

## 6.2 Solving a system by SUBSTITUTION

**GOAL** Solve systems of linear equations by substitution.

### Common Student Errors

- Thinking they must only solve for  $x$  or only solve for  $y$

**Tip** Remind students that when using the substitution method to solve a system it does not matter which variable you solve for first. Demonstrate that whether you solve for  $x$  first or  $y$  first, you will obtain the same solution. If possible, solve for the variable that has a coefficient of 1 or  $-1$ .

To determine which variable to solve for, suggest students circle the variable in the system that has a coefficient of 1 or  $-1$ .

$$3x + \textcircled{y} = 2$$

$$4x - 2y = 1$$

$$4x - 5y = 7$$

$$\textcircled{-x} + 3y = 3$$

$$\textcircled{x} + 2y = -3$$

$$12x + 3y = -1$$

**EXAMPLE 1** Use the substitution method

**Solve the linear system:**  $2x + y = 1$  Equation 1

$x + 2y = 5$  Equation 2

**Solution****STEP 1** Solve Equation 1 for  $y$ .

$2x + y = 1$  Write original Equation 1.

$y = -2x + 1$  Subtract  $2x$  from each side.

**STEP 2** Substitute  $-2x + 1$  for  $y$  in Equation 2 and solve for  $x$ .

$x + 2y = 5$  Write Equation 2.

$x + 2(-2x + 1) = 5$  Substitute  $-2x + 1$  for  $y$ .

$x - 4x + 2 = 5$  Distributive property

$-3x + 2 = 5$  Simplify.

$-3x = 3$  Subtract 2 from each side.

$x = -1$  Divide each side by  $-3$ .

**STEP 3** Substitute  $-1$  for  $x$  in the original Equation 1 to find the value of  $y$ .

$2x + y = 1$  Write original Equation 1.

$2(-1) + y = 1$  Substitute  $-1$  for  $x$ .

$-2 + y = 1$  Simplify.

$y = 3$  Solve for  $y$ .

The solution is  $(-1, 3)$ .**CHECK** Substitute  $-1$  for  $x$  and  $3$  for  $y$  in each of the original equations.**Equation 1**

$2x + y = 1$

$2(-1) + 3 \stackrel{?}{=} 1$

$1 = 1 \checkmark$

**Equation 2**

$x + 2y = 5$

$-1 + 2(3) \stackrel{?}{=} 5$

$5 = 5 \checkmark$

**EXAMPLE 2** Use the substitution method

**Solve the linear system:**  $2x + 5y = 5$  Equation 1

$x - 4y = 9$  Equation 2

**Solution****STEP 1** Solve Equation 2 for  $x$ .

$x - 4y = 9$  Write original Equation 2.

$x = 4y + 9$  Revised Equation 2

**STEP 2** Substitute  $4y + 9$  for  $x$  in Equation 1 and solve for  $y$ .

$2x + 5y = 5$  Write Equation 1.

$2(4y + 9) + 5y = 5$  Substitute  $4y + 9$  for  $x$ .

$8y + 18 + 5y = 5$  Distributive property

$13y + 18 = 5$  Simplify.

$13y = -13$  Subtract 18 from each side.

$y = -1$  Divide each side by 13.

**STEP 3** Substitute  $-1$  for  $y$  in the revised Equation 2 to find the value of  $x$ .

$x = 4y + 9$  Revised Equation 2

$x = 4(-1) + 9$  Substitute  $-1$  for  $y$ .

$x = 5$  Simplify.

The solution is  $(5, -1)$ .**CHECK** Substitute 5 for  $x$  and  $-1$  for  $y$  in each equation.**Equation 1**

$2x + 5y = 5$

$2(5) + 5(-1) \stackrel{?}{=} 5$

$5 = 5 \checkmark$

**Equation 2**

$x - 4y = 9$

$5 - 4(-1) \stackrel{?}{=} 9$

$9 = 9 \checkmark$

**Exercises for Examples 1 and 2****Solve the linear system using the substitution method.**

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

$7x - 5y = 34$

**4.**  $6x + y = 26$

$5x - 2y = -1$

**2.**  $8x + 5y = 6$

$5x - y = -21$

**5.**  $x + 3y = 11$

$5x + 6y = 1$

**3.**  $6x - 7y = 22$

$x - 4y = -2$

**6.**  $\frac{3}{2}x + y = 8$

$4x - \frac{1}{2}y = 15$