

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Block: \_\_\_\_\_ # \_\_\_\_\_

### 3 Methods of Solving a System

#### Solving a System of Equations by Graphing:

##### Steps for solving a system using graphing

1. Write each equation in a form that is easy to graph ( $y=mx+b$ )
2. Graph both equations in the same coordinate plane.
3. Estimate the coordinates of the point of intersection.
4. Check the coordinates algebraically by substituting into each equation of the original linear system.

#### Example:

$$\begin{array}{l} x + y = 4 \quad \textcircled{1} \\ 2x - y = 2 \quad \textcircled{2} \end{array}$$

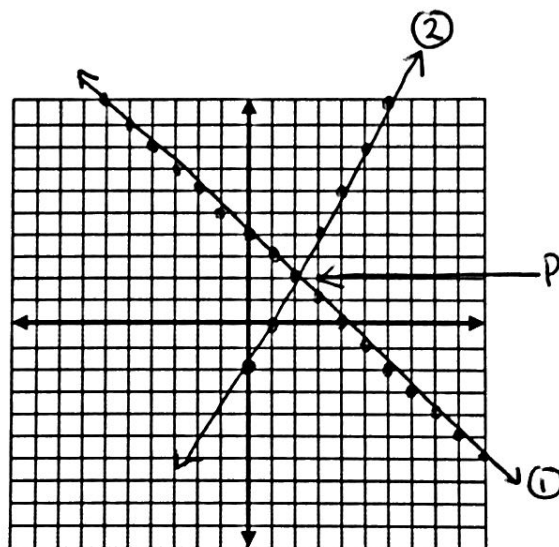
Step 1:

$$\begin{array}{r} x + y = 4 \\ -x \quad -x \\ \hline y = -x + 4 \quad \textcircled{1} \end{array}$$

$$\begin{array}{l} m = -1 \\ b = 4 \end{array}$$

$$\begin{array}{r} 2x - y = 2 \\ -2x \quad -2x \\ \hline -y = -2x + 2 \\ \frac{-y}{-1} = \frac{-2x}{-1} + \frac{2}{-1} \end{array}$$

$$y = 2x - 2 \quad \textcircled{2} \quad \begin{array}{l} m = 2 \\ b = -2 \end{array}$$



Step 3:  
pt of intersection  
(solution)  
(2, 2)

#### Step 4: Check

$$\begin{array}{l} x + y = 4 \\ 2 + 2 = 4 \\ 4 = 4 \\ \checkmark \end{array}$$

$$\begin{array}{l} 2x - y = 2 \\ 2(2) - 2 = 2 \\ 4 - 2 = 2 \\ 2 = 2 \checkmark \end{array}$$

## Solving a System of Equations by the Substitution Method:

### Steps for solving a system using substitution

1. Solve one of the equations for one of its variables.
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 the revised equation from Step 1 and solve.
4. Check the solution in each of the original equations.

### Example:

$$\begin{aligned} 6y + 5x &= 8 \\ x + 3y &= -7 \end{aligned}$$

$$\begin{array}{rcl} \text{Step 1: } x + 3y & = & -7 \\ \underline{-3y \quad -3y} & & \\ x & = & -7 - 3y \end{array}$$

$$\begin{array}{rcl} \text{Step 2: } 6y + 5x & = & 8 \\ 6y + 5(-7 - 3y) & = & 8 \\ 6y - 35 - 15y & = & 8 \\ \underline{-9y - 35 \quad +35 \quad +35} & & \\ -9y & = & 43 \\ \underline{-9 \quad -9} & & \\ y & = & -\frac{43}{9} \end{array}$$

$$\begin{array}{rcl} \text{Step 3: } x & = & -7 - 3y \\ x & = & -7 - 3\left(-\frac{43}{9}\right) \\ x & = & -\frac{7}{1} + \frac{43}{3} \\ x & = & -\frac{21}{3} + \frac{43}{3} \\ x & = & \frac{22}{3} \end{array}$$

$$\text{Step 4: } \left(\frac{22}{3}, -\frac{43}{9}\right)$$

$$\begin{array}{rcl} \text{Check:} & & \\ 6y + 5x & = & 8 \\ 6\left(-\frac{43}{9}\right) + 5\left(\frac{22}{3}\right) & = & 8 \\ -\frac{86}{3} + \frac{110}{3} & = & 8 \\ \frac{24}{3} & = & 8 \\ 8 & = & 8 \quad \checkmark \end{array}$$

$$\begin{array}{rcl} x + 3y & = & -7 \\ \frac{22}{3} + 3\left(-\frac{43}{9}\right) & = & -7 \\ \frac{22}{3} + \frac{-43}{3} & = & -7 \\ \frac{-21}{3} & = & -7 \\ -7 & = & -7 \quad \checkmark \end{array}$$

## Solving a System of Equations by the Elimination Method:

### Steps for solving a system using elimination:

1. Arrange the equations with like terms in columns (standard form)
2. Multiply one or both of the equations by a number to obtain coefficients that are opposites for one of the variables.
3. Add the equation from step 2 combining like terms will eliminate one variable. Solve for the remaining variable.
4. Substitute the value obtained in step 3 into either of the original equations and solve for the other.
5. Check the solution in each of the original equations.

### Example:

$$\begin{aligned} 3x + 2y &= 1 \\ 4x + 3y &= -2 \end{aligned}$$

$$\text{Step 1: } \begin{aligned} 3x + 2y &= 1 \\ 4x + 3y &= -2 \end{aligned}$$

$$\text{Step 2: } \begin{aligned} 3(3x + 2y &= 1) \\ -2(4x + 3y &= -2) \end{aligned}$$

$$\begin{aligned} 9x + 6y &= 3 \\ -8x - 6y &= 4 \end{aligned}$$

$$\text{Step 3: } \begin{aligned} 9x + 6y &= 3 \\ -8x - 6y &= 4 \\ \hline x &= 7 \end{aligned}$$

$$\text{Step 4: } \begin{aligned} 3x + 2y &= 1 \\ 3(7) + 2y &= 1 \\ 21 + 2y &= 1 \\ -21 &\quad -21 \\ \hline 2y &= -20 \\ \frac{2y}{2} &= \frac{-20}{2} \\ y &= -10 \end{aligned}$$

(7, -10)

$$\text{Step 5: } \begin{aligned} 4x + 3y &= -2 \\ 4(7) + 3(-10) &= -2 \\ 28 - 30 &= -2 \\ -2 &= -2 \checkmark \end{aligned}$$

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## *System of Equations - Review*

A system is two or more equations.

A solution to a system is any common point or ordered pair  $(x, y)$ . The solution will make all equations true.

There are 3 methods used to solve a system of equation.

Graphing : used mostly when the equation is easy to graph. (slope intercept form)

Substitution: used when one of the equations can be solved for a single variable.

Elimination (linear combination): used when the equations are written in standard form or when the variables are lined up vertically.

There are 3 types of solutions you may get when solving a system of equation.

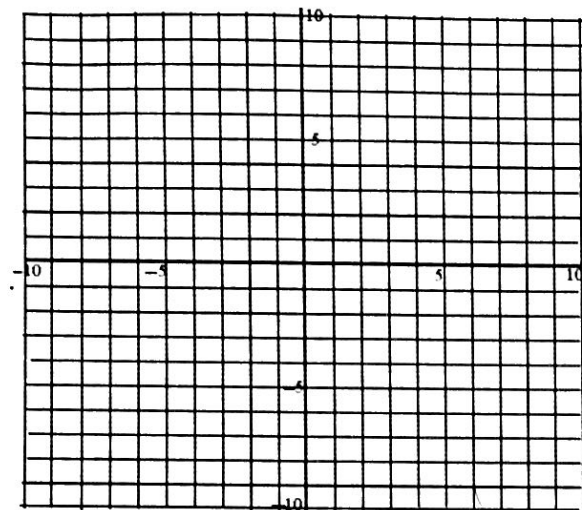
1 solution: the graphs cross in one spot. You will get a point as a solution (ordered pair)  
(hint: if you solve and get  $x=$  or  $y=$  there will be an answer)

no solution: the graph will never touch if the equations are linear the lines must be parallel (hint: parallel lines have the same slope but different y-intercepts)

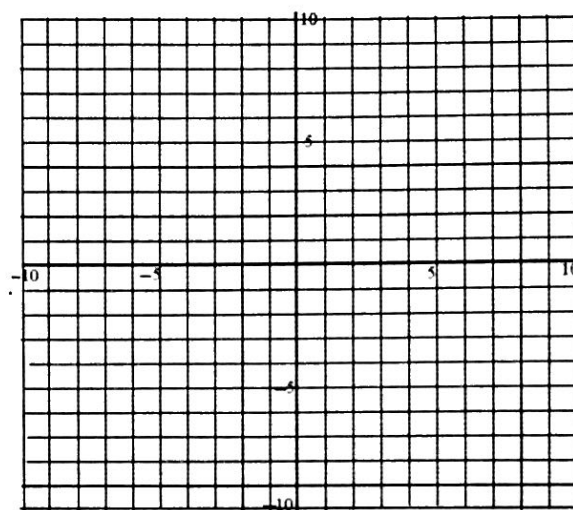
infinitely many solutions: the graph is the same graph, the graph is on top of itself  
every point will be a solution

Solve by graphing:

1.  $y = -x + 4$   
 $y = 2x + 1$



2.  $3x + y = 5$   
 $x - y = 7$



Solve using substitution.

3.  $x + 2y = 3$   
 $-x = 2y - 3$

4.  $3x + 5y = 2$   
 $x + 4y = -4$

Solve using elimination.

5. 
$$\begin{aligned} 2x - y &= 6 \\ -3x + 4y &= 1 \end{aligned}$$

6. 
$$\begin{aligned} 4x &= -2y + 1 \\ 2x + y &= 4 \end{aligned}$$

Choose any method.

7. 
$$\begin{aligned} y &= 4 \\ 3x - y &= 5 \end{aligned}$$

8. 
$$\begin{aligned} -5x + 2y &= 14 \\ -3x + y &= -2 \end{aligned}$$

9. 
$$\begin{aligned} 5x + 3y &= 6 \\ 2x - 4y &= 5 \end{aligned}$$

10. 
$$\begin{aligned} 4x - 2y &= 6 \\ -2x + y &= -3 \end{aligned}$$

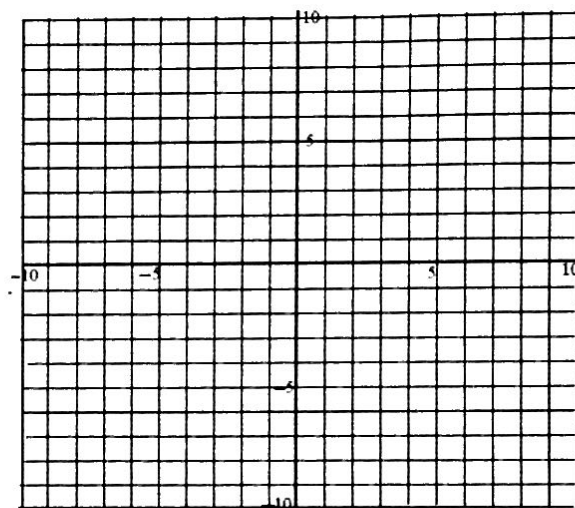
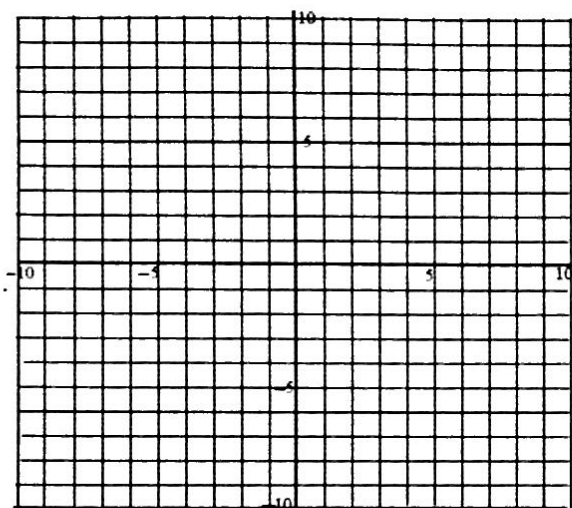
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### System of Equations - Homework

Solve by graphing:

1.  $y = 3x - 1$   
 $y = -x + 3$

2.  $3x + y = -1$   
 $x - y = -3$



Solve using substitution.

3.  $y = 3x + 11$   
 $y = -2x + 1$

4.  $4x - y = -12$   
 $-6x + 5y = -3$

Solve using elimination.

5. 
$$\begin{aligned} -x + 4y &= 12 \\ 2x - 3y &= 6 \end{aligned}$$

6. 
$$\begin{aligned} 4x &= 8 - y \\ -3x - y &= 0 \end{aligned}$$

Choose any method.

7. 
$$\begin{aligned} x + y &= 4 \\ y &= 7x + 4 \end{aligned}$$

8. 
$$\begin{aligned} -3x + 4y &= 29 \\ 3x + 2y &= -17 \end{aligned}$$

9. 
$$\begin{aligned} 3x + y &= 3 \\ -3x + 2y &= -30 \end{aligned}$$

10. 
$$\begin{aligned} y &= 3 \\ y &= \frac{4}{3}x + 2 \end{aligned}$$