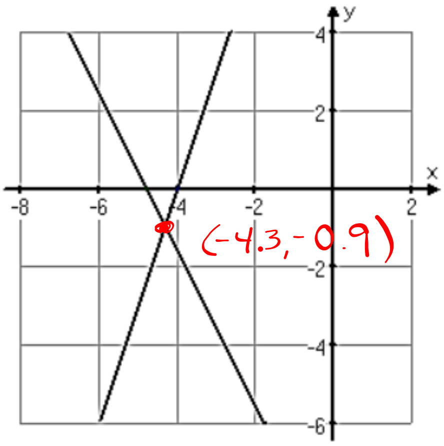
Day 3 – Solving Systems Using Substitution

Name the solution of the systems of equations below:



Were you able to figure out an exact solution??? Unless a solution to a system of equations are integer coordinate points, it can be very hard to determine the solution. This is why we have the option to solve systems using algebra. Algebra allows us to find exact solutions, especially if the solution is a messy number that involves fractions or decimals. We will learn two methods: substitution and elimination (also called linear combinations)

Think About It

How would you find the x and y values for the following systems (i.e a point or solution to the systems)?

a. $-4x + 2y = 24$
$y = 8$

ONE SOLUTION

$(-2, 8)$

$-4x + 2y = 24$

$-4x + 2(8) = 24$

$-4x + 16 = 24$

$\quad -16 \quad -16$

$\frac{-4x}{-4} = \frac{8}{-4}$

$x = -2$

b. $x = 1$
$-2x + 8y = 14$

ONE SOLUTION

$(1, 2)$

$-2x + 8y = 14$

$-2(1) + 8y = 14$

$-2 + 8y = 14$

$+2 \quad\quad +2$

$\frac{8y}{8} = \frac{16}{8}$

$y = 2$

Steps for Solving a System by Substitution

Example:

$y = x + 1$

$2x + y = -2$

Step 1: Select the equation that already has a variable isolated.	**Step 2:** Substitute the expression from Step 1 into the other equation for the variable you isolated in step 1 and solve for the other variable.	**Step 3:** Substitute the value from Step 2 into the revised equation from Step 1 and solve for the other variable. Create a point from your solutions.	**Step 4:** Check the solution in each of the original equations.
$y = x + 1$	$2x + y = -2$ $2x + (x) + 1 = -2$ $3x + \cancel{1} = -2$ $\cancel{-1} \quad -1$ $\frac{\cancel{3}x}{\cancel{3}} = \frac{-3}{3}$ $x = -1$	$y = \cancel{x} + 1$ $y = -1 + 1$ $y = 0$ ONE SOLUTION $(-1, 0)$	$y = x + 1$ $0 = -1 + 1$ $0 = 0$ ✓ $2x + y = -2$ $2(-1) + 0 = -2$ $-2 + 0 = -2$ $-2 = -2$ ✓

Example: Solve the system below:

$2x + 2y = 3$

$x = 4y - 1$

$x = 4y - 1$

$2\cancel{x} + 2y = 3$

$2(4y - 1) + 2y = 3$

$8y - 2 + 2y = 3$

$10y - \cancel{2} = 3$

$\cancel{+2} \quad +2$

$\frac{\cancel{10}y}{\cancel{10}} = \frac{5}{10}$

$y = \frac{1}{2}$ or 0.5

$x = 4y - 1$

$x = 4\left(\frac{1}{2}\right) - 1$

$x = 2 - 1$

$x = 1$

ONE SOLUTION

$\left(1, \frac{1}{2}\right)$

Example: Solve the system below:

$y = x + 1$

$y = -2x + 4$

$y = x + 1$

$y = -2x + 4$

$x + 1 = -2\cancel{x} + 4$

$+2x \quad \cancel{+2x}$

$3x + \cancel{1} = 4$

$\cancel{-1} \quad -1$

$\frac{\cancel{3}x}{\cancel{3}} = \frac{3}{3}$

$x = 1$

$y = x + 1$

$y = 1 + 1$

$y = 2$

ONE SOLUTION

$(1, 2)$

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Example: Solve the system below:

$x = 3 - y$
$x + y = 7$

$x = 3 - y$

$x + y = 7$

$3 - y + y = 7$

$3 + 0 = 7$

$3 \neq 7$

NO SOLUTION

Example: Solve the system below:

$y = -2x + 4$
$4x + 2y = 8$

$y = -2x + 4$

$4x + 2y = 8$

$4x + 2(-2x + 4) = 8$

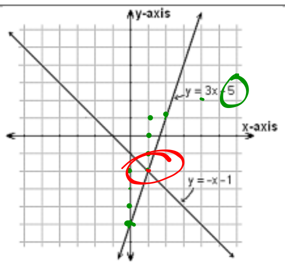
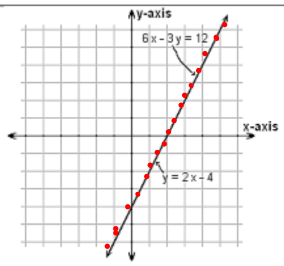
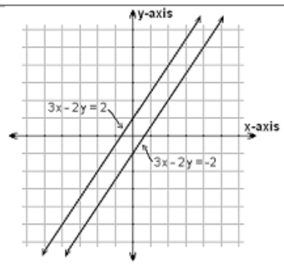
$4x - 4x + 8 = 8$

$0 + 8 = 8$

$8 = 8$

INFINITE SOLUTION

When the variables drop out and the resulting equation is **FALSE**, the answer is **NO SOLUTIONS.**
When the variables drop out and the resulting equation is **TRUE**, the answer is **INFINITE SOLUTIONS.**

		Number of Solutions		
		1 Solution	Infinitely Many Solutions	No Solution
Solving Methods	Graphing	 When graphed, the 2 lines **intersect once.**	 When graphed, the 2 lines **lie on top of one another.**	 When graphed, the 2 lines are strictly **parallel.**
	Substitution / Elimination	When using either substitution or elimination, you should get a value for either x or y. You should be able to find the other value by substituting either x or y back into the original equation.	When using either substitution or elimination, you will get an equation that has **no variable** and is **always true.** For example: 2=2 or -5=-5	When using either substitution or elimination, you will get an equation that has **no variable** and is **never true.** For example: 0=6 or -2=4