

Solving Systems of Equations

A **system of linear equations** is a set of two or more linear equations in the same variables. An example is shown at the right. A **solution of a system of linear equations** in two variables is an ordered pair that is a solution of each equation in the system.

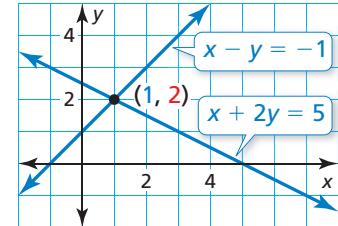
$$\begin{array}{ll} x + 2y = 5 & \text{Equation 1} \\ x - y = -1 & \text{Equation 2} \end{array}$$

Example 1 Solve the system of linear equations above by (a) graphing, (b) substitution, and (c) elimination.

a. Graph each equation. The graphs appear to intersect at (1, 2). Check this point.

$$\begin{array}{l} \text{Equation 1} \quad x + 2y = 5 \\ 1 + 2(2) \stackrel{?}{=} 5 \\ 5 = 5 \quad \checkmark \end{array}$$

$$\begin{array}{l} \text{Equation 2} \quad x - y = -1 \\ 1 - 2 \stackrel{?}{=} -1 \\ -1 = -1 \quad \checkmark \end{array}$$



▶ The solution is (1, 2).

b. Solve for x in Equation 2. $x - y = -1$
 $x = y - 1$

Substitute $y - 1$ for x in Equation 1 and solve for y .

$$\begin{array}{l} x + 2y = 5 \\ (y - 1) + 2y = 5 \\ y = 2 \end{array}$$

Substitute 2 for y in Equation 2 and solve for x .

$$\begin{array}{l} x - y = -1 \\ x - 2 = -1 \\ x = 1 \end{array}$$

▶ The solution is (1, 2).

c. Multiply Equation 2 by 2. Then add the equations and solve the resulting equation.

$$\begin{array}{r} x + 2y = 5 \Rightarrow x + 2y = 5 \\ x - y = -1 \Rightarrow \underline{2x - 2y = -2} \\ \hline 3x = 3 \\ x = 1 \end{array}$$

Substitute 1 for x in Equation 2 and solve for y .

$$\begin{array}{l} x - y = -1 \\ 1 - y = -1 \\ 2 = y \end{array}$$

▶ The solution is (1, 2).

Practice

Check your answers at BigIdeasMath.com.

Solve the system of linear equations by graphing.

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|--|---|---|---|
| 1. $y = x - 3$
$y = -x + 1$ (2, -1) | 2. $-x + 2y = -1$
$x + y = 4$ (3, 1) | 3. $2x + y = 5$
$4x - 2y = 6$ (2, 1) | 4. $9x - 3y = 3$
$3x + y = 1$
infinitely many solutions |
|--|---|---|---|

Solve the system of linear equations by substitution.

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|---|--|--|---|
| 5. $y = 1 - x$
$-2x + y = 4$ (-1, 2) | 6. $x = y + 3$
$5x - y = 7$ (1, -2) | 7. $3x - y = 5$
$2x - y = -3$ (8, 19) | 8. $x - 2y = -3$
$7x - 2y = 15$ (3, 3) |
|---|--|--|---|

Solve the system of linear equations by elimination.

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|---|--|--|---|
| 9. $-2x + 2y = -2$
$2x + y = 5$ (2, 1) | 10. $x - 4y = -3$
$4x + y = 5$ (1, 1) | 11. $x + 5y = -2$
$5x + y = 14$ (3, -1) | 12. $2x + 3y = 5$
$4x + 6y = -10$
no solution |
|---|--|--|---|