**Applications of Equations**

Objectives: To set up and solve equations from applications.

**Steps**
1. Read the problem completely.
2. Decide which unknown quantity the variable will represent.
3. Write an equation.
4. Solve.
5. State the answer to the question. Is it reasonable?
6. Check the solution.

**Example 1**

Two numbers have a sum of 24. If the second number is three times as large as the first, what are these two numbers?

Let $x = \text{first number}$

3x = second number

$x + 3x = 24$

4x = 24

$x = 6 = \text{first number}$

3x = 3(6) = 19 = second number

**Example 2**

In a biology class, there are seven more men than women. If there are a total of 43 students in the class, how many are men and how many are women?

Let $w = \text{women}$

$w + 7 = \text{men}$

$w + w + 7 = 43$

$2w + 7 = 43$

$2w = 36$

$w = 18 = \text{women}$

$w + 7 = 18 + 7 = 25 = \text{men}$

**Example 3**

A mother is five years older than twice the age of her daughter. If the mother is 37 years old, how old is her daughter?

Let $a = \text{age of daughter}$

$5 + 2a = \text{age of mother}$

$5 + 2a = 37$

$2a = 32$

$a = 16 = \text{age of daughter}$

**Example 4**

A doctor is two years older than three times the age of her patient. If the doctor is 35 years old, how old is her patient?

Let $p = \text{age of patient}$

$2 + 3p = \text{age of doctor}$

$2 + 3p = 35$

$3p = 33$

$p = 11 = \text{patient}$
**Definition**

- **Perimeter** = total distance around a figure; add all sides.

For a Rectangle, \( P = 2l + 2w \), since there are two widths and two lengths.

**Example 5**

- The length of a rectangle is four times the width. What are the dimensions of the rectangle if its perimeter is 55 ft?

  Let \( w = \text{width} \)
  
  \[ 4w = \text{length} \]
  
  \[ 55 = 2(4w) + 2w \]
  
  \[ 55 = 10w \]
  
  \[ w = \text{width} = 5.5 \]
  
  \[ 5.5(4) = \text{length} = 22 \]

**Example 6**

- An isosceles triangle has a perimeter of 43 inches. What is the length of each side if the base is 5 inches shorter than the sum of the two equal sides?

  Let \( x = \text{the length of one equal side} \)
  
  \[ x - 5 = \text{base} \]
  
  \[ x + x + (x - 5) = 43 \]
  
  \[ 3x - 5 = 43 \]
  
  \[ 3x = 48 \]
  
  \[ x = 16, \text{ and } x - 5 = 16 - 5 = 11 \]
  
  So the sides are 16, 16, and 11.

**Example 7**

A collection of 15 coins is worth $1.00. If the coins are dimes and nickels, how many of each coin are there?

Let \( d = \text{the number of dimes} \)

\[ 15 - d = \text{number of nickels} \]

\[ 0.10d + 0.05(15 - d) = 1.00 \]

(Clear decimals.)

\[ 10d + 5(15 - d) = 100 \]

\[ 10d + 75 - 5d = 100 \]

\[ 5d + 75 = 100 \]

\[ 5d = 25 \]

\[ d = \text{5 dimes} \]

\[ 15 - d = 15 - 5 = 10 \text{ nickels} \]

**Example 8**

A man has a collection of dimes and quarters worth a total of $3.50. If he has 7 more dimes than quarters, how many of each coin does he have?

Let \( q = \text{number of quarters} \)

\[ q + 7 = \text{number of dimes} \]

\[ 0.25q + 0.10(q + 7) = 3.50 \]

(Clear decimals.)

\[ 25q + 10q + 70 = 350 \]

\[ 35q + 70 = 350 \]

\[ 35q = 280 \]

\[ q = \text{8 quarters} \]

\[ q + 7 = 15 \text{ dimes} \]