Bell Ringer:

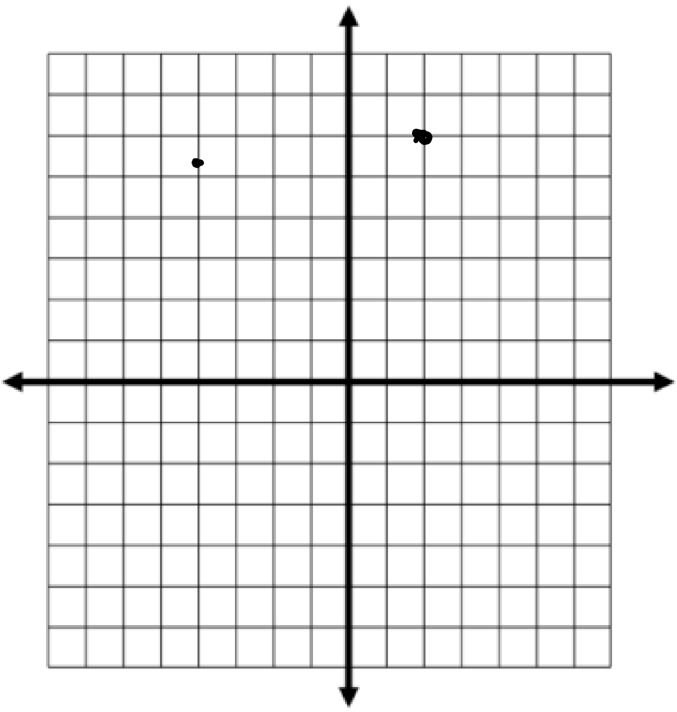
$$f(x) = \begin{cases} 4x - 2 & x \geq 2 \\ -\frac{x}{3} + 4 & x < 2 \end{cases}$$

Function? Yes or No

f (−4) = $1\frac{1}{3} + 4 = 5\frac{1}{3}$

f (8) = 30

f (2) = 6



THE TRUTH ABOUT GRAPHS
COMMON CORE ALGEBRA I

At this point we've looked at graphs of **linear functions** and more general functions as simply being plots of input/output pairs. And, for functions, this makes a lot of sense. But, more generally, we want to be able to define points that lie on the graph of an equation or on an **inequality** with a simple test/definition.

GRAPHING EQUATIONS AND INEQUALITIES

The connection between graphs and equations/inequalities is a simple one:

1. Any coordinate pair (x, y) that makes the equation or inequality **true** lies **on the graph**.
2. The **entire graph** is a collection of **all** of the (x, y) pairs that make the equation or inequality **true**.

***Exercise* #1:** Consider the linear equation $y = 4x + 2$.

(a) Does the point $(2, 10)$ lie on the graph of this equation? Justify your answer.

$10 = 4(2) + 2$
$10 = 8 + 2$
$10 = 10$ ✓

(b) Does the point $(-1, 4)$ lie on the graph of this equation? Justify your answer.

NO.
$4 = 4(-1) + 2$
$4 = -4 + 2$
$4 = -2$ ✗

***Exercise* #2:** The equation $y = 2x^2 - x + 5$ describes a **parabola**. Does the point $(3, 20)$ lie on its graph? Justify how you found your answer.

$20 = 2(3)^2 - 3 + 5$
$20 = 2 \cdot 9 - 3 + 5$
$20 = 18 + 2$
$20 = 20$ ✓
YES.

Inequalities can also be graphed and we will concentrate on that in the next lesson. But, in this lesson we can certainly determine if particular points will lie on the graph of an inequality.

***Exercise* #3:** Determine for each of the following inequalities whether the point given lies on its graph.

(a) $(4,1)$ for $y > 2x - 5$

No. $1 > 4(2) - 5$

X $1 > 8 - 5$

$1 > 3$

(b) $(2,8)$ for $x + y \le 10$

Y $10 \le 10$ ✓

(c) $(-3,2)$ for $y < x^2 - 4$

$2 < (-3)^2 - 4$

$2 < 5$ ✓

Y

(d) $(-6,-1)$ for $y \ge \frac{x+12}{3}$

$-1 \ge \frac{-6+12}{3}$

$-1 \ge \frac{6}{3}$

X $-1 \ge 2$ X

We can even determine, with some additional calculations, whether a point is a solution to a **system of equations** or a **system of inequalities**. You've studied systems before and we will devote the next unit to them. But, with a simple definition you can "easily" tell whether points are solutions.

SYSTEMS OF EQUATIONS

A **system of equations** is a collection of **two or more equations** joined by the **AND** truth condition. Because the AND condition is only true when all of its components are true, the solution set of a system is:

The collection of **all points** that result in **all** equations or inequalities being **true**.

That is an extremely important idea. Let's test it out in the next exercise:

***Exercise* #4:** Determine if the point $(3,1)$ is a solution to the system of equations shown below. Justify your work.

$y=2x-5$
and
$y=-4x+13$

$1=2(3)-5$ $1=-4(3)+13$

$1=6-5$ $1=-12+13$

$1=1$ ✓ $1=1$ ✓

Yes.

Most of the time, the word AND will not be included as it was above. The assumption will be that by telling you that it is a **system** you know that all of the equations/inequalities are connected with an AND.

***Exercise* #5:** Does the point $(5, 15)$ **lie in the solution set** of the system of inequalities shown below?

$y \geq 4x - 7$

$y < x^2 - 10$

$15 \geq 4(5) - 7$ $\quad$ $15 < 5^2 - 10$

$15 \geq 20 - 7$ ✓ $\quad$ $15 < 25 - 10$ X

$15 \geq 13$ ✓ $\quad$ $15 < 15$

No.

You can even mix equations and inequalities because the answer always depends on whether all conditions are true or not.

***Exercise* #6:** Is the point $(-2, 5)$ a solution to the system shown below? Justify your answer carefully.

$y > \frac{4 - x}{2}$

$y = 3x + 11$

$5 > \frac{4 - -2}{2}$ $\quad$ $5 = 3(-2) + 11$

$5 > \frac{6}{2}$ $\quad$ $5 = -6 + 11$

$5 > 3$ ✓ $\quad$ $5 = 5$ ✓

Yes