

# Bellringer

**Solve the system of linear equations by substitution. Check your answer.**

1. 
$$\begin{cases} x + y = 5 \\ 2x - y = 7 \end{cases}$$

2. 
$$\begin{cases} y = -2x + 6 \\ -4x - 6y = 4 \end{cases}$$

## **8.3 Solving Systems by Elimination**

### 8.EE.8b

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

### 8.EE.8c

Solve real-world and mathematical problems leading to two linear equations in two variables

# Vocabulary

- Elimination Method - used to solve systems of linear equations where one variable is eliminated by adding or subtracting the two equations to obtain a single equation in one variable

## Steps for using elimination method

Step 1: Put equations in same order

Step 2: Add or subtract equations to eliminate one variable

Step 3: Solve resulting equation for its variable

Step 4: Substitute value from step 3 into an original equation to find other variable

Step 5: Write solution as an ordered pair

Step 6: Check your solution in equations for true statements

Step 7: Interpret solution if necessary (real-world problems)

To eliminate using addition, look for opposite expressions in the original equations

Ex

$$\begin{array}{r} x + y = 5 \\ + 2x + -y = 7 \\ \hline 3x = 12 \\ \frac{3}{3} \quad \frac{12}{3} \\ \hline x = 4 \end{array}$$

$$\begin{array}{r} 4 + y = 5 \\ -4 \quad -4 \\ \hline y = 1 \end{array}$$

(4,1)

Check

$$\begin{array}{l} 4 + 1 = 5 \\ 5 = 5 \checkmark \end{array}$$

$$\begin{array}{l} 2(4) + -(1) = 7 \\ 8 + -1 = 7 \\ 7 = 7 \checkmark \end{array}$$

**EXAMPLE 1**

Solve the system of equations by adding. Check your answer.

$$\begin{cases} 2x - 3y = 12 \\ x + 3y = 6 \end{cases}$$

$$\begin{array}{r} 2x - 3y = 12 \\ + \quad x + 3y = 6 \\ \hline 3x = 18 \\ \frac{3x}{3} = \frac{18}{3} \\ \boxed{x = 6} \end{array}$$

$$\begin{array}{r} 2(6) - 3y = 12 \\ 12 - 3y = 12 \\ \underline{-12} \quad \underline{-12} \\ -3y = 0 \\ \frac{-3y}{-3} = \frac{0}{-3} \\ \boxed{y = 0} \end{array}$$

$$(6, 0)$$

Check

$$2(6) - 3(0) = 12$$

$$\begin{array}{l} 12 + 0 = 12 \\ 12 = 12 \checkmark \end{array}$$

$$6 + 3(0) = 6$$

$$6 + 0 = 6$$

$$6 = 6 \checkmark$$

## ADDITIONAL EXAMPLE 1

Solve the system of equations by adding. Check your answer.

$$\begin{cases} 2x + y = 8 \\ -2x + 3y = 16 \end{cases}$$

$$\begin{array}{r} 2x + y = 8 \\ + \quad -2x + 3y = 16 \\ \hline 4y = 24 \\ \frac{4y}{4} = \frac{24}{4} \\ \boxed{y = 6} \end{array}$$

$$\begin{array}{r} 2x + y = 8 \\ \quad -6 - 6 \\ \hline 2x = 2 \\ \frac{2x}{2} = \frac{2}{2} \\ \boxed{x = 1} \end{array}$$

$(1, 6)$

Check

$$\begin{aligned} 2(1) + 6 &= 8 \\ 2 + 6 &= 8 \\ 8 &= 8 \checkmark \\ -2(1) + 3(6) &= 16 \\ -2 + 18 &= 16 \\ 16 &= 16 \checkmark \end{aligned}$$

**YOUR TURN**

Solve each system of equations by adding. Check your answers.

$$3. \begin{cases} x + y = -1 \\ x - y = 7 \end{cases}$$

$$\begin{array}{r} x + y = -1 \\ + \quad x - y = 7 \\ \hline 2x = 6 \\ \frac{2x}{2} = \frac{6}{2} \\ \boxed{x = 3} \end{array} \quad (3, -4)$$

$$\begin{array}{r} 3 + y = -1 \\ - \quad 3 = -3 \\ \hline y = -4 \end{array}$$

$$4. \begin{cases} 2x + 2y = -2 \\ 3x - 2y = 12 \end{cases}$$

$$5. \begin{cases} 6x + 5y = 4 \\ -6x + 7y = 20 \end{cases}$$



To eliminate using subtraction, look for the equations to contain the same  $x$  or  $y$  term

$$\begin{array}{r} \text{ex) } x + 2y = 4 \\ - \quad x + y = 3 \\ \hline \end{array}$$

$$y = 1$$

$$x + 2(1) = 4 \quad (2, 1)$$

$$\begin{array}{r} x + 2 = 4 \\ -2 \quad -2 \\ \hline \end{array}$$

$$x = 2$$

Check

$$\begin{array}{l} 2 + 2(1) = 4 \\ 2 + 2 = 4 \\ 4 = 4 \checkmark \end{array}$$

$$\begin{array}{l} 2 + 1 = 3 \\ 3 = 3 \checkmark \end{array}$$

**EXAMPLE 2**

Solve the system of equations by subtracting. Check your answer.

$$\begin{cases} 3x + 3y = 6 \\ 3x - y = -6 \end{cases}$$

$$\begin{array}{r} 3x + 3y = 6 \\ - \quad 3x - y = -6 \\ \hline 4y = 12 \\ \frac{4y}{4} = \frac{12}{4} \\ \boxed{y = 3} \end{array}$$

$$\begin{array}{r} 3x + 3(3) = 6 \\ 3x + 9 = 6 \\ \quad \quad \quad -9 = -9 \\ \hline 3x = -3 \\ \frac{3x}{3} = \frac{-3}{3} \\ \boxed{x = -1} \end{array}$$

$$(-1, 3)$$

Check

$$3(-1) + 3(3) = 6$$

$$\begin{array}{l} -3 + 9 = 6 \\ 6 = 6 \checkmark \end{array}$$

$$3(-1) - 3 = -6$$

$$\begin{array}{l} -3 - 3 = -6 \\ -6 = -6 \checkmark \end{array}$$



## YOUR TURN Solve each system of equations by subtracting. Check your answers.

$$8. \begin{cases} 6x - 3y = 6 \\ 6x + 8y = -16 \end{cases}$$

$$\begin{array}{r} 6x - 3y = 6 \\ - 6x + 8y = -16 \\ \hline -11y = 22 \\ \frac{-11y}{-11} = \frac{22}{-11} \\ \boxed{y = -2} \end{array}$$

$$6x + 3(-2) = 6$$

$$\begin{array}{r} 6x + 3y = 6 \\ \underline{-6} \quad \underline{-6} \\ \hline \end{array} \quad (0, -2)$$

$$\begin{array}{r} 6x = 0 \\ \underline{6} \quad \underline{6} \\ \hline \boxed{x = 0} \end{array}$$

$$9. \begin{cases} 4x + 3y = 19 \\ 6x + 3y = 33 \end{cases}$$

$$10. \begin{cases} 2x + 6y = 17 \\ 2x - 10y = 9 \end{cases}$$

## EXAMPLE 3

The Polar Bear Club wants to buy snowshoes and camp stoves. The club will spend \$554.50 to buy them at Top Sports and \$602.00 to buy them at Outdoor Explorer, before taxes, but Top Sports is farther away. How many of each item does the club intend to buy?

	X Snowshoes	y Camp Stoves
Top Sports	\$79.50 per pair	\$39.25
Outdoor Explorer	\$89.00 per pair	\$39.25

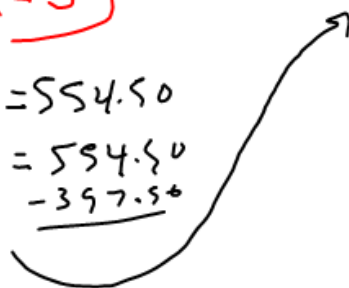
- ① Assign Variables
- ② Write equations
- ③ Elimination Method
- ④ Interpret

$$\begin{array}{r} 79.50x + 39.25y = 554.50 \\ - 89.00x + 39.25y = 602.00 \\ \hline \end{array}$$

$$\begin{array}{r} -9.50x = -47.50 \\ \hline -9.50 \quad \quad \quad -9.50 \end{array}$$

$$x = 5$$

$$\begin{array}{r} 79.50(5) + 39.25y = 554.50 \\ 397.50 + 39.25y = 554.50 \\ \hline -397.50 \end{array}$$



$$\frac{39.25y = 157.00}{39.25} \quad \frac{157.00}{39.25}$$

$$y = 4$$

(5, 4)

buying 5  
snowshoes &  
4 campstoves

## Guided Practice

Solve each system of equations by adding or subtracting.

2. 
$$\begin{cases} x + 2y = -2 \\ -3x + 2y = -10 \end{cases}$$

3. 
$$\begin{cases} 3x + y = 23 \\ 3x - 2y = 8 \end{cases}$$

4. 
$$\begin{cases} -4x - 5y = 7 \\ 3x + 5y = -14 \end{cases}$$