

# Systems of Equations

A system of equations is a collection of 2 or more equations containing the Same variables.  
In Algebra 1, We will be using the variables x and y and the equations will be linear.  
As long as we have 2 equations, we can solve for the 2 variables.

## Examples of Systems

$$-4x - 5y = 5$$

$$6x + 7y = -9$$

Standard

$$y = -\frac{1}{2}x + 4$$

$$y = 2x - 1$$

Slope-Intercept

## The Solution to Systems

The solution is the x and y value that satisfies both equations. This is written as an ordered pair.

There are 3 types of solutions:

1, infinitely many, and no solutions.

## How to Solve Systems

We will learn to solve systems in 3 ways:

Graphing, Substitution, and Elimination.

### Substitution

(This works for isolating x first too!)

Step 1: isolate y in one equation.

Step 2: Take what y equals & Substitute it into the other equation for y.

Step 3: Solve this equation for x.

Step 4: Find the value of y by Substituting the known value of x into either original equation. (or the isolated one).

This method works best when you have a variable with a coefficient of 1.

$$8x + 8y = -24$$

$$3x + y = 23$$

isolate y

$$y = -3x + 23$$

Substitute

$$8x + 8(-3x + 23) = -24$$

$$\text{STEP 3: } 8x - 24x + 184 = -24$$

$$-16x + 184 = -24$$

$$-16x = -208$$

$$x = 13$$

STEP 4 (I used isolated)

$$y = -3(13) + 23$$

$$y = -16$$

Answer: (13, -16)

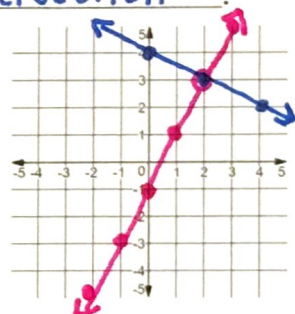
## Graphing

Solutions can be found by finding the point of intersection.

$$\bullet y = -\frac{1}{2}x + 4$$

$$\bullet y = 2x - 1$$

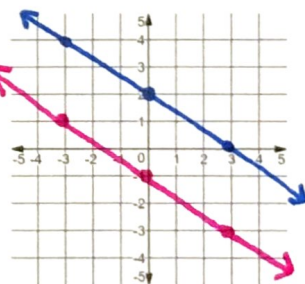
1 solution  
(2, 3)



$$\bullet 2x + 3y = 6$$

$$\bullet y = -\frac{2}{3}x - 1$$

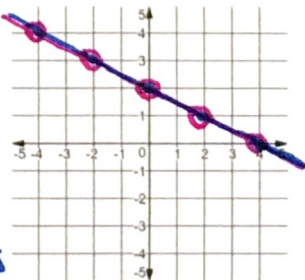
Parallel lines have no solutions.



$$\bullet 2x + 4y = 8$$

$$\bullet x + 2y = 4$$

identical lines have infinitely many solutions (IMS).



## Elimination

Rewrite the equations so that when they are added together, one of the variables will be eliminated. Solve for the remaining variable with substitution.

This method works best when none of the variables have a coefficient of 1.

$$5x - 14y = 22$$

$$2(-6x + 7y = 3)$$

multiply by 2

add

$$5x - 14y = 22$$

$$-12x + 14y = 6$$

$$-7x = 28$$

$$5(4) - 14y = 22$$

$$20 - 14y = 22$$

$$-14y = 2$$

$$y = -1/7$$

Plug in

$$x = 4$$

Answer: (4, -1/7)