Systems of Equations

Purpose: To find the common solution for two equations. This is the point where the two lines intersect; the solution is always written as a coordinate pair (x,y).

There are 4 ways to solve a system of linear equations.

- Graphing
- Equivalent Expressions
- Substitution
- Combination/Elimination

<u>Graphing</u> – If the two lines are plotted on the same graph, the common solution is the point of intersection. This answer may not always be precise.

Equivalent Expressions -

- Rearrange each equation so that they are **both** in slope-intercept form.
- Since we are looking for the situation where the equations have a common solution, the y-values for the two equations are equal to each other.
- Because the y-values are equal, you can set the equations equal to each other and solve for x.
- Once you have a value for x, substitute it into one of the original equations to find the value for y.
- To check you answer, substitute your solution (x,y) in to the remaining original equation to see if it works.

y = 5x + 6 = 2x + 12 y = 2x + 12 3x + 6 = 12 3x = 6 x = 2y = 16

Solution: (2, 16)

Substitution -

- Choose an equation so that you can solve it for one of the variables. This is easiest if you have a variable with a coefficient of 1.
- Once you have solved one equation for a particular variable, substitute that value in for the variable in the second equation.
- Solve. Once you have the value for one of the variables, substitute it in to one of the original equations to find the value for the other variable.
- To check your answer, substitute your solution (x,y) in to the remaining original equation to see if it works.

$$4x + 2y = 20$$

$$y = -3x + 13$$

$$4x + 2(-3x + 13) = 20$$

$$4x - 6x + 26 = 20$$

$$-2x + 26 = 20$$

$$-2x = -6$$

$$x = 3$$

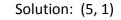
Substitute the value of y from the second equation into the first equation and solve for x.

Solution: (3, 4)

Combination/Elimination –

This involves combining the two equations so that you are able to eliminate one of the variables. • The variable you eliminate is the one that has the same coefficient (+/-) in both equations.

3x + 4y = 19	
3x - 3y = 12	Both equations contain a "3x"
7y = 7	so we can subtract one
y = 1	equation from the other to
x = 5	eliminate "x" and solve for "y".



In some cases you do not have similar coefficients so you must change **one** equation into an • equivalent form by multiplying both sides by the same number.

$$4x + 3y = 18$$

$$2x - 2y = 2$$
If we multiply the second equation by 2, we will have "x's" in both equations with a coefficient of 4.

$$4x + 3y = 18$$

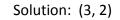
$$4x + 3y = 18$$

$$4x - 4y = 4$$

$$7y = 14$$

$$y = 2$$

$$x = 3$$
Subtract one equation from the other to eliminate x and solve for y.



In some cases you do not have similar coefficients so you must change **both** equations into • equivalent forms by multiplying both sides of each equation by its own same number.

$$3x + 2y = 14
5x - 3y = -2$$

$$9x + 6y = 42$$

$$10x - 6y = -4$$

$$19x = 38$$

$$x = 2$$

$$y = 4$$

We can multiply the top equation by 3 on both sides and the bottom equation by 2 on both sides. Then we will be able to add the equations to eliminate the yvariable and solve for x.

Solution: (2, 4)