Systems of Equations

- **system of equations**: is a set of equations that have the same variables
- **solution of a system of equations**: an ordered pair

Solve by graphing:

1) set equations into $y = mx + b$ form and graph
2) the solution is the point of intersection

Solve by substitution:

1) solve one of the equations for one of its variables, x or y
2) substitute the expression from step 1 into the other equation and solve for the other variable
3) substitute the value from step 2 into either original equation and solve for the other variable

Ex: $\begin{cases} -3x + y = 1 \\ 4x + y = 8 \end{cases}$

$4x + y = 8 \rightarrow y = -4x + 8$

$-3x + (-4x + 8) = 1$

$-3x - 4x + 8 = 1$

$-7x + 8 = 1$

$-8 \quad -8$

$-7x = -7$

$x = 1$

$4(1) + y = 8$ solution: $(1, 4)$

$4 + y = 8$

$-4 \quad -4$

$y = 4$

Solve by elimination:

1) add (opposites) or subtract (same) to eliminate one variable
2) solve the resulting equation for the other variable
3) substitute the value into either original equation to find the value of the eliminated variable

Ex: $2x - 3y = 12$ $\quad 6 + 3y = 6$

$(+)\ x + 3y = 6 \quad -6 \quad -6$

$3x = 18 \quad 3y = 0$

$\frac{3x}{3} = \frac{18}{3} \quad y = 0$

$x = 6$ solution: $(6, 0)$

* instead of subtracting you can multiply by -1 to an equation and add to avoid mistakes

Solving by multiplication and addition

1) decide which variable to eliminate
2) multiply one equation by a constant so that adding will eliminate the variable
3) solve the system by elimination

Ex: $2x+10y=2$
$2(3x-5y=-17)$ →

$2x+10y=2$
$+\ 6x-10y=-34$

$\frac{8x}{8} = \frac{-32}{8}$

$x = -4$

$2(-4)+10y=2$
$-8+10y=2$
$+8 \quad +8$

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

$y=1$

solution: $(-4, 1)$

Solving special systems

1) If $x=a$ it has one solution
2) If $a=b$ it has zero solutions and lines are parallel
3) If $a=a$ it has infinite solution and is the same line