# LESSON 15 Applications of Linear Equations in Two Variables

## ☐ SOLVING WORD PROBLEM USING LINEAR EQUATIONS IN SLOPE-INTERCEPT FORM

In real-world situations, the slope represents a constant rate of change, and the $y$-intercept represents an initial value or starting point. When solving a word problem involving these concepts, first identify the slope ($m$) and $y$-intercept ($b$) to write an equation in slope-intercept form ($y = mx + b$). Then use the equation to find what's being asked.

➔ **EXAMPLE** A plumber charges a \$50 flat fee plus \$35 per hour. a) Write an equation for the cost, $y$, after $x$ hours of service. b) How much will it cost for a job that takes 5 hours? c) If the plumber earned \$120 on a job, how long did the job take?

Here's a tip! The word "per" indicates a rate.

a. Slope $m$ = rate of change = \$35/hour
$y$-intercept $b$ = initial value = \$50
So the equation is $y = 35x + 50$.

b. Given $x = 5$, $y = 35(5) + 50 = 225$.
So a 5-hour job will cost \$225.

c. Given $y = 120$, $120 = 35x + 50$.
Solve for $x$, and $x = 2$.
So the job took 2 hours.

➔ **TRY IT 1.** An electrician charges a \$40 flat fee plus \$38 per hour.

**a.** Write an equation representing the total cost, $y$, after $x$ hours of service.

**b.** How much will it cost for a job that takes 3 hours?

**c.** If the electrician earned \$116 on a job, how long did the job take?

## ☐ SOLVING WORD PROBLEM USING LINEAR EQUATIONS IN STANDARD FORM

When a word problem involves a relationship between two quantities whose sum is a constant, you can write an equation in standard form ($Ax + By = C$) to model the relationship. Then you can use the equation to find what's being asked.

➔ **EXAMPLE** A 100-point test has $x$ questions worth 2 points each and $y$ questions worth 4 points each. a) Write an equation relating $x$ and $y$. b) If there are 20 4-point questions, how many 2-point questions are on the test? c) If there are 20 2-point questions, how many 4-point questions are on the test?

Here's a tip! Look for the total that is given. That is our constant $C$ in the equation.

a. Points from 2-point questions = $2x$
Points from 4-point questions = $4y$
Total points from all questions = 100
So the equation is $2x + 4y = 100$.

b. Given $y = 20$, $2x + 4(20) = 100$.
Solve for $x$, and $x = 10$
So there are 10 2-point questions.

c. Given $x = 20$, $2(20) + 4y = 100$.
Solve for $y$, and $y = 15$
So there are 15 4-point questions.

➔ **TRY IT 2.** Laura has $x$ five-dollar bills and $y$ ten-dollar bills amounting to \$80.

**a.** Write an equation relating $x$ and $y$.

**b.** If she has 8 five-dollar bills, how many ten-dollar bills does she have?

☐ **EXERCISE YOUR SKILLS**

Solve.

3. A bike rental shop charges a flat fee of $15 plus $9 per hour for renting a bike.
   a. Write an equation representing the total cost, $y$, of renting a bike for $x$ hours.
   b. How much will it cost to rent a bike for 3 hours?
   c. If you have $78, how many hours can you rent a bike?

4. A water tank with 240 gallons of water is being emptied at a rate of 6 gallons per minute.
   a. Write an equation representing the amount of water, $y$, in the tank after $x$ minutes.
   b. How much water will be in the tank after 15 minutes?
   c. How long will it take to empty the tank?

5. An airplane 32,000 feet above the ground begins descending at an average speed of 1,200 feet per minute.
   a. Write an equation representing the altitude, $y$, of the plane after $x$ minutes.
   b. What is the altitude of the plane after 10 minutes of descending?
   c. How long will it take the plane to reach an altitude of 26,000 feet?

6. An online bookstore sells magazines for $5.50 each. The shipping cost per order is $7.
   a. Write an equation representing the total cost, $y$, of ordering $x$ magazines.
   b. How much will it cost to order 12 magazines?
   c. If you have $62, how many magazines can you order?

Write an equation relating $x$ and $y$, then solve.

7. Olivia has $x$ dimes and $y$ nickels totaling $1.80. If she has 15 dimes, how many nickels does she have?

8. A 100-point test has $x$ multiple-choice questions worth 3 points each and $y$ short-answer questions worth 5 points each. If there are 20 3-point questions, how many 5-point questions are on the test?

9. At a festival, a group of people bought 7 adult tickets at $\$x$ each and 5 child tickets at $\$y$ each. They paid $81 in total. If adult tickets cost $8 each, how much did each child ticket cost?

10. At a bakery, Carson spent $30 to buy $x$ cookies and $y$ muffins. A cookie costs $2, and a muffin costs $4.50. How many cookies did Carson buy if he bought 4 muffins?

11. A restaurant has $x$ tables that seat 4 people and $y$ tables that seat 8 people. The restaurant can seat a total of 96 people. If 6 tables seat 8 people, how many tables seat 4 people?