

Skill check

Use Substitution to find a solution

$$5x - 2y = 9$$

$$x + y = -3$$

5-3 Elimination

Why would you use elimination?

Example 1

$$3x + 2y = 4$$

$$3x - 2y = -4$$

Step 1 Because the coefficients of the y -terms are opposites, you do not need to multiply either equation by a constant.

Step 2 Add the equations.

$$3x + 2y = 4 \quad \text{Equation 1}$$

$$\underline{3x - 2y = -4} \quad \text{Equation 2}$$

$$6x = 0 \quad \text{Add the equations.}$$

Step 3 Solve for x .

$$6x = 0 \quad \text{Resulting equation from Step 2}$$

$$x = 0 \quad \text{Divide each side by 6.}$$

Step 4 Substitute 0 for x in one of the original equations and solve for y .

$$3x + 2y = 4 \quad \text{Equation 1}$$

$$3(0) + 2y = 4 \quad \text{Substitute 0 for } x.$$

$$y = 2 \quad \text{Solve for } y.$$

► The solution is $(0, 2)$.

Example 2

$$-10x + 3y = 1$$

$$-5x - 6y = 23$$

Step 1 Multiply Equation 2 by -2 so that the coefficients of the x -terms are opposites.

$$-10x + 3y = 1$$

$$-10x + 3y = 1 \quad \text{Equation 1}$$

$$-5x - 6y = 23$$

Multiply by -2 .

$$10x + 12y = -46 \quad \text{Revised Equation 2}$$

Step 2 Add the equations.

$$-10x + 3y = 1$$

Equation 1

$$\underline{10x + 12y = -46}$$

Revised Equation 2

$$15y = -45$$

Add the equations.

Step 3 Solve for y .

$$15y = -45$$

Resulting equation from Step 2

$$y = -3$$

Divide each side by 15.

Step 4 Substitute -3 for y in one of the original equations and solve for x .

$$-5x - 6y = 23$$

Equation 2

$$-5x - 6(-3) = 23$$

Substitute -3 for y .

$$-5x + 18 = 23$$

Multiply.

$$-5x = 5$$

Subtract 18 from each side.

$$x = -1$$

Divide each side by -5 .

▶ The solution is $(-1, -3)$.

Solve the system of linear equations by elimination. Check your solution.

1. $3x + 2y = 7$

2. $x - 3y = 24$

3. $x + 4y = 22$

$-3x + 4y = 5$

$3x + y = 12$

$4x + y = 13$

ANSWERS

1. $(1, 2)$

2. $(6, -6)$

3. $(2, 5)$

EXAMPLE 3 Modeling with Mathematics

A business with two locations buys seven large delivery vans and five small delivery vans. Location A receives five large vans and two small vans for a total cost of \$235,000. Location B receives two large vans and three small vans for a total cost of \$160,000. What is the cost of each type of van?

large van small van

Variables Let x be the cost (in dollars) of a large van and let y be the cost (in dollars) of a small van.

System $5x + 2y = 235,000$ Equation 1
 $2x + 3y = 160,000$ Equation 2

Step 1 Multiply Equation 1 by -3 . Multiply Equation 2 by 2.

$5x + 2y = 235,000$ Multiply by -3 . $-15x - 6y = -705,000$ Revised Equation 1
 $2x + 3y = 160,000$ Multiply by 2. $4x + 6y = 320,000$ Revised Equation 2

Step 2 Add the equations.

$$\begin{array}{r} -15x - 6y = -705,000 \\ \underline{4x + 6y = 320,000} \\ -11x \qquad = -385,000 \end{array}$$

Revised Equation 1
Revised Equation 2
Add the equations.

Step 3 Solving the equation $-11x = -385,000$ gives $x = 35,000$.

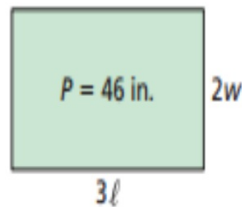
Step 4 Substitute 35,000 for x in one of the original equations and solve for y .

$$\begin{array}{r} 5x + 2y = 235,000 \\ 5(35,000) + 2y = 235,000 \\ y = 30,000 \end{array}$$

Equation 1
Substitute 35,000 for x .
Solve for y .

▶ The solution is (35,000, 30,000). So, a large van costs \$35,000 and a small van costs \$30,000.

- 31. MATHEMATICAL CONNECTIONS** A rectangle has a perimeter of 18 inches. A new rectangle is formed by doubling the width w and tripling the length ℓ , as shown. The new rectangle has a perimeter P of 46 inches.



- Write and solve a system of linear equations to find the length and width of the original rectangle.
- Find the length and width of the new rectangle.

Solve the system of linear equations by elimination.

1. $3x + y = 14$
 $4x - y = 0$

2. $2x + y = 7$
 $-3x - 2y = -9$

3. A restaurant with two locations buys twelve large bags of flour and eight large bags of sugar. Location A receives seven bags of flour and five bags of sugar for a total cost of \$584. Location B receives five bags of flour and three bags of sugar for a total cost of \$384. What is the cost of each bag of flour and each bag of sugar?