KEY LEARNING:

- Write and solve linear equations and use them to solve real world problems.

### Concept:
- Writing and Solving One-Step and Multi-Step Equations
- Solving for a Specific Variable
- Ratios and Proportions

### Lesson Essential Questions:
- **Writing and Solving One-Step and Multi-Step Equations:**
  - How do you write and evaluate equations and justify your answer?
  - Solve one-step equations
  - Solve multi-step equations
  - Translate between verbal and algebraic equations
  - Applications
  - Consecutive number problems

- **Solving for a Specific Variable:**
  - How do you solve for the unknown quantity in any equation or formula?

- **Ratios and Proportions:**
  - How do you write and solve a proportion for a real world situation and interpret the solution?

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Name: __________________________

Period: __________
CONCEPT: WRITING AND SOLVING ONE-STEP AND MULTI-STEP EQUATIONS

Translate each sentence into an equation.
1. Fifty-three plus four times c is as much as 21.
2. The sum of five times h and twice g is equal to 23.
3. One fourth the sum of r and ten is identical to r minus 4.
4. Three plus the sum of the squares of w and x is 32.

Translate each sentence into a formula.
5. Degrees Kelvin K equals 273 plus degrees Celsius C.
6. The total cost C of gas is the price p per gallon times the number of gallons g.
7. The sum S of the measures of the angles of a polygon is equal to 180 times the difference of the number of sides n and 2.

Translate each equation into a verbal sentence.
8. \( q - (4 + p) = \frac{1}{3}q \)
9. \( \frac{3}{5}t + 2 = t \)

10. \( 9(y^2 + x) = 18 \)
11. \( 2(m - n) = v + 7 \)

Write a problem based on the given information.

12. \( a \) = cost of one adult’s ticket to zoo
13. \( c \) = regular cost of one airline ticket
\[ \begin{align*}
14. & \quad a - 4 = \text{cost of one children’s ticket to zoo} \\
& \quad 2a + 4(a - 4) = 38 \\
& \quad 0.20c = \text{amount of 20% promotional discount} \\
& \quad 3(c - 0.20c) = 330
\end{align*} \]

14. GEOGRAPHY About 15% of all federally-owned land in the 48 contiguous states of the United States is in Nevada. If \( F \) represents the area of federally-owned land in these states, and \( N \) represents the portion in Nevada, write an equation for this situation.

FITNESS For Exercises 15–17, use the following information.

Deanna and Pietra each go for walks around a lake a few times per week. Last week, Deanna walked 7 miles more than Pietra.

15. If \( p \) represents the number of miles Pietra walked, write an equation that represents the total number of miles \( T \) the two girls walked.

16. If Pietra walked 9 miles during the week, how many miles did Deanna walk?

17. If Pietra walked 11 miles during the week, how many miles did the two girls walk together?
1. The Pacific Ocean covers about 46% of Earth. If \( P \) represents the area of the Pacific Ocean and \( E \) represents the area of Earth, write an equation for this situation.

2. Mrs. Patton is planning to place a fence around her vegetable garden. The fencing costs $1.75 per yard. She buys \( f \) yards of fencing and pays $3.50 in tax. If the total cost is $73.50, write an equation to represent the situation.

3. Edgar Rice Burroughs published his first *Tarzan of the Apes* story in 1912. In 1928, the California town where he lived was Tarzana. Let \( y \) represent the number of years after 1912 that the town was named. Write and use an equation to determine the number of years between the first Tarzan story and the naming of the town.

4. Darius weighs 155 pounds. He wants to start the wrestling season weighing 160 pounds. If \( g \) represents the number of pounds he wants to gain, write an equation to represent this situation. Then use the equation to find the number of pounds Darius needs to gain.

5. Write a problem based on the given information.
   
   \[ y = \text{Yolanda’s height in inches} \]
   
   \[ y + 7 = \text{Lindsey’s height in inches} \]
   
   \[ 2y + (y + 7) = 193 \]

6. Write a problem based on the given information.
   
   \[ b = \text{price of a book} \]
   
   \[ 0.065b = \text{tax} \]
   
   \[ 2(b + 0.065b) = 42.49 \]
7. The volume $V$ of a cone equals one third times the product of $\pi$, the square of the radius $r$ of the base, and the height $h$. Write a formula for the volume of the cone and then find the volume when the radius is 10 centimeters and the height is 12 centimeters.

8. The volume $V$ of a sphere is four thirds times $\pi$ times the radius $r$ of the sphere cubed. Write a formula for the volume of a sphere and then find the volume when the radius is 4 inches.

9. During a highly rated one-hour television show, the entertainment portion lasted 15 minutes longer than 4 times the advertising portion $a$. Write an expression for the entertainment portion. Write an equation for the situation.

10. If $a$ and $b$ represent the lengths of the bases of a trapezoid and $h$ represents the height, translate the equation for the area of a trapezoid, $\text{Area of a Trapezoid} = \frac{1}{2} h (a + b)$, into words.
1. HOUSES  The area of the Hartstein's kitchen is 182 square feet. This is 20% of the area of the first floor of their house. Let \( P \) represent the area of the first floor. Write an equation to represent the situation.

2. FAMILY  Katie is twice as old as her sister Mara. The sum of their ages is 24. Write a one-variable equation to represent the situation.

3. GEOMETRY  The formula \( F + V = E + 2 \) shows the relationship between the number of faces \( F \), edges \( E \), and vertices \( V \) of a polyhedron, such as a pyramid. Write the formula in words.

4. WIRELESS PHONE  Spinfrog wireless phone company bills on a monthly basis. Each bill includes a $29.95 service fee for 1000 minutes plus a $2.95 federal communication tax. Additionally, there is a charge of $0.05 for each minute used over 1000. Let \( m \) represent the number of minutes over 1000 used during the month. Write an equation to describe the cost \( c \) of the wireless phone service per month.

5. TEMPERATURE  For Exercises 5 and 6, use the table showing degrees Fahrenheit and degrees Celsius temperatures.

<table>
<thead>
<tr>
<th>Celsius</th>
<th>Fahrenheit</th>
</tr>
</thead>
<tbody>
<tr>
<td>-20°</td>
<td>-4°</td>
</tr>
<tr>
<td>-10°</td>
<td>-14°</td>
</tr>
<tr>
<td>0°</td>
<td>32°</td>
</tr>
<tr>
<td>10°</td>
<td>50°</td>
</tr>
<tr>
<td>20°</td>
<td>68°</td>
</tr>
<tr>
<td>30°</td>
<td>86°</td>
</tr>
</tbody>
</table>

5. Write a formula for converting Celsius temperatures to Fahrenheit temperatures.
Solve each equation. Then check your solution.

1. \( d - 8 = 17 \)
2. \( v + 12 = -5 \)
3. \( b - 2 = -11 \)
4. \( -16 = s + 71 \)
5. \( 29 = a - 76 \)
6. \( -14 + y = -2 \)
7. \( 8 - (-c) = 1 \)
8. \( 78 + r = -15 \)
9. \( f + (-3) = -9 \)
10. \( 4.2 = n + 7.3 \)
11. \( w + 1.9 = -2.5 \)
12. \( 4.6 - (-b) = -0.4 \)
13. \( y - (-1.5) = 0.5 \)
14. \( a - 0.13 = -0.58 \)
15. \( k + (-4.21) = -19 \)
16. \( r + \frac{1}{5} = \frac{9}{10} \)
17. \( \frac{5}{9} + q = \frac{2}{3} \)
18. \( \frac{1}{3} = h + \frac{2}{5} \)
19. \( \frac{1}{4} + x = -\frac{7}{12} \)
20. \( y + \frac{4}{5} = \frac{3}{4} \)
21. \( -\frac{7}{8} - (-n) = -\frac{7}{12} \)

Write an equation for each problem. Then solve the equation and check your solution.

22. What number minus 9 is equal to -18?

23. A number plus 15 equals -12. What is the number?

24. The sum of a number and -3 is equal to -91. Find the number.

25. Negative seventeen equals 63 plus a number. What is the number?

26. The sum of negative 14, a number, and 6 is -5. What is the number?

27. What number plus one half is equal to three eighths?

HISTORY For Exercises 28 and 29, use the following information.

Galileo Galilei was born in 1564. Many years later, in 1642, Sir Isaac Newton was born.

28. Write an addition equation to represent the situation.

29. How many years after Galileo was born was Isaac Newton born?

HURRICANES For Exercises 30 and 31, use the following information.

The day after a hurricane, the barometric pressure in a coastal town has risen to 29.7 inches of mercury, which is 2.9 inches of mercury higher than the pressure when the eye of the hurricane passed over.

30. Write an addition equation to represent the situation.

31. What was the barometric pressure when the eye passed over?
1. Over the years, the height of the Great Pyramid at Giza, Egypt, has decreased. Use an original height 481 ft and a new height of 450 ft to write an equation to model the situation. Then find the decrease in the height of the pyramid.

2. The Washington Monument in Washington, D.C., was built in two phases. During the first phase, the monument was built to a height of 152 feet. During the second phase, additional construction resulted in the monument’s final height of 555 feet. How much of the monument was added during the second construction phase? Write an equation to solve the problem. Then solve it.

3. A midsize care with a 4-cylinder engine goes 34 miles on a gallon of gasoline. This is 10 miles more than a luxury car with an 8-cylinder engine goes on a gallon of gasoline. How many miles does a luxury car travel on a gallon of gasoline? Write and then solve an equation for this situation.

4. The world’s biggest ever passenger plane, the Airbus A380, was first used by Singapore Airlines in 2005. The following description appeared on a news website after the plane was introduced.

   “That airline will see the A380 transporting some 555 passengers, 139 more than a similarly set up 747.”

How many passengers can a 747 transport?

5. The average time it takes to manufacture a car in the USA is 24.9 hours. This is 8.1 hours longer than the average time it takes to manufacture a car in Japan. Write and solve an addition equation to find the average time to manufacture a car in Japan.

6. Which equation doesn’t belong? Explain your reasoning.
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.

2. **SALARY**  
In 2004, the annual salary of the Governor of New Jersey was $157,000. During the same year, the annual salary of the Governor of Tennessee was $72,000 less. Write and solve an equation to find the annual salary of the Governor of Tennessee in 2004.

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.

4. **SEA LEVEL**  
Many parts of the city of Bangkok, Thailand, sit below sea level and the city continues to sink every year. The water is held back by a system of dikes so that the city will remain dry. The base of a building in the center of Bangkok sits at an altitude of −6 feet, meaning that it is 6 feet below sea level. The top of the building is 45 feet above sea level. Write and solve an equation to find the height of the building.

5. **SAVINGS**  
For Exercises 5 and 6, use the following information.  
Ophrice is saving $144 to buy three concert tickets. He has already saved $65.

5. Write and solve an equation to find the amount of money a he still needs to save.

6. Of the three tickets he plans to buy, two are for adults and one is for a child. The adult tickets together cost $120. Write and solve an equation to find the cost of the child ticket.
Solve each equation. Then check your solution.

1. \(8j = 96\)  
2. \(-13z = -39\)  
3. \(-180 = 15m\)  
4. \(243 = 27c\)  
5. \(\frac{y}{9} = -8\)  
6. \(-\frac{j}{12} = -8\)  
7. \(\frac{a}{15} = \frac{4}{5}\)  
8. \(\frac{g}{27} = \frac{2}{9}\)  
9. \(\frac{a}{24} = \frac{1}{6}\)  
10. \(-1 = -\frac{4}{7}t\)  
11. \(-\frac{3}{8}w = -9\)  
12. \(-\frac{3}{15}s = 4\)  
13. \(-3x = \frac{3}{2}\)  
14. \(\frac{8}{5}a = \frac{4}{3}\)  
15. \(\frac{5}{3}h = \frac{11}{6}\)  
16. \(5n = \frac{11}{4}\)  
17. \(2.5k = 20\)  
18. \(-3.4c = -3.74\)  
19. \(-1.7b = 2.21\)  
20. \(0.26p = 0.104\)  
21. \(4.2q = -3.36\)

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

22. Negative nine times a number equals \(-117\). Find the number.

23. Negative one eighth of a number is \(-\frac{3}{4}\). What is the number?

24. Five sixths of a number is \(-\frac{5}{9}\). Find the number.

25. 2.7 times a number equals 8.37. What is the number?

26. One and one fourth times a number is one and one third. What is the number?

27. **PUBLISHING** Two units of measure used in publishing are the pica and the point. A pica is one sixth of an inch. There are 12 points in a pica, so \(1\) point \(=\) \(\frac{1}{12}\) pica. Picas. How many picas are equivalent to 108 points?
1. In baseball, if all other factors are the same, the speed of a four-seam fastball is faster than a two-seam fastball. The distance from the pitcher’s mound to home plate is 60.5 ft. How long does it take a two-seam fastball to go from the pitcher’s mound to home plate? Round to the nearest hundredth. \((d = rt)\)

2. For every 8 grams of oxygen in water, there is 1 gram of hydrogen. In science lab, Ayame and her classmates are asked to determine how many grams of hydrogen and oxygen are in 477 grams of water. If \(x\) represents the number of grams of hydrogen, write an expression to represent the number of grams of oxygen. Write an equation to represent the situation. How many grams of hydrogen and oxygen are in 477 grams of water?

3. The discharge of a river equals the product of its width, its average depth, and its speed. At one location St. Louis, the Mississippi River is 533 meters wide, its speed is 0.6 meters per second, and its discharge is 3198 cubic meters per second. How deep is the Mississippi River at this location?
1. **HEART RATE** According to the American Heart Association, the target heart rate during exercise for a healthy 20-year-old person is 150 beats per minute. The target heart rate during exercise for a 70-year-old person is one half of that rate. Write and solve an equation to find the target exercise heart rate for a 70-year-old.

2. **TREES** A redwood tree can grow to be about six times as tall as a pine tree. Suppose a common pine tree measures about 56 feet tall. Write and solve an equation to find the approximate height of a redwood tree.

3. **SHOPPING** Raul bought fudge at the candy shop. After he gave his sister $\frac{1}{2}$ of the fudge he bought, he still had $\frac{3}{4}$ of a pound. How much fudge did Raul originally buy?

4. **FARMING** Mr. Hill’s farm is 126 acres. Mr. Hill’s farm is $\frac{1}{4}$ the size of Mr. Miller’s farm. How many acres is Mr. Miller’s farm?

5. **NAUTICAL** For Exercises 5 and 6, use the following information.

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

\[
\begin{align*}
1 \text{ nautical mile} &= 6080 \text{ feet} \\
1 \text{ knot} &= \frac{1}{60} \text{ nautical mile per hour}
\end{align*}
\]

5. If a boat travels 16 knots in 1 hour, how far will it have traveled in feet? Write and solve an equation.

6. About how fast was the boat traveling in miles per hour? Round your answer to the nearest hundredth.
1. Three is added to a number, and then the sum is multiplied by 4. The result is 16. Find the number.

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

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

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 stationed 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?
Solve each equation. Then check your solution.

5. \(-12n - 19 = 77\)  
6. \(17 + 3f = 14\)  
7. \(15t + 4 = 49\)

8. \(\frac{u}{5} + 6 = 2\)  
9. \(\frac{d}{-4} + 3 = 15\)  
10. \(\frac{b}{3} - 6 = -2\)

11. \(\frac{1}{2}y - \frac{1}{8} = \frac{7}{8}\)  
12. \(-32 - \frac{3}{5}f = -17\)  
13. \(8 - \frac{3}{8}k = -4\)

14. \(\frac{r + 13}{12} = 1\)  
15. \(\frac{15}{3} - a = -9\)  
16. \(\frac{3k - 7}{5} = 16\)

17. \(\frac{x}{7} - 0.5 = 2.5\)  
18. \(2.5g + 0.45 = 0.95\)  
19. \(0.4m - 0.7 = 0.22\)

Write an equation and solve each problem.

20. Seven less than four times a number equals 13. What is the number?

21. Find two consecutive odd integers whose sum is 116.

22. Find two consecutive even integers whose sum is 126.

23. Find three consecutive odd integers whose sum is 117.

24. **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?

1. Maggie was thinking of a number. If she multiplied it by 3, subtracted 8, added 2 times the original number, added -4, and then subtracted the original number, the result was 48. Write an equation that satisfies this situation and then solve to find Maggie’s original number.

2. A general rule for those climbing more than 7000 feet above sea level is to allow a total of \(\left(\frac{a - 7000}{2000}\right) + 2\) weeks of camping during the ascension. In this expression, \(a\) represents the altitude in feet. If a group of mountain climbers have allowed for 9 weeks of camping, how high can they climb without worrying about altitude sickness?
3. If \( l \) represents the length of a person’s foot in inches, the expression \( 2l - 12 \) can be used to estimate his or her shoe size. What is the approximate length of the foot of a person who wears a size 8? Measure your foot and use the expression to determine your shoe size. How does this number compare to the size of your shoe?

4. A rectangle is cut out of the corner of a 10 inch by 10 inch piece of paper. The area of the remaining piece of paper is \( \frac{4}{5} \) of the area of the original piece of paper. If the width of the rectangle removed from the paper is 4 inches, what is the length of the rectangle?

5. Determine whether the following statement is sometimes, always, or never true. Explain your reasoning. The sum of two consecutive even numbers equals the sum of two consecutive odd numbers.
Consecutive Integer Problems

Many types of problems and puzzles involve the idea of consecutive integers. Knowing how to represent these integers algebraically can help to solve the problem.

**Example** Find four consecutive odd integers whose sum is $-80$.

An odd integer can be written as $2n + 1$, where $n$ is any integer.

If $2n + 1$ is the first odd integer, then add 2 to get the next largest odd integer, and so on.

Now write an equation to solve this problem.

$$(2n + 1) + (2n + 3) + (2n + 5) + (2n + 7) = -80$$

**Exercises**

Write an equation for each problem. Then solve.

1. Complete the solution to the problem in the example.

2. Find three consecutive even integers whose sum is 132.

3. Find two consecutive integers whose sum is 19.

4. Find two consecutive integers whose sum is 100.

5. The lesser of two consecutive even integers is 10 more than one-half the greater. Find the integers.

6. The greater of two consecutive even integers is 6 less than three times the lesser. Find the integers.

7. Find four consecutive integers such that twice the sum of the two greater integers exceeds three times the first by 91.

8. Find a set of four consecutive positive integers such that the greatest integer in the set is twice the least integer in the set.
1. **TEMPERATURE** The formula for converting a Fahrenheit temperature to a Celsius temperature is \[ C = \frac{F - 32}{1.8} \]. Find the equivalent Celsius temperature for 68°F.

2. **HUMAN HEIGHT** It is a commonly used guideline that for the average American child, their maximum adult height will be about twice their height at age 2. Suppose that Micah's adult height fits the following equation \( a = 2c - 1 \), where \( a \) represents his adult height and \( c \) represents his height at age 2. At age 2, Micah was 35 inches tall. What is Micah’s adult height? Write and solve an equation.

3. **CHEMISTRY** The half-life of a radioactive substance is the time required for half of a sample to undergo radioactive decay, or for the quantity to fall to half its original amount. Carbon-14 has a half-life of 5730 years. Suppose given samples of Carbon-14 weigh \( \frac{5}{8} \) of a pound and \( \frac{7}{8} \) of a pound. What was the total weight of the samples 11,460 years ago?

4. **NUMBER THEORY** Write and solve an equation to find three consecutive odd integers whose sum is 3.

5. **GEOMETRY** For Exercises 5–7, use the following information. A rectangular swimming pool is surrounded by a concrete sidewalk that is 3 feet wide. The dimensions of the rectangle created by the sidewalk are 21 feet by 31 feet.

6. 5. Find the length and width of the pool.

7. Find the area of the pool.

8. 7. Write and solve an equation to find the area of the sidewalk in square feet.
Justify each step.

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

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

Solve each equation. Then check your solution.

3. \(2m + 12 = 3m - 31\)
4. \(2h - 8 = h + 17\)

5. \(7a - 3 = 3 - 2a\)
6. \(4n - 12 = 12 - 4n\)

7. \(4x - 9 = 7x + 12\)
8. \(-6y - 3 = 3 - 6y\)

9. \(5 + 3r = 5r - 19\)
10. \(-9 + 8k = 7 + 4k\)

11. \(8q + 12 = 4(3 + 2q)\)
12. \(3(5j + 2) = 2(3j - 6)\)

13. \((-3v + 1) = 5(-2v - 2)\)
14. \(-7(2b - 4) = 5(-2b + 6)\)

15. \(3(8 - 3t) = 5(2 + t)\)
16. \(2(3u + 7) = -4(3 - 2u)\)

17. \(8(2f - 2) = 7(3f + 2)\)
18. \(5(-6 - 3d) = 3(8 + 7d)\)

19. \(6(w - 1) = 3(3w + 5)\)
20. \(7(-3y + 2) = 8(3y - 2)\)

21. \(\frac{2}{3}v - 6 = 6 - \frac{2}{3}v\)
22. \(\frac{1}{2} - \frac{5}{8}x = \frac{7}{8}x + \frac{7}{2}\)
Solve each equation. Then check your solution.

1. \(5x - 3 = 13 - 3x\) 
2. \(-4c - 11 = 4c + 21\)

3. \(1 - s = 6 - 6s\) 
4. \(14 + 5n = -4n + 17\)

5. \(\frac{1}{2}k - 3 = 2 - \frac{3}{4}k\) 
6. \(\frac{1}{2}(6 - z) = z\)

7. \(3(-2 - 3x) = -9x - 4\) 
8. \(4(4 - w) = 3(2w + 2)\)

9. \(9(4b - 1) = 2(9b + 3)\) 
10. \(3(6 + 5y) = 2(-5 + 4y)\)

11. \(-5x - 10 = 2 - (x + 4)\) 
12. \(6 + 2(3j - 2) = 4(1 + j)\)

13. \(\frac{5}{2}t - t = 3 + \frac{3}{2}t\) 
14. \(1.4f + 1.1 = 8.3 - f\)

15. \(\frac{2}{3}x - \frac{1}{6} = \frac{1}{2}x + \frac{5}{6}\) 
16. \(2 - \frac{3}{4}z = \frac{1}{8}z + 9\)

17. \(\frac{1}{2}(3g - 2) = \frac{g}{6}\) 
18. \(\frac{1}{3}(c + 1) = \frac{1}{6}(3c - 5)\)

19. \(\frac{1}{4}(5 - 2h) = \frac{h}{2}\) 
20. \(\frac{1}{9}(2m - 16) = \frac{1}{3}(2m + 4)\)

21. \(3(d - 8) - 5 = 9(d + 2) + 1\) 
22. \(2(a - 8) + 7 = 5(a + 2) - 3a - 19\)

23. Two thirds of a number reduced by 11 is equal to 4 more than the number. Find the number.

24. Five times the sum of a number and 3 is the same as 3 multiplied by 1 less than twice the number. What is the number?

25. **NUMBER THEORY** Tripling the greater of two consecutive even integers gives the same result as subtracting 10 from the lesser even integer. What are the integers?

26. **GEOMETRY** The formula for the perimeter of a rectangle is \(P = 2\ell + 2w\), where \(\ell\) is the length and \(w\) is the width. A rectangle has a perimeter of 24 inches. Find its dimensions if its length is 3 inches greater than its width.
1. Find the value of x so that the figures have the same perimeter.

\[
\begin{align*}
\text{triangle: } & \quad 2x+5, \quad x+4, \quad 5x+1 \\
\text{rectangle: } & \quad 2x, \quad x+9
\end{align*}
\]

2. When exercising, a person’s pulse rate should not exceed a certain limit. This maximum rate is represented by the expression \(0.8(220 - a)\), where \(a\) is age in years. Find the age of a person whose maximum pulse is 152.

3. Traditionally, nails are given names such as 2-penny, 3-penny, and so on. These names describe the lengths of the nails. Use the equation NAIL LENGTH = \(1 + \frac{1}{4}(x - 2)\) where \(x\) is penny nail to find the name of a nail that is 2.5 inches long.

4. Determine whether each solution is correct. If the solution is not correct, describe the error and give the correct solution.

<table>
<thead>
<tr>
<th>(2(x + 5) = 22)</th>
<th>(5d = 2d - 18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2x + 5 = 22)</td>
<td>(5d - 2d = 2d - 18 - 2d)</td>
</tr>
<tr>
<td>(2x + 5 - 5 = 22 - 5)</td>
<td>(3d = -18)</td>
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<tr>
<td>(2x = 17)</td>
<td>(d = -6)</td>
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<td>(x = 8.5)</td>
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</tbody>
</table>
1. **OLYMPICS** In the 2004 Summer Olympic Games in Athens, Greece, the United States athletes won 2 more than 3 times the number of gold metals won by the French athletes. The United States won 24 more gold metals than the French. Solve the equation \(24 + F = 3F + 2\) 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.

3. **GEOMETRY** Supplementary angles are angles whose measures have a sum of \(180^\circ\). Complementary angles are angles whose measures have a sum of \(90^\circ\). Find the measure of an angle whose supplement is \(10^\circ\) 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.

4. **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>

**NUMBER THEORY** For Exercises 5 and 6, use the following information.

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.

5. Write and solve an equation to find the integers.

6. Does the equation have one solution, no solutions, or is it an identity? Explain.
State whether each equation is an identity. If it is not, find its solution.

1. $2(2 - 3x) = 3(3 + x) + 4$
2. $5(m + 1) + 6 = 3(4 + m) + (2m - 1)$

3. $(5t + 9) - (3t - 13) = 2(11 + t)$
4. $14 - (6 - 3c) = 4c - c$

5. $3y - 2(y + 19) = 9y - 3(9 - y)$
6. $3(3h - 1) = 4(h + 3)$

7. Use the true equation $3x - 2 = 3x - 2$ to create an identity of your own.

8. Use the false equation $1 = 2$ to create an equation with no solution.

9. Create an equation whose solution is $x = 3$. 
CONCEPT: SOLVE FOR SPECIFIC VARIABLE

Solve each equation or formula for the variable specified.

1. $7t = x$, for $t$
2. $e = wp$, for $p$
3. $q - r = r$, for $r$
4. $4m - n = m$, for $m$
5. $7a - b = 15a$, for $a$
6. $-5c + d = 2c$, for $c$
7. $x - 2y = 1$, for $y$
8. $m + 3n = 1$, for $n$
9. $7f + g = 5$, for $f$
10. $ax - c = b$, for $x$
11. $rt - 2n = y$, for $t$
12. $bc + 3g = 2k$, for $c$
13. $kn + 4f = 9v$, for $n$
14. $8c + 6j = 5p$, for $c$
15. $\frac{x - c}{2} = d$, for $x$
16. $\frac{x - c}{2} = d$, for $c$
17. $\frac{p + 9}{5} = q$, for $p$
18. $\frac{b - 4z}{7} = a$, for $b$

Solve each equation or formula for the variable specified.

1. $d = rt$, for $r$
2. $6w - y = 2z$, for $w$
3. $mx + 4y = 3c$, for $x$
4. $9s - 5g = -4u$, for $s$
5. $ab + 3c = 2d$, for $b$
6. $2p = hx - q$, for $x$
7. $\frac{2}{3}m + a = a + c$, for $m$
8. $\frac{2}{5}h + g = d$, for $h$
9. $\frac{2}{3}y + v = s$, for $y$
10. $\frac{3}{4}a - q = k$, for $a$
11. $rx + \frac{9}{5} = h$, for $x$
12. $\frac{3b - 4}{2} = c$, for $b$
13. $2w - y = 7w - 2$, for $w$
14. $3\ell + y = 5 + 5\ell$, for $\ell$
Write an equation and solve for the variable specified.

15. Three times a number \( s \) plus 4 times a number \( y \) is 1 more than 6 times the number \( s \). Solve for \( s \).

16. Five times a number \( h \) minus 9 is two thirds of a number \( j \). Solve for \( j \).

**ELECTRICITY** For Exercises 17 and 18, use the following information.
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.

17. Solve the formula for \( R \).

18. Suppose a current of 0.25 ampere flows through a resistor connected to a 12-volt battery. What is the resistance in the circuit?

**MOTION** For Exercises 19 and 20, use the following information.
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.

19. Solve the formula for \( r \).

20. 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 \( \pi \).)

1. Solve \( A = \frac{1}{2} h(a + b) \), the area of a trapezoid equation for \( h \).

2. The formula \( s = \frac{w - 10e}{m} \) is often used by placement services to find keyboarding speeds. In the formula \( s \) represents the speed in words per minute, \( w \) represents the number of words typed, \( e \) represents the number of errors, and \( m \) represents the number of minutes typed. Solve the formula for \( e \). Then find out how many errors Mateo made if he typed 410 words in 5 minutes and had a keyboard speed of 76 words per minute.

3. Write an equation to represent seven less than a number \( t \) equals another number \( r \) plus 6. Solve for \( t \).
4. Write an equation to represent five minus twice a number \( p \) equals 6 times another number \( q \) plus 1. Solve for \( p \).

5. Write an equation for five eights of a number \( x \) is 3 more than one half of another number \( y \). Solve for \( y \).

6. The formula \( P = \frac{1.2W}{H^2} \) represents the amount of pressure exerted on the floor by a dancer’s heel. In this formula, \( P \) is the pressure in pounds per square inch, \( W \) is the weight of a person wearing the shoe in pounds, and \( H \) is the width of the heel of the shoe in inches. Solve the formula for \( W \). Find the weight of the dancer if the heel is 3 inches wide and the pressure exerted is 30 pounds per square inch.

7. The Yummy Ice Cream Company wants to package ice cream in cylindrical containers that have a volume of 5453 cubic centimeters. The marketing department decides the diameter of the base of the containers should be 20 centimeters. How tall should the containers be? \( V = \pi r^2 h \)

8. \( \frac{1}{R} = \frac{1}{a} + \frac{1}{b} \), which is the total resistance \( R \) in an electrical circuit consisting of two resistances of \( a \) ohms and \( b \) ohms connected in parallel. Explain how to solve this equation for \( R \).
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 $p$.

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 $r$.

3. **GEOMETRY** The volume of a rectangular prism is given by the formula $V = \ell \times w \times h$. Suppose a cereal company wants to package 270 cubic inches of cereal in a full box. The width of the box must be 9 inches and the height of the box must be 12 inches to fit on store shelves. Solve the equation for $\ell$ and find the length of the box.

4. **PHYSICS** The pressure exerted on an object is calculated by the formula $P = \frac{F}{A}$, where $P$ is the pressure, $F$ is the force, 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 inches. Solve the equation for $F$ and find the force of the spray.

**GEOMETRY** For Exercises 5–7, use the following information.

The regular octagon is divided into 8 congruent triangles. Each triangle has an area of 12 square centimeters. The perimeter of the octagon is 48 centimeters.

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

6. Solve the area of a triangle formula for $h$.

7. What is the height of each triangle?
CONCEPT: RATIOS AND PROPORTIONS

Use cross products to determine whether each pair of ratios forms a proportion. Write yes or no.

1. \( \frac{7}{6} : \frac{52}{48} \)
2. \( \frac{3}{11} : \frac{15}{66} \)
3. \( \frac{18}{24} : \frac{36}{48} \)
4. \( \frac{12}{11} : \frac{108}{99} \)
5. \( \frac{8}{9} : \frac{72}{81} \)
6. \( \frac{15}{9} : \frac{1}{6} \)
7. \( \frac{3.4}{5.2} : \frac{7.14}{10.92} \)
8. \( \frac{1.7}{1.2} : \frac{2.9}{2.4} \)
9. \( \frac{7.6}{1.8} : \frac{3.9}{0.9} \)

Solve each proportion. If necessary, round to the nearest hundredth.

10. \( \frac{5}{a} = \frac{30}{54} \)
11. \( \frac{v}{46} = \frac{34}{23} \)
12. \( \frac{40}{56} = \frac{k}{7} \)
13. \( \frac{28}{49} = \frac{4}{w} \)
14. \( \frac{3}{u} = \frac{27}{162} \)
15. \( \frac{y}{3} = \frac{48}{9} \)
16. \( \frac{2}{y} = \frac{10}{60} \)
17. \( \frac{5}{11} = \frac{35}{x} \)
18. \( \frac{3}{51} = \frac{z}{17} \)
19. \( \frac{6}{61} = \frac{12}{h} \)
20. \( \frac{g}{16} = \frac{6}{4} \)
21. \( \frac{14}{49} = \frac{2}{a} \)
22. \( \frac{7}{9} = \frac{8}{c} \)
23. \( \frac{3}{q} = \frac{5}{6} \)
24. \( \frac{m}{6} = \frac{5}{8} \)
25. \( \frac{v}{0.23} = \frac{7}{1.61} \)
26. \( \frac{3}{0.72} = \frac{12}{b} \)
27. \( \frac{6}{n} = \frac{3}{0.51} \)
28. \( \frac{7}{a - 4} = \frac{14}{6} \)
29. \( \frac{3}{12} = \frac{2}{y + 6} \)
30. \( \frac{m - 1}{8} = \frac{2}{4} \)
31. \( \frac{5}{12} = \frac{x + 1}{4} \)
32. \( \frac{r + 2}{7} = \frac{5}{7} \)
33. \( \frac{3}{7} = \frac{x - 2}{6} \)

34. PAINTING Ysidra paints a room that has 400 square feet of wall space in \( 2\frac{1}{2} \) hours.

At this rate, how long will it take her to paint a room that has 720 square feet of wall space?
1. The Lehmans’ minivan requires 5 gallons of gasoline to travel 120 miles. How much gasoline will they need for a 350-mile trip?

2. On a blueprint for a house, 2.5 inches equals 10 feet. If the length of a wall is 12 feet, how long is the wall on the blueprint?

3. Jun earns $152 in 4 days. At that rate, how many days will it take to earn $532?

4. Lane drove 248 miles in 4 hours. At that rate, how long will it take her to drive an additional 93 miles?

5. A collector’s model racecar is scaled so that 1 inch on the model equals 6.25 feet on the actual car. If the model is \( \frac{2}{3} \) inch high, how high is the actual car?

6. On a map of Illinois, the distance between Chicago and Algonquin is 3.2 centimeters. If 2 centimeters = 40 kilometers, what is the approximate distance between the two cities?

7. To make a model of the Guadeloupe River bed, Henry used 1 inch of clay for 5 miles of the river’s actual length. His model river was 50 inches long. How long is the Guadeloupe River?

8. Josh finished 24 math problems in one hour. At that rate, how many hours will it take him to complete 72 problems?

9. Joe’s boat used 5 gallons of gasoline in 4 hours. At this rate, how many gallons of gasoline will the boat use in 10 hours?

10. Walker is planning a summer vacation. He wants to visit Petrified National Forest and Meteor Crater, the 50,000 year old impact site of a large meteor. On a map with a scale where 2 inches equals 75 miles, the two areas are about 1.5 inches apart. What is the distance between Petrified National Forest and Meteor Crater?
1. **WATER** A dripping faucet wastes 3 cups of water every 24 hours. How much water is wasted in a week?

2. **GASOLINE** In mid-2005 the average price of 5 gallons of regular unleaded gasoline in the United States was $12.95. What was the price for 16 gallons of gas?

3. **SHOPPING** Stevenson's Market is selling 3 packs of toothpicks for $0.87. How much will 10 packs of toothpicks cost at this price? Round your answer to the nearest cent.

4. **BUILDINGS** The Sears Tower in Chicago is 1450 feet tall. The John Hancock Center in Chicago is 1127 feet tall. Suppose you are asked to build a small-scale replica of each. If you make the Sears Tower 3 meters tall, what would be the approximate height of the John Hancock replica? Round your answer to the nearest hundredth.

5. Use a metric ruler to measure the distances between Robinson and Neale on the map.

6. Using the scale of the map, find the approximate actual distance by air (not by roads), between Robinson and Neale.

7. Approximately how many square miles are shown on this map?