Algebra II – Lesson 4: Systems of Linear Equations (page 1)
Upward Bound Summer 2018 **Name: ____________________**

Basic: Understanding and Solving Systems of Equations

A **system of equations** is a set of equations which must all be simultaneously true. Typically, you will have the same number of equations as variables for which you must solve. For example, you could have two equations involving x and y or 3 equations involving x, y, and z. In this lesson, our systems of equations will be systems of *linear* equations because these are generally easier to solve.

A **solution to a system of equations** is a collection of values for the variables that makes both equations true.

For example, consider the following system of equations: $\begin{cases} 2x + 3y = 23 \\ 8x - y = 1 \end{cases}$

We know the point $(1,7)$ is a solution because if we substitute $x = 1$ and $y = 7$ into the first equation we get $2(1) + 3(7) = 23$, if we substitute $x = 1$ and $y = 7$ into the second equation we get $8(1) - 7 = 1$, and both statements are true.

(1) Verify that $(3, -2)$ is a solution to the system $\begin{cases} x - 4y = 11 \\ 3x + 10y = -11 \end{cases}$

(2) Is $(1,5)$ a solution to the system $\begin{cases} 2x + y = 7 \\ 2x - y = 3 \end{cases}$? Why or why not?

There are three methods for solving systems of equations:

1. **Graphing:** If you have a graphing calculator or some other way of producing the graph of each function, you could solve the system of equations by graphing both functions and looking for their intersection point. Note that to graph the functions you may have to solve for y in terms of x first.
2. **Substitution:** Solve one of the equations for y in terms of x or for x in terms of y. Then substitute that expression into the other equation. You should then have an equation with only one variable. Once you solve for that one variable, you can plug it back into your first equation to find the other variable.
3. **Elimination:** Sometimes also called the "Addition" method, this is another method that reduces the system of 2 equations with 2 variables to 1 equation with 1 variable. We put both linear equations in standard form and add or subtract them in such a way that either x or y cancels out. To do this, you may need to first multiply an equation by a constant.

For Problems #3-6 on the next page, consider the system of equations $\begin{cases} 4x - 3y = 8 \\ 2x + y = 14 \end{cases}$

We will be solving this system using all 3 methods described above and see what answers we get.

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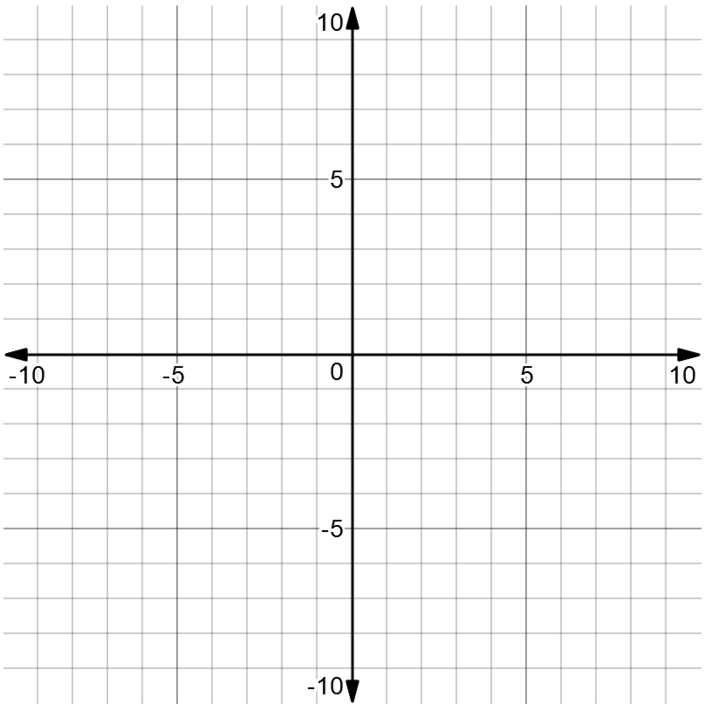
(3) Solve the system of equations $\begin{cases} 4x - 3y = 8 \\ 2x + y = 14 \end{cases}$ by graphing.



(4) Solve the system of equations $\begin{cases} 4x - 3y = 8 \\ 2x + y = 14 \end{cases}$ by substitution.

(5) Solve the system of equations $\begin{cases} 4x - 3y = 8 \\ 2x + y = 14 \end{cases}$ by elimination.

(6) Did you get the same solution from all 3 methods? Why or why not?

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Intermediate: Applications of Systems of Linear Equations

(7) For her 16th birthday, Sally got a new cell phone and now she has to choose a cell phone plan. She has narrowed it down to two options. The info below tells how much each option charges per month.

Cellular Choice: $10 + $0.75 per minute Fones R' Us: $50 + $0.25 per minute

a.) Write an equation to describe the total cost for each cell phone plan.

Cellular Choice: y-int: ______ Slope _______

Equation: ____________________

Fones R' Us: y-int: ______ Slope ______

Equation: ______________________

b.) Complete the table of values for each cell phone plan.

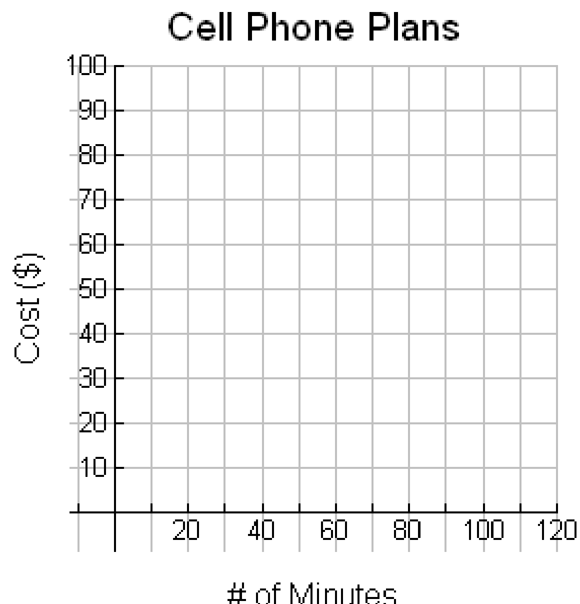
Cellular Choice

Minutes	Cost
0	
20	
40	
60	
80	
100	
120	

Fones R' Us

Minutes	Cost
0	
20	
40	
60	
80	
100	
120	

c.) Plot the points from your tables and draw the graph for cell phone plan.



d.) Which cell phone plan should Sally choose if she only uses 40 minutes per month?

How did you find your answer?

e.) Which cell phone plan should Sally choose if she uses 120 minutes per month?

How did you find your answer?

f.) How many cell phone minutes give the same cost for both plans? What is the cost at that time?

g.) Circle the point on the graph where the cost and the minutes are the same.

Circle the points on the tables where the cost and the minutes are the same.

(8) A movie theater sells adult tickets for $14 and child tickets for $10. If ticket sales for a showing of a movie totaled $530 and 43 tickets were sold, how many adults attended the movie? How many children?

(9) You are at the grocery store. You place 5 apples and 4 oranges on the scale, and their total weight is 1010 grams. You then place 2 apples and 2 oranges on the scale, and their total weight is 460 grams. Assuming all apples weigh the same amount and all oranges weigh the same amount (but the weight of an apple may be different from the weight of an orange), what would be the weight of 11 apples and 3 oranges?

Advanced: Systems of 3 or More Linear Equations

You can still use the substitution and elimination methods to solve larger systems of equations, but it is a longer process. You must reduce 3 equations with 3 variables to 2 equations with 2 variables before you can reduce it to just 1 equation with 1 variable.

(10) Solve the system of equations $\begin{cases} x + 2y + z = 9 \\ 3x + 4y - 2z = 5 \\ -x + 3y + 3z = 12 \end{cases}$

(11) A movie theater sells adult tickets for $14, child tickets for $10, and senior tickets for $8. If ticket sales for a showing of a movie totaled $890, 75 tickets were sold, and 150% more children attended the movie than seniors, how many adult tickets were sold? How many child tickets? How many senior tickets?