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Import Settings:
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Information Field: Difficulty
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Highest Answer Letter: E
Multiple Keywords in Same Paragraph: No

Chapter: Chapter 2

Multiple Choice

1. A particle travels along a curved path between two points P and Q as shown. The displacement of the particle does *not* depend on



A) the location of P.
B) the location of Q.
C) the distance traveled from P to Q.
D) the shortest distance between P and Q.
E) the direction of Q from P.

Ans: C
Difficulty: Medium
SectionDef: Section 2-1 and 2-2

2. For which one of the following situations will the path length equal the magnitude of the displacement?
A) A toy train is traveling around a circular track.
B) A ball is rolling down an inclined plane.

C) A train travels 5 miles east before it stops. It then travels 2 miles west.
D) A ball rises and falls after being thrown straight up from the earth's surface.
E) A ball on the end of a string is moving in a vertical circle.

Ans: B
Difficulty: Easy
SectionDef: Section 2-1 and 2-2

3. Which one of the physical quantities listed below is *not* correctly paired with its SI unit and dimension?

	Quantity	*Unit*	*Dimension*
A)	velocity	m/s	[L]/[T]
B)	path length	m	[L]
C)	speed	m/s	[L]/[T]
D)	displacement	m/s^2	$[L]/[T]^2$
E)	speed × time	m	[L]

Ans: D
Difficulty: Easy
SectionDef: Section 2-1 and 2-2

4. A car travels in a straight line covering a total distance of 90.0 miles in 60.0 minutes. Which one of the following statements concerning this situation is *necessarily* true?
A) The velocity of the car is constant.
B) The acceleration of the car must be non-zero.
C) The first 45 miles must have been covered in 30.0 minutes.
D) The speed of the car must be 90.0 miles per hour throughout the entire trip.
E) The average velocity of the car is 90.0 miles per hour in the direction of motion.

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Ans: E
Difficulty: Easy
SectionDef: Section 2-1 and 2-2

5. At time $t = 0$ s, an object is observed at $x = 0$ m; and its position along the x axis follows this expression: $x = -4t + t^2$, where the units for distance and time are meters and seconds, respectively. What is the object's displacement Δx between $t = 1.0$ s and $t = 3.0$ s?
A) +16 m
B) –21 m
C) +10 m
D) +2 m
E) –5 m

Ans: A
Difficulty: Medium
SectionDef: Section 2-1 and 2-2

Reference: Ref 2-1

Peter noticed a bug crawling along a meter stick and decided to record the bug's position in five-second intervals. After the bug crawled off the meter stick, Peter created the table shown.

time (s)	position (cm)
0.00	49.6
5.00	39.2
10.0	42.5
15.0	41.0
20.0	65.7

6. What is the displacement of the bug between $t = 0.00$ s and $t = 20.0$ s?
A) +39.9 cm
B) –39.9 cm
C) +65.7 cm
D) –16.1 cm
E) +16.1 cm

Ans: E

Refer To: Ref 2-1
Difficulty: Easy
SectionDef: Section 2-1 and 2-2

7. What is the total distance that the bug traveled between $t = 0.00$ s and $t = 20.0$ s? Assume the bug only changed directions at the end of a five-second interval.
A) 39.9 cm
B) 65.7 cm
C) 16.1 cm
D) 47.1 cm
E) 26.5 cm

Ans: A
Refer To: Ref 2-1
Difficulty: Medium
SectionDef: Section 2-1 and 2-2

8. In the process of delivering mail, a postal worker walks 161 m, due east from his truck. He then turns around and walks 194 m, due west from his truck. What is the worker's displacement relative to his truck?
A) 33 m, due west
B) 33 m, due east
C) 194 m, due west
D) 252 m, due east
E) 355 m, due west

Ans: A
Difficulty: Easy
SectionDef: Section 2-1 and 2-2

9. A Canadian goose flew 845 km from Southern California to Oregon with an average speed of 28.0 m/s. How long, in hours, did it take the goose to make this journey?
A) 27.7 h
B) 8.33 h
C) 66.1 h
D) 7.70 h
E) 8.38 h

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Ans: E
Difficulty: Medium
SectionDef: Section 2-1 and 2-2

10. When the outdoor emergency warning siren at Cheryl's school was tested, the sound from the siren took 7.0 s to reach her house located 2.40 km from the school. What is the speed of sound in air?
A) 240 m/s
B) 340 m/s
C) 440 m/s
D) 540 m/s
E) 640 m/s

Ans: B
Difficulty: Easy
SectionDef: Section 2-1 and 2-2

11. A bus leaves New York City, takes a non-direct route and arrives in St. Louis, Missouri 23 hours, 16 minutes later. If the distance between the two cities is 1250 km, what is the magnitude of the bus' average velocity?
A) 37.2 km/h
B) 41.4 km/h
C) 46.0 km/h
D) 53.7 km/h
E) 58.1 km/h

Ans: D
Difficulty: Easy
SectionDef: Section 2-1 and 2-2

12. Alexa's hair grows with an average speed of 3.5×10^{-9} m/s. How long does it take her hair to grow 0.30 m? Note: 1 yr = 3.156×10^{7} s.
A) 1.9 yr
B) 1.3 yr
C) 0.37 yr
D) 5.4 yr

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E) 2.7 yr

Ans: E
Difficulty: Medium
SectionDef: Section 2-1 and 2-2

13. Carl Lewis set a world record for the 100.0-m run with a time of 9.86 s. If, after reaching the finish line, Mr. Lewis walked directly back to his starting point in 90.9 s, what is the magnitude of his average velocity for the 200.0 m?
A) 0 m/s
B) 1.10 m/s
C) 1.98 m/s
D) 5.60 m/s
E) 10.1 m/s

Ans: A
Difficulty: Hard
SectionDef: Section 2-1 and 2-2

14. During the first 18 minutes of a 1.0-hour trip, a car has an average speed of 11 m/s. What must the average speed of the car be during the last 42 minutes of the trip be if the car is to have an average speed of 21 m/s for the entire trip?
A) 21 m/s
B) 23 m/s
C) 25 m/s
D) 27 m/s
E) 29 m/s

Ans: C
Difficulty: Hard
SectionDef: Section 2-1 and 2-2

15. A turtle takes 3.5 minutes to walk 18 m toward the south along a deserted highway. A truck driver stops and picks up the turtle. The driver takes the turtle to a town 1.1 km to the north with an average speed of 12 m/s. What is the magnitude of the average velocity of the turtle for its entire journey?
A) 3.6 m/s

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B) 9.8 m/s
C) 6.0 m/s
D) 2.6 m/s
E) 11 m/s

Ans: A
Difficulty: Hard
SectionDef: Section 2-1 and 2-2

Reference: Ref 2-2

A racecar, traveling at constant speed, makes one lap around a circular track of radius r in a time t. Note: The circumference of a circle is given by $C = 2\pi r$.

16. When the car has traveled halfway around the track, what is the magnitude of its *displacement* from the starting point?
A) r
B) $2r$
C) πr
D) $2\pi r$
E) zero meters

Ans: B
Refer To: Ref 2-2
Difficulty: Easy
SectionDef: Section 2-1 and 2-2

17. What is the *average speed* of the car for one complete lap?
A) $\frac{r}{t}$
B) $\frac{2r}{t}$
C) $\frac{\pi r}{t}$
D) $\frac{2\pi r}{t}$

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E) zero meters/second

Ans: D
Refer To: Ref 2-2
Difficulty: Medium
SectionDef: Section 2-1 and 2-2

18. Determine the *magnitude* of the *average velocity* of the car for one complete lap.

A) $\frac{r}{t}$

B) $\frac{2r}{t}$

C) $\frac{\pi r}{t}$

D) $\frac{2\pi r}{t}$

E) zero meters/second

Ans: E
Refer To: Ref 2-2
Difficulty: Medium
SectionDef: Section 2-1 and 2-2

19. Which one of the following statements concerning this car is true?
A) The displacement of the car does not change with time.
B) The instantaneous velocity of the car is constant.
C) The average speed of the car is the same over any time interval.
D) The average velocity of the car is the same over any time interval.
E) The average speed of the car over any time interval is equal to the magnitude of the average velocity over the same time interval.

Ans: C
Refer To: Ref 2-2
Difficulty: Medium
SectionDef: Section 2-1 and 2-2

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20. In which one of the following situations does the car have a westward acceleration?
A) The car travels westward at constant speed.
B) The car travels eastward and speeds up.
C) The car travels westward and slows down.
D) The car travels eastward and slows down.
E) The car starts from rest and moves toward the east.

Ans: D
Difficulty: Easy
SectionDef: Section 2-3

21. An elevator is moving upward with a speed of 11 m/s. Three seconds later, the elevator is still moving upward, but its speed has been reduced to 5.0 m/s. What is the average acceleration of the elevator during the 3.0 s interval?
A) 2.0 m/s^2, upward
B) 2.0 m/s^2, downward
C) 5.3 m/s^2, upward
D) 5.3 m/s^2, downward
E) 2.7 m/s^2, downward

Ans: B
Difficulty: Medium
SectionDef: Section 2-3

22. A landing airplane makes contact with the runway with a speed of 75.0 m/s and moves toward the south. After 18.5 seconds, the airplane comes to rest. What is the average acceleration of the airplane during the landing?
A) 2.11 m/s^2, north
B) 2.11 m/s^2, south
C) 4.05 m/s^2, north
D) 4.05 m/s^2, south
E) 14.3 m/s^2, north

Ans: C
Difficulty: Medium
SectionDef: Section 2-3

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23. A pitcher delivers a fast ball with a velocity of 43 m/s to the south. The batter hits the ball and gives it a velocity of 51 m/s to the north. What was the average acceleration of the ball during the 1.0 ms when it was in contact with the bat?
A) 4.3×10^4 m/s^2, south
B) 5.1×10^4 m/s^2, north
C) 9.4×10^4 m/s^2, north
D) 2.2×10^3 m/s^2, south
E) 7.0×10^3 m/s^2, north

Ans: C
Difficulty: Hard
SectionDef: Section 2-3

24. A car is moving at a constant velocity when it is involved in a collision. The car comes to rest after 0.450 s with an average acceleration of 60.0 m/s^2 in the direction opposite that of the car's velocity. What was the speed, in km/h, of the car before the collision?
A) 29.2 km/h
B) 44.8 km/h
C) 97.2 km/h
D) 105 km/h
E) 144 km/h

Ans: C
Difficulty: Medium
SectionDef: Section 2-3

25. A train with a constant velocity of +28.6 m/s approaches a small town . The operator applies the brake, reducing the train's velocity to +11.4 m/s. If the average acceleration of the train during braking is –1.35 m/s^2, for what elapsed time does the operator apply the brake?
A) 8.44 s
B) 12.7 s
C) 3.38 s
D) 5.92 s
E) 10.4 s

Ans: B
Difficulty: Medium
SectionDef: Section 2-3

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26. Which one of the following is *not* a vector quantity?
A) acceleration
B) average speed
C) displacement
D) average velocity
E) instantaneous velocity

Ans: B
Difficulty: Easy
SectionDef: Section 2-4 and Section 2-5

27. In which one of the following cases is the displacement of the object directly proportional to the elapsed time?
A) a ball rolls with constant velocity
B) a ball at rest is given a constant acceleration
C) a ball rolling with velocity $\mathbf{v}_o$ is given a constant acceleration
D) a bead falling through oil experiences a decreasing acceleration
E) a rocket fired from the earth's surface experiences an increasing acceleration

Ans: A
Difficulty: Easy
SectionDef: Section 2-4 and Section 2-5

28. Which one of the following statements must be true if the expression $x = v_0 t + \frac{1}{2} a t^2$ is to be used?
A) x is constant.
B) v is constant.
C) t is constant.
D) a is constant.
E) Both v_0 and t are constant.

Ans: D
Difficulty: Easy
SectionDef: Section 2-4 and Section 2-5

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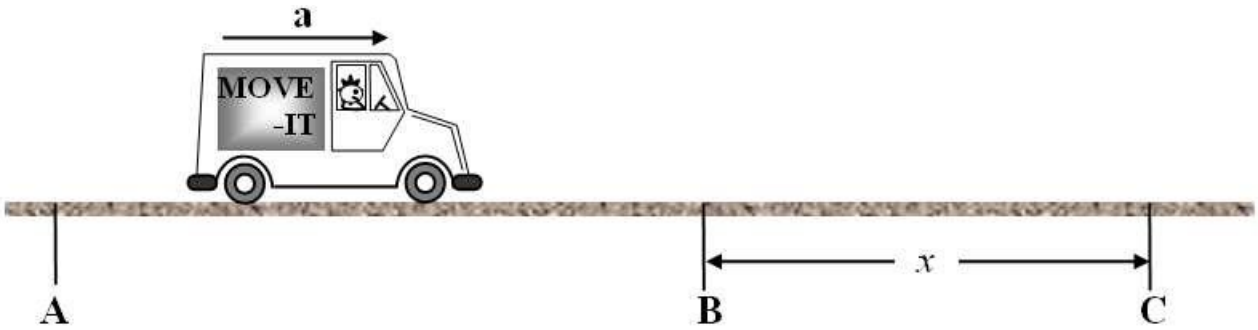
29. Starting from rest, a particle confined to move along a straight line is accelerated at a rate of 5.0 m/s^2. Which one of the following statements accurately describes the motion of this particle?
A) The particle travels 5.0 m during each second.
B) The particle travels 5.0 m *only* during the first second.
C) The speed of the particle increases by 5.0 m/s during each second.
D) The acceleration of the particle increases by 5.0 m/s^2 during each second.
E) The final speed of the particle will be proportional to the distance that the particle covers.

Ans: C
Difficulty: Medium
SectionDef: Section 2-4 and Section 2-5

30. Which one of the following situations is *not* possible?
A) A body has zero velocity and non-zero acceleration.
B) A body travels with a northward velocity and a northward acceleration.
C) A body travels with a northward velocity and a southward acceleration.
D) A body travels with a constant velocity and a time-varying acceleration.
E) A body travels with a constant acceleration and a time-varying velocity.

Ans: D
Difficulty: Medium
SectionDef: Section 2-4 and Section 2-5

31. A truck accelerates from rest at point **A** with constant acceleration of magnitude *a* and, subsequently, passes points **B** and **C** as shown in the figure.



The distance between points **B** and **C** is *x*, and the time required for the truck to travel from **B** to **C** is *t*. Which expression determines the *average speed* of the truck between the points **B** and **C**?

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A) $v^2 = 2ax$

B) $v = \dfrac{x}{t}$

C) $v = xt$

D) $v = \frac{1}{2}at^2$

E) $v = at$

Ans: B
Difficulty: Easy
SectionDef: Section 2-4 and Section 2-5

32. Two objects A and B accelerate from rest with the same constant acceleration. Object A accelerates
for twice as much time as object B, however. Which one of the following statements is true concerning these objects at the end of their respective periods of acceleration?

A) Object A will travel twice as far as object B.
B) Object A will travel four times as far as object B.
C) Object A will travel eight times further than object B.
D) Object A will be moving four times faster than object B.
E) Object A will be moving eight times faster than object B.

Ans: B
Difficulty: Medium
SectionDef: Section 2-4 and Section 2-5

33. Two cars travel along a level highway. It is observed that the distance between the cars is *increasing*. Which one of the following statements concerning this situation is *necessarily* true?

A) The velocity of each car is increasing.
B) At least one of the cars has a *non-zero* acceleration.
C) The leading car has the greater acceleration.
D) The trailing car has the smaller acceleration.
E) Both cars could be accelerating at the same rate.

Ans: E
Difficulty: Hard
SectionDef: Section 2-4 and Section 2-5

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34. A car, starting from rest, accelerates in a straight-line path at a constant rate of 2.0 m/s^2. How far will the car travel in 12 seconds?
A) 180 m
B) 144 m
C) 6 m
D) 24 m
E) 288 m

Ans: B
Difficulty: Easy
SectionDef: Section 2-4 and Section 2-5

35. An object moving along a straight line is decelerating. Which one of the following statements concerning the object's acceleration is *necessarily* true?
A) The value of the acceleration is positive.
B) The direction of the acceleration is in the same direction as the displacement.
C) An object that is decelerating has a negative acceleration.
D) The direction of the acceleration is in the direction opposite to that of the velocity.
E) The acceleration changes as the object moves along the line.

Ans: D
Difficulty: Medium
SectionDef: Section 2-4 and Section 2-5

36. A car starts from rest and accelerates at a constant rate in a straight line. In the *first* second the car moves a distance of 2.0 meters. How fast will the car be moving at the end of the *second* second?
A) 4.0 m/s
B) 16 m/s
C) 2.0 m/s
D) 32 m/s
E) 8.0 m/s

Ans: E
Difficulty: Hard
SectionDef: Section 2-4 and Section 2-5

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37. A car starts from rest and accelerates at a constant rate in a straight line. In the *first* second the car moves a distance of 2.0 meters. How much *additional* distance will the car move during the *second* second of its motion?
A) 2.0 m
B) 4.0 m
C) 6.0 m
D) 8.0 m
E) 13 m

Ans: C
Difficulty: Hard
SectionDef: Section 2-4 and Section 2-5

38. A car is initially traveling at 50.0 km/h. The brakes are applied and the car stops over a distance of 35 m. What was magnitude of the car's acceleration while it was braking?
A) 2.8 m/s^2
B) 5.4 m/s^2
C) 36 m/s^2
D) 71 m/s^2
E) 9.8 m/s^2

Ans: A
Difficulty: Hard
SectionDef: Section 2-4 and Section 2-5

39. The minimum takeoff speed for a certain airplane is 75 m/s. What minimum acceleration is required if the plane must leave a runway of length 1050 m? Assume the plane starts from rest at one end of the runway.
A) 1.5 m/s^2
B) 3.0 m/s^2
C) 4.5 m/s^2
D) 6.0 m/s^2
E) 2.7 m/s^2

Ans: E
Difficulty: Medium
SectionDef: Section 2-4 and Section 2-5

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40. A car traveling along a road begins accelerating with a constant acceleration of 1.5 m/s^2 in the direction of motion. After traveling 392 m at this acceleration, its speed is 35 m/s. Determine the speed of the car when it began accelerating.
A) 1.5 m/s
B) 7.0 m/s
C) 34 m/s
D) 49 m/s
E) 2.3 m/s

Ans: B
Difficulty: Medium
SectionDef: Section 2-4 and Section 2-5

41. A train with a constant speed of 16 m/s passes through a town. After leaving the town, the train accelerates at 0.33 m/s^2 until it reaches a speed of 35 m/s. How far did the train travel while it was accelerating?
A) 0.029 km
B) 0.53 km
C) 1.5 km
D) 2.3 km
E) 3.0 km

Ans: C
Difficulty: Medium
SectionDef: Section 2-4 and Section 2-5

42. A cheetah is walking at a speed of 1.15 m/s when it observes a gazelle 43.0 m directly ahead. If the cheetah accelerates at 9.25 m/s^2, how long does it take the cheetah to reach the gazelle if the gazelle doesn't move?
A) 4.29 s
B) 3.67 s
C) 3.05 s
D) 1.94 s
E) 2.93 s

Ans: E
Difficulty: Hard
SectionDef: Section 2-4 and Section 2-5

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43. A body initially at rest is accelerated at a constant rate for 5.0 seconds in the positive x direction. If the final speed of the body is 20.0 m/s, what was the body's acceleration?
A) 0.25 m/s^2
B) 2.0 m/s^2
C) 4.0 m/s^2
D) 9.8 m/s^2
E) 1.6 m/s^2

Ans: C
Difficulty: Easy
SectionDef: Section 2-4 and Section 2-5

44. A race car has a speed of 80 m/s when the driver releases a drag parachute. If the parachute causes a deceleration of –4 m/s^2, how far will the car travel before it stops?
A) 20 m
B) 200 m
C) 400 m
D) 800 m
E) 1000 m

Ans: D
Difficulty: Medium
SectionDef: Section 2-4 and Section 2-5

45. A car is stopped at a red traffic light. When the light turns to green, the car has a constant acceleration and crosses the 9.10-m intersection in 2.86 s. What is the magnitude of the car's acceleration?
A) 1.77 m/s^2
B) 2.98 m/s^2
C) 2.23 m/s^2
D) 7.36 m/s^2
E) 9.80 m/s^2

Ans: C
Difficulty: Medium
SectionDef: Section 2-4 and Section 2-5

Reference: Ref 2-3

An object starts from rest and accelerates uniformly in a straight line in the positive x direction. After 11 seconds, its speed is 70.0 m/s.

46. Determine the acceleration of the object.
A) +3.5 m/s^2
B) +6.4 m/s^2
C) –3.5 m/s^2
D) –6.4 m/s^2
E) +7.7 m/s^2

Ans: B
Refer To: Ref 2-3
Difficulty: Medium
SectionDef: Section 2-4 and Section 2-5

47. How far does the object travel during the first 11 seconds?
A) 35 m
B) 77 m
C) 390 m
D) 590 m
E) 770 m

Ans: C
Refer To: Ref 2-3
Difficulty: Medium
SectionDef: Section 2-4 and Section 2-5

48. What is the *average velocity* of the object during the first 11 seconds?
A) +3.6 m/s
B) +6.4 m/s
C) +35 m/s

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D) +72 m/s
E) –140 m/s

Ans: C
Refer To: Ref 2-3
Difficulty: Medium
SectionDef: Section 2-4 and Section 2-5

49. Ball A is dropped from rest from a window. At the same instant, ball B is thrown downward; and ball C is thrown upward from the same window. Which statement concerning the balls after their release is necessarily true if air resistance is neglected?
A) At some instant after it is thrown, the acceleration of ball C is zero.
B) All three balls strike the ground at the same time.
C) All three balls have the same velocity at any instant.
D) All three balls have the same acceleration at any instant.
E) All three balls reach the ground with the same velocity.

Ans: D
Difficulty: Medium
SectionDef: Section 2-6

50. A ball is thrown vertically upward from the surface of the earth. Consider the following quantities:
(1) the speed of the ball; (2) the velocity of the ball; (3) the acceleration of the ball.
Which of these is (are) zero when the ball has reached the maximum height?
A) 1 and 2 only
B) 1 and 3 only
C) 1 only
D) 2 only
E) 1, 2, and 3

Ans: A
Difficulty: Easy
SectionDef: Section 2-6

51. A ball is thrown vertically upward from the surface of the earth. The ball rises to some

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maximum height and falls back toward the surface of the earth. Which one of the following statements concerning this situation is true if air resistance is neglected?
A) As the ball rises, its acceleration vector points upward.
B) The ball is a freely falling body for the duration of its flight.
C) The acceleration of the ball is zero when the ball is at its highest point.
D) The speed of the ball is negative while the ball falls back toward the earth.
E) The velocity and acceleration of the ball always point in the same direction.

Ans: B
Difficulty: Medium
SectionDef: Section 2-6

52. A brick is dropped from rest from a height of 4.9 m. How long does it take the brick to reach the ground?
A) 0.6 s
B) 1.0 s
C) 1.2 s
D) 1.4 s
E) 2.0 s

Ans: B
Difficulty: Medium
SectionDef: Section 2-6

53. A ball is dropped from rest from a tower and strikes the ground 110 m below. Approximately how many seconds does it take the ball to strike the ground after being dropped? Neglect air resistance.
A) 2.50 s
B) 3.50 s
C) 4,74 s
D) 12.5 s
E) 16.0 s

Ans: C
Difficulty: Medium
SectionDef: Section 2-6

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54. Water drips from rest from a leaf that is 15 meters above the ground. Neglecting air resistance, what is the speed of each water drop when it hits the ground?
A) 30 m/s
B) 17 m/s
C) 40 m/s
D) 15 m/s
E) 20 m/s

Ans: B
Difficulty: Medium
SectionDef: Section 2-6

55. Ryan throws a tennis ball vertically upward. The ball returns to the point of release after 3.5 s. What is the speed of the ball as it is released?
A) 0 m/s
B) 14 m/s
C) 17 m/s
D) 21 m/s
E) 34 m/s

Ans: C
Difficulty: Medium
SectionDef: Section 2-6

56. A rock is dropped from rest from a height h above the ground. It falls and hits the ground with a speed of 11 m/s. From what height should the rock be dropped so that its speed on hitting the ground is 22 m/s? Neglect air resistance.
A) 1.4h
B) 2.0h
C) 3.0h
D) 4.0h
E) 0.71h

Ans: D
Difficulty: Hard
SectionDef: Section 2-6

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57. A hammer is accidentally dropped from rest down a vertical mine shaft. How long does it take for the rock to reach a depth of 79 m? Neglect air resistance.
A) 2.8 s
B) 9.0 s
C) 8.0 s
D) 4.9 s
E) 4.0 s

Ans: E
Difficulty: Medium
SectionDef: Section 2-6

58. Neglecting air resistance, what maximum height will be reached by an arrow launched straight upward with an initial speed of 35 m/s?
A) 98 m
B) 160 m
C) 41 m
D) 63 m
E) 18 m

Ans: D
Difficulty: Medium
SectionDef: Section 2-6

Reference: Ref 2-4

A ball is shot straight up from the surface of the earth with an initial speed of 19.6 m/s. Neglect any effects due to air resistance.

59. What is the magnitude of the ball's displacement from the starting point after 1.00 second has elapsed?
A) 9.80 m
B) 14.7 m
C) 19.6 m
D) 24.5 m
E) 58.8 m

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Ans: B
Refer To: Ref 2-4
Difficulty: Medium
SectionDef: Section 2-6

60. What maximum height will the ball reach?
A) 9.80 m
B) 14.7 m
C) 19.6 m
D) 24.5 m
E) 58.8 m

Ans: C
Refer To: Ref 2-4
Difficulty: Medium
SectionDef: Section 2-6

61. How much time elapses between the throwing of the ball and its return to the original launch point?
A) 4.00 s
B) 2.00 s
C) 12.0 s
D) 8.00 s
E) 16.0 s

Ans: A
Refer To: Ref 2-4
Difficulty: Hard
SectionDef: Section 2-6

Reference: Ref 2-5

A tennis ball is shot vertically upward in an *evacuated chamber* inside a tower with an initial speed of 20.0 m/s at time $t = 0$ s.

62. How high does the ball rise?
A) 10.2 m
B) 20.4 m
C) 40.8 m
D) 72.4 m
E) 98.0 m

Ans: B
Refer To: Ref 2-5
Difficulty: Medium
SectionDef: Section 2-6

63. Approximately how long does it take the tennis ball to reach its maximum height?
A) 0.50 s
B) 2.04 s
C) 4.08 s
D) 6.08 s
E) 9.80 s

Ans: B
Refer To: Ref 2-5
Difficulty: Hard
SectionDef: Section 2-6

64. Determine the velocity of the ball at $t = 3.00$ seconds.
A) 9.40 m/s, downward
B) 9.40 m/s, upward
C) 29.4 m/s, downward
D) 38.8 m/s, upward
E) 38.8 m/s, downward

Ans: A
Refer To: Ref 2-5
Difficulty: Medium
SectionDef: Section 2-6

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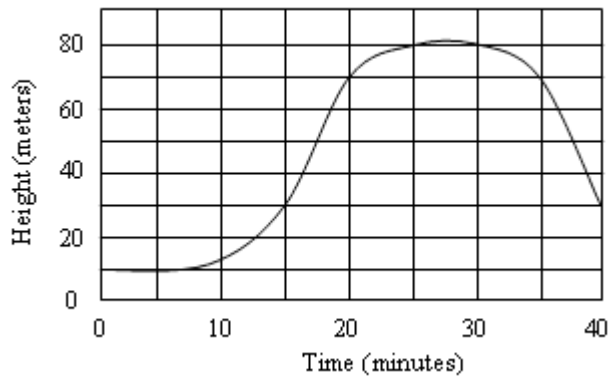
65. What is the magnitude of the acceleration of the ball when it is at its highest point?
A) zero m/s^2
B) 9.80 m/s^2
C) 19.6 m/s^2
D) 4.90 m/s^2
E) 3.13 m/s^2

Ans: B
Refer To: Ref 2-5
Difficulty: Easy
SectionDef: Section 2-6

66. Starting from rest, a particle that is confined to move along a straight line is accelerated at a rate of 5.0 m/s^2. Which statement concerning the *slope* of the *position versus time* graph for this particle is true?
A) The slope has a constant value of 5.0 m/s.
B) The slope has a constant value of 5.0 m/s^2.
C) The slope is both constant and negative.
D) The slope is not constant and *increases* with increasing time.
E) The slope is not constant and *decreases* with increasing time.

Ans: D
Difficulty: Medium
SectionDef: Section 2-7

67. The graph shows the height versus time of an object. Estimate the instantaneous velocity, in m/s, of the object at time t = 15 min.



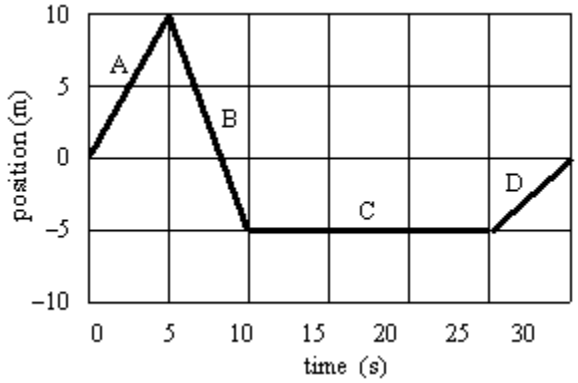
A) 0.90 m/s
B) 0.70 m/s

C) 0.50 m/s
D) 0.30 m/s
E) 0.10 m/s

Ans: E
Difficulty: Medium
SectionDef: Section 2-7

Reference: Ref 2-6

An object is moving along the *x* axis. The graph shows its position from the starting point as a function of time. Various segments of the graph are identified by the letters A, B, C, and D.



68. During which interval(s) is(are) the object moving in the negative x direction?
A) during interval B only
B) during intervals B and C
C) during intervals C and D
D) during intervals B and D
E) during intervals B, C, and D

Ans: A
Refer To: Ref 2-6
Difficulty: Easy
SectionDef: Section 2-7

69. What is the velocity of the object at $t = 7.0$ s?

A) +3.0 m/s
B) –1.0 m/s
C) –2.0 m/s
D) –3.0 m/s
E) zero m/s

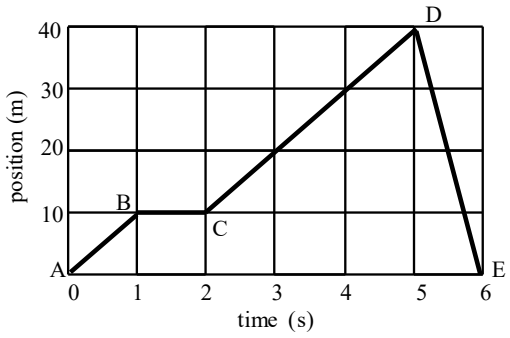
Ans: D
Refer To: Ref 2-6
Difficulty: Medium
SectionDef: Section 2-7

70. What is the acceleration of the object at t = 7.0 s?
A) zero m/s^2
B) –2.0 m/s^2
C) –3.0 m/s^2
D) +9.8 m/s^2
E) +4.0 m/s^2

Ans: A
Refer To: Ref 2-6
Difficulty: Medium
SectionDef: Section 2-7

Reference: Ref 2-7

An object is moving along a straight line. The graph shows the object's position from the starting point as a function of time.



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71. In which segment(s) of the graph does the object's *average velocity* (measured from $t = 0$ s) *decrease* with time?
A) AB only
B) BC only
C) DE only
D) AB and CD
E) BC and DE

Ans: E
Refer To: Ref 2-7
Difficulty: Easy
SectionDef: Section 2-7

72. What was the *instantaneous velocity* of the object at $t = 4$ s?
A) +6 m/s
B) +8 m/s
C) +10 m/s
D) +20 m/s
E) +40 m/s

Ans: C
Refer To: Ref 2-7
Difficulty: Medium
SectionDef: Section 2-7

73. In which segment or segments of the graph does the object have the highest speed?
A) AB
B) BC
C) CD
D) DE
E) AB and CD

Ans: D
Refer To: Ref 2-7
Difficulty: Easy
SectionDef: Section 2-7

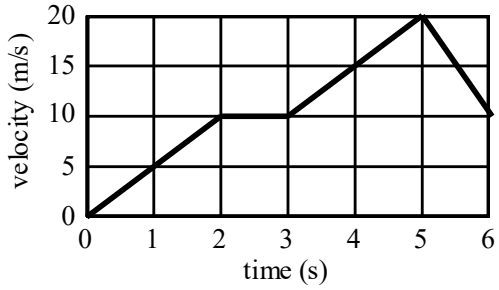
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74. At which time or times does the object reverse its direction of motion?
A) 1 s and 2 s
B) 2 s and 5 s
C) 1 s
D) 2 s
E) 5 s

Ans: E
Refer To: Ref 2-7
Difficulty: Medium
SectionDef: Section 2-7

Reference: Ref 2-8

An object is moving along a straight line. The graph shows the object's velocity as a function of time.



75. During which interval(s) of the graph does the object travel *equal distances* in *equal times*?
A) 0 s to 2 s
B) 2 s to 3 s
C) 3 s to 5 s
D) 0 s to 2 s and 3 s to 5 s
E) 0 s to 2 s, 3 to 5 s, and 5 to 6 s

Ans: B
Refer To: Ref 2-8
Difficulty: Medium
SectionDef: Section 2-7

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76. During which interval(s) of the graph does the speed of the object *increase by equal amounts* in *equal times*?
A) 0 s to 2 s
B) 2 s to 3 s
C) 3 s to 5 s
D) 0 s to 2 s and 3 s to 5 s
E) 0 s to 2 s, 3 to 5 s, and 5 to 6 s

Ans: D
Refer To: Ref 2-8
Difficulty: Hard
SectionDef: Section 2-7

77. How far does the object move in the interval from $t = 0$ to $t = 2$ s?
A) 7.5 m
B) 10 m
C) 15 m
D) 20 m
E) 25 m

Ans: B
Refer To: Ref 2-8
Difficulty: Medium
SectionDef: Section 2-7

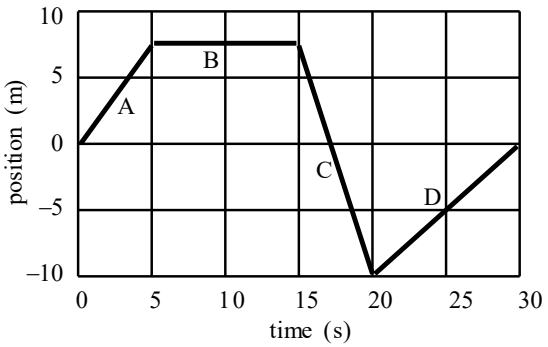
78. What is the acceleration of the object in the interval from $t = 5$ s to $t = 6$ s?
A) -40 m/s^2
B) $+40$ m/s^2
C) -20 m/s^2
D) $+20$ m/s^2
E) -10 m/s^2

Ans: E
Refer To: Ref 2-8
Difficulty: Medium
SectionDef: Section 2-7

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Reference: Ref 2-9

An object is moving along a straight line in the positive *x* direction. The graph shows its position from the starting point as a function of time. Various segments of the graph are identified by the letters A, B, C, and D.



79. Which segment(s) of the graph represent(s) a *constant velocity* of +1.0 m/s?
A) A
B) B
C) C
D) D
E) A and C

Ans: D
Refer To: Ref 2-9
Difficulty: Medium
SectionDef: Section 2-7

80. What was the *instantaneous velocity* of the object at the end of the eighth second?
A) +7.5 m/s
B) +0.94 m/s
C) –0.94 m/s
D) +1.1 m/s
E) zero m/s

Ans: E
Refer To: Ref 2-9
Difficulty: Easy

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SectionDef: Section 2-7

81. During which interval(s) did the object move in the negative x direction?
A) only during interval B
B) only during interval C
C) only during interval D
D) during both intervals C and D
E) The object never moved in the negative x direction.

Ans: B
Refer To: Ref 2-9
Difficulty: Easy
SectionDef: Section 2-7

82. The rate at which the acceleration of an object changes with time is called a *jerk*. What is the dimension of the jerk?
A) $\frac{[L]}{[T]}$
B) $\frac{[L]}{[T]^2}$
C) $\frac{[L]^2}{[T]^2}$
D) $\frac{[L]}{[T]^3}$
E) $\frac{[L]^2}{[T]^3}$

Ans: D
Difficulty: Medium
SectionDef: Additional Problems

83. In a race, Marcos runs 1.00 mile in 4.02 min, mounts a bicycle, and rides back to his starting point, which is also the finish line, in 3.02 min. What is the magnitude of Marcos' average velocity for the race?

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A) zero mi/h
B) 12.1 mi/h
C) 14.9 mi/h
D) 17.0 mi/h
E) 19.9 mi/h

Ans: A
Difficulty: Medium
SectionDef: Additional Problems

Reference: Ref 2-10

A automotive test driver travels due north in a prototype hybrid vehicle at 30 mi/h for 2 hours. She then reverses her direction and travels due south at 60 mi/h for 1 hour.

84. What is the average speed of the vehicle?
A) zero mi/h
B) 30 mi/h
C) 40 mi/h
D) 50 mi/h
E) 60 mi/h

Ans: C
Refer To: Ref 2-10
Difficulty: Medium
SectionDef: Additional Problems

85. What is the average velocity of the vehicle?
A) zero mi/h
B) 40 mi/h, north
C) 40 mi/h, south
D) 45 mi/h, north
E) 45 mi/h, south

Ans: A
Refer To: Ref 2-10
Difficulty: Hard

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SectionDef: Additional Problems

Reference: Ref 2-11

Starting from rest, a particle confined to move along a straight line is accelerated at a rate of 4 m/s^2.

86. Which statement accurately describes the motion of the particle?
A) The particle travels 4 meters during each second.
B) The particle travels 4 meters during the first second only.
C) The speed of the particle increases by 4 m/s during each second.
D) The acceleration of the particle increases by 4 m/s^2 during each second.
E) The final velocity of the particle will be proportional to the distance that the particle covers.

Ans: C
Refer To: Ref 2-11
Difficulty: Easy
SectionDef: Additional Problems

87. After 10 seconds, how far will the particle have traveled?
A) 20 m
B) 40 m
C) 100 m
D) 200 m
E) 400 m

Ans: D
Refer To: Ref 2-11
Difficulty: Medium
SectionDef: Additional Problems

88. What is the speed of the particle after it has traveled 8 m?
A) 4 m/s
B) 8 m/s

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C) 30 m/s
D) 60 m/s
E) 100 m/s

Ans: B
Refer To: Ref 2-11
Difficulty: Medium
SectionDef: Additional Problems

Reference: Ref 2-12

A rock, dropped from rest near the surface of an atmosphere-free planet, attains a speed of 20.0 m/s after falling 8.0 meters.

89. What is the magnitude of the acceleration due to gravity on the surface of this planet?
A) 0.40 m/s^2
B) 1.3 m/s^2
C) 2.5 m/s^2
D) 25 m/s^2
E) 160 m/s^2

Ans: D
Refer To: Ref 2-12
Difficulty: Medium
SectionDef: Additional Problems

90. How long did it take the object to fall the 8.0 meters mentioned?
A) 0.40 s
B) 0.80 s
C) 1.3 s
D) 2.5 s
E) 16 s

Ans: B
Refer To: Ref 2-12
Difficulty: Medium
SectionDef: Additional Problems

91. How long would it take the object, falling from rest, to fall 16 m on this planet?
A) 0.8 s
B) 1.1 s
C) 2.5 s
D) 3.5 s
E) 22 s

Ans: B
Refer To: Ref 2-12
Difficulty: Medium
SectionDef: Additional Problems

92. Determine the speed of the object after falling from rest through 16 m on this planet.
A) 28 m/s
B) 32 m/s
C) 56 m/s
D) 64 m/s
E) 320 m/s

Ans: A
Refer To: Ref 2-12
Difficulty: Medium
SectionDef: Additional Problems

Reference: Ref 2-13

A brass ball is shot vertically upward from the surface of an atmosphere-free planet with an initial speed of 20.0 m/s. One second later, the ball has an instantaneous velocity in the upward direction of 15.0 m/s.

93. What is the magnitude of the acceleration due to gravity on the surface of this planet?
A) 5.0 m/s^2
B) 9.8 m/s^2

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C) 12 m/s^2
D) 15 m/s^2
E) 24 m/s^2

Ans: A
Refer To: Ref 2-13
Difficulty: Medium
SectionDef: Additional Problems

94. How long does it take the ball to reach its maximum height?
A) 2.0 s
B) 2.3 s
C) 4.0 s
D) 4.6 s
E) 8.0 s

Ans: C
Refer To: Ref 2-13
Difficulty: Hard
SectionDef: Additional Problems

95. How high does the ball rise?
A) 70.0 m
B) 10.0 m
C) 50.0 m
D) 20.0 m
E) 40.0 m

Ans: E
Refer To: Ref 2-13
Difficulty: Hard
SectionDef: Additional Problems

96. Determine the velocity of the ball when it returns to its original position. **Note**: assume the upward direction is positive.
A) +20 m/s
B) –20 m/s

C) +40 m/s
D) –40 m/s
E) zero m/s

Ans: B
Refer To: Ref 2-13
Difficulty: Hard
SectionDef: Additional Problems

97. How long is the ball in the air when it returns to its original position?
A) 4.0 s
B) 4.6 s
C) 8.0 s
D) 9.2 s
E) 16 s

Ans: C
Refer To: Ref 2-13
Difficulty: Medium
SectionDef: Additional Problems

Reference: Ref 2-14

A small object is released from rest and falls 1.00×10^2 feet near the surface of the earth. Neglect air resistance.

98. How long will it take to fall through the 1.00×10^2 feet mentioned?
A) 2.49 s
B) 3.12 s
C) 4.50 s
D) 6.25 s
E) 10.0 s

Ans: A
Refer To: Ref 2-14
Difficulty: Medium
SectionDef: Additional Problems

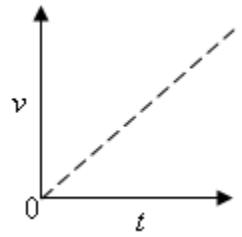
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99. Approximately how fast will the object be moving after falling through the 1.00×10^2 feet mentioned?
A) 9.8 ft/s
B) 40 ft/s
C) 80 ft/s
D) 160 ft/s
E) 320 ft/s

Ans: C
Refer To: Ref 2-14
Difficulty: Medium
SectionDef: Additional Problems

Reference: Ref 2-15

The figure shows the speed as a function of time for an object in free fall near the surface of the earth.



The object was dropped from rest in a long evacuated cylinder.

100. Which one of the following statements best explains why the graph goes through the origin?
A) The object was in a vacuum.
B) The object was dropped from rest.
C) The velocity of the object was constant.
D) All *v* vs. *t* curves pass through the origin.
E) The acceleration of the object was constant.

Ans: B
Refer To: Ref 2-15
Difficulty: Hard

SectionDef: Additional Problems

101. What is the numerical value of the slope of the line?
A) 1.0 m/s^2
B) 2.0 m/s^2
C) 7.7 m/s^2
D) 9.8 m/s^2
E) This cannot be determined from the information given since the speed and time values are unknown.

Ans: D
Refer To: Ref 2-15
Difficulty: Hard
SectionDef: Additional Problems

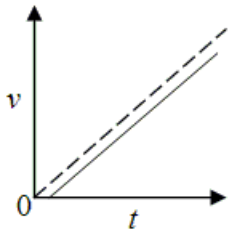
102. What is the speed of the object 3.0 seconds after it is dropped?
A) 3.0 m/s
B) 7.7 m/s
C) 9.8 m/s
D) 29 m/s
E) This cannot be determined since there is no specified value of height.

Ans: D
Refer To: Ref 2-15
Difficulty: Hard
SectionDef: Additional Problems

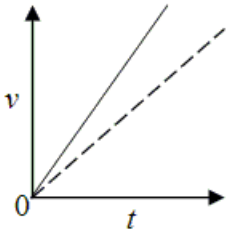
103. If the same object were released in air, the magnitude of its acceleration would begin at the free-fall value, but it would decrease continuously to zero as the object continued to fall. For which one of the choices given does the solid line best represent the speed of the object as a function of time when it is dropped from rest in air?
Note: The dashed line shows the free-fall under vacuum graph for comparison.

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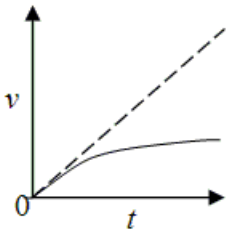
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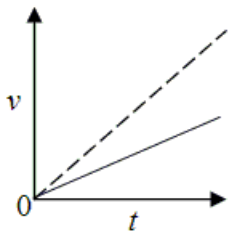
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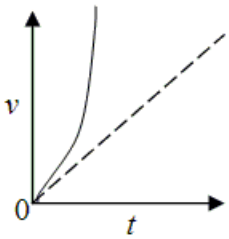
(e)



(b)



(d)



A) a
B) b
C) c
D) d
E) e

Ans: E
Refer To: Ref 2-15
Difficulty: Hard
SectionDef: Additional Problems