

## Solving Systems of Equations Algebraically

**Substitution** To solve a system of linear equations by **substitution**, first solve for one variable in terms of the other in one of the equations. Then substitute this expression into the other equation and simplify.

### Example

Use substitution to solve the system of equations.  $2x - y = 9$   
 $x + 3y = -6$

Solve the first equation for  $y$  in terms of  $x$ .

$$\begin{array}{ll} 2x - y = 9 & \text{First equation} \\ -y = -2x + 9 & \text{Subtract } 2x \text{ from both sides.} \\ y = 2x - 9 & \text{Multiply both sides by } -1. \end{array}$$

Substitute the expression  $2x - 9$  for  $y$  into the second equation and solve for  $x$ .

$$\begin{array}{ll} x + 3y = -6 & \text{Second equation} \\ x + 3(2x - 9) = -6 & \text{Substitute } 2x - 9 \text{ for } y. \\ x + 6x - 27 = -6 & \text{Distributive Property} \\ 7x - 27 = -6 & \text{Simplify.} \\ 7x = 21 & \text{Add } 27 \text{ to each side.} \\ x = 3 & \text{Divide each side by } 7. \end{array}$$

Now, substitute the value 3 for  $x$  in either original equation and solve for  $y$ .

$$\begin{array}{ll} 2x - y = 9 & \text{First equation} \\ 2(3) - y = 9 & \text{Replace } x \text{ with } 3. \\ 6 - y = 9 & \text{Simplify.} \\ -y = 3 & \text{Subtract } 6 \text{ from each side.} \\ y = -3 & \text{Multiply each side by } -1. \end{array}$$

The solution of the system is  $(3, -3)$ .

### Exercises

Solve each system of linear equations by using substitution.

1.  $3x + y = 7$   
 $4x + 2y = 16$

2.  $2x + y = 5$   
 $3x - 3y = 3$

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

4.  $2x - y = 7$   
 $6x - 3y = 14$

5.  $4x - 3y = 4$   
 $2x + y = -8$

6.  $5x + y = 6$   
 $3 - x = 0$

7.  $x + 8y = -2$   
 $x - 3y = 20$

8.  $2x - y = -4$   
 $4x + y = 1$

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

10.  $x - 4y = 4$   
 $2x + 12y = 13$

11.  $x + 3y = 2$   
 $4x + 12y = 8$

12.  $2x + 2y = 4$   
 $x - 2y = 0$