

Objective – Solve a system of equations by using the substitution method. Students will see the link between graphing method and substitution to understand that solution is an ordered pair.

What is a system of equations?

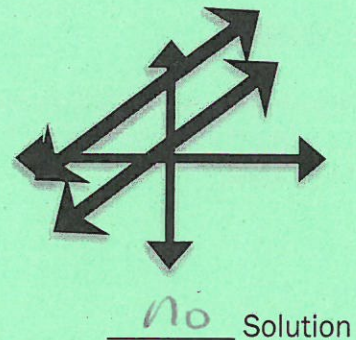
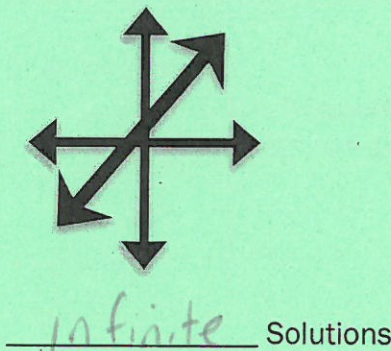
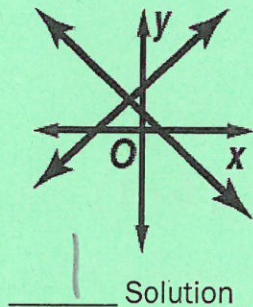
a set of 2 or more equations with the same variables

How do we find solutions to systems of equations?

To solve a system of equations, we need to find a x and a y that satisfy both equations at the same time.

Method 1 - By graphing

-The point of intersection of the two lines is the solution to the system.



In your own words, explain why we graph systems of equations.

Visual representation of the solution
Look for a point of intersection.

Method 2 - By Substitution

STEP 1: Choose one equation and solve for one variable. You can solve for x or y.

$$\textcircled{1} \quad y = 3x$$

$$x + 2y = -21$$

STEP 2: Substitute your solution into the other equation and solve for the variable.

$$\textcircled{2} \quad x + 2(3x) = -21$$

$$x + 6x = -21$$

$$7x = -21$$

$$x = -3$$

STEP 3: Substitute your solution from step 2 into the first equation and solve for the second variable.

$$\textcircled{3} \quad y = 3(-3) \quad y = -9$$

STEP 4: Verify your solution.

$$\textcircled{4} \quad (-3, -9)$$

Example 2

STEP 1: Choose one equation and solve for one variable. You can solve for x or y.

STEP 2: Substitute your solution into the other equation and solve for the variable.

STEP 3: Substitute your solution from step 2 into the first equation and solve for the second variable.

STEP 4: Verify your solution.

$$x + 5y = -3$$

$$3x - 2y = 8$$

$$\textcircled{1} x = -3 - 5y$$

$$\textcircled{2} 3(-3 - 5y) - 2y = 8$$

$$-9 - 15y - 2y = 8$$

$$-17y = -17$$

$$y = 1$$

$$\textcircled{3} x = -3 - 5(1)$$

$$\textcircled{4} x = 2$$

$$(2, 1)$$

Example 3

Explain why substitution method would be a good method to use for this example. Then solve.

$$4x + 5y = 8$$

$$3x - y = -13$$

$$\textcircled{1} y =$$

$$\textcircled{1} y = 3x + 13$$

$$\textcircled{2} 4x + 5(3x + 13) = 8$$

$$4x + 15x + 65 = 8$$

$$19x = -57$$

$$x = -3$$

$$\textcircled{3} y = 3(-3) + 13 = 4$$

$$\textcircled{4} (-3, 4)$$

Try this one on your own

Directions - Solve the system of equations below using the substitution method

$$x = 4y + 5$$

$$x = 3y - 2$$

$$4y + 5 = 3y - 2$$

$$y = -7$$

$$x = 4(-7) + 5$$

$$x = -23$$

$$(-23, -7)$$

What about "infinitely many" and "no solution" systems of equations? Can you have those as possible solutions by using the substitution method? Explain.

yes, lets see what happens!

Directions - Solve the system of equations below using the substitution method

$$2x - y = -8$$

$$-2x + y = -3 \quad y = 2x - 3$$

$$2x - (2x - 3) = -8$$

$$2x - 2x + 3 = -8$$

$$3 = -8$$

no way!

no solution

Directions - Solve the system of equations below using the substitution method

$$6x - 2y = -4$$

$$-3x + y = 2 \quad y = 3x + 2$$

$$6x - 2(3x + 2) = -4$$

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

$$-4 = -4$$

Always!

Infinite Solutions

Try these on your own.

Directions - Solve the system of equations below using the substitution method

$$x - 3y = -9 \quad x = 3y - 9$$

$$-2x + y = -2$$

$$-2(3y - 9) + y = -2$$

$$-6y + 18 + y = -2$$

$$-5y = -20$$

$$y = 4$$

$$(3, 4) \quad x = 3(4) - 9 = 3$$

Directions - Solve the system of equations below using the substitution method

$$y = \frac{3}{5}x$$

$$3x - 5y = 15$$

$$3x - 5\left(\frac{3}{5}x\right) = 15$$

$$3x - 3x = 15$$

$$0 \neq 15$$

no solution

Why do we use the substitution method?

to find the point of intersection algebraically

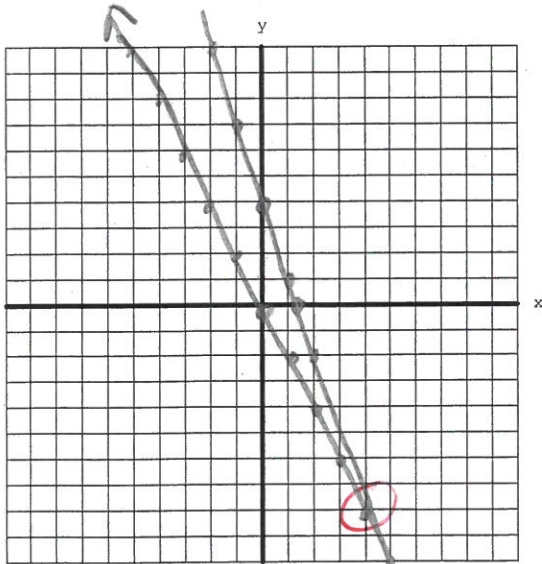
When is it best to use the substitution method?

when one variable is easy to isolate

Identify the systems of equations below that are best solved with the substitution method. Circle your answers.

1 $x = -1$ $4x + 2y = 12$	2 $y - 3x = 6$ $-2x + 5y = 17$	3 $5x + 3y = 10$ $2x - 3y = 4$
4 $2x - 4y = 12$ $7x + 2y = 10$	5 $6x + 2y = 8$ $y = -2x$	6 $8x - y = 8$ $x + y = 10$

Choose two of the problems from above. Solve one of them by graphing and solve the other by substitution.



$(4, -8)$

I chose #5

$$6x + 2(-2x) = 8$$

$$6x - 4x = 8$$

$$2x = 8$$

$$x = 4$$

$$y = -2(4) = -8$$

$(4, -8)$