Developmental Mathematics Prealgebra Elementary Algebra and Intermediate Algebra 2nd edition Sullivan Solutions Manual

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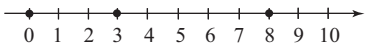
Chapter 2

Section 2.1

Are You Prepared for This Section?

P1. The numbers 0, 1, 2, 3, ... are called whole numbers.

P2. True; $0 < 5$ because 0 is located to the left of 5 on the number line.

P3. 

P4. $14 > 9$ because 14 is located to the right of 9 on a number line.

2.1 Quick Checks

1. The integers are the numbers $\{..., -3, -2, -1, 0, 1, 2, 3, ...\}$.

2. False; $\frac{16}{3}$ is not an integer because it is not a positive or a negative whole number (nor is it 0).

3. a. 15 is an integer, because it is a positive whole number.

b. $\frac{21}{4}$ is not an integer because it is not a positive or a negative whole number (nor is it 0).

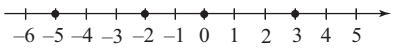
c. $-\frac{7}{5}$ is not an integer because it is not a positive or a negative whole number (nor is it 0).

d. –45 is an integer, because it is a negative whole number.

e. $\frac{12}{4}$ is an integer because $\frac{12}{4} = 12 \div 4 = 3$, which is a positive whole number.

4. a. 22 degrees below zero Fahrenheit can be written as –22.

b. 9 is the integer that describes a gain of 9 yards.

5. 

6. The symbols < and > are called inequality symbols.

7. –6 is to the left of 0 on a number line, so $-6 < 0$.

8. 16 is to the right of –4 on a number line, so $16 > -4$.

9. 2 is to the right of –7 on a number line, so $2 > -7$.

10. –8 is to the right of –10 on a number line, so $-8 > -10$.

11. The distance from zero to a point on a number line is called the absolute value of the number.

12. $|-12| = 12$ because the distance from 0 to –12 on a number line is 12.

13. $|8| = 8$ because the distance from 0 to 8 on a number line is 8.

14. $|-9| = 9$ because the distance from 0 to –9 on a number line is 9.

2.1 Exercises

16. 0, 100, –24, $\frac{14}{2} = 7$, $\frac{36}{9} = 4$, –1, and 14 are integers because they are positive or negative whole numbers, or 0.

18. False; 0 is neither positive nor negative.

20. True

22. An account overdrawn by $75 is represented by the integer –$75.

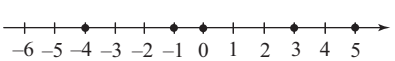
24. A deposit of $1200 can be written as $1200.

26. 62° above zero can be written as 62 degrees.

28. 2050 feet below the surface can be written as –2050 feet.

30. A loss of $5 can be written as –$5.

32. A gain of 2 pounds can be written as 2 pounds.

34. 

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36. **A**: 0; **B**: −2; **C**: −5; **D**: 6; **E**: 4

38. 0 is to the right of −10 on a number line, so $0 > -10$.

40. −8 is to the left of −7 on a number line, so $-8 < -7$.

42. 37 is to the right of −49 on a number line, so $37 > -49$.

44. −4 is to the left of 2 on a number line, so $-4 < 2$.

46. −15 is to the left of −10 on a number line, so $-15 < -10$.

48. −3 is to the left of 0 on a number line, so $-3 < 0$.

50. $|42| = 42$ because the distance from 0 to 42 on a number line is 42.

52. $|-27| = 27$ because the distance from 0 to −27 on a number line is 27.

54. $|100| = 100$ because the distance from 0 to 100 on a number line is 100.

56. $|650| = 650$ because the distance from 0 to 650 on a number line is 650.

58. $|-9| = 9$
−10 is to the left of 9 on a number line, so $10 < |-9|$.

60. $|-18| = 18$; $|-15| = 15$
18 is to the right of 15 on a number line, so $|-18| > |-15|$.

62. $|-60| = 60$
60 is to the right of −30 on a number line, so $|-60| > -30$.

64. $|-7| = 7$
0 is to the left of 7 on a number line, so $0 < |-7|$.

66. $4^2 = 16$; $|-2| = 2$
From smallest to largest: 0, 2, 8, 16 or 0, $|-2|$, 8, 4^2

68. $|-10| = 10$; $\frac{0}{12} = 0$; $|7| = 7$; $\frac{15}{3} = 5$
From smallest to largest: 0, 5, 7, 10 or $\frac{0}{12}$, $\frac{15}{3}$, $|7|$, $|-10|$

70. $|-9| + 2 = 9 + 2 = 11$

72. $7 + |-4| = 7 + 4 = 11$

74. $|-15| \cdot 3 = 15 \cdot 3 = 45$

76. $\frac{32}{|-8|} = \frac{32}{8} = 4$

78. $12 \cdot |-4| + 3 = 12 \cdot 4 + 3 = 48 + 3 = 51$

80. $11 + \frac{|-45|}{9} = 11 + \frac{45}{9} = 11 + 5 = 16$

82. 36,069 feet below sea level can be written as −36,069 ft.

84. A distance of two hundred thirty-eight thousand, nine hundred miles can be written as 238,900 miles.

86. True

88. True

90. True

92. False; 0 is neither positive nor negative.

94. The integers between −3 and 3 are −2, −1, 0, 1, and 2.

96. The nonnegative integers between −6 and 2 are 0 and 1.

98. $|6| + |15| = 6 + 15 = 21$

100. $|42 + 7| + 11 = |6| + 11 = 6 + 11 = 17$

102. $||-38|| = |38| = 38$

104. $|-|-7|| = |-7| = 7$

106. $|-(3 + 8)| - |-(2 \cdot 3)| = |-11| - |-6| = 11 - 6 = 5$

108. Yes; every negative integer is less than every positive integer because negative integers lie to the left of 0 on a number line, and positive integers lie to a right of 0 on a number line.

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Section 2.2

Are You Prepared for This Section?

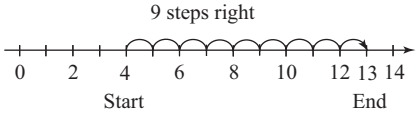
P1. 11 + 29 = 40

P2. 27 − 18 = 9

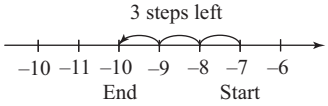
2.2 Quick Checks

1. The answer to an addition problem is called the sum.

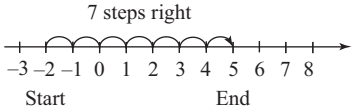
2. Begin at 4 and move 9 spaces to the right.
4 + 9 = 13



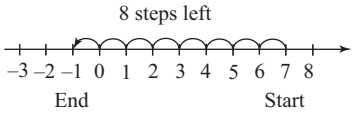
3. Begin at −7 and move 3 spaces to the left.
−7 + (−3) = −10



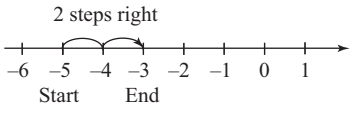
4. Begin at −2 and move 7 spaces to the right.
−2 + 7 = 5



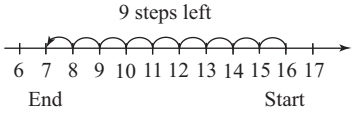
5. Begin at 7 and move 8 spaces to the left.
7 + (−8) = −1



6. Begin at −5 and move 2 spaces to the right.
−5 + 2 = −3



7. Begin at 16 and move 9 spaces to the left.
16 + (−9) = 7



8. The sum of two negative integers is negative.

9. |−9| = 9; |−13| = 13; 9 + 13 = 22
Both integers are negative, so the sign of the sum is negative.
−9 + (−13) = −22

10. |−7| = 7; |−10| = 10; 7 + 10 = 17
Both integers are negative, so the sign of the sum is negative.
−7 + (−10) = −17

11. |−31| = 31; |−19| = 19; 31 + 19 = 50
Both integers are negative, so the sign of the sum is negative.
−31 + (−19) = −50

12. |86| = 86; |49| = 49; 86 + 49 = 135
Both integers are positive, so the sign of the sum is positive.
86 + 49 = 135

13. |−12| = 12; |6| = 6; 12 − 6 = 6
The larger absolute value is 12, which was a negative number in the original problem, so the sum is negative.
−12 + 6 = −6

14. |−7| = 7; |10| = 10; 10 − 7 = 3
The larger absolute value is 10, which was a positive number in the original problem, so the sum is positive.
−7 + 10 = 3

15. |−1| = 1; |13| = 13; 13 − 1 = 12
The larger absolute value is 13, which was a positive number in the original problem, so the sum is positive.
−1 + 13 = 12

16. |95| = 95; |−48| = 48; 95 − 48 = 47
The larger absolute value is 95, which was a positive number in the original problem, so the sum is positive.
95 + (−48) = 47

17. For any integer a other than 0, there is an integer $-a$, called the additive inverse or opposite of a, such that $a + (-a) = -a + a = 0$.

18. The opposite of 14 is −14 because
14 + (−14) = 0.

19. The opposite of −10 is 10 because −10 + 10 = 0.

20. The opposite of −17 is 17 because −17 + 17 = 0.

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21. The opposite of 49 is –49 because $49 + (-49) = 0$.

22. The subtraction problem $-4 - 11$ is equivalent to $-4 + (-11)$.

23. $-16 - 43 = -16 + (-43) = -59$

24. $9 - (-12) = 9 + 12 = 21$

25. $35 - 81 = 35 + (-81) = -46$

26. $7 - 12 + 5 = 7 + (-12) + 5 = -5 + 5 = 0$

27. $$\begin{aligned} -39 - 27 + 18 &= -39 + (-27) + 18 \\ &= -66 + 18 \\ &= -48 \end{aligned}$$

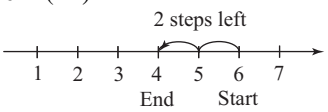
28. $$\begin{aligned} &-234 + 422 - (-581) + 416 \\ &= -234 + 422 + 581 + 416 \\ &= 188 + 581 + 416 \\ &= 769 + 416 \\ &= 1185 \end{aligned}$$

29. $$\begin{aligned} -15 + 27 + 18 + (-31) &= 12 + 18 + (-31) \\ &= 30 + (-31) \\ &= -1 \end{aligned}$$
The net change is a loss of \$1.

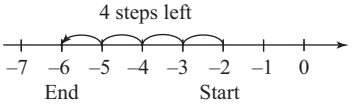
30. $$\begin{aligned} 31 + 12 + 6 + (-2) &= 43 + 6 + (-2) \\ &= 49 + (-2) \\ &= 47 \end{aligned}$$
The ball is now on the 47-yard line.

2.2 Exercises

32. Begin at 6 and move 2 spaces to the left.
$6 + (-2) = 4$



34. Begin at –2 and move 4 spaces to the left.
$-2 + (-4) = -6$



36. $|-26| = 26$; $|-13| = 13$; $26 + 13 = 39$
Both integers are negative, so the sign of the sum is negative.
$-26 + (-13) = -39$

38. $|25| = 25$; $|-35| = 35$; $35 - 25 = 10$
The larger absolute value is 35, which was a negative number in the original problem, so the sum is negative.
$25 + (-35) = -10$

40. $|45| = 45$; $|18| = 18$; $45 + 18 = 63$
Both integers are positive, so the sign of the sum is positive.
$45 + 18 = 63$

42. $|-37| = 37$; $|23| = 23$; $37 - 23 = 14$
The larger absolute value is 37, which was negative in the original problem, so the sum is negative.
$-37 + 23 = -14$

44. $|-49| = 49$; $|-92| = 92$; $49 + 92 = 141$
Both integers are negative, so the sign of the sum is negative.
$-49 + (-92) = -141$

46. $|742| = 742$; $|-742| = 742$; $742 - 742 = 0$;
$742 + (-742) = 0$

48. The opposite of 47 is –47 because $47 + (-47) = 0$.

50. The opposite of –154 is 154 because $-154 + 154 = 0$.

52. $-(-36) = 36$, because the opposite of –36 is 36.

54. $-|-135| = -135$, because the absolute value of –135 is 135, and the opposite of 135 is –135.

56. $15 - 10 = 15 + (-10)$

58. $24 - 30 = 24 + (-30)$

60. $-9 - (-3) = -9 + 3$

62. $-25 - (-27) = -25 + 27$

64. $12 - (-5) = 12 + 5 = 17$

66. $-14 - (-12) = -14 + 12 = -2$

68. $34 - 50 = 34 + (-50) = -16$

70. $-18 - 32 = -18 + (-32) = -50$

72. $-213 - (-213) = -213 + 213 = 0$

74. $100 - 300 = 100 + (-300) = -200$

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76. $12 - 15 + 6 = 12 + (-15) + 6 = -3 + 6 = 3$

78. $-231 - (-475) + (-100) = -231 + 475 + (-100)$
$= 244 + (-100)$
$= 144$

80. $42 + (-56) = -14$

82. $0 - 14 = 0 + (-14) = -14$

84. $-28 - 12 = -28 + (-12) = -40$

86. $-19 + 45 = 26$

88. $72 - (-72) = 72 + 72 = 144$

90. $-47 - 0 = -47 + (-0) = -47$

92. $-41 + (-55) = -96$

94. $0 + 97 = 97$

96. $7 - 10 - (-16) + (-3) = 7 + (-10) + 16 + (-3)$
$= -3 + 16 + (-3)$
$= 13 + (-3)$
$= 10$

98. $32 - 49 - (-75) + 42 + (-67) - 75$
$= 32 + (-49) + 75 + 42 + (-67) + (-75)$
$= -17 + 75 + 42 + (-67) + (-75)$
$= 58 + 42 + (-67) + (-75)$
$= 100 + (-67) + (-75)$
$= 33 + (-75)$
$= -42$

100. $-10 - 13 = -10 + (-13) = -23$

102. $-302 - 125 = -302 + (-125) = -427$

104. $-83 + 26 = -57$

106. $520 - (-40) = 520 + 40 = 560$
The total vertical distance is 560 feet.

108. $25{,}250 + 4500 + (-960) + (-1260)$
$= 29{,}750 + (-960) + (-1260)$
$= 28{,}790 + (-1260)$
$= 27{,}530$
The plane is currently flying at an altitude of 27,530 feet.

110. $17 + (-12) + 28 + 6 = 5 + 28 + 6$
$= 33 + 6$
$= 39$
The ball is now on the 39-yard line.

112. $|4| + |-7| = 4 + 7 = 11$

114. $|-8 - (-13)| = |-8 + 13| = |5| = 5$

116. $-|-29| - |-69| = -29 - 69 = -29 + (-69) = -98$

118. $-|-|-13|| - (-87) = -|-13| + 87 = -13 + 87 = 74$

120. $3 + (-4) + ? = 5$
$-1 + ? = 5$
$? = 6$

122. $-4 + 12 + ? = 16$
$8 + ? = 16$
$? = 8$

124. $-14 + ? = 8$
$? = 22$

126. $-? - (-23) = 0$
$-? + 23 = 0$
$? = 23$

128. $-19 - ? = 5$
$? = -24$

130. $? + 28 = -39$
$? = -67$

132. The answer is positive because the sum of the values of the positive numbers is greater than the sum of the values of the negative numbers: $-89 + 125 + (-111) + 350$.

Section 2.3

Are You Prepared for This Section?

P1. $17 \cdot 6 = 102$

P2. $3^2 = 3 \cdot 3 = 9$

P3. $75 \div 3 = 25$

P4. a. $\frac{0}{28} = 0$

b. $\frac{14}{0}$ is undefined.

2.3 Quick Checks

1. The product of two integers with the same sign is positive.

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2. The product of a negative integer and positive integer is negative.

3. The product of two positive integers is positive: $5 \cdot 6 = 30$

4. The product of one negative integer and one positive integer is negative: $(-3)7 = -21$

5. The product of one positive integer and one negative integer is negative: $13(-3) = -39$

6. The product of two positive integers is positive: $2(14) = 28$

7. The product of two negative integers is positive: $(-11)(-8) = 88$

8. The product of two negative integers is positive: $(-25)(-8) = 200$

9. total score $= 4(-3) = -12$
The total score was -12 or 12 shots under par.

10. The product of six negative integers is positive.

11. The product of seven negative integers is negative.

12. True because the product of an odd number of negative numbers is negative.

13. $-2(-5)(4) = 10(4) = 40$

14. $(-4)(-5)(-6)(-7) = 20(-6)(-7)$
$= -120(-7)$
$= 840$

15. The quotient of a nonzero integer and 0 is undefined.

16. $\dfrac{-36}{12} = -3$

17. $\dfrac{20}{-4} = -5$

18. $\dfrac{26}{0}$ is undefined.

19. $-63 \div (-9) = 7$

20. $\dfrac{0}{-6} = 0$

21. $\dfrac{-120}{-24} = 5$

22. a. $22{,}815{,}000 - 25{,}296{,}000 = -2{,}481{,}000$
The change in average local TV late-night viewership was $-2{,}481{,}000$.

b. $\dfrac{-2{,}481{,}000}{5} = -496{,}200$
The average yearly change in viewership was $-496{,}200$.

2.3 Exercises

24. $(-3)(-5) = 15$

26. $7(-9) = -63$

28. $(-11)12 = -132$

30. $14 \cdot 9 = 126$

32. $0(-31) = 0$

34. $-26 \cdot 1 = -26$

36. $(-3)(-39) = 117$

38. $68(-5) = -340$

40. $-38 \cdot 56 = -2128$

42. $-15(-4)(-5) = 60(-5) = -300$

44. $(-5)(-6)(-10)(2) = 30(-10)(2)$
$= -300(2)$
$= -600$

46. $(-15)(-2)(0)(3) = 0$

48. $\dfrac{27}{9} = 3$

50. $\dfrac{11{,}000}{100} = 110$

52. $\dfrac{-63}{9} = -7$

54. $\dfrac{-81}{-9} = 9$

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56. $\frac{-15}{0}$ is undefined.

58. $\frac{0}{-9} = 0$

60. $48 \div (-6) = -8$

62. $-96 \div (-8) = 12$

64. $\frac{35}{-35} = -1$

66. $\frac{192}{6} = 32$

68. $\frac{-920}{-4} = 230$

70. $\frac{504}{-36} = -14$

72. $156 \div (-4) = -39$

74. $-90 + 46 = -44$

76. $(-57)(26) = -1482$

78. $15 - 40 = 15 + (-40) = -25$

80. $-39 + (-23) = -62$

82. $-29(8) = -232$

84. $\frac{-1584}{-48} = 33$

86. $-43 - (-96) = -43 + 96 = 53$

88. $538 + 5(-60) + 125 = 538 + (-300) + 125$
$= 238 + 125$
$= 363$
The balance in her savings account was \$363.

90. $3(472) + 2(413) = 1416 + 826 = 2242$
He burned 2242 calories last week.

92. $\frac{?}{-15} = 30$
$? = -450$

94. $? \cdot 4 = -24$
$? = -6$

96. $\frac{?}{126} = 0$
$? = 0$

98. $\frac{?}{4} = -12$
$? = -48$

100. $\frac{(5)(6)}{15} = \frac{30}{15} = 2$

102. $\frac{(21)(-2)}{7} = \frac{-42}{7} = -6$

104. $\frac{(-10)(-2)}{4} = \frac{20}{4} = 5$

106. $\frac{(20)(-3)}{-15} = \frac{-60}{-15} = 4$

108. $\frac{-45}{5} + 12 = -9 + 12 = 3$

110. $\frac{-82}{2} - 9 = -41 - 9 = -41 + (-9) = -50$

112. $\frac{56}{-8} + \left(\frac{-81}{9}\right) = -7 + (-9) = -16$

114. $\frac{-48}{12} - \left(\frac{-50}{10}\right) = -4 - (-5) = -4 + 5 = 1$

116. $(4^2)(-5) = (16)(-5) = -80$

118. $(5^2)(-2)(2) = (25)(-2)(2) = (-50)(2) = -100$

120. $\frac{4+8}{-2} = \frac{12}{-2} = -6$

122. $\frac{(-6)(-8)}{-5+29} = \frac{48}{24} = 2$

124. The product of an odd number of negative integers gives a negative number because the product of two negative integers is positive, and the product of a positive integer and a negative integer is negative. For example, $(-3)(-4)(-5) = (12)(-5) = -60$.

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Section 2.4

Are You Prepared for This Section?

P1. $3^2 = 3 \cdot 3$

P2. $|-8| = 8$ because the distance from 0 to −8 on a number line is 8.

P3. $2 + 3(14 \div 7) = 2 + 3(2) = 2 + 6 = 8$

2.4 Quick Checks

1. The expression $2 \cdot 2 \cdot 2 \cdot 2$ is said to be in factored form or expanded form.

2. In the expression 3^5, 3 is the base, and 5 is the exponent or power.

3. The expression contains seven factors, so $11 \cdot 11 \cdot 11 \cdot 11 \cdot 11 \cdot 11 \cdot 11 = 11^7$.

4. The expression contains four factors, so $(-7)(-7)(-7)(-7) = (-7)^4$.

5. $2^4 = 2 \cdot 2 \cdot 2 \cdot 2 = 16$

6. $(-9)^2 = (-9)(-9) = 81$

7. $-6^2 = -36$ because $-6^2 = -(6)(6)$.

8. $(-6)^2 = 36$ because $(-6)^2 = (-6)(-6)$.

9. $(-5)^3 = (-5)(-5)(-5) = -125$

10. False; a negative number raised to an even power is positive.

11. False; a negative number raised to an odd power is negative.

12. False; to simplify $3 + 5(-7)$, first multiply 5 by −7.

13. True

14. $-1 + (9)(-2) = -1 + (-18) = -19$

15. $-8 + 63 \div (-7) = -8 + (-9) = -17$

16. $9 \div (-3)^2 + 7 = 9 \div 9 + 7 = 1 + 7 = 8$

17. $-4^2 + (-9)^2 = -16 + 81 = 65$

18. False; $(5 + 2)^2 = 7^2 = 49$

19.
$$\begin{aligned} 2 - 4(3 + 5)^2 &= 2 - 4(8)^2 \\ &= 2 - 4(64) \\ &= 2 - 256 \\ &= -254 \end{aligned}$$

20.
$$\begin{aligned} (3 + 7)^3 - 15 \div 3 &= 10^3 - 15 \div 3 \\ &= 1000 - 15 \div 3 \\ &= 1000 - 5 \\ &= 995 \end{aligned}$$

21.
$$\begin{aligned} |8 - 14| - [3 + 5(-2)] &= |-6| - [3 + (-10)] \\ &= 6 - (-7) \\ &= 6 + 7 \\ &= 13 \end{aligned}$$

22.
$$\begin{aligned} 6(1 - 4)^3 + |7 - 12| &= 6(-3)^3 + |-5| \\ &= 6(-27) + 5 \\ &= -162 + 5 \\ &= -157 \end{aligned}$$

23. $\dfrac{(4 - 10)^2}{2^3 - 5} = \dfrac{(-6)^2}{8 - 5} = \dfrac{36}{3} = 12$

24. $\dfrac{6 + 15 \div 3 + 16}{16 \cdot 2 - 5} = \dfrac{6 + 5 + 16}{32 - 5} = \dfrac{27}{27} = 1$

25.
$$\begin{aligned} \text{average attendance} &= \frac{32 + 24 + 23 + 17}{4} \\ &= \frac{96}{4} \\ &= 24 \end{aligned}$$

The average attendance was 24 students.

26. $\text{test average} = \dfrac{78 + 81 + 84}{3} = \dfrac{243}{3} = 81$

The test average was 81.

2.4 Exercises

28. $(-5)^2 = (-5)(-5) = 25$

30. $-5^2 = -(5)(5) = -25$

32. $-6^3 = -(6)(6)(6) = -216$

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34. $(-1)^{235} = -1$

36. $-2^5 = -2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = -32$

38. $-18^2 = -18 \cdot 18 = -324$

40. $2 + (-4)(5) = 2 + (-20) = -18$

42. $-4 + 36 \div (-12) = -4 + (-3) = -7$

44. $-5 \cdot 2 + 32 \div (-4) = -10 + (-8) = -18$

46. $-2 \cdot 12 + 45 \div 5 = -24 + 9 = -15$

48. $25 - 3(-1)^4 = 25 - 3(1) = 25 - 3 = 22$

50. $48 \div 4^2 - 21 = 48 \div 16 - 21 = 3 - 21 = -18$

52.
$$\begin{aligned} 40 - 30 \div (-3)(-2) &= 40 - (-10)(-2) \\ &= 40 - 20 \\ &= 20 \end{aligned}$$

54.
$$\begin{aligned} -17 + 6^2 \div (-34 - 2) &= -17 + 36 \div (-34 - 2) \\ &= -17 + 36 \div (-36) \\ &= -17 + (-1) \\ &= -18 \end{aligned}$$

56.
$$\begin{aligned} (-6 + 2)^3 + (8 - 10)^4 &= (-4)^3 + (-2)^4 \\ &= (-64) + (16) \\ &= -48 \end{aligned}$$

58. $-5 \cdot \left|2^4 - 4^2\right| = -5 \cdot |16 - 16| = -5 \cdot |0| = -5 \cdot 0 = 0$

60. $\dfrac{-6 - 4}{7 + (-2)} = \dfrac{-10}{5} = -2$

62. $\dfrac{3^2 + 5^2}{1 + (-1)^2} = \dfrac{9 + 25}{1 + 1} = \dfrac{34}{2} = 17$

64.
$$\begin{aligned} -3^2 - 48 \div (4^2 + 2^3) &= -9 - 48 \div (16 + 8) \\ &= -9 - 48 \div (24) \\ &= -9 - 2 \\ &= -11 \end{aligned}$$

66. $\dfrac{(-6)^2 - 6^2}{(4^2 - 3 \cdot 5)^2} = \dfrac{36 - 36}{(16 - 15)^2} = \dfrac{0}{1^2} = \dfrac{0}{1} = 0$

68. $\dfrac{(1 + 2 + 3)^2}{(1 + 2 - 3)^2} = \dfrac{6^2}{0^2} = \dfrac{36}{0}$ is undefined.

70. $-46 - 3(-2)^4 = -46 - 3(16) = -46 - 48 = -94$

72. $36(-4) = -144$

74. $(-9)^2 = (-9)(-9) = 81$

76. $7 + 4^3 \div 2^4 = 7 + 64 \div 16 = 7 + 4 = 11$

78. $\dfrac{8 - (-6)}{-3 - 4} = \dfrac{8 + 6}{-7} = \dfrac{14}{-7} = -2$

80.
$$\begin{aligned} (2 + 4^3) \div (11 \cdot 2 \cdot 3) &= (2 + 64) \div (22 \cdot 3) \\ &= 66 \div 66 \\ &= 1 \end{aligned}$$

82.
$$\begin{aligned} \frac{2 \cdot 8^2 - 10}{5^2 - [(-3)^2 + 4^2]} &= \frac{2 \cdot 64 - 10}{25 - (9 + 16)} \\ &= \frac{128 - 10}{25 - 25} \\ &= \frac{118}{0} \text{ is undefined} \end{aligned}$$

84.
$$\begin{aligned} 3 - [4(-3) + 6] &= 3 - [-12 + 6] \\ &= 3 - (-6) \\ &= 3 + 6 \\ &= 9 \end{aligned}$$

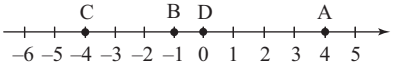
86. $2[(-3)(8) - (-6)] = 2[-24 + 6] = 2[-18] = -36$

88. First error: Jacqueline incorrectly squared -4: $(-4)^2 = 16$, not -16. Second error: Jacqueline added -16 and 7 instead of multiplying 7 by $(2^3 + 4)$.

$$\begin{aligned} (-4)^2 + 7(2^3 + 4) &= (-4)^2 + 7(8 + 4) \\ &= (-4)^2 + 7(12) \\ &= (-4)^2 + 7(8 + 4) \\ &= (-4)^2 + 7(12) \\ &= 16 + 7(12) \\ &= 16 + 84 \\ &= 100 \end{aligned}$$

Putting the Concepts Together (Sections 2.1–2.4)

1.



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2. a. -2 is to the left of 5 on a number line, so $-2 < 5$.

b. -8 is to the right of -11 on a number line, so $-8 > -11$.

3. a. $|-3| = 3$ because the distance from 0 to -3 on a number line is 3.

b. $-|-11| = -11$

c. $-(-5) = 5$

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

b. $(-13) + 7 = -6$

c. $17 + (-9) = 8$

5. a. The opposite of 3 is -3 because $3 + (-3) = 0$.

b. The opposite of -72 is 72 because $-72 + 72 = 0$.

c. The opposite of -98 is 98 because $-98 + 98 = 0$.

6. a. $18 - 25 = 18 + (-25) = -7$

b. $-21 - 11 = -21 + (-11) = -32$

c. $16 - (-6) = 16 + 6 = 22$

d. $-1 - (-7) = -1 + 7 = 6$

7. a. $9+16-23 = 9+16+(-23) = 25+(-23) = 2$

b.
$$\begin{aligned} 17-(-68)+29-10 &= 17+68+29+(-10) \\ &= 85+29+(-10) \\ &= 114+(-10) \\ &= 104 \end{aligned}$$

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

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

8. a. $\dfrac{-54}{9} = -6$

b. $\dfrac{-15}{0}$ is undefined.

c. $-6(14) = -84$

9. a.
$$\begin{aligned} -75+20-(-15) &= -75+20+15 \\ &= -55+15 \\ &= -40 \end{aligned}$$

b. $\dfrac{-252}{-14} = 18$

c.
$$\begin{aligned} -5^2+2[4-(-2)^4] &= -25+2(4-16) \\ &= -25+2(-12) \\ &= -25+(-24) \\ &= -49 \end{aligned}$$

Section 2.5

Are You Prepared for This Section?

P1. $10 + (-4) = 6$

P2. $23 - (-8) = 23 + 8 = 31$

P3. $-9 \cdot 2 \cdot 15 = -18 \cdot 15 = -270$

2.5 Quick Checks

1. A letter that represents a number from a set of numbers is called a variable.

2. $2x + 5$ is called an algebraic expression; the number 5 is called a constant.

3. Substituting a numerical value for each variable in an algebraic expression and then finding the value of the expression is called evaluating the algebraic expression.

4. a. Substitute 6 for x.
$3x + 2 = 3(6) + 2 = 18 + 2 = 20$

b. Substitute -5 for x.
$3x + 2 = 3(-5) + 2 = -15 + 2 = -13$

5. Substitute -2 for n.
$11 - n = 11 - (-2) = 11 + 2 = 13$

6. Substitute -3 for x and -5 for y.
$(x+y)^2 = [-3+(-5)]^2 = (-8)^2 = 64$

7. Substitute 11 for z and -3 for w.
$$\frac{z-8}{w-(-6)} = \frac{11-8}{-3-(-6)} = \frac{3}{-3+6} = \frac{3}{3} = 1$$

8. a. Substitute -2 for k.
$-k^2 = -(-2)^2 = -4$

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b. Substitute 2 for k.
$-k^2 = -2^2 = -4$

9. Substitute -3 for x and -1 for y.
$$\begin{aligned} 5x^3y &= 5\cdot(-3)^3\cdot(-1) \\ &= 5(-27)(-1) \\ &= -135(-1) \\ &= 135 \end{aligned}$$

10. Substitute 2 for a and -5 for b.
$$\begin{aligned} -4ab^2 &= -4\cdot 2\cdot(-5)^2 \\ &= -4\cdot 2\cdot 25 \\ &= -8\cdot 25 \\ &= -200 \end{aligned}$$

11. Substitute -2 for n.
$$\begin{aligned} n^2-3n+2 &= (-2)^2-3(-2)+2 \\ &= 4+6+2 \\ &= 10+2 \\ &= 12 \end{aligned}$$

12. Substitute 3 for h.
$90 + 25h = 90 + 25(3) = 90 + 75 = 165$
The cost for the plumber working 3 hours is \$165.

13. Substitute 203 for s and 76 for n.
$5s + 8n = 5(203) + 8(76) = 1015 + 608 = 1623$
When 203 students and 76 nonstudents attend the play, the revenue is \$1623.

14. True

15. The expression $2x^2+5xy$ contains two terms, $2x^2$ and $5xy$.

16. Rewrite the expression as
$7ab+(-bc)+3ac+(-a^2c)$.
The four terms are $7ab$, $-bc$, $3ac$, and $-a^2c$.

17. Rewrite the expression as $3mn^2+(-2mn)$.
The two terms are $3mn^2$ and $-2mn$.

18. The coefficient of $11m^2n$ is 11.

19. The coefficient of $-x$ is -1 because $-x$ can be written as $-1\cdot x$.

20. The coefficient of r^3s is 1 because r^3s can be written as $1\cdot r^3s$.

21. The coefficient of -42 is -42 because the coefficient of a constant is the number itself.

22. The terms $3a$ and $-5a$ are <u>like</u> terms, and the terms $3a$ and $3b$ are <u>unlike</u>.

23. $2x$ and $2y$ are unlike terms because the variables are not the same.

24. $4xy^2$ and $-2xy^2$ are like terms.

25. $8n$ and 8 are unlike terms because the term $8n$ has a variable and 8 does not.

26. -16 and 5 are like terms.

27. Distribute: $3(y - z) = 3 \cdot y - \underline{3z}$

28. $2(m + 5) = 2 \cdot m + 2 \cdot 5 = 2m + 10$

29. $-7(k + 3) = (-7)k + (-7)3 = -7k - 21$

30. $-(x - 5) = -1(x - 5) = (-1)x + (-1)(-5) = -x + 5$

31. $(6x^2+1)2 = 2(6x^2+1) = 2\cdot 6x^2+2\cdot 1 = 12x^2+2$

32. $4x + 6x = (4 + 6)x = 10x$

33. $9z^2-5z^2 = (9-5)z^2 = 4z^2$

34. $$\begin{aligned} 10rs+6rs-rs &= 10rs+6rs-1rs \\ &= (10+6-1)rs \\ &= 15rs \end{aligned}$$

35. $$\begin{aligned} 7y-8+3y+11 &= 7y+(-8)+3y+11 \\ &= 7y+3y+(-8)+11 \\ &= (7+3)y+(-8)+11 \\ &= 10y+3 \end{aligned}$$

36. $$\begin{aligned} &4a^2+7-2a+a^2+a-3 \\ &= 4a^2+7+(-2a)+a^2+a+(-3) \\ &= 4a^2+a^2+(-2a)+a+7+(-3) \\ &= (4+1)a^2+(-2+1)a+7+(-3) \\ &= 5a^2+(-1)a+4 \\ &= 5a^2-a+4 \end{aligned}$$

37. $$\begin{aligned} &2a + 10b - 6a + 3ab - 15b \\ &= 2a + 10b + (-6a) + 3ab + (-15b) \\ &= 2a + (-6a) + 10b + (-15b) + 3ab \\ &= [2 + (-6)]a + [10 + (-15)]b + 3ab \\ &= -4a + (-5)b + 3ab \\ &= -4a - 5b + 3ab \end{aligned}$$

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38. $2(t+4)+11 = 2\cdot t + 2\cdot 4 + 11$
$= 2t + 8 + 11$
$= 2t + 19$

39. $4x + 7(x-3) = 4x + 7\cdot x - 7\cdot 3$
$= 4x + 7x - 21$
$= 11x - 21$

40. $-(5m-3)+7 = -1(5m-3)+7$
$= (-1)5m + (-1)(-3) + 7$
$= -5m + 3 + 7$
$= -5m + 10$

41. $m + (m+3) + 2m = m + m + 3 + 2m$
$= m + m + 2m + 3$
$= 4m + 3$
The perimeter is represented by the expression $(4m + 3)$ cm.

42. a. $2L + 2(L - 5) = 2L + 2L - 10 = 4L - 10$
The perimeter of the rectangle is represented by the expression $(4L - 10)$ feet.

b. Substitute 11 for L.
$4L - 10 = 4(11) - 10 = 44 - 10 = 34$
The perimeter of the garden is 34 feet.

2.5 Exercises

44. The number of tickets sold to a play is variable because the number of tickets sold can change from play to play.

46. The number of donuts in a dozen donuts is constant. There are 12 donuts in a dozen donuts.

48. Substitute 6 for x.
$5 + 8x = 5 + 8(6) = 5 + 48 = 53$

50. Substitute 7 for n.
$n^2 - 5n + 2 = (7)^2 - 5(7) + 2$
$= 49 - 35 + 2$
$= 14 + 2$
$= 16$

52. Substitute -4 for a.
$7 - a^2 = 7 - (-4)^2 = 7 - 16 = -9$

54. Substitute 14 for x and 6 for y.
$\frac{3x}{7} + y^2 = \frac{3(14)}{7} + (6)^2 = \frac{42}{7} + 36 = 6 + 36 = 42$

56. Substitute 3 for x and -1 for y.
$\frac{2x - 6y}{x + y} = \frac{2(3) - 6(-1)}{3 + (-1)} = \frac{6 + 6}{2} = \frac{12}{2} = 6$

58. Substitute -6 for x and 2 for y.
$(x - 2y)^2 = [-6 - 2(2)]^2$
$= (-6 - 4)^2$
$= (-10)^2$
$= 100$

60. Substitute -3 for x and 1 for y.
$x^2 + 2y^2 = (-3)^2 + 2(1)^2 = 9 + 2(1) = 9 + 2 = 11$

62. Rewrite the expression as
$2z^3 + (-4z^2) + z + (-7)$.
The four terms are $2z^3$, $-4z^2$, z, and -7.
The coefficients are 2, -4, 1, and -7.

64. The two terms of $8p^3 + 3p$ are $8p^3$ and $3p$.
The coefficients are 8 and 3.

66. $6p^3$ and $-p^3$ are like terms.

68. $4x$ and 4 are unlike terms because the term $4x$ has a variable and 4 does not.

70. -12 and 8 are like terms.

72. x^4z^2 and x^2z^4 are unlike terms because the variables are not raised to the same power.

74. $4(y + 2) = 4 \cdot y + 4 \cdot 2 = 4y + 8$

76. $-2(5z - 6) = (-2)5z + (-2)(-6) = -10z + 12$

78. $(5m^2 - 3)6 = 6(5m^2 - 3)$
$= 6\cdot 5m^2 - 6\cdot 3$
$= 30m^2 - 18$

80. $-(x - 3y) = -1(x - 3y)$
$= (-1)x + (-1)(-3y)$
$= -x + 3y$

82. $12x + 19x = (12 + 19)x = 31x$

84. $19k - 22k = (19 - 22)k = -3k$

86. $8k - 8k - 4k = (8 - 6 - 4)k = -2k$

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88. $9v-6-5v-7=9v-5v-6-7$
$=(9-5)v-6-7$
$=4v-13$

90. $-3x^2+18x^2=(-3+18)x^2=15x^2$

92. $8b^2-3b-11b^2+4=8b^2-11b^2-3b+4$
$=(8-11)b^2-3b+4$
$=-3b^2-3b+4$

94. $-12h+16m-9m=-12h+(16-9)m$
$=-12h+7m$

96. $5(n+4)-12=5\cdot n+5\cdot 4-12$
$=5n+20-12$
$=5n+8$

98. $5(y+6)-6y=5\cdot y+5\cdot 6-6y$
$=5y+30-6y$
$=5y-6y+30$
$=-y+30$

100. $-8(w+4)-18=(-8)w+(-8)4-18$
$=-8w+(-32)-18$
$=-8w-50$

102. $-7(3b+2)=(-7)3b+(-7)2=-21b-14$

104. $7(2y-4)+3y=7\cdot 2y-7\cdot 4+3y$
$=14y-28+3y$
$=14y+3y-28$
$=17y-28$

106. $4-(6x+7)=4+(-1)(6x+7)$
$=4+(-1)(6x)+(-1)(7)$
$=4+(-6x)+(-7)$
$=-6x+4+(-7)$
$=-6x-3$

108. $9h+(-3h)=[9+(-3)]h=6h$

110. $3(n+6)-18=3\cdot n+3\cdot 6-18$
$=3n+18-18$
$=3n$

112. $-(2x-5y)=-1(2x-5y)$
$=(-1)2x+(-1)(-5y)$
$=-2x+5y$

114. $-3(a^2+8a)+40a=(-3)a^2+(-3)8a+40a$
$=-3a^2+(-24a)+40a$
$=-3a^2+16a$

116. $5(3k+2)+5k=5\cdot 3k+5\cdot 2+5k$
$=15k+10+5k$
$=15k+5k+10$
$=20k+10$

118. Substitute 7 for A and 4 for B.
$A+2B=7+2(4)=7+8=15$

120. Substitute -3 for a, 5 for b, 7 for c, and 6 for d.
$\frac{a-b}{c-d}=\frac{-3-5}{7-6}=\frac{-8}{1}=-8$

122. Substitute -1 for a, -3 for b, and 5 for c.
$b^2-4ac=(-3)^2-4(-1)(5)$
$=9-(-20)$
$=9+20$
$=29$

124. The perimeter is twice the length plus twice the width.
$2(4x-1)+2x=8x-2+2x=10x-2$
The perimeter is $(10x-2)$ yd.

126. There are 6 sides of equal length.
$6(-4x+12)=-24x+72$
The perimeter is $(-24x+72)$ in.

128. The perimeter is the sum of the lengths of the 4 sides.
$p+1+(2p+3)+1=p+2p+1+3+1$
$=3p+5$
The perimeter is $(3p+5)$ cm.

130. Substitute 4 for a and 5 for c.
$80a+70c=80(4)+70(5)=320+350=670$
When 4 adult tickets and 5 children's tickets are sold, the revenue is \$670.

132. a. $2w+2(6w-7)=2w+2\cdot 6w-2\cdot 7$
$=2w+12w-14$
$=14w-14$

b. Substitute 4 for w.
$14w-14=14\cdot 4-14=56-14=42$
The perimeter is 42 yards.

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134. a. Substitute -3 for y.
$8y + 2y = 8(-3) + 2(-3) = -24 + (-6) = -30$

b. $8y + 2y = (8 + 2)y = 10y$
Substitute -3 for y.
$10y = 10(-3) = -30$

The results are the same.

136. a. Substitute 8 for k.
$3(k + 2) = 3(8 + 2) = 3(10) = 30$

b. $3(k + 2) = 3 \cdot k + 3 \cdot 2 = 3k + 6$
Substitute 8 for k.
$3k + 6 = 3 \cdot 8 + 6 = 24 + 6 = 30$

The results are the same.

138. a. Substitute -4 for m.
$$\begin{aligned} 5(m-2)+3m &= 5(-4-2)+3(-4) \\ &= 5(-6)+3(-4) \\ &= -30+(-12) \\ &= -42 \end{aligned}$$

b. $$\begin{aligned} 5(m-2)+3m &= 5\cdot m-5\cdot 2+3m \\ &= 5m+3m-10 \\ &= 8m-10 \end{aligned}$$
Substitute -4 for m.
$8m - 10 = 8(-4) - 10 = -32 - 10 = -42$

The results are the same.

140. a. Substitute 8 for w.
$$\begin{aligned} -2(w+5)-10 &= -2(8+5)-10 \\ &= -2(13)-10 \\ &= -26-10 \\ &= -36 \end{aligned}$$

b. $$\begin{aligned} -2(w+5)-10 &= -2\cdot w+(-2)\cdot 5-10 \\ &= -2w-10-10 \\ &= -2w-20 \end{aligned}$$
Substitute 8 for w.
$-2w - 20 = -2(8) - 20 = -16 - 20 = -36$

The results are the same.

142. (the area of the garden) ÷ (4 yards)
The area of the garden is variable and 4 yards is constant.

144. (the length of the room) − (18 inches)
The length of the room is variable and 18 inches is constant.

146. area = length · width
$$\begin{aligned} &= (4x+3)2 \\ &= 2(4x+3) \\ &= 2\cdot 4x+2\cdot 3 \\ &= 8x+6 \end{aligned}$$
The area is $(8x + 6)$ square centimeters.

148. area = length · width = $3(8y) = 24y$
The area is $(24y)$ square yards.

150. a. Substitute 4 for x and 5 for y.
$x^2 + y^2 = 4^2 + 5^2 = 16 + 25 = 41$

b. Substitute 4 for x and 5 for y.
$(x+y)^2 = (4+5)^2 = 9^2 = 81$

c. The expression $x^2 + y^2$ is not equivalent to $(x+y)^2$. As seen from parts (a) and (b), the value of $x^2 + y^2$ for $x = 4$ and $y = 5$ is not equal to the value of $(x+y)^2$ for the same values of x and y. The square of the sum of two quantities is not equal to the sum of the squares of the quantities.

Section 2.6

Are You Prepared for This Section?

P1. The additive inverse of 2 is -2 because $2 + (-2) = 0$.

P2. $$\begin{aligned} -3(2x+5) &= -3\cdot 2x+(-3)\cdot 5 \\ &= -6x+(-15) \\ &= -6x-15 \end{aligned}$$

P3. $$\begin{aligned} 9-(x-5) &= 9+(-1)(x-5) \\ &= 9+(-1)\cdot x+(-1)(-5) \\ &= 9-x+5 \\ &= -x+9+5 \\ &= -x+14 \end{aligned}$$

P4. a. Substitute 2 for x.
$3x - 5 = 3 \cdot 2 - 5 = 6 - 5 = 1$

b. Substitute -6 for x.
$3x - 5 = 3(-6) - 5 = -18 - 5 = -23$

2.6 Quick Checks

1. An equation is of the form expression = expression.

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2. Replace a with -2.

$$\begin{aligned} a-5&=-7\\ -2-5&\stackrel{?}{=}-7\\ -7&=-7 \text{ True}\end{aligned}$$

Yes, $a=-2$ is a solution of the equation.

3. Replace t with 13.

$$\begin{aligned} t+17&=29\\ 13+17&\stackrel{?}{=}29\\ 30&\stackrel{?}{=}29 \text{ False}\end{aligned}$$

No, $t=13$ is not a solution of the equation.

4. Replace x with 6.

$$\begin{aligned} 2-(x+3)&=-7\\ 2-(6+3)&\stackrel{?}{=}-7\\ 2-9&\stackrel{?}{=}-7\\ -7&=-7 \text{ True}\end{aligned}$$

Yes, $x=6$ is a solution of the equation.

5. Replace y with 3.

$$\begin{aligned} -6y+5&=8y-37\\ -6(3)+5&\stackrel{?}{=}8(3)-37\\ -18+5&\stackrel{?}{=}24-37\\ -13&=-13 \text{ True}\end{aligned}$$

Yes, $y=3$ is a solution of the equation.

6.

$$\begin{aligned} x+2&=-4\\ x+2-2&=-4-2\\ x+0&=-6\\ x&=-6\end{aligned}$$

Check: $x+2=-4$

$$-6+2\stackrel{?}{=}-4$$

$$-4=-4 \text{ True}$$

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

7.

$$\begin{aligned} n-7&=3\\ n-7+7&=3+7\\ n+0&=10\\ n&=10\end{aligned}$$

Check: $n-7=3$

$$10-7\stackrel{?}{=}3$$

$$3=3 \text{ True}$$

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

8.

$$\begin{aligned} p-17&=-12\\ p-17+17&=-12+17\\ p+0&=5\\ p&=5\end{aligned}$$

Check: $p-17=-12$

$$5-17\stackrel{?}{=}-12$$

$$-12=-12 \text{ True}$$

The solution set is $\{5\}$.

9.

$$\begin{aligned} y+12&=-1\\ y+12-12&=-1-12\\ y+0&=-13\\ y&=-13\end{aligned}$$

Check: $y+12=-1$

$$-13+12\stackrel{?}{=}-1$$

$$-1=-1 \text{ True}$$

The solution set is $\{-13\}$.

10.

$$\begin{aligned} 8&=m+4\\ 8-4&=m+4-4\\ 4&=m+0\\ 4&=m\end{aligned}$$

Check: $8=m+4$

$$8\stackrel{?}{=}4+4$$

$$8=8 \text{ True}$$

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

11.

$$\begin{aligned} -1&=z-11\\ -1+11&=z-11+11\\ 10&=z+0\\ 10&=z\end{aligned}$$

Check: $-1=z-11$

$$-1\stackrel{?}{=}10-11$$

$$-1=-1 \text{ True}$$

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

12.

$$\begin{aligned} n+6&=-4-9\\ n+6&=-13\\ n+6-6&=-13-6\\ n+0&=-19\\ n&=-19\end{aligned}$$

The solution set is $\{-19\}$.

13.

$$\begin{aligned} 7-19&=p-3\\ -12&=p-3\\ -12+3&=p-3+3\\ -9&=p+0\\ -9&=p\end{aligned}$$

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

14.

$$\begin{aligned} p+1472&=13{,}927\\ p+1472-1472&=13{,}927-1472\\ p+0&=12{,}455\\ p&=12{,}455\end{aligned}$$

The price of the car before the extra charges is \$12,455.

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15. $7z = 56$

$\frac{7z}{7} = \frac{56}{7}$

$1 \cdot z = 8$

$z = 8$

Check: $7z = 56$

$7 \cdot 8 \stackrel{?}{=} 56$

$56 = 56$ True

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

16. $12n = -108$

$\frac{12n}{12} = \frac{-108}{12}$

$1 \cdot n = -9$

$n = -9$

Check: $12n = -108$

$12(-9) \stackrel{?}{=} -108$

$-108 = -108$ True

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

17. $-10k = 220$

$\frac{-10k}{-10} = \frac{220}{-10}$

$1 \cdot k = -22$

$k = -22$

Check: $-10k = 220$

$-10(-22) \stackrel{?}{=} 220$

$220 = 220$ True

The solution set is $\{-22\}$.

18. $-5p = -80$

$\frac{-5p}{-5} = \frac{-80}{-5}$

$1 \cdot p = 16$

$p = 16$

Check: $-5p = -80$

$-5 \cdot 16 \stackrel{?}{=} -80$

$-80 = -80$ True

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

19. $21 = 3x$

$\frac{21}{3} = \frac{3x}{3}$

$7 = 1 \cdot x$

$7 = x$

Check: $21 = 3x$

$21 \stackrel{?}{=} 3(7)$

$21 = 21$ True

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

20. $-b = 17$

$-1 \cdot b = 17$

$\frac{-1 \cdot b}{-1} = \frac{17}{-1}$

$1 \cdot b = -17$

$b = -17$

Check: $-b = 17$

$-(-17) \stackrel{?}{=} 17$

$17 = 17$ True

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

21. $-2x = 58$

$\frac{-2x}{-2} = \frac{58}{-2}$

$1 \cdot x = -29$

$x = -29$

Check: $-2x = 58$

$-2(-29) \stackrel{?}{=} 58$

$58 = 58$ True

The solution set is $\{-29\}$.

22. $5x = -7 - 8$

$5x = -15$

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

$1 \cdot x = -3$

$x = -3$

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

23. $4p = 19 - (-1)$

$4p = 19 + 1$

$4p = 20$

$\frac{4p}{4} = \frac{20}{4}$

$1 \cdot p = 5$

$p = 5$

The solution set is $\{5\}$.

24. $\frac{p}{2} = -4$

$2 \cdot \frac{p}{2} = 2 \cdot (-4)$

$\frac{2}{2} \cdot p = -8$

$1 \cdot p = -8$

$p = -8$

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Check: $\frac{p}{2} = -4$

$\frac{-8}{2} \stackrel{?}{=} -4$

$-4 = -4$ True

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

25. $\frac{n}{-5} = -6$

$-5 \cdot \frac{n}{-5} = -5(-6)$

$\frac{-5}{-5} \cdot n = 30$

$1 \cdot n = 30$

$n = 30$

Check: $\frac{n}{-5} = -6$

$\frac{30}{-5} \stackrel{?}{=} -6$

$-6 = -6$ True

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

26. $35h = 560$

$\frac{35h}{35} = \frac{560}{35}$

$1 \cdot h = 16$

$h = 16$

Alejandro's hourly wage is $16.

2.6 Exercises

28. Replace p with -20.

$p + 7 = -13$

$-20 + 7 \stackrel{?}{=} -13$

$-13 = -13$ True

Yes, $p = -20$ is a solution.

30. Replace x with -2.

$-4x + 1 = -7$

$-4(-2) + 1 \stackrel{?}{=} -7$

$8 + 1 \stackrel{?}{=} -7$

$9 \stackrel{?}{=} -7$ False

No, -2 is not a solution.

32. Replace a with -5.

$3 - 6a = 33$

$3 - 6(-5) \stackrel{?}{=} 33$

$3 + 30 \stackrel{?}{=} 33$

$33 \stackrel{?}{=} 33$ True

Yes, $a = -5$ is a solution.

34. Replace z with -1.

$19 - 3z = 14 + 2z$

$19 - 3(-1) \stackrel{?}{=} 14 + 2(-1)$

$19 + 3 \stackrel{?}{=} 14 - 2$

$22 \stackrel{?}{=} 12$ False

No, $z = -1$ is not a solution.

36. Replace x with 2.

$-3(x + 2) = -11$

$-3(2 + 2) \stackrel{?}{=} -11$

$-3(4) \stackrel{?}{=} -11$

$-12 \stackrel{?}{=} -11$ False

No, $x = 2$ is not a solution.

38. Replace n with -2.

$-4n + 5 = 8n + 25 - 2n$

$-4(-2) + 5 \stackrel{?}{=} 8(-2) + 25 - 2(-2)$

$8 + 5 \stackrel{?}{=} -16 + 25 + 4$

$13 = 13$ True

Yes, $n = -2$ is a solution.

40. $b - 4 = -6$

$b - 4 + 4 = -6 + 4$

$b + 0 = -2$

$b = -2$

Check: $b - 4 = -6$

$-2 - 4 \stackrel{?}{=} -6$

$-6 = -6$ True

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

42. $n + 8 = -2$

$n + 8 - 8 = -2 - 8$

$n + 0 = -10$

$n = -10$

Check: $n + 8 = -2$

$-10 + 8 \stackrel{?}{=} -2$

$-2 = -2$ True

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

44. $-9 = z + 5$

$-9 - 5 = z + 5 - 5$

$-14 = z + 0$

$-14 = z$

Check: $-9 = z + 5$

$-9 \stackrel{?}{=} -14 + 5$

$-9 = -9$ True

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

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46. $9 = a - 5$
$9 + 5 = a - 5 + 5$
$14 = a + 0$
$14 = a$
Check: $9 = a - 5$
$9 \stackrel{?}{=} 14 - 5$
$9 = 9$ True
The solution set is $\{14\}$.

48. $-2 = 2 + r$
$-2 - 2 = 2 - 2 + r$
$-4 = 0 + r$
$-4 = r$
Check: $-2 = 2 + r$
$-2 \stackrel{?}{=} 2 + (-4)$
$-2 = -2$ True
The solution set is $\{-4\}$.

50. $z - 4 = -19 + 3$
$z - 4 = -16$
$z - 4 + 4 = -16 + 4$
$z + 0 = -12$
$z = -12$
Check: $z - 4 = -19 + 3$
$-12 - 4 \stackrel{?}{=} -19 + 3$
$-16 = -16$ True
The solution set is $\{-12\}$.

52. $n + 2 = -9 - 3$
$n + 2 = -12$
$n + 2 - 2 = -12 - 2$
$n + 0 = -14$
$n = -14$
Check: $n + 2 = -9 - 3$
$-14 + 2 \stackrel{?}{=} -9 - 3$
$-12 = -12$ True
The solution set is $\{-14\}$.

54. $8z = 56$
$\frac{8z}{8} = \frac{56}{8}$
$1 \cdot z = 7$
$z = 7$
Check: $8z = 56$
$8 \cdot 7 \stackrel{?}{=} 56$
$56 = 56$ True
The solution set is $\{7\}$.

56. $-6p = 42$
$\frac{-6p}{-6} = \frac{42}{-6}$
$1 \cdot p = -7$
$p = -7$
Check: $-6p = 42$
$-6(-7) \stackrel{?}{=} 42$
$42 = 42$ True
The solution set is $\{-7\}$.

58. $99 = 9b$
$\frac{99}{9} = \frac{9b}{9}$
$11 = 1 \cdot b$
$11 = b$
Check: $99 = 9b$
$99 \stackrel{?}{=} 9 \cdot 11$
$99 = 99$ True
The solution set is $\{11\}$.

60. $-96 = 8m$
$\frac{-96}{8} = \frac{8m}{8}$
$-12 = 1 \cdot m$
$-12 = m$
Check: $-96 = 8m$
$-96 \stackrel{?}{=} 8(-12)$
$-96 = -96$ True
The solution set is $\{-12\}$.

62. $-4x = -36$
$\frac{-4x}{-4} = \frac{-36}{-4}$
$1 \cdot x = 9$
$x = 9$
Check: $-4x = -36$
$-4 \cdot 9 \stackrel{?}{=} -36$
$-36 = -36$ True
The solution set is $\{9\}$.

64. $-56 = -4y$
$\frac{-56}{-4} = \frac{-4y}{-4}$
$14 = 1 \cdot y$
$14 = y$
Check: $-56 = -4y$
$-56 \stackrel{?}{=} -4(14)$
$-56 = -56$ True
The solution set is $\{14\}$.

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66. $9w = 19 - 28$
$9w = -9$
$\frac{9w}{9} = \frac{-9}{9}$
$1 \cdot w = -1$
$w = -1$
Check: $9w = 19 - 28$
$9(-1) \stackrel{?}{=} 19 - 28$
$-9 = -9$ True
The solution set is $\{-1\}$.

68. $\frac{x}{2} = -11$
$2 \cdot \frac{x}{2} = 2(-11)$
$\frac{2}{2} \cdot x = -22$
$1 \cdot x = -22$
$x = -22$
Check: $\frac{x}{2} = -11$
$\frac{-22}{2} \stackrel{?}{=} -11$
$-11 = -11$ True
The solution set is $\{-22\}$.

70. $\frac{r}{-2} = -2$
$-2 \cdot \frac{r}{-2} = -2(-2)$
$\frac{-2}{-2} \cdot r = 4$
$1 \cdot r = 4$
$r = 4$
Check: $\frac{r}{-2} = -2$
$\frac{4}{-2} \stackrel{?}{=} -2$
$-2 = -2$ True
The solution set is $\{-4\}$.

72. $p - 12 = -7$
$p - 12 + 12 = -7 + 12$
$p + 0 = 5$
$p = 5$
Check: $p - 12 = -7$
$5 - 12 \stackrel{?}{=} -7$
$-7 = -7$ True
The solution set is $\{5\}$.

74. $x + 8 = -12$
$x + 8 - 8 = -12 - 8$
$x + 0 = -20$
$x = -20$
Check: $x + 8 = -12$
$-20 + 8 \stackrel{?}{=} -12$
$-12 = -12$ True
The solution set is $\{-20\}$.

76. $-21 = 3c$
$\frac{-21}{3} = \frac{3c}{3}$
$-7 = 1 \cdot c$
$-7 = c$
Check: $-21 = 3c$
$-21 \stackrel{?}{=} 3(-7)$
$-21 = -21$ True
The solution set is $\{-7\}$.

78. $-3z = 36$
$\frac{-3z}{-3} = \frac{36}{-3}$
$1 \cdot z = -12$
$z = -12$
Check: $-3z = 36$
$-3(-12) \stackrel{?}{=} 36$
$36 = 36$ True
The solution set is $\{-12\}$.

80. $-20 = x - 37$
$-20 + 37 = x - 37 + 37$
$17 = x + 0$
$17 = x$
Check: $-20 = x - 37$
$-20 \stackrel{?}{=} 17 - 37$
$-20 = -20$ True
The solution set is $\{17\}$.

82. $-16 = -298 + x$
$-16 + 298 = -298 + 298 + x$
$282 = 0 + x$
$282 = x$
Check: $-16 = -298 + x$
$-16 \stackrel{?}{=} -298 + 282$
$-16 = -16$ True
The solution set is $\{282\}$.

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84. $5m = 8 - 23$
$5m = -15$
$\frac{5m}{5} = \frac{-15}{5}$
$1 \cdot m = -3$
$m = -3$
Check: $5m = 8 - 23$
$5(-3) \stackrel{?}{=} 8 - 23$
$-15 = -15$ True
The solution set is $\{-3\}$.

86. $\frac{z}{-5} = 10$
$-5 \cdot \frac{z}{-5} = -5 \cdot 10$
$\frac{-5}{-5} \cdot z = -50$
$1 \cdot z = -50$
$z = -50$

Check: $\frac{z}{-5} = 10$
$\frac{-50}{-5} \stackrel{?}{=} 10$
$10 = 10$ True
The solution set is $\{-50\}$.

88. $c - 189 = 989$
$c - 189 + 189 = 989 + 189$
$c + 0 = 1178$
$c = 1178$
The original price of the computer was \$1178.

90. $3p = 27$
$\frac{3p}{3} = \frac{27}{3}$
$\frac{3}{3} \cdot p = 9$
$1 \cdot p = 9$
$p = 9$
The average price per book is \$9.

92. $m + 96 = 1295$
$m + 96 - 96 = 1295 - 96$
$m + 0 = 1199$
$m = 1199$
The price of the washing machine without the extra charges is \$1199.

94. Substitute -9 for x.
$x - \beta = -3$
$-9 - \beta = -3$
$-9 + 9 - \beta = -3 + 9$
$0 - \beta = 6$
$-\beta = 6$
$\frac{-1 \cdot \beta}{-1} = \frac{6}{-1}$
$\beta = -6$

96. Substitute 2 for x.
$\phi x = -86$
$\phi \cdot 2 = -86$
$\frac{2\phi}{2} = \frac{-86}{2}$
$\frac{2}{2} \cdot \phi = -43$
$1 \cdot \phi = -43$
$\phi = -43$

98. Subtracting 7 from both sides of the equation is incorrect. Use the Multiplication Property of Equality to divide both sides by 7, to get the coefficient of the variable equal to 1.

Section 2.7

Are You Prepared for This Section?

P1. Substitute -3 for a.
$2a + 5 = 2(-3) + 5 = -6 + 5 = -1$

P2. $3 - 5(n - 4) = 3 - 5 \cdot n + (-5)(-4)$
$= 3 - 5n + 20$
$= -5n + 3 + 20$
$= -5n + 23$

P3. $x - 7 = 11$
$x - 7 + 7 = 11 + 7$
$x + 0 = 18$
$x = 18$
The solution set is $\{18\}$.

P4. $5y = 125$
$\frac{5y}{5} = \frac{125}{5}$
$\frac{5}{5} \cdot y = 25$
$1 \cdot y = 25$
$y = 25$
The solution set is $\{25\}$.

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2.7 Quick Checks

1. True

2.
$$\begin{aligned} 3y-5&=22\\ 3y-5+5&=22+5\\ 3y&=27\\ \frac{3y}{3}&=\frac{27}{3}\\ y&=9 \end{aligned}$$
Check: $3y-5=22$
$3(9)-5 \stackrel{?}{=} 22$
$27-5 \stackrel{?}{=} 22$
$22=22$ True
The solution set is $\{9\}$.

3.
$$\begin{aligned} 2a+6&=38\\ 2a+6-6&=38-6\\ 2a&=32\\ \frac{2a}{2}&=\frac{32}{2}\\ a&=16 \end{aligned}$$
Check: $2a+6=38$
$2(16)+6 \stackrel{?}{=} 38$
$32+6 \stackrel{?}{=} 38$
$38=38$ True
The solution set is $\{16\}$.

4.
$$\begin{aligned} -5n+3&=18\\ -5n+3-3&=18-3\\ -5n&=15\\ \frac{-5n}{-5}&=\frac{15}{-5}\\ n&=-3 \end{aligned}$$
Check: $-5n+3=18$
$-5(-3)+3 \stackrel{?}{=} 18$
$15+3 \stackrel{?}{=} 18$
$18=18$ True
The solution set is $\{-3\}$.

5.
$$\begin{aligned} -4b-5&=11\\ -4b-5+5&=11+5\\ -4b&=16\\ \frac{-4b}{-4}&=\frac{16}{-4}\\ b&=-4 \end{aligned}$$
Check: $-4b-5=11$
$-4(-4)-5 \stackrel{?}{=} 11$
$16-5 \stackrel{?}{=} 11$
$11=11$ True
The solution set is $\{-4\}$.

6.
$$\begin{aligned} 15&=7-x\\ 15-7&=7-7-x\\ 8&=-x\\ \frac{8}{-1}&=\frac{-x}{-1}\\ -8&=x \end{aligned}$$
Check: $15=7-x$
$15 \stackrel{?}{=} 7-(-8)$
$15 \stackrel{?}{=} 7+8$
$15=15$ True
The solution set is $\{-8\}$.

7.
$$\begin{aligned} 1-2x&=-35\\ 1-1-2x&=-35-1\\ -2x&=-36\\ \frac{-2x}{-2}&=\frac{-36}{-2}\\ x&=18 \end{aligned}$$
Check: $1-2x=-35$
$1-2(18) \stackrel{?}{=} -35$
$1-36 \stackrel{?}{=} -35$
$-35=-35$ True
The solution set is $\{18\}$.

8.
$$\begin{aligned} 14-6p&=-4\\ 14-14-6p&=-4-14\\ -6p&=-18\\ \frac{-6p}{-6}&=\frac{-18}{-6}\\ p&=3 \end{aligned}$$
Check: $14-6p=-4$
$14-6(3) \stackrel{?}{=} -4$
$14-18 \stackrel{?}{=} -4$
$-4=-4$ True
The solution set is $\{3\}$.

9.
$$\begin{aligned} 7+6n-4n&=31\\ 7+2n&=31\\ 7-7+2n&=31-7\\ 2n&=24\\ \frac{2n}{2}&=\frac{24}{2}\\ n&=12 \end{aligned}$$
Check: $7+6n-4n=31$
$7+6(12)-4(12) \stackrel{?}{=} 31$
$7+72-48 \stackrel{?}{=} 31$
$79-48 \stackrel{?}{=} 31$
$31=31$ True
The solution set is $\{12\}$.

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10. $16 = 7a + 8 - 11a$
$16 = -4a + 8$
$16 - 8 = -4a + 8 - 8$
$8 = -4a$
$\frac{8}{-4} = \frac{-4a}{-4}$
$-2 = a$
Check: $16 = 7a + 8 - 11a$
$16 \stackrel{?}{=} 7(-2) + 8 - 11(-2)$
$16 \stackrel{?}{=} -14 + 8 + 22$
$16 \stackrel{?}{=} -6 + 22$
$16 = 16$ True
The solution set is $\{-2\}$.

11. $2(y + 5) - 3 = 11$
$2y + 10 - 3 = 11$
$2y + 7 = 11$
$2y + 7 - 7 = 11 - 7$
$2y = 4$
$\frac{2y}{2} = \frac{4}{2}$
$y = 2$
Check: $2(y + 5) - 3 = 11$
$2(2 + 5) - 3 \stackrel{?}{=} 11$
$2(7) - 3 \stackrel{?}{=} 11$
$14 - 3 \stackrel{?}{=} 11$
$11 = 11$ True
The solution set is $\{2\}$.

12. $3(x + 2) - 4 = 17$
$3x + 6 - 4 = 17$
$3x + 2 = 17$
$3x + 2 - 2 = 17 - 2$
$3x = 15$
$\frac{3x}{3} = \frac{15}{3}$
$x = 5$
Check: $3(x + 2) - 4 = 17$
$3(5 + 2) - 4 \stackrel{?}{=} 17$
$3(7) - 4 \stackrel{?}{=} 17$
$21 - 4 \stackrel{?}{=} 17$
$17 = 17$ True
The solution set is $\{5\}$.

13. $-2(z + 6) + 1 = 19$
$-2z - 12 + 1 = 19$
$-2z - 11 = 19$
$-2z - 11 + 11 = 19 + 11$
$-2z = 30$
$\frac{-2z}{-2} = \frac{30}{-2}$
$z = -15$
Check: $-2(z + 6) + 1 = 19$
$-2(-15 + 6) + 1 \stackrel{?}{=} 19$
$-2(-9) + 1 \stackrel{?}{=} 19$
$18 + 1 \stackrel{?}{=} 19$
$19 = 19$ True
The solution set is $\{-15\}$.

14. $-3(2b + 1) + 6 = -16 + 7$
$-6b - 3 + 6 = -9$
$-6b + 3 = -9$
$-6b + 3 - 3 = -9 - 3$
$-6b = -12$
$\frac{-6b}{-6} = \frac{-12}{-6}$
$b = 2$
Check: $-3(2b + 1) + 6 = -16 + 7$
$-3(2 \cdot 2 + 1) + 6 \stackrel{?}{=} -16 + 7$
$-3(4 + 1) + 6 \stackrel{?}{=} -9$
$-3(5) + 6 \stackrel{?}{=} -9$
$-15 + 6 \stackrel{?}{=} -9$
$-9 = -9$ True
The solution set is $\{2\}$.

15. $5z - 5 = z + 19$
$5z - z - 5 = z - z + 19$
$4z - 5 = 19$
$4z - 5 + 5 = 19 + 5$
$4z = 24$
$\frac{4z}{4} = \frac{24}{4}$
$z = 6$
Check: $5z - 5 = z + 19$
$5(6) - 5 \stackrel{?}{=} 6 + 19$
$30 - 5 \stackrel{?}{=} 25$
$25 = 25$ True
The solution set is $\{6\}$.

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16.
$$\begin{aligned} 7z-1 &= 4z+38 \\ 7z-4z-1 &= 4z-4z+38 \\ 3z-1 &= 38 \\ 3z-1+1 &= 38+1 \\ 3z &= 39 \\ \frac{3z}{3} &= \frac{39}{3} \\ z &= 13 \end{aligned}$$
Check: $7z-1=4z+38$
$7(13)-1 \stackrel{?}{=} 4(13)+38$
$91-1 \stackrel{?}{=} 52+38$
$90=90$ True
The solution set is $\{13\}$.

17.
$$\begin{aligned} z+17 &= 4z-1 \\ z-z+17 &= 4z-z-1 \\ 17 &= 3z-1 \\ 17+1 &= 3z-1+1 \\ 18 &= 3z \\ \frac{18}{3} &= \frac{3z}{3} \\ 6 &= z \end{aligned}$$
The solution set is $\{6\}$.

18.
$$\begin{aligned} -2n+28 &= 7n+1 \\ -2n+2n+28 &= 7n+2n+1 \\ 28 &= 9n+1 \\ 28-1 &= 9n+1-1 \\ 27 &= 9n \\ \frac{27}{9} &= \frac{9n}{9} \\ 3 &= n \end{aligned}$$
The solution set is $\{3\}$.

19.
$$\begin{aligned} 8x-16 &= 4(x-1) \\ 8x-16 &= 4x-4 \\ 8x-4x-16 &= 4x-4x-4 \\ 4x-16 &= -4 \\ 4x-16+16 &= -4+16 \\ 4x &= 12 \\ \frac{4x}{4} &= \frac{12}{4} \\ x &= 3 \end{aligned}$$
Check: $8x-16=4(x-1)$
$8(3)-16 \stackrel{?}{=} 4(3-1)$
$24-16 \stackrel{?}{=} 4(2)$
$8=8$ True
The solution set is $\{3\}$.

20.
$$\begin{aligned} 7+2(x-16) &= -3x-15 \\ 7+2x-32 &= -3x-15 \\ 2x-25 &= -3x-15 \\ 2x+3x-25 &= -3x+3x-15 \\ 5x-25 &= -15 \\ 5x-25+25 &= -15+25 \\ 5x &= 10 \\ \frac{5x}{5} &= \frac{10}{5} \\ x &= 2 \end{aligned}$$
Check: $7+2(x-16)=-3x-15$
$7+2(2-16) \stackrel{?}{=} -3(2)-15$
$7+2(-14) \stackrel{?}{=} -6-15$
$7-28 \stackrel{?}{=} -21$
$-21=-21$ True
The solution set is $\{2\}$.

21.
$$\begin{aligned} 3(k-1) &= -2k-3 \\ 3k-3 &= -2k-3 \\ 3k+2k-3 &= -2k+2k-3 \\ 5k-3 &= -3 \\ 5k-3+3 &= -3+3 \\ 5k &= 0 \\ \frac{5k}{5} &= \frac{0}{5} \\ k &= 0 \end{aligned}$$
The solution set is $\{0\}$.

22.
$$\begin{aligned} 11w-(2-4w) &= 2w+24 \\ 11w-2+4w &= 2w+24 \\ 15w-2 &= 2w+24 \\ 15w-2w-2 &= 2w-2w+24 \\ 13w-2 &= 24 \\ 13w-2+2 &= 24+2 \\ 13w &= 26 \\ \frac{13w}{13} &= \frac{26}{13} \\ w &= 2 \end{aligned}$$
The solution set is $\{2\}$.

23.
$$\begin{aligned} 4(2y+4)+3 &= 2y+25 \\ 8y+16+3 &= 2y+25 \\ 8y+19 &= 2y+25 \\ 8y-2y+19 &= 2y-2y+25 \\ 6y+19 &= 25 \\ 6y+19-19 &= 25-19 \\ 6y &= 6 \\ \frac{6y}{6} &= \frac{6}{6} \\ y &= 1 \end{aligned}$$
The solution set is $\{1\}$.

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24. $40w+3(2w)=828$
$40w+6w=828$
$46w=828$
$\frac{46w}{46}=\frac{828}{46}$
$w=18$
Jan earns \$18 per hour.

2.7 Exercises

26. $4x-3=5$
$4x-3+3=5+3$
$4x=8$
$\frac{4x}{4}=\frac{8}{4}$
$x=2$
The solution set is $\{2\}$.

28. $3n+8=-13$
$3n+8-8=-13-8$
$3n=-21$
$\frac{3n}{3}=\frac{-21}{3}$
$n=-7$
The solution set is $\{-7\}$.

30. $-5a+1=26$
$-5a+1-1=26-1$
$-5a=25$
$\frac{-5a}{-5}=\frac{25}{-5}$
$a=-5$
The solution set is $\{-5\}$.

32. $15-6r=45$
$15-15-6r=45-15$
$-6r=30$
$\frac{-6r}{-6}=\frac{30}{-6}$
$r=-5$
The solution set is $\{-5\}$.

34. $2x+3x-3=12$
$5x-3=12$
$5x-3+3=12+3$
$5x=15$
$\frac{5x}{5}=\frac{15}{5}$
$x=3$
Check: $2x+3x-3=12$
$2(3)+3(3)-3 \stackrel{?}{=} 12$
$6+9-3 \stackrel{?}{=} 12$
$15-3 \stackrel{?}{=} 12$
$12=12$ True
The solution set is $\{3\}$.

36. $8z+2z-9=-49$
$10z-9=-49$
$10z-9+9=-49+9$
$10z=-40$
$\frac{10z}{10}=\frac{-40}{10}$
$z=-4$
Check: $8z+2z-9=-49$
$8(-4)+2(-4)-9 \stackrel{?}{=} -49$
$-32+(-8)-9 \stackrel{?}{=} -49$
$-40-9 \stackrel{?}{=} -49$
$-49=-49$ True
The solution set is $\{-4\}$.

38. $19a-6a-5=19+2$
$13a-5=21$
$13a-5+5=21+5$
$13a=26$
$\frac{13a}{13}=\frac{26}{13}$
$a=2$
Check: $19a-6a-5=19+2$
$19(2)-6(2)-5 \stackrel{?}{=} 19+2$
$38-12-5 \stackrel{?}{=} 21$
$26-5 \stackrel{?}{=} 21$
$21=21$ True
The solution set is $\{2\}$.

40. $3(x+2)=-3$
$3x+6=-3$
$3x+6-6=-3-6$
$3x=-9$
$\frac{3x}{3}=\frac{-9}{3}$
$x=-3$
Check: $3(x+2)=-3$
$3(-3+2) \stackrel{?}{=} -3$
$3(-1) \stackrel{?}{=} -3$
$-3=-3$ True
The solution set is $\{-3\}$.

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42.
$$\begin{aligned} 7(x-2) &= -35 \\ 7x-14 &= -35 \\ 7x-14+14 &= -35+14 \\ 7x &= -21 \\ \frac{7x}{7} &= \frac{-21}{7} \\ x &= -3 \end{aligned}$$
Check: $7(x-2) = -35$
$7(-3-2) \stackrel{?}{=} -35$
$7(-5) \stackrel{?}{=} -35$
$-35 = -35$ True
The solution set is $\{-3\}$.

44.
$$\begin{aligned} -4(n+11) &= -60 \\ -4n-44 &= -60 \\ -4n-44+44 &= -60+44 \\ -4n &= -16 \\ \frac{-4n}{-4} &= \frac{-16}{-4} \\ n &= 4 \end{aligned}$$
Check: $-4(n+11) = -60$
$-4(4+11) \stackrel{?}{=} -60$
$-4(15) \stackrel{?}{=} -60$
$-60 = -60$ True
The solution set is $\{4\}$.

46.
$$\begin{aligned} -(y+6)+4 &= -4 \\ -y-6+4 &= -4 \\ -y-2 &= -4 \\ -y-2+2 &= -4+2 \\ -y &= -2 \\ \frac{-1y}{-1} &= \frac{-2}{-1} \\ y &= 2 \end{aligned}$$
Check: $-(y+6)+4 = -4$
$-(2+6)+4 \stackrel{?}{=} -4$
$-8+4 \stackrel{?}{=} -4$
$-4 = -4$ True
The solution set is $\{2\}$.

48.
$$\begin{aligned} 2(x-4)-x &= -8 \\ 2x-8-x &= -8 \\ x-8 &= -8 \\ x-8+8 &= -8+8 \\ x &= 0 \end{aligned}$$
Check: $2(x-4)-x = -8$
$2(0-4)-0 \stackrel{?}{=} -8$
$2(-4)-0 \stackrel{?}{=} -8$
$-8 = -8$ True
The solution set is $\{0\}$.

50.
$$\begin{aligned} 12y+22 &= 11y-3 \\ 12y-11y+22 &= 11y-11y-3 \\ y+22 &= -3 \\ y+22-22 &= -3-22 \\ y &= -25 \end{aligned}$$
Check: $12y+22 = 11y-3$
$12(-25)+22 \stackrel{?}{=} 11(-25)-3$
$-300+22 \stackrel{?}{=} -275-3$
$-278 = -278$ True
The solution set is $\{-25\}$.

52.
$$\begin{aligned} 8z+5 &= 3z-15 \\ 8z-3z+5 &= 3z-3z-15 \\ 5z+5 &= -15 \\ 5z+5-5 &= -15-5 \\ 5z &= -20 \\ \frac{5z}{5} &= \frac{-20}{5} \\ z &= -4 \end{aligned}$$
Check: $8z+5 = 3z-15$
$8(-4)+5 \stackrel{?}{=} 3(-4)-15$
$-32+5 \stackrel{?}{=} -12-15$
$-27 = -27$ True
The solution set is $\{-4\}$.

54.
$$\begin{aligned} 6a-3 &= 2a+25 \\ 6a-2a-3 &= 2a-2a+25 \\ 4a-3 &= 25 \\ 4a-3+3 &= 25+3 \\ 4a &= 28 \\ \frac{4a}{4} &= \frac{28}{4} \\ a &= 7 \end{aligned}$$
Check: $6a-3 = 2a+25$
$6(7)-3 \stackrel{?}{=} 2(7)+25$
$42-3 \stackrel{?}{=} 14+25$
$39 = 39$ True
The solution set is $\{7\}$.

56.
$$\begin{aligned} -2y-10 &= -3y+4+8y \\ -2y-10 &= 5y+4 \\ -2y+2y-10 &= 5y+2y+4 \\ -10 &= 7y+4 \\ -10-4 &= 7y+4-4 \\ -14 &= 7y \\ \frac{-14}{7} &= \frac{7y}{7} \\ -2 &= y \end{aligned}$$

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Check: $-2y-10=-3y+4+8y$
$-2(-2)-10 \stackrel{?}{=} -3(-2)+4+8(-2)$
$4-10 \stackrel{?}{=} 6+4+(-16)$
$-6 \stackrel{?}{=} 10+(-16)$
$-6=-6$ True
The solution set is $\{-2\}$.

58. $-(6-3c)=5c+6$
$-6+3c=5c+6$
$-6+3c-3c=5c-3c+6$
$-6=2c+6$
$-6-6=2c+6-6$
$-12=2c$
$\frac{-12}{2}=\frac{2c}{2}$
$-6=c$
Check: $-(6-3c)=5c+6$
$-[6-3(-6)] \stackrel{?}{=} 5(-6)+6$
$-(6+18) \stackrel{?}{=} -30+6$
$-24=-24$ True
The solution set is $\{-6\}$.

60. $6(v+3)+2v=7v+4$
$6v+18+2v=7v+4$
$8v+18=7v+4$
$8v-7v+18=7v-7v+4$
$v+18=4$
$v+18-18=4-18$
$v=-14$
Check: $6(v+3)+2v=7v+4$
$6(-14+3)+2(-14) \stackrel{?}{=} 7(-14)+4$
$6(-11)+(-28) \stackrel{?}{=} -98+4$
$-66+(-28) \stackrel{?}{=} -94$
$-94=-94$ True
The solution set is $\{-14\}$.

62. $5x=7-2(2x-1)$
$5x=7-4x+2$
$5x=9-4x$
$5x+4x=9-4x+4x$
$9x=9$
$\frac{9x}{9}=\frac{9}{9}$
$x=1$
Check: $5x=7-2(2x-1)$
$5(1) \stackrel{?}{=} 7-2(2\cdot 1-1)$
$5 \stackrel{?}{=} 7-2(2-1)$
$5 \stackrel{?}{=} 7-2(1)$
$5 \stackrel{?}{=} 7-2$
$5=5$ True
The solution set is $\{1\}$.

64. $-5x+14=-11$
$-5x+14-14=-11-14$
$-5x=-25$
$\frac{-5x}{-5}=\frac{-25}{-5}$
$x=5$
Check: $-5x+14=-11$
$-5(5)+14 \stackrel{?}{=} -11$
$-25+14 \stackrel{?}{=} -11$
$-11=-11$ True
The solution set is $\{5\}$.

66. $7x+12=3x-4$
$7x-3x+12=3x-3x-4$
$4x+12=-4$
$4x+12-12=-4-12$
$4x=-16$
$\frac{4x}{4}=\frac{-16}{4}$
$x=-4$
Check: $7x+12=3x-4$
$7(-4)+12 \stackrel{?}{=} 3(-4)-4$
$-28+12 \stackrel{?}{=} -12-4$
$-16=-16$ True
The solution set is $\{-4\}$.

68. $3(x+1)=7x-5$
$3x+3=7x-5$
$3x-3x+3=7x-3x-5$
$3=4x-5$
$3+5=4x-5+5$
$8=4x$
$\frac{8}{4}=\frac{4x}{4}$
$2=x$
Check: $3(x+1)=7x-5$
$3(2+1) \stackrel{?}{=} 7(2)-5$
$3(3) \stackrel{?}{=} 14-5$
$9=9$ True
The solution set is $\{2\}$.

70. $35+5c=6c+10$
$35+5c-5c=6c-5c+10$
$35=c+10$
$35-10=c+10-10$
$25=c$
Check: $35+5c=6c+10$
$35+5(25) \stackrel{?}{=} 6(25)+10$
$35+125 \stackrel{?}{=} 150+10$
$160=160$ True
The solution set is $\{25\}$.

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72. $10+5(x-2)=4x+1$
$10+5x-10=4x+1$
$5x=4x+1$
$5x-4x=4x-4x+1$
$x=1$
Check: $10+5(x-2)=4x+1$
$10+5(1-2) \stackrel{?}{=} 4(1)+1$
$10+5(-1) \stackrel{?}{=} 4+1$
$10-5 \stackrel{?}{=} 5$
$5=5$ True
The solution set is $\{1\}$.

74. $4(2a+5)=7a+15$
$8a+20=7a+15$
$8a-7a+20=7a-7a+15$
$a+20=15$
$a+20-20=15-20$
$a=-5$
Check: $4(2a+5)=7a+15$
$4[2(-5)+5] \stackrel{?}{=} 7(-5)+15$
$4(-10+5) \stackrel{?}{=} -35+15$
$4(-5) \stackrel{?}{=} -20$
$-20=-20$ True
The solution set is $\{-5\}$.

76. $95x-14=-10+30x-4$
$95x-14=-14+30x$
$95x-30x-14=-14+30x-30x$
$65x-14=-14$
$65x-14+14=-14+14$
$65x=0$
$\frac{65x}{65}=\frac{0}{65}$
$x=0$
Check: $95x-14=-10+30x-4$
$95(0)-14 \stackrel{?}{=} -10+30(0)-4$
$0-14 \stackrel{?}{=} -10+0-4$
$-14=-14$ True
The solution set is $\{0\}$.

78. $2w+2(2w+1)=32$
$2w+4w+2=32$
$6w+2=32$
$6w+2-2=32-2$
$6w=30$
$\frac{6w}{6}=\frac{30}{6}$
$w=5$
$2w+1=2(5)+1=10+1=11$
The garden has a width of 5 feet and a length of 11 feet.

80. $x+2(x+6)=33$
$x+2x+12=33$
$3x+12=33$
$3x+12-12=33-12$
$3x=21$
$\frac{3x}{3}=\frac{21}{3}$
$x=7$
$x+6=7+6=13$
The two equal sides are 13 inches and the third side is 7 inches.

82. $40x+10(2x)=1080$
$40x+20x=1080$
$60x=1080$
$\frac{60x}{60}=\frac{1080}{60}$
$x=18$
Juan's regular pay rate is \$18 per hour.

84. $3[10-4(x-3)]+2(3x+6)-4=6x+2$
$3(10-4x+12)+6x+12-4=6x+2$
$3(22-4x)+6x+8=6x+2$
$66-12x+6x+8=6x+2$
$74-6x=6x+2$
$74-6x+6x=6x+6x+2$
$74=12x+2$
$74-2=12x+2-2$
$72=12x$
$\frac{72}{12}=\frac{12x}{12}$
$6=x$
Check:
$3[10-4(x-3)]+2(3x+6)-4=6x+2$
$3[10-4(6-3)]+2(3\cdot 6+6)-4 \stackrel{?}{=} 6\cdot 6+2$
$3[10-4(3)]+2(18+6)-4 \stackrel{?}{=} 36+2$
$3(10-12)+2(24)-4 \stackrel{?}{=} 38$
$3(-2)+48-4 \stackrel{?}{=} 38$
$-6+44 \stackrel{?}{=} 38$
$38=38$ True
The solution set is $\{6\}$.

86. To evaluate an expression means to substitute a numerical value for the variable into the expression and simplify the result. To simplify an algebraic expression, remove any parentheses and combine like terms. To solve an equation, find the value of the variable that satisfies the equation.

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Section 2.8

Are You Prepared for This Section?

P1. $x + 25 = 87$
$x + 25 - 25 = 87 - 25$
$x = 62$
The solution set is $\{62\}$.

P2. $y + (y + 7) = 39$
$y + y + 7 = 39$
$2y + 7 = 39$
$2y + 7 - 7 = 39 - 7$
$2y = 32$
$\frac{2y}{2} = \frac{32}{2}$
$y = 16$
The solution set is $\{16\}$.

2.8 Quick Checks

1. "The product of 11 and 5" is represented mathematically as $11(5)$.

2. "The difference of -3 and 6" is represented mathematically as $-3 - 6$.

3. "The quotient of 18 and -9" is represented mathematically as $\frac{18}{-9}$.

4. "The sum of -8 and 4" is represented mathematically as $-8 + 4$.

5. "A number increased by 3" is $x + 3$.

6. "A number minus 5" is $x - 5$.

7. "A number subtracted from 4" is $4 - x$.

8. "Twelve less than a number" is $x - 12$.

9. "The product of -7 and 8" is $-7(8)$.

10. "A number divided by 3" is $\frac{x}{3}$.

11. "The ratio of 33 and 11" is $\frac{33}{11}$.

12. "Triple a number" is $3x$.

13. The word *less* means subtraction and the word *times* means multiply, so "3 less than 4 times 12" is $4(12) - 3$.

14. The word *sum* means addition and the expression *twice* means "two times," so "the sum of twice 3 and 11" is $2(3) + 11$.

15. The expression *twice* means "two times" and the word *sum* means addition, so "twice the sum of 3 and 11" is $2(3 + 11)$.

16. The expression *twice* means "two times" and the word *difference* means subtraction, so "twice the difference of 10 and 1" is $2(10 - 1)$.

17. The word *difference* means subtraction, so "the difference of a number k and 11" is $k - 11$.

18. The words *more than* means addition and the word *times* means multiplication, so "3 more than 4 times a number z" is $4z + 3$.

19. The word *decreased* means subtraction, so "15 decreased by a number n" is $15 - n$.

20. The expression *twice* means "two times" and the word *quotient* means division, so "twice the quotient of a and 5" is $2\left(\frac{a}{5}\right)$.

21. In mathematics, English statements can be represented symbolically as equations.

22. $\underbrace{\text{the product of 9 and } x}_{9x}$ $\underbrace{\text{is equal to}}_{=}$ $\underbrace{45}_{45}$

23. $\underbrace{\text{the sum of 7 and } x}_{7+x}$ $\underbrace{\text{is}}_{=}$ $\underbrace{23}_{23}$

24. $\underbrace{\text{the difference of } x \text{ and } 12}_{x-12}$ $\underbrace{\text{is}}_{=}$ $\underbrace{41}_{41}$

25. $\underbrace{\text{three less than a number } y}_{y-3}$ $\underbrace{\text{is}}_{=}$ $\underbrace{\text{five}}_{5}$

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26. $\underbrace{\text{seven times the sum of a number } t \text{ and } 1}_{7(t+1)}$ $\underbrace{\text{is equal to}}_{=}$ $\underbrace{16}_{16}$

27. **Step 1: IDENTIFY** Find an unknown number.
Step 2: NAME Let x represent the number.
Step 3: TRANSLATE $\underbrace{\text{the sum of a number and } 13}_{x+13}$ $\underbrace{\text{is}}_{=}$ $\underbrace{71}_{71}$
Step 4: SOLVE Solve the equation.

$$x+13=71$$
$$x+13-13=71-13$$
$$x=58$$

Step 5: CHECK Is the sum of 58 and 13 equal to 71?
Yes; 58 + 13 = 71
The answer is correct.
Step 6: ANSWER The number is 58.

28. **Step 1: IDENTIFY** Find an unknown number.
Step 2: NAME Let x represent the number.
Step 3: TRANSLATE $\underbrace{\text{twice a number less } 3}_{2x-3}$ $\underbrace{\text{is}}_{=}$ $\underbrace{19}_{19}$
Step 4: SOLVE Solve the equation.

$$2x-3=19$$
$$2x-3+3=19+3$$
$$2x=22$$
$$\frac{2x}{2}=\frac{22}{2}$$
$$x=11$$

Step 5: CHECK
Is twice 11 less 3 equal to 19? Yes. The answer is correct.
Step 6: ANSWER The number is 11.

29. **Step 1: IDENTIFY** Find an unknown number.
Step 2: NAME Let x represent the number.
Step 3: TRANSLATE $\underbrace{\text{A number plus } 6}_{x+6}$ $\underbrace{\text{is the same as}}_{=}$ $\underbrace{\text{twice the number less } 7}_{2x-7}$
Step 4: SOLVE Solve the equation.

$$x+6=2x-7$$
$$x-x+6=2x-x-7$$
$$6=x-7$$
$$6+7=x-7+7$$
$$13=x$$

Step 5: CHECK Is 13 plus 6 the same as twice 13 less 7?
Yes; 13 + 6 = 2(13) − 7
The answer is correct.
Step 6: ANSWER The number is 13.

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30. **Step 1: IDENTIFY** Find the price of the refrigerator before the extra charges.
Step 2: NAME Let x represent the price before the extra charges.
Step 3: TRANSLATE

$$\underbrace{\text{original price}}_{x} \ \underbrace{\text{plus}}_{+} \ \underbrace{\text{extra charges}}_{62} \ \underbrace{\text{is}}_{=} \ \underbrace{\text{total price}}_{897}$$

Step 4: SOLVE Solve the equation.

$$\begin{aligned} x+62 &= 897 \\ x+62-62 &= 897-62 \\ x &= 835 \end{aligned}$$

Step 5: CHECK Is 835 plus 62 equal to 897?
Yes; 835 + 62 = 897
The answer is correct.
Step 6: ANSWER The price of the refrigerator before the extra charges was $835.

31. **Step 1: IDENTIFY** Find the number of shares Leon bought.
Step 2: NAME Let x represent the number of shares Leon bought.
Step 3: TRANSLATE

$$\underbrace{\text{profit}}_{1271} \ \underbrace{\text{equals}}_{=} \ \underbrace{\text{selling price}}_{98x} \ \underbrace{\text{minus}}_{-} \ \underbrace{\text{purchase price}}_{67x}$$

Step 4: SOLVE Solve the equation.

$$\begin{aligned} 1271 &= 98x-67x \\ 1271 &= 31x \\ \frac{1271}{31} &= \frac{31x}{31} \\ 41 &= x \end{aligned}$$

Step 5: CHECK Is the difference between the selling price and purchase price 1271?
Yes; 98(41) – 67(41) = 1271
The answer is correct.
Step 6: ANSWER Leon bought 41 shares of stock.

32. The phrase *more than* implies addition. Your friend has $(d + 2)$ classes.

33. If m represents the distance traveled, then $(220 - m)$ miles represents the remaining distance.

34. The sociology book costs less (implying subtraction), so it cost $(b - 25)$ dollars.

35. Let T = the amount Tami spent. Since Maria spent more (addition), $T + 14$ = amount Maria spent.

36. Let s = amount invested in stocks. Since twice that amount is invested in bonds, $2s$ = amount invested in bonds.

37. Let J = Judy's earnings. Since Dave earned less (subtraction) than Judy, $J - 15{,}000$ = Dave's earnings.

38. **Step 1: IDENTIFY** Find the amount put into the savings account.
Step 2: NAME Let s represent the amount put into the savings account. Then $s - 55$ represents the amount used to pay the credit card bill.
Step 3: TRANSLATE The total amount is $175.

$$\underbrace{\text{savings}}_{s} \ \underbrace{\text{plus}}_{+} \ \underbrace{\text{credit card}}_{s-55} \ \underbrace{\text{equals}}_{=} \ \underbrace{\text{total}}_{175}$$

Step 4: SOLVE Solve the equation.

$$\begin{aligned} s+s-55 &= 175 \\ 2s-55 &= 175 \\ 2s-55+55 &= 175+55 \\ 2s &= 230 \\ s &= 115 \end{aligned}$$

Step 5: CHECK Is 115 plus 115 – 55 equal to 175? Yes; 115 + (115 – 55) = 175
The answer is correct.
Step 6: ANSWER Pamela put $115 into her savings account.

39. **Step 1: IDENTIFY** Find the amount of money received for the tent.
Step 2: NAME Let c = amount received for the other camping equipment. Then $4c$ = amount received for the tent.
Step 3: TRANSLATE The total amount is $135.

$$\underbrace{\text{other equipment}}_{c} \ \underbrace{\text{plus}}_{+} \ \underbrace{\text{tent}}_{4c} \ \underbrace{\text{equals}}_{=} \ \underbrace{\text{total}}_{135}$$

Step 4: SOLVE Solve the equation.

$$\begin{aligned} c+4c &= 135 \\ 5c &= 135 \\ c &= 27 \end{aligned}$$

Then $4c = 4(27) = 108$.
Step 5: CHECK Is 27 plus 108 equal to 135?
Yes; 27 + 108 = 135
The answer is correct.
Step 6: ANSWER You received $108 for the tent.

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40. **Step 1: IDENTIFY** Find the length of each of the three pieces. The total length is 24 feet.
Step 2: NAME Because the lengths are described in terms of the first, let x = length of the first piece, then $2x$ = length of second pieces, and $3x$ = length of the third piece.
Step 3: TRANSLATE $\underbrace{\text{length of 1st piece}}_{x}$ $\underbrace{\text{plus}}_{+}$ $\underbrace{\text{length of 2nd piece}}_{2x}$ $\underbrace{\text{plus}}_{+}$ $\underbrace{\text{length of 3rd piece}}_{3x}$ $\underbrace{\text{is}}_{=}$ $\underbrace{\text{total length}}_{24}$
Step 4: SOLVE Solve the equation.

$$x + 2x + 3x = 24$$
$$6x = 24$$
$$x = 4$$

Then $2x = 2(4) = 8$ and $3x = 3(4) = 12$
Step 5: CHECK Is the sum of the three pieces 24 feet?
Yes; $4 + 8 + 12 = 24$.
The answer is correct.
Step 6: ANSWER The lengths of the pieces are 4 feet, 8 feet, and 12 feet.

2.8 Exercises

42. "10 less than 29" is represented mathematically as $29 - 10$.

44. "29 increased by 18" is represented mathematically as $29 + 18$.

46. "17 less than 6" is represented mathematically as $6 - 17$.

48. "The difference of a number and 6" is $x - 6$.

50. "Triple a number" is $3x$.

52. *Three times* means multiply and the word *difference* means subtraction, so "three times the difference of a number and 6" is $3(x - 6)$.

54. The word *sum* means addition and the expression "three times" means multiplication, so "the sum of three times a number and 8" is $3x + 8$.

56. The word *quotient* means division and the word *twice* means "multiply by 2," so "the quotient of 25 and twice a number" is $\dfrac{25}{2x}$.

58. $\underbrace{\text{the sum of } x \text{ and } 84}_{x+(-84)}$ $\underbrace{\text{is}}_{=}$ $\underbrace{-46}_{-46}$

60. $\underbrace{34}_{34}$ $\underbrace{\text{is}}_{=}$ $\underbrace{2 \text{ less than triple a number}}_{3x-2}$

62. $\underbrace{\text{the quotient of 16 and three times a number}}_{\frac{16}{3x}}$ $\underbrace{\text{is}}_{=}$ $\underbrace{4}_{4}$

64. $\underbrace{\text{a number decreased by 9}}_{x-9}$ $\underbrace{\text{is}}_{=}$ $\underbrace{17}_{17}$

66. $\underbrace{\text{the sum of triple a number and 6}}_{3x+6}$ $\underbrace{\text{is}}_{=}$ $\underbrace{15}_{15}$

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68. $\underbrace{\text{double the sum of a number and 11}}_{2(x+11)}$ $\underbrace{\text{equals}}_{=}$ $\underbrace{15}_{15}$

70. $\underbrace{\text{the quotient of four times a number and 12}}_{\frac{4x}{12}}$ $\underbrace{\text{is}}_{=}$ $\underbrace{6}_{6}$

72. Let m = the number of points Michelle scored. Since Austin scored 4 points lower, then $m - 4$ = the number of points Austin scored.

74. Let y = the number of runs the New York Yankees scored. Since the Chicago White Sox scored 9 more runs than the New York Yankees, then $y + 9$ = the number of runs the Chicago White Sox scored.

76. Let s = the number of quarters Sally has. Since Janet has 8 fewer than Sally, then $s - 7$ = the number of quarters Janet has.

78. Let J = amount of Juan's winnings. Since the amounts total \$1,000,000, then $1{,}000{,}000 - J$ = amount of Emily's winnings.

80. Let t = number of prepaid admission tickets. Since there were a total of 784 visitors, then $784 - t$ = number that paid admission at the door.

82. **Step 1: IDENTIFY** Find an unknown number.
Step 2: NAME Let x represent the number.
Step 3: TRANSLATE

$$\underbrace{\text{the sum of a number and 10}}_{x+10} \ \underbrace{\text{is}}_{=} \ \underbrace{-31}_{-31}$$

Step 4: SOLVE Solve the equation.

$$x + 10 = -31$$
$$x + 10 - 10 = -31 - 10$$
$$x = -41$$

Step 5: CHECK Is the sum of −41 and 10 equal to −31? Yes; −41 + 10 = −31.
The answer is correct.
Step 6: ANSWER The number is −41.

84. **Step 1: IDENTIFY** Find an unknown number.
Step 2: NAME Let x represent the number.
Step 3: TRANSLATE

$$\underbrace{\text{19 less than a number}}_{x-19} \ \underbrace{\text{is}}_{=} \ \underbrace{7}_{7}$$

Step 4: SOLVE Solve the equation.

$$x - 19 = 7$$
$$x - 19 + 19 = 7 + 19$$
$$x = 26$$

Step 5: CHECK Is 19 less than 26 equal to 7? Yes; 26 − 19 = 7.
The answer is correct.
Step 6: ANSWER The number is 26.

86. **Step 1: IDENTIFY** Find the price of the snow blower before taxes.
Step 2: NAME Let x represent the price of the snow blower before taxes.
Step 3: TRANSLATE

$$\underbrace{\text{original price plus taxes}}_{x+75} \ \underbrace{\text{is}}_{=} \ \underbrace{\text{total price}}_{1324}$$

Step 4: SOLVE Solve the equation.

$$x + 75 = 1324$$
$$x + 75 - 75 = 1324 - 75$$
$$x = 1249$$

Step 5: CHECK Is 1249 plus 75 equal to 1324? Yes; 1249 + 75 = 1324.
The answer is correct.
Step 6: ANSWER The price of the snow blower before taxes is \$1249.

88. **Step 1: IDENTIFY** Find the number of shares that Ahmed bought.
Step 2: NAME Let x represent the number of shares that Ahmed bought.
Step 3: TRANLATE

$$\underbrace{\text{profit}}_{64} \ \underbrace{\text{equals}}_{=} \ \underbrace{\text{selling price}}_{29x} \ \underbrace{\text{minus}}_{-} \ \underbrace{\text{purchase price}}_{21x}$$

Step 4: SOLVE Solve the equation.

$$64 = 29x - 21x$$
$$64 = 8x$$
$$\frac{64}{8} = \frac{8x}{8}$$
$$8 = x$$

Step 5: CHECK Is the difference between the selling price and the purchase price 64? Yes; 29(8) − 21(8) = 64.
The answer is correct.
Step 6: ANSWER Ahmed bought 8 shares.

90. **Step 1: IDENTIFY** Find the amount received by Mary and Paul.
Step 2: NAME Let x = the amount received by Paul. Then $x - 3000$ = the amount received by Mary. The total amount is 10,000.
Step 3: TRANSLATE

$$\underbrace{\text{Paul's amount}}_{x} \ \underbrace{\text{plus}}_{+} \ \underbrace{\text{Mary's amount}}_{x-3000} \ \underbrace{\text{equals}}_{=} \ \underbrace{\text{total}}_{10{,}000}$$

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Step 4: SOLVE Solve the equation.

$$\begin{aligned} x + x - 3000 &= 10,000 \\ 2x - 3000 &= 10,000 \\ 2x - 3000 + 3000 &= 10,000 + 3000 \\ 2x &= 13,000 \\ x &= 6500 \end{aligned}$$

Then $x - 3000 = 6500 - 3000 = 3500$.
Step 5: CHECK Is Paul's amount plus Mary's amount equal to 10,000? Yes;
$6500 + 3500 = 10,000$.
The answer is correct.
Step 6: ANSWER Mary received \$3500 and Paul received \$6500.

92. **Step 1: IDENTIFY** Find the amount each will take from the winnings.
Step 2: NAME Let g = amount Ginny will take. Then $3g$ = amount Hermione will take. The total is 10,000.
Step 3: TRANSLATE $\underbrace{\text{Ginny's amount}}_{g}$ $\underbrace{\text{plus}}_{+}$ $\underbrace{\text{Hermione's amount}}_{3g}$ $\underbrace{\text{equals}}_{=}$ $\underbrace{\text{total}}_{10,000}$

Step 4: SOLVE Solve the equation.

$$\begin{aligned} g + 3g &= 10,000 \\ 4g &= 10,000 \\ g &= 2500 \end{aligned}$$

Then $3g = 3(2500) = 7500$.
Step 5: CHECK Is Ginny's amount plus Hermione's amount equal to 10,000?
Yes; $2500 + 7500 = 10,000$.
The answer is correct.
Step 6: ANSWER Hermione took \$7500 and Ginny took \$2500.

94. **Step 1: IDENTIFY** Find the number of cell phones for each country.
Step 2: NAME Let x = number of cell phones in India. Then $x + 610,260,000$ = number of cell phones in China.
The total is 2,709,740,000.
Step 3: TRANSLATE $\underbrace{\text{India's cell phones}}_{x}$ $\underbrace{\text{plus}}_{+}$ $\underbrace{\text{China's cell phones}}_{x+610,260,000}$ $\underbrace{\text{equals}}_{=}$ $\underbrace{\text{total}}_{2,709,740,000}$

Step 4: SOLVE Solve the equation.

$$\begin{aligned} x + x + 610,260,000 &= 2,709,740,000 \\ 2x + 610,260,000 &= 2,709,740,000 \\ 2x &= 2,099,480,000 \\ x &= 1,049,740,000 \end{aligned}$$

Then $x + 610,260,000 = 1,049,740,000 + 610,260,000 = 1,660,000,000$.
Step 5: CHECK Is the sum of the numbers of cell phones equal to 2,709,740,000?
Yes; $1,049,740,000 + 1,660,000,000 = 2,709,740,000$.
The answer is correct.
Step 6: ANSWER India has 1,049,740,000 cell phones and China has 1,660,000,000 cell phones.

96. **Step 1: IDENTIFY** Find the capacity of each arena.
Step 2: NAME Let r = capacity of Rupp Arena. Then
$r + 9500$ = capacity of the Carrier Dome. The total is 56,500.
Step 3: TRANSLATE $\underbrace{\text{Rupp Arena capacity}}_{r}$ $\underbrace{\text{plus}}_{+}$ $\underbrace{\text{Carrier Dome capacity}}_{r+9500}$ $\underbrace{\text{equals}}_{=}$ $\underbrace{\text{total}}_{56,500}$

Step 4: SOLVE Solve the equation.

$$\begin{aligned} r + r + 9500 &= 56,500 \\ 2r + 9500 &= 56,500 \\ 2r &= 47,000 \\ r &= 23,500 \end{aligned}$$

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Then $r + 9500 = 23{,}500 + 9500 = 33{,}000$.
Step 5: CHECK Is the sum of the two capacities equal to 56,500? Yes; $23{,}500 + 33{,}000 = 56{,}500$.
The answer is correct.
Step 6: ANSWER The Carrier Dome has capacity 33,000 and Rupp Arena capacity is 23,500.

98. **Step 1: IDENTIFY** Find Elizabeth's adjusted gross income.
Step 2: NAME Let d = Dan's adjusted gross income. Then $d + 2621$ = Elizabeth's adjusted gross income. Their combined income is 56,547.
Step 3: TRANSLATE $\underbrace{\text{Dan's income}}_{d}\ \underbrace{\text{plus}}_{+}\ \underbrace{\text{Elizabeth's income}}_{d+2621}\ \underbrace{\text{equals}}_{=}\ \underbrace{\text{combined income}}_{56{,}547}$
Step 4: SOLVE Solve the equation.

$$\begin{aligned} d + d + 2621 &= 56{,}547 \\ 2d + 2621 &= 56{,}547 \\ 2d &= 53{,}926 \\ d &= 26{,}963 \end{aligned}$$

Then $d + 2621 = 26{,}963 + 2621 = 29{,}584$.
Step 5: CHECK Is their combined income equal to 56,547? Yes; $26{,}963 + 29{,}584 = 56{,}547$.
The answer is correct.
Step 6: ANSWER Elizabeth's adjusted gross income is $29,584.

100. **Step 1: IDENTITY** Find the number of hours each man worked.
Step 2: NAME Let B = number of hours Bill worked. Then $2B + 3$ = number of hours Jon worked. Together they worked 48 hours.
Step 3: TRANSLATE $\underbrace{\text{Bill's hours}}_{B}\ \underbrace{\text{plus}}_{+}\ \underbrace{\text{Jon's hours}}_{2B+3}\ \underbrace{\text{equals}}_{=}\ \underbrace{\text{total}}_{48}$
Step 4: SOLVE Solve the equation.

$$\begin{aligned} B + 2B + 3 &= 48 \\ 3B + 3 &= 48 \\ 3B &= 45 \\ B &= 15 \end{aligned}$$

Then $2B + 3 = 2(15) + 3 = 33$.
Step 5: CHECK Is the sum of the hours equal to 48? Yes; $15 + 33 = 48$.
The answer is correct.
Step 6: ANSWER Bill worked 15 hours and Jon worked 33 hours.

102. **Step 1: IDENTIFY** Find the length of each piece of ribbon.
Step 2: NAME Let x = length of shortest piece. Then $3x$ = length of longest piece and $2x + 6$ = length of third piece. The total length is 96.
Step 3: TRANSLATE $\underbrace{\text{short piece}}_{x}\ \underbrace{\text{plus}}_{+}\ \underbrace{\text{third piece}}_{2x+6}\ \underbrace{\text{plus}}_{+}\ \underbrace{\text{long piece}}_{3x}\ \underbrace{\text{equals}}_{=}\ \underbrace{\text{total}}_{96}$
Step 4: SOLVE

$$\begin{aligned} x + 2x + 6 + 3x &= 96 \\ 6x + 6 &= 96 \\ 6x &= 90 \\ x &= 15 \end{aligned}$$

Then $2x + 6 = 2(15) + 6 = 36$ and
$3x = 3(15) = 45$.
Step 5: CHECK Is the sum of the lengths 96?
Yes; $15 + 36 + 45 = 96$.
The answer is correct.
Step 6: ANSWER The lengths of the pieces are 15 inches, 36 inches, and 45 inches.

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104. Answers may vary. One possible answer is: Ten more than twice a number n is 140.

106. Answers may vary. One possible answer is: One month a person sent 120 more text messages than the previous month. The total number of text messages for both months is 1956.

108. **Step 1: IDENTIFY** Find the number of shares J. K. Rowling bought.
Step 2: NAME Let x = number of shares she bought.
Step 3: TRANSLATE

$$\underbrace{\text{loss}}_{-96}\ \underbrace{\text{equals}}_{=}\ \underbrace{\text{selling price}}_{76x}\ \underbrace{\text{minus}}_{-}\ \underbrace{\text{purchase price}}_{84x}$$

Step 4: SOLVE Solve the equation.

$$\begin{aligned} -96 &= 76x - 84x \\ -96 &= -8x \\ 12 &= x \end{aligned}$$

Step 5: CHECK Is the difference between the selling price and the purchase price a loss of 96? Yes; 76(12) − 84(12) = −96.
The answer is correct.
Step 6: ANSWER J. K. Rowling bought 12 shares.

110. $D = 45$, $S = 102$

$$\begin{aligned} S &= P - D \\ 102 &= P - 45 \\ 102 + 45 &= P - 45 + 45 \\ 147 &= P \end{aligned}$$

The original price of the coat was $147.

112. $D = 15{,}500$, $S = 129{,}750$

$$\begin{aligned} S &= P - D \\ 129{,}750 &= P - 15{,}500 \\ 129{,}750 + 15{,}500 &= P - 15{,}500 + 15{,}500 \\ 145{,}250 &= P \end{aligned}$$

The value of the house 1 year ago was $145,250.

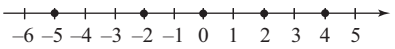
114. Answers may vary. For example, evaluate $2x + 3$ for $x = 7$. Solve the equation $2x + 3 = 15$.

Chapter 2 Review

1. $\frac{0}{4} = 0$, $\frac{10}{5} = 2$, -56, and 1 are integers because they are a positive or a negative whole number, or 0.

2. 15 feet below sea level is represented by the integer −15.

3. A deposit of $100 is represented by the integer 100.

4. 

5. 6 is to the right of −3 on a number line, so $6 > -3$.

6. −4 is to the right of −8 on a number line, so $-4 > -8$.

7. −1 is to the left of 0 on a number line, so $-1 < 0$.

8. −23 is to the left of 32 on a number line, so $-23 < 32$.

9. 0 is to the left of 5 on a number line, so $0 < 5$.

10. 0 is to the right of −4 on a number line, so $0 > -4$.

11. $|0| = 0$ because the distance from 0 to 0 on a number line is 0.

12. $|52| = 52$ because the distance from 0 to 52 on a number line is 52.

13. $|-17| = 17$ because the distance from 0 to −17 on a number line is 17.

14. $|-100| = 100$ because the distance from 0 to −100 on a number line is 100.

15. $|8| = 8$; $|-7| = 7$; $8 - 7 = 1$
The larger absolute value is 8, which was a positive number in the original problem, so the sum is positive.
$8 + (-7) = 1$

16. $|-10| = 10$; $|4| = 4$; $10 - 4 = 6$
The larger absolute value is 10, which was a negative number in the original problem, so the sum is negative.
$-10 + 4 = -6$

17. $|-21| = 21$; $|21| = 21$; $21 - 21 = 0$; $-21 + 21 = 0$

18. $|-15| = 15$; $|-10| = 10$; $15 + 10 = 25$
Both integers are negative, so the sign of the sum is negative.
$-15 + (-10) = -25$

19. $|52| = 52$; $|390| = 390$; $52 + 390 = 442$
Both integers are positive, so the sign of the sum is positive.
$52 + 390 = 442$

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20. $|-86| = 86$; $|-15| = 15$; $86 + 15 = 101$
Both integers are negative, so the sign of the sum is negative.
$-86 + (-15) = -101$

21. $|47| = 47$; $|-10| = 10$; $47 - 10 = 37$
The larger absolute value is 47, which was a positive number in the original problem, so the sum is positive.
$47 + (-10) = 37$

22. $|-35| = 35$; $|25| = 25$; $35 - 25 = 10$
The larger absolute value is 35, which was a negative number in the original problem, so the sum is negative.
$-35 + 25 = -10$

23. $|146| = 146$; $|-146| = 146$; $146 - 146 = 0$;
$146 + (-146) = 0$

24. The opposite of 7 is -7 because $7 + (-7) = 0$.

25. The opposite of -10 is 10 because $-10 + 10 = 0$.

26. The opposite of -183 is 183 because $-183 + 183 = 0$.

27. The opposite of 402 is -402 because $402 + (-402) = 0$.

28. $-(-13) = 13$, because the opposite of -13 is 13.

29. $-|-18| = -18$, because the absolute value of -18 is 18, and the opposite of 18 is -18.

30. $-|-|-29|| = -|-29| = -29$

31. $-(-4) = 4$

32. $-6 - 4 = -6 + (-4) = -10$

33. $12 - 8 = 12 + (-8) = 4$

34. $20 - (-10) = 20 + 10 = 30$

35. $-15 - (-4) = -15 + 4 = -11$

36. $-17 - 13 = -17 + (-13) = -30$

37. $0 - (-16) = 0 + 16 = 16$

38. $-31 - (-25) = -31 + 25 = -6$

39. $402 - 39 = 402 + (-39) = 363$

40. $-74 - 74 = -74 + (-74) = -148$

41. $7 - 3 + 12 = 7 + (-3) + 12 = 4 + 12 = 16$

42.
$$\begin{aligned} -14-(-3)+(-9) &= -14+3+(-9) \\ &= -11+(-9) \\ &= -20 \end{aligned}$$

43.
$$\begin{aligned} -73+36+73-42 &= -73+36+73+(-42) \\ &= -37+73+(-42) \\ &= 36+(-42) \\ &= -6 \end{aligned}$$

44.
$$\begin{aligned} 5-20-(-35)+(-15) &= 5+(-20)+35+(-15) \\ &= -15+35+(-15) \\ &= 20+(-15) \\ &= 5 \end{aligned}$$

45. $37 - (-24) = 37 + 24 = 61$

46. $-57 - 32 = -57 + (-32) = -89$

47.
$$\begin{aligned} 17+7+15+(-12) &= 24+15+(-12) \\ &= 39+(-12) \\ &= 27 \end{aligned}$$
The ball is now on the 27-yard line.

48. $(-9)6 = -54$

49. $(14)(-2) = -28$

50. $0(-35) = 0$

51. $(-8)(-7) = 56$

52. $53(-4) = -212$

53. $-2(-5)(3)(-6) = 10(3)(-6) = 30(-6) = -180$

54. $\dfrac{-64}{-8} = 8$

55. $\dfrac{144}{-12} = -12$

56. $\dfrac{-36}{9} = -4$

57. $-\dfrac{0}{18} = 0$

58. $\dfrac{-806}{-31} = 26$

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59. $\frac{-13}{0}$ is undefined.

60. $-5^4 = -(5)(5)(5)(5) = -625$

61. $(-5)^4 = (-5)(-5)(-5)(-5) = 625$

62. $(-2)^3 = (-2)(-2)(-2) = -8$

63. $-2^3 = -(2)(2)(2) = -8$

64.
$$\begin{aligned}(-4-3\div 3\cdot 2)^2 &= (-4-1\cdot 2)^2\\ &= (-4-2)^2\\ &= (-6)^2\\ &= 36\end{aligned}$$

65.
$$\begin{aligned}\frac{(-18)(-2)-4(5-7)}{-20-8(-3)} &= \frac{(-18)(-2)-4(-2)}{-20-8(-3)}\\ &= \frac{36-(-8)}{-20-(-24)}\\ &= \frac{36+8}{-20+24}\\ &= \frac{44}{4}\\ &= 11\end{aligned}$$

66. The number of cars in the parking lot is variable because the number of cars can change throughout the day.

67. The number of inches in a mile is constant. There are 63,360 inches in a mile.

68. Substitute -2 for x.
$8 - 3x = 8 - 3(-2) = 8 + 6 = 14$

69. Substitute -1 for z.
$-4 + z^2 = -4 + (-1)^2 = -4 + 1 = -3$

70. Substitute -3 for x and 5 for y.
$$\begin{aligned}(2x+y)^{10} &= [2(-3)+5]^{10}\\ &= (-6+5)^{10}\\ &= (-1)^{10}\\ &= 1\end{aligned}$$

71. Substitute 0 for x and -1 for y.
$$\frac{4x-5y}{2x-y^2} = \frac{4(0)-5(-1)}{2(0)-(-1)^2} = \frac{0+5}{0-1} = \frac{5}{-1} = -5$$

72. Rewrite the expression as $4x^2 + (-x) + 5$.
The three terms are $4x^2$, $-x$, and 5.
The coefficients are 4, -1, and 5.

73. The terms $5x$ and 5 are unlike terms because $5x$ has a variable and 5 does not.

74. $-8(2x - 1) = -8(2x) + (-8)(-1) = -16x + 8$

75. $8x - 12x = (8 - 12)x = -4x$

76. $14n + n = 14n + 1n = (14 + 1)n = 15n$

77.
$$\begin{aligned}26x+13-10x+2 &= 26x-10x+13+2\\ &= (26-10)x+13+2\\ &= 16x+15\end{aligned}$$

78.
$$\begin{aligned}3z^2+z-5z^2-z &= 3z^2-5z^2+z-z\\ &= (3-5)z^2+(1-1)z\\ &= -2z^2+0z\\ &= -2z^2\end{aligned}$$

79.
$$\begin{aligned}4(n-3)-3(n-5) &= 4n-4\cdot 3-3n+(-3)(-5)\\ &= 4n-12-3n+15\\ &= 4n-3n-12+15\\ &= (4-3)n-12+15\\ &= 1n+3\\ &= n+3\end{aligned}$$

80.
$$\begin{aligned}7-5(x-4)+3x &= 7-5\cdot x+(-5)(-4)+3x\\ &= 7-5x+20+3x\\ &= -5x+3x+7+20\\ &= (-5+3)x+7+20\\ &= -2x+27\end{aligned}$$

81. Replace x with 2.
$$\begin{aligned}7x-8 &= 14x+6\\ 7(2)-8 &\stackrel{?}{=} 14(2)+6\\ 14-8 &\stackrel{?}{=} 28+6\\ 6 &\stackrel{?}{=} 34 \quad \text{False}\end{aligned}$$
No, $x = 2$ is not a solution.

82. Replace z with -3.
$$\begin{aligned}11+3z &= 2(z+4)\\ 11+3(-3) &\stackrel{?}{=} 2(-3+4)\\ 11+(-9) &\stackrel{?}{=} 2(1)\\ 2 &= 2 \quad \text{True}\end{aligned}$$
Yes, $z = -3$ is a solution.

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83. $x-10=-2$

$x-10+10=-2+10$

$x+0=8$

$x=8$

Check: $x-10=-2$

$8-10 \stackrel{?}{=} -2$

$-2=-2$ True

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

84. $x+15=-4$

$x+15-15=-4-15$

$x+0=-19$

$x=-19$

Check: $x+15=-4$

$-19+15 \stackrel{?}{=} -4$

$-4=-4$ True

The solution set is $\{-19\}$.

85. $38=z+24$

$38-24=z+24-24$

$14=z+0$

$14=z$

Check: $38=z+24$

$38 \stackrel{?}{=} 14+24$

$38=38$ True

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

86. $13=-17+r$

$13+17=-17+17+r$

$30=0+r$

$30=r$

Check: $13=-17+r$

$13 \stackrel{?}{=} -17+30$

$13=13$ True

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

87. $-6p=-54$

$\frac{-6p}{-6}=\frac{-54}{-6}$

$\frac{-6}{-6}\cdot p=9$

$1\cdot p=9$

$p=9$

Check: $-6p=-54$

$-6\cdot 9 \stackrel{?}{=} -54$

$-54=-54$ True

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

88. $18x=126$

$\frac{18x}{18}=\frac{126}{18}$

$\frac{18}{18}\cdot x=7$

$1\cdot x=7$

$x=7$

Check: $18x=126$

$18(7) \stackrel{?}{=} 126$

$126=126$ True

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

89. $\frac{a}{2}=-8$

$2\cdot\frac{a}{2}=2\cdot(-8)$

$\frac{2}{2}\cdot a=-16$

$1\cdot a=-16$

$a=-16$

Check: $\frac{a}{2}=-8$

$\frac{-16}{2} \stackrel{?}{=} -8$

$-8=-8$ True

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

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

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

$\frac{-7}{-7}\cdot x=-98$

$1\cdot x=-98$

$x=-98$

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

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

$14=14$ True

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

91. $3x-10=-22$

$3x-10+10=-22+10$

$3x=-12$

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

$x=-4$

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Check: $3x-10=-22$
$3(-4)-10 \stackrel{?}{=} -22$
$-12-10 \stackrel{?}{=} -22$
$-22=-22$ True
The solution set is $\{-4\}$.

92. $-2x+8=-6$
$-2x+8-8=-6-8$
$-2x=-14$
$\frac{-2x}{-2}=\frac{-14}{-2}$
$x=7$
Check: $-2x+8=-6$
$-2(7)+8 \stackrel{?}{=} -6$
$-14+8 \stackrel{?}{=} -6$
$-6=-6$ True
The solution set is $\{7\}$.

93. $29=4x+33$
$29-33=4x+33-33$
$-4=4x$
$\frac{-4}{4}=\frac{4x}{4}$
$-1=x$
Check: $29=4x+33$
$29 \stackrel{?}{=} 4(-1)+33$
$29 \stackrel{?}{=} -4+33$
$29=29$ True
The solution set is $\{-1\}$.

94. $30-5r=40$
$-30+30-5r=-30+40$
$-5r=10$
$\frac{-5r}{-5}=\frac{10}{-5}$
$r=-2$
Check: $30-5r=40$
$30-5(-2) \stackrel{?}{=} 40$
$30+10 \stackrel{?}{=} 40$
$40=40$ True
The solution set is $\{-2\}$.

95. $7x+10-3x=-6$
$4x+10=-6$
$4x+10-10=-6-10$
$4x=-16$
$\frac{4x}{4}=\frac{-16}{4}$
$x=-4$
Check: $7x+10-3x=-6$
$7(-4)+10-3(-4) \stackrel{?}{=} -6$
$-28+10+12 \stackrel{?}{=} -6$
$-6=-6$ True
The solution set is $\{-4\}$.

96. $-5(a+3)=-60$
$-5a-15=-60$
$-5a-15+15=-60+15$
$-5a=-45$
$\frac{-5a}{-5}=\frac{-45}{-5}$
$a=9$
Check: $-5(a+3)=-60$
$-5(9+3) \stackrel{?}{=} -60$
$-5(12) \stackrel{?}{=} -60$
$-60=-60$ True
The solution set is $\{9\}$.

97. $12(2x-3)+23=-13$
$24x-36+23=-13$
$24x-13=-13$
$24x-13+13=-13+13$
$24x=0$
$\frac{24x}{24}=\frac{0}{24}$
$x=0$
Check: $12(2x-3)+23=-13$
$12(2\cdot 0-3)+23 \stackrel{?}{=} -13$
$12(-3)+23 \stackrel{?}{=} -13$
$-36+23 \stackrel{?}{=} -13$
$-13=-13$ True
The solution set is $\{0\}$.

98. $2n-14n-1=3-8(2n+4)$
$2n-14n-1=3-16n-32$
$-12n-1=-16n-29$
$-12n+16n-1=-16n+16n-29$
$4n-1=-29$
$4n-1+1=-29+1$
$4n=-28$
$\frac{4n}{4}=\frac{-28}{4}$
$n=-7$
Check: $2n-14n-1=3-8(2n+4)$
$2(-7)-14(-7)-1 \stackrel{?}{=} 3-8[2(-7)+4]$
$-14+98-1 \stackrel{?}{=} 3-8(-10)$
$83=83$ True
The solution set is $\{-7\}$.

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99.
$$\begin{aligned} -15a+12 &= 3a-24 \\ -15a+15a+12 &= 3a+15a-24 \\ 12 &= 18a-24 \\ 12+24 &= 18a-24+24 \\ 36 &= 18a \\ \frac{36}{18} &= \frac{18a}{18} \\ 2 &= a \end{aligned}$$
Check: $-15a+12 = 3a-24$
$-15(2)+12 \stackrel{?}{=} 3(2)-24$
$-30+12 \stackrel{?}{=} 6-24$
$-18 = -18$ True
The solution set is $\{2\}$.

100.
$$\begin{aligned} -3(m-10) &= 15-(2m+1) \\ -3m+30 &= 15-2m-1 \\ -3m+30 &= 14-2m \\ -3m+3m+30 &= 14-2m+3m \\ 30 &= 14+m \\ 30-14 &= 14-14+m \\ 16 &= m \end{aligned}$$
Check: $-3(m-10) = 15-(2m+1)$
$-3(16-10) \stackrel{?}{=} 15-(2\cdot 16+1)$
$-3(6) \stackrel{?}{=} 15-33$
$-18 = -18$ True
The solution set is $\{16\}$.

101.
$$\begin{aligned} 7x-15 &= 9x+5 \\ 7x-7x-15 &= 9x-7x+5 \\ -15 &= 2x+5 \\ -15-5 &= 2x+5-5 \\ -20 &= 2x \\ \frac{-20}{2} &= \frac{2x}{2} \\ -10 &= x \end{aligned}$$
Check: $7x-15 = 9x+5$
$7(-10)-15 \stackrel{?}{=} 9(-10)+5$
$-70-15 \stackrel{?}{=} -90+5$
$-85 = -85$ True
The solution set is $\{-10\}$.

102.
$$\begin{aligned} 13-10(2x+1) &= -12x-45 \\ 13-20x-10 &= -12x-45 \\ 3-20x &= -12x-45 \\ 3-20x+20x &= -12x+20x-45 \\ 3 &= 8x-45 \\ 3+45 &= 8x-45+45 \\ 48 &= 8x \\ \frac{48}{8} &= \frac{8x}{8} \\ 6 &= x \end{aligned}$$
Check: $13-10(2x+1) = -12x-45$
$13-10(2\cdot 6+1) \stackrel{?}{=} -12(6)-45$
$13-10(13) \stackrel{?}{=} -72-45$
$-117 = -117$ True
The solution set is $\{6\}$.

103.
$$\begin{aligned} 2l+2(l-4) &= 88 \\ 2l+2l-8 &= 88 \\ 4l-8 &= 88 \\ 4l-8+8 &= 88+8 \\ 4l &= 96 \\ \frac{4l}{4} &= \frac{96}{4} \\ l &= 24 \end{aligned}$$
Then $l - 4 = 24 - 4 = 20$
The length is 24 inches and the width is 20 inches.

104.
$$\begin{aligned} 5000+2m+m &= 86{,}000 \\ 5000+3m &= 86{,}000 \\ 5000-5000+3m &= 86{,}000-5000 \\ 3m &= 81{,}000 \\ \frac{3m}{3} &= \frac{81{,}000}{3} \\ m &= 27{,}000 \end{aligned}$$
Then $5000 + 2m = 5000 + 2(27{,}000) = 59{,}000$.
Margarita's share is \$27,000 and Roberto's share is \$59,000.

105. The word *product* means multiply, so "the product of -5 and x" is $-5x$.

106. The word *decreased* means subtraction, so "x decreased by 13" is $x - 13$.

107. Since 14 is subtracted from a number, the expression is $x - 14$.

108. The word *sum* means addition, so "the sum of a number and 17" is $x + 17$.

109. *Twice* means multiply by 2, and *sum* means addition, so "twice the sum of a number and -6" is $2[x + (-6)]$ or $2(x - 6)$.

110. The word *sum* means addition and *twice* means multiply by 2, so "the sum of twice a number and 12" is $2x + 12$.

111. The word *more* means addition, so John invested $a + 500$.

112. $\underbrace{14 \text{ decreased by } 5}_{14-5}$ $\underset{=}{\text{is}}$ $\underset{9}{9}$

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113. $\underbrace{\text{the quotient of 45 and } -3}_{\frac{45}{-3}} \underbrace{\text{is}}_{=} \underbrace{-15}_{-15}$

114. $\underbrace{8 \text{ more than a number } z}_{8+z} \underbrace{\text{is}}_{=} \underbrace{\text{twice } z}_{2z}$

115. $\underbrace{\text{three times the difference of a number } x \text{ and } 2}_{3(x-2)} \underbrace{\text{is the same as}}_{=} \underbrace{4 \text{ less than the number}}_{x-4}$

116. **Step 1: IDENTIFY** Find an unknown number.
Step 2: NAME Let x = the number.
Step 3: TRANSLATE $\underbrace{\text{the sum of a number and 28}}_{x+28} \underbrace{\text{is}}_{=} \underbrace{-15}_{-15}$
Step 4: SOLVE Solve the equation.

$$x+28=-15$$
$$x+28-28=-15-28$$
$$x=-43$$

Step 5: CHECK Is the sum of the number and 28 equal to −15? Yes; −43 + 28 = −15. The answer is correct.
Step 6: ANSWER The number is −43.

117. **Step 1: IDENTIFY** Find an unknown number.
Step 2: NAME Let x = the number.
Step 3: TRANSLATE $\underbrace{\text{twice a number less 7}}_{2x-7} \underbrace{\text{is}}_{=} \underbrace{-11}_{-11}$
Step 4: SOLVE Solve the equation.

$$2x-7=-11$$
$$2x-7+7=-11+7$$
$$2x=-4$$
$$\frac{2x}{2}=\frac{-4}{2}$$
$$x=-2$$

Step 5: CHECK Is twice the number less 7 equal to −11? Yes; 2(−2) − 7 = −11. The answer is correct.
Step 6: ANSWER The number is −2.

118. **Step 1: IDENTIFY** Find the price of the house.
Step 2: NAME Let x = price of the house.
Step 3: TRANSLATE $\underbrace{\text{price}}_{x} \underbrace{\text{plus}}_{+} \underbrace{\text{commission}}_{17{,}340} \underbrace{\text{equals}}_{=} \underbrace{\text{total cost}}_{306{,}340}$
Step 4: SOLVE Solve the equation.

$$x+17{,}340=306{,}340$$
$$x+17{,}340-17{,}340=306{,}340-17{,}340$$
$$x=289{,}000$$

Step 5: CHECK Is the sum of the price and commission equal to the total cost? Yes; 289,000 + 17,340 = 306,340. The answer is correct.
Step 6: ANSWER The price of the house was $289,000.

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119. **Step 1: IDENTIFY** Find the amount earned by each person.
Step 2: NAME Let m = amount Margaret earned. Then $m - 2500$ = amount Charles earned. The total amount earned is 37,100.
Step 3: TRANSLATE $\underbrace{\text{Margaret's earnings}}_{m}\ \underbrace{\text{plus}}_{+}\ \underbrace{\text{Charles' earnings}}_{m-2500}\ \underbrace{\text{equal}}_{=}\ \underbrace{\text{total}}_{37,100}$
Step 4: SOLVE Solve the equation.

$$\begin{aligned} m+m-2500 &= 37,100 \\ 2m-2500 &= 37,100 \\ 2m-2500+2500 &= 37,100+2500 \\ 2m &= 39,600 \\ m &= 19,800 \end{aligned}$$

Then $m - 2500 = 19,800 - 2500 = 17,300$.
Step 5: CHECK Does the sum of their earnings total 37,100? Yes; 19,800 + 17,300 = 37,100. The answer is correct.
Step 6: ANSWER Margaret earned \$19,800 and Charles earned \$17,300.

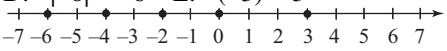
120. **Step 1: IDENTIFY** Find the measure of each angle.
Step 2: NAME Let m = measure of middle angle. Then $2m$ = measure of largest angle and $m - 28$ = measure of the smallest angle. The sum of the measures is 180.
Step 3: TRANSLATE $\underbrace{\text{small angle}}_{m-28}\ \underbrace{\text{plus}}_{+}\ \underbrace{\text{middle angle}}_{m}\ \underbrace{\text{plus}}_{+}\ \underbrace{\text{large angle}}_{2m}\ \underbrace{\text{equals}}_{=}\ \underbrace{\text{total}}_{180}$
Step 4: SOLVE Solve the equation.

$$\begin{aligned} m-28+m+2m &= 180 \\ 4m-28 &= 180 \\ 4m &= 208 \\ m &= 52 \end{aligned}$$

Then $m - 28 = 52 - 28 = 24$ and $2m = 2(52) = 104$.
Step 5: CHECK Do the measures sum to 180? Yes; 24 + 52 + 104 = 180. The answer is correct.
Step 6: ANSWER The angles measure: small angle 24 degrees, middle angle 52 degrees, and large angle 104 degrees.

Chapter 2 Test

1. A. -4 B. $\dfrac{0}{-1} = 0$ C. $-(-(-2)) = -2$
D. $-|-6| = -6$ E. $-(-3) = 3$



2. $-2 + 10 = 8$

3. $-6(5) = -30$

4. $\dfrac{-420}{-70} = 6$

5. $14 - 20 = 14 + (-20) = -6$

6. $\dfrac{-18}{0}$ is undefined

7. $33 - (-4) = 33 + 4 = 37$

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8. $-10^2 = -10 \cdot 10 = -100$

9. $-31 + (-26) = -57$

10. $-2^4 - (-5)^2 = -16 - 25 = -16 + (-25) = -41$

11. $\dfrac{0}{-9} = 0$

12. $(15)(-2) = -30$

13.
$$\begin{aligned} 5 - 8[(-3)^2 - 4(2^3 - 5)] &= 5 - 8[9 - 4(8 - 5)] \\ &= 5 - 8[9 - 4(3)] \\ &= 5 - 8(9 - 12) \\ &= 5 - 8(-3) \\ &= 5 + 24 \\ &= 29 \end{aligned}$$

14. $-|-8| = -8$ and $\dfrac{0}{-4} = 0$

Since $-8 < 0$, then $-|-8| < \dfrac{0}{-4}$.

15.
$$\begin{aligned} 8x - 13 - 2x + 5 &= 8x - 2x - 13 + 5 \\ &= (8-2)x + (-13) + 5 \\ &= 6x - 8 \end{aligned}$$

16.
$$\begin{aligned} 4 - 3(2x - 5) - (x + 3) &= 4 - 6x + 15 - x - 3 \\ &= -6x - x + 4 + 15 - 3 \\ &= (-6-1)x + (4 + 15 - 3) \\ &= -7x + 16 \end{aligned}$$

17. Let $x = -3$ and $y = -5$.
$$\begin{aligned} (2x - 4y)^2 &= [2(-3) - 4(-5)]^2 \\ &= (-6 + 20)^2 \\ &= 14^2 \\ &= 196 \end{aligned}$$

18.
$$\frac{x}{-10} = -30$$
$$-10 \cdot \frac{x}{-10} = -10(-30)$$
$$x = 300$$
Check: $\dfrac{x}{-10} = -30$
$$\frac{300}{-10} \stackrel{?}{=} -30$$
$$-30 = -30 \text{ True}$$
The solution set is $\{300\}$.

19.
$$126 = x + 302$$
$$126 - 302 = x + 302 - 302$$
$$-176 = x$$
Check: $126 = x + 302$
$$126 \stackrel{?}{=} -176 + 302$$
$$126 = 126 \text{ True}$$
The solution set is $\{-176\}$.

20.
$$8x + 12 = 4x - 36$$
$$8x - 4x + 12 = 4x - 4x - 36$$
$$4x + 12 = -36$$
$$4x + 12 - 12 = -36 - 12$$
$$4x = -48$$
$$\frac{4x}{4} = \frac{-48}{4}$$
$$x = -12$$
Check: $8x + 12 = 4x - 36$
$$8(-12) + 12 \stackrel{?}{=} 4(-12) - 36$$
$$-96 + 12 \stackrel{?}{=} -48 - 36$$
$$-84 = -84 \text{ True}$$
The solution set is $\{-12\}$.

21.
$$3(2x + 1) = 2 + 5x + 1$$
$$6x + 3 = 3 + 5x$$
$$6x - 5x + 3 = 3 + 5x - 5x$$
$$x + 3 = 3$$
$$x + 3 - 3 = 3 - 3$$
$$x = 0$$
Check: $3(2x + 1) = 2 + 5x + 1$
$$3(2 \cdot 0 + 1) \stackrel{?}{=} 2 + 5 \cdot 0 + 1$$
$$3(1) \stackrel{?}{=} 2 + 0 + 1$$
$$3 = 3 \text{ True}$$
The solution set is $\{0\}$.

22.
$$8 - 2(1 - x) = 5 - (2 - 5x)$$
$$8 - 2 + 2x = 5 - 2 + 5x$$
$$6 + 2x = 3 + 5x$$
$$6 + 2x - 2x = 3 + 5x - 2x$$
$$6 = 3 + 3x$$
$$6 - 3 = 3 - 3 + 3x$$
$$3 = 3x$$
$$\frac{3}{3} = \frac{3x}{3}$$
$$1 = x$$
Check: $8 - 2(1 - x) = 5 - (2 - 5x)$
$$8 - 2(1 - 1) \stackrel{?}{=} 5 - (2 - 5 \cdot 1)$$
$$8 - 2(0) \stackrel{?}{=} 5 - (-3)$$
$$8 - 0 \stackrel{?}{=} 5 + 3$$
$$8 = 8 \text{ True}$$
The solution set is $\{1\}$.

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23. $-10-3+3x=4x+5x+5$
$-13+3x=9x+5$
$-13+3x-3x=9x-3x+5$
$-13=6x+5$
$-13-5=6x+5-5$
$-18=6x$
$\frac{-18}{6}=\frac{6x}{6}$
$-3=x$

Check: $-10-3+3x=4x+5x+5$
$-10-3+3(-3) \stackrel{?}{=} 4(-3)+5(-3)+5$
$-10-3+(-9) \stackrel{?}{=} -12-15+5$
$-13+(-9) \stackrel{?}{=} -27+5$
$-22=-22$ True

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

24. The word *product* indicates multiplication (or multiply).

25. The words *increased by* indicates addition (or add).

26. The word *difference* indicates subtraction (or subtract).

27. **Step 1: IDENTIFY** Find each woman's winnings.
Step 2: NAME Let m = Marta's winnings. Then $2m$ = Liesel's winnings. The total winnings is 6750.
Step 3: TRANSLATE $\underbrace{\text{Marta's winnings}}_{m}$ $\underbrace{\text{plus}}_{+}$ $\underbrace{\text{Leisel's winnings}}_{2m}$ $\underbrace{\text{equals}}_{=}$ $\underbrace{\text{total}}_{6750}$

Step 4: SOLVE Solve the equation.
$m+2m=6750$
$3m=6750$
$\frac{3m}{3}=\frac{6750}{3}$
$m=2250$

Then $2m = 2(2250) = 4500$.
Step 5: CHECK Do the winning amounts sum to 6750? Yes; 2250 + 4500 = 6750.
The answer is correct.
Step 6: ANSWER Marta won \$2250 and Liesel won \$4500.

Getting Ready for Chapter 3

1. Since $\frac{-10}{-2}=5$ and $\frac{15}{15}=1$, the natural numbers are $\frac{-10}{-2}$ and $\frac{15}{15}$.

2. The whole numbers include the natural numbers, $\frac{-10}{-2}$ and $\frac{15}{15}$, as well as $\frac{0}{-3}$, since $\frac{0}{-3}=0$.

3. The integers include the whole numbers, $\frac{-10}{-2}$, $\frac{15}{15}$, and $\frac{0}{-3}$, as well as -100.

4. $-5 > -10$, since -5 is to the right of -10 on a number line.

5. Divide: 69 ÷ 7 = 9 R 6.

a. The dividend is 69.

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b. The divisor is 7.

c. The quotient is 9.

d. The remainder is 6.

6.
$$\begin{array}{c} 45 \\ /\ \backslash \\ 9 \cdot 5 \\ /\ \backslash \\ 3 \cdot 3 \end{array}$$
$45 = 3 \cdot 3 \cdot 5$

7.
$$\begin{array}{c} 275 \\ /\ \backslash \\ 5 \cdot 55 \\ /\ \backslash \\ 5 \cdot 11 \end{array}$$
$275 = 5 \cdot 5 \cdot 11$

8. a.
$$\begin{aligned} 12 &= 2 \cdot 2 \cdot 3 \\ 18 &= 2 \cdot 3 \cdot 3 \\ \text{LCM} &= 2 \cdot 2 \cdot 3 \cdot 3 \\ &= 36 \end{aligned}$$

b.
$$\begin{aligned} 24 &= 2 \cdot 2 \cdot 2 \cdot 3 \\ 28 &= 2 \cdot 2 \cdot 7 \\ 68 &= 2 \cdot 2 \cdot 17 \\ \text{LCM} &= 2 \cdot 2 \cdot 2 \cdot 3 \cdot 7 \cdot 17 \\ &= 2856 \end{aligned}$$

9. a.
$$\begin{aligned} 35 &= 5 \cdot 7 \\ 49 &= 7 \cdot 7 \\ \text{GCF} &= 7 \end{aligned}$$

b.
$$\begin{aligned} 60 &= 2 \cdot 2 \cdot 3 \cdot 5 \\ 150 &= 2 \cdot 3 \cdot 5 \cdot 5 \\ 210 &= 2 \cdot 3 \cdot 5 \cdot 7 \\ \text{GCF} &= 2 \cdot 3 \cdot 5 \\ &= 30 \end{aligned}$$

10. a. $|-17| = 17$

b. Since $|-35| = 35$, $-|-35| = -35$.

11. $\dfrac{-39}{0}$ is undefined since 0 is the divisor.

12. $-13 + (-4)$
Since the numbers have the same sign, add their absolute values.
$13 + 4 = 17$
Since both numbers are negative, the sum is negative.
$-13 + (-4) = -17$

13. $-125 + 41$
Since the numbers have different signs, subtract the smaller absolute value from the larger absolute value.
$125 - 41 = 84$
Since the number with the larger absolute value is negative, the sum is negative.
$-125 + 41 = -84$

14. $42 + (-32)$
Since the numbers have different signs, subtract the smaller absolute value from the larger absolute value.
$42 - 32 = 10$
Since the number with the larger absolute value is positive, the sum is positive.
$42 + (-32) = 10$

15. $-20 - 10 = -20 + (-10) = -30$

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

17. $-6 - (-15) = -6 + 15 = 9$

18. $25(-3)$
The product of a positive number and a negative number is negative.
$25(-3) = -75$

19. $(-4)(2)(-10)(3) = -8(-10)(3) = 80(3) = 240$

20. $\dfrac{-100}{-25}$
The quotient of two negative numbers is positive.
$\dfrac{-100}{-25} = 4$

21. -5^4
The exponent applies only to the 5.
$-5^4 = -(5 \cdot 5 \cdot 5 \cdot 5) = -625$

22. $(-3)^4 = (-3)(-3)(-3)(-3) = 81$

23. $(-2)^5 = (-2)(-2)(-2)(-2)(-2) = -32$

24.
$$\begin{aligned} -30 \div 2(15) - (6-9)^2 &= -30 \div 2(15) - (-3)^2 \\ &= -30 \div 2(15) - 9 \\ &= -15(15) - 9 \\ &= -225 - 9 \\ &= -234 \end{aligned}$$

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25. $$\frac{-5-2(6+5)}{-3-6(-2)} = \frac{-5-2(11)}{-3-6(-2)} = \frac{-5-22}{-3+12} = \frac{-27}{9} = -3$$

26. $$\left|-2^2-3^2\right|-\left|3-4(-5)\right| = \left|-4-9\right|-\left|3+20\right| = \left|-13\right|-\left|23\right| = 13-23 = 13+(-23) = -10$$

27. $$\frac{2(-4)^2-(-4)}{3^2-[4+2(-3)-7]} = \frac{2(-4)^2-(-4)}{3^2-[4+(-6)-7]} = \frac{2(-4)^2-(-4)}{3^2-[-2-7]} = \frac{2(-4)^2-(-4)}{3^2-[-9]} = \frac{2(16)-(-4)}{9-[-9]} = \frac{32+4}{9+9} = \frac{36}{18} = 2$$

28. Let $x = 5$ and $y = -2$.
$(x-y)^2 = [5-(-2)]^2 = 7^2 = 49$

29. The coefficient of $-6x$ is the numerical factor, -6.

30. $9n-15n = (9-15)n = -6n$

31. $$7x-y+2z-9x+3y-2z = (7x-9x)+(-y+3y)+(2z-2z) = -2x+2y$$

32. $$-(6x+3)+7x-1 = -6x-3+7x-1 = (-6x+7x)+(-3-1) = 1x+(-4) = x-4$$

33. $$12-8(3x+5)-2(6x-1) = 12-24x-40-12x+2 = (-24x-12x)+(12-40+2) = -36x-26$$

34. $$-32+7 = n-13$$
$$-25 = n-13$$
$$-25+13 = n-13+13$$
$$-12 = n$$
The solution set is $\{-12\}$.

35. $$\frac{x}{-8} = 16$$
$$-8\cdot\frac{x}{-8} = -8\cdot 16$$
$$x = -128$$
The solution set is $\{-128\}$.

36. $$5x-9 = -24$$
$$5x-9+9 = -24+9$$
$$5x = -15$$
$$\frac{5x}{5} = \frac{-15}{5}$$
$$x = -3$$
The solution set is $\{-3\}$.

37. $$4-2(5x+3)+2x = -2$$
$$4-10x-6+2x = -2$$
$$-8x-2 = -2$$
$$-8x-2+2 = -2+2$$
$$-8x = 0$$
$$\frac{-8x}{-8} = \frac{0}{-8}$$
$$x = 0$$
The solution set is $\{0\}$.

38. $$6z+2 = -3z-16$$
$$6z+2+3z = -3z-16+3z$$
$$9z+2 = -16$$
$$9z+2-2 = -16-2$$
$$9z = -18$$
$$\frac{9z}{9} = \frac{-18}{9}$$
$$z = -2$$
The solution set is $\{-2\}$.

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39. $4(a-2)+1=a+2$
$4a-8+1=a+2$
$4a-7=a+2$
$4a-7-a=a+2-a$
$3a-7=2$
$3a-7+7=2+7$
$3a=9$
$\frac{3a}{3}=\frac{9}{3}$
$a=3$
The solution set is $\{3\}$.

40. Let x be the number.
$x-17=-12$
$x-17+17=-12+17$
$x=5$
The number is 5.

41. Let x be the length of the middle-size piece. Then $2x$ is the length of the longest piece, and $x-4$ is the length of the shortest piece.
$x+2x+(x-4)=28$
$4x-4=28$
$4x=32$
$x=8$
The middle-size piece is 8 inches long. The longest piece is $2x = 2(8) = 16$ inches long, and the shortest piece is $x - 4 = 8 - 4 = 4$ inches long.

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Mini-Lecture 2.1

Fundamentals of Integers

Learning Objectives:

1. Identify integers.
2. Plot integers on a number line.
3. Compare integers.
4. Compute the absolute value of a number.

Are You Ready for This Section?

i) True or False $3 > 7$

ii) Fill in the blank with the symbol $<$ or $>$ to make a true sentence: 9 ____ 12

Examples:

1. Which of the following numbers are integers?

   (a) $\frac{9}{5}$ (b) -17

   (c) 3 (d) 3.2

2. On a number line, plot the points 4, −3, 0, and −1.

3. Insert $<$ or $>$ to make a true statement.

   (a) -2 _____ 5 (b) -3 _____ -12

   (c) 0 _____ -9 (d) 6 _____ -3

4. Find each absolute value.

   (a) $|0|$ (b) $|-7|$

   (c) $|4|$ (d) $|-15|$

Teaching Notes:

Remind students that the smaller end of an inequality symbol points to the smaller number (the number that is less than).
Remind students that the absolute value of a number is always either positive or zero.

Answers: i) False; ii) <; 1) b, c; 2) graph answers at end of mini-lectures; 3a) <; 3b) >; 3c) >; 3d) >; 4a) 0; 4b) 7; 4c) 4; 4d) 15

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Mini-Lecture 2.2

Adding and Subtracting Integers

Learning Objectives:

1. Add integers.
2. Determine the additive inverse of a number.
3. Subtract integers.

Are You Ready for This Section?

i) Find the sum: $13+38$

ii) Find the difference: $22-15$

Examples:

1. Use absolute value to find each sum.

   (a) $-5+(-12)$

   (b) $-18+(-24)$

   (c) $-31+22$

   (d) $34+(-19)$

2. Find the opposite of the given integer.

   (a) 33

   (b) -7

   (c) 41

   (d) -25

3. Find the value of each expression.

   (a) $-14-8$

   (b) $23-(-11)$

   (c) $-46-(-27)$

   (d) $7-31$

Teaching Notes:

Refer students to the summary box for adding integers with the same sign.
Remind students that when adding numbers with different signs, the sum can be positive, negative, or zero. Tell them to use the sign of the integer having the larger absolute value when adding two numbers.
Remind students that the sum of any number and its opposite, or additive inverse, is zero.
Discuss the role of parentheses in attaching a negative sign to a number.
Review the definition of subtraction.

Answers: i) 51; ii) 7; 1a) −17; 1b) −42; 1c) −9; 1d) 15; 2a) −33; 2b) 7; 2c) −41; 2d) 25; 3a) −22; 3b) 34; 3c) −19; 3d) −24

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Mini-Lecture 2.3

Multiplying and Dividing Integers

Learning Objectives:

1. Multiply integers.
2. Divide integers.

Are You Ready for This Section?

i) Find the product: $13 \cdot 7$

ii) Find the quotient: $84 \div 4$

Examples:

1. Find the product.

   (a) $-5(-11)$

   (b) $9 \cdot 12$

   (c) $(-11)(7)$

   (d) $(-4)17$

   (e) $6(-8)$

   (f) $(-3)(-16)$

   (g) $5(-6)10$

   (h) $(2)(-7)(-3)(4)$

2. Find the quotient, if possible.

   (a) $-81 \div (-3)$

   (b) $56 \div (-14)$

   (c) $\dfrac{0}{-23}$

   (d) $\dfrac{100}{-4}$

   (e) $\dfrac{-65}{-13}$

   (f) $\dfrac{0}{0}$

   (g) $-72 \div 8$

   (h) $12 \div 0$

Teaching Notes:

Review the rules of signs for multiplying two integers. The product is positive if the signs of the two factors are the same. The product is negative if the signs of the two factors are different.
Discuss the properties of multiplication found on page 85.
Compare the rules of signs for dividing with the rules of signs for multiplying.
Discuss the division properties of zero.

Answers: i) 91; ii) 21; 1a) 55; 1b) 108; 1c) −77; 1d) −68; 1e) −48; 1f) 48; 1g) −300; 1h) 168; 2a) 27; 2b) −4; 2c) 0; 2d) −25; 2e) 5; 2f) undefined; 2g) −9; 2h) undefined

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Mini-Lecture 2.4

Exponents; Order of Operations

Learning Objectives:

1. Evaluate exponential expressions.
2. Apply the order of operations using integers.

Are You Ready for This Section?

i) Write 5^3 in expanded form.

ii) Evaluate: $2+7(8-6\div 2)$

Examples:

1. Evaluate each exponential expression.

   (a) -4^3

   (b) $(-3)^4$

   (c) -2^5

   (d) $(-7)^2$

2. True or False:

   (a) The result of computing $(-83)^{12}$ is a positive number.

   (b) The result of computing $(-66)^{17}$ is a negative number.

3. Evaluate each expression.

   (a) $(2-3\cdot 2)^2+5$

   (b) $-12-6(-2)^3$

   (c) $-5|2(15\div 3-8)|$

   (d) $[-3(-6+-9)\div 5]-|4-(-7)|$

   (e) $\dfrac{-2+5^2-7}{(11+5)\div 2}$

   (f) $\dfrac{7+(-3)^3}{3(12\div 6)^2-10}$

Teaching Notes:

Emphasize the difference between $(-a)^n$ and $-a^n$.

Discuss the order of operations found on page 91. Stress that multiplication and division are performed working from left to right, and then addition and subtraction are performed working from left to right.

Answers: i) $5\cdot 5\cdot 5$ *; ii) 37; 1a) −64; 1b) 81; 1c) −32; 1d) 49; 2a) True; 2b) True; 3a) 21; 3b) 36; 3c) −30; 3d) −2; 3e) 2; 3f) −10*

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Mini-Lecture 2.5

Simplifying Algebraic Expressions

Learning Objectives:

1. Identify variables, constants, and expressions.
2. Evaluate algebraic expressions.
3. Identify terms, coefficients, and like terms.
4. Simplify algebraic expressions and use the Distributive Property.

Are You Ready for This Section?

i) Find the difference: $13-(-7)$

ii) Find the product: $-3\cdot 4(-6)$

Examples:

1. Determine whether the quantity is a variable or a constant.

   (a) The number of seconds in an hour

   (b) The time it takes to walk to a nearby store

2. Evaluate each algebraic expression.

   (a) $5x-3$ for $x=-4$

   (b) $6a^2b^3$ for $a=-3$ and $b=2$

3. Identify the terms of the expression $2x^3-3x+4$.

4. Tell whether the terms are like or unlike.

   (a) $-4s$ and $-4t$

   (b) $-8ab^4$ and ab^4

5. Simplify each algebraic expression.

   (a) $-3x+7+8x-3$

   (b) $4(3y-13)-5y+22$

   (c) $5a(a-7)+a^2-1$

   (d) $-2(-6b+5)-(3b+9)$

Teaching Notes:

Review the definitions of variables, constants, algebraic expressions, terms, coefficients, and like terms.
Remind students that in like terms, the coefficients don't have to match, but the variables and the exponents on the variables do.
Review the Distributive Property and how to use it to simplify algebraic expressions.

Answers: i) 20; ii) 72; 1a) constant; 1b) variable; 2a) −23; 2b) 432; 3) $2x^3$, $-3x$, 4; 4a) unlike; 4b) like; 5a) $5x+4$; 5b) $7y-30$; 5c) $6a^2-35a-1$; 5d) $9b-19$

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Mini-Lecture 2.6

Linear Equations: The Addition and Multiplication Properties

Learning Objectives:

1. Determine whether a number is a solution of an equation.
2. Use the Addition Property of Equality to solve linear equations.
3. Use the Multiplication Property of Equality to solve linear equations.

Are You Ready for This Section?

i) Determine the additive inverse of -5. *ii)* Simplify: $2(8x-7)+10$

Examples:

1. Determine whether the given number is a solution of the equation. Answer yes or no.

   (a) $x+7=12;\ x=5$ (b) $-6y=54;\ y=9$

   (c) $3a-9=12;\ a=13$ (d) $-2(7b+10)=6b;\ b=-1$

2. Solve each equation using the Addition Property of Equality.

   (a) $x-6=-14$ (b) $16=m+9$

   (c) $8+n=-4-(-3)$ (d) $5-17=p+12$

3. Solve each equation using the Multiplication Property of Equality.

   (a) $-11x=44$ (b) $13=-y$

   (c) $7z=-20+(-22)$ (d) $\frac{q}{-4}=-8$

Teaching Notes:

Discuss the differences between an expression and an equation.
Remind students that whatever they add to one side of an equation, they must also add to the other side of the equation.
Remind students that when they multiply or divide one side of an equation by a nonzero number, they must also multiply or divide the other side of the equation by the same nonzero number.

Answers: i) 5; ii) $16x-4$; 1a) yes; 1b) no; 1c) no; 1d) yes; 2a) {−8}; 2b) {7}; 2c) {−9}; 2d) {−24}; 3a) {−4}; 3b) {−13}; 3c) {−6}; 3d) {32}

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Mini-Lecture 2.7

Linear Equations: Using the Properties Together

Learning Objectives:

1. Apply the Addition and Multiplication Properties of Equality to solve linear equations.
2. Combine like terms and apply the Distributive Property.
3. Solve a linear equation with the variable on both sides of the equation.

Are You Ready for This Section?

i) Solve the equation: $x+5=-17$

ii) Solve the equation: $-6y=78$

Examples:

1. Solve each equation.

   (a) $3x+7=-20$

   (b) $-5y-14=41$

   (c) $9-2m=5$

   (d) $-12-4n=-32$

2. Solve each equation.

   (a) $9x-6+5x=22$

   (b) $15=-7y-9+3y$

   (c) $2(n+8)-10=-4$

   (d) $-8(3p+12)+30=6$

3. Solve each equation.

   (a) $6x-9=x+26$

   (b) $-3y+(-17)=8y+16$

   (c) $-7+3(z-12)=-2z-13$

   (d) $-4(5w-9)-16=-12w+20$

   (e) $5-(7-a)=6(4a+2)-9a$

   (f) $18+2(11-3b)=-5(-4b-16)+38$

Teaching Notes:

Review the Addition Property of Equality, the Multiplication Property of Equality, and the Distributive Property.

Refer students to the summary of solving an equation in one variable found on page 122.

Stress that students should check their answers as these problems often have many steps.

Answers: i) {−22}; ii) {−13}; 1a) {−9}; 1b) {−11}; 1c) {2}; 1d) {5}; 2a) {2}; 2b) {−6}; 2c) {−5}; 2d) {−3}; 3a) {7}; 3b) {−3}; 3c) {6}; 3d) {0}; 3e) {−1}; 3f) {−3}

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Mini-Lecture 2.8

Introduction to Problem Solving: Direct Translation Problems

Learning Objectives:

1. Translate English phrases into algebraic expressions.
2. Translate English sentences into equations.
3. Solve direct translation problems containing one unknown.
4. Solve direct translation problems containing two unknowns.

Are You Ready for This Section?

i) Solve the equation: $x+3(x-8)=4$

Examples:

1. Express each phrase using mathematical symbols. Use x as the variable.

   (a) 5 more than a number

   (b) The ratio of a number and 9

   (c) Triple the sum of a number and 1

2. Translate each of the following sentences into an equation. Do not solve the equation.

   (a) The difference of 11 and x is -13.

   (b) Five times the sum of 2 and the product of 8 and x is equal to 50.

3. Translate each of the following sentences into an equation and solve.

   (a) 5 decreased by the product of 7 and a number is -23. Find the number.

   (b) 6 more than the quotient of a number and 3 is equal to the number plus 4. Find the number.

4. **Apples and Oranges** You bought apples and oranges from a fruit vendor. If you bought 5 fewer apples than oranges and 17 pieces of fruit altogether, how many oranges did you buy?

Teaching Notes:

Do many examples using a variety of words to represent mathematical operations. Students will need a lot practice to translate phrases into expressions and sentences into equations proficiently.
Remind students that it is helpful to let the variable represent the quantity that we know the least about.
Review the steps for solving problems with mathematical models found on page 129.

Answers: i) {7}; 1a) $x+5$; 1b) $\frac{x}{9}$; 1c) $3(x+1)$; 2a) $11-x=-13$; 2b) $5(2+8x)=50$; 3a) {4}; 3b) {3}; 4) 11 oranges

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Section 2.1: Fundamentals of Integers

For Problems 1–5, determine whether the given number is an integer. Answer yes or no.

_____ 1. $-\frac{3}{4}$

_____ 2. -12

_____ 3. -5.7

_____ 4. $\frac{11}{5}$

_____ 5. 107,586

For Problems 6–10, plot the given points on a number line.

6. 0 and −5



7. 3 and −4



8. 2 and −2



9. 7 and −6



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Section 2.1: Fundamentals of Integers

10. -8 and -10



For Problems 11–15, insert $<$ or $>$ to make a true statement.

11. 5 _____ 11

12. -13 _____ -17

13. 9 _____ -3

14. -14 _____ 0

15. -4 _____ 6

For Problems 16–20, find the absolute value.

_____16. $|6|$

_____17. $|-13|$

_____18. $|-8|$

_____19. $|11|$

_____20. $|-32|$

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Section 2.2: Adding and Subtracting Integers

For Problems 1–4, use a number line to find the sum.

_____1. $2 + 3$

_____2. $-4 + (-3)$

_____3. $-6 + 9$

_____4. $4 + (-5)$

For Problems 5–8, use absolute value to find the sum.

_____5. $52 + (-29)$

_____6. $-13 + (-36)$

_____7. $-11 + 30$

_____8. $-47 + (-24)$

For Problems 9–14, find the opposite of the given integer.

_____9. 7

_____10. −15

_____11. 11

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Section 2.2: Adding and Subtracting Integers

_____12. -13

_____13. -38

_____14. 72

For Problems 15–20, find the value of the expression.

_____15. $16 - 37$

_____16. $27 - (-5)$

_____17. $-40 - 23$

_____18. $-54 - (-39)$

_____19. $-15 + 7 - (-18)$

_____20. $8 + (-13) - 35 - (-12)$

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Section 2.3: Multiplying and Dividing Integers

For Problems 1–10, find the product.

_____1. $15(4)$

_____2. -6×5

_____3. $-14(7)$

_____4. $(-3)(-19)$

_____5. $8(-11)$

_____6. $-7(-20)$

_____7. $3(-8)10$

_____8. $-2(-3)12$

_____9. $(-4)(-2)(-5)(7)$

_____10. $(6)(5)(-2)(3)$

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Section 2.3: Multiplying and Dividing Integers

For Problems 11–20, find the quotient, if possible.

_____ 11. $\frac{32}{-8}$

_____ 12. $60 \div 5$

_____ 13. $\frac{-96}{4}$

_____ 14. $61 \div 0$

_____ 15. $\frac{-45}{-9}$

_____ 16. $\frac{75}{-15}$

_____ 17. $\frac{-23}{0}$

_____ 18. $-63 \div (-3)$

_____ 19. $\frac{0}{14}$

_____ 20. $\frac{-121}{-11}$

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Section 2.4: Exponents; Order of Operations

For Problems 1–5, evaluate the exponential expression.

_____1. 2^6

_____2. $(-5)^2$

_____3. -6^3

_____4. $(-8)^2$

_____5. -10^3

For Problems 6–8, write True or False.

_____6. The result of computing $(-56)^{24}$ is a negative number.

_____7. The result of computing $(-96)^{17}$ is a positive number.

_____8. The result of computing $(-74)^{23}$ is a negative number.

For Problems 9–20, evaluate the expression.

_____9. $(6 \cdot 3 - 27)^2 + 8$

_____10. $-4(-3)^3 - (-15)$

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Section 2.4: Exponents; Order of Operations

_____ 11. $-(3-7)^3+12$

_____ 12. $-5^2 \div (3 \cdot 8+1)$

_____ 13. $6|-3(16 \div 4 \cdot 2)|$

_____ 14. $[4(-7+13) \div 8]+|6-15|$

_____ 15. $(-8+10 \div 5+3)-|9(-7+2)|$

_____ 16. $[-(17-9) \div 2+14]+|4(-8)|$

_____ 17. $\dfrac{(-8)^2+16-3}{(12 \cdot 6+5) \div 7}$

_____ 18. $\dfrac{(-8+5)^2+17}{(28-5 \cdot 4^2) \div 4}$

_____ 19. $\dfrac{18-(2)^3}{6(14 \div 7)^2-14}$

_____ 20. $\dfrac{7-9(2 \cdot 5-12)}{2(16 \cdot 2-7) \div 10}$

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Section 2.5: Simplifying Algebraic Expressions

For Problems 1–4, determine whether the quantity is a variable or a constant.

_____1. The amount of money in Sara's pocket

_____2. The number of centimeters in a meter

_____3. The number of minutes in a day

_____4. The distance between a car and its destination

For Problems 5–9, evaluate the algebraic expression.

_____5. $8x + 5$ for $x = -6$

_____6. $3 - 7y$ for $y = 5$

_____7. $-6z - 15$ for $z = -8$

_____8. $4a^2b$ for $a = -4$ and $b = -3$

_____9. $-6pq^3$ for $p = 5$ and $q = -2$

For Problems 10–11, identify the terms in the expression.

_____10. $8x^2 + 5x - y$

_____11. $-3m + 4mn - 5n^2$

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Section 2.5: Simplifying Algebraic Expressions

For Problems 12–13, identify the coefficient of the term.

_____12. $-a$

_____13. $16b^3$

For Problems 14–15, tell whether the terms are like or unlike.

_____14. 7 and −29

_____15. $16x$ and 16

For Problems 16–20, simplify the algebraic expression.

_____16. $9x + 6 - 12x - 13$

_____17. $5(15 - 6y) + 11y + 17$

_____18. $-7(2z + 8) - 30 + 5z$

_____19. $-4(-10 - 18a) - (6a + 5)$

_____20. $-b(7b - 1) + 4b^2 - 9$

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Section 2.6: Linear Equations: The Addition and Multiplication Properties

For Problems 1–6, determine whether the given number is a solution of the equation. Answer yes or no.

_____1. $x - 9 = 13;\ x = 4$

_____2. $7y = 84;\ y = 12$

_____3. $8z - 5 = -32;\ z = 1$

_____4. $11 - 6a = -7;\ a = 3$

_____5. $5(4b + 12) = 18b;\ b = -30$

_____6. $-2(10 - 9n) = 6n + 4;\ n = -1$

For Problems 7–13, solve the equation using the Addition Property of Equality.

_____7. $x + 3 = -18$

_____8. $22 = y - 7$

_____9. $5 = z + 14$

_____10. $a - 8 = -7 + (-12)$

_____11. $-2 + b = 12 - (-10)$

_____12. $4 - 13 = n + 21$

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Section 2.6: Linear Equations: The Addition and Multiplication Properties

_____13. $5-(-14)=-6+p$

For Problems 14–20, solve the equation using the Multiplication Property of Equality.

_____14. $-9x=108$

_____15. $18=-y$

_____16. $4z=-15+(-21)$

_____17. $-8a=14+(-70)$

_____18. $\frac{b}{-6}=-12$

_____19. $\frac{n}{8}=5$

_____20. $\frac{p}{-7}=13$

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Section 2.7: Linear Equations: Using the Properties Together

For Problems 1–20, solve the equation.

_____1. $4x + 9 = -19$

_____2. $7y - 3 = -45$

_____3. $-3z - 17 = 37$

_____4. $-6a + 18 = 42$

_____5. $11 - 2b = 7$

_____6. $16 - 5c = -24$

_____7. $-8 - 10n = 42$

_____8. $-12 - 4m = -56$

_____9. $4x + 9 - 7x = 24$

_____10. $16 = 8y - 14 + 2y$

_____11. $-31 = -5z + 11 + 3z$

_____12. $3(a + 7) - 8 = 1$

_____13. $-6(b - 9) + 8 = -4$

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Section 2.7: Linear Equations: Using the Properties Together

_____14. $-4(-2c+13)-11=-7$

_____15. $-3x-7=x+81$

_____16. $5y+(-12)=12y+30$

_____17. $-8+6(z-12)=2z-4$

_____18. $-9(2w-11)-22=-15w-1$

_____19. $12-(2-a)=4(7a-3)-5a$

_____20. $18+2(3-8b)=-7(-3b-14)$

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Section 2.8: Introduction to Problem Solving: Direct Translation Problems

For Problems 1–5, express the phrase using mathematical symbols. Use x as the variable.

_____1. A number increased by 15

_____2. A number subtracted from −7

_____3. Triple a number

_____4. 6 more than the ratio of a number and 12

_____5. 4 less than the product of a number and 9

For Problems 6–10, translate the sentence into an equation. Do not solve the equation.

_____6. 5 times x is 20.

_____7. The difference of x and 3 is equal to 14.

_____8. The quotient of 6 and the product of x and 2 is 1.

_____9. 11 more than the quotient of x and 4 is equal to 15.

_____10. The sum of 5 and the product of x and 17 is −12.

For Problems 11–13, translate the sentence into an equation and solve.

_____11. The product of a number and 4 is 3 less than −21. Find the number.

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Section 2.8: Introduction to Problem Solving: Direct Translation Problems

_____12. The difference of a number and 8 is the quotient of the number and 2. Find the number.

_____13. The quotient of a number increased by 9 and 13 is equal to 2. Find the number.

_____14. The total cost of a new bicycle is $229, including taxes and accessories of $54. Find the price of the bicycle before the extra charges.

_____15. Inder bought some shares of stock for $47 a share and sold all of the stock for $62 a share, making a profit of $165. How many shares of stock did Inder own?

For Problems 16–18, translate each phrase into an algebraic expression.

_____16. A box of one brand of cereal costs c dollars. A box of a second brand of cereal costs $1 more than a box of the first brand. Express the cost of a box of the second brand of cereal in terms of c.

_____17. Sam has had a driver's license for t months. If Taylor has had a driver's license for 5 fewer months than Sam, how long has Taylor had a driver's license?

_____18. You are d miles from a restaurant. If the zoo is twice as far away as the restaurant, how far away is the zoo?

_____19. Tessa has nickels and dimes in a jar. If she has 3 times as many dimes as she has nickels, and 92 coins altogether, how many nickels and dimes does she have?

_____20. Katie worked 50 hours less than 4 times the number of hours that Reilly worked last week. Together they worked 80 hours. How many hours did each person work last week?

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Section 3.1: Fundamentals of Fractions

_____1. Determine which of the following are proper fractions:
$\frac{7}{12}, \frac{53}{53}, \frac{1}{23}, \frac{6}{1}, \frac{5}{10}, \frac{36}{11}$

_____2. Determine which of the following are improper fractions:
$\frac{8}{24}, \frac{1}{9}, \frac{15}{7}, \frac{18}{1}, \frac{32}{15}, \frac{42}{42}$

For Problems 3–4, rewrite each fraction with the denominator indicated.

_____3. $\frac{8}{17}$; 85

_____4. $\frac{4}{5}$; 35

For Problems 5–8, write each fraction in lowest terms.

_____5. $\frac{68}{72}$

_____6. $\frac{36}{90}$

_____7. $\frac{144}{86}$

_____8. $\frac{132}{84}$

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Section 3.1: Fundamentals of Fractions

For Problems 9–12, list the numbers in the set $\left\{-\frac{18}{36},\ 3,\ \frac{9}{9},\ \frac{17}{8},\ 0,\ \frac{-12}{4},\ \frac{22}{-22}\right\}$ that are:

_____ 9. Natural numbers

_____ 10. Whole numbers

_____ 11. Integers

_____ 12. Rational numbers

13. On a number line, label the points with coordinates $\frac{3}{4}$, -1, $\frac{1}{6}$, and $-\frac{1}{6}$.



For Problems 14–16, replace the question mark by < or > to make a true statement.

_____ 14. $\frac{6}{11}$? $\frac{4}{11}$

_____ 15. $\frac{12}{15}$? $\frac{16}{21}$

_____ 16. $-\frac{4}{5}$? $-\frac{7}{10}$

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Section 3.1: Fundamentals of Fractions

For Problems 17–20, write each fraction in lowest terms. Assume that no values of the variables will result in a zero denominator.

_____ 17. $\dfrac{56r^3s^2}{48rs}$

_____ 18. $\dfrac{24x^7y^2}{96x^2y^4}$

_____ 19. $\dfrac{5a^2b}{15a^5b^3}$

_____ 20. $\dfrac{72p^2q}{18pq^4}$

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Section 3.2: Multiplying and Dividing Fractions

For Problems 1–5, find each product, and write the answer in lowest terms.

_____1. $\frac{3}{5} \cdot \frac{15}{19}$

_____2. $\frac{18}{20}\left(-\frac{9}{10}\right)$

_____3. $-\frac{5}{7}\left(-\frac{1}{8}\right)$

_____4. $\frac{2}{9} \cdot \frac{1}{4} \cdot \frac{12}{18}$

_____5. $\frac{4b}{20b^3} \cdot \frac{5}{16b^5}$

_____6. Evaluate the exponential expression: $\left(-\frac{2}{5}\right)^2$

_____7. Find the reciprocal of $\frac{23}{52}$.

For Problems 8–12, find each quotient, and write the answer in lowest terms.

_____8. $\frac{13}{15} \div \frac{26}{4}$

_____9. $-\frac{48}{63} \div \frac{3}{28}$

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Section 3.2: Multiplying and Dividing Fractions

_____ 10. $-\frac{22}{35} \div \left(-\frac{11}{15}\right)$

_____ 11. $\frac{y}{12} \div \frac{3y^3}{4}$

_____ 12. $\frac{7}{2a^2} \div \left(-\frac{9a^5}{16}\right)$

For Problems 13–16, evaluate each expression for the given values of the variables.

_____ 13. xy for $x = \frac{1}{4}$ and $y = -\frac{7}{9}$

_____ 14. $y \div x$ for $x = \frac{5}{12}$ and $y = \frac{4}{8}$

_____ 15. $-3x^3y$ for $x = -\frac{2}{5}$ and $y = -\frac{10}{3}$

_____ 16. $x^2 \div y^2$ for $x = \frac{7}{6}$ and $y = \frac{1}{3}$

For Problems 17–20, solve each equation.

_____ 17. $8x + 7 = 10$

_____ 18. $13 = -4x - 5$

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Section 3.2: Multiplying and Dividing Fractions

_____19. $42-15x=-11$

_____20. $9x-4=-10$

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Section 3.3: Adding and Subtracting Like Fractions

For Problems 1–12, perform the indicated operation, and write the answer in lowest terms.

_____ 1. $\frac{4}{13}+\frac{11}{13}$

_____ 2. $\frac{2}{7}-\frac{5}{7}$

_____ 3. $-\frac{4}{15}-\frac{10}{15}$

_____ 4. $\frac{23}{42}+\left(-\frac{19}{42}\right)$

_____ 5. $\frac{25}{57}-\left(-\frac{14}{57}\right)$

_____ 6. $-\frac{3}{9}+\frac{2}{9}$

_____ 7. $\frac{5}{7}-\frac{1}{7}$

_____ 8. $\frac{4}{17}+\frac{8}{17}$

_____ 9. $-\frac{8}{21}-\left(-\frac{17}{21}\right)$

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Section 3.3: Adding and Subtracting Like Fractions

_____10. $\frac{7}{44}-\left(-\frac{26}{44}\right)$

_____11. $-\frac{41}{27}+\frac{34}{27}$

_____12. $-\frac{57}{34}-\frac{63}{34}$

For Problems 13–14, evaluate each expression for the given values of the variables.

_____13. $3x-y$ for $x=\frac{8}{9}$ and $y=\frac{3}{9}$

_____14. $x+y$ for $x=\frac{2}{15}$ and $y=\frac{11}{15}$

For Problems 15–16, simplify each algebraic expression.

_____15. $\frac{7x}{18}+\left(-\frac{15x}{18}\right)$

_____16. $\frac{9}{10}x+\frac{2}{10}-\frac{7}{10}-\frac{5}{10}x$

For Problems 17–20, solve each equation.

_____17. $x+\frac{20}{14}=-\frac{11}{14}$

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Section 3.3: Adding and Subtracting Like Fractions

_____18. $-\frac{23}{32}+x=\frac{19}{32}$

_____19. $\frac{3}{16}=x+\frac{1}{16}$

_____20. $-\frac{15}{26}+x=-\frac{10}{26}$

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Section 3.4: Adding and Subtracting Unlike Fractions

For Problems 1–2, find the LCD of the two fractions. Then rewrite each fraction with the LCD.

_____1. $\frac{5}{18}$ and $\frac{11}{24}$

_____2. $\frac{1}{6}$ and $\frac{3}{4}$

For Problems 3–12, perform the indicated operation, and write your answer in lowest terms.

_____3. $\frac{4}{5}+\frac{1}{4}$

_____4. $\frac{2}{7}-\frac{1}{5}$

_____5. $\frac{18}{21}-\left(-\frac{6}{9}\right)$

_____6. $-\frac{10}{11}-\frac{3}{7}$

_____7. $-\frac{17}{24}+\frac{1}{16}$

_____8. $\frac{5}{6}+\left(-\frac{8}{15}\right)$

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Section 3.4: Adding and Subtracting Unlike Fractions

_____ 9. $-\frac{3}{14}-\left(-\frac{1}{4}\right)$

_____ 10. $\frac{4}{5}+\frac{8}{7}$

_____ 11. $-\frac{6}{7}-\frac{11}{14}$

_____ 12. $-\frac{1}{8}+\left(-\frac{3}{20}\right)$

For Problems 13–14, evaluate each expression for the given values of the variables.

_____ 13. $x+4y$ for $x=\frac{8}{10}$ and $y=-\frac{7}{6}$

_____ 14. $y-x$ for $x=-\frac{9}{12}$ and $y=\frac{15}{18}$

For Problems 15–16, simplify each algebraic expression.

_____ 15. $\frac{11x}{6}+\frac{5x}{3}$

_____ 16. $\frac{5}{15}x+\left(-\frac{7}{9}x\right)$

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Section 3.4: Adding and Subtracting Unlike Fractions

For Problems 17–20, solve each equation.

_____17. $\frac{5}{9}+x=\frac{1}{2}$

_____18. $-\frac{7}{10}=x+\frac{3}{4}$

_____19. $-\frac{5}{6}=x-\frac{2}{9}$

_____20. $x-\frac{11}{12}=\frac{14}{16}$

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Section 3.5: Order of Operations and Complex Fractions

For Problems 1–10, evaluate each expression.

_____ 1. $\dfrac{9+(4\cdot 3+11)}{12-8\div 4}$

_____ 2. $-\dfrac{2}{3}\left(\dfrac{1}{12}+\dfrac{3}{8}\right)$

_____ 3. $\dfrac{5}{6}-\dfrac{7}{24}\div\dfrac{21}{16}$

_____ 4. $\dfrac{10\cdot 4-(9+13)}{5^2\div 5}$

_____ 5. $\dfrac{48\div(10-2\cdot 3)}{12-7+9}$

_____ 6. $\dfrac{2}{5}\cdot\dfrac{3}{4}+\left(\dfrac{9}{10}-\dfrac{7}{8}\right)$

_____ 7. $\dfrac{10-[2(8+9)]}{27\div 3^2+2}$

_____ 8. $\dfrac{11}{5}\cdot\dfrac{5}{6}-\dfrac{7}{10}\div\dfrac{8}{15}$

_____ 9. $\left(\dfrac{8}{6}+\dfrac{4}{9}\right)\dfrac{3}{8}$

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Section 3.5: Order of Operations and Complex Fractions

_____10. $\dfrac{3(36 \div 4 - 15)}{4^3 \div 2^2}$

For Problems 11–20, simplify the complex fraction using any method you wish.

_____11. $\dfrac{\frac{14}{63}}{\frac{7}{9}}$

_____12. $\dfrac{-\frac{8}{10} + \frac{2}{6}}{\frac{1}{5}}$

_____13. $\dfrac{1}{\frac{9}{14} - \frac{11}{21}}$

_____14. $\dfrac{\frac{13}{18} - \frac{9}{12}}{\frac{5}{6} + \frac{7}{3}}$

_____15. $\dfrac{\frac{15 - 2 \cdot 7}{16}}{\frac{1}{4} + \left(-\frac{5}{8}\right)}$

_____16. $\dfrac{\frac{3}{14} + \frac{12}{7}}{-9}$

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Section 3.5: Order of Operations and Complex Fractions

_____17. $\dfrac{\dfrac{8\div 2+6}{7}}{\dfrac{10-2\cdot 4}{3}}$

_____18. $\dfrac{\dfrac{1}{x}+\dfrac{8}{y}}{\dfrac{5}{x}-\dfrac{2}{y}}$

_____19. $\dfrac{\dfrac{x^2y^3}{xy}}{\dfrac{x^3}{xy^5}}$

_____20. $\dfrac{\dfrac{3}{x}-\dfrac{10}{y}}{\dfrac{x^3y^4}{xy}}$

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Section 3.6: Operations with Mixed Numbers

For Problems 1–3, write the improper fraction as a mixed number or an integer.

_____ 1. $\frac{18}{7}$

_____ 2. $\frac{23}{5}$

_____ 3. $\frac{51}{17}$

For Problems 4–6, write the mixed number as an improper fraction.

_____ 4. $6\frac{1}{7}$

_____ 5. $25\frac{5}{8}$

_____ 6. $3\frac{13}{14}$

For Problems 7–18, perform the indicated operation, and write your answer as a mixed number or an integer.

_____ 7. $4\frac{2}{3} \div 3\frac{1}{2}$

_____ 8. $6\frac{5}{8} + 11\frac{1}{2}$

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Section 3.6: Operations with Mixed Numbers

_____ 9. $7\frac{4}{5}-7\frac{5}{6}$

_____ 10. $12\frac{3}{7}-5\frac{1}{2}$

_____ 11. $1\frac{5}{9}\cdot 3\frac{2}{3}$

_____ 12. $17\frac{1}{3}\div 14\frac{2}{9}$

_____ 13. $22\frac{1}{6}+\left(-16\frac{7}{8}\right)$

_____ 14. $-7\frac{3}{11}\cdot 5\frac{2}{3}$

_____ 15. $14\frac{7}{10}-\left(-10\frac{3}{4}\right)$

_____ 16. $4\frac{4}{5}+11\frac{1}{3}$

_____ 17. $2\frac{2}{3}\left(-5\frac{5}{7}\right)$

_____ 18. $22\frac{3}{5}\div\left(-2\frac{7}{10}\right)$

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Section 3.6: Operations with Mixed Numbers

_____19. Hunter has $9\frac{3}{4}$ yards of fabric to make a blanket. If he uses $5\frac{1}{8}$ yards of the fabric, how much does he have left?

_____20. Gabriella exercises every day. During one week she exercised a total of $23\frac{4}{5}$ hours. If she exercised the same amount of time every day during that week, how long did she exercise each day?

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Section 3.7: Solving Equations That Contain Fractions

For Problems 1–18, solve each equation.

_____ 1. $\frac{7}{10} - x = 2x + \frac{4}{5}$

_____ 2. $\frac{9}{10}x = \frac{5}{3}$

_____ 3. $x + \frac{4}{11} = -\frac{1}{2}$

_____ 4. $\frac{x}{6} = -\frac{11}{12}$

_____ 5. $\frac{15}{22} = \frac{7}{4} - \frac{x}{4}$

_____ 6. $2x - \frac{8}{9} = -4x - \frac{4}{12}$

_____ 7. $\frac{8x}{3} + 2 = \frac{1}{3}$

_____ 8. $-4 + \frac{x}{5} = \frac{2}{5} + 3x$

_____ 9. $\frac{3x}{5} = \frac{9}{4}$

_____ 10. $20 - \frac{2x}{10} = \frac{7x}{4} + 17$

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Section 3.7: Solving Equations That Contain Fractions

_____11. $\frac{5}{12} - x = \frac{11}{8}$

_____12. $\frac{15}{8} = -\frac{3x}{12}$

_____13. $\frac{10}{25} = -\frac{9}{5} - x$

_____14. $\frac{1}{6}x + \frac{2}{3} = \frac{5}{9}x - \frac{7}{12}$

_____15. $\frac{5}{7}x + \frac{9}{7} = \frac{1}{3}x$

_____16. $-\frac{8}{13} = \frac{x}{2}$

_____17. $\frac{4}{5} - \frac{6x}{11} = \frac{1}{5}$

_____18. $3 - \frac{x}{10} = \frac{1}{4} + x$

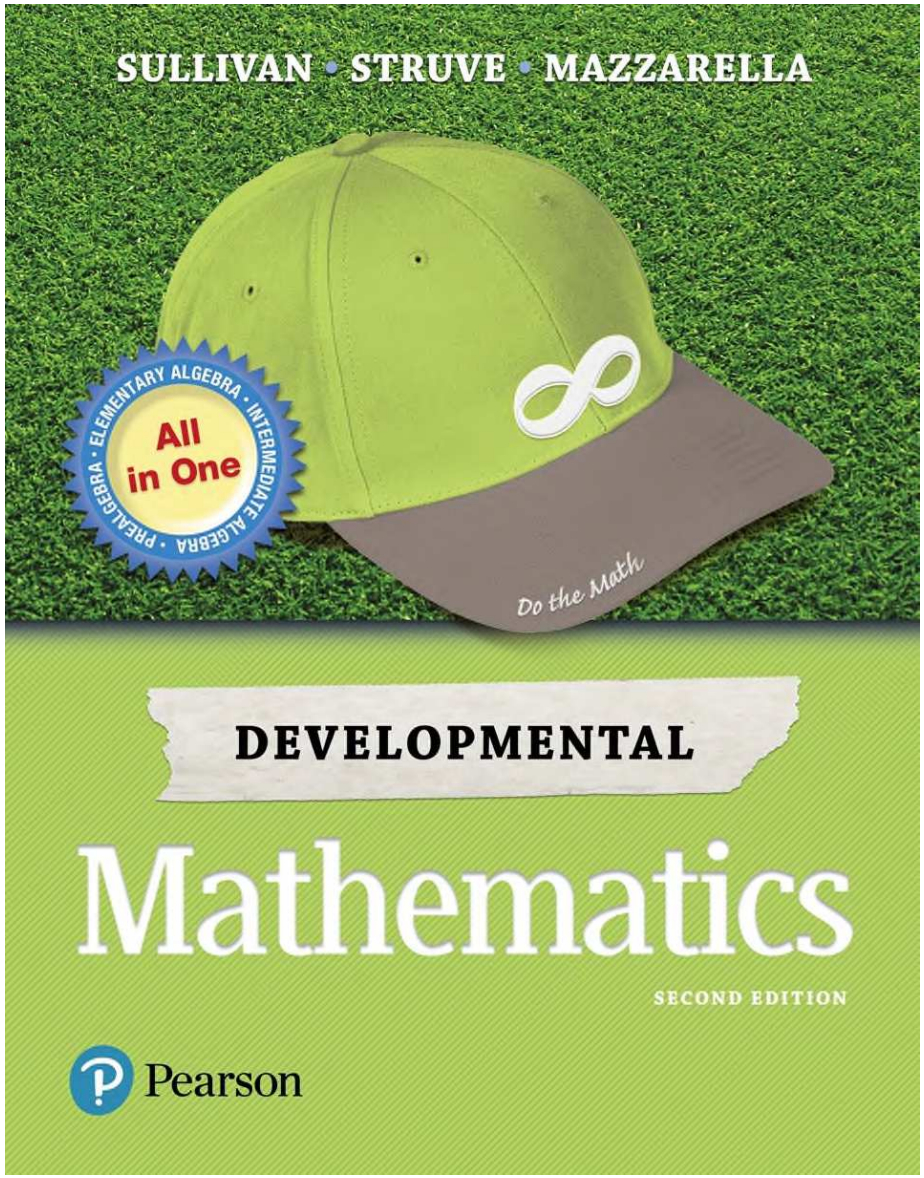
_____19. Josh is training for a marathon. One day he runs $\frac{23}{8}$ miles. The next day he runs $\frac{17}{6}$ miles. If Josh runs a total of $\frac{29}{4}$ miles in three days, how many miles did he run on his third day of training?

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Chapter 1
Whole Numbers

Section 2
Fundamentals of Whole Numbers



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Objectives

1. Determine Place Value; Read and Write Whole Numbers
2. Use a Number Line and Inequality Symbols
3. Round Whole Numbers

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Definitions

The **natural numbers,** or **counting numbers,** are the numbers in the set {1, 2, 3,…}.

The **whole numbers** are the numbers in the set {0, 1, 2, 3, …}.

hundred trillions	ten trillions	trillions	hundred billions	ten billions	billions	hundred millions	ten millions	millions	hundred thousands	ten thousands	thousands	hundreds	tens	ones
trillions			billions			millions			thousands			units		
	1	5	7	2	4	9	0	7	3	6	4	9	9	5

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Example: Determining Place Value for Whole Numbers

Determine the place value of the following digits in the number 7,408,219,635

(a) 7 (b) 6 (c) 2 (d) 0

(a) The 7 is in the billions place.

(b) The 6 is in the hundreds place.

(c) The 2 is in the hundred thousands place.

(d) The 0 is in the ten millions place.

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Example: Word Names for Numbers

Express each of the following numbers in words.

(a) 73 (b) 14,310,004

(c) 150,000,302,040

(a) seventy-three

(b) fourteen million, three hundred ten thousand, four

(c) one hundred fifty billion, three hundred two thousand, forty

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Definitions

A *number line* is used to illustrate the order of numbers.

To construct a number line of whole numbers, pick a point toward the left end of your line and label this point zero, the smallest whole number. The point 1 unit to the right of 0 corresponds to the whole number 1.

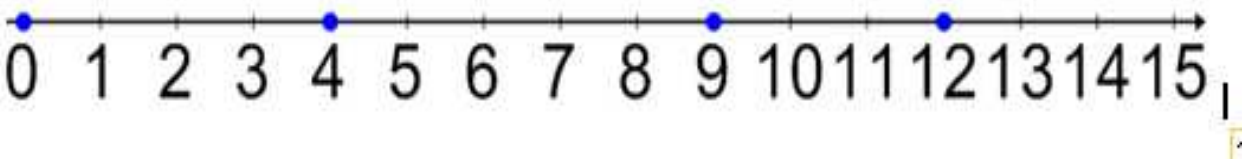
The distance between 0 and 1 determines the **scale** of the number line.

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Example: Reading Coordinates on a Number Line

Determine the coordinate associated with each point shown below.



The first point is 0.
The next point is 4.
The next point is 9
The last point is 12.

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Example: Using Inequality Symbols

Replace the question mark with the correct inequality symbol, < or >.

(a) 17 ? 18

17 < 18

(b) 49 ? 45

49 > 45

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Rounding Whole Numbers

Rounding Whole Numbers to a Specified Place Value

Step 1: Identify the digit in the specified place value to which you are rounding. It is helpful to underline this digit.

Step 2: If the digit to the right is 5 or more, add 1 to the underlined digit. If the digit to the right of the underlined digit is 4 or less, leave the underlined digit as is.

Step 3: Replace all of the digits to the right of the underlined digit with zeros.

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Example: Rounding Whole Numbers

Round 450 to the nearest hundred.

When rounding to the nearest hundred, we round 450 to 500.

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Example: Rounding Whole Numbers

Round 1782 to
(a) the nearest hundred
(b) the nearest ten

1782 rounds to 1800

1782 rounds to 1780

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