Name: ____________________________________ Date: __________________

Properties of Systems and Their Solutions
Common Core Algebra I

There is one final way that we will solve systems of equations, but we won't look at that until the next lesson. Systems are important because they tell us **multiple conditions** that relate **multiple variables** or **unknowns.** In this lesson, we will experiment with systems and what we can do with them and how this affects their solutions.

***Exercise* #1:** Consider the system shown to the right and its solution $(1, 5)$.

$$4x + 2y = 14$$

$$x - y = -4$$

(a) Show that $x = 1$ and $y = 5$ is a solution to the system of equations.

(b) Find the sum of the two equations. Is the point $(1, 5)$ a solution to this new equation? Justify your yes/no response.

(c) Multiply both sides of the second equation by 2 to get an equivalent equation. Is the point $(1, 5)$ a solution to this new equation? Justify your yes/no response.

(d) Take the equation you found in (c) and add it to the first equation. What happens? How does this allow us to now solve for the variable x? Do so, what do you find?

(e) Once you know the value of x, how can you find the value of y?

So, what we see is that a solution to a system of equations remains a solution to that system under a variety of conditions.

SOLUTIONS TO SYSTEMS REMAIN SOLUTIONS IF

1. Properties of equality are used to rewrite either of the equations.
2. The equations are added or subtracted or any rewrite is added or subtracted.

Let's play some more with these ideas, but with a new system.

***Exercise* #2:** Consider the system shown to the right:

$$4x - 3y = 15$$

$$3x + 2y = 7$$

(a) Show that the point $(3, -1)$ is a solution to the system.

(b) The point $(3, -1)$ will be a solution to the system shown below. How can you determine this without substituting the point in?

$$8x - 6y = 30$$

$$9x + 6y = 21$$

(c) What happens when you add these two equations together? How can this let you solve for x? Find it and find y.

***Exercise* #3:** Solve the system below using the **method** of **elimination**. Show the steps in your work and show that your answer is in fact a solution to the system.

$$2x + 4y = 2$$

$$6x + 3y = -3$$

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Properties of Systems and Their Solutions
Common Core Algebra I Homework

Fluency

1. The point $(2, 7)$ is a solution to the system of equations given below.

$$3x + 2y = 20$$
$$x - y = -5$$

(a) Show that this point is a solution.

(b) Add the two equations together and show that $(2, 7)$ is a solution to the result.

(c) Subtract the two equations (be careful) and show that $(2, 7)$ is a solution to the result.

(d) Multiply both sides of the second equation by 2. Show that $(2, 7)$ is a solution to the result.

2. The point $(4, -2)$ is a solution to the system of equations $\begin{array}{l} 2x + y = 6 \\ x + 5y = -6 \end{array}$. Which of the following equations would it *not* be a solution to?

(1) $3x + 6y = 0$　　(3) $2x + 2y = 12$

(2) $2x + 10y = -12$　　(4) $x - 4y = 12$

3. Which of the following points is a solution to the system?

$$x - 2y = -11$$
$$5x + 2y = 29$$

(1) $(4, 1)$　　(3) $(-3, 9)$

(2) $(5, 2)$　　(4) $(3, 7)$

APPLICATIONS

4. A small movie theater sells children's tickets for \$4 each and adult tickets for \$10 each for an animated movie. The theater sells a total of \$388 in ticket sales.

(a) If c represents the number of children's tickets sold and a represents the number of adult tickets sold, write an equation that models the information shown above.

(b) Show that $c = 52$ and $a = 18$ is a solution to this equation (not system).

(c) Show that after multiplying both sides of the equation in (a) by 2, $c = 52$ and $a = 18$ is still a solution to this equation.

(d) How can you interpret multiplying both sides of the equation by 2 in letter (a) in terms of ticket prices and total ticket sales?

REASONING

In the next lesson, we will reinforce solving systems using the **Method of Elimination**. This last question reinforces why and how the method works.

5. Consider the system of equation:

$$x + 4y = 13$$
$$3x + 2y = 19$$

(a) Multiply both sides of the second equation by -2. What equation results?

(b) Add the equation from (a) to the first equation. What happens? What can you now solve for?

(c) Now that you know the value of x, how can you find the value of y? Find it.

(d) What could you have multiplied both sides of the first equation by to **eliminate** the x instead of the y?