B) 16.
   C) 55.
   D) 35.
   E) none of these

2) Carol scored 75 points on the exam. In approximately what percentile of the class does this score place her? 2) _____
   A) 34th percentile
   B) 84th percentile
   C) 68th percentile
   D) 95th percentile
   E) none of these

250 students in a math class take the final exam. The scores on the exam have an approximately normal distribution with mean $\mu = 75$ and standard deviation $\sigma = 10$.

3) The average score on the exam was approximately 3) _____
   A) 10.
   B) 75.
   C) 95.
   D) 85.
   E) none of these

4) Assuming there were no outliers, the lowest score on the exam was around 4) _____
   A) 45.
   B) 10.
   C) 0.
   D) 75.
   E) none of these

5) Approximately what percent of the students scored between 65 and 75 points? 5) _____
   A) 95%
   B) 68%
   C) 10%
   D) 34%
   E) none of these

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6) Peter's score on the exam places him in the 16th percentile of the class. Peter's score on the exam is approximately 6) _____
A) 55.
B) 45.
C) 65.
D) 16.
E) none of these

7) Carol scored 85 points on the exam. In approximately what percentile of the class does this score place her? 7) _____
A) 95th percentile
B) 34th percentile
C) 68th percentile
D) 84th percentile
E) none of these

8) Approximately how many students had test scores between 68.25 and 85? 8) _____
A) 147
B) 107
C) 85
D) 188
E) none of these

150 students in a math class take the final exam. The scores on the exam have an approximately normal distribution with mean $\mu = 65$ and standard deviation $\sigma = 10$.

9) The third quartile of the scores on the exam is approximately 9) _____
A) 80 points.
B) 67 points.
C) 84 points.
D) 72 points.
E) none of these

250 students in a math class take the final exam. The scores on the exam have an approximately normal distribution with mean $\mu = 75$ and standard deviation $\sigma = 10$.

10) The third quartile of the scores on the exam is approximately 10) _____
A) 90 points.
B) 77 points.
C) 82 points.
D) 94 points.
E) none of these

As part of a study on the metabolism of athletes, 400 college basketball players are randomly chosen and their weights taken. The distribution of the weights is approximately normal. The average weight is 215 pounds and the standard deviation is 15 pounds.

11) The first quartile of the weights was approximately 11) _____
A) 208 pounds.
B) 225 pounds.
C) 205 pounds.
D) 200 pounds.
E) none of these

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As part of a study, 800 college football players are randomly chosen and their weights taken. The distribution of the weights is approximately normal. The average weight is 235 pounds and the standard deviation is 25 pounds.

12) The first quartile of the weights was approximately 12) _____

A) 235 pounds.
B) 218 pounds.
C) 200 pounds.
D) 223 pounds.
E) none of these

Answer the question(s) based on the following situation: For a population of 4000 students taking the SAT math exam, the scores on the exam have an approximately normal distribution with mean $\mu = 610$ and standard deviation $\sigma = 60$.

13) The third quartile of the scores on the exam is approximately 13) _____

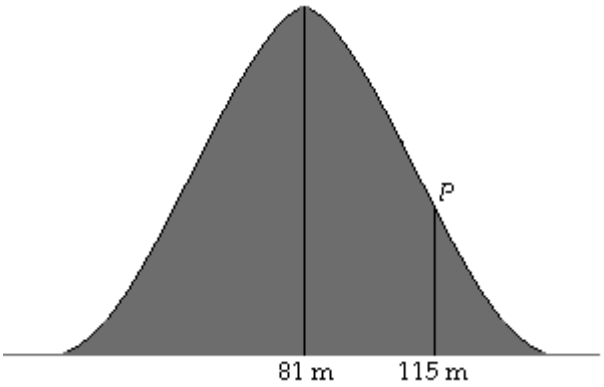
A) 670.
B) 650.
C) 630.
D) 640.
E) none of these

Solve the problem.

14) The standard deviation of a normal distribution is $\sigma = 20$. What is the interquartile range for this distribution? 14) _____

A) 27
B) 6.75
C) 33.75
D) 13.5
E) none of these

Consider the normal distribution given below and assume that P is a point of inflection of the curve.



15) Find the median M of the distribution. 15) _____

A) 47 m B) 115 m C) 50 m D) 81 m E) 34 m

16) Find the standard deviation σ of the distribution. 16) _____

A) 34 m B) 81 m C) 47 m D) 115 m E) 50 m

17) Find the third quartile Q_3 of the distribution rounded to the nearest meter. 17) _____

A) 58 m B) 115 m C) 149 m D) 150 m E) 104 m

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Solve the problem.

18) If μ is the mean and σ is the standard deviation of a normal distribution, then which of the following statements is true? 18) _____

A) μ and σ must always be positive numbers.
B) σ must always be positive, μ can be positive or negative.
C) μ must always be bigger than σ.
D) μ must always be positive, σ can be positive or negative.
E) none of these

150 students in a math class take the final exam. The scores on the exam have an approximately normal distribution with mean μ = 65 and standard deviation σ = 10.

19) A score of 85 corresponds to a standardized value of 19) _____

A) –2.
B) 2.
C) 20.
D) 8.5.
E) none of these

250 students in a math class take the final exam. The scores on the exam have an approximately normal distribution with mean μ = 75 and standard deviation σ = 10.

20) A score of 60 corresponds to a standardized value of 20) _____

A) –5.
B) 5.
C) –1.5.
D) 1.5.
E) none of these

As part of a study on the metabolism of athletes, 400 college basketball players are randomly chosen and their weights taken. The distribution of the weights is approximately normal. The average weight is 215 pounds and the standard deviation is 15 pounds.

21) A weight of 260 pounds corresponds to a standardized value of 21) _____

A) 1.
B) 2.
C) 3.
D) 4.
E) none of these

22) A weight of 188 pounds corresponds to a standardized value of 22) _____

A) 1.8.
B) –1.8.
C) –1.5.
D) 27.
E) none of these

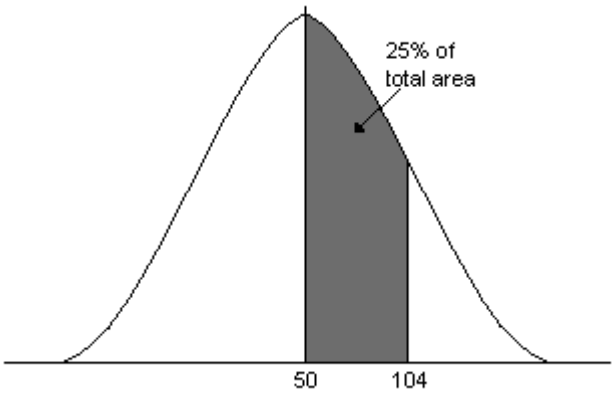
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As part of a study, 800 college football players are randomly chosen and their weights taken. The distribution of the weights is approximately normal. The average weight is 235 pounds and the standard deviation is 25 pounds.

23) A weight of 300 pounds corresponds to a standardized value of 23) _____

A) 1.2.
B) 2.6.
C) –1.2.
D) 2.3.
E) none of these

Refer to a normal distribution described by the following figure. The mean is μ and the standard deviation is σ.



24) A data value of –70 corresponds to a standardized value of 24) _____

A) –0.5.
B) –2.22.
C) –1.5.
D) –0.25.
E) none of these

25) If the standardized value of x is 1.25, then x = 25) _____

A) 110.
B) 150.
C) 117.5.
D) 170.
E) none of these

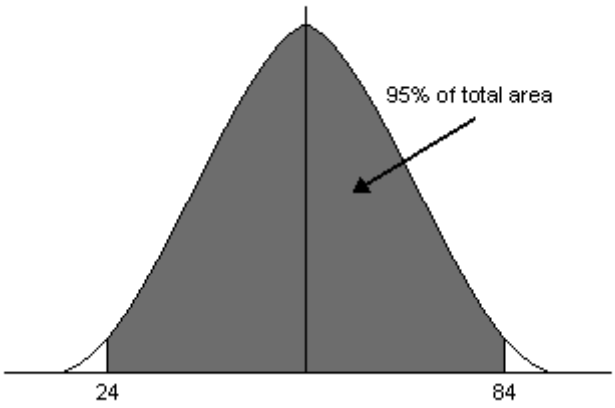
Answer the question(s) based on the following situation: For a population of 4000 students taking the SAT math exam, the scores on the exam have an approximately normal distribution with mean $\mu = 610$ and standard deviation $\sigma = 60$.

26) A score of 700 has an approximate standardized value of 26) _____

A) 1.5.
B) –1.75.
C) 2.
D) –1.
E) none of these

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Refer to the following normal curve, with mean μ and standard deviation σ.



27) The mean μ = 27) _____

A) 48
B) 54
C) 39
D) 12
E) none of these

28) The standard deviation σ = 28) _____

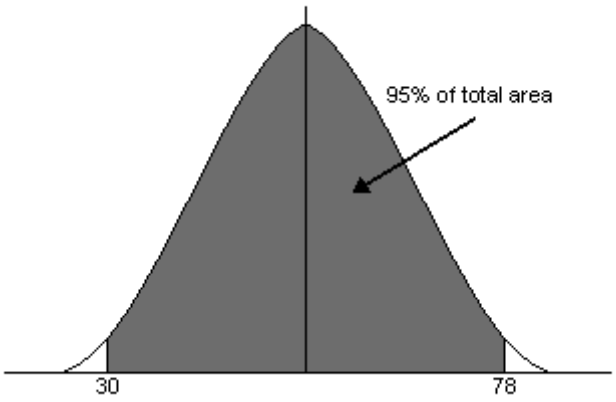
A) 30
B) 10
C) 60
D) 15
E) none of these

29) A data value of 36 corresponds to a standardized value of 29) _____

A) –1.5.
B) –1.2.
C) 1.5.
D) 1.2.
E) none of these

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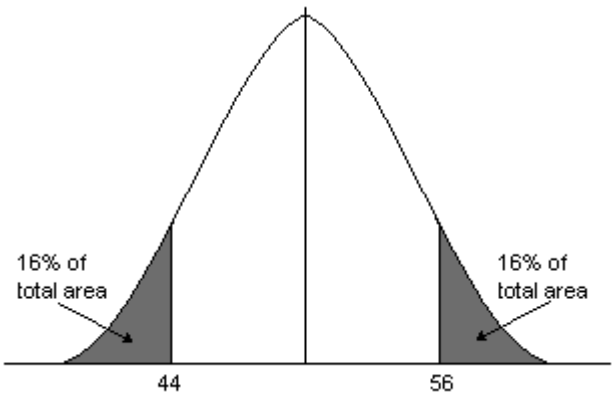
Refer to the following normal curve, with mean μ and standard deviation σ.



30) A data value of 30 corresponds to a standardized value of 30) _____

A) –1.
B) 1.
C) –2.
D) 2.
E) none of these

Refer to the following normal curve, with mean μ and standard deviation σ.

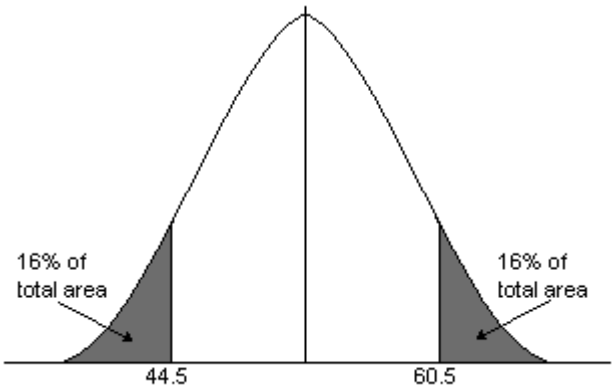


31) If the standardized value of x is 0.5, then x = 31) _____

A) 52.5.
B) 51.
C) 50.5.
D) 53.
E) none of these

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Refer to a normal distribution described by the following figure. The mean is μ and the standard deviation is σ.



32) The mean μ = 32) _____
A) 32
B) 52.5
C) 48.5
D) 50
E) none of these

33) What is the approximate value of Q_3? 33) _____
A) 57.9
B) 65.7
C) 75
D) 55.2
E) none of these

34) A data value of 40.5 corresponds to a standardized value of 34) _____
A) –1.5.
B) 12.
C) 0.
D) –1.
E) none of these

35) If the standardized value of x is –1.25, then x = 35) _____
A) 65.
B) 42.5.
C) 51.25.
D) 62.5.
E) none of these

150 students in a math class take the final exam. The scores on the exam have an approximately normal distribution with mean μ = 65 and standard deviation σ = 10.

36) Approximately how many students had test scores with standardized values between –0.675 and 1? 36) _____
A) 140
B) 37
C) 75
D) 88
E) none of these

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37) Approximately 95% of the class scored between 37) _____

A) 45 and 85.
B) 65 and 85.
C) 35 and 95.
D) 0 and 85.
E) none of these

250 students in a math class take the final exam. The scores on the exam have an approximately normal distribution with mean $\mu = 75$ and standard deviation $\sigma = 10$.

38) Approximately 95% of the class scored between 38) _____

A) 55 and 95.
B) 65 and 85.
C) 0 and 95.
D) 45 and 100.
E) none of these

39) Approximately what percentage of the test scores had standardized values between -3 and 3? 39) _____

A) 68%
B) 99.7%
C) 50%
D) 95%
E) none of these

40) Approximately how many students had test scores with standardized values between -2 and 0.675? 40) _____

A) 181 B) 85 C) 125 D) 147 E) 204

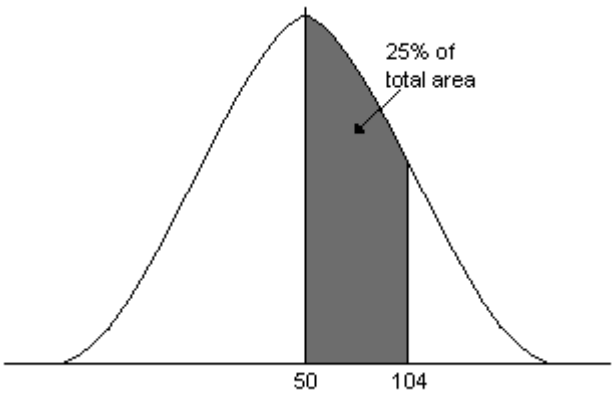
As part of a study on the metabolism of athletes, 400 college basketball players are randomly chosen and their weights taken. The distribution of the weights is approximately normal. The average weight is 215 pounds and the standard deviation is 15 pounds.

41) Approximately how many players had weights with standardized values between 1 and 2? 41) _____

A) 216
B) 108
C) 54
D) 200
E) none of these

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Refer to a normal distribution described by the following figure. The mean is μ and the standard deviation is σ.



42) The standard deviation σ = 42) _____

A) 80
B) 54
C) 27
D) 108
E) none of these

43) The value of the first quartile Q_1 = 43) _____

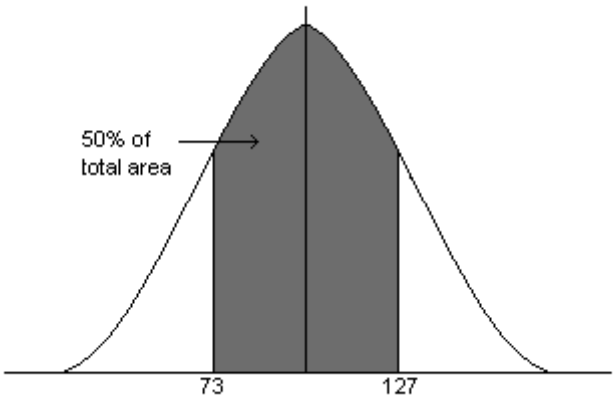
A) –4.
B) 40.
C) 27.
D) 0.
E) none of these

44) Approximately 84% of the data lies below 44) _____

A) 130.
B) 112.
C) 154.
D) 210.
E) none of these

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Refer to the following normal curve, with mean μ and standard deviation σ.



45) The value of the first quartile Q_1 = 45) _____

A) 127
B) 100
C) 50
D) 73
E) none of these

Answer the question(s) based on the following situation: Over the last 80 years records have been kept of the annual rainfall in the Tasmanian desert. The distribution of annual rainfall is approximately normal and has no outliers. The minimum of 2.5 inches of rain occurred in 1959; the maximum of 9.7 inches of rain occurred in 1938.

46) The standard deviation of the rainfall distribution is approximately 46) _____

A) 1.2 inches.
B) 3.6 inches.
C) 1.8 inches.
D) 2.7 inches.
E) none of these

47) Two years ago, the annual rainfall was 7.3 inches. The standardized value corresponding to this rainfall is approximately 47) _____

A) 1.
B) 0.5.
C) –0.5.
D) 0.
E) none of these

48) In this part of the world, anything over 8.5 inches of annual rainfall is considered a "wet" year. Of the last 80 years, approximately how many were "wet" ones? 48) _____

A) 16
B) 6
C) 2
D) 4
E) none of these

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Answer the question(s) based on the following situation: Over the last 80 years records have been kept of the annual rainfall in the Tasmanian desert. The distribution of annual rainfall is approximately normal and has no outliers. The minimum of 4.5 inches of rain occurred in 1952; the maximum of 11.7 inches of rain occurred in 1934.

49) The standard deviation of the rainfall distribution is approximately 49) _____

A) 1.2 inches.
B) 1.8 inches.
C) 7.2 inches.
D) 3.6 inches.
E) none of these

50) Two years ago, the annual rainfall was 7.5 inches. The standardized value corresponding to this rainfall is approximately 50) _____

A) 2.5.
B) 0.
C) 1.
D) –0.5.
E) none of these

As part of a study on the metabolism of athletes, 400 college basketball players are randomly chosen and their weights taken. The distribution of the weights is approximately normal. The average weight is 215 pounds and the standard deviation is 15 pounds.

51) Assuming there were no outliers, the range of weights was approximately 51) _____

A) 400 pounds.
B) 180 pounds.
C) 90 pounds.
D) 60 pounds.
E) none of these

As part of a study, 800 college football players are randomly chosen and their weights taken. The distribution of the weights is approximately normal. The average weight is 235 pounds and the standard deviation is 25 pounds.

52) Of the 800 players approximately how many weighed 210 pounds or less? 52) _____

A) 200
B) 544
C) 64
D) 128
E) none of these

53) Assuming there were no outliers, the range of weights was approximately 53) _____

A) 400 pounds.
B) 100 pounds.
C) 200 pounds.
D) 150 pounds.
E) none of these

54) Approximately how many players weighed over 252 pounds? 54) _____

A) 150
B) 168
C) 200
D) 128
E) none of these

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55) Approximately how many players had weights between 235 and 252 pounds? 55) _____

A) 200
B) 37
C) 100
D) 50
E) none of these

Answer the question(s) based on the following situation: For a population of 4000 students taking the SAT math exam, the scores on the exam have an approximately normal distribution with mean $\mu = 610$ and standard deviation $\sigma = 60$.

56) Approximately how many students scored between 490 and 730? 56) _____

A) 3000
B) 3900
C) 3800
D) 2720
E) none of these

57) Approximately how many students scored below 730 points? 57) _____

A) 3900
B) 3000
C) 2720
D) 3800
E) none of these

Answer the question(s) based on the following situation: For a population of 2000 students taking the SAT math exam, the scores on the exam have an approximately normal distribution with mean $\mu = 590$ and standard deviation $\sigma = 70$.

58) Approximately how many students scored less than 543 points? 58) _____

A) 543
B) 750
C) 500
D) 637
E) none of these

Answer the question based on the following situation:
An honest coin is tossed 1600 times. The random variable X denotes the total number of heads that come up in the 1600 tosses.

59) What are the chances that X is 800 or less? 59) _____

A) approximately 0%
B) approximately 40%
C) approximately 50%
D) approximately 100%
E) none of these

60) What are the chances that X is less than 600? 60) _____

A) approximately 0%
B) approximately 16%
C) approximately 32%
D) approximately 25%
E) none of these

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61) What are the chances that X is more than 787? 61) _____

A) approximately 75%
B) approximately 84%
C) approximately 16%
D) approximately 25%
E) none of these

62) What are the chances that X is more than 813? 62) _____

A) approximately 16%
B) approximately 75%
C) approximately 84%
D) approximately 25%
E) none of these

Answer the question(s) based on the following situation: A dishonest coin (landing heads $\frac{2}{5}$ of the time) is tossed 1350 times. The random variable X denotes the total number of heads that come up in the 1350 tosses.

63) The mean μ of this approximately normal distribution X is approximately 63) _____

A) 810.
B) 23.2.
C) 540.
D) 675.
E) none of these

64) What are the chances that X is 540 or less? 64) _____

A) approximately 60%
B) approximately 0%
C) approximately 40%
D) approximately 50%
E) none of these

65) What are the chances that X is 522 or less? 65) _____

A) approximately 37.5%
B) approximately 16%
C) approximately 25%
D) approximately 5%
E) none of these

66) If the standardized value of x is 1.75, then x = 66) _____

A) 711.
B) 706.5.
C) 571.5
D) 541.5.
E) none of these

67) Assuming that there are no outliers, what is the range for this distribution? 67) _____

A) approximately 36
B) approximately 108
C) approximately 54
D) approximately 81
E) none of these

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Solve the problem.

68) Suppose that one out of every five federal tax returns which are submitted has an error. Out of 10,000 submitted returns, find the probability that there are at most 2000 with an error. 68) _____

A) approximately 0.025
B) approximately 0.5
C) approximately 0.95
D) approximately 0.75
E) approximately 0.25

69) Suppose that one out of every five federal tax returns which are submitted has an error. Out of 10,000 submitted returns, find the probability that there are more than 2080 with an error. 69) _____

A) approximately 0.25
B) approximately 0.95
C) approximately 0.75
D) approximately 0.025
E) approximately 0.5

70) In a survey of 1000 Americans, 850 said that they own a cell phone. Assume that the survey was properly conducted and that the 1000 people surveyed represent an unbiased sample of the entire population. Compute a 99.7% confidence interval (expressed using percents) for this survey. 70) _____

A) 83.9% to 86.1%
B) 84.8% to 85.2%
C) 81.7% to 88.3%
D) 84.08% to 85.02%
E) 82.8% to 87.2%

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1) C
2) B
3) B
4) A
5) D
6) C
7) D
8) A
9) D
10) C
11) C
12) B
13) B
14) A
15) D
16) A
17) E
18) B
19) B
20) C
21) C
22) B
23) B
24) C
25) B
26) A
27) B
28) D
29) B
30) C
31) D
32) B
33) A
34) A
35) B
36) D
37) A
38) A
39) B
40) A
41) C
42) A
43) A
44) A
45) D
46) A
47) A
48) C
49) A
50) D

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51) C
52) D
53) D
54) C
55) A
56) C
57) A
58) C
59) C
60) A
61) A
62) D
63) C
64) D
65) B
66) C
67) B
68) B
69) D
70) C

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Chapter 17

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

150 students in a math class take the final exam. The scores on the exam have an approximately normal distribution with mean $\mu = 65$ and standard deviation $\sigma = 10$.

1) The number of students scoring 65 points or more is approximately 1) _____
   A) 50.
   B) 95.
   C) 75.
   D) 65.
   E) none of these

2) Approximately what percent of the students scored between 65 and 75 points? 2) _____
   A) 95%
   B) 68%
   C) 10%
   D) 34%
   E) none of these

3) Peter's score on the exam places him in the 16th percentile of the class. Peter's score on the exam is approximately 3) _____
   A) 55.
   B) 35.
   C) 16.
   D) 45.
   E) none of these

4) Carol scored 75 points on the exam. In approximately what percentile of the class does this score place her? 4) _____
   A) 95th percentile
   B) 68th percentile
   C) 84th percentile
   D) 34th percentile
   E) none of these

250 students in a math class take the final exam. The scores on the exam have an approximately normal distribution with mean $\mu = 75$ and standard deviation $\sigma = 10$.

5) The number of students scoring 75 points or more is approximately 5) _____
   A) 125.
   B) 75.
   C) 83.
   D) 158.
   E) none of these

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6) Approximately what percent of the students scored between 65 and 75 points? 6) _____
A) 68%
B) 95%
C) 34%
D) 10%
E) none of these

7) Peter's score on the exam places him in the 16th percentile of the class. Peter's score on the exam is approximately 7) _____
A) 55.
B) 45.
C) 65.
D) 16.
E) none of these

8) Approximately how many students had test scores between 68.25 and 85? 8) _____
A) 85
B) 107
C) 188
D) 147
E) none of these

150 students in a math class take the final exam. The scores on the exam have an approximately normal distribution with mean $\mu = 65$ and standard deviation $\sigma = 10$.

9) The third quartile of the scores on the exam is approximately 9) _____
A) 80 points.
B) 84 points.
C) 67 points.
D) 72 points.
E) none of these

As part of a study on the metabolism of athletes, 400 college basketball players are randomly chosen and their weights taken. The distribution of the weights is approximately normal. The average weight is 215 pounds and the standard deviation is 15 pounds.

10) The first quartile of the weights was approximately 10) _____
A) 205 pounds.
B) 200 pounds.
C) 225 pounds.
D) 208 pounds.
E) none of these

As part of a study, 800 college football players are randomly chosen and their weights taken. The distribution of the weights is approximately normal. The average weight is 235 pounds and the standard deviation is 25 pounds.

11) The first quartile of the weights was approximately 11) _____
A) 223 pounds.
B) 235 pounds.
C) 218 pounds.
D) 200 pounds.
E) none of these

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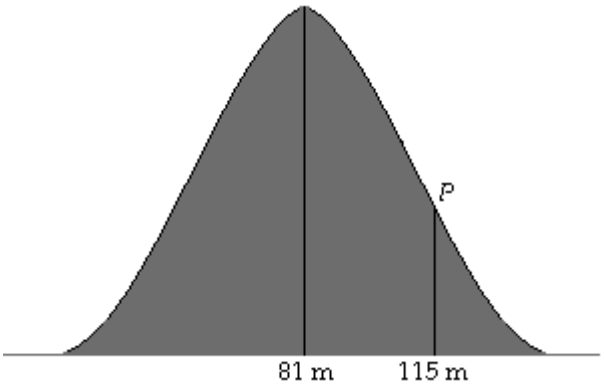
Answer the question(s) based on the following situation: For a population of 4000 students taking the SAT math exam, the scores on the exam have an approximately normal distribution with mean $\mu = 610$ and standard deviation $\sigma = 60$.

12) The third quartile of the scores on the exam is approximately 12) _____

A) 670.
B) 640.
C) 650.
D) 630.
E) none of these

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Consider the normal distribution given below and assume that P is a point of inflection of the curve.



13) Find the mean μ of the distribution. 13) _____

14) Find the standard deviation σ of the distribution. 14) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

15) If μ is the mean and σ is the standard deviation of a normal distribution, then which of the following statements is true? 15) _____

A) σ must always be positive, μ can be positive or negative.
B) μ and σ must always be positive numbers.
C) μ must always be positive, σ can be positive or negative.
D) μ must always be bigger than σ.
E) none of these

150 students in a math class take the final exam. The scores on the exam have an approximately normal distribution with mean $\mu = 65$ and standard deviation $\sigma = 10$.

16) A score of 85 corresponds to a standardized value of 16) _____

A) 20.
B) 8.5.
C) –2.
D) 2.
E) none of these

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17) A score of 50 corresponds to a standardized value of 17) _____

A) 5.
B) –5.
C) 1.5.
D) –1.5.
E) none of these

As part of a study on the metabolism of athletes, 400 college basketball players are randomly chosen and their weights taken. The distribution of the weights is approximately normal. The average weight is 215 pounds and the standard deviation is 15 pounds.

18) A weight of 188 pounds corresponds to a standardized value of 18) _____

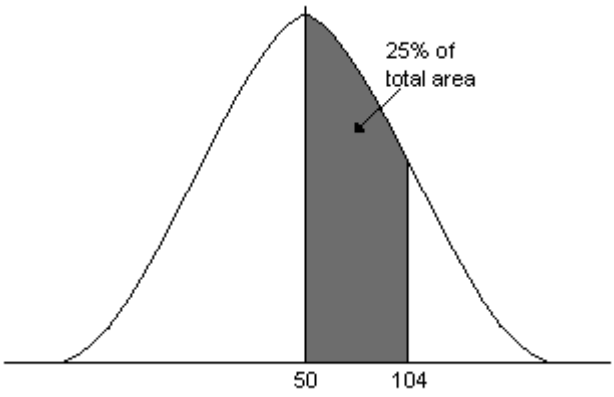
A) 1.8.
B) 27.
C) –1.5.
D) –1.8.
E) none of these

As part of a study, 800 college football players are randomly chosen and their weights taken. The distribution of the weights is approximately normal. The average weight is 235 pounds and the standard deviation is 25 pounds.

19) A weight of 185 pounds corresponds to a standardized value of 19) _____

A) –3.
B) –2.
C) –1.5.
D) –1.
E) none of these

Refer to a normal distribution described by the following figure. The mean is μ and the standard deviation is σ.



20) A data value of –70 corresponds to a standardized value of 20) _____

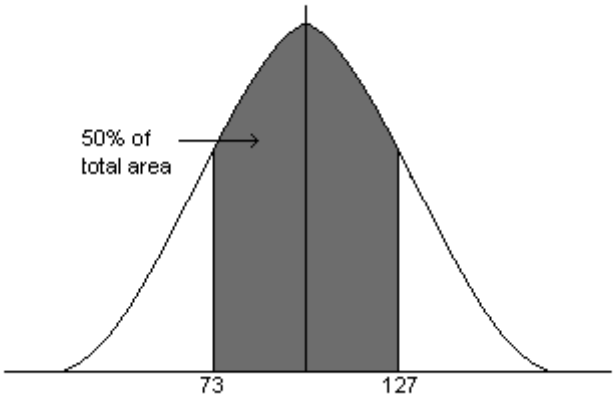
A) –0.5.
B) –2.22.
C) –1.5.
D) –0.25.
E) none of these

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21) If the standardized value of x is 1.25, then x = 21) _____

A) 150.
B) 110.
C) 170.
D) 117.5.
E) none of these

Refer to the following normal curve, with mean μ and standard deviation σ.



22) A data value of 60 corresponds to a standardized value of 22) _____

A) 0.
B) –1.
C) –40.
D) –2.
E) none of these

23) If the standardized value of x is 0.5, then x = 23) _____

A) 120.
B) 137.
C) 100.
D) 80.
E) none of these

Answer the question(s) based on the following situation: For a population of 2000 students taking the SAT math exam, the scores on the exam have an approximately normal distribution with mean μ = 590 and standard deviation σ = 70.

24) A score of 700 has an approximate standardized value of 24) _____

A) 1.57.
B) 10.
C) –1.57.
D) 110.
E) none of these

Solve the problem.

25) The difference in the standardized values of Q_3 and Q_1 is about 25) _____

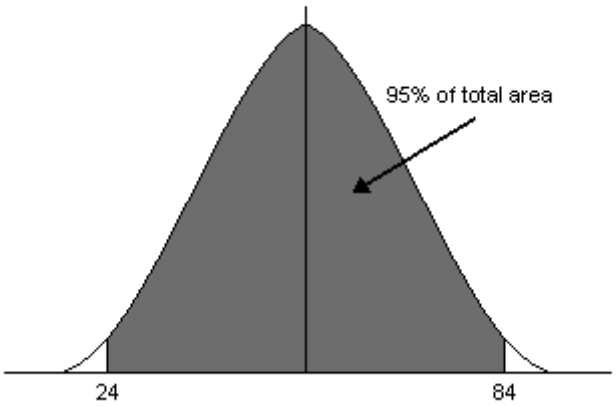
A) 3. B) 0.675. C) 1. D) 0.5. E) 1.35.

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26) A normal distribution has $\mu = 80$ inches and $Q_3 = 93.5$ inches. The standardized value of 40 inches is 26) _____

A) −0.675. B) −2. C) −3. D) −1. E) −0.5.

Refer to the following normal curve, with mean μ and standard deviation σ.



27) The mean μ = 27) _____

A) 39
B) 54
C) 48
D) 12
E) none of these

28) The standard deviation σ = 28) _____

A) 30
B) 15
C) 60
D) 10
E) none of these

29) A data value of 24 corresponds to a standardized value of 29) _____

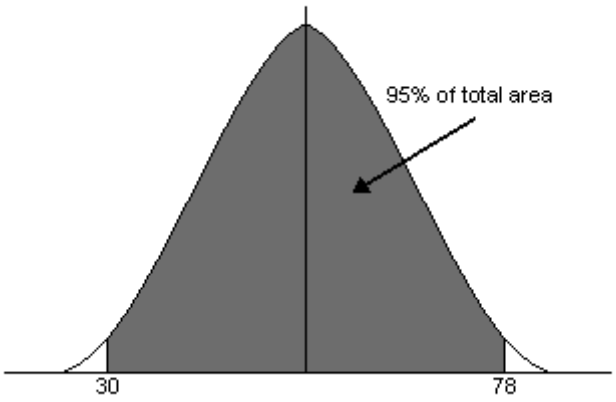
A) 2.
B) 1.
C) −2.
D) −1.
E) none of these

30) A data value of 36 corresponds to a standardized value of 30) _____

A) −1.2.
B) 1.2.
C) −1.5.
D) 1.5.
E) none of these

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Refer to the following normal curve, with mean μ and standard deviation σ.



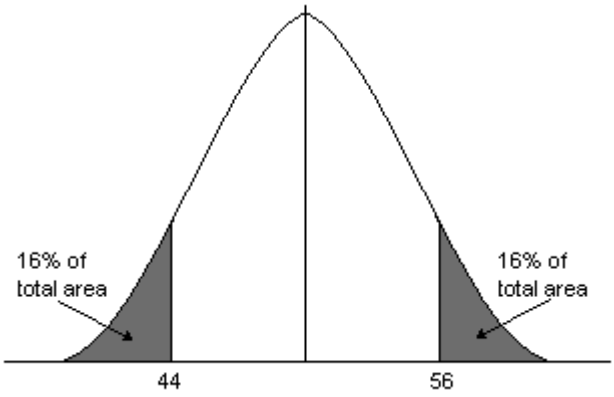
31) The mean μ = 31) _____

A) 48
B) 39
C) 54
D) 12
E) none of these

32) A data value of 39 corresponds to a standardized value of 32) _____

A) –1.25.
B) –1.5.
C) 1.5.
D) 1.25.
E) none of these

Refer to the following normal curve, with mean μ and standard deviation σ.



33) The mean μ = 33) _____

A) 38
B) 50
C) 62
D) 48
E) none of these

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34) The standard deviation σ = 34) _____

A) 6
B) 3
C) 12
D) 24
E) none of these

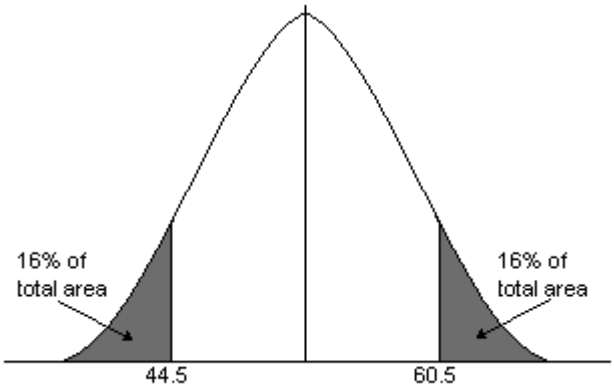
35) A data value of 41 corresponds to a standardized value of 35) _____

A) –2.
B) –1.
C) –0.5.
D) –1.5.
E) none of these

36) If the standardized value of x is 0.5, then x = 36) _____

A) 51.
B) 50.5.
C) 53.
D) 52.5.
E) none of these

Refer to a normal distribution described by the following figure. The mean is μ and the standard deviation is σ.



37) The mean μ = 37) _____

A) 48.5
B) 32
C) 50
D) 52.5
E) none of these

38) A data value of 40.5 corresponds to a standardized value of 38) _____

A) –1.5.
B) –1.
C) 12.
D) 0.
E) none of these

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150 students in a math class take the final exam. The scores on the exam have an approximately normal distribution with mean $\mu = 65$ and standard deviation $\sigma = 10$.

39) Approximately 95% of the class scored between 39) _____

A) 0 and 85.
B) 35 and 95.
C) 65 and 85.
D) 45 and 85.
E) none of these

250 students in a math class take the final exam. The scores on the exam have an approximately normal distribution with mean $\mu = 75$ and standard deviation $\sigma = 10$.

40) Approximately what percentage of the test scores had standardized values between -3 and 3? 40) _____

A) 68%
B) 50%
C) 95%
D) 99.7%
E) none of these

41) Approximately how many students had test scores with standardized values between -0.675 and 1? 41) _____

A) 107
B) 147
C) 188
D) 85
E) none of these

42) Approximately how many students had test scores with standardized values between -2 and 0.675? 42) _____

A) 85 B) 125 C) 181 D) 204 E) 147

As part of a study on the metabolism of athletes, 400 college basketball players are randomly chosen and their weights taken. The distribution of the weights is approximately normal. The average weight is 215 pounds and the standard deviation is 15 pounds.

43) Approximately how many players had weights with standardized values between 1 and 2? 43) _____

A) 54
B) 200
C) 216
D) 108
E) none of these

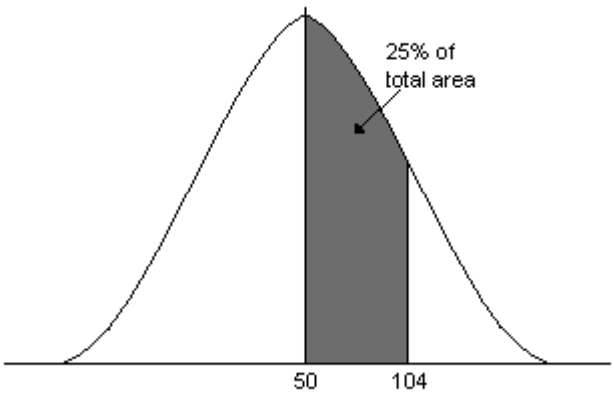
As part of a study, 800 college football players are randomly chosen and their weights taken. The distribution of the weights is approximately normal. The average weight is 235 pounds and the standard deviation is 25 pounds.

44) Approximately how many players had weights with standardized values between 1 and 2? 44) _____

A) 108
B) 216
C) 432
D) 400
E) none of these

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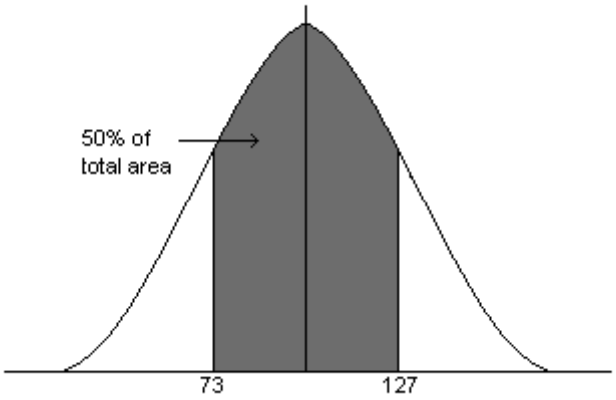
Refer to a normal distribution described by the following figure. The mean is μ and the standard deviation is σ.



45) The value of the first quartile Q_1 = 45) _____

A) –4.
B) 40.
C) 27.
D) 0.
E) none of these

Refer to the following normal curve, with mean μ and standard deviation σ.



46) The standard deviation σ = 46) _____

A) 100
B) 27
C) 40
D) 54
E) none of these

47) The value of the first quartile Q_1 = 47) _____

A) 100
B) 73
C) 127
D) 50
E) none of these

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Answer the question(s) based on the following situation: Over the last 80 years records have been kept of the annual rainfall in the Tasmanian desert. The distribution of annual rainfall is approximately normal and has no outliers. The minimum of 2.5 inches of rain occurred in 1959; the maximum of 9.7 inches of rain occurred in 1938.

48) Two years ago, the annual rainfall was 7.3 inches. The standardized value corresponding to this rainfall is approximately 48) _____

A) 1.
B) –0.5.
C) 0.5.
D) 0.
E) none of these

49) In this part of the world, anything over 8.5 inches of annual rainfall is considered a "wet" year. Of the last 80 years, approximately how many were "wet" ones? 49) _____

A) 2
B) 6
C) 4
D) 16
E) none of these

Answer the question(s) based on the following situation: Over the last 80 years records have been kept of the annual rainfall in the Tasmanian desert. The distribution of annual rainfall is approximately normal and has no outliers. The minimum of 4.5 inches of rain occurred in 1952; the maximum of 11.7 inches of rain occurred in 1934.

50) The standard deviation of the rainfall distribution is approximately 50) _____

A) 7.2 inches.
B) 1.8 inches.
C) 1.2 inches.
D) 3.6 inches.
E) none of these

51) Two years ago, the annual rainfall was 7.5 inches. The standardized value corresponding to this rainfall is approximately 51) _____

A) –0.5.
B) 1.
C) 2.5.
D) 0.
E) none of these

52) The third quartile of the rainfall distribution is approximately 52) _____

A) 8.1 inches.
B) 7.3 inches.
C) 8.9 inches.
D) 7 inches.
E) none of these

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As part of a study, 800 college football players are randomly chosen and their weights taken. The distribution of the weights is approximately normal. The average weight is 235 pounds and the standard deviation is 25 pounds.

53) Of the 800 players approximately how many weighed 210 pounds or less? 53) _____

A) 128
B) 200
C) 544
D) 64
E) none of these

54) Assuming there were no outliers, the range of weights was approximately 54) _____

A) 400 pounds.
B) 200 pounds.
C) 100 pounds.
D) 150 pounds.
E) none of these

55) Approximately how many players weighed over 252 pounds? 55) _____

A) 150
B) 168
C) 128
D) 200
E) none of these

56) Approximately how many players had weights between 235 and 252 pounds? 56) _____

A) 50
B) 37
C) 100
D) 200
E) none of these

Answer the question(s) based on the following situation: For a population of 4000 students taking the SAT math exam, the scores on the exam have an approximately normal distribution with mean $\mu = 610$ and standard deviation $\sigma = 60$.

57) Approximately how many students scored between 490 and 730? 57) _____

A) 3800
B) 2720
C) 3900
D) 3000
E) none of these

Answer the question(s) based on the following situation: For a population of 2000 students taking the SAT math exam, the scores on the exam have an approximately normal distribution with mean $\mu = 590$ and standard deviation $\sigma = 70$.

58) Approximately how many students scored less than 543 points? 58) _____

A) 637
B) 500
C) 750
D) 543
E) none of these

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Answer the question based on the following situation:
An honest coin is tossed 1600 times. The random variable X denotes the total number of heads that come up in the 1600 tosses.

59) What are the chances that X is 800 or less? 59) _____
A) approximately 0%
B) approximately 100%
C) approximately 40%
D) approximately 50%
E) none of these

60) What are the chances that X is between 760 and 840? 60) _____
A) approximately 68%
B) approximately 81.5%
C) approximately 95%
D) approximately 34%
E) none of these

61) What are the chances that X is between 780 and 820? 61) _____
A) approximately 68%
B) approximately 95%
C) approximately 80%
D) approximately 34%
E) none of these

62) What are the chances that X is less than 600? 62) _____
A) approximately 16%
B) approximately 0%
C) approximately 32%
D) approximately 25%
E) none of these

63) What are the chances that X is less than 650? 63) _____
A) approximately 0%
B) approximately 32%
C) approximately 16%
D) approximately 25%
E) none of these

Answer the question(s) based on the following situation: A dishonest coin (landing heads $\frac{2}{5}$ of the time) is tossed 1350 times. The random variable X denotes the total number of heads that come up in the 1350 tosses.

64) What is the interquartile range for this distribution? 64) _____
A) approximately 12.15
B) approximately 24.3
C) approximately 18
D) approximately 30.15
E) none of these

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65) If the standardized value of x is 1.75, then x = 65) _____

A) 571.5
B) 706.5.
C) 541.5.
D) 711.
E) none of these

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Solve the problem.

66) Suppose that one out of every five federal tax returns which are submitted has an error. Out of 10,000 submitted returns, find the probability that there are at most 2000 with an error. 66) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

67) An honest coin is tossed n times. Let the random variable X denote the number of heads tossed. 67) _____

How many tosses n are required to be 97.5% certain that X will be less than $\frac{n}{2} + 20$?

A) 400
B) 800
C) 100
D) 200
E) none of these

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

68) In a survey of 1000 Americans, 850 said that they own a cell phone. Assume that the survey was properly conducted and that the 1000 people surveyed represent an unbiased sample of the entire population. Estimate the standard error for this survey. 68) _____

69) In a survey of 1000 Americans, 850 said that they own a cell phone. Assume that the survey was properly conducted and that the 1000 people surveyed represent an unbiased sample of the entire population. Compute a 95% confidence interval (expressed using percents) for this survey. 69) _____

70) In a survey of 1000 Americans, 850 said that they own a cell phone. Assume that the survey was properly conducted and that the 1000 people surveyed represent an unbiased sample of the entire population. Compute a 99.7% confidence interval (expressed using percents) for this survey. 70) _____

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1) C
2) D
3) A
4) C
5) A
6) C
7) C
8) D
9) D
10) A
11) C
12) C
13) 81 m
14) 34 m
15) A
16) D
17) D
18) D
19) B
20) C
21) A
22) B
23) A
24) A
25) E
26) B
27) B
28) B
29) C
30) A
31) C
32) A
33) B
34) A
35) D
36) C
37) D
38) A
39) D
40) D
41) B
42) C
43) A
44) A
45) A
46) C
47) B
48) A
49) A
50) C

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51) A
52) C
53) A
54) D
55) D
56) D
57) A
58) B
59) D
60) C
61) A
62) B
63) A
64) B
65) A
66) approximately 0.5
67) A
68) ≈ 1.1%
69) 82.8% to 87.2%
70) 81.7% to 88.3%

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