



Solving Systems of Linear Equations by Substitution

(equations not in slope-intercept form) (page 1)

We know that when both equations are written in slope-intercept form, you can set the equations equal to each other since both are equal to y . However, we can sometimes save steps and time by using substitution a different way.

- 1) Choose one equation and isolate the variable.
- 2) Substitute the solution from step 1 into the second equation. and solve for the variable in the equation.
- 3) Solve for the variable in the equation for step 2.
- 4) Using the value found in step 2, substitute it into the first equation and solve for the second variable.
- 5) Substitute the values for both variables into both equations to show they are correct.

Example: Solve the system by substitution.
$$\begin{cases} y - 3x = 7 \\ y + x = 3 \end{cases}$$

Step 1: To isolate the y variable, subtract x from both sides

$$\begin{array}{r} y + x = 3 \\ -x = -x \\ \hline y = -x + 3 \end{array}$$

Step 2: In equation (a) $y - 3x = 7$, replace the variable y with the value for y obtained in step 1, from equation (b) $(-x + 3)$.

$$\begin{array}{r} y - 3x = 7 \\ (-x + 3) - 3x = 7 \end{array}$$

Step 3: Solve for x by first combining like terms, then *isolating* the terms with the x variable. Divide both sides by the coefficient of x to *isolate* x .

$$\begin{array}{r} (-x + 3) - 3x = 7 \\ -4x + 3 = 7 \\ -3 = -3 \\ -4x = 4 \\ \frac{-4x}{-4} = \frac{4}{-4} \\ x = -1 \end{array}$$

Step 4: Now we take the value of $x = -1$ and plug it back into $y + x = 3$ and solve for the value of y .

$$\begin{array}{r} y + x = 3 \\ y + (-1) = 3 \\ +1 = +1 \\ y = 4 \end{array}$$

Solution: $(-1, 4)$

Step 5: Now we substitute the value of $x = -1$ and $y = 4$ into both of our original equations.

$$\begin{array}{r} y - 3x = 7 \\ 4 - 3(-1) = 7 \\ 4 + 3 = 7 \\ 7 = 7 \quad \checkmark \end{array} \qquad \begin{array}{r} y + x = 3 \\ (4) + (-1) = 3 \\ 3 = 3 \quad \checkmark \end{array}$$

Solving Systems of Linear Equations by Substitution

(equations not in slope-intercept form) (page 2)

Solve the following systems using the substitution method.

1.
$$\begin{cases} y = x - 2 \\ 2x + 2y = 4 \end{cases}$$

2.
$$\begin{cases} x = -4y - 4 \\ 3x + 5y = 2 \end{cases}$$

3.
$$\begin{cases} y = -2x - 1 \\ x - 2y = 12 \end{cases}$$

4.
$$\begin{cases} -3x - 7y = 1 \\ y = -2x + 3 \end{cases}$$

5.
$$\begin{cases} y = -3x + 4 \\ 6x + 2y = 7 \end{cases}$$

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