Intermediate Algebra with Applications and Visualization 3rd edition Rockswold Solutions Manual

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Chapter 2: Linear Equations and Inequalities

Section 2.1 Introduction to Equations

1. solution
2. true
3. false
4. solution set
5. solutions
6. Equivalent
7. $b+c$
8. subtraction
9. bc
10. division
11. equivalent
12. given
13. 22
14. $-\frac{1}{6}$
15. 3
16. $\frac{1}{4}$
17. $x+5=0 \Rightarrow x+5-5=0-5 \Rightarrow x+0=-5 \Rightarrow x=-5$; To check your answer, substitute -5 for x in the original equation, $-5+5=0$. This statement is true. Thus, the solution $x=-5$ is correct.
18. $x+3=7 \Rightarrow x+3-3=7-3 \Rightarrow x+0=4 \Rightarrow x=4$; To check your answer, substitute 4 for x in the original equation, $4+3=7$. This statement is true. Thus, the solution $x=4$ is correct.
19. $a-12=-3 \Rightarrow a-12+12=-3+12 \Rightarrow a+0=9 \Rightarrow a=9$
20. $a-19=-11 \Rightarrow a-19+19=-11+19 \Rightarrow a+0=8 \Rightarrow a=8$
21. $9=y-8 \Rightarrow 9+8=y-8+8 \Rightarrow 17=y+0 \Rightarrow 17=y \Rightarrow y=17$
22. $97=-23+y \Rightarrow 97+23=23+(-23)+y \Rightarrow 120=0+y \Rightarrow y=120$
23. $\frac{1}{5}=z-\frac{3}{2} \Rightarrow \frac{1}{5}+\frac{3}{2}=z-\frac{3}{2}+\frac{3}{2} \Rightarrow \frac{17}{10}=z+0 \Rightarrow \frac{17}{10}=z \Rightarrow z=\frac{17}{10}$
24. $\frac{3}{4}+z=-\frac{1}{2} \Rightarrow \frac{3}{4}+\left(-\frac{3}{4}\right)+z=-\frac{1}{2}+\left(-\frac{3}{4}\right) \Rightarrow 0+z=-\frac{5}{4} \Rightarrow z=-\frac{5}{4}$
25. $t-0.8=4.3 \Rightarrow t-0.8+0.8=4.3+0.8 \Rightarrow t+0=5.1 \Rightarrow t=5.1$
26. $y-1.23=-0.02 \Rightarrow y-1.23+1.23=-0.02+1.23 \Rightarrow y+0=1.21 \Rightarrow y=1.21$

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27. $4+x=1 \Rightarrow 4-4+x=1-4 \Rightarrow 0+x=-3 \Rightarrow x=-3$

28. $16+x=-2 \Rightarrow 16-16+x=-2-16 \Rightarrow 0+x=-18 \Rightarrow x=-18$

29. $1=\frac{1}{3}+y \Rightarrow 1-\frac{1}{3}=\frac{1}{3}-\frac{1}{3}+y \Rightarrow \frac{2}{3}=0+y \Rightarrow \frac{2}{3}=y \Rightarrow y=\frac{2}{3}$

30. $\frac{7}{2}=-2+y \Rightarrow \frac{7}{2}+2=-2+2+y \Rightarrow \frac{11}{2}=0+y \Rightarrow \frac{11}{2}=y \Rightarrow y=\frac{11}{2}$

31. a

32. a

33. $\frac{1}{5}$

34. $\frac{3}{4}$

35. 6

36. 0.2

37. $5x=15 \Rightarrow \frac{5x}{5}=\frac{15}{5} \Rightarrow x=3$

38. $-2x=8 \Rightarrow \frac{-2x}{-2}=\frac{8}{-2} \Rightarrow x=-4$

39. $-7x=0 \Rightarrow \frac{-7x}{-7}=\frac{0}{-7} \Rightarrow x=0$

40. $25x=0 \Rightarrow \frac{25x}{25}=\frac{0}{25} \Rightarrow x=0$

41. $-35=-5a \Rightarrow \frac{-35}{-5}=\frac{-5a}{-5} \Rightarrow 7=a \Rightarrow a=7$

42. $-32=-4a \Rightarrow \frac{-32}{-4}=\frac{-4a}{-4} \Rightarrow 8=a \Rightarrow a=8$

43. $-18=3a \Rightarrow \frac{-18}{3}=\frac{3a}{3} \Rightarrow -6=a \Rightarrow a=-6$

44. $-70=10a \Rightarrow \frac{-70}{10}=\frac{10a}{10} \Rightarrow -7=a \Rightarrow a=-7$

45. $\frac{1}{2}x=\frac{3}{2} \Rightarrow \frac{2}{1}\cdot\frac{1}{2}x=\frac{3}{2}\cdot\frac{2}{1} \Rightarrow x=3$

46. $\frac{3}{4}x=\frac{5}{8} \Rightarrow \frac{4}{3}\cdot\frac{3}{4}x=\frac{5}{8}\cdot\frac{4}{3} \Rightarrow x=\frac{5}{6}$

47. $\frac{1}{2}=\frac{2}{5}z \Rightarrow \frac{5}{2}\cdot\frac{1}{2}=\frac{5}{2}\cdot\frac{2}{5}z \Rightarrow \frac{5}{4}=z \Rightarrow z=\frac{5}{4}$

48. $-\frac{3}{4}=-\frac{1}{8}z \Rightarrow -\frac{3}{4}\cdot\left(-\frac{8}{1}\right)=-\frac{8}{1}\cdot\left(-\frac{1}{8}\right)z \Rightarrow 6=z \Rightarrow z=6$

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49. $0.5t = 3.5 \Rightarrow \frac{0.5t}{0.5} = \frac{3.5}{0.5} \Rightarrow t = 7$

50. $2.2t = -9.9 \Rightarrow \frac{2.2t}{2.2} = \frac{-9.9}{2.2} \Rightarrow t = -\frac{9.9}{2.2} \Rightarrow t = -4.5$

51. $-1.7 = 0.2x \Rightarrow \frac{-1.7}{0.2} = \frac{0.2x}{0.2} \Rightarrow -8.5 = x \Rightarrow x = -8.5$

52. $6.4 = 1.6x \Rightarrow \frac{6.4}{1.6} = \frac{1.6x}{1.6} \Rightarrow 4 = x \Rightarrow x = 4$

53. *a*

54. *a*

55. (a) See Figure 55.

(b) Let R represent total rainfall and let x represent the number of hours past noon. Start with 3 inches of rain and then add $\frac{1}{2}$, or 0.5, inches per hour after noon,

$3 + 0.5x = R$, or equivalently $R = 0.5x + 3$.

(c) At 3 pm, $x = 3$. Substituting x with 3 in the formula, $R = 0.5 \cdot 3 + 3 \Rightarrow R = 4.5$ inches. This answer agrees with the table from part (a).

(d) At 2:15 pm, $x = 2.25$. Substituting x with 2.25 in the formula,

$R = 0.5 \cdot 2.25 + 3 \Rightarrow R = 4.125$ inches.

Hours (x)	0	1	2	3	4	5	6
Rainfall (R)	3	3.5	4	4.5	5	5.5	6

Figure 55

Hours (x)	0	1	2	3	4	5	6	7
Temp. (T)	0	10	20	30	40	50	60	70

Figure 56

56. (a) See Figure 56.

(b) Let T represent the temperature and let x represent the number of hours past midnight. Since the temperature increases 10°F per hour, $T = 10x$.

(c) At 5 am, $x = 5$. Substituting x with 5 in the formula, $T = 10 \cdot 5 \Rightarrow T = 50°\text{F}$. This agrees with the table from part (a).

(d) At 2:45 am, $x = 2.75$. Substituting x with 2.75 in the formula, $T = 10 \cdot 2.75 \Rightarrow T = 27.5°\text{F}$.

57. (a) Let L be the length of the football fields and x be the number of fields. Because each field x contains 300 feet, $L = 300x$.

(b) Substitute L with 870. Then $870 = 300x$.

(c) $870 = 300x \Rightarrow \frac{870}{300} = \frac{300x}{300} \Rightarrow x = \frac{870}{300} \Rightarrow x = 2.9$

58. (a) Let A represent the number of acres and let S represent the number of square feet. Because each acre contains 43,560 square feet, let $S = 43,560A$.

(b) Substitute S with 871,200. Then, $871,200 = 43,560A$.

(c) $871,200 = 43,560A \Rightarrow \frac{871,200}{43,560} = \frac{43,560A}{43,560} \Rightarrow A = \frac{871,200}{43,560} \Rightarrow A = 20$

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59. The formula for this scenario is $T = 0.3x$ where x is in days and T is in millions. To find the number of days needed for Twitter to add 15 million new accounts, replace the variable T in the formula with 15. $T = 0.3x \Rightarrow 15 = 0.3x \Rightarrow \frac{15}{0.3} = \frac{0.3x}{0.3} \Rightarrow 50 = x$ At this rate it takes 50 days to add 15 million accounts.

60. The formula for this scenario is $W = 14{,}000x$ where x is in days and W is the number of visitors. To find the number of days for the Web site to add 98,000 new visitors, replace the variable W in the formula with 98,000. $W = 14{,}000x \Rightarrow 98{,}000 = 14{,}000x \Rightarrow \frac{98{,}000}{14{,}000} = \frac{14{,}000x}{14{,}000} \Rightarrow 7 = x$ At this rate it takes 7 days to add 98,000 new visitors.

61. a) The latitude of Winnipeg to the nearest degree is 50° N

b) The sun at the equator will be approximately $\frac{325}{57} \approx 5.7$ times as intense as they are in Winnipeg on March 21st.

62. a) The latitude of Columbus, Ohio to the nearest degree is 40° N

b) The sun in Limon, Costa Rica will be approximately $\frac{275}{199} \approx 1.4$ times as intense as they are in Columbus on June 21st.

63. Let x represent the cost of the car to obtain the equation $0.07x = 1750$. Then the solution is $\frac{0.07x}{0.07} = \frac{1750}{0.07} \Rightarrow x = \frac{1750}{0.07} \Rightarrow x = 25{,}000$. Thus, the cost of the car is \$25,000.

64. Let S represent the employee's current salary to obtain the equation $1.06S = 58{,}300$. Then the solution is $\frac{1.06S}{1.06} = \frac{58{,}300}{1.06} \Rightarrow S = \frac{58{,}300}{1.06} \Rightarrow S = 55{,}000$. Thus, the employee's current salary is \$55,000.

Section 2.2 Linear Equations

1. constant
2. $ax + b = 0$
3. Exactly one
4. numerically
5. addition, multiplication
6. LCD
7. None
8. Infinitely many
9. $3x - 7 = 0$ is a linear equation. $a = 3$ and $b = -7$.

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10. $-2x+1=4$ is a linear equation. $-2x+1=4 \Rightarrow -2x+1-4=4-4 \Rightarrow -2x-3=0.$

$a=-2$ and $b=-3.$

11. $\frac{1}{2}x=0$ is a linear equation. $a=\frac{1}{2}$ and $b=0.$

12. $-\frac{3}{4}x=0$ is a linear equation. $a=-\frac{3}{4}$ and $b=0.$

13. $4x^2-6=11$ is not a linear equation because it cannot be written in the form $ax+b=0.$ It has a non-zero term containing $x^2.$

14. $-2x^2+x=4$ is not a linear equation because it cannot be written in the form $ax+b=0.$ It has a non-zero term containing $x^2.$

15. $\frac{6}{x}-4=2$ is not a linear equation because it cannot be written in the form $ax+b=0.$ It has the variable x in the denominator.

16. $2\sqrt{x}-1=0$ is not a linear equation because it cannot be written in the form $ax+b=0.$ It has a non-zero term containing $\sqrt{x}.$

17. $1.1x+0.9=1.8$ is a linear equation.
$1.1x+0.9=1.8 \Rightarrow 1.1x+0.9-1.8=1.8-1.8 \Rightarrow 1.1x-0.9=0.$ $a=1.1$ and $b=-0.9.$

18. $-5.7x-3.4=-6.8$ is a linear equation.
$-5.7x-3.4=6.8 \Rightarrow -5.7x-3.4+6.8=-6.8+6.8 \Rightarrow -5.7x+3.4=0.$ $a=-5.7$ and $b=3.4.$

19. $2(x-3)=0$ is a linear equation. Use the distributive property to obtain

$2x-6=0.$ $a=2$ and $b=-6.$

20. $\frac{1}{2}(x+4)=0$ is a linear equation. Use the distributive property to obtain

$\frac{1}{2}x+2=0.$ $a=\frac{1}{2}$ and $b=2.$

21. $|3x|+2=1$ is not a linear equation because it cannot be written in the form $ax+b=0.$ It has a non-zero term containing $|x|.$

22. $3x=4x^3$ is not a linear equation because it cannot be written in the form $ax+b=0.$ It has a non-zero term containing $x^3.$

23. For $x=-1,$ substitute -1 for x and solve: $-1-3=-4.$

For $x=0,$ substitute 0 for x and solve: $0-3=-3.$

For $x=1,$ substitute 1 for x and solve: $1-3=-2.$

For $x=2,$ substitute 2 for x and solve: $2-3=-1.$

For $x=3,$ substitute 3 for x and solve: $3-3=0.$

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See Figure 23. From the table, we see that the equation $x-3=-1$ is true when $x=2$. Therefore, the solution to the equation $x-3=-1$ is $x=2$.

x	−1	0	1	2	3
$x-3$	−4	−3	−2	−1	0

Figure 23

x	-2	-1	0	1	2
$-2x$	4	2	0	-2	-4

Figure 24

24. For $x=-2$, substitute -2 for x and solve: $-2(-2)=4$.

For $x=-1$, substitute -1 for x and solve: $-2(-1)=2$.

For $x=0$, substitute 0 for x and solve: $-2(0)=0$.

For $x=1$, substitute 1 for x and solve: $-2(1)=-2$.

For $x=2$, substitute 2 for x and solve: $-2(2)+7=-4$.

See Figure 24. From the table, we see that the equation $-2x=0$ is true when $x=0$. Therefore, the solution to the equation $-2x=0$ is $x=0$.

25. For $x=0$, substitute 0 for x and solve: $-3(0)+7=0+7=7$.

For $x=1$, substitute 1 for x and solve: $-3(1)+7=-3+7=4$.

For $x=2$, substitute 2 for x and solve: $-3(2)+7=-6+7=1$.

For $x=3$, substitute 3 for x and solve: $-3(3)+7=-9+7=-2$.

For $x=4$, substitute 4 for x and solve: $-3(4)+7=-12+7=-5$.

See Figure 25. From the table, we see that the equation $-3x+7=1$ is true when $x=2$. Therefore, the solution to the equation $-3x+7=1$ is $x=2$.

x	0	1	2	3	4
$-3x+7$	7	4	1	−2	−5

Figure 25

x	−1	0	1	2	3
$5x-2$	−7	−2	3	8	13

Figure 26

26. For $x=-1$, substitute -1 for x and solve: $5(-1)-2=-5-2=-7$.

For $x=0$, substitute 0 for x and solve: $5(0)-2=0-2=-2$.

For $x=1$, substitute 1 for x and solve: $5(1)-2=5-2=3$.

For $x=2$, substitute 2 for x and solve: $5(2)-2=10-2=8$.

For $x=3$, substitute 3 for x and solve: $5(3)-2=15-2=13$.

See Figure 26. From the table, we see that the equation $5x-2=3$ is true when $x=1$. Therefore, the solution to the equation $5x-2=3$ is $x=1$.

27. For $x=-2$, substitute -2 for x and solve: $4-2(-2)=4+4=8$.

For $x=-1$, substitute -1 for x and solve: $4-2(-1)=4+2=6$.

For $x=0$, substitute 0 for x and solve: $4-2(0)=4-0=4$.

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For $x = 1$, substitute 1 for x and solve: $4 - 2(1) = 4 - 2 = 2$.

For $x = 2$, substitute 2 for x and solve: $4 - 2(2) = 4 - 4 = 0$.

See Figure 27. From the table, we see that the equation $4 - 2x = 6$ is true when $x = -1$. Therefore, the solution to the equation $4 - 2x = 6$ is $x = -1$.

x	-2	-1	0	1	2
$4 - 2x$	8	6	4	2	0

Figure 27

x	-2	-1	0	1	2
$9 - (x + 3)$	8	7	6	5	4

Figure 28

28. For $x = -2$, substitute -2 for x and solve: $9 - (-2 + 3) = 9 - 1 = 8$.

For $x = -1$, substitute -1 for x and solve: $9 - (-1 + 3) = 9 - 2 = 7$.

For $x = 0$, substitute 0 for x and solve: $9 - (0 + 3) = 9 - 3 = 6$.

For $x = 1$, substitute 1 for x and solve: $9 - (1 + 3) = 9 - 4 = 5$.

For $x = 2$, substitute 2 for x and solve: $9 - (2 + 3) = 9 - 5 = 4$.

See Figure 28. From the table, we see that the equation $9 - (x + 3) = 4$ is true when $x = 2$.

Therefore, the solution to the equation $9 - (x + 3) = 4$ is $x = 2$.

29. $11x = 3 \Rightarrow \frac{11x}{11} = \frac{3}{11} \Rightarrow x = \frac{3}{11}$

30. $-5x = 15 \Rightarrow \frac{-5x}{-5} = \frac{15}{-5} \Rightarrow x = -3$

31. $x - 18 = 5 \Rightarrow x - 18 + 18 = 5 + 18 \Rightarrow x = 23$

32. $8 = 5 + 3x \Rightarrow 8 - 5 = 5 - 5 + 3x \Rightarrow 3 = 3x \Rightarrow \frac{3}{3} = \frac{3x}{3} \Rightarrow 1 = x \Rightarrow x = 1$

33. $\frac{1}{2}x - 1 = 13 \Rightarrow \frac{1}{2}x - 1 + 1 = 13 + 1 \Rightarrow \frac{1}{2}x = 14 \Rightarrow 2 \cdot \frac{1x}{2} = 2 \cdot 14 \Rightarrow x = 28$

34. $\frac{1}{4}x + 3 = 9 \Rightarrow \frac{1}{4}x + 3 - 3 = 9 - 3 \Rightarrow \frac{1}{4}x = 6 \Rightarrow 4 \cdot \frac{1x}{4} = 4 \cdot 6 \Rightarrow x = 24$

35. $-6 = 5x + 5 \Rightarrow -6 - 5 = 5x + 5 - 5 \Rightarrow -11 = 5x \Rightarrow \frac{-11}{5} = \frac{5x}{5} \Rightarrow x = -\frac{11}{5}$

36. $31 = -7x - 4 \Rightarrow 31 + 4 = -7x - 4 + 4 \Rightarrow 35 = -7x \Rightarrow \frac{35}{-7} = \frac{-7x}{-7} \Rightarrow x = -5$

37. $3z + 2 = z - 5 \Rightarrow 3z + 2 - 2 = z - 5 - 2 \Rightarrow 3z = z - 7 \Rightarrow 3z - z = z - z - 7 \Rightarrow 2z = -7 \Rightarrow$

$\frac{2z}{2} = \frac{-7}{2} \Rightarrow z = -\frac{7}{2}$

38. $z - 5 = 5z - 3 \Rightarrow z - 5 + 5 = 5z - 3 + 5 \Rightarrow z = 5z + 2 \Rightarrow z - 5z = 5z - 5z + 2 \Rightarrow -4z = 2 \Rightarrow$

$\frac{-4z}{-4} = \frac{2}{-4} \Rightarrow z = -\frac{1}{2}$

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39. $12y-6=33-y \Rightarrow 12y-6+6=33+6-y \Rightarrow 12y=39-y \Rightarrow 12y+y=39-y+y \Rightarrow$

$13y=39 \Rightarrow \frac{13y}{13}=\frac{39}{13} \Rightarrow y=3$

40. $-13y+2=22-3y \Rightarrow -13y+2-2=22-2-3y \Rightarrow -13y=20-3y \Rightarrow$

$-13y+3y=20-3y+3y \Rightarrow -10y=20 \Rightarrow \frac{-10y}{-10}=\frac{20}{-10} \Rightarrow y=-2$

41. $4(x-1)=5 \Rightarrow 4x-4=5 \Rightarrow 4x-4+4=5+4 \Rightarrow 4x=9 \Rightarrow \frac{4x}{4}=\frac{9}{4} \Rightarrow x=\frac{9}{4}$

42. $-2(2x+7)=1 \Rightarrow -4x-14=1 \Rightarrow -4x-14+14=1+14 \Rightarrow -4x=15 \Rightarrow \frac{-4x}{-4}=\frac{15}{-4} \Rightarrow x=-\frac{15}{4}$

43. $1-(3x+1)=5-x \Rightarrow 1-3x-1=5-x \Rightarrow -3x=5-x \Rightarrow -3x+x=5-x+x \Rightarrow$

$-2x=5 \Rightarrow \frac{-2x}{-2}=\frac{5}{-2} \Rightarrow x=-\frac{5}{2}$

44. $6+2(x-7)=10-3(x-3) \Rightarrow 6+2x-14=10-3x+9 \Rightarrow 2x-8=19-3x \Rightarrow$

$2x+3x-8=19-3x+3x \Rightarrow 5x-8=19 \Rightarrow 5x-8+8=19+8 \Rightarrow 5x=27 \Rightarrow \frac{5x}{5}=\frac{27}{5} \Rightarrow x=\frac{27}{5}$

45. $(5t-6)=2(t+1)+2 \Rightarrow 5t-6=2t+2+2 \Rightarrow 5t-6=2t+4 \Rightarrow 5t-2t-6+6=2t-2t+6+4 \Rightarrow$

$3t=10 \Rightarrow \frac{3t}{3}=\frac{10}{3} \Rightarrow t=\frac{10}{3}$

46. $-2(t-7)-(t+5)=5 \Rightarrow -2t+14-t-5=5 \Rightarrow -3t+9=5 \Rightarrow -3t+9-9=5-9 \Rightarrow$

$-3t=-4 \Rightarrow \frac{-3t}{-3}=\frac{-4}{-3} \Rightarrow t=\frac{4}{3}$

47. $3(4z-1)-2(z+2)=2(z+1) \Rightarrow 12z-3-2z-4=2z+2 \Rightarrow 10z-7=2z+2 \Rightarrow$

$10z-7+7=2z+2+7 \Rightarrow 10z=2z+9 \Rightarrow 10z-2z=2z-2z+9 \Rightarrow 8z=9 \Rightarrow \frac{8z}{8}=\frac{9}{8} \Rightarrow z=\frac{9}{8}$

48. $-(z+4)+(3z+1)=-2(z+1) \Rightarrow -z-4+3z+1=-2z-2 \Rightarrow 2z-3=-2z-2 \Rightarrow$

$2z-3+3=-2z-2+3 \Rightarrow 2z=-2z+1 \Rightarrow 2z+2z=-2z+2z+1 \Rightarrow 4z=1 \Rightarrow \frac{4z}{4}=\frac{1}{4} \Rightarrow z=\frac{1}{4}$

49. $7.3x-1.7=5.6 \Rightarrow 7.3x-1.7+1.7=5.6+1.7 \Rightarrow 7.3x=7.3 \Rightarrow \frac{7.3x}{7.3}=\frac{7.3}{7.3} \Rightarrow x=1$

50. $5.5x+3x=51 \Rightarrow 8.5x=51 \Rightarrow \frac{8.5x}{8.5}=\frac{51}{8.5} \Rightarrow x=6$

51. $-9.5x-0.05=10.5x+1.05 \Rightarrow -9.5x-10.5x-0.05=10.5x-10.5x+1.05 \Rightarrow$

$-20x-0.05=1.05 \Rightarrow -20x-0.05+0.05=1.05+0.05 \Rightarrow -20x=1.1 \Rightarrow \frac{-20x}{-20}=\frac{1.1}{-20} \Rightarrow x=-0.055$

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52. $0.04x+0.03=0.02x-0.1 \quad 0.04x \quad 0.02x \quad 0.03 \quad 0.02x \quad 0.02x \quad 0.1 \quad 0.02x+0.03=-0.1 \Rightarrow$

$0.02x+0.03-0.03=-0.1-0.03 \Rightarrow 0.02x=-0.13 \Rightarrow \dfrac{0.02x}{0.02}=\dfrac{-0.13}{0.02} \Rightarrow x=-6.5$

53. $\dfrac{1}{2}x-\dfrac{3}{2}=\dfrac{5}{2} \Rightarrow \dfrac{1}{2}x-\dfrac{3}{2}+\dfrac{3}{2}=\dfrac{5}{2}+\dfrac{3}{2} \Rightarrow \dfrac{1}{2}x=4 \Rightarrow 2\cdot\dfrac{1}{2}x=4\cdot 2 \Rightarrow x=8$

54. $-\dfrac{1}{4}x+\dfrac{5}{4}=\dfrac{3}{4} \Rightarrow -\dfrac{1}{4}x+\dfrac{5}{4}-\dfrac{5}{4}=\dfrac{3}{4}-\dfrac{5}{4} \Rightarrow -\dfrac{1}{4}x=-\dfrac{2}{4} \Rightarrow (-4)\cdot\left(-\dfrac{1}{4}x\right)=-\dfrac{2}{4}\cdot(-4) \Rightarrow x=2$

55. $-\dfrac{3}{8}x+\dfrac{1}{4}=\dfrac{1}{8} \Rightarrow -\dfrac{3}{8}x=-\dfrac{1}{4}+\dfrac{1}{8} \Rightarrow -\dfrac{3}{8}x=-\dfrac{1}{8} \Rightarrow \left(-\dfrac{8}{3}\right)\left(-\dfrac{3}{8}\right)x=\left(-\dfrac{1}{8}\right)\left(-\dfrac{8}{3}\right) \Rightarrow x=\dfrac{1}{3}$

56. $\dfrac{1}{3}x+\dfrac{1}{4}=\dfrac{1}{6}-x \Rightarrow \dfrac{1}{3}x+x+\dfrac{1}{4}=\dfrac{1}{6}-x+x \Rightarrow \dfrac{4}{3}x+\dfrac{1}{4}=\dfrac{1}{6} \Rightarrow \dfrac{4}{3}x+\dfrac{1}{4}-\dfrac{1}{4}=\dfrac{1}{6}-\dfrac{1}{4} \Rightarrow$

$\dfrac{4}{3}x=-\dfrac{1}{12} \Rightarrow \dfrac{3}{4}\cdot\dfrac{4}{3}x=-\dfrac{1}{12}\cdot\dfrac{3}{4} \Rightarrow x=-\dfrac{3}{48} \Rightarrow x=-\dfrac{1}{16}$

57. $4y-2(y+1)=0 \Rightarrow 4y-2y-2=0 \Rightarrow 2y-2=0 \Rightarrow 2y-2+2=0+2 \Rightarrow 2y=2 \Rightarrow \dfrac{2y}{2}=\dfrac{2}{2} \Rightarrow y=1$

58. $(15y+20)-5y=5-10y \Rightarrow 10y+20=5-10y \Rightarrow 10y+10y+20=5-10y+10y \Rightarrow$

$20y+20=5 \Rightarrow 20y+20-20=5-20 \Rightarrow 20y=-15 \Rightarrow \dfrac{20y}{20}=\dfrac{-15}{20} \Rightarrow y=-\dfrac{3}{4}$

59. $ax+b=0 \Rightarrow ax+b-b=0-b \Rightarrow ax=-b \Rightarrow \dfrac{ax}{a}=\dfrac{-b}{a} \Rightarrow x=-\dfrac{b}{a}$

60. $\dfrac{1}{a}x-b=0 \Rightarrow \dfrac{1}{a}x-b+b=0+b \Rightarrow \dfrac{1}{a}x=b \Rightarrow a\cdot\dfrac{1}{a}x=a\cdot b \Rightarrow x=ab$

61. $5x=5x+1 \Rightarrow 5x-5x=5x-5x+1 \Rightarrow 0=1$

Because the equation $0=1$ is always false, there are no solutions.

62. $2(x-3)=2x-6 \Rightarrow 2x-6=2x-6 \Rightarrow 2x-2x-6=2x-2x-6 \Rightarrow -6=-6$

Since the equation $-6=-6$ is always true, there are infinitely many solutions.

63. $8x=0 \Rightarrow \dfrac{8x}{8}=\dfrac{0}{8} \Rightarrow x=0$ Thus, there is one solution.

64. $9x=x+1 \Rightarrow 9x-x=x-x+1 \Rightarrow 8x=1 \Rightarrow \dfrac{8x}{8}=\dfrac{1}{8} \Rightarrow x=\dfrac{1}{8}$ Thus, there is one solution.

65. $4x=5(x+3)-x \Rightarrow 4x=5x+15-x \Rightarrow 4x=4x+15 \Rightarrow 4x-4x=4x-4x+15 \Rightarrow 0=15$

Because the equation $0=15$ is always false, there are no solutions.

66. $5x=15-2(x+7) \Rightarrow 5x=15-2x-14 \Rightarrow 5x+2x=15-2x+2x-14 \Rightarrow 7x=1 \Rightarrow$

$\dfrac{7x}{7}=\dfrac{1}{7} \Rightarrow x=\dfrac{1}{7}$ Thus, there is one solution.

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67. $5(2x+7)-(10x+5)=30 \Rightarrow 10x+35-10x-5=30 \Rightarrow 30=30$

Since the equation $30=30$ is always true, there are infinitely many solutions.

68. $4(x+2)-2(2x+3)=10 \Rightarrow 4x+8-4x-6=10 \Rightarrow 8-6=10 \Rightarrow 2=10$

Because the equation $2=10$ is always false, there are no solutions.

69. $x-(3x+2)=15-2x \Rightarrow x-3x-2=15-2x \Rightarrow -2x-2=15-2x \Rightarrow$

$-2x+2x-2=15-2x+2x \Rightarrow -2=15$

Because the equation $-2=15$ is always false, there are no solutions.

70. $2x-(x+5)=x-5 \Rightarrow 2x-x-5=x-5 \Rightarrow x-5=x-5 \Rightarrow x-x-5=x-x-5 \Rightarrow -5=-5$ Since the equation $-5=-5$ is always true, there are infinitely many solutions.

71. (a) See Figure 71.

(b) Let D represent the distance from home and x represent the number of hours. Then $D=4+8x$.

(c) Substitute 3 for x. Then, $D=4+8(3)=28$ miles. This agrees with the value found in the table.

(d) Using the formula $D=4+8x$, substitute 22 for D. Then, $22=4+8x$. Then, solving for x:

$22-4=4-4+8x \Rightarrow 18=8x \Rightarrow \frac{18}{8}=\frac{8x}{8} \Rightarrow \frac{9}{4}=x \Rightarrow x=2.25$ hours. Thus, the bicyclist is 22 miles from home after 2 hours and 15 minutes.

Hours (x)	0	1	2	3	4
Distance (D)	4	12	20	28	36

Figure 71

72. (a) Let D represent distance from home and x represent hours. Note that each hour spent running decreases the distance from home by 6 miles. Thus, set the formula to $D=16-6x$.

(b) Using the formula, substitute 1.5 for x and solve for D.

$D=16-6(1.5) \Rightarrow D=16-9 \Rightarrow D=7$ miles.

(c) Substitute 5.5 for D and solve for x. $5.5=16-6x \Rightarrow 5.5-16=16-16-6x \Rightarrow -10.5=-6x \Rightarrow$

$\frac{-10.5}{-6}=\frac{-6x}{-6} \Rightarrow 1.75=x \Rightarrow x=1.75$ Thus, the athlete is 5.5 miles from home after 1 hour and 45 minutes of running.

73. Using the formula, substitute 1730 for I and solve for x. $1730=241x-482,440 \Rightarrow$

$1730+482,440=241x-482,440+482,440 \Rightarrow 484,170=241x \Rightarrow \frac{484,170}{241}=\frac{241x}{241} \Rightarrow x \approx 2009$

74. Using the formula, substitute 970 for N and solve for x.

$970=42x-83,197 \Rightarrow 970+83,197 \Rightarrow 42x-83,197+83,197$

$\Rightarrow 84,167=42x \Rightarrow \frac{84,167}{42}=\frac{42x}{42} \Rightarrow x \approx 2004$

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75. Using the formula, substitute 1.5 for N and solve for x.

$1.5 = 0.03x - 58.62 \Rightarrow 1.5 + 58.62 = 0.03x - 58.62 + 58.62$

$\Rightarrow 60.12 = 0.03x \Rightarrow \frac{60.12}{0.03} = \frac{0.03x}{0.03} \Rightarrow x = 2004$

76. Using the formula, substitute 6.6 for C and solve for x. $6.6 = 0.35x - 684 \Rightarrow$

$6.6 + 684 = 0.35x - 684 + 684 \Rightarrow 690.6 = 0.35x \Rightarrow \frac{690.6}{0.35} = \frac{0.35x}{0.35} \Rightarrow 1973.143 \approx x \Rightarrow$

$x \approx 1973.143$ Thus, the cost reached \$6.6 billion sometime in the year 1973.

77. Using the formula, substitute 2841 for H and solve for x. $2841 = -33x + 69{,}105 \Rightarrow$

$2841 - 69{,}105 = -33x - 69{,}105 + 69{,}105 \Rightarrow -66264 = -33x \Rightarrow \frac{-66264}{-33} = \frac{-33x}{-33} \Rightarrow 2008 = x$

Thus, the number of hospitals reached 2841 in 2008.

78. Using the formula, substitute 2504 for F and solve for x. $2504 = 34x - 65{,}734 \Rightarrow$

$2504 + 65{,}734 = 34x - 65{,}734 + 65{,}734 \Rightarrow 68{,}238 = 34x \Rightarrow \frac{68{,}238}{34} = \frac{34x}{34} \Rightarrow 2007 = x$

Thus, the average home size reached 2504 square feet in 2007.

Checking Basic Concepts Sections 2.1 and 2.2

1. (a) $4x^3 - 2 = 0$ is not linear because it cannot be written in the form $ax + b = 0$. It has a non-zero term containing x^3.

   (b) $2(x+1) = 4$ is a linear equation. Use the distributive property to obtain $2x + 2 = 4$, then $2x + 2 - 4 = 4 - 4 \Rightarrow 2x - 2 = 0$. $a = 2$ and $b = -2$.

2. For $x = 3$, substitute 3 for x and solve: $4(3) - 3 = 12 - 3 = 9$

   For $x = 3.5$, substitute 3.5 for x and solve: $4(3.5) - 3 = 14 - 3 = 11$

   For $x = 4$, substitute 4 for x and solve: $4(4) - 3 = 16 - 3 = 13$

   For $x = 4.5$, substitute 4.5 for x and solve: $4(4.5) - 3 = 18 - 3 = 15$

   For $x = 5$, substitute 5 for x and solve: $4(5) - 3 = 20 - 3 = 17$

   See Figure 2. To solve $4x - 3 = 13$, the table tells us that when $x = 4$, $4x - 3 = 13$.

x	3	3.5	4	4.5	5
$4x - 3$	9	11	13	15	17

Figure 2

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3. (a) $x-12=6 \Rightarrow x-12+12=6+12 \Rightarrow x=18$ To check the answer, substitute 18 for x in the original equation $x-12=6$. $18-12=6 \Rightarrow 6=6$. Since this is true $x=18$ is correct.

   (b) $\frac{3}{4}z=\frac{1}{8} \Rightarrow \frac{4}{3}\cdot\frac{3}{4}z=\frac{1}{8}\cdot\frac{4}{3} \Rightarrow z=\frac{4}{24} \Rightarrow z=\frac{1}{6}$

   (c) $0.6t+0.4=2 \Rightarrow 0.6t+0.4-0.4=2-0.4 \Rightarrow 0.6t=1.6 \Rightarrow \frac{0.6t}{0.6}=\frac{1.6}{0.6} \Rightarrow t=2.\overline{6}$

   (d) $5-2(x-2)=3(4-x) \Rightarrow 5-2x+4=12-3x \Rightarrow 9-2x=12-3x \Rightarrow$
   $9-2x+3x=12-3x+3x \Rightarrow 9+x=12 \Rightarrow 9-9+x=12-9 \Rightarrow x=3$

4. (a) $x-5=6x \Rightarrow x-x-5=6x-x \Rightarrow -5=5x \Rightarrow \frac{-5}{5}=\frac{5x}{5} \Rightarrow -1=x$. Thus, the equation has one solution.

   (b) $-2(x-5)=10-2x \Rightarrow -2x+10=10-2x \Rightarrow -2x+2x+10=10-2x+2x \Rightarrow 10=10$

   Since $10=10$ is always true, the equation has infinitely many solutions.

   (c) $-(x-1)=-x-1 \Rightarrow -x+1=-x-1 \Rightarrow -x+x+1=-x+x-1 \Rightarrow 1=-1$

   Since this is never true, the equation has no solutions.

5. (a) Let D represent distance from home and x represent hours driven. Note that the driver is initially 300 miles from home and that each hour driven the driver gets closer to home by 75 miles. Thus, the formula is $D=300-75x$.

   (b) Since the distance from home, when the driver is home, is 0, use the formula and set D equal to 0. Thus, $0=300-75x$.

   (c) $0=300-75x \Rightarrow 0+75x=300-75x+75x \Rightarrow 75x=300 \Rightarrow \frac{75x}{75}=\frac{300}{75} \Rightarrow x=4$ hours.

Section 2.3 Introduction to Problem Solving

1. Check your solution.
2. +
3. =
4. $n+1$ and $n+2$
5. $\frac{x}{100}$
6. 0.01
7. left
8. right
9. $\frac{B-A}{A}\cdot 100$

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10. increase; decrease

11. rt

12. distance; time

13. Let t represent the number. $2+t=12 \Rightarrow 2-2+t=12-2 \Rightarrow t=10$

14. $2x+7=9 \Rightarrow 2x+7-7=9-7 \Rightarrow 2x=2 \Rightarrow \frac{2x}{2}=\frac{2}{2} \Rightarrow x=1$

15. $\frac{x}{5}=x-24 \Rightarrow \frac{x}{5}\cdot 5=5(x-24) \Rightarrow x=5x-120 \Rightarrow x-5x=5x-5x-120 \Rightarrow -4x=-120 \Rightarrow$

$\frac{-4x}{-4}=\frac{-120}{-4} \Rightarrow x=30$

16. $25x=125 \Rightarrow \frac{25x}{25}=\frac{125}{25} \Rightarrow x=5$

17. $\frac{x+5}{2}=7 \Rightarrow \frac{x+5}{2}\cdot 2=7\cdot 2 \Rightarrow x+5=14 \Rightarrow x+5-5=14-5 \Rightarrow x=9$

18. $8-x=5 \Rightarrow 8-8-x=5-8 \Rightarrow -x=-3 \Rightarrow -1(-x)=-1(-3) \Rightarrow x=3$

19. $\frac{x}{2}=17 \Rightarrow \frac{x}{2}\cdot 2=17\cdot 2 \Rightarrow x=34$

20. $5x=95 \Rightarrow \frac{5x}{5}=\frac{95}{5} \Rightarrow x=19$

21. Let the smallest natural number be represented by x. $x+(x+1)+(x+2)=96 \Rightarrow 3x+3=96 \Rightarrow$

$3x+3-3=96-3 \Rightarrow 3x=93 \Rightarrow \frac{3x}{3}=\frac{93}{3} \Rightarrow x=31$ Thus, the numbers are 31, 32 and 33.

22. Let x represent the smallest integer, $x+(x+1)+(x+2)=-123 \Rightarrow 3x+3=-123 \Rightarrow$

$3x+3-3=-123-3 \Rightarrow 3x=-126 \Rightarrow \frac{3x}{3}=\frac{-126}{3} \Rightarrow x=-42$

Thus, the numbers are -42, -41 and -40.

23. $3x=102 \Rightarrow \frac{3x}{3}=\frac{102}{3} \Rightarrow x=34$

24. $x+18=2x \Rightarrow x-x+18=2x-x \Rightarrow 18=x \Rightarrow x=18$

25. $5x=2x+24 \Rightarrow 5x-2x=2x-2x+24 \Rightarrow 3x=24 \Rightarrow \frac{3x}{3}=\frac{24}{3} \Rightarrow x=8$

26. $3x=x-18 \Rightarrow 3x-x=x-x-18 \Rightarrow 2x=-18 \Rightarrow \frac{2x}{2}=\frac{-18}{2} \Rightarrow x=-9$

27. $\frac{6x}{7}=18 \Rightarrow \frac{6x}{7}\cdot 7=18\cdot 7 \Rightarrow 6x=126 \Rightarrow \frac{6x}{6}=\frac{126}{6} \Rightarrow x=21$

28. $\frac{2x-2}{5}=4 \Rightarrow \frac{2x-2}{5}\cdot 5=4\cdot 5 \Rightarrow 2x-2=20 \Rightarrow 2x-2+2=20+2 \Rightarrow 2x=22 \Rightarrow \frac{2x}{2}=\frac{22}{2} \Rightarrow x=11$

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29. Let x represent the child's current age.

$x+10=2x+3 \Rightarrow x-x+10=2x-x+3 \Rightarrow 10=x+3 \Rightarrow 10-3=x+3-3 \Rightarrow 7=x \Rightarrow x=7$

30. Let x be the age of the daughter then $2x+15$ is the age of the mother.

The equation is $49=2x+15$.

$49=2x+15 \Rightarrow 49-15=2x+15-15 \Rightarrow 34=2x \Rightarrow \frac{34}{2}=\frac{2}{2}x \Rightarrow x=17$ and $2x+15=49$

31. Let x be the previous weight of the individual.

$x-30=\frac{1}{3}x+110 \Rightarrow 3(x-30)=3\left(\frac{1}{3}x+110\right) \Rightarrow 3x-90=x+330 \Rightarrow 3x-x-90=x-x+330 \Rightarrow$

$2x-90=330 \Rightarrow 2x-90+90=330+90 \Rightarrow 2x=420 \Rightarrow \frac{2x}{2}=\frac{420}{2} \Rightarrow x=210$ lb

32. Let x be the person's weight before gaining 25 pounds. The equation is $x+25=2x-115$.

$x-x+25=2x-x-115 \Rightarrow 25=x-115 \Rightarrow 25+115=x-115+115 \Rightarrow x=140$ pounds

33. Let x be the number of waste sites in Washington.

$24=2x-2 \Rightarrow 24+2=2x-2+2 \Rightarrow 26=2x \Rightarrow \frac{26}{2}=\frac{2x}{2} \Rightarrow 13=x \Rightarrow x=13$

34. Let x be the number of unhealthy air quality days in San Diego.

$100=3x+1 \Rightarrow 100-1=3x+1-1 \Rightarrow 99=3x \Rightarrow \frac{99}{3}=\frac{3x}{3} \Rightarrow 33=x \Rightarrow x=33$

35. Let x be the number of reptiles on the endangered species list.

$92=2x+12 \Rightarrow 92-12=2x-12+12 \Rightarrow 80=2x \Rightarrow \frac{80}{2}=\frac{2x}{2} \Rightarrow 40=x \Rightarrow x=40$

36. $84=3x+x \Rightarrow 84=4x \Rightarrow \frac{84}{4}=\frac{4x}{4} \Rightarrow 21=x \Rightarrow x=21$ and $3x=63$

There are 63,000 millionaires in Kentucky and 21,000 millionaires in Rhode Island.

37. $x-1562=250 \Rightarrow x-1562+1562=250+1562 \Rightarrow x=1812$ million

38. $311=2x-189 \Rightarrow 311+189=2x-189+189 \Rightarrow 500=2x \Rightarrow \frac{500}{2}=\frac{2x}{2} \Rightarrow 250=x \Rightarrow$

$x=250$ billion kilowatt-hours

39. $2x-4=70 \Rightarrow 2x-4+4=70+4 \Rightarrow 2x=74 \Rightarrow \frac{2x}{2}=\frac{74}{2} \Rightarrow x=37$

There were 37,000 cosmetic surgeries performed on persons under age 18.

40. $368=13x-22 \Rightarrow 368+22=13x-22+22 \Rightarrow 390=13x \Rightarrow \frac{390}{13}=\frac{13x}{13} \Rightarrow 30=x \Rightarrow x=30$ thousand

41. $106=2(x+5)+2x \Rightarrow 106=2x+10+2x \Rightarrow 106=4x+10 \Rightarrow 106-10=4x+10-10 \Rightarrow$

$96=4x \Rightarrow \frac{96}{4}=\frac{4x}{4} \Rightarrow 24=x \Rightarrow x=24$

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42. $24 = (x+4)+(x+2)+x \Rightarrow 24 = 3x+6 \Rightarrow 24-6 = 3x+6-6 \Rightarrow 18 = 3x \Rightarrow$

$\frac{18}{3} = \frac{3x}{3} \Rightarrow 6 = x \Rightarrow x = 6$

43. $62 = 2x+2(x+7) \Rightarrow 62 = 2x+2x+14 \Rightarrow 62 = 4x+14 \Rightarrow 62-14 = 4x+14-14 \Rightarrow$

$48 = 4x \Rightarrow \frac{48}{4} = \frac{4x}{4} \Rightarrow 12 = x \Rightarrow x = 12$ and $x+7 = 19$

The length is 19 inches and the width is 12 inches.

44. $102 = x+(x-15)+(x-6) \Rightarrow 102 = 3x-21 \Rightarrow 102+21 = 3x-21+21 \Rightarrow$.

$123 = 3x \Rightarrow \frac{123}{3} = \frac{3x}{3} \Rightarrow 41 = x \Rightarrow x = 41$, $x-6 = 35$, and $x-15 = 26$

The measures are 26, 35, and 41 feet.

45. $170 = x+(2x-10) \Rightarrow 170 = 3x-10 \Rightarrow 170+10 = 3x-10+10 \Rightarrow$

$180 = 3x \Rightarrow \frac{180}{3} = \frac{3x}{3} \Rightarrow 60 = x \Rightarrow x = 60$ and $2x-10 = 110$

Therefore, Facebook had 60 million users and MySpace had 110 million users.

46. $x+225 = 400 \Rightarrow x+225-225 = 400-225 \Rightarrow x = 175$

There were 175 million Facebook users in February 2009.

47. $248{,}000 = x+(x-52{,}000) \Rightarrow 248{,}000 = 2x-52{,}000 \Rightarrow 248{,}000+52{,}000 = 2x \Rightarrow$

$300{,}000 = 2x \Rightarrow \frac{300{,}000}{2} = \frac{2x}{2} \Rightarrow 150{,}000 = x \Rightarrow x = 150{,}000$ and $x-52{,}000 = 98{,}000$

In 2003 there were 150,000 troops and in 2010 there were 98,000 troops.

48. $64 = x+(x-12) \Rightarrow 64 = 2x-12 \Rightarrow 64+12 = 2x-12+12 \Rightarrow$

$76 = 2x \Rightarrow \frac{76}{2} = \frac{2x}{2} \Rightarrow 38 = x \Rightarrow x-38$ and $x-12 = 26$

In 1980 there were 38 million acres and in 2009 there were 26 million acres.

49. $37\% = \frac{37}{100}$ $\qquad 37\% = 37 \times 0.01 = 0.37$

50. $52\% = \frac{52}{100} = \frac{13 \cdot 4}{25 \cdot 4} = \frac{13}{25}$ $\qquad 52\% = 52 \times 0.01 = 0.52$

51. $148\% = \frac{148}{100} = \frac{37 \cdot 4}{25 \cdot 4} = \frac{37}{25}$ $\qquad 148\% = 148 \times 0.01 = 1.48$

52. $252\% = \frac{252}{100} = \frac{63 \cdot 4}{25 \cdot 4} = \frac{63}{25}$ $\qquad 252\% = 252 \times 0.01 = 2.52$

53. $6.9\% = \frac{6.9}{100} = \frac{6.9}{100} \cdot \frac{10}{10} = \frac{69}{1000}$ $\qquad 6.9\% = 6.9 \times 0.01 = 0.069$

54. $8.1\% = \frac{8.1}{100} = \frac{8.1}{100} \cdot \frac{10}{10} = \frac{81}{1000}$ $\qquad 8.1\% = 8.1 \times 0.01 = 0.081$

55. $0.05\% = \frac{0.05}{100} = \frac{0.05}{100} \cdot \frac{100}{100} = \frac{5}{10{,}000} = \frac{1 \cdot 5}{2000 \cdot 5} = \frac{1}{2000}$

$0.05\% = 0.05 \times 0.01 = 0.0005$

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56. $0.12\% = \frac{0.12}{100} = \frac{0.12}{100} \cdot \frac{100}{100} = \frac{12}{10,000} = \frac{3 \cdot 4}{2500 \cdot 4} = \frac{3}{2500}$

$0.12\% = 0.12 \times 0.01 = 0.0012$

57. $0.45 = 0.45 \times 100\% = 45\%$

58. $0.08 = 0.08 \times 100\% = 8\%$

59. $1.8 = 1.8 \times 100\% = 180\%$

60. $2.97 = 2.97 \times 100\% = 297\%$

61. $0.006 = 0.006 \times 100\% = 0.6\%$

62. $0.0001 = 0.0001 \times 100\% = 0.01\%$

63. $\frac{2}{5} = 0.4 = 0.4 \times 100\% = 40\%$

64. $\frac{1}{3} = 0.33\overline{3} = 0.33\overline{3} \times 100\% = 33.\overline{3}\%$

65. $\frac{3}{4} = 0.75 = 0.75 \times 100\% = 75\%$

66. $\frac{7}{20} = 0.35 = 0.35 \times 100\% = 35\%$

67. $\frac{5}{6} = 0.83\overline{3} = 0.83\overline{3} \times 100\% = 83.\overline{3}\%$

68. $\frac{53}{50} = 1.06 = 1.06 \times 100\% = 106\%$

69. Let B represent voters in 2008 and let A represent voters in 1980. Then, the percent change in the number of voters is $\frac{B-A}{A} = \frac{132.6-86.5}{86.5} = \frac{46.1}{86.5} \approx 0.533$ or about 53.3%.

70. Let B represent the number of master's degrees received in 2010 and let A represent the number of master's degrees received in 2005. Then, the percent change in the number of master's degrees received is $\frac{B-A}{A} = \frac{659,000-594,000}{594,000} = \frac{65,000}{594,000} \approx 0.109$ or about 10.9%.

71. Calculate the value of 4% of 950, then add the value to 950. Thus, 4% of $950 = .04(950) = 38$.

Then, $950 + 38 = \$988$ per credit.

72. Calculate the value of 8% of 125, then add the value to 125. Thus, 8% of $125 = .08(125) = 10$.

Then, $125 + 10 = \$135$ per credit.

73. To calculate the total area of Wisconsin, let x represent the unknown number and note that 13.6 is 38% of the unknown number. Then, $0.38x = 13.6 \Rightarrow \frac{0.38x}{0.38} = \frac{13.6}{0.38} \Rightarrow x \approx 35.8$. Thus, the total area of Wisconsin is about 35.8 million acres.

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74. Let x be the number of female military personnel in 2008.

$$x + 0.0038x = 203,375 - x \Rightarrow 1.0038x = 203,375 \Rightarrow \frac{1.0038x}{1.0038} = \frac{203,375}{1.0038} \Rightarrow x \approx 202,605.$$

75. The percent change from \$1.20 to \$1.50 is, $\frac{1.50-1.20}{1.20} \cdot 100 = 25$ Thus, the percent change from \$1.20 to \$1.50 is 25%. The percent change from \$1.50 to \$1.20 is $\frac{1.20-1.50}{1.50} \cdot 100 = -20$ Thus, the percent change from \$1.50 to \$1.20 is -20%.

76. Given the percent change is 30% when the amount increases from A_1 to A_2, then $\frac{A_2 - A_1}{A_1} = 0.3$

$$\Rightarrow A_1\left(\frac{A_2 - A_1}{A_1}\right) = 0.3A_1 \Rightarrow A_2 - A_1 = 0.3A_1 \Rightarrow A_2 - A_1 + A_1 = 0.3A_1 + A_1$$

$$\Rightarrow A_2 = 0.3A_1 + A_1 \Rightarrow A_2 = (0.3+1)A_1 \Rightarrow A_2 = 1.3A_1.$$

Then, if the amount decreases from A_2 back to A_1,

$$\frac{A_1 - A_2}{A_2} = \frac{A_1 - 1.3A_1}{1.3A_1} = \frac{(1-1.3)A_1}{1.3A_1} = \frac{-0.3}{1.3} \cdot \frac{A_1}{A_1} \approx -0.231.$$

So the percent charge is not -30%, it is about -23.1%.

77. $d = rt \Rightarrow d = 4 \cdot 2 \Rightarrow d = 8$ miles

78. $d = rt \Rightarrow d = 70 \cdot 2.5 \Rightarrow d = 175$ miles

79. $d = rt \Rightarrow 1000 = r \cdot 50 \Rightarrow \frac{1000}{50} = \frac{r \cdot 50}{50} \Rightarrow 20 = r \Rightarrow r = 20$ feet/second

80. $d = rt \Rightarrow 1250 = r \cdot 5 \Rightarrow \frac{1250}{5} = \frac{r \cdot 5}{5} \Rightarrow 250 = r \Rightarrow r = 250$ miles/day

81. $d = rt \Rightarrow 200 = 40t \Rightarrow \frac{200}{40} = \frac{40t}{40} \Rightarrow 5 = t \Rightarrow t = 5$ hours

82. $d = rt \Rightarrow 1700 = 10t \Rightarrow \frac{1700}{10} = \frac{10t}{10} \Rightarrow 170 = t \Rightarrow t = 170$ seconds

83. Given that the distance traveled (d) is 255 and that the time spent traveling (t) is 4.25 hours, calculate the speed of the car (r).

Then, $d = rt \Rightarrow 255 = r \cdot 4.25 \Rightarrow \frac{255}{4.25} = \frac{r \cdot 4.25}{4.25} \Rightarrow 60 = r \Rightarrow r = 60$ miles/hour.

84. Given the distance and the time, calculate the speed. Then, $715 = r \cdot 5.5 \Rightarrow \frac{715}{5.5} = \frac{r \cdot 5.5}{5.5} \Rightarrow$ $130 = r \Rightarrow r = 130$ miles/hour.

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85. Let the slower runner be standing still. Then, the faster runner will be traveling at $0+2$ mph. Then, this problem is equivalent to solving how long it takes the faster runner to travel $\frac{3}{4}$ of a mile. Using the $d=rt$ formula: $\frac{3}{4}=2t \Rightarrow \frac{3}{4}\cdot\frac{1}{2}=\frac{2}{1}\cdot\frac{1}{2}t \Rightarrow \frac{3}{8}=t \Rightarrow t=\frac{3}{8}$. So, in $\frac{3}{8}$ hour the faster runner will be $\frac{3}{4}$ mile ahead of the slower runner.

86. Since the athlete runs $\frac{1}{3}$ of an hour at 6 mph, the athlete runs $\frac{1}{3}\cdot 6=2$ miles in the first $\frac{1}{3}$ of an hour. Since the athlete runs a total of 8 miles, the athlete runs $8-2=6$ miles in the remaining $1-\frac{1}{3}=\frac{2}{3}$ of an hour. Using the $d=rt$ formula : $6=r\cdot\frac{2}{3} \Rightarrow 6\cdot\frac{3}{2}=r\cdot\frac{2}{3}\cdot\frac{3}{2} \Rightarrow 9=r \Rightarrow r=9.$
Therefore, the second speed is 9 miles/hour.

87. Let t represent the amount of time spent running 5 mph. Since the total time spent running was 1.1 hours, then $1.1-t$ represents the amount of time running at 8 mph. Using the $d=rt$ formula, the distance run will equal the sum of $5t$ and $8(1.1-t)$.
Thus, $7=5t+8(1.1-t) \Rightarrow 7=5t+8.8-8t \Rightarrow 7=8.8-3t \Rightarrow$
$3t+7=8.8-3t+3t \Rightarrow 3t+7=8.8 \Rightarrow 3t+7-7=8.8-7 \Rightarrow 3t=1.8 \Rightarrow t=\frac{1.8}{3}=0.6.$
Therefore, the athlete ran at 5 mph for 0.6 hour and ran at 8 mph for $(1.1-0.6)=0.5$ hour.

88. The distance the bus travels is $160+295=455$ miles. The bus travels at 70 mph. Then, $455=70t \Rightarrow \frac{455}{70}=\frac{70t}{70} \Rightarrow 6.5=t \Rightarrow t=6.5$. Therefore, it will take the bus 6.5 hours to be 295 miles west of the border.

89. Since the plane is already 300 miles west of Chicago, it will have to fly $2175-300=1875$ miles to be 2175 miles west of Chicago. The plane is traveling at 500 mph. Then, $1875=500t \Rightarrow \frac{1875}{500}=\frac{500t}{500} \Rightarrow 3.75=t \Rightarrow t=3.75$. Therefore, it will take the plane 3.75 hours to be 2175 miles west of Chicago.

90. Let x represent the speed of the slower car and $x+6$ represent the speed of the faster car. Then, the distance of 171 miles will equal the speed of the slower car multiplied by the time added to the speed of the faster car multiplied by the time.
Therefore, $171=x(1.5)+(x+6)(1.5) \Rightarrow 171=1.5x+1.5x+9 \Rightarrow$
$171=3x+9 \Rightarrow 171-9=3x+9-9 \Rightarrow 162=3x \Rightarrow \frac{162}{3}=\frac{3x}{3} \Rightarrow 54=x \Rightarrow x=54.$
Thus, 54 mph is the speed of the slower car and $54+6=60$ mph is the speed of the faster car.

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91. Let x represent the amount of water that should be added. Note that there is no salt in pure water and that we will add the amount of pure water to the 3% salt solution to obtain a 1.2% solution. Therefore, set up the equation so that the amount of salt on both sides of the equation is equal. Thus, $x(0.00)+20(0.03)=(x+20)(0.012) \Rightarrow 0.00x+0.6=0.012x+0.24 \Rightarrow$

$$0.6-0.24=0.012x+0.24-0.24 \Rightarrow 0.36=0.012x \Rightarrow \frac{0.36}{0.012}=\frac{0.012x}{0.012} \Rightarrow 30=x \Rightarrow x=30.$$

Therefore, 30 ounces of water should be added.

92. Let x represent the amount of water that should be added. Note that there is no hydrochloric acid in pure water and that we will add the amount of pure water to the 15% solution to obtain a 2% solution. Therefore, set up the equation so that the amount of hydrochloric acid on both sides of the equation is equal. Thus, $x(0.00)+50(0.15)=(x+50)(0.02) \Rightarrow 0.00x+7.5=0.02x+1 \Rightarrow$

$$7.5-1=0.02x+1-1 \Rightarrow 6.5=0.02x \Rightarrow \frac{6.5}{0.02}=\frac{0.02x}{0.02} \Rightarrow 325=x \Rightarrow x=325.$$

Therefore, 325 ml of water should be added.

93. Let x represent the amount of the loan at 6% and let $x+1000$ represent the amount of the loan at 5%. The total interest for one year is \$215 and this is the sum of the interest paid on the two loans. Therefore: $0.06x+0.05(x+1000)=215 \Rightarrow 0.06x+0.05x+50=215 \Rightarrow$

$0.11x+50-50=215-50 \Rightarrow 0.11x=165 \Rightarrow \frac{0.11x}{0.11}=\frac{165}{0.11} \Rightarrow x=1500.$ Therefore, the amount of the loan at 6% interest is \$1500 and the amount of the loan at 5% interest is $1500+1000=\$2500$.

94. Let x represent the interest rate for the \$3000 loan and let $x-0.03$ represent the interest rate for the \$5000 loan. The total interest cost for the year will equal the sum of the interest for each loan. Therefore: $3000x+5000(x-0.03)=550 \Rightarrow 3000x+5000x-150=550 \Rightarrow$

$$8000x-150+150=550+150 \Rightarrow 8000x=700 \Rightarrow \frac{8000x}{8000}=\frac{700}{8000} \Rightarrow x=0.0875.$$

Therefore, the interest rate for the \$3000 loan is 8.75% and the interest rate for the for the \$5000 loan is $0.0875-0.03=0.0575$ or 5.75%.

95. Let x represent the amount of 70% antifreeze. Then, the 45% antifreeze mixture is the sum of the 70% mixture and the 30% mixture. Therefore, $0.7x+10(0.3)=(x+10)(0.45) \Rightarrow$

$0.7x+3=0.45x+4.5 \Rightarrow 0.7x+3-3=0.45x+4.5-3 \Rightarrow$

$$0.7x=0.45x+1.5 \Rightarrow 0.7x-0.45x=0.45x-0.45x+1.5 \Rightarrow 0.25x=1.5 \Rightarrow \frac{0.25x}{0.25}=\frac{1.5}{0.25} \Rightarrow x=6.$$

Therefore, 6 gallons of 70% antifreeze should be mixed with 10 gallons of 30% antifreeze to obtain the 45% mixture.

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96. Since there is a total of 50 gallons of mixture, let x represent the gallons of 65% antifreeze. Then $50-x$ represent the 20% antifreeze. Then: $0.65x+0.20(50-x)=50(0.56)\Rightarrow$

$0.65x+10-0.20x=28\Rightarrow 0.45x+10-10=28-10\Rightarrow$

$0.45x=18\Rightarrow\dfrac{0.45x}{0.45}=\dfrac{18}{0.45}\Rightarrow x=40.$

Therefore, 40 gallons of 65% antifreeze should be mixed with 10 gallons of 20% antifreeze.

97. Let x represent the amount of 2.5% cream. Then, the 1% cream is the sum of the 2.5% cream and the base cream (0%). Therefore $0.025x+15(0)=(x+15)(0.01)\Rightarrow$

$0.025x=0.01x+0.15\Rightarrow 0.025x-0.01x=0.01x-0.01x+0.15\Rightarrow$

$0.015x=0.15\Rightarrow\dfrac{0.015x}{0.015}=\dfrac{0.15}{0.015}\Rightarrow x=10.$ Therefore, 10 grams of 2.5% hydrocortisone cream should be mixed with the base to obtain the 1% cream.

98. Let x represent the balance on the card with the 1.75% interest rate. Then the balance on the other card is $x-600$. The total interest for the month will equal the sum of the interest for each card. Therefore: $0.0175x+0.015(x-600)=49.50\Rightarrow 0.0175x+0.015x-9=49.50\Rightarrow$

$0.0325x-9=49.50\Rightarrow 0.0325x-9+9=49.50+9\Rightarrow$

$0.0325x=58.50\Rightarrow\dfrac{0.0325x}{0.0325}=\dfrac{58.50}{0.0325}\Rightarrow x=1800.$ Therefore, the balance on the 1.75% card is \$1800 and the balance on the 1.5% card is $\$1800-\$600=\$1200$.

Group Activity Working with Real Data

1. Area $(A)=$ length $(l)\times$ width (w). Then, $A=lw=(12)(11)=132\text{ cm}^2$.
2. Volume $(V)=$ length $(l)\times$ width $(w)\times$ height (h). Then, $V=lwh=(12)(11)(5)=660\text{ cm}^3$.
3. The area of the bottom of the box is 50 square centimeters and the formula for area is $A=lw$. Thus, $50=lw$. Since $V=lwh\Rightarrow 100=50h\Rightarrow\dfrac{100}{50}=\dfrac{50h}{50}\Rightarrow 2=h\Rightarrow h=2$ cm.
4. Because one cubic centimeter weighs 2.7 grams, $\dfrac{5.4}{2.7}=2\text{ cm}^3$. Thus, the volume of the aluminum foil is 2 cm^3.
5. Because the sheet of foil weighs 5.4 grams, from the previous problem the volume of the foil is 2 cm^3. Then, insert this information into the volume formula $V=lwh$. Thus,

$V=lwh\Rightarrow 2=(50)(20)h\Rightarrow 2=1000h\Rightarrow\ \dfrac{2}{1000}=\dfrac{1000h}{1000}\Rightarrow\dfrac{2}{1000}=h\Rightarrow h=\dfrac{2}{1000}=0.002$ cm.

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Section 2.4 Formulas

1. formula
2. lw
3. $\frac{1}{2}bh$
4. $\frac{1}{360}$
5. 360
6. 180
7. lwh
8. $2lw+2wh+2lh$
9. $2\pi r$
10. πr^2
11. $\pi r^2 h$
12. $\frac{1}{2}(a+b)h$
13. $A=lw$. Thus, $A=6\cdot 3=18$ ft^2.
14. $A=lw$. Thus, $A=4\cdot 2.5=10$ yd^2.
15. $A=\frac{1}{2}bh$. Thus, $A=\frac{1}{2}\cdot 6\cdot 3=9$ in^2.
16. $A=\frac{1}{2}bh$. Thus, $A=\frac{1}{2}\cdot 3\cdot 1=\frac{3}{2}$ mi^2.
17. $A=\pi r^2$. Thus, $A=\pi 4^2=16\pi\approx 50.3$ cm^2.
18. $A=\pi r^2$. Thus, $A=\pi 3^2=9\pi\approx 28.3$ km^2.
19. $A=\frac{1}{2}(a+b)h$. Thus, $A=\frac{1}{2}(5+6)2=\frac{1}{2}(11)2=11$ mm^2.
20. $A=\frac{1}{2}(a+b)h$. Thus, $A=\frac{1}{2}(4+3)2=\frac{1}{2}(7)2=7$ ft^2.
21. $A=lw$. Thus, $A=13\cdot 7=91$ in^2.
22. $A=\frac{1}{2}bh$. Thus, $A=\frac{1}{2}\cdot 9\cdot 72=324$ cm^2.
23. Convert yards to feet in order to keep the units consistent. Therefore, 7 yards $=7\cdot 3=21$ feet.

    $A=lw$. Thus, $A=21\cdot 5=105$ ft^2. Or, convert feet to yards to obtain $\frac{5}{3}$ yards. Then

    $A=lw=7\cdot\frac{5}{3}=\frac{35}{3}$ yd^2.

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24. $A = \frac{1}{2}bh$. Thus, $A = \frac{1}{2} \cdot 12 \cdot 6 = 36 \text{ mm}^2$.

25. $C = 2\pi r$. Because the circle has a diameter of 8 inches, the radius is $= \frac{8}{2} = 4$ inches. Thus, $C = 2\pi r = 2\pi 4 = 8\pi \approx 25.1$ inches.

26. $A = \pi r^2$. Thus, $A = \pi 9^2 = 81\pi \approx 254.5 \text{ ft}^2$.

27. The total area of the lot is the sum of the area of the square and the area of the triangle. The area of the square is $lw = 52 \cdot 52 = 2704 \text{ ft}^2$. The area of the triangle is $\frac{1}{2}bh = \frac{1}{2} \cdot 73 \cdot 52 = 1898 \text{ ft}^2$. Thus, the area of the lot is $1898 + 2704 = 4602 \text{ ft}^2$.

28. The total area of the lot is the sum of the area of the rectangle and the areas of the two triangles. The area of the rectangle is $lw = 60 \cdot 20 = 1200 \text{ yd}^2$. The area of the triangle on the left is $\frac{1}{2}bh = \frac{1}{2} \cdot 10 \cdot 20 = 100 \text{ yd}^2$. The area of the triangle on the rights is $\frac{1}{2}bh = \frac{1}{2} \cdot 30 \cdot 20 = 300 \text{ yd}^2$. Thus, the total area is $1200 + 100 + 300 = 1600 \text{ yd}^2$.

29. The sum of the angles of a triangle is 180º. Let the unknown angle be represented by x. Then, $x + 75 + 40 = 180 \Rightarrow x + 75 + 40 - 75 - 40 = 180 - 75 - 40 \Rightarrow x = 65$. Thus, the third angle is 65º.

30. The sum of the angles of a triangle is 180º. Let the unknown angle be represented by x. Then, $x + 30 + 25 = 180 \Rightarrow x + 30 + 25 - 30 - 25 = 180 - 30 - 25 \Rightarrow x = 125$. Thus, the third angle is 125º.

31. The sum of the angles of a triangle is 180º. Let the unknown angle be represented by x. Then, $x + 23 + 76 = 180 \Rightarrow x + 23 + 76 - 23 - 76 = 180 - 23 - 76 \Rightarrow x = 81$. Thus, the third angle is 81º.

32. Because there are three angles in any triangle and because the measures of the angles in an equilateral triangle are equal, $x + x + x = 180 \Rightarrow 3x = 180 \Rightarrow \frac{3x}{3} = \frac{180}{3} \Rightarrow x = 60$. Thus, the measure of each angle is 60º.

33. Because the sum of the angles of a triangle is 180, $x + 2x + 2x = 180 \Rightarrow 5x = 180 \Rightarrow \frac{5x}{5} = \frac{180}{5} \Rightarrow x = 36$. Thus, the value of x is 36º.

34. $3x + 4x + 11x = 180 \Rightarrow 18x = 180 \Rightarrow \frac{18x}{18} = \frac{180}{18} \Rightarrow x = 10$. Thus, the value of x is 10º.

35. Let x represent the largest angle. Then, $x + \frac{1}{3}x + \frac{1}{3}x = 180 \Rightarrow \frac{5}{3}x = 180 \Rightarrow \frac{3}{5} \cdot \frac{5}{3}x = \frac{180}{1} \cdot \frac{3}{5} \Rightarrow x = \frac{540}{5} \Rightarrow x = 108$. Thus, the largest angle has a measure of 108º and the two small angles each have measure $\frac{1}{3} \cdot \frac{108}{1} = \frac{108}{3} = 36º$.

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36. Let x represent the largest angle. Then, $x-10$ represents the second largest angle and $x-50$ represents the smallest angle. Then, $x+(x-10)+(x-50)=180 \Rightarrow x+x-10+x-50=180 \Rightarrow$ $3x-60=180 \Rightarrow 3x-60+60=180+60 \Rightarrow 3x=240 \Rightarrow \frac{3x}{3}=\frac{240}{3} \Rightarrow x=80$. Thus, the largest angle has measure 80º, the second largest angle has measure $80-10=70^{\circ}$ and the smallest angle has measure $80-50=30^{\circ}$.

37. $C=2\pi r$. Since the diameter of the circle is 12 inches, the radius is $\frac{12}{2}=6$ inches. Then, $C=2\pi 6=12\pi \approx 37.7$ inches. Then, $A=\pi r^2=\pi 6^2=36\pi \approx 113.1 \text{ in}^2$.

38. $C=2\pi r$. Then, $C=2\pi\left(\frac{5}{4}\right)=\frac{5}{2}\pi \approx 7.9$ feet. Then, $A=\pi r^2=\pi\left(\frac{5}{4}\right)^2=\frac{25}{16}\pi \approx 4.9 \text{ ft}^2$.

39. $C=2\pi r$. Then, set C equal to 2π and solve for r.

$2\pi=2\pi r \Rightarrow \frac{2\pi}{2\pi}=\frac{2\pi r}{2\pi} \Rightarrow 1=r \Rightarrow r=1$ inch. Then, $A=\pi r^2$.

Because $r=1$, substitute 1 for r and solve for A.

$A=\pi(1)^2=\pi$. Thus, the area is equal to π, which is approximately equal to 3.14 in^2.

40. $C=2\pi r$. Then, set C equal to 13π and solve for r.

$13\pi=2\pi r \Rightarrow \frac{13\pi}{2\pi}=\frac{2\pi r}{2\pi} \Rightarrow \frac{13}{2}\cdot\frac{\pi}{\pi}=r \Rightarrow \frac{13}{2}=r \Rightarrow r=\frac{13}{2}$. Thus, the radius is $\frac{13}{2}=6.5$ feet.

Then, $A=\pi r^2$. Thus, $A=\pi(6.5)^2=42.25\pi \approx 132.7 \text{ ft}^2$.

41. $V=lwh$. Thus, $V=22\cdot 12\cdot 10=2640 \text{ in}^3$. Surface area equals $2lw+2lh+2wh$.

Thus, $S=2\cdot 22\cdot 12+2\cdot 22\cdot 10+2\cdot 12\cdot 10=528+440+240=1208 \text{ in}^2$.

42. $V=lwh$. Thus, $V=5\cdot 3\cdot 6=90 \text{ ft}^3$. Surface area equals $2lw+2lh+2wh$.

Thus, $S=2\cdot 5\cdot 3+2\cdot 5\cdot 6+2\cdot 3\cdot 6=30+60+36=126 \text{ ft}^2$.

43. Convert yards to feet. Then, $\frac{2}{3}\text{yard}=\frac{2}{3}\cdot 3=2$ feet. Then, $V=lwh=2\cdot\frac{2}{3}\cdot\frac{3}{2}=2 \text{ ft}^3$. Surface area equals $2lw+2lh+2wh$. Thus, $S=2\cdot 2\cdot\frac{2}{3}+2\cdot 2\cdot\frac{3}{2}+2\cdot\frac{2}{3}\cdot\frac{3}{2}=\frac{8}{3}+6+2=8\frac{8}{3}=10\frac{2}{3} \text{ ft}^2$.

44. $V=lwh$. Thus, $V=1.2\cdot 0.8\cdot 0.6=0.576 \text{ m}^3$. Surface area equals $2lw+2lh+2wh$.

Thus, $S=2\cdot 1.2\cdot 0.8+2\cdot 1.2\cdot 0.6+2\cdot 0.8\cdot 0.6=1.92+1.44+0.96=4.32 \text{ m}^2$.

45. $V=\pi r^2 h$. Thus, $V=\pi 2^2\cdot 5=\pi\cdot 4\cdot 5=20\pi \text{ in}^3$.

46. $V=\pi r^2 h$. Thus, $V=\pi\left(\frac{1}{2}\right)^2\left(\frac{3}{2}\right)=\pi\left(\frac{1}{4}\right)\left(\frac{3}{2}\right)=\frac{3}{8}\pi \text{ in}^3$.

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47. Convert feet to inches to obtain $h = 2 \text{ feet} = 2 \text{ feet} \cdot \dfrac{12 \text{ inches}}{1 \text{ foot}} = 24 \text{ inches}.$

Then, $V = \pi r^2 h$. Thus, $V = \pi 5^2 \cdot 24 = \pi \cdot 25 \cdot 24 = 600\pi \text{ in}^3$.

48. Convert yards to feet to obtain $h = 1.5 \text{ yards} = 1.5 \text{ yards} \cdot \dfrac{3 \text{ feet}}{1 \text{ yard}} = 4.5 \text{ feet}.$ Then,

$V = \pi r^2 h$. Thus, $V = \pi(2.5)^2(4.5) = \pi \cdot 6.25 \cdot 4.5 = 28.125\pi \text{ ft}^3$.

49. (a) $V = \pi r^2 h$. Thus, $V = \pi\left(\dfrac{3}{4}\right)^2\left(\dfrac{5}{2}\right) = \pi\left(\dfrac{9}{16}\right)\left(\dfrac{5}{2}\right) = \pi\left(\dfrac{45}{32}\right) = \dfrac{45}{32}\pi \approx 4.4 \text{ in}^3$.

(b) Because there is about 4.4 cubic inches of volume in the can, the number of fluid ounces is $(4.4)(0.554) \approx 2.4$ fl oz.

50. The volume formula for a cylindrical container is given by $V = \pi r^2 h$. Because the diameter of the barrel is $1\dfrac{3}{4} = \dfrac{7}{4}$ feet, the radius is $\left(\dfrac{1}{2}\right)\left(\dfrac{7}{4}\right) = \dfrac{7}{8}$ feet. Thus,

$V = \pi r^2 h = \pi\left(\dfrac{7}{8}\right)^2(3) = \pi\left(\dfrac{49}{64}\right)(3) = \pi\left(\dfrac{147}{64}\right) = \dfrac{147}{64}\pi \approx 7.2 \text{ ft}^3$.

51. $9x + 3y = 6 \Rightarrow 9x - 9x + 3y = 6 - 9x \Rightarrow 3y = 6 - 9x \Rightarrow \dfrac{3y}{3} = \dfrac{6}{3} - \dfrac{9x}{3} \Rightarrow y = 2 - 3x \Rightarrow y = -3x + 2$

52. $-2x - 2y = 10 \Rightarrow -2x + 2x - 2y = 10 + 2x \Rightarrow -2y = 10 + 2x \Rightarrow \dfrac{-2y}{-2} = \dfrac{10}{-2} + \dfrac{2x}{-2} \Rightarrow$

$y = -5 - x \Rightarrow y = -x - 5$

53. $4x + 3y = 12 \Rightarrow 4x - 4x + 3y = 12 - 4x \Rightarrow 3y = 12 - 4x \Rightarrow \dfrac{3y}{3} = \dfrac{12}{3} - \dfrac{4x}{3} \Rightarrow$

$y = 4 - \dfrac{4}{3}x \Rightarrow y = -\dfrac{4}{3}x + 4$

54. $5x - 2y = 22 \Rightarrow 5x - 5x - 2y = 22 - 5x \Rightarrow -2y = 22 - 5x \Rightarrow \dfrac{-2y}{-2} = \dfrac{22}{-2} - \dfrac{5x}{-2} \Rightarrow$

$y = -11 + \dfrac{5}{2}x \Rightarrow y = \dfrac{5}{2}x - 11$

55. The formula is given as $A = lw$. To solve for w, proceed as follows: $A = lw \Rightarrow \dfrac{A}{l} = \dfrac{lw}{l} \Rightarrow w = \dfrac{A}{l}$.

56. The formula is given as $A = \dfrac{1}{2}bh$. To solve for b, proceed as follows: $A = \dfrac{1}{2}bh \Rightarrow 2A = \dfrac{1}{2}(2)bh \Rightarrow$

$2A = bh \Rightarrow \dfrac{2A}{h} = \dfrac{bh}{h} \Rightarrow b = \dfrac{2A}{h}$.

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57. The formula is given as $V = \pi r^2 h$. To solve for h, proceed as follows: $V = \pi r^2 h \Rightarrow \frac{V}{\pi r^2} = \frac{\pi r^2 h}{\pi r^2} \Rightarrow$

$h = \frac{V}{\pi r^2}$.

58. The formula is given as $V = \frac{1}{3}\pi r^2 h$. To solve for h, proceed as follows:

$V = \frac{1}{3}\pi r^2 h \Rightarrow 3V = \frac{1}{3}(3)\pi r^2 h \Rightarrow \ 3V = \pi r^2 h \Rightarrow \frac{3V}{\pi r^2} = \frac{\pi r^2 h}{\pi r^2} \Rightarrow h = \frac{3V}{\pi r^2}$.

59. The formula is given as $A = \frac{1}{2}(a+b)h$ To solve for a, proceed as follows: $A = \frac{1}{2}(a+b)h \Rightarrow$

$2A = \frac{1}{2}(2)(a+b)h \Rightarrow 2A = (a+b)h \Rightarrow \frac{2A}{h} = \frac{(a+b)h}{h} \Rightarrow \frac{2A}{h} = a+b \Rightarrow \frac{2A}{h} - b = a+b-b \Rightarrow$

$a = \frac{2A}{h} - b$.

60. The formula is given as $C = 2\pi r$. To solve for r, proceed as follows:

$C = 2\pi r \Rightarrow \frac{C}{2\pi} = \frac{2\pi r}{2\pi} \Rightarrow r = \frac{C}{2\pi}$.

61. The formula is given as $V = lwh$. To solve for w, proceed as follows: $V = lwh \Rightarrow \frac{V}{lh} = \frac{lwh}{lh} \Rightarrow$

$w = \frac{V}{lh}$.

62. $P = 2l + 2w \Rightarrow P - 2l = 2l - 2l + 2w \Rightarrow P - 2l = 2w \Rightarrow \frac{P-2l}{2} = \frac{2w}{2} \Rightarrow w = \frac{P-2l}{2}$

63. $s = \frac{a+b+c}{2} \Rightarrow 2s = \frac{a+b+c}{2} \cdot 2 \Rightarrow 2s = a+b+c \Rightarrow 2s-a-c = a+b+c-a-c \Rightarrow$

$2s-a-c = b \Rightarrow b = 2s-a-c$

64. $t = \frac{x-y}{3} \Rightarrow 3t = \frac{x-y}{3} \cdot 3 \Rightarrow 3t = x-y \Rightarrow 3t+y = x-y+y \Rightarrow 3t+y = x \Rightarrow x = 3t+y$

65. $\frac{a}{b} - \frac{c}{b} = 1 \Rightarrow b\left(\frac{a}{b} - \frac{c}{b}\right) = 1(b) \Rightarrow a-c = b \Rightarrow b = a-c$

66. $\frac{x}{y} + \frac{z}{y} = 5 \Rightarrow y\left(\frac{x}{y} + \frac{z}{y}\right) = 5y \Rightarrow x+z = 5y \Rightarrow x-x+z = 5y-x \Rightarrow z = 5y-x$

67. $ab = cd + ad \Rightarrow ab - ad = cd + ad - ad \Rightarrow ab - ad = cd \Rightarrow a(b-d) = cd \Rightarrow$

$\frac{a(b-d)}{(b-d)} = \frac{cd}{(b-d)} \Rightarrow a = \frac{cd}{b-d}$

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68. $S = 2lw + 2lh + 2wh \Rightarrow S - 2lh = 2lw + 2lh + 2wh - 2lh \Rightarrow S - 2lh = 2lw + 2wh \Rightarrow$

$S - 2lh = w(2l + 2h) \Rightarrow \dfrac{S - 2lh}{(2l + 2h)} = \dfrac{w(2l + 2h)}{(2l + 2h)} \Rightarrow \dfrac{S - 2lh}{(2l + 2h)} = w \Rightarrow w = \dfrac{S - 2lh}{(2l + 2h)}$

69. Because the perimeter equals the lengths of the four sides, $P = 2W + 2L$. Thus, $P = 2W + 2L \Rightarrow$

$40 = 2(5) + 2L \Rightarrow 40 = 10 + 2L \Rightarrow 40 - 10 = 10 + 2L - 10 \Rightarrow 2L = 30 \Rightarrow \dfrac{2L}{2} = \dfrac{30}{2} \Rightarrow L = 15$ Thus, the length of the rectangle is 15 inches.

70. Let x represent the length of the third side. Thus, $5 + 7 + x = 21 \Rightarrow 5 + 7 + x - 5 - 7 = 21 - 5 - 7 \Rightarrow$ $x = 9$. Thus, the length of the third side is 9 feet.

71. The formula for GPA is given by $\dfrac{4a + 3b + 2c + d}{a + b + c + d + f}$.

$\dfrac{4(30) + 3(45) + 2(12) + 1(4)}{30 + 45 + 12 + 4 + 4} = \dfrac{120 + 135 + 24 + 4}{95} = \dfrac{283}{95} \approx 2.98$. Thus, the GPA is 2.98.

72. The formula for GPA is given by $\dfrac{4a + 3b + 2c + d}{a + b + c + d + f}$.

$\dfrac{4(70) + 3(35) + 2(5) + 1(0)}{70 + 35 + 5 + 0 + 0} = \dfrac{280 + 105 + 10 + 0}{110} = \dfrac{395}{110} \approx 3.59$. Thus, the GPA is 3.59.

73. The formula for GPA is given by $\dfrac{4a + 3b + 2c + d}{a + b + c + d + f}$.

$\dfrac{4(0) + 3(60) + 2(80) + 1(10)}{0 + 60 + 80 + 10 + 6} = \dfrac{0 + 180 + 160 + 10}{156} = \dfrac{350}{156} \approx 2.24$. Thus, the GPA is 2.24.

74. The formula for GPA is given by $\dfrac{4a + 3b + 2c + d}{a + b + c + d + f}$.

$\dfrac{4(3) + 3(5) + 2(8) + 1(0)}{3 + 5 + 8 + 0 + 22} = \dfrac{12 + 15 + 16 + 0}{38} = \dfrac{43}{38} \approx 1.13$. Thus, the GPA is 1.13.

75. To convert Celsius to Fahrenheit temperature, the formula given is $\dfrac{9}{5}C + 32 = F$.

$\dfrac{9}{5}(25) + 32 = F \Rightarrow \dfrac{225}{5} + \dfrac{160}{5} = F \Rightarrow \dfrac{385}{5} = F \Rightarrow F = 77°\text{F}$.

76. To convert Celsius to Fahrenheit temperature, the formula given is $\dfrac{9}{5}C + 32 = F$.

$\dfrac{9}{5}(100) + 32 = F \Rightarrow \dfrac{900}{5} + \dfrac{160}{5} = F \Rightarrow \dfrac{1060}{5} = F \Rightarrow F = 212°\text{F}$.

77. To convert Celsius to Fahrenheit temperature, the formula given is $\dfrac{9}{5}C + 32 = F$.

$\dfrac{9}{5}(-40) + 32 = F \Rightarrow \dfrac{-360}{5} + \dfrac{160}{5} = F \Rightarrow \dfrac{-200}{5} = F \Rightarrow F = -40°\text{F}$.

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78. To convert Celsius to Fahrenheit temperature, the formula given is $\frac{9}{5}C+32=F$.

$\frac{9}{5}(0)+32=F \Rightarrow \frac{0}{5}+\frac{160}{5}=F \Rightarrow \frac{160}{5}=F \Rightarrow F=32°\text{F}.$

79. To convert Fahrenheit to Celsius temperature, the formula given is $C=\frac{5}{9}(F-32)$.

$C=\frac{5}{9}(23-32) \Rightarrow C=\frac{5}{9}(-9) \Rightarrow C=\frac{-45}{9} \Rightarrow C=-5°\text{C}.$

80. To convert Fahrenheit to Celsius temperature, the formula given is $C=\frac{5}{9}(F-32)$.

$C=\frac{5}{9}(98.6-32) \Rightarrow C=\frac{5}{9}(66.6) \Rightarrow C=\frac{333}{9} \Rightarrow C=37°\text{C}.$

81. To convert Fahrenheit to Celsius temperature, the formula given is $C=\frac{5}{9}(F-32)$.

$C=\frac{5}{9}(-4-32) \Rightarrow C=\frac{5}{9}(-36) \Rightarrow C=\frac{-180}{9} \Rightarrow C=-20°\text{C}.$

82. To convert Fahrenheit to Celsius temperature, the formula given is $C=\frac{5}{9}(F-32)$.

$C=\frac{5}{9}(-31-32) \Rightarrow C=\frac{5}{9}(-63) \Rightarrow C=\frac{-315}{9} \Rightarrow C=-35°\text{C}.$

83. The formula for calculating gas mileage is $M=\frac{D}{G}$, where D is the distance and G is the gasoline used. Therefore, $M=\frac{88,043-87,625}{38} \Rightarrow M=\frac{418}{38} \Rightarrow M=11$ mpg.

84. The formula for gas mileage is $M=\frac{D}{G}$, where D is the distance and G is the gasoline used.

Therefore, $34=\frac{578}{G} \Rightarrow 34G=\left(\frac{578}{G}\right)G \Rightarrow 34G=578 \Rightarrow \frac{34G}{34}=\frac{578}{34} \Rightarrow G=17$ gal.

85. $D=\frac{x}{5} \Rightarrow D=\frac{12}{5} \Rightarrow D=2\frac{2}{5}=2.4$ miles.

86. $D=\frac{x}{5} \Rightarrow 2.5=\frac{x}{5} \Rightarrow 5(2.5)=\frac{x}{5}\cdot 5 \Rightarrow 12.5=x \Rightarrow x=12.5$ seconds.

Checking Basic Concepts Sections 2.3 and 2.4

1. (a) $3x=36 \Rightarrow \frac{3x}{3}=\frac{36}{3} \Rightarrow x=12$

(b) $35-x=43 \Rightarrow 35-35-x=43-35 \Rightarrow -x=8 \Rightarrow -1(x)=8(-1) \Rightarrow x=-8$

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2. $x+(x+1)+(x+2)=-93 \Rightarrow 3x+3=-93 \Rightarrow 3x+3-3=-93-3 \Rightarrow 3x=-96 \Rightarrow$

$\frac{3x}{3}=\frac{-96}{3} \Rightarrow x=-32$. The three consecutive integers are $-32, -31, -30$.

3. $9.5\% = 0.095$

4. $\frac{5}{4}=1\frac{1}{4}=1.25=125\%$

5. Convert 38.8% to the decimal 0.388 and let x represent the unknown rate. Therefore,

$x-0.388x=46,357$. Thus, $x-0.388x=46,357 \Rightarrow 0.612x=46,357 \Rightarrow$

$\frac{0.612x}{0.612}=\frac{46,357}{0.612} \Rightarrow x \approx 75,747$. Thus, the rate in 2009 was about 75,747.

6. Use the formula $D=rt$, where D is distance, r is the speed and t is the time. Thus, $390=60t \Rightarrow$

$\frac{390}{60}=\frac{60t}{60} \Rightarrow 6.5=t$. Thus, the travel time is 6.5 hours.

7. Let x represent the amount of the loan at 7% and $x+2000$ represent the amount of the loan at 6%. Thus, $0.07x+0.06(x+2000)=510 \Rightarrow 0.07x+0.06x+120=510 \Rightarrow$

$0.13x+120-120=510-120 \Rightarrow 0.13x=390 \Rightarrow \frac{0.13x}{0.13}=\frac{390}{0.13} \Rightarrow x=3000$. Thus, the loan at 7% was \$3000 and the loan at 6% was \$5000.

8. The formula for gas mileage is $M=\frac{D}{G}$, where D is the distance and G is the gasoline used.

Therefore, $28=\frac{504}{G} \Rightarrow 28G=\left(\frac{504}{G}\right)G \Rightarrow 28G=504 \Rightarrow \frac{28G}{28}=\frac{504}{28} \Rightarrow G=18$ gal.

9. The area of a triangle is given by $A=\frac{1}{2}bh$. Thus, $A=\frac{1}{2}bh \Rightarrow 36=\frac{1}{2}(6)h \Rightarrow 36=3h \Rightarrow \frac{36}{3}=\frac{3h}{3} \Rightarrow$

$12=h$. Thus, the height of the triangle is 12 inches.

10. The area of a circle is given by $A=\pi r^2$. Thus, $A=\pi r^2 \Rightarrow A=\pi(3)^2 \Rightarrow A=9\pi \approx 28.3$ ft^2.

The circumference of a circle is given by $C=2\pi r$. Thus, $C=2\pi r \Rightarrow C=2\pi 3 \Rightarrow C=6\pi \approx 18.8$ feet.

11. $x+2x+3x=180 \Rightarrow 6x=180 \Rightarrow \frac{6x}{6}=\frac{180}{6} \Rightarrow x=30$. Thus, the value of x is 30º.

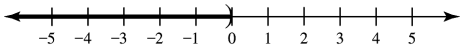
12. $A=\pi r^2+\pi rl \Rightarrow A-\pi r^2=\pi r^2-\pi r^2+\pi rl \Rightarrow A-\pi r^2=\pi rl \Rightarrow \frac{A-\pi r^2}{\pi r}=\frac{\pi rl}{\pi r} \Rightarrow l=\frac{A-\pi r^2}{\pi r}$

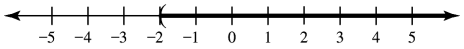
Section 2.5 Linear Inequalities

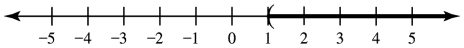
1. $<; \leq; >; \geq$
2. greater than; less than
3. solution

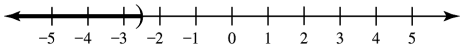
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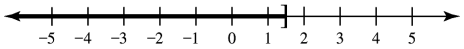
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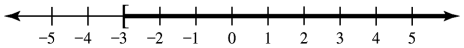
4. equivalent
5. True
6. True
7. number line
8. >
9. <
10. >
11. 

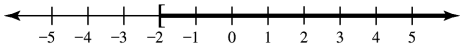
12. 

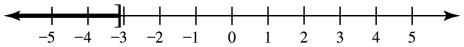
13. 

14. 

15. 

16. 

17. 

18. 

19. $x < 0$
20. $x \geq -2$
21. $x \leq 3$
22. $x > -5$
23. $x \geq 10$
24. $x < -20$
25. $[6, \infty)$
26. $(-\infty, 3)$
27. $(-2, \infty)$
28. $[1, \infty)$
29. $(-\infty, 7]$
30. $(-\infty, -5)$
31. Substitute x with 4 in order to test the inequality. Thus, $x + 5 > 5 \Rightarrow 4 + 5 > 5 \Rightarrow 9 > 5$. Because this inequality statement is true, $x = 4$ is a solution.
32. Substitute x with -2 in order to test the inequality. Thus, $-3(-2) \leq -8 \Rightarrow 6 \leq -8$. Because this inequality statement is not true, $x = -2$ is not a solution.
33. Substitute x with 5 in order to test the inequality. Thus, $5(5) \geq 25 \Rightarrow 25 \geq 25$. Because this inequality statement is true, $x = 5$ is a solution.

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34. Substitute y with -3 in order to test the inequality. Thus, $4(-3)-3\le 5 \Rightarrow -12-3\le 5 \Rightarrow -15\le 5$

Because this inequality statement is true, $y=-3$ is a solution.

35. Substitute y with -3 in order to test the inequality. Thus, $3(-3)+5\ge -8 \Rightarrow -9+5\ge -8 \Rightarrow -4\ge -8$

Because this inequality statement is true, $y=-3$ is a solution.

36. Substitute z with 2 in order to test the inequality. Thus, $-(2+7)>3(6-2) \Rightarrow -(9)>3(4) \Rightarrow -9>12$

Because this inequality statement is not true, $z=2$ is not a solution.

37. Substitute z with -4 in order to test the inequality. Thus,

$5(-4+1)<3(-4)-7 \Rightarrow 5(-3)<-12-7 \Rightarrow -15<-19$ Because this inequality statement is not true, $z=-4$ is not a solution.

38. Substitute t with $\frac{3}{5}$ in order to test the inequality. Thus,

$$\frac{3}{2}\left(\frac{3}{5}\right)-\frac{1}{2}\ge 1-\frac{3}{5} \Rightarrow \frac{9}{10}-\frac{1}{2}\ge \frac{5}{5}-\frac{3}{5} \Rightarrow \frac{9}{10}-\frac{5}{10}\ge \frac{2}{5} \Rightarrow \frac{4}{10}\ge \frac{2}{5} \Rightarrow \frac{2}{5}\ge \frac{2}{5}$$

Because this inequality statement is true, $t=\frac{3}{5}$ is a solution.

39. $x>-2$

40. $x\ge 2$

41. $x<1$

42. $x\le 3.8$

43. To complete the table, insert the x value into $-2x+6$ whenever there is a missing value in the table. Thus, $-2x+6 \Rightarrow -2(2)+6 \Rightarrow -4+6=2$; $-2x+6 \Rightarrow -2(3)+6 \Rightarrow -6+6=0$;

$-2x+6 \Rightarrow -2(4)+6 \Rightarrow -8+6=-2$. Thus, the missing values in the table are 2, 0 and -2.

See Figure 43.

From the table, we see that $-2x+6\le 0$ whenever $x\ge 3$. Thus, the solution to the inequality is $x\ge 3$.

x	1	2	3	4	5
$-2x+6$	4	2	0	-2	-4

Figure 43

x	0	1	2	3	4
$3x-1$	-1	2	5	8	11

Figure 44

44. To complete the table, insert the x value into $3x-1$ whenever there is a missing value in the table. Thus, $3x-1 \Rightarrow 3(1)-1 \Rightarrow 3-1=2$; $3x-1 \Rightarrow 3(2)-1 \Rightarrow 6-1=5$;

$3x-1 \Rightarrow 3(3)-1 \Rightarrow 9-1=8$; $3x-1 \Rightarrow 3(4)-1 \Rightarrow 12-1=11$. Thus, the missing values in the table are 2, 5, 8 and 11. See Figure 44.

From the table, we see that $3x-1<8$ whenever $x<3$. Thus, the solution to the inequality is $x<3$.

45. To complete the table, insert the x value into $5-x$ and $x+7$ whenever there is a missing value in the table. $5-x \Rightarrow 5-(-2)=7$; $5-x \Rightarrow 5-(-1)=6$; $5-x \Rightarrow 5-(0)=5$.

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Thus, the missing values in the table that correspond to $5-x$ are 7, 6 and 5.

$x+7 \Rightarrow (-2)+7=5;\ x+7 \Rightarrow (-1)+7=6;\ x+7 \Rightarrow (0)+7=7.$

Thus, the missing values in the table that correspond to $x+7$ are 5, 6 and 7. See Figure 45.

From the table, we see that $5-x > x+7$ whenever $x<-1$. The solution to the inequality is $x<-1$.

x	-3	-2	-1	0	1
$5-x$	8	7	6	5	4
$x+7$	4	5	6	7	8

Figure 45

x	-2	-1	0	1	2
$2(3-x)$	10	8	6	4	2
$-3(x-2)$	12	9	6	3	0

Figure 46

46. To complete the table, insert the x value into $2(3-x)$ and $-3(x-2)$ whenever there is a missing value in the table. $2(3-x) \Rightarrow 2(3-(-2)) \Rightarrow 2(5)=10;\ 2(3-x) \Rightarrow 2(3-(-1)) \Rightarrow 2(4)=8;$

$2(3-x) \Rightarrow\ 2(3-(0)) \Rightarrow 2(3)=6;\ 2(3-x) \Rightarrow 2(3-1) \Rightarrow 2(2)=4;$

$2(3-x) \Rightarrow 2(3-2) \Rightarrow 2(1)=2.$ Thus, the missing values that correspond to $2(3-x)$ are 10, 8, 6, 4 and 2. $-3(x-2) \Rightarrow -3(-2-2) \Rightarrow -3(-4)=12;\ -3(x-2) \Rightarrow -3(-1-2) \Rightarrow -3(-3)=9;$

$-3(x-2) \Rightarrow -3(0-2) \Rightarrow -3(-2)=6;\ -3(x-2) \Rightarrow -3(1-2) \Rightarrow -3(-1)=3;$

$-3(x-2) \Rightarrow -3(2-2) \Rightarrow -3(0)=0.$ Thus, the missing values that correspond to $-3(x-2)$ are 12, 9, 6, 3 and 0. See Figure 46. From the table, we see that $2(3-x) \geq -3(x-2)$ whenever $x \geq 0$. Thus, the solution to the inequality is $x \geq 0$.

47. $x-3>0 \Rightarrow x-3+3>0+3 \Rightarrow x>3.$ See Figure 47.

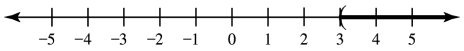


Figure 47

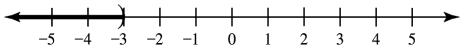


Figure 48

48. $x+6<3 \Rightarrow x+6-6<3-6 \Rightarrow x<-3.$ See Figure 48.

49. $3-y \leq 5 \Rightarrow 3-5-y+y \leq 5-5+y \Rightarrow -2 \leq y \Rightarrow y \geq -2.$ See Figure 49.

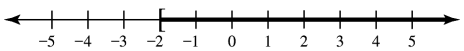


Figure 49

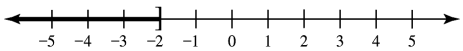


Figure 50

50. $8-y \geq 10 \Rightarrow 8-10-y+y \geq 10-10+y \Rightarrow -2 \geq y \Rightarrow y \leq -2.$ See Figure 50.

51. $12<4+z \Rightarrow 12-4<4-4+z \Rightarrow 8<z \Rightarrow z>8.$ See Figure 51.

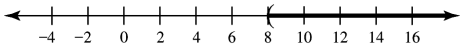


Figure 51

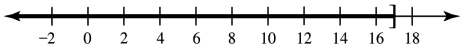


Figure 52

52. $2z \leq z+17 \Rightarrow 2z-z \leq z-z+17 \Rightarrow z \leq 17.$ See Figure 52.

53. $5-2t \geq 10-t \Rightarrow 5-10-2t+2t \geq 10-10-t+2t \Rightarrow -5 \geq t \Rightarrow t \leq -5.$ See Figure 53.

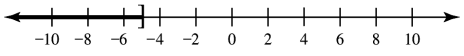


Figure 53

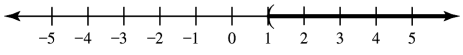


Figure 54

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54. $-2t > -3t + 1 \Rightarrow -2t + 3t > -3t + 3t + 1 \Rightarrow t > 1$. See Figure 54.

55. $2x < 10 \Rightarrow \frac{2x}{2} < \frac{10}{2} \Rightarrow x < 5$. See Figure 55.

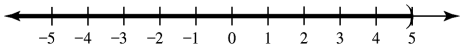


Figure 55

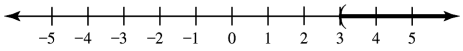


Figure 56

56. $3x > 9 \Rightarrow \frac{3x}{3} > \frac{9}{3} \Rightarrow x > 3$. See Figure 56.

57. $-\frac{1}{2}t \geq 1 \Rightarrow -2 \cdot \frac{1}{-2}t \leq -2 \cdot 1 \Rightarrow t \leq -2$. See Figure 57.

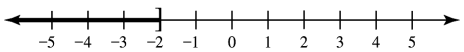


Figure 57

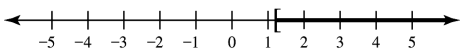


Figure 58

58. $-5t \leq -6 \Rightarrow \frac{-5t}{-5} \geq \frac{-6}{-5} \Rightarrow t \geq \frac{6}{5}$. See Figure 58.

59. $\frac{3}{4} > -5y \Rightarrow -5y < \frac{3}{4} \Rightarrow \frac{-5y}{-5} > \frac{\frac{3}{4}}{-5} \Rightarrow y > \frac{3}{4} \cdot \left(-\frac{1}{5}\right) \Rightarrow y > -\frac{3}{20}$. See Figure 59.

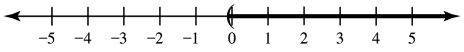


Figure 59

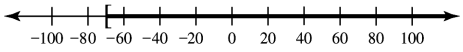


Figure 60

60. $10 \geq -\frac{1}{7}y \Rightarrow -\frac{1}{7}y \leq 10 \Rightarrow -\frac{7}{1}\left(-\frac{1}{7}y\right) \geq \frac{10}{1}\left(-\frac{7}{1}\right) \Rightarrow y \geq -70$. See Figure 60.

61. $-\frac{2}{3} \leq \frac{1}{7}z \Rightarrow \frac{1}{7}z \geq -\frac{2}{3} \Rightarrow \frac{7}{1}\left(\frac{1}{7}z\right) \geq -\frac{2}{3}\left(\frac{7}{1}\right) \Rightarrow z \geq -\frac{14}{3}$. See Figure 61.

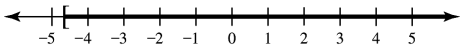


Figure 61

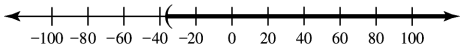


Figure 62

62. $-\frac{3}{10}z < 11 \Rightarrow -\frac{10}{3}\left(-\frac{3}{10}\right)z > 11\left(-\frac{10}{3}\right) \Rightarrow z > -\frac{110}{3}$. See Figure 62.

63. $x + 6 > 7 \Rightarrow x + 6 - 6 > 7 - 6 \Rightarrow x > 1 \Rightarrow \{x \mid x > 1\}$

64. $x + 4 < 1 \Rightarrow x + 4 - 4 < 1 - 4 \Rightarrow x < -3 \Rightarrow \{x \mid x < -3\}$

65. $-3x \leq 21 \Rightarrow \frac{-3x}{-3} \geq \frac{21}{-3} \Rightarrow x \geq -7 \Rightarrow \{x \mid x \geq -7\}$

66. $4x \geq -20 \Rightarrow \frac{4x}{4} \geq \frac{-20}{4} \Rightarrow x \geq -5 \Rightarrow \{x \mid x \geq -5\}$

67. $2x - 3 < 9 \Rightarrow 2x - 3 + 3 < 9 + 3 \Rightarrow 2x < 12 \Rightarrow \frac{2x}{2} < \frac{12}{2} \Rightarrow x < 6 \Rightarrow \{x \mid x < 6\}$

68. $-5x + 4 < 44 \Rightarrow -5x + 4 - 4 < 44 - 4 \Rightarrow -5x < 40 \Rightarrow \frac{-5x}{-5} > \frac{40}{-5} \Rightarrow x > -8 \Rightarrow \{x \mid x > -8\}$

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69. $3x+1<22 \Rightarrow 3x+1-1<22-1 \Rightarrow 3x<21 \Rightarrow \frac{3x}{3}<\frac{21}{3} \Rightarrow x<7$

70. $4+5x \le 9 \Rightarrow 4-4+5x \le 9-4 \Rightarrow 5x \le 5 \Rightarrow \frac{5x}{5} \le \frac{5}{5} \Rightarrow x \le 1$

71. $5-\frac{3}{4}x \ge 6 \Rightarrow 5-5-\frac{3}{4}x \ge 6-5 \Rightarrow -\frac{3}{4}x \ge 1 \Rightarrow -\frac{4}{3}\left(-\frac{3}{4}x\right) \le 1\left(-\frac{4}{3}\right) \Rightarrow x \le -\frac{4}{3}$

72. $10-\frac{2}{5}x>0 \Rightarrow 10-10-\frac{2}{5}x>0-10 \Rightarrow -\frac{2}{5}x>-10 \Rightarrow -\frac{5}{2}\left(-\frac{2}{5}x\right)<-10\left(-\frac{5}{2}\right) \Rightarrow x<\frac{50}{2} \Rightarrow \ x<25$

73. $45>6-2x \Rightarrow 6-2x<45 \Rightarrow 6-6-2x<45-6 \Rightarrow -2x<39 \Rightarrow \frac{-2x}{-2}>\frac{39}{-2} \Rightarrow x>-\frac{39}{2}$

74. $69 \ge 3-11x \Rightarrow 3-11x \le 69 \Rightarrow 3-3-11x \le 69-3 \Rightarrow -11x \le 66 \Rightarrow \frac{-11x}{-11} \ge \frac{66}{-11} \Rightarrow x \ge -6$

75. $5x-2 \le 3x+1 \Rightarrow 5x-3x-2 \le 3x-3x+1 \Rightarrow 2x-2 \le 1 \Rightarrow 2x-2+2 \le 1+2 \Rightarrow 2x \le 3 \Rightarrow$

$\frac{2x}{2} \le \frac{3}{2} \Rightarrow x \le \frac{3}{2}$

76. $12x+1<25-3x \Rightarrow 12x+3x+1<25-3x+3x \Rightarrow 15x+1<25 \Rightarrow 15x+1-1<25-1 \Rightarrow$

$15x<24 \Rightarrow \frac{15x}{15}<\frac{24}{15} \Rightarrow x<\frac{8}{5}$

77. $-x+24<x+23 \Rightarrow -x-x+24<x-x+23 \Rightarrow -2x+24<23 \Rightarrow -2x+24-24<23-24 \Rightarrow$

$-2x<-1 \Rightarrow \frac{-2x}{-2}>\frac{-1}{-2} \Rightarrow x>\frac{1}{2}$

78. $6-4x \le x+1 \Rightarrow 6-4x-x \le x-x+1 \Rightarrow 6-5x \le 1 \Rightarrow 6-6-5x \le 1-6 \Rightarrow -5x \le -5 \Rightarrow$

$\frac{-5x}{-5} \ge \frac{-5}{-5} \Rightarrow x \ge 1$

79. $-(x+1) \ge 3(x-2) \Rightarrow -x-1 \ge 3x-6 \Rightarrow -x-3x-1 \ge 3x-3x-6 \Rightarrow -4x-1 \ge -6 \Rightarrow$

$-4x-1+1 \ge -6+1 \Rightarrow -4x \ge -5 \Rightarrow \frac{-4x}{-4} \le \frac{-5}{-4} \Rightarrow x \le \frac{5}{4}$

80. $5(x+2)>-2(x-3) \Rightarrow 5x+10>-2x+6 \Rightarrow 5x+2x+10>-2x+2x+6 \Rightarrow 7x+10>6 \Rightarrow$

$7x+10-10>6-10 \Rightarrow 7x>-4 \Rightarrow \frac{7x}{7}>\frac{-4}{7} \Rightarrow x>-\frac{4}{7}$

81. $3(2x+1)>-(5-3x) \Rightarrow 6x+3>-5+3x \Rightarrow 6x-3x+3>-5+3x-3x \Rightarrow 3x+3>-5 \Rightarrow$

$3x+3-3>-5-3 \Rightarrow 3x>-8 \Rightarrow \frac{3x}{3}>\frac{-8}{3} \Rightarrow x>-\frac{8}{3}$

82. $4x \ge -3(7-2x)+1 \Rightarrow 4x \ge -21+6x+1 \Rightarrow 4x \ge 6x-20 \Rightarrow 4x-6x \ge 6x-6x-20 \Rightarrow$

$-2x \ge -20 \Rightarrow \frac{-2x}{-2} \le \frac{-20}{-2} \Rightarrow x \le 10$

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83. $1.6x+0.4\le 0.4x \Rightarrow 1.6x-0.4x+0.4\le 0.4x-0.4x \Rightarrow 1.2x+0.4\le 0 \Rightarrow$

$1.2x+0.4-0.4\le 0-0.4 \Rightarrow 1.2x\le -0.4 \Rightarrow \frac{1.2x}{1.2}\le \frac{-0.4}{1.2} \Rightarrow x\le -\frac{1}{3}$

84. $-5.1x+1.1<0.1-0.1x \Rightarrow -5.1x+0.1x+1.1<0.1-0.1x+0.1x \Rightarrow -5x+1.1<0.1 \Rightarrow$

$-5x+1.1-1.1<0.1-1.1 \Rightarrow -5x<-1 \Rightarrow \frac{-5x}{-5}>\frac{-1}{-5} \Rightarrow x>\frac{1}{5}$

85. $0.8x-0.5<x+1-0.5x \Rightarrow 0.8x-0.5<0.5x+1 \Rightarrow 0.8x-0.5x-0.5<0.5x-0.5x+1 \Rightarrow$

$0.3x-0.5<1 \Rightarrow 0.3x-0.5+0.5<1+0.5 \Rightarrow 0.3x<1.5 \Rightarrow \frac{0.3x}{0.3}<\frac{1.5}{0.3} \Rightarrow x<5$

86. $0.1(x+1)-0.1\le 0.2x-0.5 \Rightarrow 0.1x+0.1-0.1\le 0.2x-0.5 \Rightarrow 0.1x\le 0.2x-0.5 \Rightarrow$

$0.1x-0.2x\le 0.2x-0.2x-0.5 \Rightarrow -0.1x\le -0.5 \Rightarrow \frac{-0.1x}{-0.1}\ge \frac{-0.5}{-0.1} \Rightarrow x\ge 5$

87. $-\frac{1}{2}\left(\frac{2}{3}x+4\right)\ge x \Rightarrow -\frac{1}{3}x-2\ge x \Rightarrow -\frac{1}{3}x-x-2\ge x-x \Rightarrow -\frac{4}{3}x-2\ge 0 \Rightarrow$

$-\frac{4}{3}x-2+2\ge 0+2 \Rightarrow -\frac{4}{3}x\ge 2 \Rightarrow -\frac{3}{4}\left(-\frac{4}{3}x\right)\le 2\left(-\frac{3}{4}\right) \Rightarrow x\le -\frac{3}{2}$

88. $-5x>\frac{4}{5}\left(\frac{10}{3}x+10\right) \Rightarrow -5x>\frac{8}{3}x+8 \Rightarrow -5x-\frac{8}{3}x>\frac{8}{3}x-\frac{8}{3}x+8 \Rightarrow -\frac{15}{3}x-\frac{8}{3}x>8 \Rightarrow$

$-\frac{23}{3}x>8 \Rightarrow -\frac{3}{23}\left(-\frac{23}{3}x\right)<8\left(-\frac{3}{23}\right) \Rightarrow x<-\frac{24}{23}$

89. $\frac{3}{7}x+\frac{2}{7}>-\frac{1}{7}x-\frac{5}{14} \Rightarrow \frac{3}{7}x+\frac{1}{7}x+\frac{2}{7}>-\frac{1}{7}x+\frac{1}{7}x-\frac{5}{14} \Rightarrow \frac{4}{7}x+\frac{2}{7}>-\frac{5}{14} \Rightarrow$

$\frac{4}{7}x+\frac{2}{7}-\frac{2}{7}>-\frac{5}{14}-\frac{2}{7} \Rightarrow \frac{4}{7}x>-\frac{5}{14}-\frac{4}{14} \Rightarrow \frac{4}{7}x>-\frac{9}{14} \Rightarrow \frac{7}{4}\left(\frac{4}{7}x\right)>-\frac{9}{14}\left(\frac{7}{4}\right) \Rightarrow x>-\frac{63}{56} \Rightarrow x>-\frac{9}{8}$

90. $\frac{5}{6}-\frac{1}{3}x\ge -\frac{1}{3}\left(\frac{5}{6}x-1\right) \Rightarrow \frac{5}{6}-\frac{1}{3}x\ge -\frac{5}{18}x+\frac{1}{3} \Rightarrow \frac{5}{6}-\frac{1}{3}x+\frac{5}{18}x\ge -\frac{5}{18}x+\frac{5}{18}x+\frac{1}{3} \Rightarrow$

$\frac{5}{6}-\frac{6}{18}x+\frac{5}{18}x\ge \frac{1}{3} \Rightarrow \frac{5}{6}-\frac{1}{18}x\ge \frac{1}{3} \Rightarrow \frac{5}{6}-\frac{5}{6}-\frac{1}{18}x\ge \frac{1}{3}-\frac{5}{6} \Rightarrow -\frac{1}{18}x\ge \frac{2}{6}-\frac{5}{6} \Rightarrow -\frac{1}{18}x\ge -\frac{1}{2} \Rightarrow$

$-\frac{18}{1}\left(-\frac{1}{18}x\right)\le -\frac{1}{2}\left(-\frac{18}{1}\right) \Rightarrow x\le 9$

91. $\frac{x}{3}+\frac{5x}{6}\le \frac{2}{3} \Rightarrow \frac{2x}{6}+\frac{5x}{6}\le \frac{2}{3} \Rightarrow \frac{7x}{6}\le \frac{2}{3} \Rightarrow 6\left(\frac{7x}{6}\right)\le \frac{2}{3}(6) \Rightarrow 7x\le 4 \Rightarrow \frac{7x}{7}\le \frac{4}{7} \Rightarrow x\le \frac{4}{7}$

92. $\frac{3x}{4}-\frac{x}{2}<1 \Rightarrow \frac{3x}{4}-\frac{2x}{4}<1 \Rightarrow \frac{x}{4}<1 \Rightarrow 4\left(\frac{x}{4}\right)<1(4) \Rightarrow x<4$

93. $\frac{6x}{7}<\frac{1}{3}x+1 \Rightarrow \frac{6x}{7}-\frac{1}{3}x<\frac{1}{3}x-\frac{1}{3}x+1 \Rightarrow \frac{6x}{7}-\frac{x}{3}<1 \Rightarrow \frac{18x}{21}-\frac{7x}{21}<1 \Rightarrow \frac{11x}{21}<1 \Rightarrow$

$21\left(\frac{11x}{21}\right)<1(21) \Rightarrow 11x<21 \Rightarrow \frac{11x}{11}<\frac{21}{11} \Rightarrow x<\frac{21}{11}$

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94. $\frac{5x}{8}-\frac{3x}{4}\le 8 \Rightarrow \frac{5x}{8}-\frac{6x}{8}\le 8 \Rightarrow \frac{-x}{8}\le 8 \Rightarrow 8\left(\frac{-x}{8}\right)\le 8(8) \Rightarrow -x\le 64 \Rightarrow -1(-x)\ge 64(-1) \Rightarrow x\ge -64$

95. $x>60$

96. $x\le 60$

97. $x\ge 21$

98. $x<21$

99. $x>40{,}000$

100. $x\le 40{,}000$

101. $x\le 70$

102. $x\ge 70$

103. $2(x+5)+2x<50 \Rightarrow 2x+10+2x<50 \Rightarrow 4x+10<50 \Rightarrow 4x+10-10<50-10 \Rightarrow$

$4x<40 \Rightarrow \frac{4x}{4}<\frac{40}{4} \Rightarrow x<10$ feet.

104. The area of a triangle is $\frac{1}{2}bh$. Substitute 12 for h and solve. $\frac{1}{2}bh<120 \Rightarrow \frac{1}{2}b(12)<120 \Rightarrow$

$6b<120 \Rightarrow \frac{6b}{6}<\frac{120}{6} \Rightarrow b<20$. Thus, the base of the triangle must be less than 20 inches.

105. Let x represent the unknown test score. Then, $\frac{74+x}{2}\ge 80 \Rightarrow 2\left(\frac{74+x}{2}\right)\ge 80(2) \Rightarrow 74+x\ge 160 \Rightarrow$

$74-74+x\ge 160-74 \Rightarrow x\ge 86$. Thus, the student needs a score of 86 or more to maintain an average of at least 80.

106. Let x represent the unknown test score. Then, $\frac{65+82+x}{3}\ge 70 \Rightarrow 3\left(\frac{65+82+x}{3}\right)\ge 70(3) \Rightarrow$

$65+82+x\ge 210 \Rightarrow 147+x\ge 210 \Rightarrow 147-147+x\ge 210-147 \Rightarrow x\ge 63$. Thus, the student needs a score of 63 or more to maintain an average of at least 70.

107. Let x represent the number of hours parked after the first half hour. We see that there is a \$2.00 cost for the first half hour and \$1.25 cost for each hour after that. Therefore,

$2+1.25x\le 8 \Rightarrow 2-2+1.25x\le 8-2 \Rightarrow 1.25x\le 6 \Rightarrow \frac{1.25x}{1.25}\le\frac{6}{1.25} \Rightarrow x\le 4.8$. This result would indicate that the student can park for as long as 4.8 hours beyond the first half hour for \$8.00. However, because a partial hour of parking is charged as a full hour, the longest amount of time that the student could park beyond the first hour is 4 hours for a total of 4.5 hours.

108. Let x represent the number of parking hours in the student lot and y represent the number of parking hours in the nearby lot. Examine the first question and compare the results for x and y. Therefore, $2.50+1x\le 5 \Rightarrow 2.50-2.50+x\le 5-2.50 \Rightarrow x\le 2.50$. Because a partial hour is charged as a full hour, the student could park in the lot for 3 hours. Then, $1.25y\le 5 \Rightarrow \frac{1.25y}{1.25}\le\frac{5}{1.25} \Rightarrow y\le 4$.

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Therefore, the student could park in this lot for 4 hours. Thus, for \$5.00, the student could park for a longer time in the nearby lot. Now, examine the second question, $2.50+1x \le 11 \Rightarrow 2.50-2.50+x \le 11-2.50 \Rightarrow x \le 8.50$. Because a partial hour is charged as a full hour, the student could park in the lot for 9 hours. Then, $1.25y \le 11 \Rightarrow \frac{1.25y}{1.25} \le \frac{11}{1.25} \Rightarrow y \le 8.8$.

Because a partial hour is charged as a full hour, the student could park in this lot for 8 hours. Thus, for \$11.00, the student could park for a longer time in the first lot.

109. Let x represent the number of days. Then, $25x+0.20(90)x \le 200 \Rightarrow 25x+18x \le 200 \Rightarrow$

$43x \le 200 \Rightarrow \frac{43x}{43} \le \frac{200}{43} \Rightarrow x \le 4.65$. Because the car can not be rented for a partial day, the person can rent the car for 4 days.

110. Let x represent the number of miles. Then, $37 < 20+0.25x \Rightarrow 37-20 < 20-20+0.25x \Rightarrow$

$17 < 0.25x \Rightarrow \frac{17}{0.25} < \frac{0.25x}{0.25} \Rightarrow 68 < x \Rightarrow x > 68$. Therefore, for more than 68 miles per day, the second rental agency is a better deal.

111. (a) $C = 1.5x + 2000$

(b) $R = 12x$

(c) $P = 12x - (1.5x + 2000) \Rightarrow P = 10.5x - 2000$

(d) To yield a positive profit, revenue must be greater than cost. Then, $12x > 1.5x + 2000 \Rightarrow$

$12x - 1.5x > 1.5x - 1.5x + 2000 \Rightarrow 10.5x > 2000 \Rightarrow \frac{10.5x}{10.5} > \frac{2000}{10.5} \Rightarrow x > 190.476$. Thus, 191 or more compact discs must be sold to yield a profit.

112. (a) $C = 100,000 + 890x$

(b) $R = 1520x$

(c) $P = 1520x - (100,000 + 890x) \Rightarrow P = 630x - 100,000$

(d) To yield a positive profit, revenue must exceed cost. Then, $1520x > 100,000 + 890x \Rightarrow$

$1520x - 890x > 100,000 + 890x - 890x \Rightarrow 630x > 100,000 \Rightarrow \frac{630x}{630} > \frac{100,000}{630} \Rightarrow x > 158.73$.

Thus, 159 or more laptop computers must be sold to yield a positive profit.

113. (a) Set the distances equal and then solve for x. Then, $\frac{1}{6}x = \frac{1}{8}x + 2 \Rightarrow 4x = 3x + 48 \Rightarrow x = 48$.

Thus, at 48 minutes the athletes are the same distance from the parking lot.

(b) $\frac{1}{6}x > \frac{1}{8}x + 2 \Rightarrow 4x > 3x + 48 \Rightarrow x > 48$. Thus, after more than 48 minutes, the first athlete is farther from the parking lot than the second athlete.

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114. $65-5.8x>36 \Rightarrow 65-65-5.8x>36-65 \Rightarrow -5.8x>-29 \Rightarrow \dfrac{-5.8x}{-5.8}<\dfrac{-29}{-5.8} \Rightarrow x<5.$ Thus, at altitudes less than 5 miles, the dew point is greater than 36ºF.

115. Because $T=90-19x,$ set an inequality statement with T equal to 4.5 and solve. Then,

$$90-19x<4.5 \Rightarrow 90-90-19x<4.5-90 \Rightarrow -19x<-85.5 \Rightarrow \frac{-19x}{-19}>\frac{-85.5}{-19} \Rightarrow x>4.5.$$

Thus, at altitudes more than 4.5 miles, the air temperature is less than 4.5ºF.

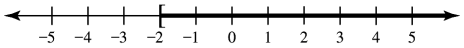
116. (a) $W=0.96x-14.4 \Rightarrow 7.2=0.96x-14.4 \Rightarrow 7.2+14.4=0.96x-14.4+14.4 \Rightarrow 21.6=0.96x \Rightarrow$

$\dfrac{21.6}{0.96}=\dfrac{0.96x}{0.96} \Rightarrow 22.5=x \Rightarrow x=22.5.$ Thus, the length of bass is likely to be 22.5 inches.

(b) $0.96x-14.4<7.2 \Rightarrow 0.96x-14.4+14.4<7.2+14.4 \Rightarrow 0.96x<21.6 \Rightarrow \dfrac{0.96x}{0.96}<\dfrac{21.6}{0.96} \Rightarrow$

$x<22.5.$ Thus, bass less than 22.5 inches in length are likely to weigh less than 7.2 pounds

Checking Basic Concepts Section 2.5

1. 

2. $x<1$

3. Substitute -3 into the inequality. Thus $4(-3)-5 \le -15 \Rightarrow -12-5+5 \le -15 \Rightarrow -17 \le -15.$

Thus, -3 is a solution to the inequality.

4. When $x=-2,$ then $5-2(-2)=5+4=9;$ When $x=-1,$ then $5-2(-1)=5+2=7;$

When $x=0,$ then $5-2(0)=5-0=5;$ When $x=1,$ then $5-2(1)=5-2=3.$ Therefore, the numbers that complete the table are 9, 7, 5 and 3. See Figure 4.

x	−2	−1	0	1	2
$5-2x$	9	7	5	3	1

Figure 4

From the table, we see that $5-2x \le 7$ whenever $x \ge -1.$

Thus, the solution to the inequality is $x \ge -1.$

5. (a) $x+5>8 \Rightarrow x+5-5>8-5 \Rightarrow x>3$

(b) $-\dfrac{5}{7}x \le 25 \Rightarrow -\dfrac{7}{5}\left(-\dfrac{5}{7}x\right) \ge 25\left(-\dfrac{7}{5}\right) \Rightarrow x \ge -\dfrac{175}{5} \Rightarrow x \ge -35$

(c) $3x \ge -2(1-2x)+3 \Rightarrow 3x \ge -2+4x+3 \Rightarrow 3x \ge 1+4x \Rightarrow 3x-4x \ge 1+4x-4x \Rightarrow$

$-x \ge 1 \Rightarrow -1(-x) \le -1(1) \Rightarrow x \le -1$

6. $x \le 12$

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7. Let l represent length and w represent width. Then, $l = 2w+5$. Therefore, $2(2w+5)+2w > 88 \Rightarrow$

$4w+10+2w > 88 \Rightarrow 6w+10 > 88 \Rightarrow 6w+10-10 > 88-10 \Rightarrow 6w > 78 \Rightarrow \frac{6w}{6} > \frac{78}{6} \Rightarrow w > 13.$

Thus, the possible widths must be more than 13 inches.

Chapter 2 Review Exercises

1. $x+9=3 \Rightarrow x+9-9=3-9 \Rightarrow x=-6$ Check: $-6+9=3 \Rightarrow 3=3$
2. $x-4=-2 \Rightarrow x-4+4=-2+4 \Rightarrow x=2$ Check: $2-4=-2 \Rightarrow -2=-2$
3. $x-\frac{3}{4}=\frac{3}{2} \Rightarrow x-\frac{3}{4}+\frac{3}{4}=\frac{3}{2}+\frac{3}{4} \Rightarrow x=\frac{6}{4}+\frac{3}{4} \Rightarrow x=\frac{9}{4}$ Check: $\frac{9}{4}-\frac{3}{4}=\frac{3}{2} \Rightarrow \frac{6}{4} \Rightarrow \frac{3}{2} \Rightarrow \frac{3}{2}=\frac{3}{2}$
4. $x+0.5=0 \Rightarrow x+0.5-0.5=0-0.5 \Rightarrow x=-0.5 \Rightarrow x=-\frac{1}{2}$

Check: $-\frac{1}{2}+0.5=0 \Rightarrow -0.5+0.5=0 \Rightarrow 0=0$

5. $4x=12 \Rightarrow \frac{4x}{4}=\frac{12}{4} \Rightarrow x=3$ Check: $4(3)=12 \Rightarrow 12=12$
6. $3x=-7 \Rightarrow \frac{3x}{3}=\frac{-7}{3} \Rightarrow x=-\frac{7}{3}$ Check: $3\left(-\frac{7}{3}\right)=-7 \Rightarrow -7=-7$
7. $-0.5x=1.25 \Rightarrow \frac{-0.5x}{-0.5}=\frac{1.25}{-0.5} \Rightarrow x=-2.5$ Check: $-0.5(-2.5)=1.25 \Rightarrow 1.25=1.25$
8. $-\frac{1}{3}x=\frac{7}{6} \Rightarrow -\frac{3}{1}\left(-\frac{1}{3}x\right)=\frac{7}{6}\left(-\frac{3}{1}\right) \Rightarrow x=-\frac{21}{6} \Rightarrow x=-\frac{7}{2}$ Check: $-\frac{1}{3}\left(-\frac{7}{2}\right)=\frac{7}{6} \Rightarrow \frac{7}{6}=\frac{7}{6}$
9. The equation $-4x+3=2$ is linear. $-4x+3=2 \Rightarrow -4x+3-2=2-2 \Rightarrow -4x+1=0$; $a=-4$, $b=1$
10. The equation $\frac{3}{8}x^2-x=\frac{1}{4}$ is not a linear equation because it cannot be written in the form

$ax+b=0$.

11. $4x-5=3 \Rightarrow 4x-5+5=3+5 \Rightarrow 4x=8 \Rightarrow \frac{4x}{4}=\frac{8}{4} \Rightarrow x=2$. To check the solution, substitute 2 for x in the original equation: $4x-5=3 \Rightarrow 4(2)-5=3 \Rightarrow 8-5=3$. Because this statement is true, the solution checks.
12. $7-\frac{1}{2}x=-4 \Rightarrow 7-7-\frac{1}{2}x=-4-7 \Rightarrow -\frac{1}{2}x=-11 \Rightarrow -\frac{2}{1}\left(-\frac{1}{2}x\right)=-\frac{11}{1}\left(-\frac{2}{1}\right) \Rightarrow x=22$. To check the solution, substitute 22 for x in the original equation:

$7-\frac{1}{2}x=-4 \Rightarrow 7-\frac{1}{2}(22)=-4 \Rightarrow 7-11=-4$. Because this statement is true, the solution checks.

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13. $5(x-3)=12 \Rightarrow 5x-15=12 \Rightarrow 5x-15+15=12+15 \Rightarrow 5x=27 \Rightarrow \frac{5x}{5}=\frac{27}{5} \Rightarrow x=\frac{27}{5}$. To check the solution, substitute $\frac{27}{5}$ for x in the original equation: $5\left(\frac{27}{5}-3\right)=12 \Rightarrow 5\left(\frac{27}{5}-\frac{15}{5}\right)=12 \Rightarrow$ $5\left(\frac{12}{5}\right)=12 \Rightarrow \frac{60}{5}=12$. Because this statement is true, the solution checks.

14. $3+x=2x-4 \Rightarrow 3+x-x=2x-x-4 \Rightarrow 3=x-4 \Rightarrow 3+4=x-4+4 \Rightarrow 7=x \Rightarrow x=7$.
To check the solution, substitute 7 for x in the original equation:
$3+x=2x-4 \Rightarrow 3+7=2(7)-4 \Rightarrow 10=14-4 \Rightarrow 10=10$. Because this statement is true, the solution checks.

15. $2(x-1)=4(x+3) \Rightarrow 2x-2=4x+12 \Rightarrow 2x-2x-2=4x-2x+12 \Rightarrow -2=2x+12$
$\Rightarrow -2-12=2x+12-12 \Rightarrow -14=2x \Rightarrow \frac{-14}{2}=\frac{2x}{2} \Rightarrow -7=x \Rightarrow x=-7$.
To check the solution, substitute -7 for x in the original equation:
$2(x-1)=4(x+3) \Rightarrow 2(-7-1)=4(-7+3) \Rightarrow 2(-8)=4(-4) \Rightarrow -16=-16$. Because this statement is true, the solution checks.

16. $1-(x-3)=6+2x \Rightarrow 1-x+3=6+2x \Rightarrow 4-x=6+2x \Rightarrow 4-x+x=6+2x+x \Rightarrow$
$4=6+3x \Rightarrow 4-6=6-6+3x \Rightarrow -2=3x \Rightarrow \frac{-2}{3}=\frac{3x}{3} \Rightarrow -\frac{2}{3}=x \Rightarrow x=-\frac{2}{3}$. To check the solution, substitute $-\frac{2}{3}$ for x in the original equation: $1-\left(-\frac{2}{3}-3\right)=6+2\left(-\frac{2}{3}\right) \Rightarrow$
$1+\frac{2}{3}+3=6-\frac{4}{3} \Rightarrow 4\frac{2}{3}=4\frac{2}{3}$. Because this statement is true, the solution checks.

17. $3.4x-4=5-0.6x \Rightarrow 3.4x-4+4=5+4-0.6x \Rightarrow 3.4x=9-0.6x \Rightarrow$
$3.4x+0.6x=9-0.6x+0.6x \Rightarrow 4x=9 \Rightarrow \frac{4x}{4}=\frac{9}{4} \Rightarrow x=\frac{9}{4}$. To check the solution, substitute $\frac{9}{4}$ for x in the original equation: $3.4\left(\frac{9}{4}\right)-4=5-0.6\left(\frac{9}{4}\right) \Rightarrow 3.4(2.25)-4=5-0.6(2.25) \Rightarrow$
$7.65-4=5-1.35 \Rightarrow 3.65=3.65$. Because this statement is true, the solution checks.

18. $-\frac{1}{3}(3-6x)=-(x+2)+1 \Rightarrow -1+2x=-x-2+1 \Rightarrow 2x-1=-x-1 \Rightarrow$
$2x-1+1=-x-1+1 \Rightarrow 2x=-x \Rightarrow 2x+x=-x+x \Rightarrow 3x=0 \Rightarrow \frac{3x}{3}=\frac{0}{3} \Rightarrow x=0$.
To check the solution, substitute 0 for x in the original equation: $-\frac{1}{3}(3-6(0))=-(0+2)+1 \Rightarrow$
$-\frac{1}{3}(3)=-2+1 \Rightarrow -1=-1$. Because this statement is true, the solution checks.

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19. $\frac{2}{3}x-\frac{1}{6}=\frac{5}{12}\Rightarrow\frac{2}{3}x-\frac{1}{6}+\frac{1}{6}=\frac{5}{12}+\frac{1}{6}\Rightarrow\frac{2}{3}x=\frac{5}{12}+\frac{2}{12}\Rightarrow\frac{2}{3}x=\frac{7}{12}\Rightarrow\frac{3}{2}\left(\frac{2}{3}x\right)=\frac{7}{12}\left(\frac{3}{2}\right)\Rightarrow$

$x=\frac{21}{24}\Rightarrow x=\frac{7}{8}$. To check the solution, substitute $\frac{7}{8}$ for x in the original equation:

$\frac{2}{3}\left(\frac{7}{8}\right)-\frac{1}{6}=\frac{5}{12}\Rightarrow\ \frac{14}{24}-\frac{4}{24}=\frac{10}{24}\Rightarrow\frac{10}{24}=\frac{10}{24}$. Because this statement is true, the solution checks.

20. $2y-3(2-y)=5+y\Rightarrow 2y-6+3y=5+y\Rightarrow 5y-6=5+y\Rightarrow 5y-y-6=5+y-y\Rightarrow$

$4y-6=5\Rightarrow 4y-6+6=5+6\Rightarrow 4y=11\Rightarrow\frac{4y}{4}=\frac{11}{4}\Rightarrow y=\frac{11}{4}$. To check the solution, substitute

$\frac{11}{4}$ for y in the original equation: $2\left(\frac{11}{4}\right)-3\left(2-\frac{11}{4}\right)=5+\frac{11}{4}\Rightarrow\frac{22}{4}-6+\frac{33}{4}=\frac{20}{4}+\frac{11}{4}\Rightarrow$

$\frac{22}{4}-\frac{24}{4}+\frac{33}{4}=\frac{20}{4}+\frac{11}{4}\Rightarrow\frac{31}{4}=\frac{31}{4}$. Because this statement is true, the solution checks.

21. First, solve for x: $4(3x-2)=2(6x+5)\Rightarrow 12x-8=12x+10\Rightarrow$

$12x-12x-8=12x-12x+10\Rightarrow\ -8=10$. Because this statement is not true, the equation has no solutions.

22. First, solve for x: $5(3x-1)=15x-5\Rightarrow 15x-5=15x-5$. Because this statement is true for any value of x, the equation has infinitely many solutions.

23. First, solve for x: $8x=5x+3x\Rightarrow 8x=8x$. Because this statement is true for any value of x, the equation has infinitely many solutions.

24. First solve for x: $9x-2=8x-2\Rightarrow 9x-8x-2=8x-8x-2\Rightarrow x-2=-2\Rightarrow$

$x-2+2=-2+2\Rightarrow x=0$. Thus, there is one solution to the equation.

25. When $x=1.0$, then $-2(1.0)+3=-2+3=1$; When $x=1.5$, then $-2(1.5)+3=-3+3=0$;

When $x=2.0$, then $-2(2.0)+3=-4+3=-1$; When $x=2.5$, then $-2(2.5)+3=-5+3=-2$;

Thus, the missing values in the table are 1, 0, -1 and -2. See Figure 25. From the table we see that when $x=1.5$, the value of $-2x+3$ is 0.

x	0.5	1.0	1.5	2.0	2.5
$-2x+3$	2	1	0	-1	-2

Figure 25

x	-2	-1	0	1	2
$-(x+1)+3$	4	3	2	1	0

Figure 26

26. When $x=-2$, then $-(-2+1)+3=2-1+3=4$; When $x=-1$, then $-(-1+1)+3=1-1+3=3$;

When $x=0$, then $-(0+1)+3=0-1+3=2$; When $x=1$, then $-(1+1)+3=-2+3=1$;

When $x=2$, then $-(2+1)+3=-3+3=0$; Thus, the missing values in the table are

4, 3, 2, 1 and 0 See Figure 26. From the table we see that when $x=0$, the value

of $-(x+1)+3$ is 2.

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27. $6x = 72 \Rightarrow \frac{6x}{6} = \frac{72}{6} \Rightarrow x = 12$

28. $x + 18 = -23 \Rightarrow x + 18 - 18 = -23 - 18 \Rightarrow x = -41$

29. $2x - 5 = x + 4 \Rightarrow 2x - 5 + 5 = x + 4 + 5 \Rightarrow 2x = x + 9 \Rightarrow 2x - x = x - x + 9 \Rightarrow x = 9$

30. $x + 4 = 3x \Rightarrow x - 3x + 4 = 3x - 3x \Rightarrow -2x + 4 = 0 \Rightarrow -2x + 4 - 4 = 0 - 4 \Rightarrow -2x = -4 \Rightarrow$

$\frac{-2x}{-2} = \frac{-4}{-2} \Rightarrow x = 2$

31. $\frac{5x}{3} = 15 \Rightarrow \frac{3}{5} \cdot \frac{5x}{3} = \frac{3}{5} \cdot \frac{15}{1} \Rightarrow x = 9$

32. $x + (x+1) + (x+2) = -153 \Rightarrow 3x + 3 = -153 \Rightarrow 3x + 3 - 3 = -153 - 3 \Rightarrow 3x = -156 \Rightarrow$

$\frac{3x}{3} = \frac{-156}{3} \Rightarrow x = -52$. The numbers are -52, -51 and -50.

33. $85\% = \frac{85}{100} = \frac{17}{20}$; $85\% = 0.85$

34. $5.6\% = \frac{5.6}{100} = \frac{56}{1000} = \frac{7}{125}$; $5.6\% = 0.056$

35. $0.03\% = \frac{0.03}{100} = \frac{3}{10,000}$; $0.03\% = 0.0003$

36. $342\% = \frac{342}{100} = \frac{171}{50}$; $342\% = 3.42$

37. $0.89 = 89\%$

38. $0.005 = 0.5\%$

39. $2.3 = 230\%$

40. $1 = 100\%$

41. $d = rt \Rightarrow d = 8(3) \Rightarrow d = 24$ miles.

42. $d = rt \Rightarrow d = 70(55) \Rightarrow d = 3850$ feet.

43. $d = rt \Rightarrow 500 = r(20) \Rightarrow \frac{500}{20} = r\frac{20}{20} \Rightarrow \frac{500}{20} = r \Rightarrow r = 25$ yd/sec.

44. $d = rt \Rightarrow 125 = 15t \Rightarrow \frac{125}{15} = \frac{15t}{15} \Rightarrow \frac{125}{15} = t \Rightarrow t = \frac{25}{3}$ hours.

45. The area of a triangle is $\frac{1}{2}(\text{base})(\text{height})$. Thus, $A = \frac{1}{2}(b)(h) = \frac{1}{2}(5)(3) = 7.5$ m^2.

46. The area of a circle is πr^2 where r represents radius. Thus, $A = \pi r^2 = \pi(6^2) = 36\pi \approx 113.1$ ft^2.

47. The area of a rectangle is given as length (l) times width (w). Thus,

$A = lw = (36)(24) = 864$ in^2 or 6 ft^2.

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48. $P = 2l + 2w$ where P represents perimeter, l represents the length of the base and w represents the width. Thus, $P = 2l + 2w = 2(13) + 2(7) = 26 + 14 = 40$ in.

49. The circumference of a circle is $2\pi r$, where r represents radius. Thus,

$r = \frac{1}{2}(\text{diameter}) = \frac{1}{2}(18) = 9$. $C = 2\pi r = 2\pi(9) = 18\pi \approx 56.5$ feet.

50. $A = \pi r^2$, where A represents area and r represents radius. Thus, $A = \pi r^2 = \pi\left(5^2\right) = 25\pi \approx 78.5 \text{ in}^2$.

51. The angles in a triangle must add up to 180º. Let x represent the unknown angle. Thus,

$90 + 40 + x = 180 \Rightarrow 130 + x = 180 \Rightarrow 130 - 130 + x = 180 - 130 \Rightarrow x = 50°$.

52. The angles in a triangle must add up to 180º. Thus, $x + 3x + 4x = 180 \Rightarrow 8x = 180 \Rightarrow \frac{8x}{8} = \frac{180}{8} \Rightarrow$

$x = 22.5°$.

53. $V = \pi r^2 h = \pi\left(5^2\right)(25) = \pi(25)(25) = 625\pi \approx 1963.5 \text{ in}^3$.

54. First, convert height (h) and base (b) to inches. $h = 5 \text{ feet} \cdot \frac{12 \text{ inches}}{1 \text{ foot}} = 60$ inches and

$b = 3 \text{ feet} \cdot \frac{12 \text{ inches}}{1 \text{ foot}} = 36$ inches.

Then, $A = \frac{1}{2}(a+b)h = \frac{1}{2}(36+18)60 = \frac{1}{2}(54)60 = (27)60 = 1620 \text{ in}^2$.

Or, convert the base in inches to feet. $b = 18 \text{ inches} \cdot \frac{1 \text{ foot}}{12 \text{ inches}} = 1.5$ feet. Then,

$A = \frac{1}{2}(a+b)h = \frac{1}{2}(3+1.5)5 = \frac{1}{2}(4.5)5 = (2.25)5 = 11.25 \text{ ft}^2$.

55. The total area of the figure is the sum of the area of the triangle and the area of the rectangle. The area of the triangle is $\frac{1}{2}bh = \frac{1}{2} \cdot 8 \cdot 6 = 24 \text{ in}^2$. The area of the rectangle is $lw = 25 \cdot 6 = 150 \text{ in}^2$.

Thus, the total area is $24 + 150 = 174 \text{ in}^2$.

56. The total area of the figure is the sum of the area of the rectangle and the area of a circle. The area of the rectangle is $lw = 12 \cdot 4 = 48 \text{ ft}^2$. The area of the circle is $\pi r^2 = \pi\left(\frac{4}{2}\right)^2 = \pi(2)^2 = 4\pi \approx 12.6 \text{ ft}^2$.

Thus, the total area is about $48 + 12.6 = 60.6 \text{ ft}^2$.

57. $3x = 5 + y \Rightarrow 3x - 5 = 5 - 5 + y \Rightarrow 3x - 5 = y$

58. $16 = 2x + 2y \Rightarrow 16 - 2x = 2x - 2x + 2y \Rightarrow 16 - 2x = 2y \Rightarrow \frac{16 - 2x}{2} = \frac{2y}{2} \Rightarrow 8 - x = y \Rightarrow \quad y = -x + 8$

59. $z = 2xy \Rightarrow \frac{z}{2x} = \frac{2xy}{2x} \Rightarrow \frac{z}{2x} = y \Rightarrow y = \frac{z}{2x}$

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60. $S=\frac{a+b+c}{3}\Rightarrow 3S=\frac{a+b+c}{3}\cdot 3\Rightarrow 3S=a+b+c\Rightarrow 3S-a-c=a+b+c-a-c\Rightarrow$

$3S-a-c=b\Rightarrow b=3S-a-c$

61. $T=\frac{a}{3}+\frac{b}{4}\Rightarrow \frac{12T}{12}=\frac{4a}{12}+\frac{3b}{12}\Rightarrow 12\left(\frac{12T}{12}\right)=12\left(\frac{4a}{12}\right)+12\left(\frac{3b}{12}\right)\Rightarrow 12T=4a+3b\Rightarrow$

$12T-4a=4a-4a+3b\Rightarrow 12T-4a=3b\Rightarrow \frac{12T-4a}{3}=\frac{3b}{3}\Rightarrow \frac{12T-4a}{3}=b\Rightarrow b=\frac{12T-4a}{3}$

62. $cd=ab+bc\Rightarrow cd-bc=ab+bc-bc\Rightarrow cd-bc=ab\Rightarrow c(d-b)=ab\Rightarrow$

$\frac{c(d-b)}{(d-b)}=\frac{ab}{(d-b)}\Rightarrow c=\frac{ab}{d-b}$

63. The formula for GPA is given by $\frac{4a+3b+2c+d}{a+b+c+d+f}$.

$\frac{4(20)+3(25)+2(12)+4}{20+25+12+4+4}=\frac{80+75+24+4}{65}=\frac{183}{65}\approx 2.82$. Thus, the GPA is 2.82.

64. The formula for GPA is given by $\frac{4a+3b+2c+d}{a+b+c+d+f}$.

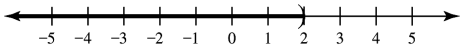
$\frac{4(64)+3(32)+2(20)+10}{64+32+20+10+3}=\frac{256+96+40+10}{129}=\frac{402}{129}\approx 3.12$. Thus, the GPA is 3.12.

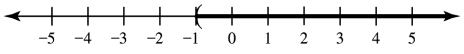
65. To convert Celsius to Fahrenheit temperature, the formula given is $\frac{9}{5}C+32=F$.

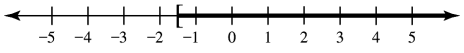
$\frac{9}{5}(15)+32=F\Rightarrow \frac{135}{5}+32=F\Rightarrow 27+32=F\Rightarrow F=59°\text{F}$.

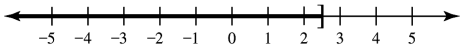
66. To convert Fahrenheit to Celsius temperature, the formula given is $C=\frac{5}{9}(F-32)$.

$C=\frac{5}{9}(113-32)\Rightarrow C=\frac{5}{9}(81)\Rightarrow C=\frac{405}{9}\Rightarrow C=45°\text{C}$.

67. 

68. 

69. 

70. 

71. $x<3$

72. $x\geq -1$

73. Substitute -2 for x and check for accuracy: $1-(x+3)\geq x\Rightarrow 1-(-2+3)\geq -2\Rightarrow 1-1\geq -2\Rightarrow$

$0\geq -2$. Because this statement is true, $x=-2$ is a solution to the inequality.

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74. Substitute -1 for x and check for accuracy: $4(x+1)<-(5-x) \Rightarrow 4(-1+1)<-(5-(-1)) \Rightarrow$ $4(0)<-(6) \Rightarrow 0<-6$. Because this statement is not true, $x=-1$ is not a solution to the inequality.

75. When $x=1$, then $5-x=5-1=4$; When $x=2$, then $5-x=5-2=3$; When $x=3$, then $5-x=5-3=2$; When $x=4$, then $5-x=5-4=1$; Thus, the missing values in the table are 4, 3, 2 and 1. See Figure 75. From the table we see that $5-x>3$, when $x<2$.

x	0	1	2	3	4
$5-x$	5	4	3	2	1

Figure 75

x	1	1.5	2	2.5	3
$2x-5$	-3	-2	-1	0	1

Figure 76

76. When $x=1.5$, then $2x-5=2(1.5)-5=3-5=-2$; When $x=2$, then $2x-5=2(2)-5=4-5=-1$; When $x=2.5$, then $2x-5=2(2.5)-5=5-5=0$; When $x=3$, then $2x-5=2(3)-5=6-5=1$; Thus, the missing values in the table are -2, -1, 0 and 1. See Figure 76. From the table we see that $2x-5\le 0$ when $x\le 2.5$.

77. $x-3>0 \Rightarrow x-3+3>0+3 \Rightarrow x>3$

78. $-2x\le 10 \Rightarrow \dfrac{-2x}{-2}\ge\dfrac{10}{-2} \Rightarrow x\ge -5$

79. $5-2x\ge 7 \Rightarrow 5-5-2x\ge 7-5 \Rightarrow -2x\ge 2 \Rightarrow \dfrac{-2x}{-2}\le\dfrac{2}{-2} \Rightarrow x\le -1$

80. $3(x-1)<20 \Rightarrow 3x-3<20 \Rightarrow 3x-3+3<20+3 \Rightarrow 3x<23 \Rightarrow \dfrac{3x}{3}<\dfrac{23}{3} \Rightarrow x<\dfrac{23}{3}$

81. $5x\le 3-(4x+2) \Rightarrow 5x\le 3-4x-2 \Rightarrow 5x+4x\le 3-4x+4x-2 \Rightarrow 9x\le 1 \Rightarrow \dfrac{9x}{9}\le\dfrac{1}{9} \Rightarrow x\le\dfrac{1}{9}$

82. $3x-2(4-x)\ge x+1 \Rightarrow 3x-8+2x\ge x+1 \Rightarrow 5x-8+8\ge x+1+8 \Rightarrow 5x\ge x+9 \Rightarrow$ $5x-x\ge x-x+9 \Rightarrow 4x\ge 9 \Rightarrow \dfrac{4x}{4}\ge\dfrac{9}{4} \Rightarrow x\ge\dfrac{9}{4}$

83. $x<50$

84. $x\le 45{,}000$

85. $x\ge 16$

86. $x<1995$ or $x\le 1994$

87. (a) See Figure 87.

(b) $R=2+\dfrac{3}{4}x$

(c) At 5 PM, $x=5$; $R=2+\dfrac{3}{4}(5)=2+\dfrac{15}{4}=\dfrac{23}{4}=5\dfrac{3}{4}$ inches. This value does agree with the table.

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(d) At 3:45 PM, $x = 3.75$; $R = 2 + \frac{3}{4}\left(3\frac{3}{4}\right) = 2 + \frac{3}{4}\left(\frac{15}{4}\right) = 2 + \frac{45}{16} = \frac{32}{16} + \frac{45}{16} = \frac{77}{16} = 4\frac{13}{16}$ inches.

Time	12:00	1:00	2:00	3:00	4:00	5:00
Rainfall (R)	2	2.75	3.5	4.25	5	5.75

Figure 87

Hours (x)	1	2	3	4	5
Distance (D)	40	30	20	10	0

Figure 89

88. Let x represent the cost of the laptop. $0.05x = 106.25 \Rightarrow \frac{0.05x}{0.05} = \frac{106.25}{0.05} \Rightarrow x = 2125$. Thus, the cost of the laptop is \$2125.

89. (a) See Figure 89.

(b) $D = 50 - 10x$

(c) $D = 50 - 10x = 50 - 10(3) = 50 - 30 = 20$ miles. This value does agree with the table.

(d) $D \geq 20$. Thus, $50 - 10x \geq 20 \Rightarrow 50 - 50 - 10x \geq 20 - 50 \Rightarrow -10x \geq -30 \Rightarrow \frac{-10x}{-10} \leq \frac{-30}{-10} \Rightarrow$ $x \leq 3$. Thus, the bicyclist was at least 20 miles from home when he had traveled for 3 or fewer hours, or from noon to 3 PM.

90. First, subtract the smaller number from the larger to obtain the difference between them: $625,000 - 468,500 = 156,500$. Then, determine what percentage 156,500 is of 468,500 Do this by dividing the smaller number by the larger: $\frac{156,500}{468,500} \approx 0.334$. Thus, there was about an 33.4% change in master's degrees received between 2001 and 2008.

91. Use the distance (d) = rate $(r) \times$ time (t) formula. Determine how long it takes the faster car to be 2 miles ahead of the slower car, let $(r + 12)$ be the rate of the faster car and r be the rate of the slower car. $d = rt \Rightarrow 2 = (r + 12 - r)t \Rightarrow 2 = 12t \Rightarrow \frac{2}{12} = \frac{12t}{12} \Rightarrow \frac{1}{6} = t \Rightarrow t = \frac{1}{6}$ hour, or 10 minutes.

92. Perimeter $(P) = 2 \times$ width $(W) + 2 \times$ length (L). Then, $W = L - 10 \Rightarrow 2(L - 10) + 2L = 112 \Rightarrow$ $2L - 20 + 2L = 112 \Rightarrow 2L - 20 + 20 + 2L = 112 + 20 \Rightarrow 4L = 132 \Rightarrow \frac{4L}{4} = \frac{132}{4} \Rightarrow L = 33$. Because the length is 33, the width is $(L - 10) = 23$. Thus, the dimensions are 33 by 23 inches.

93. Let x represent the amount of water. The amount of salt on one side of the equation must equal the amount of salt on the other side. Thus, $100(0.03) + x(0.00) = (100 + x)(0.02) \Rightarrow 3 + 0 = 2 + 0.02x \Rightarrow$ $3 - 2 = 2 - 2 + 0.02x \Rightarrow 1 = 0.02x \Rightarrow \frac{1}{0.02} = \frac{0.02x}{0.02} \Rightarrow 50 = x \Rightarrow x = 50.$

Thus, 50 ml of water must be added.

94. Let x represent the higher interest rate. Then, $800(x) + 500(x - 0.02) = 55 \Rightarrow$ $800x + 500x - 10 = 55 \Rightarrow 1300x - 10 + 10 = 55 + 10 \Rightarrow 1300x = 65 \Rightarrow \frac{1300x}{1300} = \frac{65}{1300} \Rightarrow x = 0.05.$

Thus, the interest rate on the \$800 loan is 5% and the interest rate on the \$500 loan is 3%.

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95. Area (A) of a triangle is $\frac{1}{2}\times$ base $(b)\times$ height (h). Thus, $A=\frac{1}{2}bh \Rightarrow \frac{1}{2}bh \le 100 \Rightarrow \frac{1}{2}b(8) \le 100 \Rightarrow$

$4b \le 100 \Rightarrow \frac{4b}{4} \le \frac{100}{4} \Rightarrow b \le 25$. Therefore, the base must be 25 inches or less.

96. Let x represent the unknown test score. Then, $\frac{75+91+x}{3} \ge 80 \Rightarrow \frac{166+x}{3} \ge 80 \Rightarrow$

$3\left(\frac{166+x}{3}\right) \ge 3(80) \Rightarrow 166+x \ge 240 \Rightarrow 166-166+x \ge 240-166 \Rightarrow x \ge 74$. Thus, the student must score 74 or more.

97. Let x represent the unknown number of hours after the first hour. Then, $2.25+1.25x=9 \Rightarrow$

$2.25-2.25+1.25x=9-2.25 \Rightarrow 1.25x=6.75 \Rightarrow \frac{1.25x}{1.25}=\frac{6.75}{1.25} \Rightarrow x=5.4$. Because each partial hour is charged as a full hour, the person can park for $1+5=6$ hours.

98. (a) $C=150{,}000+85x$

(b) $R=225x$

(c) $P=225x-(150{,}000+85x) \Rightarrow P=140x-150{,}000$

(d) $140x-150{,}000<0 \Rightarrow 140x-150{,}000+150{,}000<0+150{,}000 \Rightarrow 140x<150{,}000 \Rightarrow$

$\frac{140x}{140}<\frac{150{,}000}{140} \Rightarrow x<1071.43$. Therefore, if 1071 or fewer DVD players are sold, there will be a loss.

Chapter 2 Test

1. $9=3-x \Rightarrow 9-3=3-3-x \Rightarrow 6=-x \Rightarrow 6(-1)=(-x)(-1) \Rightarrow -6=x \Rightarrow x=-6$

To check the solution: $9=3-(-6) \Rightarrow 9=9$. The solution checks.

2. $4x-3=7 \Rightarrow 4x-3+3=7+3 \Rightarrow 4x=10 \Rightarrow \frac{4x}{4}=\frac{10}{4} \Rightarrow x=\frac{5}{2}$

To check the solution: $4\left(\frac{5}{2}\right)-3=7 \Rightarrow \frac{20}{2}-\frac{6}{2}=7 \Rightarrow \frac{14}{2}=7 \Rightarrow 7=7$. The solution checks.

3. $4x-(2-x)=-3(2x+6) \Rightarrow 4x-2+x=-6x-18 \Rightarrow 5x-2=-6x-18 \Rightarrow$

$5x-2+2=-6x-18+2 \Rightarrow 5x=-6x-16 \Rightarrow 5x+6x=-6x+6x-16 \Rightarrow 11x=-16 \Rightarrow$

$\frac{11x}{11}=\frac{-16}{11} \Rightarrow x=-\frac{16}{11}$. To check the solution: $4\left(-\frac{16}{11}\right)-\left(2-\left(-\frac{16}{11}\right)\right)=-3\left(2\left(-\frac{16}{11}\right)+6\right) \Rightarrow$

$-\frac{64}{11}-2-\frac{16}{11}=-6\left(-\frac{16}{11}\right)-18 \Rightarrow -\frac{64}{11}-\frac{22}{11}-\frac{16}{11}=\frac{96}{11}-\frac{198}{11} \Rightarrow -\frac{102}{11}=-\frac{102}{11}$. The solution checks.

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4. $\frac{1}{12}x-\frac{2}{3}=\frac{1}{2}\left(\frac{3}{4}-\frac{1}{3}x\right)\Rightarrow\frac{1}{12}x-\frac{2}{3}=\frac{3}{8}-\frac{1}{6}x\Rightarrow\frac{1}{12}x+\frac{1}{6}x-\frac{2}{3}=\frac{3}{8}-\frac{1}{6}x+\frac{1}{6}x\Rightarrow$

$\frac{3}{12}x-\frac{2}{3}+\frac{2}{3}=\frac{3}{8}+\frac{2}{3}\Rightarrow\frac{3}{12}x=\frac{9}{24}+\frac{16}{24}\Rightarrow\frac{3}{12}x=\frac{25}{24}\Rightarrow\frac{12}{3}\left(\frac{3}{12}x\right)=\frac{12}{3}\left(\frac{25}{24}\right)\Rightarrow x=\frac{300}{72}=\frac{25}{6}.$

To check the solution: $\frac{1}{12}\left(\frac{25}{6}\right)-\frac{2}{3}=\frac{1}{2}\left(\frac{3}{4}-\frac{1}{3}\left(\frac{25}{6}\right)\right)\Rightarrow\frac{25}{72}-\frac{48}{72}=\frac{1}{2}\left(\frac{27}{36}-\frac{50}{36}\right)\Rightarrow$

$-\frac{23}{72}=\frac{1}{2}\left(-\frac{23}{36}\right)\Rightarrow-\frac{23}{72}=-\frac{23}{72}.$ The solution checks.

5. First, solve for x: $6(2x-1)=-4(3-3x)\Rightarrow12x-6=-12+12x\Rightarrow12x-12x-6=-12+12x-12x\Rightarrow$

$-6=-12.$ Because this statement is not true, there are no solutions.

6. First, solve for x: $4(2x-1)=8x-4\Rightarrow8x-4=8x-4\Rightarrow8x-8x-4+4=8x-8x-4+4\Rightarrow0=0$

Because this statement is always true, there are infinitely many solutions.

7. When $x=1$, then $6-2x=6-2(1)=4$; When $x=2$, then $6-2x=6-2(2)=2$;

When $x=3$, then $6-2x=6-2(3)=0$; When $x=4$, then $6-2x=6-2(4)=-2$;

Thus, the missing values in the table are $4,\ 2,\ 0$ and -2. See Figure 7. From the table we see that $6-2x=0$, when $x=3$.

x	0	1	2	3	4
$6-2x$	6	4	2	0	−2

Figure 7

8. $x+(-7)=6\Rightarrow x-7=6\Rightarrow x-7+7=6+7\Rightarrow x=13$

9. $2x+6=x-7\Rightarrow2x-x+6=x-x-7\Rightarrow x+6=-7\Rightarrow x+6-6=-7-6\Rightarrow x=-13$

10. $x+(x+1)+(x+2)=336\Rightarrow3x+3=336\Rightarrow3x+3-3=336-3\Rightarrow3x=333\Rightarrow$

$\frac{3x}{3}=\frac{333}{3}\Rightarrow x=111.$ Thus, the three numbers are 111, 112 and 113.

11. $3.2\%=0.032;\ 3.2\%=\frac{3.2}{100}=\frac{32}{1000}=\frac{16}{500}=\frac{8}{250}=\frac{4}{125}$

12. $0.345=34.5\%$

13. $d=rt\Rightarrow200=r\cdot4\Rightarrow r=\frac{200}{4}=50$ Thus, 50 ft/sec

14. Area $(A)=\frac{1}{2}\times$ base $(b)\times$ height (h). Thus, $A=\frac{1}{2}bh=\frac{1}{2}(5)(3)=7.5\text{ in}^2.$

15. Circumference of a circle is given as

$C=2\pi r.$ Then, $C=2\pi r=2\pi\left(\frac{30}{2}\right)=2\pi(15)=30\pi\approx94.2$ inches.

Area of a circle is given as $A=\pi r^2.$ Then, $A=\pi r^2=\pi(15)^2=225\pi\approx706.9\text{ in}^2.$

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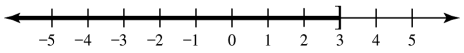
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16. The angles in a triangle must add up to 180º.

Then, $x+2x+3x=180 \Rightarrow 6x=180 \Rightarrow \frac{6x}{6}=\frac{180}{6} \Rightarrow x=30$. Thus, the angles are 30º, 60º and 90º.

17. $z=y-3xy \Rightarrow z-y=y-y-3xy \Rightarrow z-y=-3xy \Rightarrow \frac{z-y}{-3y}=\frac{-3xy}{-3y} \Rightarrow \frac{z-y}{-3y}=x \Rightarrow x=\frac{y-z}{3y}$

18. $R=\frac{x}{4}+\frac{y}{5} \Rightarrow 20R=5x+4y \Rightarrow 20R-4y=5x \Rightarrow x=\frac{20R-4y}{5}$

19. 

20. $x > 0$

21. $-3x+9 \geq x-15 \Rightarrow -3x+9-9 \geq x-15-9 \Rightarrow -3x \geq x-24 \Rightarrow -3x-x \geq x-x-24$

$\Rightarrow -4x \geq -24 \Rightarrow \frac{-4x}{-4} \leq \frac{-24}{-4} \Rightarrow x \leq 6$

22. $3(6-5x) < 20-x \Rightarrow 18-15x < 20-x \Rightarrow 18-18-15x < 20-18-x \Rightarrow -15x < 2-x \Rightarrow$

$-15x+x < 2-x+x \Rightarrow -14x < 2 \Rightarrow \frac{-14x}{-14} > \frac{2}{-14} \Rightarrow x > -\frac{1}{7}$

23. (a) $S=5+2x$, where x represents hours past noon.

(b) $x=8$. Thus, $S=5+2(8)=21$ inches.

(c) $x=6.25$. Thus, $S=5+2(6.25)=17.5$ inches.

24. The amount of acid on the left side of the equation must equal the amount of acid on the right side of the equation. Let x represent the unknown amount of water. Then,

$1000(0.45)+x(0)=(1000+x)(0.15) \Rightarrow 450=150+0.15x \Rightarrow 450-150=150-150+0.15x \Rightarrow$

$300=0.15x \Rightarrow \frac{300}{0.15}=\frac{0.15x}{0.15} \Rightarrow 2000=x \Rightarrow x=2000$. Thus, 2000 ml of water must be added.

25. Subtract the lesser amount from the larger amount and then calculate the percentage difference as compared to the smaller amount. Then, $95-75=20$; $\frac{20}{75} \approx 0.267 \Rightarrow 26.7\%$. Therefore, there will be a 26.7% increase in cost from 2010 to 2015.

Chapters 2 Extended Discovery Exercises

1. For the first hour, the distance traveled was $d=rt$ such that $d=(50)(1)=50$ miles. For the second hour, the distance traveled was $d=rt$ such that $d=(70)(1)=70$ miles.

Thus, for the two hours $r=\frac{d}{t}$ such that $r=\frac{70+50}{1+1}=\frac{120}{2}=60$. Thus, the average speed of the car was 60 mph.

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2. Uphill, $t = \frac{d}{r}$ such that $t = \frac{1}{5} = \frac{1}{5}$ of an hour.

   Downhill, $t = \frac{d}{r}$ such that $t = \frac{1}{10} = \frac{1}{10}$ of an hour. Thus, the average speed

   $r = \frac{d}{t}$ is $r = \frac{1+1}{\frac{1}{5}+\frac{1}{10}} = \frac{2}{\frac{3}{10}} = \frac{20}{3} = 6.\overline{6}$ mph. *Answers may vary.*

3. For the first two miles, $t = \frac{d}{r}$ such that $t = \frac{2}{8} = \frac{1}{4}$ of an hour. For the third mile, $t = \frac{d}{t}$ such that

   $t = \frac{1}{10} = \frac{1}{10}$ of an hour. Thus, the average speed of the athlete is

   $r = \frac{d}{t} = \frac{3}{\frac{1}{4}+\frac{1}{10}} = \frac{3}{\frac{5}{20}+\frac{2}{20}} = \frac{3}{\frac{7}{20}} = \frac{60}{7} \approx 8.6$ mph.

4. Choose a distance of 400 miles as the distance between the two cities (the distance is arbitrary because any distance gives the same average speed). Then, the pilot flew at 200 mph for 1 hour and at 100 mph for 2 hours. Then, $r = \frac{d}{t} = \frac{400}{1+2} = \frac{400}{3} = 133.\overline{3}$. Thus, the average speed is $133.\overline{3}$ mph.

5. The lighter coin can be found in two weighings as follows: Place two coins on each pan of the balance and set three coins off to the side. Case 1: The pans balance and the lighter coin is one of the three coins that were set off to the side. Case 2: The pans do not balance and the lighter coin is one of the two coins on the higher pan. To find the lighter coin in Case 1, work only with the three remaining coins. Place one coin on each side of the balance and set one coin off to the side. If the pans do not balance, the lighter coin is the one on the higher pan. To find the lighter coin in Case 2, work with only the two coins from the higher pan. Place one coin on each side of the balance. The lighter coin is on the higher pan.

6. (a) Surface area $(A) = 4\pi r^2 = 4\pi(3960)^2 \approx 197,060,797$ mi^2.

   (b) $0.71(197,060,797) \approx 139,913,166$ mi^2.

   (c) $\frac{680,000}{139,913,166} \approx 0.00486$ miles. To convert 0.00486 miles to feet:

   $0.00486 \text{ mile} \cdot \frac{5280 \text{ feet}}{1 \text{ mile}} \approx 25.7$ feet.

   (d) They would be flooded.

   (e) Divide the volume of the Antarctic ice cap by the surface area of the oceans:

   $\frac{6,300,000}{139,913,166} \approx 0.045$ miles. To convert 0.045 miles to feet: $0.045 \text{ mile} \cdot \frac{5280 \text{ feet}}{1 \text{ mile}} \approx 237.7$ feet.

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Chapters 1 and 2 Cumulative Review Exercises

1. The number 45 is a composite number because it has factors other than itself and 1; $45 = 3 \times 3 \times 5$

2. The number 37 is a prime number because its only factors are itself and 1.

3. $\frac{4}{3} \cdot \frac{3}{8} = \frac{4 \cdot 3}{3 \cdot 8} = \frac{12}{24} = \frac{1 \cdot 12}{2 \cdot 12} = \frac{1}{2} \cdot \frac{12}{12} = \frac{1}{2} \cdot 1 = \frac{1}{2}$

4. $\frac{2}{3} \div 6 = \frac{2}{3} \div \frac{6}{1} = \frac{2}{3} \cdot \frac{1}{6} = \frac{2 \cdot 1}{3 \cdot 6} = \frac{2}{18} = \frac{1 \cdot 2}{9 \cdot 2} = \frac{1}{9} \cdot \frac{2}{2} = \frac{1}{9} \cdot 1 = \frac{1}{9}$

5. $\frac{11}{12} - \frac{3}{8} = \frac{11}{12} \cdot \frac{2}{2} - \frac{3}{8} \cdot \frac{3}{3} = \frac{11 \cdot 2}{12 \cdot 2} - \frac{3 \cdot 3}{8 \cdot 3} = \frac{22}{24} - \frac{9}{24} = \frac{22 - 9}{24} = \frac{13}{24}$

6. $\frac{2}{3} + \frac{1}{5} = \frac{2}{3} \cdot \frac{5}{5} + \frac{1}{5} \cdot \frac{3}{3} = \frac{2 \cdot 5}{3 \cdot 5} + \frac{1 \cdot 3}{5 \cdot 3} = \frac{10}{15} + \frac{3}{15} = \frac{10 + 3}{15} = \frac{13}{15}$

7. -1 is a rational number, and is an integer.

8. $\sqrt{3}$ is an irrational number.

9. $15 - 4 \cdot 3 = 15 - 12 = 3$

10. $30 \div 6 \cdot 2 = 5 \cdot 2 = 10$

11. $23 - 4^2 \div 2 = 23 - 16 \div 2 = 23 - 8 = 15$

12. $11 - \frac{3+1}{6-4} = 11 - \frac{4}{2} = 11 - 2 = 9$

13. $5x^3 - x^3 = (5-1)x^3 = 4x^3$

14. $4 + 2x - 1 + 3x = 4 - 1 + 2x + 3x = 4 - 1 + (2+3)x = 3 + 5x$

15. $x - 3 = 11 \Rightarrow x - 3 + 3 = 11 + 3 \Rightarrow x = 14$

16. $4x - 6 = -22 \Rightarrow 4x - 6 + 6 = -22 + 6 \Rightarrow 4x = -16 \Rightarrow \frac{4x}{4} = \frac{-16}{4} \Rightarrow x = -4$

17. $5(6y + 2) = 25 \Rightarrow 5(6y) + 5(2) = 25 \Rightarrow 30y + 10 = 25 \Rightarrow 30y + 10 - 10 = 25 - 10 \Rightarrow 30y = 15 \Rightarrow$

    $\frac{30y}{30} = \frac{15}{30} \Rightarrow y = \frac{1}{2}$

18. $11 - (y + 2) = 3y + 5 \Rightarrow 11 - y - 2 = 3y + 5 \Rightarrow 11 - 2 - y = 3y + 5$

    $\Rightarrow 9 - y = 3y + 5 \Rightarrow 9 - y + y = 3y + y + 5 \Rightarrow 9 = 4y + 5$

    $\Rightarrow 9 - 5 = 4y + 5 - 5 \Rightarrow 4 = 4y \Rightarrow \frac{4}{4} = \frac{4y}{4} \Rightarrow 1 = y \Rightarrow y = 1$

19. First, solve for x: $6x + 2 = 2(3x + 1) \Rightarrow 6x + 2 = 6x + 2 \Rightarrow 6x - 6x + 2 = 6x - 6x + 2 \Rightarrow 2 = 2$. Because this statement is true for any value of x, the equation has infinitely many solutions.

20. First, solve for x: $2(3x - 4) = 6(x - 1) \Rightarrow 6x - 8 = 6x - 6 \Rightarrow 6x - 6x - 8 = 6x - 6x - 6 \Rightarrow -8 = -6$. Because this statement is not true, the equation has no solutions.

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21. Let x represent the first integer. Then $x+1$ and $x+2$ represent the other two integers. The sum of the integers is $x+x+1+x+2,\ x+x+1+x+2=90 \Rightarrow 3x+3=90 \Rightarrow 3x+3-3=90-3 \Rightarrow 3x=87$

$\Rightarrow \frac{3x}{3}=\frac{87}{3} \Rightarrow x=29,\ x+1=30,\ x+2=31.$ The integers are 29, 30, and 31.

22. $4.7\% = \frac{4.7}{100} = \frac{47}{1000} = 0.047$

23. $0.17 = 0.17 \times 100\% = 17\%$

24. Given that the distance traveled (d) is 325 miles and that the time spent traveling (t) is 5 hours, calculate the speed of the car (r).

Then, $d = rt \Rightarrow 325 = r \cdot 5 \Rightarrow \frac{325}{5} = \frac{r \cdot 5}{5} \Rightarrow 65 = r \Rightarrow r = 65$ miles/hour.

25. The sum of the measures of the angles of a triangle is 180°. Then

$2x+3x+4x=180 \Rightarrow (2+3+4)x=180 \Rightarrow 9x=180 \Rightarrow \frac{9x}{9}=\frac{180}{9} \Rightarrow x=20$

26. Since the diameter of the circle is 10 inches, the radius is $\frac{10}{2}=5$ inches. Then,

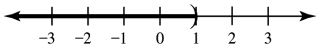
$A=\pi r^2=\pi 5^2=25\pi \approx 78.5 \text{ in}^2.$

27. $a=3xy-4 \Rightarrow a+4=3xy-4+4 \Rightarrow a+4=3xy \Rightarrow \frac{a+4}{3y}=\frac{3xy}{3y} \Rightarrow \frac{a+4}{3y}=x$

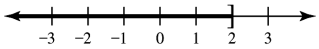
28. $A=\frac{x+y+z}{3} \Rightarrow 3A=3\left(\frac{x+y+z}{3}\right) \Rightarrow 3A=x+y+z \Rightarrow 3A-y-z=x+y-y+z-z \Rightarrow$

$3A-y-z=x$

29. $7-3x>4 \Rightarrow 7-7-3x>4-7 \Rightarrow -3x>4+(-7) \Rightarrow -3x>-3 \Rightarrow \frac{-3x}{-3}<\frac{-3}{-3} \Rightarrow x<1$



30. $6x \le 5-(x-9) \Rightarrow 6x \le 5-x+9 \Rightarrow 6x \le 14-x \Rightarrow 6x+x \le 14-x+x \Rightarrow 7x \le 14 \Rightarrow \frac{7x}{7} \le \frac{14}{7} \Rightarrow x \le 2$



31. $I = 36Y$

32. Start with the initial balance, subtract the amounts withdrawn and add the amounts deposited:

$468-14+200-73-21+58=454+200-73-21+58=$

$654-73-21+58=581-21+58=560+58=\$618$

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33. Let x represent the amount of 4% acid. Then, the 6% acid solution is the sum of the 4% acid and the 10% acid. Therefore $0.04x + 0.10(150) = 0.06\,(x + 150) \Rightarrow 0.04x + 15 = 0.06x + 9$

$\Rightarrow 0.04x - 0.04x + 15 = 0.06x - 0.04x + 9 \Rightarrow 15 = 0.02x + 9 \Rightarrow 15 - 9 = 0.02x + 9 - 9 \Rightarrow 6 = 0.02x$

$\Rightarrow \dfrac{6}{0.02} = \dfrac{0.02x}{0.02} \Rightarrow 300 = x$

300 mL of 4% acid solution should be mixed with the 10% acid solution to dilute it to a 6% acid solution.

34. Let x represent the 2009 production level and the equation is $2x - 188 = 356$.

$2x - 188 = 356 \Rightarrow 2x - 188 + 188 = 356 + 188 \Rightarrow 2x = 544 \Rightarrow \dfrac{2x}{2} = \dfrac{544}{2} \Rightarrow x = 272$

The 2009 production level was 272 billion kilowatt-hours.

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