

Solving Systems by Substitution

1) Substitution is the replacement of a term of an equation by another known to have the same value.

Another way to think of it is if one equation is equal to y and another equation is equal to y, then the two equations must be equal to each other.

= Same as

if $a = b$ & $b = c$
then $a = c$

2) So, if $y = 2x + 1$ and $y = 5x + 4$
then, $2x + 1 = 5x + 4$, Now, solve for x!

$$\begin{array}{r} y = y \\ 2x + 1 = 5x + 4 \\ -2x \quad | \quad -2x \\ \hline -4 = 3x + 4 \\ -4 \quad | \quad -4 \\ \hline -3 = 3x \\ \frac{-3}{3} = \frac{3x}{3} \\ -1 = x \end{array}$$

3) Now that you have solved for x, plug it into one of the equations and solve for y!

- 1) Distribute ()
- 2) Combine Like terms
- 3) All x's on one side
- 4) All constants (#) on the other side.
- 5) Solve for x.

4) Remember to write your answer as a coordinate point.

$(-1, -1)$
x, y

Solve each system by substitution.

5) $y = 5x + 18$
 $y = -8x - 21$

Solution:
 $(-3, 3)$

$$\begin{array}{r} 5x + 18 = -8x - 21 \\ -5x \quad | \quad -5x \\ \hline 18 = -13x - 21 \\ +21 \quad | \quad +21 \\ \hline 39 = -13x \\ \frac{39}{-13} = \frac{-13x}{-13x} \\ -3 = x \end{array}$$

6) $y = -3x$
 $y = -8x + 10$

$$\begin{array}{r} 5x + 18 = -8x - 21 \\ +8x \quad | \quad +8x \\ \hline 13x + 18 = -21 \\ -18 \quad | \quad -18 \\ \hline 13x = -39 \\ \frac{13x}{13} = \frac{-39}{13} \\ x = -3 \end{array}$$

$y = 5(-3) + 18$

7) $y = 2x + 2$
 $y = 7x + 2$

$$\begin{array}{r} 2x + 2 = 7x + 2 \\ -2x \quad | \quad -2x \\ \hline -2 = 5x + 2 \\ -2 \quad | \quad -2 \\ \hline 0 = 5x \\ 0 = x \end{array}$$

$(0, 2)$
Solution

$-15 + 18$
 $y = 3$

Solution:
 $(-6, \frac{3}{4})$

8) $y = -2x - 9$
 $y = 2x + 15$

$$\begin{array}{r} -2x - 9 = 2x + 15 \\ +2x \quad | \quad +2x \\ \hline -9 = 4x + 15 \\ -15 \quad | \quad -15 \\ \hline -24 = 4x \\ \frac{-24}{4} = \frac{4x}{4} \\ -6 = x \end{array}$$

$y = -2(-6) - 9$
 $12 - 9$
 $y = 3$

$-9 = 4x + 15$
 $-15 \quad | \quad -15$
 $-24 = 4x$
 $\frac{-24}{4} = \frac{4x}{4}$
 $-6 = x$

9) $2x - 2y = -4$ -
 $y = 4x + 11$ -

$y = y$

Solution:
 $(-3, -1)$
 (x, y)

$$2x - 2(4x + 11) = -4$$

$$2x - 8x - 22 = -4$$

$$-6x - 22 = -4$$

$$\begin{array}{r} -6x - 22 = -4 \\ +22 \quad +22 \\ \hline -6x = 18 \\ \frac{-6x}{-6} = \frac{18}{-6} \end{array}$$

$$x = -3 \quad y = -1$$

$$y = 4(-3) + 11$$

11) $-2x + 2y = 6$
 $y = -3x + 15$

$$-2x + 2(-3x + 15) = 6$$

$$-2x - 6x + 30 = 6$$

$$\begin{array}{r} -2x - 6x + 30 = 6 \\ -30 \quad -30 \\ \hline -8x = -24 \\ \frac{-8x}{-8} = \frac{-24}{-8} \end{array}$$

$$x = 3$$

$$y = -3x + 15$$

$$y = -3(3) + 15$$

$$y = -9 + 15$$

$$y = 6$$

Solution
(3, 6)

13) $x - 2y = -5$
 $-2x + 3y = 11$

$$x - 2y = -5$$

$$\begin{array}{r} x - 2y = -5 \\ +2y \quad +2y \\ \hline x = 2y - 5 \end{array}$$

$$-2(2y - 5) + 3y = 11$$

$$-4y + 10 + 3y = 11$$

$$\begin{array}{r} -4y + 10 + 3y = 11 \\ +10 \quad -10 \\ \hline -y = 1 \\ \frac{-y}{-1} = \frac{1}{-1} \\ y = -1 \end{array}$$

$$x - 2y = -5$$

$$x - 2(-1) = -5$$

$$x + 2 = -5$$

$$\begin{array}{r} x + 2 = -5 \\ -2 \quad -2 \\ \hline x = -7 \end{array}$$

Solution:
(-7, -1)

10) $-5x - 2y = -22$
 $y = 4x - 2$

Solution:
 $(2, 6)$

$$-5x - 2(4x - 2) = -22$$

$$-5x - 8x + 4 = -22$$

$$-13x + 4 = -22$$

$$\begin{array}{r} -13x + 4 = -22 \\ -4 \quad -4 \\ \hline -13x = -26 \\ \frac{-13x}{-13} = \frac{-26}{-13} \\ x = 2 \end{array}$$

$$4(2) - 2 = y$$

$$8 - 2 = y$$

$$6 = y$$

12) $y = -6x - 24$
 $2x + 5y = 20$

14) $8x + 4y = -12$
 $6x + y = 1$