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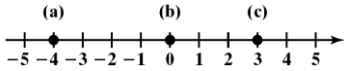
Chapter 2
Integers and Introduction to Solving Equations

2.1 Check Points

1. a. -500

b. -282

2.



3. a. $6 > -7$ because 6 is to the right of –7 on the number line.

b. $-8 < -1$ because –8 is to the left of –1 on the number line.

c. $-25 < -2$ because –25 is to the left of –2 on the number line.

d. $-14 < 0$ because –14 is to the left of 0 on the number line.

4. a. $|-8| = 8$ because –8 is 8 units from 0.

b. $|6| = 6$ because 6 is 6 units from 0.

b. $-|8| = -8$ because 8 is 8 units from 0 and the negative of 8 is -8.

5. a. The opposite of -14 is 14.

b. The opposite of 17 is -17.

c. The opposite of 0 is 0.

6. a. We can use the double-negative rule, $-(-a) = a$, to simplify.

$-(-25) = 25$

b. We cannot use the double-negative rule when one of the negatives is inside the absolute value bars.

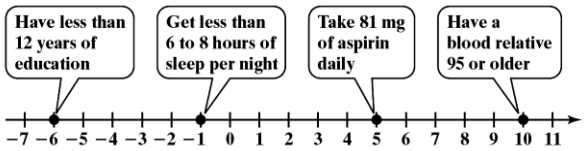
$-|-14| = -14$

c. We can use the double-negative rule, $-(-a) = a$, inside the absolute value bars.

$|-(-30)| = |30| = 30$

7. a. Take aspirin daily: 5; Blood relative 95 or older: 10; Less than 6 to 8 hours sleep: -1; Less than 12 years education: -6

b. Number line:



c. Less than 12 years education; Less than 6 to 8 hours sleep; Take aspirin daily; Blood relative 95 or older

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2.1 Concept and Vocabulary Check

1. $\{\ldots,-3,-2,-1,0,1,2,3,\ldots\}$

2. left

3. the distance from 0 to *a*

4. opposites

5. *a*

2.1 Exercise Set

1. –20

2. 65

3. 8

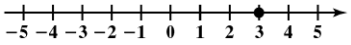
4. –12,500

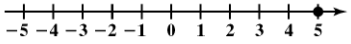
5. –3000

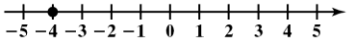
6. –3

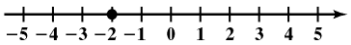
7. –4,000,000,000

8. -14

9. 

10. 

11. 

12. 

13. –2 < 7 because –2 is to the left of 7 on the number line.

14. –1 < 13 because –1 is to the left of 13 on the number line.

15. –13 < –2 because –13 is to the left of –2 on the number line.

16. –1 > –13 because –1 is to the right of –13 on the number line.

18. 7 > –9 because 7 is to the right of –9 on the number line.

19. –100 < 0 because –100 is to the left of 0 on the number line.

20. 0 > –300 because 0 is to the right of –300 on the number line.

21. $|-14| = 14$

22. $|-16| = 16$

23. $|14| = 14$

24. $|16| = 16$

25. $|-300,000| = 300,000$

26. $|-1,000,000| = 1,000,000$

27. $-|14| = -14$

28. $-|16| = -16$

29. The opposite of -7 is 7.

30. The opposite of -8 is 8.

31. The opposite of 13 is -13.

32. The opposite of 15 is -15.

1 8 is to the right of –50 on the number line.

7. 8 > –50 because

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33. $-(-12) = 12$

34. $-|-(-14)| = -|14| = -14$

35. $|-6| > |-3|$, because $6 > 3$

36. $-(-8) = 8$

37. $|0| = 0$

38. $|80| = 80$

39. $-|-7| = -7$

40. $|0| = 0$

41. $-|-8| = -8$

$-(|-1|) = -(1) = -1$

$|-(-12)| = |12| = 12$

$-(|-(-14)|) = -(|14|) = -14$

$-|-(-12)| = -|12| = -12$

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42. $|-20| < |-50|$, because $20 < 50$

43. $-|-6| < -|-3|$, because $-6 < -3$

44. $-|-20| > -|-50|$, because $-20 > -50$

45. $-(-5) > -|-5|$, because $5 > -5$

46. $-(-7) > -|-7|$, because $7 > -7$

47. –63 has the greater absolute value because it is further from zero on the number line.

48. –74 has the greater absolute value because it is further from zero on the number line.

49. $-x = -(-5) = 5$

50. $-(-x) = -(-6) = 6$

51. 1873; Ulysses S. Grant

52. 1985; Ronald Reagan

53. Cleveland

54. Reagan

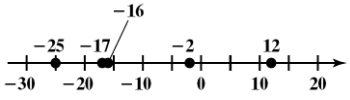
55. Van Buren and Cleveland

56. Van Buren and Cleveland

57. Grant and Reagan

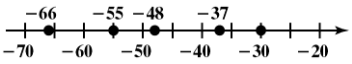
58. Grant, Kennedy, and Reagan

59. a.



b. Rhode Island, Georgia, Louisiana, Florida, Hawaii

60. a.



b. Wyoming, Wisconsin, Washington, West Virginia, Virginia

61. a. $4^\circ F$

b. $-4^\circ F$

c. Yes, 4 and –4 are the same distance from 0 on opposite sides of 0 on a number line.

62. a. $9^\circ F$

b. $-9^\circ F$

c. Yes, 9 and –9 are the same distance from 0 on opposite sides of 0 on a number line.

63. When the wind speed is 5 miles per hour and the air temperature is $-5^\circ F$ the temperature feels like $-16^\circ F$.
When the wind speed is 50 miles per hour and the air temperature is $10^\circ F$ the temperature feels like $-17^\circ F$.
It feels colder when the wind speed is 50 miles per hour and the air temperature is $10^\circ F$.

64. When the wind speed is 60 miles per hour and the air temperature is $15^\circ F$ the temperature feels like $-11^\circ F$.
When the wind speed is 15 miles per hour and the air temperature is $5^\circ F$ the temperature feels like $-13^\circ F$.
It feels colder when the wind speed is 15 miles per hour and the air temperature is $5^\circ F$.

65. – 70. Answers will vary.

71. does not make sense; Explanations will vary. Sample explanation: The *Titanic's* resting place is higher because it is less feet below sea level.

72. does not make sense; Explanations will vary. Sample explanation: The lowest a class size could be is zero.

73. makes sense

74. does not make sense; Explanations will vary. Sample explanation: We cannot use the double-negative rule when one of the negatives is inside the absolute value bars.

75. true

76. true

77. true

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b. $-4^\circ F$

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78. false; Changes to make the statement true will vary. A sample change is: If $a > b$ and a and b are integers, then a can be a negative or positive integer depending upon the value of b.

79. $-(-37) + |-93| = 37 + 93 = 130$

80. $-(-|600|) - |-76| = -(-600) - 76 = 600 - 76 = 524$

81.
$$\begin{aligned} 3[6(9-5)+2] &= 3[6(4)+2] \\ &= 3[24+2] \\ &= 3[26] \\ &= 78 \end{aligned}$$

82.
$$\begin{aligned} 6x^2 + 5x + 3 &= 6(2)^2 + 5(2) + 3 \\ &= 6(4) + 5(2) + 3 \\ &= 24 + 10 + 3 \\ &= 37 \end{aligned}$$

83. associative property of addition

84. $814 - 347 = 467$

85. $150 + (-90) = 60$

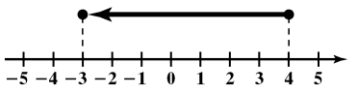
86. $-40 + (-10) = -50$

2.2 Check Points

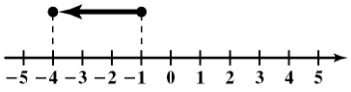
1. a. A loss of \$60 followed by a loss of \$40 results in a loss of \$100.
$-60 + (-40) = -100$

b. A gain of \$60 followed by a loss of \$40 results in a gain of \$20.
$60 + (-40) = 20$

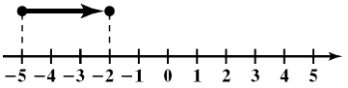
2. $4 + (-7) = -3$
Start at 4 and move 7 units to the left.



3. a. $-1 + (-3) = -4$
Start at -1 and move 3 units to the left.



b. $-5 + 3 = -2$
Start at -5 and move 3 units to the right.



4. a. $-7 + (-2) = -9$; Add the absolute values and use the common sign.

b. $-18 + (-46) = -64$; Add the absolute values and use the common sign.

c. $52 + 43 = 95$; Add the absolute values and use the common sign.

5. a. $-12 + 7 = -5$; Subtract the absolute values and use the sign of the number with the greater absolute value.

b. $20 + (-3) = 17$; Subtract the absolute values and use the sign of the number with the greater absolute value.

6. a. $-46 + 71 = 25$; Subtract the absolute values and use the sign of the number with the greater absolute value.

b. $27 + (-95) = -68$; Subtract the absolute values and use the sign of the number with the greater absolute value.

7. a. $26 + (-48) = -22$; The addends have different signs, so subtract the absolute values and use the sign of the number with the greater absolute value.

b. $-35 + (-102) = -137$; The addends have the same signs, so add the absolute values and use the common sign.

c. $-453 + 619 = 166$; The addends have different signs, so subtract the absolute values and use the sign of the number with the greater absolute value.

d. $79 + (-79) = 0$; The sum of any integer and its opposite is 0.

8. $-23 + 44 + (-66) + 38 = (44 + 38) + [(-23) + (-66)]$

$$= 8 2 + (- 8 9) = - 7$$

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9. $2+(-4)+1+(-5)+3=(2+1+3)+\left[(-4)+(-5)\right]$
$=6+(-9)$
$=-3$
At the end of 5 months the water level was down 3 feet.

2.2 Concept and Vocabulary Check

1. *a*; right; left; *a*; sum

2. 0

3. negative

4. negative integer

5. positive integer

6. 0

7. positive integer

8. negative integer

2.2 Exercise Set

1. A loss of \$8 followed by a loss of \$2 results in a loss of \$10.
$-8+(-2)=-10$

2. A loss of \$10 followed by a loss of \$6 results in a loss of \$16.
$-10+(-6)=-16$

3. A gain of \$12 followed by a loss of \$8 results in a gain of \$4.
$12+(-8)=4$

4. A gain of \$15 followed by a loss of \$10 results in a gain of \$5.
$15+(-10)=5$

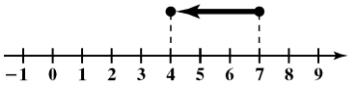
5. A gain of \$20 followed by a loss of \$25 results in a loss of \$5.
$20+(-25)=-5$

6. A gain of \$30 followed by a loss of \$36 results in a loss of \$6.
$30+(-36)=-6$

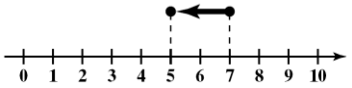
7. A loss of \$4 followed by a gain of \$5 results in a gain of \$1.
$-4+5=1$

8. A loss of \$7 followed by a gain of \$7 results in a gain of \$1.
$-6+7=1$

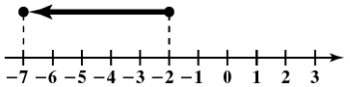
9. $7+(-3)=4$



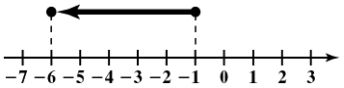
10. $7+(-2)=5$



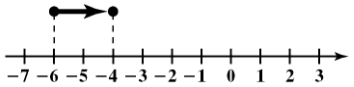
11. $-2+(-5)=-7$



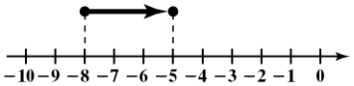
12. $-1+(-5)=-6$



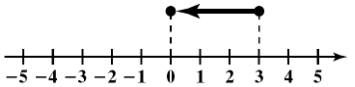
13. $-6+2=-4$



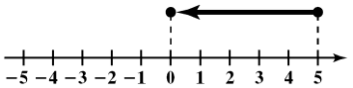
14. $-8+3=-5$



15. $3+(-3)=0$



16. $5+(-5)=0$



17. $-8+(-10)=-18$

18. $-4+(-6)=-10$

19. $-17+(-36)=-53$

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20. $-19+(-47)=-66$

21. $17+36=53$

22. $19+47=66$

23. $-12+7=-5$

24. $-14+6=-8$

25. $15+(-6)=9$

26. $18+(-11)=7$

27. $-46+93=47$

28. $-37+82=45$

29. $34+(-76)=-42$

30. $38+(-89)=-51$

31. $-68+(-91)=-159$

32. $-58+(-83)=-141$

33. $-247+913=666$

34. $-358+817=459$

35. $247+913=1160$

36. $358+817=1175$

37. $247+(-247)=0$

38. $358+(-358)=0$

39. $-247+247=0$

40. $-358+358=0$

41. $4+(-7)+(-5)=4+\left[(-7)+(-5)\right]$
$=4+(-12)$
$=-8$

42. $10+(-3)+(-8)=10+\left[(-3)+(-8)\right]$

43. $7+(-10)+2+(-3)=(7+2)+\left[(-10)+(-3)\right]$
$=9+(-13)$
$=-4$

44. $5+(-7)+3+(-6)=(5+3)+\left[(-7)+(-6)\right]$
$=8+(-13)$
$=-5$

45. $-19+13+(-33)+17=(13+17)+\left[(-19)+(-33)\right]$
$=30+(-52)$
$=-22$

46. $-18+15+(-34)+25=(15+25)+\left[(-18)+(-34)\right]$
$=40+(-52)$
$=-12$

47. $27+(-13)+14+(-28)=(27+14)+\left[(-13)+(-28)\right]$
$=41+(-41)$
$=0$

48. $38+(-16)+11+(-33)=(38+11)+\left[(-16)+(-33)\right]$
$=49+(-49)$
$=0$

49. $15+(-63)=-48$

50. $11+(-74)=-63$

51. =
1

52. 0
+

53. (
−

54. 1
1

55.)
=
−
1

56.

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$-50 + 13 = -37$

$-40 + 17 = -23$

$-26 + 39 = -13$

$-37 + 54 = -17$

$-3 + (-5) + 2 + (-6) = -8 + -4$

$= 8 + 4$

$= 12$

$4 + (-11) + -3 + (-4) = -7 + -7$

$= 7 + 7$

$= 14$

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57. $-20+\left[-\left|15+(-25)\right|\right]=-20+\left[-\left|-10\right|\right]$

$=-20+[-10]$

$=-30$

58. $-25+\left[-\left|18+(-26)\right|\right]=-25+\left[-\left|-8\right|\right]$

$=-25+[-8]$

$=-33$

59. Left side: $6+\left[2+(-13)\right]=6+[-11]=-5$

Right side: $-3+\left[4+(-8)\right]=-3+[-4]=-7$

$6+\left[2+(-13)\right]>-3+\left[4+(-8)\right]$ because $-5>-7$

60. Left side: $\left[(-8)+(-6)\right]-10=-14-10=-24$

Right side: $-8+\left[9+(-21)\right]=-8+[-12]=-20$

$\left[(-8)+(-6)\right]-10<-8+\left[9+(-21)\right]$ because $-24<-20$

61. $-56+100=44$

The high temperature was 44°F.

62. $-4+49=45$

The high temperature was 45°F.

63. $-1312+712=-600$

The elevation of the person is 600 feet below sea level.

64. $-512+642=130$

The elevation of the person is 130 feet above sea level.

65. $-7+15-5=3$

The temperature at 4:00 P.M. was 3°F.

66. $-15+13+(-4)=-6$

The team had a total loss of 6 yards.

67. $27+4-2+8-12$

$=(27+4+8)+(-2-12)$

$=34-14$

$=25$

68. $20+3+(-2)+(-1)+(-4)+2$

$=(20+3+2)+(-2+(-1)+(-4))$

$=25-7$

$=18$

The level of the reservoir is 18 feet.

69. **a.** $2304+(-3603)=-1299$

The deficit is \$1299 billion for 2011.

b. $2450+(-3537)=-1087$

The deficit is \$1087 billion for 2012. This is better than 2011 because 2012 had less debt.

c. $-1299+(-1087)=-2386$

The combined deficit is \$2386 billion.

70. **a.** $2105+(-3518)=-1413$

The deficit is \$1413 billion for 2009.

b. $2163+(-3457)=-1294$

The location of the football at the end of the fourth play is at the 25-yard line.

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The deficit in 2010 was greater than the deficit in 2009 because 2010 had less debt.

c. $-1413 + (-1294) = -2707$

The combined deficit is $2707 billion.

71. – 76. Answers will vary.

77. makes sense

78. makes sense

79. does not make sense; Explanations will vary. Sample explanation: The sum of two negative integers is a negative integer.

80. makes sense

81. true

82. false; Changes to make the statement true will vary. A sample change is: The sum of a positive integer and a negative integer can be positive or negative or zero.

83. true

84. false; Changes to make the statement true will vary. The absolute value of two negative integers is always a positive integer.

85. The sum is negative. The sum of two negative numbers is always a negative number.

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86. The sum is negative. When finding the sum of numbers with different signs, use the sign of the number with the greater absolute value as the sign of the sum. Since a is further from 0 than c, we use a negative sign.

87. The sum is positive. When finding the sum of numbers with different signs, use the sign of the number with the greater absolute value as the sign of the sum. Since c is further from 0 than b, we use a positive sign.

88. Though the sum inside the absolute value is negative, the absolute value of this sum is positive.

89. – 90. Answers will vary.

91. $(2\cdot 3)^2 - 2\cdot 3^2 = 6^2 - 2\cdot 9 = 36 - 18 = 18$

92. $2y + 7 = 13$

$2(3) + 7 = 13$

$6 + 7 = 13$

$13 = 13$, true

The number is a solution.

93. commutative property of addition

94. $7 - 10 = 7 + (-10) = -3$

95. $-8 - 13 = -8 + (-13) = -21$

96. $-8 - (-13) = -8 + 13 = 5$

2.3 Check Points

Note that for Check Points #1 – 2, first change all subtractions to additions of opposites.

1. a. $3 - 11 = 3 + (-11) = -8$

b. $4 - (-5) = 4 + 5 = 9$

c. $-7 - (-2) = -7 + 2 = -5$

2. a. $-46 - 87 = -46 + (-87) = -133$

b. $129 - (-317) = 129 + 317 = 446$

3. First change all subtractions to additions of opposites. Then add the positive numbers and negative numbers separately.

$$\begin{aligned} 10 - (-12) - 4 - (-3) - 6 &= 10 + 12 + (-4) + 3 + (-6) \\ &= (10 + 12 + 3) + [(-4) + (-6)] \\ &= 25 + (-10) \\ &= 15 \end{aligned}$$

4. The difference can be found by subtracting the elevation of the Marianas Trench from the elevation of Mount Everest.

$8848 - (-10,915) = 8848 + 10,915 = 19,763$

The difference in elevation is 19,763 meters.

5. a. $3 - (-5) = 3 + 5 = 8$

The difference in lifespan is 8 years.

b. $-1 - (-15) = -1 + 15 = 14$

The difference in lifespan is 14 years.

c. $2 + (-5) = -3$

You shrink your lifespan by 3 years.

d. $5 + (-5) = 0$

There is no change to your lifespan.

2.3 Concept and Vocabulary Check

1. (-14)

2. 14

3. 14

4. -8; (-14)

5. 3; (-12); (-23)

2.3 Exercise Set

1. a. -12

b. $5 - 12 = 5 + (-12)$

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c. $-164-(-38)=-164+38=-126$

2. a. -10

b. $4-10=4+(-10)$

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3. **a.** 7

b. $5-(-7)=5+7$

4. **a.** 8

b. $2-(-8)=2+8$

5. $14-8=14+(-8)=6$

6. $15-2=15+(-2)=13$

7. $8-14=8+(-14)=-6$

8. $2-15=2+(-15)=-13$

9.

10.

11.

12.

13.

14.

15.

16.

17.

18.

19.

20.

21.

22.

23.

24.

25. $0-(-13)=0+13=13$

26. $0-(-15)=0+15=15$

27. $-29-86=-29+(-86)=-115$

28. $-37-95=-37+(-95)=-132$

29. $274-(-391)=274+391=665$

30. $268-(-419)=268+419=687$

31. $-146-(-89)=-146+89=-57$

32. $-263-(-98)=-263+98=-165$

$3-(-20)=3+20=23$ $-21-17=-21+(-17)=-38$

$5-(-17)=5+17=22$ $26-26=26+(-26)=0$

$-7-(-18)=-7+18=11$ $-5-(-19)=-5+19=14$

$-13-(-2)=-13+2=-11$

$-21-(-3)=-21+3=-18$

$-29-21=-29+(-21)=-50$

$-45-(-45)=-45+45=0$

$-65-(-65)=-65+65=0$

$23-23=23+(-23)=0$

$13-(-13)=13+13=26$

$15-(-15)=15+15=30$

$0-13=0+(-13)=-13$

$0-15=0+(-15)=-15$

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33. $-146-(-146) = -146+146$
$= 0$

34.
$-263-(-263) = -263+263$

35. $= 0$

36. $-146-146 = -146+(-146)$
$= -292$

37.
$-263-263 = -263+(-263)$
$= -526$

38. $13-2-(-8) = 13+(-2)+8$
$= (13+8)+(-2)$
$= 21+(-2)$
$= 19$

39. $14-3-(-7) = 14+(-3)+7$
$= (14+7)+$
(-3)
$= 21+(-3)$
$= 18$

40. $9-8+3-7 = 9+(-8)+3+$
(-7)
$= (9+3)+[(-8)$
$+(-7)]$
$= 12+(-15)$
$= -3$

$8-2+5-13 = 8+(-2)+5+$
(-13)
$= (8+5)+[(-2)$
$+(-13)$
$= 13+(-15)$
$= -2$

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41. $-6-2+3-10$
$=-6+(-2)+3+(-10)$
$=[(-6)+(-2)+(-10)]+3$
$=-18+3$
$=-15$

42. $-9-5+4-17$
$=-9+(-5)+4+(-17)$
$=[(-9)+(-5)+(-17)]+4$
$=-31+4$
$=-27$

43. $-10-(-5)+7-2$
$=-10+5+7+(-2)$
$=[(-10)+(-2)]+(5+7)$
$=-12+12$
$=0$

44. $-6-(-3)+8-11$
$=-6+3+8+(-11)$
$=[(-6)+(-11)]+(3+8)$
$=-17+11$
$=-6$

45. $-23-11-(-7)+(-25)$
$=(-23)+(-11)+7+(-25)$

46.

48. $17-42+11-78-(-13)$
$=17+(-42)+11+(-78)+13$
$=[(-42)+(-78)]+(17+11+13)$
$=-120+41$
$=-79$

49. $-823-146-50-(-832)$
$=-823+(-146)+(-50)+832$
$=[(-823)+(-146)+(-50)]+832$
$=-1019+832$
$=-187$

50. $-726-422-921-(-816)$
$=-726+(-422)+(-921)+816$
$=[(-726)+(-422)+(-921)]+816$
$=-2069+816$
$=-1253$

51. $15-(-17)=15+17=32$

52. $29-(-11)=29+11=40$

53. $-5000-(-7)=-5000+7=-4993$

54. $-6000-(-8)=-6000+8=-5992$

55. $18-(-4)=18+4=22$
$=[(-2)+(-25)]+7$
$=-59+7$
$=-52$

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$-19-8-(-6)-(-21)$
$=(-19)+(-8)+6-(-21)$

56.

57.

58.

$=[(-19)+(-8)]+[6+(+21)]$
$=-27+27$
$=0$

47. $20-37+19-48-(-17)$
$=20+(-37)+19+(-48)+17$

$=[(-37)+(-48)]+(20+19+17)$
$=-85+56$
$=-29$

$16-(-5)=16+5=21$

$-100-40=-100+(-40)=-140$

$-100-60=-100+(-60)=-160$

59. $-50-20=-50+(-20)=-70$

60. $-70-20=-70+(-20)=-90$

61. $-534-100=-534+(-100)=-634$

62. $-342-100=-342+(-100)=-442$

63. $-760-40=-760+(-40)=-800$

64. $-540-60=-540+(-60)=-600$

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65. Left side: $-26-(-18) = -26+18 = -8$

Right side: $-60-(-48) = -60+48 = -12$

$-26-(-18) > -60-(-48)$ because $-8 > -12$

66. Left side: $-26-51 = -26+(-51) = -77$

Right side: $-44-27 = -44+(-27) = -71$

$-26-51 < -44-27$ because $-77 < -71$

67. $12-x-y = 12-(-2)-5$

$= 12+2+(-5)$

$= 14+(-5)$

$= 9$

68. $15-x-y = 15-(-3)-7$

$= 15+3+(-7)$

$= 18+(-7)$

$= 11$

69. $9-x = 13$

$9-(-4) = 13$

$9+4 = 13$

$13 = 13$, true

The number is a solution.

70. $8-x = 15$

$8-(-7) = 15$

$8+7 = 15$

$15 = 15$, true

The number is a solution.

71. $-3-(6-10) = -3-(6+(-10))$

$= -3-(-4)$

$= -3+4$

$= 1$

72. $-5-(4-12) = -5-(4+(-12))$

$= -5-(-8)$

$= -5+8$

$= 3$

74. Elevation of Mount Kilimanjaro – elevation of Qattara Depression

$= 19,321-(-436) = 19,757$

The difference in elevation between the two geographic locations is 19,757 feet.

75. $2-(-19) = 2+19 = 21$

The difference is $21^\circ F$.

76. $6-(-12) = 6+12 = 18$

The difference is $18^\circ F$.

77. $-19-(-22) = -19+22 = 3$

$3^\circ F$ warmer

78. $-12-(-19) = -12+19 = 7$

$7^\circ F$ warmer

79. $-1413+(-1300) = -2713$

The combined deficit is \$2713 billion.

80. $-161+(-1413)+(-1300) = -2874$

The combined deficit is \$2874 billion.

81. $128-(-1300) = 128+1300 = 1428$

The difference is \$1428 billion.

82. $128-(-1413) = 128+1413 = 1541$

The difference is \$1541 billion.

83. – 85. Answers will vary.

86. makes sense

87. makes sense

88. makes sense

89. makes sense

90. true

91. false; Changes to make the statement true will vary. A sample change is: $7-(-2) = 9$.

92. true

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73. Elevation of Mount McKinley – elevation of Death Valley

$= 20,320 - (-282) = 20,602$

The difference in elevation between the two geographic locations is 20,602 feet.

93. true

94. positive

95. negative

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96. negative

97. positive

98. $|x-y| = |(-6)-(-8)| = |(-6)+8| = |2| = 2$

$|x|-|y| = |-6|-|-8| = 6-8 = 6+(-8) = -2$

$|x+y| = |(-6)+(-8)| = |-14| = 14$

From least to greatest is: $|x|-|y|;\ |x-y|;\ |x+y|$

99. – 100. Answers will vary.

101. seventy-six thousand, three hundred five

102.
$$\begin{array}{r} 203 \\ 47\overline{)9541} \\ \underline{94} \\ 14 \\ \underline{0} \\ 141 \\ \underline{141} \\ 0 \end{array}$$

$9541 \div 47 = 203$

103. $\dfrac{70+84+90+91+100}{5} = \dfrac{435}{5} = 87$

104. $4(-3) = (-3)+(-3)+(-3)+(-3) = -12$

105. $3(-3) = (-3)+(-3)+(-3) = -9$

106. $2(-3) = -6$

$1(-3) = -3$

$0(-3) = 0$
$-1(-3) = 3$
$-2(-3) = 6$
$-3(-3) = 9$

$-4(-3) = \boxed{12}$

b. $(-4)(-9) = 36$ The product of two integers with same signs is positive.

3. a. $15(-19) = -285$ The product of two integers with different signs is negative.

b. $(-6)(-204) = 1224$ The product of two integers with same signs is positive.

c. $(-204)(0) = 0$ The product of any number and zero is zero.

d. $-7(38) = -266$ The product of two integers with different signs is negative.

4. a. $(-2)(3)(-1)(4) = 24$ When multiplying an even number of negative integers the product is positive.

b. $(-1)(-3)(2)(-1)(5) = -30$ **…** When multiplying an odd number of negative integers the product is negative.

5. a. $(-6)^2 = (-6)(-6) = 36$

b. $-6^2 = -(6 \cdot 6) = -36$

c. $(-5)^3 = (-5)(-5)(-5) = -125$

d. $(-1)^4 = (-1)(-1)(-1)(-1) = 1$

e. $-1^4 = -(1 \cdot 1 \cdot 1 \cdot 1) = -1$

f. $(-2)^5 = (-2)(-2)(-2)(-2)(-2) = -32$

6. a. $\dfrac{-45}{} = -9$ 5

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2.4 Check Points

1. a. $8(-5) = -40$ The product of two integers with different signs is negative.

b. $(-6)(2) = -12$ The product of two integers with different signs is negative.

2. a. $(-7)(-10) = 70$ The product of two integers with same signs is positive.

The quotient of two integers with different signs is negative.

b. $(-30) \div (-10) = 3$ The quotient of two integers with same signs is positive.

c. $\frac{1220}{-4} = -305$ The quotient of two integers with different signs is negative.

d. $\frac{0}{-1220} = 0$ Any nonzero integer divided into zero is zero.

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7. a. Because there are 7 days in a week, we can find the number of deaths in a week by multiplying the number of daily deaths by 7.
$(-156,000)\cdot 7 = -1,092,000$
Each week, there are 1,092,000 deaths in the world.

b. Because there are 7 days in a week, we can find the number of births in a week by multiplying the number of daily births by 7.
$384,000\cdot 7 = 2,688,000$
Each week, there are 2,688,000 births in the world.

c. We find the increase in world population each week by combining the number of deaths and the number of births.
$(-1,092,000) + 2,688,000 = 1,596,000$
Each week, the population increases by 1,596,000.

2.4 Concept and Vocabulary Check

1. negative

2. positive

3. positive

4. negative

5. 0

6. negative

7. positive

8. 0

9. undefined

2.4 Exercise Set

1. $5(-9) = -45$

2. $10(-7) = -70$

3. $(-8)(-3) = 24$

6. $-4(8) = -32$

7. $(-19)(-1) = 19$

8. $(-11)(-1) = 11$

9. $0(-19) = 0$

10. $0(-11) = 0$

11. $12(-13) = -156$

12. $13(-14) = -182$

13. $(-6)(-207) = 1242$

14. $(-6)(-308) = 1848$

15. $(-207)(0) = 0$

16. $(-308)(0) = 0$

17. $(-5)(-2)(3) = 30$

18. $(-6)(-3)(10) = 180$

19. $(-4)(-3)(-1)(6) = -72$

20. $(-2)(-7)(-1)(3) = -42$

21. $-2(-3)(-4)(-1) = 24$

22. $-3(-2)(-5)(-1) = 30$

23. $(-3)(-3)(-3) = -27$

24. $(-4)(-4)(-4) = -64$

25. $5(-3)(-1)(2)(3) = 90$

26. $2(-5)(-2)(3)(1) = 60$

27. $(-2)(-2)(-2)(-2)(-2) = -32$

28. $(-2)(-2)(-2)(-2)(-2)(-2) = 64$

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4. $(-9)(-5) = 45$

5. $-3(7) = -21$

29. $(-8)(-4)(0)(-17)(-6) = 0$

30. $(-9)(-12)(-18)(0)(-3) = 0$

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31. $(-4)^2 = (-4)(-4) = 16$

32. $(-7)^2 = (-7)(-7) = 49$

33. $-4^2 = -(4 \cdot 4) = -16$

34. $-7^2 = -(7 \cdot 7) = -49$

35. $(-10)^3 = (-10)(-10)(-10) = -1000$

36. $(-4)^3 = (-4)(-4)(-4) = -64$

37. $-10^3 = -(10 \cdot 10 \cdot 10) = -1000$

38. $-4^3 = -(4 \cdot 4 \cdot 4) = -64$

39. $(-3)^4 = (-3)(-3)(-3)(-3) = 81$

40. $(-2)^4 = (-2)(-2)(-2)(-2) = 16$

41. $-3^4 = -(3 \cdot 3 \cdot 3 \cdot 3) = -81$

42. $-2^4 = -(2 \cdot 2 \cdot 2 \cdot 2) = -16$

43. $(-1)^5 = (-1)(-1)(-1)(-1)(-1) = -1$

44. $(-1)^6 = (-1)(-1)(-1)(-1)(-1)(-1) = 1$

45. $-1^8 = -(1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1) = -1$

46. $-1^{10} = -(1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1) = -1$

47. $\frac{12}{-4} = -3$

48. $\frac{40}{-5} = -8$

52. $(-80) \div 8 = -10$

53. $(-180) \div (-30) = 6$

54. $(-120) \div (-20) = 6$

55. $\frac{120}{-10} = -12$

56. $\frac{130}{-10} = -13$

57. $0 \div (-120) = 0$

58. $0 \div (-130) = 0$

59. $(-120) \div 0$ undefined

60. $(-130) \div 0$ undefined

61. $\frac{-3542}{-7} = 506$

62. $\frac{-2448}{-6} = 408$

63. $-234 \div 13 = -18$

64. $-304 \div 16 = -19$

65. $743 \div (-743) = -1$

66. $971 \div (-971) = -1$

67. $(-73)(-4) = 292$

68. $(-96)(-5) = 480$

69. $2(-15) = -30$

70. $3(-12) = -36$

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49. $\frac{-21}{3} = -7$

50. $\frac{-27}{3} = -9$

51. $(-60) \div 6 = -10$

71. $(-5)^2 = (-5)(-5) = 25$

72. $(-6)^2 = (-6)(-6) = 36$

73. $-5^2 = -(5 \cdot 5) = -25$

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74. $-6^2 = -(6 \cdot 6) = -36$

75. $\frac{460}{-5} = -92$

76. $\frac{696}{-8} = -87$

77. $\frac{-44}{-11} = 4$

78. $\frac{-84}{-12} = 7$

79. Left side: $-8(5) = -40$

Right side: $18 \div (-2) = -9$

$-8(5) < 18 \div (-2)$ because $-40 < -9$

80. Left side: $-3(15) = -45$

Right side: $60 \div (-5) = -12$

$-3(15) < 60 \div (-5)$ because $-45 < -12$

81. $\frac{-48}{xy} = \frac{-48}{(-2)(-3)} = \frac{-48}{6} = -8$

82. $\frac{-75}{xy} = \frac{-75}{(-3)(-5)} = \frac{-75}{15} = -5$

83. $\frac{-30}{x} + 5 = 5x$

$\frac{-30}{-3} + 5 = 5(-3)$

$10 + 5 = -15$

$15 = -15$, false

The number is not a solution.

84. $\frac{-70}{x} + 32 = 6x$

$\frac{-70}{-7} + 32 = 6(-7)$

$10 + 32 = -42$

$42 = -42$, false

86. $7(-4) = -28$

The decrease is 28°.

87. $65(29 - 35) = 65(29 + (-35)) = 65(-6) = -390$

The total loss is \$390.

88. $85(39 - 47) = 85(39 + (-47)) = 85(-8) = -680$

The total loss is \$680.

89. **a.** $16(-5) = -80$

You are fined 80 cents.

b. $10(8) = 80$

You are owed 80 cents.

c. Neither owes money to the other because the values are opposites.

90. **a.** $12(-5) = -60$

You are fined 60 cents.

b. $16(8) = 128$

You are owed 128 cents.

c. $(-60) + 128 = 68$

We owe you 68 cents.

91. $\frac{-32,200}{7} = -4600$

Each person losses \$4600.

92. $\frac{-26,500}{5} = -5300$

Each person losses \$5300.

93. $\frac{(-311) + (-330) + (-357) + (-344) + (-338)}{5}$

$= \frac{-1680}{5} = -336$

On average, women with college degrees get paid \$336 less per week than their male counterparts during this five-year period.

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94.

$$\left(-3\frac{4}{4}\right)+\left(-3\frac{3}{8}\right)=\frac{-682}{2}=-341$$

On average, women with college degrees get paid \$341 less per week than their male counterparts during this two-year period.

The number is not a solution.

85. $6(-3) = -18$

The decrease is 18°.

95. – 100. Answers will vary.

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101. does not make sense; Explanations will vary. Sample explanation: The sign rules for multiplication and division are the same.

102. does not make sense; Explanations will vary. Sample explanation: When I multiply more than two integers, I determine the sign of the product by counting the number of negative factors.

103. makes sense

104. makes sense

105. false; Changes to make the statement true will vary. A sample change is: The addition of two negative numbers results in a negative answer. While, the multiplication of two negative integers results in a positive answer.

106. true

107. false; Changes to make the statement true will vary.

A sample change is: $0 \div (-154,293) = 0$.

108. true

109.
$$-x + 6x = -15 + \frac{25}{x}$$
$$-(-5) + 6(-5) = -15 + \frac{25}{-5}$$
$$5 + (-30) = -15 + (-5)$$
$$-25 = -20, \quad \text{false}$$

The number is not a solution.

110. $-12x$

111. $\dfrac{-25,000}{x}$

112. – 114. Answers will vary.

115. $-27 + (-3) = -30$

116. $-27 - (-3) = -27 + 3 = -24$

117. $-27 \div (-3) = 9$

120.
$$3\lceil 6 + 2(11-8)^2 \rceil = 3\lceil 6 + 2(3)^2 \rceil$$
$$= 3[6 + 2 \cdot 9]$$
$$= 3[6 + 18]$$
$$= 3[24]$$
$$= 72$$

Mid-Chapter Check Point – Chapter 2

1. $-80 \div 10 = -8$

2. $17 - (-12) = 17 + 12 = 29$

3. $-14 + (-16) = -30$

4. $(-4)^3 = (-4)(-4)(-4) = -64$

5. $-6(-11) = 66$

6.
$$-10 + 4 + (-15) + 7 = [-10 + (-15)] + (4 + 7)$$
$$= [-25] + 11$$
$$= -14$$

7. $(-20) \div (-4) = 5$

8. $3(-5)(-2)(-1) = -30$

9. $-15 - 19 = -15 + (-19) = -34$

10. $(-2)^4 = (-2)(-2)(-2)(-2) = 16$

11. $-2^4 = -(2 \cdot 2 \cdot 2 \cdot 2) = -16$

12. $\dfrac{222}{-6} = -37$

13.
$$-7 - (-11) - 5 + 18 = -7 + 11 + (-5) + 18$$
$$= [-7 + (-5)] + (11 + 18)$$
$$= [-12] + 29$$

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118. $8 + 27 \div 3 = 8 + 9$
$= 17$

119. $12 \div 4 \cdot 2^3 = 12 \div 4 \cdot 8$
$= 3 \cdot 8$
$= 24$

$= 17$

14. $-3 > -300$

15. $|-12| = 12$

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16. $-|12| = -12$

17. $-(-12) = 12$

18. $-|-12| = -12$

19. $15,400 - (-760) = 15,400 + 760 = 16,160$
The difference is 16,160 feet.

20. $5 + (-8) + 2 + 3 + (-7) + (-1)$

$= (5 + 2 + 3) + (-8) + (-7) + (-1)$
$= 10 + [-16]$
$= -6$

The temperature at the final measurement is -6°.

21. **a.** $-13 - (-9) = -13 + 9 = -4$

It was $4^\circ F$ colder in Wisconsin

b. $\frac{-13 + (-9)}{2} = \frac{-22}{2} = -11$

The mean was $-11^\circ F$.

c. $-13 + 15 = 2$
The temperature was $2^\circ F$.

2.5 Check Points

1. There are no grouping symbols or exponents. We start by performing the division.
$3 + (-25) \div 5 = 3 + (-5)$

$= -2$

2. There are no grouping symbols or exponents. We begin by evaluating the exponential expression.
$20 \div 10(-3)^3 = 20 \div 10(-27)$
$= 2(-27)$
$= -54$

3. Because grouping symbols appear, we perform the operations in parentheses first.
$-20 - (3 - 7 \cdot 2) = -20 - (3 - 14)$
$= -20 - (-11)$
$= -20 + 11$
$= -9$

4. There are no grouping symbols or exponents. We begin by evaluating the exponential expression.
$21 - 25 \div 5(-3)^2 - 7 = 21 - 25 \div 5(9) - 7$

$= 21 - 5(9) - 7$
$= 21 - 45 - 7$
$= 21 + (-45) + (-7)$

$= 21 + (-52)$

$= -31$

5. Begin by performing the operation within the innermost grouping symbol, the parentheses, first.
$-3\lceil 8 - 10(4 - 6)^2 \rceil = -3\lceil 8 - 10(-2)^2 \rceil$
$\lfloor$
$= -3[8 - 10(4)]$
$= -3[8 - 40]$
$= -3[8 + (-40)$
$= -3[-32]$
$= 96$

6. Fraction bars are grouping symbols that separate expressions into two parts. Simplify above and below the fraction bar separately.
$\frac{-68 \div 2 + 4}{43 - 7^2} = \frac{-34 + 4}{43 - 49}$
$= \frac{-30}{-6}$
$= 5$

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7. Because absolute value donates grouping, we perform the operations inside the absolute value bars first.

$$\begin{aligned} 43+\left|-18-4\left(-2\right)\right|-7^2-2^3 &= 43+\left|-18-\left(-8\right)\right|-7^2-2^3 \\ &= -43+\left|-18+8\right|-7^2-2^3 \\ &= 43+\left|-10\right|-7^2-2^3 \\ &= 43+10-7^2-2^3 \\ &= 43+10-49-8 \\ &= 43+10+\left(-49\right)+\left(-8\right) \\ &= 53+\left(-57\right) \\ &= -4 \end{aligned}$$

8. Begin by substituting –5 for each occurrence of x in the algebraic expression. Then use the order of operations to evaluate the expression.

$$\begin{aligned} -x^2-9x+4\left(x+2\right) &= -\left(-5\right)^2-9\left(-5\right)+4\left(-5+2\right) \\ &= -\left(-5\right)^2-9\left(-5\right)+4\left(-3\right) \\ &= -25-9\left(-5\right)+4\left(-3\right) \\ &= -25-\left(-45\right)+\left(-12\right) \\ &= -25+45+\left(-12\right) \\ &= 45+\left(-37\right) \\ &= 8 \end{aligned}$$

9. Begin by substituting the values for each variable in the algebraic expression. Then use the order of operations to evaluate the expression.

$$\begin{aligned} b^2-4ac &= \left(-6\right)^2-4\left(5\right)\left(-2\right) \\ &= 36-4\left(5\right)\left(-2\right) \\ &= 36-\left(-40\right) \\ &= 36+40 \\ &= 76 \end{aligned}$$

10. **a.** To determine whether –9 is a solution to the equation, substitute –9 for all occurrences of the variable and evaluate each side of the equation.

$$\begin{aligned} -7x &= 99+4x \\ -7\left(-9\right) &= 99+4\left(-9\right) \\ 63 &= 99+\left(-36\right) \\ 63 &= 63, \quad \text{true} \end{aligned}$$

The number is a solution.

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b. To determine whether –3 is a solution to the equation, substitute –3 for all occurrences of the variable and evaluate each side of the equation.

$$-5t^2 + 8t + 70 = 0$$
$$-5(-3)^2 + 8(-3) + 70 = 0$$
$$-5(9) + 8(-3) + 70 = 0$$
$$-45 + (-24) + 70 = 0$$
$$-69 + 70 = 0$$
$$1 = 0, \quad \text{false}$$

The number is not a solution.

11. a. Begin with the median weekly earnings of male college graduates in 2005. Because 2005 is 5 years after 2000, we substitute 5 for x in the formula for earnings of males.

$$M = \left(-2x^2 + 170x + 5115\right) \div 5$$
$$M = \left(-2 \cdot 5^2 + 170 \cdot 5 + 5115\right) \div 5$$
$$M = \left(-2 \cdot 25 + 170 \cdot 5 + 5115\right) \div 5$$
$$M = \left(-50 + 850 + 5115\right) \div 5$$
$$M = \left(-50 + 5965\right) \div 5$$
$$M = 5915 \div 5$$
$$M = 1183$$

The formula indicates that the median weekly earnings of male college graduates in 2005 were \$1183. The bar graph shows earnings of \$1167. Thus, the model overestimates weekly earnings by \$1183 – \$1167, or by \$16.

b. Begin with the median weekly earnings of female college graduates in 2005. Because 2005 is 5 years after 2000, we substitute 5 for x in the formula for earnings of females.

$$F = \left(-3x^2 + 145x + 3775\right) \div 5$$
$$F = \left(-3 \cdot 5^2 + 145 \cdot 5 + 3775\right) \div 5$$
$$F = \left(-3 \cdot 25 + 145 \cdot 5 + 3775\right) \div 5$$
$$F = \left(-75 + 725 + 3775\right) \div 5$$
$$F = \left(-75 + 4500\right) \div 5$$
$$F = 4425 \div 5$$
$$F = 885$$

The formula indicates that the median weekly earnings of female college graduates in 2005 were \$885. The bar graph shows earnings of \$883. Thus, the model overestimates weekly earnings by \$885 – \$883, or by \$2.

c. Make a Table:

	Male Earnings in 2005	Female Earnings in 2005	Difference (Gap)
Mathematical Models	\$1183	\$885	\$1183 – \$885 = \$298
Data from Figure	\$1167	\$883	\$1167 – \$883 = \$284

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2.5 Concept and Vocabulary Check

1. divide

2. multiply

3. subtract

4. add

5. subtract

2.5 Exercise Set

1. $-6+5(-3) = -6+(-15)$
$= -21$

2. $-8+4(-3) = -8+(-12)$
$= -20$

3. $7+(-20)\div 4 = 7+(-5)$
$= 2$

4. $9+(-35)\div 5 = 9+(-7)$
$= 2$

5. $4(-2)^3 = 4(-8)$
$= -32$

6. $3(-2)^5 = 3(-32)$
$= -96$

7. $50\div(-10)(-3)^2 = 50\div(-10)(9)$
$= -5(9)$
$= -45$

8. $30\div(-10)(-4)^2 = 30\div(-10)(16)$
$= -3(16)$
$= -48$

9. $4-3(2-7) = 4-3(-5)$
$= 4-(-15)$
$= 4+15$
$= 19$

10. $7-3(4-10) = 7-3(-6)$
$= 7-(-18)$
$= 7+18$
$= 25$

11. $(4-3)(2-7) = 1(-5)$
$= -5$

12. $(7-3)(4-10) = 4(-6)$
$= -24$

13. $-25-(2-4\cdot 3) = -25-(2-12)$
$= -25-(-10)$
$= -25+10$
$= -15$

14. $-35-(3-4\cdot 2) = -35-(3-8)$
$= -35-(-5)$
$= -35+5$
$= -30$

15. $6(-2)^3+12\div(-4) = 6(-8)+12\div(-4)$
$= -48+(-3)$
$= -51$

16. $4(-2)^3+30\div(-5) = 4(-8)+30\div(-5)$
$= -32+(-6)$
$= -38$

17. $30-35\div 5(-3)^2-6 = 30-35\div 5(9)-6$
$= 30-7(9)-6$
$= 30-63-6$
$= 30+(-63)+(-6)$
$= 30+(-69)$
$= -39$

18. $40-50\div 10(-2)^2-8 = 40-50\div 10(4)-8$
$= 40-5(4)-8$
$= 40-20-8$
$= 40+(-20)+(-8)$

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$$= 40 + (-28)$$
$$= -12$$

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19. $-20-40\div10(-4)^2+3=-20-40\div10(16)+3$
$=-20-4(16)+3$
$=-20-64+3$
$=-20+(-64)+3$
$=-84+3$
$=-81$

20. $-12-30\div10(-5)^2+6=-12-30\div10(25)+6$
$=-12-3(25)+6$
$=-12-75+6$
$=-12+(-75)+6$
$=-87+6$
$=-81$

21. $(-8+18)^2\div(8-9)^3=(10)^2\div(-1)^3$
$=100\div(-1)$
$=-100$

22. $(-10+4)^2\div(6-7)^3=(-6)^2\div(-1)^3$
$=36\div(-1)$
$=-36$

23. $(3^2-12)^3=(9-12)^3$
$=(-3)^3$
$=-27$

24. $(12-4^2)^3=(12-16)^3$
$=(-4)^3$
$=-64$

25. $(-18\div3)-(-14\div7)=(-6)-(-2)$
$=(-6)+2$
$=-4$

26. $(-24\div3)-(-15\div5)=(-8)-(-3)$
$=(-8)+3$
$=-5$

28. $-40\div(-5)\div(-2)\cdot4=8\div(-2)\cdot4$
$=(-4)\cdot4$
$=-16$

29. $2[-3(-9\div3)]=2[-3(-3)]$
$=2[9]$
$=18$

30. $2[-5(-12\div3)=2[-5(-4)$
$=2[20]$
$=40$

31. $-2\lceil40-2(10-15)^2\rceil=-2\lceil40-2(-5)^2\rceil$
$=-2[40-2(25)$
$=-2[40-50]$
$=-2[-10]$
$=20$

32. $-3\lfloor30-2(15-20)=-3\lfloor30-2(-5)$
$=-3[30-2(25)]$
$=-3[30-50]$
$=-3[-20]$
$=60$

33. $\dfrac{-50\div2+4}{9-16}=\dfrac{-25+4}{-7}$
$=\dfrac{-21}{-7}$
$=3$

34. $\dfrac{-90\div3+6}{8-14}=\dfrac{-30+6}{-6}$
$=\dfrac{-24}{-6}$
$=4$

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35.

$$\left(\frac{9}{-3}\right)^2 + 4\left(\frac{4}{-6}\right) - \frac{2}{3}\left[\frac{-5}{6}\right] = \frac{8}{-5} + \frac{9}{+}\left[\frac{-}{2}\right] = \frac{3}{-15} = -5$$

27. $-50 \div (-5) \div (-2) \cdot 3 = 10 \div (-2) \cdot 3$
$= (-5) \cdot 3$
$= -15$

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36. $\dfrac{(-6)^2+8(-5)}{2^3-6} = \dfrac{36+8(-5)}{8-6}$

$= \dfrac{36+(-40)}{2}$

$= \dfrac{-4}{2}$

$= -2$

37. $\dfrac{-24-3(-5)}{1-(-2)} = \dfrac{-24-(-15)}{1+2}$

$= \dfrac{-24+15}{3}$

$= \dfrac{-9}{3}$

$= -3$

38. $\dfrac{-32-2(-6)}{2-(-2)} = \dfrac{-32-(-12)}{2+2}$

$= \dfrac{-32+12}{4}$

$= \dfrac{-20}{4}$

$= -5$

39. $-36 \div |-6+(-6)| = -36 \div |-12|$

$= -36 \div 12$

$= -3$

40. $-40 \div |-4+(-4)| = -40 \div |-8|$

$= -40 \div 8$

$= -5$

41. $-4|3-8|-4(-5) = -4|-5|-4(-5)$

$= -4(5)-4(-5)$

$= -20-(-20)$

$= -20+20$

$= 0$

42. $-5|4-10|-5(-6) = -5|-6|-5(-6)$

$= -5(6)-5(-6)$

$= -30-(-30)$

$= -30+30$

$= 0$

43. $|2^3-12|-4^2-(-11) = |8-12|-4^2-(-11)$

$= |-4|-4^2-(-11)$

$= 4-16-(-11)$

$= 4+(-16)+11$

$= 15+(-16)$

$= -1$

44. $|2^3-10|-5^2-(-6) = |8-10|-5^2-(-6)$

$= |-2|-5^2-(-6)$

$= 2-25-(-6)$

$= 2+(-25)+6$

$= 8+(-25)$

$= -17$

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45. $45+\left|-12-2(-3)\right|-8^2+(-5)^2 = 45+\left|-12-(-6)\right|-8^2+(-5)^2$

$= 45+\left|-12+6\right|-8^2+(-5)^2$

$= 45+\left|-6\right|-8^2+(-5)^2$

$= 45+6-8^2+(-5)^2$

$= 45+6-64+25$

$= 76+(-64)$

$= 12$

46. $40+\left|-10-4(-3)\right|-6^2+(-4)^2 = 40+\left|-10-(-12)\right|-6^2+(-4)^2$

$= 40+\left|-10+12\right|-6^2+(-4)^2$

$= 40+\left|2\right|-6^2+(-4)^2$

$= 40+2-6^2+(-4)^2$

$= 40+2-36+16$

$= 58+(-36)$

$= 22$

47. $x^2-3x-7 = (-5)^2-3(-5)-7$

$= 25-3(-5)-7$

$= 25-(-15)-7$

$= 25+15+(-7)$

$= 40+(-7)$

$= 33$

48. $x^2-7x-8 = (-6)^2-7(-6)-8$

$= 36-7(-6)-8$

$= 36-(-42)-8$

$= 36+42+(-8)$

$= 78+(-8)$

$= 70$

49. $-3y^2+7y+15 = -3(-4)^2+7(-4)+15$

$= -3(16)+7(-4)+15$

$= -48+(-28)+15$

$= -76+15$

$= -61$

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50. $-4y^2 + 6y + 23 = -4(-3)^2 + 6(-3) + 23$
$= -4(9) + 6(-3) + 23$
$= -36 + (-18) + 23$
$= -54 + 23$
$= -31$

51. $-m^2 - 3m + 4(m + 5) = -(-7)^2 - 3(-7) + 4(-7 + 5)$
$= -(-7)^2 - 3(-7) + 4(-2)$
$= -49 - 3(-7) + 4(-2)$
$= -49 - (-21) + (-8)$
$= -49 + 21 + (-8)$
$= -57 + 21$
$= -36$

52. $-m^2 - 5m + 6(m + 2) = -(-8)^2 - 5(-8) + 6(-8 + 2)$
$= -(-8)^2 - 5(-8) + 6(-6)$
$= -64 - 5(-8) + 6(-6)$
$= -64 - (-40) + (-36)$
$= -64 + 40 + (-36)$
$= -100 + 40$
$= -60$

53. $-12,500x^2 + 3472x + 1776 = -12,500(0)^2 + 3472(0) + 1776$
$= 0 + 0 + 1776$
$= 1776$

54. $-14,700x^2 + 4723x + 1812 = -14,700(0)^2 + 4723(0) + 1812$
$= 0 + 0 + 1812$
$= 1812$

55. $\dfrac{|x + 3| - 7}{x^3 + 5x^2} = \dfrac{|-10 + 3| - 7}{(-10)^3 + 5(-10)^2}$
$= \dfrac{|-7| - 7}{-1000 + 5(100)}$
$= \dfrac{7 - 7}{-1000 + 500}$
$= \dfrac{0}{-500}$
$= 0$

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56. $$\frac{|x+4|-6}{x^3+3x^2} = \frac{|-10+4|-6}{(-10)^3+3(-10)^2}$$
$$= \frac{|-6|-6}{-1000+3(100)}$$
$$= \frac{6-6}{-1000+300}$$
$$= \frac{0}{-700}$$
$$= 0$$

57. $$5x-3y+17 = 5(-6)-3(4)+17$$
$$= -30-12+17$$
$$= -42+17$$
$$= -25$$

58. $$4x-7y+19 = 4(-9)-7(2)+19$$
$$= -36-14+19$$
$$= -50+19$$
$$= -31$$

59. $$-3m^3-m+n^2+5n = -3(-2)^3-(-2)+(-10)^2+5(-10)$$
$$= -3(-8)-(-2)+100+5(-10)$$
$$= 24-(-2)+100+(-50)$$
$$= 24+2+100+(-50)$$
$$= 126+(-50)$$
$$= 76$$

60. $$-2m^3-m+n^2+6n = -2(-3)^3-(-3)+(-8)^2+6(-8)$$
$$= -2(-27)-(-3)+64+6(-8)$$
$$= 54-(-3)+64+(-48)$$
$$= 54+3+64+(-48)$$
$$= 121+(-48)$$
$$= 73$$

61. $$-2c+|a^2-4b| = -2(6)+|(8)^2-4(20)|$$
$$= -2(6)+|64-80|$$
$$= -2(6)+|-16|$$
$$= -12+16$$
$$= 4$$

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62. $-5c + |a^2 - 3b| = -5(10) + |9^2 - 3(30)|$
$= -5(10) + |81 - 90|$
$= -5(10) + |-9|$
$= -50 + 9$
$= -41$

63. $b^2 - 4ac = (6)^2 - 4(3)(-5)$
$= 36 - 4(3)(-5)$
$= 36 - (-60)$
$= 36 + 60$
$= 96$

64. $b^2 - 4ac = (3)^2 - 4(6)(-4)$
$= 9 - 4(6)(-4)$
$= 9 - (-96)$
$= 9 + 96$
$= 105$

65. $\dfrac{b^2}{2c - a} = \dfrac{(-12)^2}{2(8) - 25}$

$= \dfrac{144}{16 - 25}$
$= \dfrac{144}{-9}$
$= -16$

66. $\dfrac{b^2}{2c - a} = \dfrac{(-15)^2}{2(7) - 29}$
$= \dfrac{225}{14 - 29}$
$= \dfrac{225}{-15}$
$= -15$

67. $2x = 48 + 6x$
$2(-12) = 48 + 6(-12)$
$-24 = 48 + (-72)$
$-24 = -24$, true
The number is a solution.

68. $-2x = 5x + 28$
$-2(-4) = 5(-4) + 28$
$8 = -20 + 28$
$8 = 8$, true
The number is a solution.

69. $-4x + 10 = -2(3x + 1)$
$-4(-6) + 10 = -2(3(-6) + 1)$
$24 + 10 = -2(-18 + 1)$
$34 = -2(-17)$
$34 = 34$, true
The number is a solution.

70. $-3x + 1 = -2(4x + 2)$
$-3(-1) + 1 = -2(4(-1) + 2)$
$3 + 1 = -2(-4 + 2)$
$4 = -2(-2)$
$4 = 4$, true

The number is a solution.

71. $\dfrac{w}{5} - 7 = 5 - \dfrac{w}{3}$

$\dfrac{-15}{5} - 7 = 5 - \dfrac{-15}{3}$
$-3 - 7 = 5 - (-5)$
$-3 + (-7) = 5 + 5$
$-10 = 10$, false
The number is not a solution.

72. $\dfrac{w}{8} - 6 = 4 - \dfrac{w}{2}$
$\dfrac{-16}{8} - 6 = 4 - \dfrac{-16}{2}$
$-2 - 6 = 4 - (-8)$
$-2 + (-6) = 4 + 8$
$-8 = 12$, false
The number is not a solution.

73. $-3y + 6 + 5y = 7y - 8y$
$-3(-2) + 6 + 5(-2) = 7(-2) - 8(-2)$
$6 + 6 + (-10) = --14 - (-16)$
$12 + (-10) = -14 + 16$
$2 = 2$, true

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The number is a solution.

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74. $4y - 8 - y = 10y - 3y$

$4(-2) - 8 - (-2) = 10(-2) - 3(-2)$

$-8 - 8 - (-2) = -20 - (-6)$

$-8 + (-8) + 2 = -20 + 6$

$-14 = -14$, true

The number is a solution.

75. $5m - (2m - 10) = -25$

$5(-5) - (2(-5) - 10) = -25$

$-25 - (-10 - 10) = -25$

$-25 - (-20) = -25$

$-25 + 20 = -25$

$-5 = -25$, false

The number is not a solution.

76. $8m - (3m - 5) = -40$

$8(7) - (3(7) - 5) = -40$

$56 - (21 - 5) = -40$

$56 - 16 = -40$

$40 = -40$, false

The number is not a solution.

77. $x^2 + 6x + 8 = 0$

$(-4)^2 + 6(-4) + 8 = 0$

$16 + (-24) + 8 = 0$

$24 + (-24) = 0$

$0 = 0$, true

The number is a solution.

78. $x^2 + 6x + 8 = 0$

$(-2)^2 + 6(-2) + 8 = 0$

$4 + (-12) + 8 = 0$

$12 + (-12) = 0$

$0 = 0$, true

The number is a solution.

79. $3y^2 + y = -2$

$3(-1)^2 + (-1) = -2$

$3(1) + (-1) = -2$

$3 + (-1) = -2$

$2 = -2$, false

The number is not a solution.

80. $3y^2 + 5y = -2$

$3(-2)^2 + 5(-2) = -2$

$3(4) + 5(-2) = -2$

$12 + (-10) = -2$

$2 = -2$, false

The number is not a solution.

81. $(x + 3)(x + 8) = x$

$(-4 + 3)(-4 + 8) = -4$

$(-1)(4) = -4$

$-4 = -4$, true

The number is a solution.

82. $(x + 3)(x + 8) = x$

$(-6 + 3)(-6 + 8) = -6$

$(\quad)(\quad)$

$-3 \quad 2 = -6$

$-6 = -6$, true

The number is a solution.

83. $3z^3 - 12z = 0$

$3(-2)^3 - 12(-2) = 0$

$3(-8) - 12(-2) = 0$

$(\quad)$

$-24 - -24 = 0$

$-24 + 24 = 0$

$0 = 0$, true

The number is a solution.

84. $3z^3 - 27z = 0$

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$3(-3)^3 - 27(-3) = 0$

$3(-27) - 27(-3) = 0$

$-81 - (-81) = 0$

$-81 + 81 = 0$

$0 = 0$, true

The number is a solution.

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85. $13-6y=3y^2+8y-11$

$13-6(-6)=3(-6)^2+8(-6)-11$

$13-(-36)=3(36)+8(-6)-11$

$13+36=108+(-48)+(-11)$

$49=108+(-59)$

$49=49$, true

The number is a solution.

86. $4+3y=2y^2+12y-1$

$4+3(-5)=2(-5)^2+12(-5)-1$

$4+(-15)=2(25)+12(-5)-1$

$-11=50+(-60)+(-1)$

$-11=-11$, true

The number is a solution.

87. a. $-3x-8$

b. $-3x-8=-3(-5)-8$

$=15-8$

$=7$

88. a. $\frac{-50}{x}-5$

b. $\frac{-50}{x}-5=\frac{-50}{-5}-5$

$=10-5$

$=5$

89. a. $-6-10x$

b. $-6-10x=-6-10(-5)$

$=-6-(-50)$

$=-6+50$

$=44$

90. a. $-9-6x$

b. $-9-6x=-9-6(-5)$

91. a. $[x+(-10)]-x^2$

b. $[x+(-10)]-x^2=(-5)+(-10)-(-5)^2$

$=-15-25$

$=-40$

92. a. $[x+(-12)]+x^2$

b. $[x+(-12)]+x^2=(-5)+(-12)+(-5)^2$

$=-17+25$

$=8$

93. a. $e=-2x^2+57x+143$

$e=-2(3)^2+57(3)+143$

$e=-2(9)+57(3)+143$

$e=-18+171+143$

$e=296$

296 billion worldwide emails in 2010

b. $e=-2x^2+57x+143$

$e=-2(2)^2+57(2)+143$

$e=-2(4)+57(2)+143$

$e=-8+114+143$

$e=249$

249 billion worldwide emails in 2009

c. According to the model there were 296 billion – 249 billion, or 47 billion more worldwide emails in 2010.

d. According to the graph there were 294 billion – 247 billion, or 47 billion more worldwide emails in 2010. This is the same as the number obtained by the model.

94. a. $D=-40x(10-x)+6310$

$D=-40(3)(10-3)+6310$

$D=-40(3)(7)+6310$

$=-9-(-30)$

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$= -9 + 30$

$= 21$

$D = -840 + 6310$

$D = 5470$

The mean credit card debt in 2011 was \$5470.

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b. $D = -40x(10 - x) + 6310$

$D = -40(5)(10 - 5) + 6310$

$D = -40(5)(5) + 6310$

$D = -1000 + 6310$

$D = 5310$

The mean credit card debt in 2013 was \$5310.

c. According to the model the mean credit card balance in 2013 was \$5470 – \$5310, or \$160 less than in 2011.

d. According to the model the mean credit card balance in 2013 was \$5476 – \$5325, or \$151 less than in 2011. The number obtained by the model is \$9 greater.

95. – 97. Answers will vary.

98. does not make sense; Explanations will vary. Sample explanation: –3 is not a solution because when it is substituted for the variable in the equation a false statement occurs.

99. makes sense

100. makes sense

101. makes sense

102. false; Changes to make the statement true will vary. A sample change is: $-14 \div 7 \cdot 2 = -2 \cdot 2 = -4$.

103. false; Changes to make the statement true will vary.

A sample change is: $-2\left(6 - 4^2\right)^3 = -2(6 - 16)^3$

$= -2(-10)^3$

$= -2(-1000)$

$= 2000$

104. true

105. true

106. $\left(2^2 - 12\right) \div (-4) = (4 - 12) \div (-4)$

$= (-8) \div (-4)$

$= 2$

107. No additional parentheses are needed.

109.
$$\begin{array}{r} 823 \\ -\ 297 \\ \hline 526 \end{array}$$

110.
$$\begin{array}{r} 26 \\ 53\overline{)1383} \\ \underline{106} \\ 323 \\ \underline{318} \\ 5 \end{array}$$

$1383 \div 53 = 26$ R 5

111. $-6 = y - 15$

$-6 = 9 - 15$

$-6 = -6$, true

The number is a solution.

112. $8 + w = -12$

$8 + (-20) = -12$

$-12 = -12$, true

The number is a solution.

113. $7 = \dfrac{w}{-w}$

$7 = \dfrac{28}{-28}$

$7 = -1$, false

The number is not a solution.

2.6 Check Points

1. We can isolate the variable, x, by adding 5 to both sides of the equation.

$x - 5 = 12$

$x - 5 + 5 = 12 + 5$

$x + 0 = 17$

$x = 17$

Check:

$x - 5 = 12$

$17 - 5 = 12$

$12 = 12$

The solution set is $\{17\}$.

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108.
$$\begin{array}{r} 576 \\ +\ 94 \\ \hline 670 \end{array}$$

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2. We can isolate the variable, z, by subtracting 30 from both sides of the equation.

$$z + 30 = 20$$
$$z + 30 - 30 = 20 - 30$$
$$z = -10$$

Check:

$$z + 30 = 20$$
$$-10 + 30 = 20$$
$$20 = 20$$

The solution set is $\{-10\}$.

3. We can isolate the variable, y, by adding 13 to both sides of the equation.

$$-9 = y - 13$$
$$-9 + 13 = y - 13 + 13$$
$$4 = y$$

Check:

$$-9 = 4 - 13$$
$$-9 = 4 - 13$$
$$-9 = -9$$

The solution set is $\{4\}$.

4. We can isolate the variable, w, by subtracting 12 from both sides of the equation.

$$12 + w = -14$$
$$12 + w - 12 = -14 - 12$$
$$w = -26$$

Check:

$$12 + w = -14$$
$$12 + (-26) = -14$$
$$-14 = -14$$

The solution set is $\{-26\}$.

5. We can isolate the variable, x, by multiplying both sides of the equation by 5.

$$\frac{x}{3} = 12$$
$$3 \cdot \frac{x}{3} = 3 \cdot 12$$
$$1x = 36$$
$$x = 36$$

Check:

$$\frac{x}{3} = 12$$
$$\frac{36}{3} = 12$$
$$12 = 12$$

6. We can isolate the variable, w, by multiplying both sides of the equation by –6.

$$10 = \frac{w}{-6}$$
$$-6 \cdot 10 = -6 \cdot \left(\frac{w}{-6}\right)$$
$$-60 = 1w$$
$$-60 = w$$

Check:

$$10 = \frac{w}{-6}$$
$$10 = \frac{-60}{-6}$$
$$10 = 10$$

The solution set is $\{-60\}$.

7. a. We can isolate the variable, x, by dividing both sides of the equation by 4.

$$4x = 84$$
$$\frac{4x}{4} = \frac{84}{4}$$
$$1x = 21$$
$$x = 21$$

Check:

$$4x = 84$$
$$4(21) = 84$$
$$84 = 84$$

The solution set is $\{21\}$.

b. We can isolate the variable, y, by dividing both sides of the equation by –11.

$$-11y = 44$$
$$\frac{-11y}{-11} = \frac{44}{-11}$$

The solution set is $\{36\}$.

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$$\frac{1}{y} = \frac{-}{4}$$

$$y = -4$$

Check:

$$-11y = 44$$

$$-11(-4) = 44$$

$$44 = 44$$

The solution set is $\{-4\}$.

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c. We can isolate the variable, z, by dividing both sides of the equation by 5.

$$-15 = 5z$$

$$\frac{-15}{5} = \frac{5z}{5}$$

$$-3 = 1z$$

$$-3 = z$$

Check:

$$-15 = 5z$$

$$-15 = 5(-3)$$

$$-15 = -15$$

The solution set is $\{-3\}$.

8. a. We can isolate the variable, x, by multiplying both sides of the equation by –9.

$$\frac{x}{-9} = -11$$

$$-9 \cdot \frac{x}{-9} = -9 \cdot (-11)$$

$$1x = 99$$

$$x = 99$$

Check:

$$\frac{x}{-9} = -11$$

$$\frac{99}{-9} = -11$$

$$-11 = -11$$

The solution set is $\{99\}$.

b. We can isolate the variable, y, by adding 12 to both sides of the equation.

$$y - 12 = -38$$

$$y - 12 + 12 = -38 + 12$$

$$y = -26$$

Check:

$$y - 12 = -38$$

$$-26 - 12 = -38$$

$$-38 = -38$$

The solution set is $\{-26\}$.

c. We can isolate the variable, z, by dividing both sides of the equation by –8.

$$56 = -8z$$

$$\frac{56}{-8} = \frac{-8z}{-8}$$

$$-7 = 1z$$

$$-7 = z$$

Check:

$$56 = -8z$$

$$56 = -8(-7)$$

$$56 = 56$$

The solution set is $\{-7\}$.

d. We can isolate the variable, m, by subtracting 20 from both sides of the equation.

$$0 = m + 20$$

$$0 - 20 = m + 20 - 20$$

$$-20 = m$$

Check:

$$0 = m + 20$$

$$0 = -20 + 20$$

$$0 = 0$$

The solution set is $\{-20\}$.

9. In the formula, A represents the child's age, in months. Thus, we substitute 50 for A. Then use the addition property of equality to find V, the number of words in the child's vocabulary.

$$V + 900 = 60A$$

$$V + 900 = 60(50)$$

$$V + 900 = 3000$$

$$V + 900 - 900 = 3000 - 900$$

$$V = 2100$$

At 50 months, a child will have a vocabulary of 2100 words.

10. Substitute 630 for R Then use the multiplication property of equality to find L, the lifespan of mice.

$$RL = 1890$$

$$630L = 1890$$

$$\frac{630L}{630} = \frac{1890}{630}$$

$$1L = 3$$

$$L = 3$$

At 630 beats per minute, the average lifespan of mice is 3 years.

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2.6 Concept and Vocabulary Check

1. solving

2. equivalent

3. $b+c$

4. subtract; solution

5. adding 7

6. subtracting 7

7. bc

8. divide

9. multiplying; 7

10. dividing; –8

2.6 Exercise Set

1. $x-4=19$
$x-4+4=19+4$
$x=23$
Check:
$x-4=19$
$23-4=19$
$19=19$
The solution set is $\{23\}$.

2. $x-5=18$
$x-5+5=18+5$
$x=23$
Check:
$x-5=18$
$23-5=18$
$18=18$
The solution set is $\{23\}$.

3. $z+8=12$
$z+8-8=12-8$
$z=4$
Check:
$z+8=12$
$4+8=12$
$12=12$

4. $z+13=15$
$z+13-13=15-13$
$z=2$
Check:
$z+13=15$
$2+13=15$
$15=15$
The solution set is $\{2\}$.

5. $z+8=-12$
$z+8-8=-12-8$
$z=-20$
Check:
$z+8=-12$
$-20+8=-12$
$-12=-12$
The solution set is $\{-20\}$.

6. $z+13=-15$
$z+13-13=-15-13$
$z=-28$
Check:
$z+13=-15$
$-28+13=-15$
$-15=-15$
The solution set is $\{-28\}$.

7. $-2=y+14$
$-2-14=y+14-14$
$-16=y$
Check:
$-2=y+14$
$-2=-16+14$
$-2=-2$
The solution set is $\{-16\}$.

8. $-13=y+11$
$-13-11=y+11-11$
$-24=y$
Check:
$-13=y+11$
$-13=-24+11$
The solution set is $\{4\}$.

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$-13 = -13$

The solution set is $\{-24\}$.

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9. $-17 = w - 5$

$-17 + 5 = w - 5 + 5$

$-12 = w$

Check:

$-17 = w - 5$

$-17 = -12 - 5$

$-17 = -17$

The solution set is $\{-12\}$.

10. $-21 = w - 4$

$-21 + 4 = w - 4 + 4$

$-17 = w$

Check:

$-21 = w - 4$

$-21 = -17 - 4$

$-21 = -21$

The solution set is $\{-17\}$.

11. $-6 + y = -20$

$-6 + y + 6 = -20 + 6$

$y = -14$

Check:

$-6 + y = -20$

$-6 + (14) = -20$

$-20 = -20$

The solution set is $\{-14\}$.

12. $-8 + y = -29$

$-8 + y + 8 = -29 + 8$

$y = -21$

Check:

$-8 + y = -29$

$-8 + (-21) = -29$

$-29 = -29$

The solution set is $\{-21\}$.

13. $7 + x = 11$

$7 + x - 7 = 11 - 7$

$x = 4$

Check:

$7 + x = 11$

$7 + 4 = 11$

$11 = 11$

The solution set is $\{4\}$.

14. $18 + x = 14$

$18 + x - 18 = 14 - 18$

$x = -4$

Check:

$18 + x = 14$

$18 + (-4) = 14$

$14 = 14$

The solution set is $\{-4\}$.

15. $\frac{x}{6} = 5$

$6 \cdot \frac{x}{6} = 6 \cdot 5$

$1x = 30$

$x = 30$

Check:

$\frac{x}{6} = 5$

$\frac{30}{6} = 5$

$5 = 5$

The solution set is $\{30\}$.

16. $\frac{x}{7} = 4$

$7 \cdot \frac{x}{7} = 7 \cdot 4$

$1x = 28$

$x = 28$

Check:

$\frac{x}{7} = 4$

$\frac{28}{7} = 4$

$4 = 4$

The solution set is $\{28\}$.

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17. $11 = \frac{y}{-3}$

$-3 \cdot 11 = (-3)\frac{y}{-3}$

$-33 = 1y$

$-33 = y$

Check:

$11 = \frac{y}{-3}$

$11 = \frac{-33}{-3}$

$11 = 11$

The solution set is $\{-33\}$.

18. $8 = \frac{y}{-5}$

$-5 \cdot 8 = (-5)\frac{y}{-5}$

$-40 = 1y$

$-40 = y$

Check:

$8 = \frac{y}{-5}$

$8 = \frac{-40}{-5}$

$8 = 8$

The solution set is $\{-40\}$.

19. $5z = 35$

$\frac{5z}{5} = \frac{35}{5}$

$1z = 7$

$z = 7$

Check:

$5z = 35$

$5(7) = 35$

$35 = 35$

The solution set is $\{7\}$.

20. $6z = 42$

$\frac{6z}{6} = \frac{42}{6}$

$1z = 7$

$z = 7$

Check:

$6z = 42$

$6(7) = 42$

$42 = 42$

The solution set is $\{7\}$.

21. $-7y = 63$

$\frac{-7y}{-7} = \frac{63}{-7}$

$1y = -9$

$y = -9$

Check:

$-7y = 63$

$-7(-9) = 63$

$63 = 63$

The solution set is $\{-9\}$.

22. $-4y = 32$

$\frac{-4y}{-4} = \frac{32}{-4}$

$1y = -8$

$y = -8$

Check:

$-4y = 32$

$(-4)(-8) = 32$

$32 = 32$

The solution set is $\{-8\}$.

23. $-48 = 8x$

$\frac{-48}{8} = \frac{8x}{8}$

$-6 = 1x$

$-6 = x$

Check:

$-48 = 8x$

$-48 = 8(-6)$

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$-48 = -48$

The solution set is $\{-6\}$.

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24. $-56 = 8x$

$$\frac{-56}{8} = \frac{8x}{8}$$

$$-7 = 1x$$

$$-7 = x$$

Check:

$-56 = 8x$

$-56 = 8(-7)$

$-56 = -56$

The solution set is $\{-7\}$.

25. $-18 = -3z$

$$\frac{-18}{-3} = \frac{-3z}{-3}$$

$$6 = 1z$$

$$6 = z$$

Check:

$-18 = -3z$

$-18 = -3(6)$

$-18 = -18$

The solution set is $\{6\}$.

26. $-54 = -9z$

$$\frac{-54}{-9} = \frac{-9z}{-9}$$

$$6 = 1z$$

$$6 = z$$

Check:

$-54 = -9z$

$-54 = -9(6)$

$-54 = -54$

The solution set is $\{6\}$.

27. $-17y = 0$

$$\frac{-17y}{-17} = \frac{0}{-17}$$

$$1y = 0$$

$$y = 0$$

Check:

28. $-16y = 0$

$$\frac{-16y}{-16} = \frac{0}{-16}$$

$$1y = 0$$

$$y = 0$$

Check:

$-16y = 0$

$-16(0) = 0$

$0 = 0$

The solution set is $\{0\}$.

29. $x - 7 = -14$

$x - 7 + 7 = -14 + 7$

$x + 0 = -7$

$x = -7$

Check:

$x - 7 = -14$

$-7 - 7 = -14$

$-14 = -14$

The solution set is $\{-7\}$.

30. $x - 8 = -16$

$x - 8 + 8 = -16 + 8$

$x + 0 = -8$

$x = -8$

Check:

$x - 8 = -16$

$-8 - 8 = -16$

$-16 = -16$

The solution set is $\{-8\}$.

31. $-7x = -14$

$$\frac{-7x}{-7} = \frac{-14}{-7}$$

$$1x = 2$$

$$x = 2$$

$-17y = 0$

$-17(0) = 0$

$0 = 0$

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The solution set is $\{0\}$.

Check:

$$-7x = -14$$
$$-7(2) = -14$$
$$-14 = -14$$

The solution set is $\{2\}$.

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32. $-8x = -16$

$$\frac{-8x}{-8} = \frac{-16}{-8}$$

$$1x = 2$$

$$x = 2$$

Check:

$$-8x = -16$$

$$-8(2) = -16$$

$$-16 = -16$$

The solution set is $\{2\}$.

33. $$\frac{x}{-7} = -14$$

$$-7 \cdot \frac{x}{-7} = (-7) \cdot (-14)$$

$$1x = 98$$

$$x = 98$$

Check:

$$\frac{x}{-7} = -14$$

$$\frac{-98}{-7} = -14$$

$$-14 = -14$$

The solution set is $\{98\}$.

34. $$\frac{x}{-8} = -16$$

$$-8 \cdot \frac{x}{-8} = (-8) \cdot (-16)$$

$$1x = 128$$

$$x = 128$$

Check:

$$\frac{x}{-8} = -16$$

$$\frac{128}{-8} = -16$$

$$-16 = -16$$

The solution set is $\{128\}$.

35. $$-14 = 7 + x$$

$$-14 - 7 = 7 + x - 7$$

$$-21 = x$$

Check:

$$-14 = 7 + x$$

$$-14 = 7 + (-21)$$

$$-14 = -14$$

The solution set is $\{-21\}$.

36. $$-16 = 8 + x$$

$$-16 - 8 = 8 + x - 8$$

$$-24 = x$$

Check:

$$-16 = 8 + x$$

$$-16 = 8 + (-24)$$

$$-16 = -16$$

The solution set is $\{-24\}$.

37. $$y - 172 = -243$$

$$y - 172 + 172 = -243 + 172$$

$$y = -71$$

Check:

$$y - 172 = -243$$

$$-71 - 172 = -243$$

$$-243 = -243$$

The solution set is $\{-71\}$.

38. $$y - 183 = -421$$

$$y - 183 + 183 = -421 + 183$$

$$y = -238$$

Check:

$$y - 183 = -421$$

$$-238 - 183 = -421$$

$$-421 = -421$$

The solution set is $\{-238\}$.

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39.

$96 = x - 128$

$96 = 224 - 128$

$96 = 96$

The solution set is $\{224\}$.

40.

$84 = x - 137$

$84 + 137 = x - 137 + 137$

$221 = x$

Check:

$84 = x - 137$

$84 = 221 - 137$

$84 = 84$

The solution set is $\{221\}$.

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41. $-5w = 1015$

$\frac{-5w}{-5} = \frac{1015}{-5}$

$w = -203$

Check:

$-5w = 1015$

$-5(-203) = 1015$

$1015 = 1015$

The solution set is $\{-203\}$.

42. $-6w = 1812$

$\frac{-6w}{-6} = \frac{1812}{-6}$

$w = -302$

Check:

$-6w = 1812$

$-6(-302) = 1812$

$1812 = 1812$

The solution set is $\{-302\}$.

43. $-496 = -31z$

$\frac{-496}{-31} = \frac{-31z}{-31}$

$16 = z$

Check:

$-496 = -31z$

$-496 = -31(16)$

$-496 = -496$

The solution set is $\{16\}$.

44. $-714 = -42z$

$\frac{-714}{-42} = \frac{-42z}{-42}$

$17 = z$

Check:

$-714 = -42z$

$-714 = -42(17)$

$-714 = -714$

The solution set is $\{17\}$.

45. $-496 = -31 + z$

$-496 + 31 = -31 + z + 31$

$-465 = z$

Check:

$-496 = -31 + z$

$-496 = -31 + (-465)$

$-496 = -496$

The solution set is $\{-465\}$.

46. $-714 = -42 + z$

$-714 + 42 = -42 + z + 42$

$-672 = z$

Check:

$-714 = -42 + z$

$-714 = -42 + (-672)$

$-714 = -714$

The solution set is $\{-672\}$.

47. $0 = 31 + z$

$0 - 31 = 31 + z - 31$

$-31 = z$

Check:

$0 = 31 + z$

$0 = 31 + (-31)$

$0 = 0$

The solution set is $\{-31\}$.

48. $0 = 42 + z$

$0 - 42 = 42 + z - 42$

$-42 = z$

Check:

$0 = 42 + z$

$0 = 42 + (-42)$

$0 = 0$

The solution set is $\{-42\}$.

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49. $\frac{z}{31} = -496$

$31 \cdot \frac{z}{31} = 31(-496)$

$z = -15,376$

Check:

$\frac{z}{31} = -496$

$\frac{-15,376}{31} = -496$

$-496 = -496$

The solution set is $\{-15,376\}$.

50. $\frac{z}{42} = -714$

$42 \cdot \frac{z}{42} = 42(-714)$

$z = -29,988$

Check:

$\frac{z}{42} = -714$

$\frac{-29,988}{42} = -714$

$-714 = -714$

The solution set is $\{-29,988\}$.

51. $\frac{z}{-31} = -496$

$-31 \cdot \frac{z}{-31} = (-31)(-496)$

$z = 15,376$

Check:

$\frac{z}{-31} = -496$

$\frac{15,376}{-31} = -496$

$-496 = -496$

The solution set is $\{15,376\}$.

52. $\frac{z}{-42} = -714$

$-42 \cdot \frac{z}{-42} = (-42)(-714)$

$z = 29,988$

Check:

$\frac{z}{-42} = -714$

$\frac{29,988}{-42} = -714$

$-714 = -714$

The solution set is $\{29,988\}$.

53. $x - \square = \square$

$x - \square + \square = \square + \square$

$x = \square + \square$

54. $x + \square = \square$

$x + \square - \square = \square - \square$

$x = \square - \square$

55. $\frac{x}{\square} = \square$

$\square \cdot \frac{x}{\square} = \square \cdot \square$

$x = \square\square$

56. $\square = \square x$

$\frac{\square}{\square} = \frac{\square x}{\square}$

$\frac{\square}{\square} = x$

57. $x - 12 = -8$

$x = -8 + 12$

$x = 4$

The number is 4.

58. $x - 23 = -8$

$x - 23 + 23 = -8 + 23$

$x = 15$

The number is 15.

59. $x + 50 = 35$

$x + 50 - 50 = 35 - 50$

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$x = -15$

The number is –15.

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60. $x + 60 = 25$

$x + 60 - 60 = 25 - 60$

$x = -35$

The number is –35.

61. $\frac{x}{-2} = -20$

$-2 \cdot \frac{x}{-2} = -2(-20)$

$x = 40$

The number is 40.

62. $\frac{x}{-3} = -15$

$-3 \cdot \frac{x}{-3} = -3(-15)$

$x = 45$

The number is 45.

63. $9x = -63$

$\frac{9x}{9} = \frac{-63}{9}$

$x = -7$

The number is –7.

64. $8x = -48$

$\frac{8x}{8} = \frac{-48}{8}$

$x = -6$

The number is –6.

65. $S = 1850,\ M = 150$

$C + M = S$

$C + 150 = 1850$

$C = 1850 - 150$

$C = 1700$

The cost of the computer is $1700.

66. $C = 520, S = 650$

$C + M = S$

$520 + M = 650$

$M = 650 - 520$

$M = 130$

The markup is $130.

67. $10D - 335 = 7x$

$10(65) - 335 = 7x$

$650 - 335 = 7x$

$315 = 7x$

$\frac{315}{7} = \frac{7x}{7}$

$45 = x$

45 years after 1980, or in 2025 the U.S. diversity index will be 65.

68. $10D - 335 = 7x$

$10(72) - 335 = 7x$

$720 - 335 = 7x$

$385 = 7x$

$\frac{385}{7} = \frac{7x}{7}$

$55 = x$

55 years after 1980, or in 2035 the U.S. diversity index will be 72.

69. $M = \frac{n}{5}$

$2 = \frac{n}{5}$

$5(2) = 5\left(\frac{n}{5}\right)$

$10 = n$

If you are 2 miles away from the lightning flash, it will take 10 seconds for the sound of thunder to reach you.

70. $M = \frac{n}{5}$

$3 = \frac{n}{5}$

$5(3) = 5\left(\frac{n}{5}\right)$

$15 = n$

If you are 3 miles away from the lightning flash, it will take 15 seconds for the sound of thunder to reach you.

71. *B*

72. *C*

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73. a. $A = lw$

$171 = l(9)$

$\frac{171}{9} = \frac{l(9)}{9}$

$19 = l$

The length is 19 yards.

b. $P = 2l + 2w$

$P = 2(19) + 2(9)$

$P = 38 + 18$

$P = 56$

The perimeter is 56 yards.

74. a. $A = lw$

$161 = l(7)$

$\frac{161}{7} = \frac{l(7)}{7}$

$23 = l$

The length is 23 feet.

b. $P = 2l + 2w$

$P = 2(23) + 2(7)$

$P = 46 + 14$

$P = 60$

The perimeter is 60 feet.

75. $150p = wA$

$150p = (60)(25)$

$150p = 1500$

$\frac{150p}{150} = \frac{1500}{150}$

$p = 10$

The dosage is 10 milligrams.

76. $150p = wA$

$150p = (90)(25)$

$150p = 2250$

$\frac{150p}{150} = \frac{2250}{150}$

82. makes sense

83. makes sense

84. does not make sense; Explanations will vary.

Sample explanation: To isolate the variable we need to use the multiplication property of equality.

85. false; Changes to make the statement true will vary.

A sample change is: If $-3x = 18$, then $x = \frac{18}{-3}$.

86. true

87. true

88. false; Changes to make the statement true will vary.

A sample change is: $y = -7$.

89. Answers will vary. Example: $x - 100 = -101$

89. Answers will vary. Example: $-60x = -120$

91. $x - 37,256 = -19,125$

$x - 37,256 + 37,256 = -19,125 + 37,256$

$x = 18,131$

The solution set is $\{18,131\}$.

92. $67,592 = y + 127,963$

$67,592 - 127,963 = y + 127,963 - 127,963$

$-60,371 = y$

The solution set is $\{-60,371\}$.

93. $\frac{w}{578} = -3002$

$578 \cdot \frac{w}{578} = -3002(578)$

$w = -1,735,156$

The solution set is $\{-1,735,156\}$.

94. $-860,778 = -1746z$

$\frac{p}{} = 15$

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$$\frac{-860,778}{-1746} =$$

The dosage is 15 milligrams.

77. – 80. Answers will vary.

81. does not make sense; Explanations will vary. Sample explanation: They are both mathematically the same.

$$\frac{-1746z}{-1746}$$

$$493 = z$$

The solution set is $\{493\}$.

95. $(-10)^2 = (-10)(-10) = 100$

96. $-10^2 = -(10 \cdot 10) = -100$

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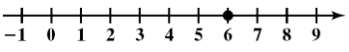
97. $x^3 - 4x = (-1)^3 - 4(-1)$
$= -1 - (-4)$
$= -1 + 4$
$= 3$

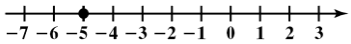
98. $a = 7$; $b = 19$

99. $a = -4$; $b = 13$

100. $a = -3$; $b = -10$

Chapter 2 Review Exercises

1. 

2. 

3. $-93 < 17$

4. $-2 > -200$

5. $0 > -1$

6. $|-58| = 58$

7. $-|58| = -58$

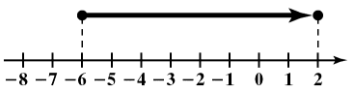
8. The opposite of -19 is 19.

9. The opposite of 23 is -23.

10. $-(-72) = 72$

11. $-|-30| = -30$

12. $|-(-63)| = |63| = 63$

13. $-6 + 8 = 2$


14. $-23 + (-17) = -40$

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15. $18 + (-25) = -7$

16. $-15 + 29 = 14$

17. $326 + (-326) = 0$

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18. $7+(-5)+(-13)+4=(7+4)+[(-5)+(-13)]$
$=11+(-18)$
$=-7$

19. $-41+213+(-15)+(-72)=213+[(-41)+(-15)+(-72)$
$=213+(-128)$
$=85$

20. $-1312+512=-800$
The person is standing at 800 feet below sea level.

21. $25+(-3)+2+1+(-4)+2=(25+2+1+2)+[(-3)+(-4)$
$=30+[-7]$
$=23$
The water level is 23 feet.

22. $9-13=9+(-13)$

23. $-9-(-15)=-9+15=6$

24. $2-20=2+(-20)=-18$

25. $-28-31=-28+(-31)=-59$

26. $146-(-204)=146+204=350$

27. $-124-(-59)=-124+59=-65$

28. $-75-(-75)=-75+75=0$

29. $75-(-75)=75+75=150$

30. $0-(-83)=0+83=83$

31. $-7-(-5)+11-16=-7+5+11-16$
$=[5+11]+[(-7)+(-16)]$
$=16+(-23)$
$=-7$

32. $-25-4-(-10)+16=-25+(-4)+10+16$
$=-29+16$
$=-3$

33. $39-(-11)=39+11=50$

34.

35.

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$-50 -$
$30 =$
$-50 +$
(-30)
$= -80$

$-50 -$
$30 =$
$-50 +$
(-30)
$= -80$

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36. $-20-80=-20+(-80)=-100$

37. $26{,}500-(-650)=26{,}500+650=27{,}150$
The difference in elevation is 27,150 feet.

38. $-7(-12)=84$

39. $14(-5)=-70$

40. $-11(6)=-66$

41. $(-7)(-2)(10)=140$

42. $5(-2)(-3)(-4)=-120$

43. $(-6)^2=(-6)(-6)=36$

44. $-6^2=-(6\cdot 6)=-36$

45. $(-5)^3=(-5)(-5)(-5)=-125$

46. $(-2)^4=(-2)(-2)(-2)(-2)=16$

47. $-2^4=-(2\cdot 2\cdot 2\cdot 2)=-16$

48. $(-3)^5=(-3)(-3)(-3)(-3)(-3)=-243$

49. $\dfrac{45}{-5}=-9$

50. $-90\div 9=-10$

51. $(-44)\div(-4)=11$

52. $0\div(-50)=0$

53. $(-50)\div 0$ undefined

54.

55.

b. Lost money in January, April, and May.
$-150+(-75)+(-190)=-415$
The total loss was \$415.

c. Made money in February, March, and June.
$15+130+30=175$
The total made was \$175.

d. $\dfrac{-415+175}{6}=-40$
The mean loss was \$40.

e. $-150-(-75)=-75$
You loss \$75 more in January.

f. $3(-150)=-450$
The total loss would be \$450.

57. $-40\div 5\cdot 2=-8\cdot 2$
$=-16$

58. $-6+(-2)\cdot 5=-6+(-10)$
$=-16$

59. $30\div 10(-2)^3=30\div 10(-8)$
$=3(-8)$
$=-24$

60. $-12-(3-4\cdot 5)=-12-(3-20)$
$=-12-(-17)$
$=-12+17$
$=5$

61. $16-30\div 10(-4)^2-6=16-30\div 10(16)-6$
$=16-3(16)-6$
$=16-48-6$
$=-38$

62. $28\div(2-4^2)=28\div(2-16)$

$\dfrac{-15}{06}$ -502 3

=

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$$\frac{-22}{1} = 17$$

-13 **63.**

$$= 28 \div (-14)$$

$$= -2$$

$$24 - 36 \div 4 \cdot 3 - 1 = 24 - 9 \cdot 3 - 1$$

$$= 24 - 27 - 1$$

56. a. **L**ost the most money in May.

$(-190)(12) = -2280$

The total loss would be $2280.

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$= 24 + (-27) + (-1)$

$= 24 + (-28)$

$= -4$

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64. $-8\left[-4(2-5)+5(-3)\right] = -8\left[-4(-3)+5(-3)\right]$
$= -8\left[12+(-15)\right]$
$= -8\left[-3\right]$
$= 24$

65. $\dfrac{6(-10+3)}{2(-15)-9(-3)} = \dfrac{6(-7)}{-30-(-27)}$

$= \dfrac{-42}{-30+27}$
$= \dfrac{-42}{-3}$
$= 14$

66. $\left|-10-12\right|-14 = \left|-22\right|-14$
$= 22-14$
$= 8$

67. $-x^2-3x+4(x+2) = -(-5)^2-3(-5)+4(-5+2)$
$= -25-3(-5)+4(-3)$
$= -25-(-15)+(-12)$
$= -25+15+(-12)$
$= 15+(-37)$
$= -22$

68. $b^2-4ac = (-5)^2-4(3)(-2)$
$= 25-4(3)(-2)$
$= 25-(-24)$
$= 25+24$
$= 49$

69. $5x+16 = -8-x$
$5(-6)+16 = -8-(-6)$
$-30+16 = -8+6$
$-14 = -2$, false
The number is not a solution.

70. $2(x+3)-18 = 5x$
$2(-4+3)-18 = 5(-4)$
$2(-1)-18 = -20$
$-2-18 = -20$
$-20 = -20$, true

71. **a.** $F = -x^2-x+2860+x(22x+152)$
$F = -(10)^2-10+2860+10(22\cdot 10+152)$
$F = -(10)^2-10+2860+10(220+152)$
$F = -(10)^2-10+2860+10(372)$

$F = -100-10+2860+3720$
$F = -110+6580$

72. The number is a solution.

73.

74.

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$F = 6470$ There was 6470 farmers markets in 2010.

b. The model overestimates by $6470 - 6132$, or by 338 farmers markets.

$x - 10 = 22$

$x - 10 + 10 = 22 + 10$

$x = 32$

Check:

$x - 10 = 22$

$32 - 10 = 22$

$22 = 22$

The solution set is $\{32\}$.

$-14 = y + 8$

$-14 - 8 = y + 8 - 8$

$-22 = y$

Check:

$-14 = y + 8$

$-14 = -22 + 8$

$-14 = -14$

The solution set is $\{-22\}$.

$\frac{z}{6} = 10$

$6 \cdot \frac{z}{6} = 6 \cdot 10$

$1x = 60$

$x = 60$

Check:

$\frac{z}{6} = 10$

$\frac{60}{6} = 10$

$10 = 10$

The solution set is $\{60\}$.

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75. $7 = \frac{w}{-8}$

$-8 \cdot 7 = -8 \cdot \frac{w}{-8}$

$-56 = w$

Check:

$7 = \frac{w}{-8}$

$7 = \frac{-56}{-8}$

$7 = 7$

The solution set is $\{-56\}$.

76. $7x = 77$

$\frac{7x}{7} = \frac{77}{7}$

$x = 11$

Check:

$7x = 77$

$7(11) = 77$

$77 = 77$

The solution set is $\{11\}$.

77. $-36 = -9y$

$\frac{-36}{-9} = \frac{-9y}{-9}$

$4 = y$

Check:

$-36 = -9y$

$-36 = -9(4)$

$-36 = -36$

The solution set is $\{4\}$.

78. a. $rt = 420$

$30t = 420$

$\frac{30t}{30} = \frac{420}{30}$

$t = 14$

The time for the trip is 14 hours.

b. $rt = 420$

$60t = 420$

$\frac{60t}{60} = \frac{420}{60}$

$t = 7$

The time for the trip is 7 hours.

Chapter 2 Test

1. $14 - (-26) = 14 + 26 = 40$

2. $-9 + 3 + (-11) + 6 = [-9 + (-11)] + (3 + 6)$

$= -20 + 9$

$= -11$

3. $-3(-17) = 51$

4. $2(-4)(-5)(-1) = -40$

5. $-50 \div 10 = -5$

6. $-6 - (5 - 12) = -6 - (-7)$

$= -6 + 7$

$= 1$

7. $(-3)(-4) \div (7 - 10) = (-3)(-4) \div (-3)$

$= 12 \div (-3)$

$= -4$

8. $(6 - 8)^2 (5 - 7)^3 = (-2)^2 (-2)^3$

$= 4(-8)$

$= -32$

9. $\frac{3(-2) - 2(2)}{-2(8 - 3)} = \frac{-6 - 4}{-2(5)}$

$= \frac{-10}{-10}$

$= 1$

10. $-1 > -100$

11. $16,200 - (-830) = 16,200 + 830 = 17,030$

The difference in elevation is 17,030 feet.

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12. a. $-7 = 7$

b. c. $-\,-7 = -7$ $\quad |\ |$

$-(-7) = 7$

c. The difference is 14 hours – 7 hours, or 7 hours.

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13. $-x^2 - 5x + 2(x+3) = -(-4)^2 - 5(-4) + 2(-4+3)$
$= -16 - 5(-4) + 2(-1)$
$= -16 - (-20) + (-2)$
$= -16 + 20 + (-2)$
$= 20 + (-18)$
$= 2$

14. $3(x+2) - 15 = 4x$
$3(-9+2) - 15 = 4(-9)$
$3(-7) - 15 = -36$
$-21 - 15 = -36$
$-36 = -36$, true
The number is a solution.

15. $x - 12 = 25$
$x - 12 + 12 = 25 + 12$
$x = 37$

Check:
$x - 12 = 25$
$37 - 12 = 25$
$25 = 25$
The solution set is $\{37\}$.

16. $-70 = -7y$
$\frac{-70}{-7} = \frac{-7y}{-7}$
$10 = y$
Check:
$-70 = -7y$
$-70 = -7(10)$
$-70 = -70$
The solution set is $\{10\}$.

17. $-16 = y + 7$
$-16 - 7 = y + 7 - 7$
$-23 = y$
Check:
$-16 = y + 7$
$-16 = -23 + 7$
$-16 = -16$
The solution set is $\{-23\}$.

18. $\frac{w}{-5} = 6$
$-5 \cdot \frac{w}{-5} = -5 \cdot 6$
$w = -30$
Check:
$\frac{w}{-5} = 6$
$\frac{-30}{-5} = 6$
$6 = 6$
The solution set is $\{-30\}$.

19. a. $A = -5x + 308$
$A = -5(20) + 308$
$A = -100 + 308$
$A = 208$
The office area per worker in 2010 was 208 square feet.

b. The model underestimates by 225 square feet – 208 square feet, or by 17 square feet.

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