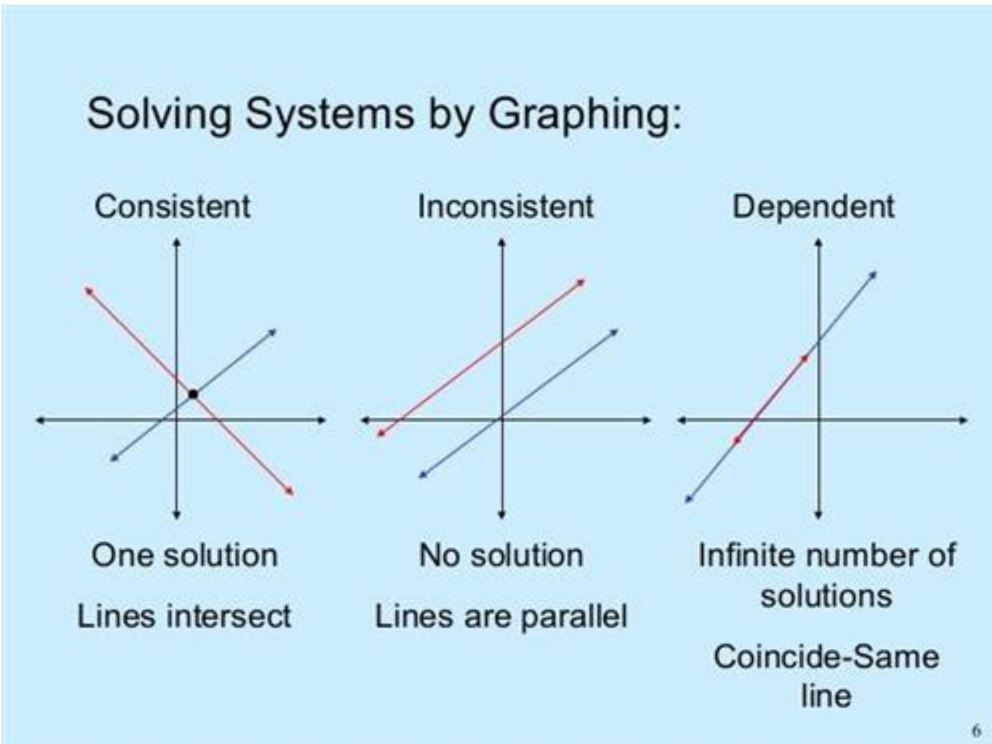
Systems of Equations

Solve by Graphing:



Solving Systems of Equations by Substitution:

Given two equations

$$\begin{cases} y = 2x \\ y = x + 5 \end{cases}$$

Step 1	$y = 2x$ $y = x + 5$	*Both equations are solved for y.*
Step 2	$y = x + 5$ $2x = x + 5$	*Substitute 2x for y in the second equation.*
Step 3	$\underline{-x} \quad \underline{-x}$ $x = 5$	*Now solve this equation for x. Subtract x from both sides to combine like terms.*
Step 4	$y = 2x$ $y = 2(5)$ $y = 10$	*Write one of the original equations.* *Substitute 5 for x.*
Step 5	$(5, 10)$	*Write the solution as an ordered pair.*

Check Substitute $(5, 10)$ into both equations in the system.

$y = 2x$	
10	2(5)
10	10 ✓

$y = x + 5$	
10	5 + 5
10	10 ✓

Solve each system by substitution.

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

Step 1 $y = x - 4$	*The second equation is solved for y.*
Step 2 $2x + y = 5$	*Write the first equation.*
$2x + (x - 4) = 5$	*Substitute x − 4 for y in the first equation.*
Step 3 $3x - 4 = 5$	*Simplify. Then solve for x.*
$\underline{\quad +4} \quad \underline{+4}$	*Add 4 to both sides.*
$3x = 9$	
$\frac{3x}{3} = \frac{9}{3}$	*Divide both sides by 3.*
$x = 3$	
Step 4 $y = x - 4$	*Write one of the original equations.*
$y = 3 - 4$	*Substitute 3 for x.*
$y = -1$	
Step 5 $(3, -1)$	*Write the solution as an ordered pair.*

$$\begin{cases} x + 4y = 6 \\ x + y = 3 \end{cases}$$

Step 1 $x + 4y = 6$	*Solve the first equation for x by subtracting 4y from both sides.*
$\underline{\quad -4y} \quad \underline{-4y}$	
$x = 6 - 4y$	
Step 2 $x + y = 3$	
$(6 - 4y) + y = 3$	*Substitute 6 − 4y for x in the second equatio*
Step 3 $6 - 3y = 3$	*Simplify. Then solve for y.*
$\underline{-6} \quad \underline{-6}$	*Subtract 6 from both sides.*
$-3y = -3$	
$\frac{-3y}{-3} = \frac{-3}{-3}$	*Divide both sides by −3.*
$y = 1$	
Step 4 $x + y = 3$	*Write one of the original equations.*
$x + 1 = 3$	*Substitute 1 for y.*
$\underline{\quad -1} \quad \underline{-1}$	*Subtract 1 from both sides.*
$x = 2$	
Step 5 $(2, 1)$	*Write the solution as an ordered pair.*

Solving by Elimination:

Elimination Using Addition

Solve $\begin{cases} x - 2y = -19 \\ 5x + 2y = 1 \end{cases}$ by elimination.

Step 1 $x - 2y = -19$ — *Write the system so that like terms are aligned.*

Step 2 $+\ 5x + 2y = 1$

$6x + 0 = -18$ — *Add the equations to eliminate the y-terms.*

Step 3 $6x = -18$ — *Simplify and solve for x.*

$\frac{6x}{6} = \frac{-18}{6}$ — *Divide both sides by 6.*

$x = -3$

Step 4 $x - 2y = -19$ — *Write one of the original equations.*

$-3 - 2y = -19$ — *Substitute −3 for x.*

$+3 \qquad +3$ — *Add 3 to both sides.*

$-2y = -16$

$\frac{-2y}{-2} = \frac{-16}{-2}$ — *Divide both sides by −2.*

$y = 8$

Step 5 $(-3, 8)$ — *Write the solution as an ordered pair.*

Elimination Using Subtraction

Solve $\begin{cases} 3x + 4y = 18 \\ -2x + 4y = 8 \end{cases}$ by elimination.

Step 1 $\quad 3x + 4y = 18$

Step 2 $\quad -(-2x + 4y = 8)$

$$\begin{aligned} 3x + 4y &= 18 \\ +\,2x - 4y &= -8 \\ \hline 5x + 0 &= 10 \end{aligned}$$

Add the opposite of each term in the second equation.

Eliminate the y-term.

Step 3 $\quad 5x = 10$ *Simplify and solve for x.*

$x = 2$

Step 4 $\quad -2x + 4y = 8$ *Write one of the original equations.*

$-2(2) + 4y = 8$ *Substitute 2 for x.*

$-4 + 4y = 8$

$\underline{+4} \quad \underline{+4}$ *Add 4 to both sides.*

$4y = 12$ *Simplify and solve for y.*

$y = 3$

Step 5 $\quad (2, 3)$ *Write the solution as an ordered pair.*

Elimination Using Multiplication First

Solve each system by elimination.

A $\begin{cases} 2x + y = 3 \\ -x + 3y = -12 \end{cases}$

Step 1 $2x + y = 3$

Step 2 $2(-x + 3y = -12)$ — Multiply each term in the second equation by 2 to get opposite x-coefficients.

$$\begin{aligned} 2x + y &= 3 \\ +(-2x + 6y &= -24) \end{aligned}$$

Add the new equation to the first equation.

Step 3 $7y = -21$

$y = -3$ — *Simplify and solve for y.*

Step 4

$2x + y = 3$ — *Write one of the original equations.*

$2x - 3 = 3$ — *Substitute −3 for y.*

$+3 \quad +3$ — *Add 3 to both sides.*

$2x = 6$ — *Simplify and solve for x.*

$x = 3$

Step 5 $(3, -3)$ — *Write the solution as an ordered pair.*

B $\begin{cases} 7x - 12y = -22 \\ 5x - 8y = -14 \end{cases}$

Step 1 $2(7x - 12y = -22)$

Step 2 $(-3)(5x - 8y = -14)$ — *Multiply the first equation by 2 and the second equation by −3 to get opposite y-coefficients.*

$$\begin{aligned} 14x - 24y &= -44 \\ +(-15x + 24y &= 42) \end{aligned}$$

Add the new equations.

$-x + 0 = -2$

Step 3 $x = 2$ — *Simplify and solve for x.*

Step 4

$7x - 12y = -22$ — *Write one of the original equations.*

$7(2) - 12y = -22$ — *Substitute 2 for x.*

$14 - 12y = -22$

$-14 \quad -14$ — *Subtract 14 from both sides.*

$-12y = -36$ — *Simplify and solve for y.*

$y = 3$

Step 5 $(2, 3)$ — *Write the solution as an ordered pair.*

You can look at the slope and 'y-intercept' to tell how many solutions there are for a system of equations.

How many solutions does the following system equation have?

y = 5x+8-7x

y =-4x+1

set the equations equal to each other, since they are both equal to 'y'

5x+8-7x=-4x+1

Combine like terms first: 5x- 7x+8=- 4x+1

-2x+8 = - 4x+1

At this point we can look at what is the same and what is different for the variables (letters) and the constants (numbers by themselves).

One Solution:

If the variables have different numbers, then it will be ONE SOLUTION. **y = -2x+8 and y=-4x+1**

-2x+8 = - 4x+1 must be different can be the same or different (doesn't matter)

If the variables have the same number and sign, but the constants are different, then it will be NO SOLUTIONS **y = 14(z+3) and y-14z=21**

14(z+3)=14z+21 multiply 14 times z and + 3....

14Z + 42 = 14Z + 21 must be the exact same Must be different

If the variables and the constants are exactly the same on each side of the equal symbol (=), then there are an **INFINITED NUMBER OF SOLUTIONS.**

3X + 6 = 3X + 6 must be exactly the same

4x - 3y = 5 and 8x - 6y = 10 they look different, but they are exactly the same. One equation is double the other.