

# Solving Linear Systems Algebraically Using Substitution

Solve this system of equations using substitution. Check.

$$\begin{aligned}3y - 2x &= 11 \\ y + 2x &= 9\end{aligned}$$



The substitution method is used to eliminate one of the variables by replacement when solving a system of equations.



Think of it as "grabbing" what one variable equals from one equation and "plugging" it into the other equation.

Systems of Equations may also be referred to as "simultaneous equations".

Let's look at an example using the substitution method:

**Solve this system of equations  
(and check):**

$$\begin{aligned}3y - 2x &= 11 \\ y + 2x &= 9\end{aligned}$$

1. Solve one of the equations for either "x =" or "y =".

This example solves the second equation for "y =".

$$\begin{aligned}3y - 2x &= 11 \\ y &= 9 - 2x\end{aligned}$$

2. Replace the "y" value in the first equation by what "y" now equals. **Grab the "y" value and plug it into the other**

$$3(9 - 2x) - 2x = 11$$

equation.

3. Solve this new equation for "x".

$$\begin{aligned}(27 - 6x) - 2x &= 11 \\ 27 - 6x - 2x &= 11 \\ 27 - 8x &= 11 \\ -8x &= -16 \\ x &= 2\end{aligned}$$

4. Place this new "x" value into either of the ORIGINAL equations in order to solve for "y". **Pick the easier one to work with!**

$$\begin{aligned}y + 2x &= 9 \text{ or} \\ y &= 9 - 2x \\ y &= 9 - 2(2) \\ y &= 9 - 4 \\ y &= 5\end{aligned}$$

5. **Check:** substitute  $x = 2$  and  $y = 5$  into BOTH ORIGINAL equations. If these answers are correct, BOTH equations will be TRUE!

$$\begin{aligned}3y - 2x &= 11 \\ 3(5) - 2(2) &= 11 \\ 15 - 4 &= 11 \\ 11 &= 11 \text{ (check!)}\end{aligned}$$

$$\begin{aligned}y + 2x &= 9 \\ 5 + 2(2) &= 9 \\ 5 + 4 &= 9 \\ 9 &= 9 \text{ (check!)}\end{aligned}$$