

# Solving Equations

A problem often requires finding solutions to equations. In previous Units, you developed strategies for solving linear and quadratic equations. In this Investigation, you will use the properties of real numbers to extend these strategies.

## 3.1 Selling Greeting Cards

### Solving Linear Equations



The steps below show one way to solve  $100 + 4x = 25 + 7x$  for  $x$ .

$$100 + 4x = 25 + 7x$$

- (1)  $100 + 4x - 4x = 25 + 7x - 4x$
- (2)  $100 = 25 + 3x$
- (3)  $100 - 25 = 25 + 3x - 25$
- (4)  $75 = 3x$
- (5)  $\frac{75}{3} = \frac{3x}{3}$
- (6)  $25 = x$

#### Common Core State Standards

**8.EE.C.7a** Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions . . .

**8.EE.C.8b** Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection.

Also **8.EE.A.2**, **8.EE.C.7**, **8.EE.C.7b**, **8.EE.C.8**, **8.EE.C.8a**, **8.EE.C.8c**, **8.FA.1**, **N-Q.A.1**, **N-Q.A.2**, **A-SSE.A.1**, **A-SSE.A.1a**, **A-SSE.A.1b**, **A-SSE.A.2**, **A-SSE.B.3**, **A-SSE.B.3a**, **A-CED.A.1**, **A-CED.A.2**, **A-REI.A.1**, **A-REI.B.3**, **A-REI.B.4**, **A-REI.B.4b**, **A-REI.C.6**, **A-REI.D.10**, **A-REI.D.11**

- How could you explain Steps 1, 3, and 5 in the solution?
- The solution begins by subtracting  $4x$  from each side of the equation. Could you begin with a different first step? Explain.
- How can you check that  $x = 25$  is the correct solution?
- Can you describe another method for finding the solution to the equation?

The preceding example uses the **properties of equality** that you learned in the Grade 7 Unit *Moving Straight Ahead*.

- You can add or subtract the same quantity from each side of an equation to write an equivalent equation.
- You can multiply or divide each side of an equation by the same nonzero quantity to write an equivalent equation.

You can use these properties as well as the Distributive and Commutative properties to solve equations.

### Problem 3.1



- A** The school choir is selling boxes of greeting cards to raise money for a trip. The equation for the profit in dollars  $P$  in terms of the number of boxes sold  $s$  is

$$P = 5s - (100 + 2s)$$

1. What information do the expressions  $5s$  and  $100 + 2s$  represent in the situation? What information do  $100$  and  $2s$  represent?
  2. Use the equation to find the number of boxes the choir must sell to make a \$200 profit. Explain.
  3. How many boxes must the choir sell to break even? Explain.
  4. Write a simpler expression for profit. Explain how your expression is equivalent to the original expression for profit.
  5. One of the choir members wrote the following expression for profit:  $5s - 2(50 + s)$ . Explain whether this expression is equivalent to the original expression for profit.
- B** Describe how to solve an equation that has parentheses such as  $200 = 5s - (100 + 2s)$  without using a table or graph.

*continued on the next page >*

### Problem 3.1 *continued*

Ⓒ Solve each equation for  $x$  when  $y = 0$ . Check your solutions.

1.  $y = 5 + 2(3 + 4x)$

2.  $y = 5 - 2(3 + 4x)$

3.  $y = 5 + 2(3 - 4x)$

4.  $y = 5 - 2(3 - 4x)$

**A C E** Homework starts on page 55.

## 3.2 Comparing Costs

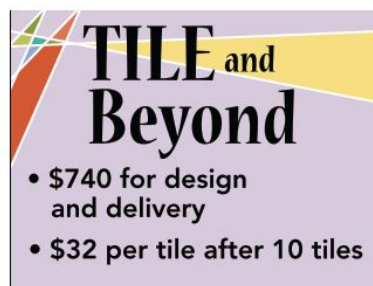
### Solving More Linear Equations

▶ Ms. Lucero wants to install tiles around her square swimming pool. She finds the following two advertisements for tile companies.



**COVER and SURROUND IT**

\$1,000 for design and delivery  
\$25 per tile after 12 tiles



**TILE and Beyond**

- \$740 for design and delivery
- \$32 per tile after 10 tiles

The equations below show the estimated costs  $C$  (in dollars) of buying and installing  $N$  border tiles.

$$\text{Cover and Surround It: } C_C = 1,000 + 25(N - 12)$$

$$\text{Tile and Beyond: } C_T = 740 + 32(N - 10)$$

You can use *subscripts* to show different uses for a variable:  $C_C$  means cost for *Cover and Surround It*;  $C_T$  means cost for *Tile and Beyond*.

- Do the equations make sense, given the description above for each company's charges? Explain.
- Is the cost of *Tile and Beyond* always cheaper than the cost of *Cover and Surround It*? Explain.

Ms. Lucero wants to know when the costs of each company were equal.

- How can Ms. Lucero use the equation  $C_C = C_T$  to answer her question?