Chapter 2

2-1 Skills Practice

Write Verbal Sentences You can translate equations into verbal sentences.

Translate each equation into a sentence.

1. $3m + 2 = 18$
   Two added to three times a number $m$ is the same as 18.

2. $2a + a^2 = b$
   Twice $a$ increased by the cube of $a$ equals $b$.

3. $p + t - 7 = 6$
   Seven less than the sum of $p$ and $t$ is as much as 6.

4. $x + x^2 = yz$
   The sum of $x$ and its square is equal to $y$ times $z$.

5. $4(f + g) = 6g$
   Four times the sum of $f$ and $g$ is identical to six times $g$.

Translate each sentence into an equation.

6. The perimeter $P$ of a square equals four times the length of a side $\ell$.
   $P = 4\ell$

7. The area $A$ is $\pi$ times the radius squared.
   $A = \pi r^2$

8. The perimeter $P$, the width $w$, and the height $h$.
   $P + w + h = 20$

9. The area $A$ of a circle is $\pi$ times the radius squared.
   $A = \pi r^2$

10. $C = \frac{1}{2}(F - 32)$
    Half of the sum of $f$ and $y$ is $f$ minus 5.

11. $g + 10 = 3g$
    $g$ plus 10 is the same as three times $g$.

12. $2p + 4t = 20$
    Twice $p$ plus 4 times $t$ is 20.

13. $4(a + b) = 9a$
    Four times the sum of $a$ and $b$ is 9 times $a$.

14. $8 - 6x = 4 + 2x$
    8 minus 6 times $x$ is 4 plus 2 times $x$.

15. $\frac{1}{2}(f + y) = f - 5$
    $k$ squared minus $n$ squared is $f$ minus 5.

Write a problem based on the given information.

16. $p = \text{cost of dinner plus a } 15\% \text{ tip}$
    Sample answer: The cost of dinner plus a 15% tip was $23. How much was the dinner?

17. $c = \text{cost per pound of plain coffee beans}$
    Sample answer: The cost of two pounds of plain coffee beans plus one pound of flavored beans is $21. How much does 1 pound of plain beans cost?

0.15$p = \text{cost of a } 15\% \text{ tip}$

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Translate each sentence into an equation.

1. Fifty-three plus four times \( b \) is as much as 21. \( 53 + 4b = 21 \)

2. The sum of five times \( k \) and twice \( g \) is equal to 23. \( 5k + 2g = 23 \)

3. One fourth the sum of \( r \) and ten is identical to \( r \) minus 4. \( \frac{1}{4}(r + 10) = r - 4 \)

4. Three plus the sum of the squares of \( w \) and \( x \) is 32. \( 3 + (w^2 + x^2) = 32 \)

5. Degrees Kelvin \( K \) equals 273 plus degrees Celsius \( C \).

\( K = 273 + C \)

6. The total cost \( C \) of gas is the price \( p \) per gallon times the number of gallons \( g \).

\( C = pg \)

7. Fifty-three plus four times \( b \) is as much as 21. \( 53 + 4b = 21 \)

8. The sum of the area of the kitchen and the first floor is 20%. \( 0.20F = r - 4 \)

9. The total cost \( C \) of gas is the price \( p \) per gallon times the number of gallons \( g \). Let \( m \) represent the number of minutes over 1000 used during the month. Write an equation to describe the cost of \( p \) of the wireless phone service per month.

\( p = 32.90 + 0.05m \)

10. The total cost \( C \) of gas is the price \( p \) per gallon times the number of gallons \( g \). Let \( m \) represent the number of minutes over 1000 used during the month. Write an equation to describe the cost of \( p \) of the wireless phone service per month.

\( p = 32.90 + 0.05m \)

11. The total cost \( C \) of gas is the price \( p \) per gallon times the number of gallons \( g \). Let \( m \) represent the number of minutes over 1000 used during the month. Write an equation to describe the cost of \( p \) of the wireless phone service per month.

\( p = 32.90 + 0.05m \)

12. The total cost \( C \) of gas is the price \( p \) per gallon times the number of gallons \( g \). Let \( m \) represent the number of minutes over 1000 used during the month. Write an equation to describe the cost of \( p \) of the wireless phone service per month.

\( p = 32.90 + 0.05m \)

13. The total cost \( C \) of gas is the price \( p \) per gallon times the number of gallons \( g \). Let \( m \) represent the number of minutes over 1000 used during the month. Write an equation to describe the cost of \( p \) of the wireless phone service per month.

\( p = 32.90 + 0.05m \)

14. The total cost \( C \) of gas is the price \( p \) per gallon times the number of gallons \( g \). Let \( m \) represent the number of minutes over 1000 used during the month. Write an equation to describe the cost of \( p \) of the wireless phone service per month.

\( p = 32.90 + 0.05m \)

15. The total cost \( C \) of gas is the price \( p \) per gallon times the number of gallons \( g \). Let \( m \) represent the number of minutes over 1000 used during the month. Write an equation to describe the cost of \( p \) of the wireless phone service per month.

\( p = 32.90 + 0.05m \)

16. The total cost \( C \) of gas is the price \( p \) per gallon times the number of gallons \( g \). Let \( m \) represent the number of minutes over 1000 used during the month. Write an equation to describe the cost of \( p \) of the wireless phone service per month.

\( p = 32.90 + 0.05m \)
2-2 Study Guide and Intervention (continued)
Solving One-Step Equations

Solve Equations Using Multiplication and Division If each side of an equation is multiplied by the same number, the resulting equation is equivalent to the given one. You can use the property to solve equations involving multiplication and division. To solve equations with multiplication and division, you can also use the Division Property of Equality. If each side of an equation is divided by the same number, the resulting equation is true.

- **Multiplication Property of Equality**
  - For any numbers a, b, and c, if a = b, then ac = bc.

- **Division Property of Equality**
  - For any numbers a, b, and c, with c ≠ 0, if a = b, then \(\frac{a}{c} = \frac{b}{c}\).

**Example 1** Solve \(3\frac{1}{2}p = 1\frac{1}{2}\).

\[
3\frac{1}{2} = 1\frac{1}{2} \\
\frac{7}{2}p = \frac{3}{2} \\
\text{Rewrite each mixed number as an improper fraction.} \\
\frac{2(7)}{2(2)} = \frac{14}{4} \\
\text{Multiply each side by } \frac{2}{7}. \\
p = \frac{3}{7} \\
The solution is \(\frac{3}{7}\).
\]

**Example 2** Solve \(-5n = 60\).

\[
-5n = 60 \\
\text{Original equation} \\
\frac{-5n}{-5} = \frac{60}{-5} \\
\text{Divide each side by } -5. \\
n = -12 \\
The solution is \(-12\).
\]

**Exercises**

Solve each equation. Check your solution.

1. \(\frac{8}{3} = -2\) \(-6\)
2. \(\frac{1}{2}m = 6\) \(48\)
3. \(\frac{3}{8}p = \frac{3}{5}\) \(3\)
4. \(5 = \frac{7}{2}x\) \(60\)
5. \(-\frac{1}{6}k = -2.5\) \(10\)
6. \(-\frac{m}{5} = \frac{5}{3}\) \(-5\)
7. \(-\frac{3}{4}h = 4\) \(-8\)
8. \(-\frac{1}{6} = -\frac{3}{2}\) \(8\)
9. \(\frac{4}{5} = \frac{2}{3}\) \(1\frac{1}{5}\)
10. \(-\frac{3}{5}b = -1\frac{1}{2}\) \(1\)
11. \(-\frac{3}{10}m = 10\) \(14\)
12. \(-\frac{p}{6} = \frac{1}{2}\) \(-\frac{1}{4}\)
13. \(3a = -42\) \(-14\)
14. \(8m = 16\) \(2\)
15. \(-3t = 51\) \(-17\)
16. \(-3r = -24\) \(8\)
17. \(8k = -64\) \(-8\)
18. \(-2m = 16\) \(-8\)
19. \(12h = 4\) \(\frac{1}{3}\)
20. \(-2.4p = 7.2\) \(-3\)
21. \(0.5y = 5\) \(10\)
22. \(-25 = 5m\) \(-5\)
23. \(6m = 15\) \(2\frac{1}{2}\)
24. \(-1.5p = -75\) \(50\)
Chapter 2

2-2 Practice

Solving One-Step Equations

Solve each equation. Check your solution.

1. \(d - 8 = 17\) \(\rightarrow\) \(d = 25\)

2. \(v + 12 = -5\) \(\rightarrow\) \(v = -17\)

3. \(b - 2 = -11\) \(\rightarrow\) \(b = -9\)

4. \(-16 = m + 71 - 87\) \(\rightarrow\) \(m = -96\)

5. \(29 = a - 76\) \(\rightarrow\) \(a = 105\)

6. \(-14 + y = -2\) \(\rightarrow\) \(y = 12\)

7. \(8 - (-n) = 1\) \(\rightarrow\) \(n = -7\)

8. \(78 + r = -15\) \(\rightarrow\) \(r = -93\)

9. \(f + (-3) = -9\) \(\rightarrow\) \(f = -6\)

10. \(8y = 96\) \(\rightarrow\) \(y = 12\)

11. \(-13z = -39\) \(\rightarrow\) \(z = 3\)

12. \(-180 = 15m - 12\) \(\rightarrow\) \(m = -12\)

13. \(243 = 27r\) \(\rightarrow\) \(r = 9\)

14. \(\frac{1}{9} = -8 - 72\) \(\rightarrow\) \(r = 96\)

15. \(-\frac{1}{12} = -8\) \(\rightarrow\) \(r = 96\)

16. \(\frac{4}{3} = 12\) \(\rightarrow\) \(r = 12\)

17. \(\frac{7}{2} = \frac{2}{9}\) \(\rightarrow\) \(r = 6\)

18. \(\frac{2}{24} = \frac{1}{6}\) \(\rightarrow\) \(r = 4\)

Write an equation for each sentence. Then solve the equation.

19. Negative nine times a number equals -117. \(\rightarrow\) \(-9n = -117; n = 13\)

20. Negative one eighth of a number is \(-\frac{3}{4}\). \(\rightarrow\) \(-\frac{1}{8}n = -\frac{3}{4}; n = 6\)

21. Five sixths of a number is \(\frac{5}{6}\). \(\rightarrow\) \(\frac{5}{6}n = \frac{5}{6}; n = 6\)

22. 2.7 times a number equals 8.37. \(\rightarrow\) \(2.7n = 8.37; n = 3.1\)

23. HURRICANES The day after a hurricane, the barometric pressure in a coastal town has risen to 28.7 inches of mercury, which is 1.9 inches of mercury higher than the pressure when the eye of the hurricane passed over.

a. Write an addition equation to represent the situation. \(b + 2.9 = 29.7\)

b. What was the barometric pressure when the eye passed over? \(26.8\) in. of mercury

24. ROLLER COASTERS Kingda Ka in New Jersey is the tallest and fastest roller coaster in the world. Riders travel at an average speed of 61 feet per second for 3118 feet. They reach a maximum speed of 187 feet per second.

a. If \(x\) represents the total time that the roller coaster is in motion for each ride, write an expression to represent the situation. \(61x = 3118\)

b. How long is the roller coaster in motion? \(51.1\) seconds

Chapter 2

2-2 Word Problem Practice

Solving One-Step Equations

1. SUPREME COURT Chief Justice William Rehnquist served on the Supreme Court for 33 years until his death in 2005. Write and solve an equation to determine the year he was confirmed as a justice on the Supreme Court.

2005 \(- x = 33; x = 1972\)

2. SALARY In a recent year, the annual salary of the Governor of New York was $179,000. During the same year, the annual salary of the Governor of Tennessee was $94,000 less. Write and solve an equation to determine what the annual salary of the Governor of Tennessee in that year.

179,000 \(- 94,000 = s\) or
179,000 \(- s = 94,000; s = 85,000\)

3. WEATHER On a cold January day, Mavis noticed that the temperature dropped 21 degrees over the course of the day to -9°C. Write and solve an equation to determine what the temperature was at the beginning of the day.

\(x - 21 = -9; x = 12°C\)

4. FARMING Mr. Hill’s farm is 126 acres. Mr. Hill’s farm is \(\frac{2}{3}\) the size of Mr. Miller’s farm. How many acres is Mr. Miller’s farm?

504 acres

5. NAUTICAL On the sea, distances are measured in nautical miles rather than miles.

a. If a boat travels 16 knots in 1 hour, how far will it have traveled in feet?

\(6080\) feet

b. About how fast was the boat traveling in miles per hour? Round your answer to the nearest hundredth.

\(18.42\) mph

Glencoe Algebra 1

Lesson 2-2
Solve Multi-Step Equations

To solve equations with more than one operation, often called multi-step equations, undo operations by working backward. Reverse the usual order of operations as you work.

Example

Solve $5x + 3 = 23$.

Original equation

$5x + 3 = 23$

Subtract 3 from each side.

$\frac{5x}{5} = \frac{20}{5}$

Divide each side by 5.

$x = 4$

Solve each equation. Check your solution.

1. $5x + 3 = 23$
   
   $5x + 3 = 23$
   
   Subtract 3 from each side.
   
   $\frac{5x}{5} = \frac{20}{5}$
   
   Divide each side by 5.
   
   $x = 4$

2. $3x - 5 = 17$
   
   $3x - 5 = 17$
   
   Add 5 to each side.
   
   $3x = 22$
   
   Divide each side by 3.
   
   $x = \frac{22}{3}$

3. $2x + 4 = 16$
   
   $2x + 4 = 16$
   
   Subtract 4 from each side.
   
   $2x = 12$
   
   Divide each side by 2.
   
   $x = 6$

4. $4x - 8 = 12$
   
   $4x - 8 = 12$
   
   Add 8 to each side.
   
   $4x = 20$
   
   Divide each side by 4.
   
   $x = 5$

5. $-2x + 7 = 13$
   
   $-2x + 7 = 13$
   
   Subtract 7 from each side.
   
   $-2x = 6$
   
   Divide each side by $-2$.
   
   $x = -3$

6. $3x - 6 = 18$
   
   $3x - 6 = 18$
   
   Add 6 to each side.
   
   $3x = 24$
   
   Divide each side by 3.
   
   $x = 8$

7. $2x + 5 = 15$
   
   $2x + 5 = 15$
   
   Subtract 5 from each side.
   
   $2x = 10$
   
   Divide each side by 2.
   
   $x = 5$

8. $3x - 4 = 13$
   
   $3x - 4 = 13$
   
   Add 4 to each side.
   
   $3x = 17$
   
   Divide each side by 3.
   
   $x = \frac{17}{3}$

9. $4x + 5 = 19$
   
   $4x + 5 = 19$
   
   Subtract 5 from each side.
   
   $4x = 14$
   
   Divide each side by 4.
   
   $x = \frac{7}{2}$

10. $-3x + 2 = 7$
    
    $-3x + 2 = 7$
    
    Subtract 2 from each side.
    
    $-3x = 5$
    
    Divide each side by $-3$.
    
    $x = -\frac{5}{3}$

11. $5x - 9 = 23$
    
    $5x - 9 = 23$
    
    Add 9 to each side.
    
    $5x = 32$
    
    Divide each side by 5.
    
    $x = \frac{32}{5}$

12. $2x + 3 = 11$
    
    $2x + 3 = 11$
    
    Subtract 3 from each side.
    
    $2x = 8$
    
    Divide each side by 2.
    
    $x = 4$

13. $3x - 5 = 12$
    
    $3x - 5 = 12$
    
    Add 5 to each side.
    
    $3x = 17$
    
    Divide each side by 3.
    
    $x = \frac{17}{3}$

14. $-2x + 4 = 10$
    
    $-2x + 4 = 10$
    
    Subtract 4 from each side.
    
    $-2x = 6$
    
    Divide each side by $-2$.
    
    $x = -3$

15. $3x - 7 = 19$
    
    $3x - 7 = 19$
    
    Add 7 to each side.
    
    $3x = 26$
    
    Divide each side by 3.
    
    $x = \frac{26}{3}$

16. $4x - 9 = 13$
    
    $4x - 9 = 13$
    
    Add 9 to each side.
    
    $4x = 22$
    
    Divide each side by 4.
    
    $x = \frac{11}{2}$

17. $2x + 5 = 11$
    
    $2x + 5 = 11$
    
    Subtract 5 from each side.
    
    $2x = 6$
    
    Divide each side by 2.
    
    $x = 3$

18. $3x - 2 = 7$
    
    $3x - 2 = 7$
    
    Add 2 to each side.
    
    $3x = 9$
    
    Divide each side by 3.
    
    $x = 3$

19. $5x + 2 = 12$
    
    $5x + 2 = 12$
    
    Subtract 2 from each side.
    
    $5x = 10$
    
    Divide each side by 5.
    
    $x = 2$

20. $2x + 3 = 11$
    
    $2x + 3 = 11$
    
    Subtract 3 from each side.
    
    $2x = 8$
    
    Divide each side by 2.
    
    $x = 4$

21. $4x - 7 = 13$
    
    $4x - 7 = 13$
    
    Add 7 to each side.
    
    $4x = 20$
    
    Divide each side by 4.
    
    $x = 5$

22. $3x + 4 = 17$
    
    $3x + 4 = 17$
    
    Subtract 4 from each side.
    
    $3x = 13$
    
    Divide each side by 3.
    
    $x = \frac{13}{3}$

23. $2x + 7 = 15$
    
    $2x + 7 = 15$
    
    Subtract 7 from each side.
    
    $2x = 8$
    
    Divide each side by 2.
    
    $x = 4$

24. $3x - 2 = 11$
    
    $3x - 2 = 11$
    
    Add 2 to each side.
    
    $3x = 13$
    
    Divide each side by 3.
    
    $x = \frac{13}{3}$

25. $4x + 3 = 17$
    
    $4x + 3 = 17$
    
    Subtract 3 from each side.
    
    $4x = 14$
    
    Divide each side by 4.
    
    $x = \frac{7}{2}$

26. $5x - 7 = 13$
    
    $5x - 7 = 13$
    
    Add 7 to each side.
    
    $5x = 20$
    
    Divide each side by 5.
    
    $x = 4$
2-3 Practice
Solving Multi-Step Equations

Solve each problem by working backward.

1. Three is added to a number, and then the sum is multiplied by 4. The result is 16. Find the number.
   \[ 7.15t + 4 = 49 \]

2. A number is divided by 4, and the quotient is added to 3. The result is 24. What is the number?
   \[ 4. \]

3. Two is subtracted from a number, and then the difference is multiplied by 5. The result is 30. Find the number.
   \[ 8. \]

4. BIRD WATCHING While Michelle sat observing birds at a bird feeder, one fourth of the birds flew away when they were startled by a noise. Two birds left the feeder to go to another station a few feet away. Three more birds flew into the branches of a nearby tree. Four birds remained at the feeder. How many birds were at the feeder initially?
   \[ 12. \]

Solve each equation. Check your solution.

5. \[ -12n - 19 = 77 \]
   \[ -8. \]

6. \[ 6.17 + 3f = 14 - 1 \]
   \[ -1. \]

7. \[ 7.15t + 4 = 49 \]
   \[ 3. \]

8. \[ \frac{5}{9} + 6 = 2 - 20 \]
   \[ -20. \]

9. \[ \frac{1}{4} + 3 = 15 - 48 \]
   \[ -10. \]

10. \[ \frac{5}{9} - 6 = -2 - 12 \]
    \[ 12. \]

11. \[ \frac{1}{2}y - \frac{1}{8} = \frac{7}{8} \]
    \[ 2. \]

12. \[ -32 - \frac{3}{5}f = -17 - 25 \]
    \[ -13. \]

13. \[ \frac{8}{3}k = -4 \]
    \[ 32. \]

14. \[ \frac{15 - a}{3} = -9 \]
    \[ 42. \]

15. \[ \frac{3k - 7}{5} = 16 \]
    \[ 29. \]

16. \[ \frac{11}{2} - 0.5 = 2.5 \]
    \[ 21. \]

17. \[ 25g + 0.45 = 0.95 \]
    \[ 0.2. \]

18. \[ 0.4m - 0.7 = 0.22 \]
    \[ 2.3. \]

Write an equation and solve each problem.

19. Seven less than four times a number equals 13. What is the number?
    \[ 4n - 7 = 13; 5. \]

20. Find two consecutive odd integers whose sum is 116.
    \[ n + (n + 2) = 116; 57, 59. \]

21. Find two consecutive even integers whose sum is 126.
    \[ n + (n + 2) = 126; 62, 64. \]

22. Find three consecutive odd integers whose sum is 117.
    \[ n + (n + 2) + (n + 4) = 117; 37, 39, 41. \]

23. COIN COLLECTING Jung has a total of 92 coins in his coin collection. This is 8 more than three times the number of quarters in the collection. How many quarters does Jung have in his collection?
    \[ 28. \]
2-4 Study Guide and Intervention (continued)

Solving Equations with the Variable on Each Side

Grouping Symbols When solving equations that contain grouping symbols, first use the Distributive Property to eliminate grouping symbols. Then solve.

Example
Solve \(4(2a - 1) = -10(a - 5)\).

\[
\begin{align*}
4(2a - 1) &= -10(a - 5) \\
8a - 4 &= -10a + 50 \\
8a + 10a &= 50 + 4 \\
18a &= 54 \\
18a &= 54/18 \\
a &= 3
\end{align*}
\]

The solution is 3.

Exercises
Solve each equation. Check your solution.

1. \(-3(x + 5) = 3x - 1\)
2. \(-2(t + 3) = -t\)
3. \(3x + 1) - 5 = 3a - 2\)
4. \(75 - 9g = 5(-4 + 2g)\)
5. \(5f + 2 = 23 - f\)
6. \(4p + 3 = 36\)
7. \(18 = 3(2t + 2)\)
8. \(3x = 3(2t + 2)\)
9. \(5p + 3) = 3p - 2 + 6\)
10. \(4x - 2 = 6(5 - b)\)
11. \(12x - 2 = 2 - x\)
12. \(3 + x = \frac{-y}{8}\)
13. \(12 - \frac{8}{3} = \frac{2x + 5}{3}\)
14. \(2(4 + 2x) + 10 = k\)
15. \(2(w - 1) + 4 = 4(w + 1)\)
16. \(6(n - 1) = 2(2a + 4)\)
17. \(2(2x - 1) = 22\)
18. \(-4(r + 2) = 4(2 - 4y)\)
19. \(-3(x - 8) = 24\)
20. \(4(4 - 4k) = -10 - 16k\)
21. \(6(2 - 2y) = 5(2y - 2)\)

2-4 Skills Practice

Solving Equations with the Variable on Each Side

Justify each step:

1. \(4k - 3 = 2k + 5\)
   \(4k - 3 - 2k = 2k + 5 - 2k\)
   \(2k - 3 = 5\)
   \(2k = 8\)
   \(k = \frac{8}{2}\)
   \(k = 4\)

2. \(2(8u + 2) = 3(2u - 7)\)
   \(16u + 4 = 6u - 21\)
   \(16u + 4 - 6u = 6u - 21 - 6u\)
   \(10u + 4 = -21 - 4\)
   \(10u = -25\)
   \(u = \frac{-25}{10}\)
   \(u = -2.5\)

3. \(2n + 12 = 3n - 31\)
4. \(2h - 8 = k + 17\)
5. \(7a - 3 = -2a + 2\)
6. \(4a = 12 = 12 - 4a\)
7. \(4x - 9 = 7x + 12 = -7\)
8. \(-6y = 3 - 3 - 6y\)
9. \(5 + 3r = 5r - 19\)
10. \(-9 + 8k = 7 + 4k\)
11. \(8y + 12 = 4(3 + 2y)\)
12. \(3(5j + 2) = 3(5 - 6)\)
13. \(6 - 3c = 1) - 5(-2c - 2)\)
14. \(-7(2b - 4) = 5(-2b + 5)\)
15. \(3b - 3c = 5(2b + t)\)
16. \(2(3u + 7) = -4(3 - 2h)\)
17. \(32f - 2b = 7(3f + 2b)\)
18. \(5(6 - 3d - 3d = 3b + 7d)\)
19. \(6w - 1) = 3(3x + 5)\)
20. \(7(3y + 2) = 8y - 2\)
21. \(\frac{3}{9} = 6 - 6 - \frac{3}{9}\)
22. \(\frac{1}{2} - \frac{3}{4} = \frac{3}{8} + \frac{1}{2} - 2\)
4. OLYMPICS In the 2010 Winter Olympic Games in Vancouver, Canada, the United States athletes won 1 more than 4 times the number of gold metals won by the French athletes. The United States won 7 more gold metals than the French. Solve the equation \(7 + P = 4P + 1\) to find the number of gold metals won by the French athletes.

2. AGE Diego’s mother is twice as old as he is. She is also as old as the sum of the ages of Diego and both of his younger twin brothers. The twins are 11 years old. Solve the equation \(2d = d + 11 + 11\) to find the age of Diego.

22 years old

3. GEOMETRY Supplementary angles are angles whose measures have a sum of 180°. Complementary angles are angles whose measures have a sum of 90°. Find the measure of an angle whose supplement is 10° more than twice its complement. Let \(90 - x\) equal the degree measure of its complement and \(180 - x\) equal the degree measure of its supplement. Write and solve an equation.

\[180 - x = 10 + 2(90 - x); 10\]

2. NATURE The table shows the current heights and average growth rates of two different species of trees. How long will it take for the two trees to be the same height?

<table>
<thead>
<tr>
<th>Tree Species</th>
<th>Current Height</th>
<th>Annual Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>38 inches</td>
<td>4 inches</td>
</tr>
<tr>
<td>B</td>
<td>45.5 inches</td>
<td>2.5 inches</td>
</tr>
</tbody>
</table>

\[
38 + 4x = 45.5 + 2.5x
\]

1.5x = 7.5

x = 5 years

5. NUMBER THEORY Mrs. Simms told her class to find two consecutive even integers such that twice the lesser of two integers is 4 less than two times the greater integer.

a. Write and solve an equation to find the integers. Let integers be \(n\) and \((n + 2)\)

\[2n = 2(n + 2) - 4\]

\[2n = 2n + 4 - 4\]

\[2n = 2n\]

\[1 = 1, n \neq 0\]

b. Does the equation have one solution, no solutions, or is it an identity? Explain.

It is an identity because it is true for every pair of consecutive even integers.
**Skills Practice**

**Solving Equations Involving Absolute Value**

Evaluate each expression if \( a = 2, b = -3, \) and \( c = -4. \)

1. \( |a - b| - 2 \)
2. \( |b + 1| + 8 \)
3. \( 5 - |c + 1| \)
4. \( |a + b| - c \)

Solve each equation. Then graph the solution set.

5. \( |w + 1| = 5 \quad \{-6, 4\} \)
6. \( |c - 3| = 1 \quad \{2, 4\} \)
7. \( |n + 2| = 1 \quad \{-3, -1\} \)
8. \( |t + 6| = 4 \quad \{-10, -2\} \)
9. \( |w - 2| = 2 \quad \{0, 4\} \)
10. \( |k - 1| = 4 \quad \{1, 9\} \)

Write an equation involving absolute value for each graph.

11. \( |x| = 1 \)
12. \( |x + 3| = 2 \)
13. \( |x - 4| = 1 \)
14. \( |x| = 4 \)

13. **FITNESS** Taisha uses the elliptical cross-trainer at the gym. Her general goal is to burn 280 Calories per workout, but she varies by as much as 25 Calories from this amount on any given day. Write and solve an equation to find the maximum and minimum number of Calories Taisha burns on the cross-trainer.

\[ \{c - 280\} = 25; \text{min}=255; \text{max}=305 \]

14. **TEMPERATURE** A thermometer is guaranteed to give a temperature no more than 1.2°F from the actual temperature. If the thermometer reads 28°F, write and solve an equation to find the maximum and minimum temperatures it could be.

\[ \{t - 28\} = 1.2; \text{min}=26.8°F; \text{max}=29.2°F \]
State whether each percent of change is a percent of increase or a percent of decrease. Then find each percent of change. Round to the nearest whole percent.

1. original: 25  
   new: 10  
   decrease; 60%

2. original: 50  
   new: 28  
   increase; 50%

3. original: 55  
   new: 95  
   increase; 12%

4. original: 10  
   new: 60  
   decrease; 9%

5. original: 50  
   new: 30  
   decrease; 40%

6. original: 48  
   new: 60  
   increase; 25%

Find the total price of each item.

9. dress: $69.00  
   tax: 5%  
   $72.45

10. binder: $14.50  
    tax: 6%  
    $15.52

11. crib: $240.00  
    tax: 6.5%  
    $255.60

12. class ring: $325.00  
    tax: 5.5%  
    $344.50

Find the discounted price of each item.

16. dry cleaning: $25.00  
   discount: 15%  
   $21.25

17. computer game: $49.99  
   discount: 25%  
   $37.49

18. luggage: $185.00  
   discount: 30%  
   $129.50

Find the final price of each item.

22. television: $375.00  
   discount: 20%  
   $298.13

23. printer: $255.00  
   discount: 30%  
   $188.32

24. INVESTMENTS The price per share of a stock decreased from $80 per share to $36 per share. By what percent did the price of the stock decrease?
   decrease; 60%

25. HEATING COSTS Customers of a utility company received notices in their monthly bills that heating costs for the average customer had increased 125% over last year because of an unusually severe winter. In January of last year, the Garcia's paid $120 for heating. What should they expect to pay this January if their bill increased by 125%?
   $270
5. **MUSIC** The table below shows the total number of CDs, downloaded singles, and music videos sold in 2004, 2006, and 2008.

| Sales of Recorded Music and Music Videos (millions of units) |
|-----------------|-----------------|-----------------|
| Format          | 2004            | 2006            | 2008            |
| CD              | 7670            | 614.9           | 368.4           |
| Downloaded      | 139.4           | 566.4           | 1042.7          |
| Video           | 32.8            | 23.1            | 20.8            |

Source: Recording Industry Association of America

**a.** Find the percent of change in the number of units sold between 2004 and 2006 and between 2006 and 2008 for each format. Round your answers to the nearest tenth.

CD: Increase; 40.1%
Downloaded: Increase; 77.8%
Video: Increase; 10.0%

**b.** Tell whether each percent of change in part **a** is a percent of increase or a percent of decrease.

CD: Increase; 40.1%
Downloaded: Increase; 77.8%
Video: Increase; 10.0%

**c.** Did these trends change from 2004 to 2008? Explain.

The CD sales and video sales decreased in both time periods and downloaded sales increased both time periods.

4. **CARS** Mr. Thompson plans to purchase a used car priced at $8400. He will receive a 15% employee discount and then will have to pay a 5.5% sales tax. What will be the final price of the car?

\[
\text{Final Price} = 8400 - (0.15 \times 8400) + (0.055 \times (8400 - 0.15 \times 8400)) = 2288.2
\]

CARS

**5.** Use what you have learned about percent to solve each problem.

**a.** Find the percent of change in the number of units sold during a show.

T = the number of TV households
x = the number of TV households with the TV on.

\[
0.15T = 0.25(T - x) \\
x = \frac{0.10T}{0.43} \\
Solve for \ x.
\]

Forty percent of the TV households had their TVs off when the movie was aired.

**b.** Find the percent of TV households with their TVs turned off during a show with a rating of 18.9 and a 29 share.

\[
S = 0.29(T - x) \\
x = \frac{0.18T}{0.71} \\
Solve for \ x.
\]

The percent of TV households with their TVs turned off was about 48.6%.

**c.** Did these trends change from 2004 to 2008? Explain.

The sales tax is 6.5%. What is the total price of the movie, including tax?

\[
\text{Total Price} = 21.99 + (0.065 \times 21.99) = 23.42
\]

**2-7 Enrichment**

**Using Percent**

Use what you have learned about percent to solve each problem.

A TV movie had a “rating” of 15 and a 25 “share.” The rating is the percentage of the nation’s total TV households that were tuned in to this show. The share is the percentage of homes with TVs turned on that were tuned to the movie. How many TV households had their TVs turned off at this time?

To find out, let \( T \) = the number of TV households and \( x \) = the number of TV households with the TV off.

\[
0.15T = 0.25(T - x) \\
x = \frac{0.10T}{0.45} \\
The percent of TV households with their TVs off was about 48.6%.
\]

4. If the fraction of TV households with no TV on is \( \frac{a}{b} \) then show that the fraction of TV households with TVs on is \( \frac{a}{b} - \frac{a}{b} = \frac{a}{b} \).

5. Find the percent of TV households with TVs on during the most watched serial program in history: the last episode of M*A*S*H, which had a 60.3 rating and a 77 share. \( \frac{60.3}{77} = 78.3\% \)

6. A local station now has a 2 share. Each share is worth $50,000 in advertising revenue per month. The station is thinking of going commercial free for the three months of summer to gain more listeners. What would its new share have to be for the last 4 months of the year to make more money for the year than it would have made had it not gone commercial free? Greater than 3.5
Chapter 2

2-7 Spreadsheet Activity

Discounts

Electronics Warehouse is having a software clearance sale. The manager is making a discounted price list to distribute to customers as they shop. Different tables will have software that is discounted by a different percent. Use a spreadsheet to show the discounted price of software that is originally priced $5.99, $7.99, $9.99, $15.99, $19.99, $23.99, $27.99, $29.99, $33.99, and $35.99. Compute discounted prices for software that is 10%, 15%, 25%, and 50% off.

If an item is on sale for 10% off, that means that discounted price is (1 – 0.1) or 0.9 times the original price. Use this pattern to complete the spreadsheet.

Step 1 Use Column A of the spreadsheet for the original prices.

Step 2 Columns B through E contain the formulas for the discounted prices.

Step 3 Because these are prices, the numbers must be rounded to 2 digits. You can program the spreadsheet to list the information as dollars and cents by choosing currency from the number menu when you format the cells.

Exercise

1. For the second week of the sale, the Electronics Warehouse manager is changing the discounts to 20%, 30%, 45%, and 75% off. Use a spreadsheet to create a new discount price list for the software. See students' work.

2. How should the spreadsheet be altered if the manager wished to show the final prices of the software including the 6% sales tax for their area? Multiply each discounted price by 1.06.

Chapter 2

2-8 Study Guide and Intervention

Literal Equations and Dimensional Analysis

Solve for Variables Sometimes you may want to solve an equation such as V = ℓw for one of its variables. For example, if you know the values of V, w, and h, then the equation ℓ = \( \frac{V}{wh} \) is more useful for finding the value of ℓ. If an equation contains more than one variable to be solved for a specific variable, use the properties of equality to isolate the specified variable on one side of the equation.

Example 1 Solve 2x – 4y = 8, for y.

\[ 2x - 4y = 8 \]
\[ -4y = 8 - 2x \]
\[ y = \frac{8 - 2x}{-4} \]
\[ y = -\frac{2x - 8}{4} \]

The value of y is \( -\frac{2x - 8}{4} \).

Example 2 Solve 3m - n = km - 8, for m.

\[ 3m - n - km = -8 \]
\[ 3m - km = -8 + n \]
\[ 3m = -8 + n + km \]
\[ m = \frac{-8 + n + km}{3} \]

The value of m is \( \frac{-8 + n + km}{3} \). Since division by 0 is undefined, \( 3 - k \neq 0 \) or \( k \neq 3 \).

Exercises

Solve each equation or formula for the variable indicated.

1. \( ax - b = c \), for \( x \)
2. \( 15x + 1 = y \), for \( x \)
3. \( (s + f) + 2 = j \), for \( x \)
4. \( ary + w = 9 \), for \( y \)
5. \( x(4 - k) = p \), for \( k \)
6. \( 7x + 3y = m \), for \( y \)
7. \( 4(r + 3) = t \), for \( r \)
8. \( 2s + b = w \), for \( s \)
9. \( x(1 + y) = z \), for \( x \)
10. \( 16w + 4x = y \), for \( x \)
11. \( d = n \), for \( r \)
12. \( A = \frac{9(x + b)}{a} \), for \( a \)
13. \( C = \frac{3(N - 32)}{F} \), for \( F \)
14. \( P = 2f + 2w \), for \( P \)
15. \( A = \frac{e}{w} \), for \( \ell \)

Chapter 2

A23 Algebra 1

Answers (Lesson 2-7 and Lesson 2-8)
Skills Practice

Literal Equations and Dimensional Analysis

Use Formulas Many real-world problems require the use of formulas. Sometimes solving a formula for a specified variable will help you solve the problem.

Example: The formula \( C = \pi d \) represents the circumference of a circle, or the distance around the circle, where \( d \) is the diameter. If an airplane could fly around Earth at the equator without stopping, it would have traveled about 24,900 miles. Find the diameter of Earth.

\[ C = \pi d \quad \text{Given formula} \]
\[ d = \frac{C}{\pi} \quad \text{Solve for} \ d \]
\[ d = \frac{24,900}{3.14} \quad \text{Use} \ \pi \approx 3.14. \]
\[ d = 7930 \quad \text{Simplify.} \]

The diameter of Earth is about 7930 miles.

Exercises

1. GEOMETRY The volume of a cylinder \( V \) is given by the formula \( V = \pi r^2h \), where \( r \) is the radius and \( h \) is the height.
   a. Solve the formula for \( h \). \( h = \frac{V}{\pi r^2} \)
   b. Find the height of a cylinder with volume 2500 cubic feet and radius 10 feet. \( 25 \text{ ft} \)

2. WATER PRESSURE The water pressure on a submerged object is given by \( P = \rho gh \), where \( P \) is the pressure in pounds per square foot, \( \rho \) is the density of water, and \( h \) is the depth of the object in feet.
   a. Solve the formula for \( h \). \( h = \frac{P}{\rho g} \)
   b. Find the depth of a submerged object if the pressure is 672 pounds per square foot. \( 20 \text{ ft} \)

3. GRAPH The equation of a line containing the points \((a, 0)\) and \((0, b)\) is given by the formula \( y = bx + a \).
   a. Solve the equation for \( y \). \( y = b(x - \frac{a}{x}) \)
   b. Suppose the line contains the points \((4, 0)\), \((0, -2)\). If \( x = 3 \), find \( y \). \( y = -\frac{1}{2} \)

4. GEOMETRY The surface area of a rectangular solid is given by the formula \( S = 2ℓw + 2ℓh + 2wh \), where \( ℓ \) is the length, \( w \) is the width, and \( h \) is the height.
   a. Solve the formula for \( h \). \( h = \frac{S - 2ℓw}{2ℓ + 2w} \)
   b. The surface area of a rectangular solid with length 6 centimeters and width 3 centimeters is 72 square centimeters. Find the height. \( 2 \text{ cm} \)

5. 7a - b = 15a, for \( a \) \( a = -\frac{b}{8} \)

6. \( 4m - t = m \), for \( m \) \( m = \frac{t}{3} \)

7. \( x - 2y = 1 \), for \( y \) \( y = \frac{x - 1}{2} \)

8. \( d + 3n = 1 \), for \( n \) \( n = \frac{1 - d}{3} \)

9. \( 7f + g = 5 \), for \( f \) \( f = \frac{5 - g}{7} \)

10. \( ax - c = b \), for \( x \) \( x = \frac{b + c}{a} \quad ; \quad a \neq 0 \)

11. \( rt - 2n = y \), for \( t \) \( t = \frac{2n + y}{r} \quad ; \quad r \neq 0 \)

12. \( bc + 3g = 2k \), for \( c \) \( c = \frac{2k - 3g}{b} \quad ; \quad b \neq 0 \)

13. \( kn + 4f = 9v \), for \( n \) \( n = \frac{9v - 4f}{k} \quad ; \quad k \neq 0 \)

14. \( 8c + 6j = 5p \), for \( c \) \( c = \frac{5p - 6j}{8} \)

15. \( \frac{3 - c}{2} = d \), for \( x \) \( x = c + 2d \)

16. \( \frac{3 - c}{2} = d \), for \( c \) \( c = x - 2d \)

17. \( p + 9 = r \), for \( p \) \( p = 5r - 9 \)

18. \( \frac{b - 4c}{7} = a \), for \( b \) \( b = 7a + 4z \)

19. The volume of a box \( V \) is given by the formula \( V = ℓwh \), where \( ℓ \) is the length, \( w \) is the width, and \( h \) is the height.
   a. Solve the formula for \( h \). \( h = \frac{V}{ℓw} \)
   b. What is the height of a box with a volume of 50 cubic meters, length of 10 meters, and width of 2 meters? \( 2.5 \text{ m} \)

20. Trent purchases 44 euros worth of souvenirs while on vacation in France. If $1 U.S. = 0.678 euros, find the cost of the souvenirs in United States dollars. Round to the nearest cent. \$64.90
2-8 Practice

Literal Equations and Dimensional Analysis

Solve each equation or formula for the variable indicated.

1. \(d = rt\), for \(r = \frac{d}{t}\)

2. \(6w - y = 2x\), for \(w = \frac{2x + y}{6}\)

3. \(mx + 4y = 3t\), for \(x = \frac{3t - 4y}{m}\); \(m \neq 0\)

4. \(9s - 5g = -4u\), for \(s = \frac{-4u + 5g}{9}\)

5. \(ab + 3c = 2x\), for \(b = \frac{2x - 3c}{a}\); \(a \neq 0\)

6. \(2p = kx - t\), for \(x = \frac{2p + t}{k}\); \(k \neq 0\)

7. \(\frac{2}{3}m + a = a + r\), for \(m = \frac{3}{2}r\)

8. \(\frac{3}{2}h + g = d\), for \(h = \frac{5}{2}(d - g)\)

9. \(\frac{2}{3}y + v = x\), for \(y = \frac{3}{2}(x - v)\)

10. \(\frac{3}{4}a - q = k\), for \(a = \frac{4}{3}(k + q)\)

11. \(\frac{5}{3}a + b = h\), for \(x = \frac{5h - b}{r}\); \(r \neq 0\)

12. \(\frac{3}{2}b - 4 = c\), for \(b = \frac{2c + 4}{3}\)

13. \(2w - y = 7w - 2\), for \(w = \frac{2 - y}{5}\)

14. \(3t + y = 5 + 5f\), for \(t = \frac{y - 5}{2}\)

15. ELECTRICITY The formula for Ohm’s Law is \(E = IR\), where \(E\) represents voltage measured in volts, \(I\) represents current measured in amperes, and \(R\) represents resistance measured in ohms.

a. Solve the formula for \(R\). \(R = \frac{E}{I}\)

b. Suppose a current of 0.25 amperes flows through a resistor connected to a 12-volt battery. What is the resistance in the circuit? 48 ohms

16. MOTION In uniform circular motion, the speed \(v\) of a point on the edge of a spinning disk is \(v = \frac{2\pi r}{t}\), where \(r\) is the radius of the disk and \(t\) is the time it takes the point to travel once around the circle.

a. Solve the formula for \(r\). \(r = \frac{tv}{2\pi}\)

b. Suppose a merry-go-round is spinning once every 3 seconds. If a point on the outside edge has a speed of 12.56 feet per second, what is the radius of the merry-go-round? (Use 3.14 for \(\pi\)). 6 ft

17. HIGHWAYS Interstate 90 is the longest interstate highway in the United States, connecting the cities of Seattle, Washington and Boston, Massachusetts. The interstate is 4,987,000 meters in length. If 1 mile = 1.609 kilometers, how many miles long is Interstate 90? 3099 mi

2-8 Word Problem Practice

Literal Equations and Dimensional Analysis

1. INTEREST Simple interest that you may earn on money in a savings account can be calculated with the formula \(I = prt\). \(I\) is the amount of interest earned, \(p\) is the principal or initial amount invested, \(r\) is the interest rate, and \(t\) is the amount of time the money is invested for. Solve the formula for \(p\).

\[ p = \frac{I}{rt}\]

2. DISTANCE The distance \(d\) a car can travel is found by multiplying its rate of speed \(r\) by the amount of time \(t\) that it took to travel the distance. If a car has already traveled 5 miles, the total distance \(d\) is found by the formula \(d = rt + 5\). Solve the formula for \(r\).

\[ r = \frac{d - 5}{t}\]

3. ENVIRONMENT The United States released 5.877 billion metric tons of carbon dioxide into the environment through the burning of fossil fuels in a recent year. If 1 trillion pounds = 0.4536 billion metric tons, how many trillion pounds of carbon dioxide did the United States release in that year?

\[ \approx 12.96\] 15 pounds

4. PHYSICS The pressure exerted on an object is calculated by the formula \(F = \frac{P}{A}\), where \(F\) is the force, \(P\) is the pressure, and \(A\) is the surface area of the object. Water shooting from a hose has a pressure of 75 pounds per square inch (psi). Suppose the surface area covered by the direct hose spray is 0.442 square inch. Solve the equation for \(F\) and find the force of the spray. 33.15 pounds

5. GEOMETRY The regular octagon is divided into 8 congruent triangles. Each triangle has an area of 21.7 square centimeters. The perimeter of the octagon is 48 centimeters.

a. What is the length of each side of the octagon?

6 centimeters

b. Solve the area of a triangle formula for \(h\).

\[ h = \frac{2A}{b}\]

c. What is the height of each triangle? Round to the nearest tenth.

7.2 centimeters
Chapter 2

2-8 Enrichment

Compound Interest

In most banks, interest on savings accounts is compounded at set time periods such as three or six months. At the end of each period, the bank adds the interest earned to the account. During the next period, the bank pays interest on all the money in the bank, including interest. In this way, the account earns interest on interest.

Suppose Ms. Tanner has $1000 in an account that is compounded quarterly at 5%. Find the balance after the first two quarters.

Use $I = prt$ to find the interest earned in the first quarter if $p = 1000$ and $r = 5\%$. Why is $t$ equal to $\frac{1}{4}$?

First quarter: $I = 1000 \times 0.05 \times \frac{1}{4}$

$I = 12.50$

The interest, $12.50, earned in the first quarter is added to $1000$.

Second quarter: $I = 1012.50 \times 0.05 \times \frac{1}{4}$

$I = 12.65625$

The interest in the second quarter is $12.66$.

The balance after two quarters is $1012.50 + 12.66$ or $1025.16$.

Answer each of the following questions.

1. How much interest is earned in the third quarter of Ms. Tanner's account? $I = \text{?} 12.81$

2. What is the balance in her account after three quarters? $\text{?} 1037.97$

3. How much interest is earned in the fourth quarter? $I = \text{?} 12.97$

4. What is the balance in her account after one year? $\text{?} 1050.94$

5. Suppose Ms. Tanner’s account is compounded semiannually. What is the balance at the end of six months? $\text{?} 1025.00$

6. What is the balance after one year if her account is compounded semiannually? $\text{?} 1050.63$

2-9 Study Guide and Intervention

Weighted Averages

Mixture Problems Mixture Problems are problems where two or more parts are combined into a whole. They involve weighted averages. In a mixture problem, the weight is usually a price or a percent of something.

Example COOKIES Delectable Cookie Company sells chocolate chip cookies for $6.95 per pound and white chocolate cookies for $5.95 per pound. How many pounds of chocolate chip cookies should be mixed with 4 pounds of white chocolate cookies to obtain a mixture that sells for $6.75 per pound.

Let $w = \text{number of pounds of chocolate chip cookies}$.

First quarter: $I = 1000 \times 0.05 \times \frac{1}{4}$

$I = 12.50$

The principal becomes $1012.50$.

Second quarter: $I = 1012.50 \times 0.05 \times \frac{1}{4}$

$I = 12.65625$

Third quarter: $I = 1012.50 \times 0.05 \times \frac{1}{4}$

$I = 12.65625$

Fourth quarter: $I = 1012.50 \times 0.05 \times \frac{1}{4}$

$I = 12.65625$

The interest in the second quarter is $12.66$.

The balance after two quarters is $1012.50 + 12.66$ or $1025.16$.

Answer each of the following questions.

1. How much interest is earned in the third quarter of Ms. Tanner’s account? $I = \text{?} 12.81$

2. What is the balance in her account after three quarters? $\text{?} 1037.97$

3. How much interest is earned in the fourth quarter? $I = \text{?} 12.97$

4. What is the balance in her account after one year? $\text{?} 1050.94$

5. Suppose Ms. Tanner’s account is compounded semiannually. What is the balance at the end of six months? $\text{?} 1025.00$

6. What is the balance after one year if her account is compounded semiannually? $\text{?} 1050.63$

Exercises

1. SOLUTIONS How many grams of sugar must be added to 60 grams of a solution that is 32% sugar to obtain a solution that is 50% sugar? $21.6 \text{ g}$

2. NUTS The Quik Mart has two kinds of nuts. Pecans sell for $1.55 per pound and walnuts sell for $1.95 per pound. How many pounds of pecans must be added to 15 pounds of walnuts to make a mixture that sells for $1.75 per pound? $15 \text{ lb}$

3. INVESTMENTS Alice Gleason invested a portion of $32,000 at 9% interest and the balance at 11% interest. How much did she invest at each rate if her total income from both investments was $3200$. $16,000 \text{ at } 9\% \text{ and } 16,000 \text{ at } 11\%$

4. MILK Whole milk is 4% butterfat. How much skim milk with 0% butterfat should be added to 32 ounces of whole milk to obtain a mixture that is 2.5% butterfat? $19.2 \text{ oz}$
2-9 Study Guide and Intervention (continued)

Weighted Averages

Uniform Motion Problems Motion problems are another application of weighted averages. Uniform motion problems are problems where an object moves at a certain speed, or rate. Use the formula \( d = rt \) to solve these problems, where \( d \) is the distance, \( r \) is the rate, and \( t \) is the time.

Example DRIVING Bill Gutierrez drove at a speed of 65 miles per hour on an expressway for 2 hours. He then drove for 1.5 hours at a speed of 45 miles per hour on a state highway. What was his average speed?

\[ M = \frac{65 \cdot 2 + 45 \cdot 1.5}{2 + 1.5} \]

Definition of weighted average

\[ \approx 56.4 \]

Simplify

Bill drove at an average speed of about 56.4 miles per hour.

Exercises

1. TRAVEL Mr. Anders and Ms. Rich each drove home from a business meeting. Mr. Anders traveled east at 100 kilometers per hour and Ms. Rich traveled west at 80 kilometers per hour. In how many hours were they 100 kilometers apart?

2. AIRPLANES An airplane flies 750 miles due west in \( \frac{5}{2} \) hours and 750 miles due south in 2 hours. What is the average speed of the airplane? About 429 mph.

3. TRACK Sprinter A runs 100 meters in 15 seconds, while sprinter B starts 1.5 seconds later and runs 100 meters in 14 seconds. If each of them runs at a constant rate, who is farther in 10 seconds after the start of the race? Explain.

Sprinter A; since sprinter A runs 100 m in 15 s, this sprinter runs at a rate of \( \frac{100}{15} \) m/s. In 10 seconds, sprinter A will have run \( \frac{100}{15} \cdot (10) = 66.7 \) m.

Sprinter B’s rate is \( \frac{100}{14} \). In 10 seconds, with the delayed start, sprinter B has run \( \frac{100}{14} \cdot (10 - 1.5) = 60.7 \) m.

4. TRAINS An express train travels 90 kilometers per hour from Smallville to Megatown. A local train takes 2.5 hours longer to travel the same distance at 50 kilometers per hour. How far apart are Smallville and Megatown? 281.25 km.

5. CYCLING Two cyclists begin traveling in the same direction on the same bike path. One travels at 15 miles per hour, and the other travels at 12 miles per hour. When will the cyclists be 10 miles apart? \( 3 \frac{1}{3} \) h.

6. TRAINS Two trains leave Chicago, one traveling east at 30 miles per hour and one traveling west at 40 miles per hour. When will the trains be 210 miles apart? 3 h.

2-9 Skills Practice

Weighted Averages

1. SEASONING A health food store sells seasoning blends in bulk. One blend contains 20% basil. Sheila wants to add pure basil to some 20% blend to make 16 ounces of her own 30% blend. Let \( b \) represent the amount of basil Sheila should add to the 20% blend.

a. Complete the table representing the problem.

<table>
<thead>
<tr>
<th>Blend</th>
<th>Ounces</th>
<th>Amount of Basil</th>
</tr>
</thead>
<tbody>
<tr>
<td>20% Basil Blend</td>
<td>16 - ( b )</td>
<td>0.20(16 - ( b ))</td>
</tr>
<tr>
<td>100% Basil</td>
<td>( b )</td>
<td>1.00( b )</td>
</tr>
<tr>
<td>30% Basil Blend</td>
<td>16</td>
<td>0.30(16)</td>
</tr>
</tbody>
</table>

b. Write an equation to represent the problem. \( 0.20(16 - b) + 1.00b = 0.30(16) \)

c. How many ounces of basil should Sheila use to make the 30% blend? 2 oz

d. How many ounces of the 20% blend should she use? 14 oz

2. HIKING At 7:00 A.M., two groups of hikers begin 21 miles apart and head toward each other. The first group, hiking at an average rate of 1.5 miles per hour, carries tents, sleeping bags, and cooking equipment. The second group, hiking at an average rate of 2 miles per hour, carries food and water. Let \( t \) represent the hiking time.

a. Copy and complete the table representing the problem.

<table>
<thead>
<tr>
<th></th>
<th>( r )</th>
<th>( t )</th>
<th>( d = rt )</th>
</tr>
</thead>
<tbody>
<tr>
<td>First group of hikers</td>
<td>1.5</td>
<td>( t )</td>
<td>1.5( t )</td>
</tr>
<tr>
<td>Second group of hikers</td>
<td>2</td>
<td>( t )</td>
<td>2( t )</td>
</tr>
</tbody>
</table>

b. Write an equation using \( t \) that describes the distances traveled. \( 1.5t + 2t = 21 \)

c. How long will it be until the two groups of hikers meet? 6 h

3. SALES Sergio sells a mixture of Virginia peanuts and Spanish peanuts for $3.40 per pound. To make the mixture, he uses Virginia peanuts that cost $3.50 per pound and Spanish peanuts that cost $3.00 per pound. He mixes 10 pounds at a time.

a. How many pounds of Virginia peanuts does Sergio use? 8 lb

b. How many pounds of Spanish peanuts does Sergio use? 2 lb
1. **GRASS SEED** A nursery sells Kentucky Blue Grass seed for $5.75 per pound and Tall Fescue seed for $4.50 per pound. The nursery sells a mixture of the two kinds of seed for $5.25 per pound. Let $k$ represent the amount of Kentucky Blue Grass seed the nursery uses in 5 pounds of the mixture.

a. Complete the table representing the problem.

<table>
<thead>
<tr>
<th>Number of Pounds</th>
<th>Price per Pound</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kentucky Blue Grass</td>
<td>$5.75</td>
<td>$5.75k</td>
</tr>
<tr>
<td>Tall Fescue</td>
<td>$4.50</td>
<td>4.50(5 - k)</td>
</tr>
<tr>
<td>Mixture</td>
<td>$5.25</td>
<td>5.25(5)</td>
</tr>
</tbody>
</table>

b. Write an equation to represent the problem. $5.75k + 4.50(5 - k) = 5.25(5)$

c. How much Kentucky Blue Grass does the nursery use in 5 pounds of the mixture? 3 lb

d. How much Tall Fescue does the nursery use in 5 pounds of the mixture? 2 lb

2. **TRAVEL** Two commuter trains carry passengers between two cities, one traveling east, and the other west, on different tracks. Their respective stations are 150 miles apart. Both trains leave at the same time, one traveling at an average speed of 55 miles per hour and the other at an average speed of 65 miles per hour. Let $t$ represent the time until the trains pass each other.

a. Copy and complete the table representing the problem.

<table>
<thead>
<tr>
<th>$r$</th>
<th>$t$</th>
<th>$d = rt$</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Train</td>
<td>55</td>
<td>$55t$</td>
</tr>
<tr>
<td>Second Train</td>
<td>65</td>
<td>$65t$</td>
</tr>
</tbody>
</table>

b. Write an equation using $t$ that describes the distances traveled. $55t + 65t = 150$

c. How long after departing will the trains pass each other? 1.25 h

3. **TRAVEL** Two trains leave Raleigh at the same time, one traveling north, and the other south. The first train travels at 50 miles per hour and the second at 60 miles per hour. In how many hours will the trains be 275 miles apart? 2.5 h

4. **JUICE** A pineapple drink contains 15% pineapple juice. How much pure pineapple juice should be added to 8 quarts of the pineapple drink to obtain a mixture containing 50% pineapple juice? 5.6 qt

5. **BUSINESS** Mrs. Winship sells chocolate fudge for $7.50 per pound and peanut butter fudge for $7.00 per pound. The total number of pounds sold on Saturday was 146 and the total amount of money collected was $1065. How many pounds of each type of fudge were sold?

86 pounds of chocolate and 60 pounds of peanut butter
Expected Value

Expected value is the average return of an event over repeated trial. Expected value is also a form of weighted average and can be used to determine whether or not you should play a game based on what the expected value of your winnings is. It can also be used to determine the expected length of a game.

Example

You are rolling a die to determine the number of candy bars you will win at a school fair. If you roll a one, you get 12 candy bars. If you roll a two or a three, you get 3 candy bars. If you roll a four, five or six, you get 2 candy bars.

Since there are six possibilities for what you can roll:

- \( \frac{1}{6} \) of the time, you will win 12 candy bars.
- \( \frac{2}{6} \) or \( \frac{1}{3} \) of the time, you will win 3 candy bars.
- \( \frac{3}{6} \) or \( \frac{1}{2} \) of the time, you will win 2 candy bars.

The expected value is \( \frac{1}{6} \times 12 + \frac{1}{3} \times 3 + \frac{1}{2} \times 2 \) or 4 candy bars.

Therefore, if you played the game 100 times, you could expect to win about 4 candy bars each time.

Exercises

Find the expected value of each of the following events.

1. You are flipping a coin. If you flip heads, you win $5.00. If you flip tails, you win $1.00. $3.00

2. You are rolling a die to determine the number of candy bars you will win at a school fair. If you roll a 1, you get 18 candy bars. If you roll a 2 or a 3, you get 6 candy bars. If you roll a 4, 5 or 6, you get 0 candy bars. 5

3. You are rolling a die to determine the amount of money you will win at a school fair. If you roll a 1, you get $12.00. If you roll a 2 or a 3, you get $3.00. If you roll a 4, 5 or 6, you owe $2.00. $2.00

4. You are flipping a coin. If you flip heads, you win $10. If you flip tails, you win $2. $6.00

5. You are rolling a die to determine the number of candy bars you will win at a school fair. If you roll a 1, you get 24 candy bars. If you roll a 2 or a 3, you get 6 candy bars. If you roll a 4, 5 or 6, you get none. 6
Chapter 2 Assessment Answer Key

Quiz 1 (Lessons 2-1 through 2-3)  
Page 63

1. \( y^2 - 12 = 5x \)

Two times \( b \) minus 10 equals 4.

3. The sum of \( y \) and the product of 3 and the square of \( x \) is 5 times \( x \).

4. 14

5. -49

6. -9

7. 40

8. 7

9. 84

10. D

Quiz 2 (Lessons 2-4 and 2-5)  
Page 63

1. -5

2. no solution

3. 0

4. 7

5. C

6. 11

7. 5

8. -5

9. \{2, 5\}

10. \{-6, 7\}

Quiz 3 (Lessons 2-6 and 2-7)  
Page 64

1. yes

2. no

3. no

4. 15

5. 27

6. 99

7. decrease; 28%

8. increase; 25%

9. $19.08

10. B

Quiz 4 (Lessons 2-8 and 2-9)  
Page 64

1. \( x = \frac{p + r}{n} \)

2. \( b = x - ac \)

3. 4 g

4. A

5. \( \ell = \frac{p - 2w}{2} \); 14 m

Mid Chapter Test  
Page 65

Part I

1. B

2. J

3. A

4. H

5. B

6. G

Part II

Four times \( n \) equals \( x \) times the difference of five and \( n \).

7. 

8. 0

9. all numbers

10. -2

11. $116.15

12. \{-2, 5\}
Chapter 2 Assessment Answer Key

Vocabulary Test
Page 66

1. ratio
2. weighted average
3. percent of change
4. rate
5. multi-step equation
6. unit rate
7. identity

Sample answer: A proportion is an equation stating that two ratios are equal.

8. ______________

Sample answer: A formula is an equation that states a rule for the relationship between certain quantities.

9. ______________

10. ______

B:_______ 45

Form 1
Page 67

1. B
2. G
3. D
4. G
5. C
6. F
7. A
8. H
9. D
10. B
11. B
12. H
13. A
14. J
15. C
16. H
17. B
18. J
19. B
20. F
## Chapter 2 Assessment Answer Key

<table>
<thead>
<tr>
<th>Form 2A Page 69</th>
<th>Form 2B Page 71</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. C</td>
<td>1. B</td>
</tr>
<tr>
<td>2. J</td>
<td>12. F</td>
</tr>
<tr>
<td>3. A</td>
<td>13. C</td>
</tr>
<tr>
<td>5. D</td>
<td>15. B</td>
</tr>
<tr>
<td>7. C</td>
<td>17. B</td>
</tr>
<tr>
<td>8. G</td>
<td>18. F</td>
</tr>
<tr>
<td>9. C</td>
<td>19. A</td>
</tr>
<tr>
<td>10. G</td>
<td>20. H</td>
</tr>
<tr>
<td>B: 4 L</td>
<td>B: 21</td>
</tr>
</tbody>
</table>

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Chapter 2 Assessment Answer Key

Form 2C
Page 73

1. \(36 - x = 3(4 + x)\)
   Three times the sum of \(x\) and \(y\) equals two times \(y\) minus \(x\).

2. \(\frac{14}{5}\)

3. \(-9\)

4. \(-5\)

5. \(5\)

6. \(2\) L

7. \(45\)

8. \(6\)

9. \(n - 3.5 = 12.7; \quad 16.2\)

10. \(5n + 12 = -3; -3\)

11. \(\$134.40\)

12. \(3\)

13. \(\{ -1, \frac{7}{5} \}\)

14. \(\{ -1, 0 \}\)

15. yes

16. 22.5

17. \(-1\)

18. all numbers

19. \(\frac{bc}{a}\)

20. decrease; 20%

21. \$12.84

22. \(3\) L

23. 2.5 h

24. \(h = \frac{V}{\pi r^2}; 10.5\) in.

25. B: \(8\)

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Chapter 2 Assessment Answer Key

Form 2D
Page 75

1. \(18 + n = 7(n - 3)\)
   Three divided by \(y\) minus five equals \(x\) times the sum of \(y\) and 7.

2. \(\frac{7}{7}\)

3. \(4\)

4. \(7\)

5. \(7\)

6. \(7\)

7. \(50\)

8. \(7\)

9. \(n - 8.1 = 4.9; 13\)

10. \(6n + 15 = 9; -1\)

11. \(\$176.80\)

12. \(11\)

13. \(\{-3, -1\}\)

14. \(\{-4, -2\}\)

Page 76

15. \(\text{no}\)

16. \(20\)

17. \(3\)

18. \(\text{no solution}\)

19. \(11\)

20. \(r = n(4v - t)\)

21. \(\text{increase; 25%}\)

22. \(\$13.50\)

23. \(7.5 \text{ lb of nuts, 2.5 lb of dried fruit}\)

24. \(4 \text{ h}\)

25. \(h = \frac{V}{\pi r^2}; 18.67 \text{ in.}\)

B: \(\$9.60\)
Chapter 2 Assessment Answer Key

Form 3
Page 77

1. \( \frac{x - 45}{12} + 20 = 5(32 + x) \)
   Five times the sum of two times \( x \) and three times \( y \) equals the square of \( y \) minus two times the cube of \( x \).

2. 10 ft

3. -27

4. -13

5. \(-2 \frac{2}{3}\)

6. \(-1 \frac{2}{3}\)

7. 126

8. 8

9. \( \frac{3}{5} x = 1; \frac{5}{3} \)

10. \((x + 2)10 = 8x + 36; 8\)

11. 10

12. \{-7, -5\}

13. $4000

14. yes

15. 10 ft

B: 12 mi

Page 78

16. -6

17. \(-\frac{7}{9}\)

18. 2

19. \(x = \frac{r + n}{a} \quad x = \frac{r y - t}{4}\)

20. increase; 12%

22. $63.60

23. $7000

24. 510 mph, 540 mph

25. 1.95 ft/s
## Chapter 2 Assessment Answer Key

### Page 79, Extended-Response Test

#### Scoring Rubric

<table>
<thead>
<tr>
<th>Score</th>
<th>General Description</th>
<th>Specific Criteria</th>
</tr>
</thead>
</table>
| 4     | **Superior**  
A correct solution that is supported by well-developed, accurate explanations | • Shows thorough understanding of the concepts of translating between verbal sentences and equations, solving equations, percents of increase and decrease, uniform motion problems, and proportions.  
• Uses appropriate strategies to solve problems.  
• Computations are correct.  
• Written explanations are exemplary.  
• Goes beyond requirements of some or all problems. |
| 3     | **Satisfactory**  
A generally correct solution, but may contain minor flaws in reasoning or computation | • Shows an understanding of the concepts of translating between verbal sentences and equations, solving equations, percents of increase and decrease, uniform motion problems, and proportions.  
• Uses appropriate strategies to solve problems.  
• Computations are mostly correct.  
• Written explanations are effective.  
• Satisfies all requirements of problems. |
| 2     | **Nearly Satisfactory**  
A partially correct interpretation and/or solution to the problem | • Shows an understanding of most of the concepts of translating between verbal sentences and equations, solving equations, percents of increase and decrease, uniform motion problems, and proportions.  
• May not use appropriate strategies to solve problems.  
• Computations are mostly correct.  
• Written explanations are satisfactory.  
• Satisfies the requirements of most of the problems. |
| 1     | **Nearly Unsatisfactory**  
A correct solution with no supporting evidence or explanation | • Final computation is correct.  
• No written explanations or work is shown to substantiate the final computation.  
• Satisfies minimal requirements of some of the problems. |
| 0     | **Unsatisfactory**  
An incorrect solution indicating no mathematical understanding of the concept or task, or no solution is given | • Shows little or no understanding of most of the concepts of translating between verbal sentences and equations, solving equations, percents of increase and decrease, uniform motion problems, and proportions.  
• Does not use appropriate strategies to solve problems.  
• Computations are incorrect.  
• Written explanations are unsatisfactory.  
• Does not satisfy requirements of problems.  
• No answer may be given. |
Chapter 2 Assessment Answer Key

Page 79, Extended-Response Test
Sample Answers

In addition to the scoring rubric found on page A40, the following sample answers may be used as guidance in evaluating extended-response assessment items.

1a. The student should explain that the first phrase is a product of \( x \) and \( y \) and then the addition of \( z \), while the second phrase is a product of \( x \) and the quantity \( y + z \).

1b. Check that the student’s values for \( x \), \( y \), and \( z \) satisfy both \( xy + z \) and \( x(y + z) \). One example is \( x = 1 \), \( y = 2 \), and \( z = 3 \). Another example is \( x = 2 \), \( y = 3 \), and \( z = 0 \).

2a. \[ \frac{ry + z}{m} - t = x \]
   (Original equation)
   \[ \frac{ry + z}{m} - t + t = x + t \]
   (Add \( t \) to each side.)
   \[ \frac{ry + z}{m} = x + t \]
   (Simplify.)
   \[ m\left(\frac{ry + z}{m}\right) = m(x + t) \]
   (Multiply each side by \( m \).)
   \[ ry + z = mx + mt \]
   (Simplify.)
   \[ ry + z - z = mx + mt - z \]
   (Subtract \( z \) from each side.)
   \[ ry = mx + mt - z \]
   (Simplify.)
   \[ \frac{ry}{r} = \frac{mx + mt - z}{r} \]
   (Divide each side by \( r \).)
   \[ y = \frac{mx + mt - z}{r} \]
   (Simplify.)
   The value of \( y \) is \( \frac{mx + mt - z}{r} \).

2b. Division by 0 is undefined, so in the original equation \( m \neq 0 \), and in the final equation \( r \neq 0 \).

3a. The student should conclude that a 10% decrease followed by a 10% increase results in a net decrease of 1%. Thus, the final cost would be 99% of the original price.

3b. Since multiplication is commutative, multiplying by 1.1 and then 0.9 would yield the same result as multiplying by 0.9 and then 1.1. The student should conclude that a 10% increase followed by a 10% decrease yields the same result as a 10% decrease followed by a 10% increase.

4a. Since the two people walked for the same amount of time and time can be calculated as distance divided by rate, the proportion
   \[ \frac{\text{Tony's distance}}{\text{Tony's rate}} = \frac{\text{Ivia's distance}}{\text{Ivia's rate}} \]
   can be used to solve this problem.

4b. The length of Tony’s walk can be calculated directly from his rate of 3 miles per hour and his distance of 6 miles. Ivia walked 1 mile per hour faster, so her rate is 4 miles per hour. The length of Ivia’s walk can be calculated directly from her rate of 4 miles per hour and distance of 6 miles. Thus, a proportion would not be used to solve this problem.

5a. Sample answer: \( x + 2 = 10 \), \( x - 2 = 6 \), \( 2x = 16 \), \( \frac{x}{2} = 4 \)

5b. Sample answer: \( 2x + 1 = x + 9 \)

5c. These two equations are equivalent. The solution to both equations is 5. The student should recognize that the solution to all equations in parts a and b is 8. Therefore neither of these two equations could be equivalent to any of the equations created for parts a and b.
Chapter 2 Assessment Answer Key

Standardized Test Practice

1. \( \bigcirc \bigcirc \bullet \bigcirc \)
2. \( \bigcirc \bigcirc \bullet \bigcirc \)
3. \( \bullet \bigcirc \bigcirc \bigcirc \)
4. \( \bigcirc \bullet \bigcirc \bigcirc \)
5. \( \bigcirc \bigcirc \bigcirc \bullet \)
6. \( \bigcirc \bullet \bigcirc \bigcirc \)
7. \( \bigcirc \bigcirc \bigcirc \bullet \)
8. \( \bigcirc \bigcirc \bullet \bigcirc \)
9. \( \bullet \bigcirc \bigcirc \bigcirc \)
10. \( \bigcirc \bigcirc \bullet \bigcirc \)
11. \( \bigcirc \bigcirc \bullet \bigcirc \)
12. \( \bullet \bigcirc \bigcirc \bigcirc \)
13. \( \bigcirc \bigcirc \bullet \bigcirc \)
14. \( \bullet \bigcirc \bigcirc \bigcirc \)

15. 
16. 

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Chapter 2 Assessment Answer Key

Standardized Test Practice
Page 82

17. 22

18. 5u + 9x

19. Sample answer:

20. 85 - 9y = 7(4 + y)

21. 31

22. 7

23. -3

24. 3

25. m = x(t - p)

26. 7 L

The final price would be 99% of the original price.

27a. No; since multiplication is commutative, a 10% increase followed by a 10% decrease would have the same result as a 10% decrease followed by a 10% increase.

27b.
Chapter 2 Assessment Answer Key

Unit 1 Test
Page 83

1. Sample answer: the sum of four times r and 9

2. \(5 - n^3\)

3. \(71\)
   Multiplicative Inverse Property; \(\frac{1}{6}\)

4. \(7t^2 + 3t\)

5. \(7r + 9t\)

6. \(23a + 6b\)

7. \(\{4\}\)

8. yes

9. no

10. 8

11. False

12. Sample answer: 6x + 12

13. Sample answer: the difference of m squared and 4 is equal to the sum of 2 times r plus 1

14. Sample answer: Four math textbooks are stacked on top of two science textbooks. Write an expression for the total height of the stack of books.

15. Sample answer: \(v = t - kr\)

16. Sample answer: the sum of four times r and 9

Page 84

17. \(-18\)

18. \(-12\)

19. 42

20. 56

21. \(-2\)

22. all real numbers

23. \(3 \frac{2}{7}\)

24. 11

25. \(-2, 3\)

26. yes

27. Sample answer: \$3.91

28. \(8 \text{ lb}\)