7-2 Substitution *(Pages 376–381)*

To solve a system of equations without graphing, you can use the **substitution method** shown in the example below. In general, if you solve a system of equations and the result is a *true* statement, such as $-5 = -5$, the system has *infinitely many* solutions; if the result is a *false* statement, such as $-5 = 7$, the system has *no solution*.

Example

Use substitution to solve the system of equations $x + y = 1$ and $2x + y = -1$.

Step 1: Solve one of the equations for x or y.

$x + y = 1$ Solve the first equation for x since the
  $x = 1 - y$ coefficient of x is 1.

Step 2: Substitute this value into the other equation.

    $2x + y = -1$ Use the second equation.
$2(1 - y) + y = -1$ Substitute $1 - y$ for x.
  $2 - 2y + y = -1$ Distribute.

Step 3: Solve this equation.

$2 - 2y + y = -1$ Solve for y.
    $-y = -3$ or $y = 3$

Step 4: Find the value of the other variable using substitution into either equation.

$x + y = 1$ Use the first equation.
$x + 3 = 1$ Substitute 3 for y.
  $x = -2$ Solve for x.
The solution to the system is $(-2, 3)$.
Check: Substitute -2 for x and 3 for y in each of the original equations and check for true statements.

Try These Together

*Use substitution to solve each system of equations. If the system does not have exactly one solution, state whether it has **no** solution or **infinitely many** solutions.*

1. $3x + y = 19$
   $x - 2y = -10$

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

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

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

HINT: If possible, choose to first solve an equation for a variable that has a coefficient of 1.

Practice

Use substitution to solve each system of equations. If the system does not have exactly one solution, state whether it has *no* solution or *infinitely many* solutions.

5. $5x + 4 = y$
   $y - 3x = 7$

6. $3y + x = -1$
   $2x + 6 = -3y$

7. $6x - y = 0$
   $3x + 4y = 18$

8. $3y - 4x = 2$
   $8x = 6y - 4$

9. $2x - y = -4$
   $-x + y = -9$

10. $5x - 2y = -6$
    $2x + 3y = 9$

11. $3x + y = 28$
    $x + 3y = -12$

12. $5x - y = 98$
    $-2x + 3y = 5$

13. | Standardized Test Practice | All CDs in the budget bin are priced the same. Packs of AA batteries are on sale. Keisha's total bill (before tax) for 3 CDs and 1 pack of AA batteries was $39. Eduardo's total for 2 CDs and 3 packs of batteries was $33. What was the price of a single CD?

   A $3   **B** $10   **C** $12   **D** $13

Answers: 1. $(4, 7)$ **2.** $(1, -5)$ **3.** no solution **4.** $\left(\frac{3}{4}, -\frac{3}{4}\right)$ **5.** $\left(\frac{11}{2}, 11\frac{1}{2}\right)$ **6.** $\left(-5, \frac{4}{3}\right)$ **7.** $\left(\frac{2}{3}, 4\right)$ **8.** infinitely many **9.** $(-13, -22)$ **10.** $(0, 3)$ **11.** $(12, -8)$ **12.** $(23, 17)$ **13.** C