3.1 Systems and Solutions

SWBAT determine if a point is a solution to a system.

Assignments

HW18

What is a system of equations?

- Definition: A set (or group) of two or more equations that have the same variables.
- In this class, we will only be working with systems of 2 linear equations, or with a system of inequalities.
- Identify whether the following are systems of equations. Why or why not?

1. $y=3x-2$
   $y=-\frac{1}{2}x+8$
2. $y=4x$
   $3x-2y=9$
3. $x=3y+2$
   $x=4v+7$
4. $y=x^2+8$
   $y=3x-1$
5. $4w-t=3$
   $t=2+w$
6. $h-5=7r$
   $r=3x+2$

Solutions to a System of Equations

- The values that make *all* of the equations/inequalities in the system TRUE

- Is $(3, 2)$ a solution of the system?
  - $y = 2x - 4$
$y = -x + 5$
  - $y = -2x + 8$
$y = 3x - 5$

Determine if the value is a solution to the system.

- Is $(0,2)$ a solution to the system?

1. $$y = \frac{4}{3}x + 2$$ $$y = -\frac{2}{3}x + 2$$
2. $$4x - 7y = -14$$ $$8x + 2y = 4$$
3. $$y = 3x - 5$$ $$4x - 3y = -6$$
4. $$3x + 2y > (-1)$$ $$5x - 6y < 13$$

- Is $(-4,3)$ a solution to the system?

5. $$3x + 2y = -6$$ $$-2x - 4y = 12$$
6. $$y = 2x + 9$$ $$y = -x - 1$$
7. $$4x + 3y \leq 0$$ $$y \geq -\frac{1}{2}x - 6$$
8. $$2x - 4y = -8$$ $$x + y = -1$$

3.1 Systems and Solutions

A **system** is a set[1] of two or more equations or inequalities that have the same variables.

Examples:

$$\begin{cases} y = 3x + 8 \\ y = 4x - 7 \end{cases}$$

$$\begin{cases} 3x + 8y = 8 \\ -2x - 7y = 24 \end{cases}$$

$$\begin{cases} 3n - 2r = 14 \\ 6n + 7r = 21 \end{cases}$$

> Note: Systems are often written with a bracket connecting the equations/inequalities in the set, especially when several systems are written close together. However, you don't have to include the bracket.

While systems can be made of set of 3, 4, 5, or even 20 equations, or have equations with 3, 4, or more variables, in Algebra 1, we are working on systems of two equations with two variables – and, specifically, *linear* equations or inequalities (which create a line when graphed). You will explore solving systems of 3 equations with 3 variables in Algebra 2.

Because there are multiple equations or inequalities in a system, a **solution to a system** must make *all* of the equations or inequalities true. This means that there are usually far fewer solutions to a system than there are to a single equation.

Example 1: Is $(3,2)$ a solution to the system $\begin{cases} y = 2x - 4 \\ y = -x + 5 \end{cases}$?

If $(3,2)$ is a solution, then we should get true equations when we substitute in those values for x and y in both equations. Let's try out the first equation:

$$y = 2x - 4$$

$$2 = 2(3) - 4$$

$$2 = 6 - 4$$

$$2 = 2$$

That's true! So far, $(3,2)$ seems to be a viable solution. But we still have to test the point in $y = -x + 5$.

$$y = -x + 5$$

$$2 = -(3) + 5$$

$$2 = -3 + 5$$

$$2 = 2$$

Also true! Since $(3,2)$ makes all of the equations in the system true, it is a solution to the system.[2]

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[1] A group. Think of the English examples of a *set* of keys, or a *set* of plates, or a *set* of rules.

[2] $(3,2)$ happens to be the *only* solution to that system. We'll talk about why in later sections.

Example 2: Is $(3,2)$ a solution to the system $\begin{cases} y = -2x + 8 \\ y = 3x - 5 \end{cases}$?

Let's test the point in the system.

$$y = -2x + 8$$

$$2 = -2(3) + 8$$

$$2 = -6 + 8$$

$$2 = 2$$

So far, so good! But again, we still need to try it in the second equation.

$$y = 3x - 5$$

$$2 = 3(3) - 5$$

$$2 = 9 - 5$$

$$2 = 4$$

False! $(3,2)$ doesn't make *all* the equations true, so it is not a solution to this system.

Example 3: Is $(0, -2)$ a solution to the system $\begin{cases} y = 6x + 7 \\ y = -2x - 9 \end{cases}$?

Testing the first equation:

$$y = 6x + 7$$

$$-2 = 6(0) + 7$$

$$-2 = 0 + 7$$

$$-2 = 7$$

False! Because $(0, -2)$ is not a solution to one equation, it is not a solution to the system, and there is no need to test the second equation.[3]

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[3] In this case, $(0, -2)$ is also not a solution to the second equation, which is irrelevant.