# 4.1 - Graphing Review

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# Unit 3: Quadratic Functions

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| **4.2**: Analyzing the Graph of y = $ax^2 + bx + c$ | Pg. 139 "Summary of Characteristics" Section<br>Pg. 333 # 1 - 14 |
| **4.3**: Analyzing the Graph of y = $a(x - h)^2 + k$ | Pg. 148 "Summary of Characteristics" Section<br>#1 - 12 |
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Recall from previous years the idea of a **relation**. A relation is a way that we can compare two variables.

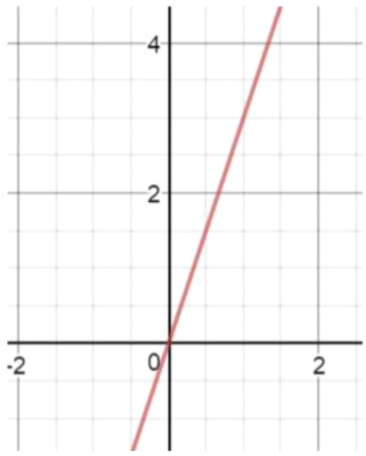
We've seen relations in the form of words: "x is three times y"

Equations: $y = 4x + 2$

A table of values:

| x | y |
|---|---|
| 1 | 2 |
| 2 | 4 |
| 3 | 6 |

and graphs:




Also recall that we can graph equations using a table of values.

**Example**: Graph the equation y = 3x + 5

The first thing we should always do when graphing an equation is to set up a table of values with some positive and negative values for x:

| x | y |
|---|---|
| -2 | -1 |
| -1 | 2 |
| 0 | 5 |
| 1 | 8 |
| 2 | 11 |

And now use the equation to solve for values of y:

$x = -2$

$y = 3x + 5$

$y = 3(-2) + 5$

$y = -1$

$x = 0$

$y = 3x + 5$

$y = 3(0) + 5$

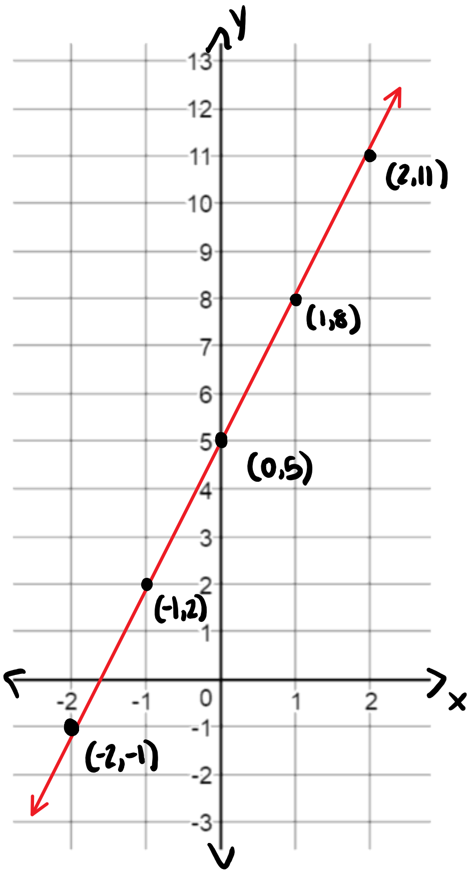
$y = 5$

etc....

Now we can create a list of **ordered pairs** that are going to serve as **points** on our graph. These points are always in the form ( $x$ , $y$ ):

(-2,-1) , (-1,2) , (0,5), (1,8), (2,11)

Now let's place these points on a graph and connect them with a line:




How would you describe the shape of this line?

It's perfectly straight

↳ "linear"

Now let's do the same with the equation $y = x^2 + 4$:

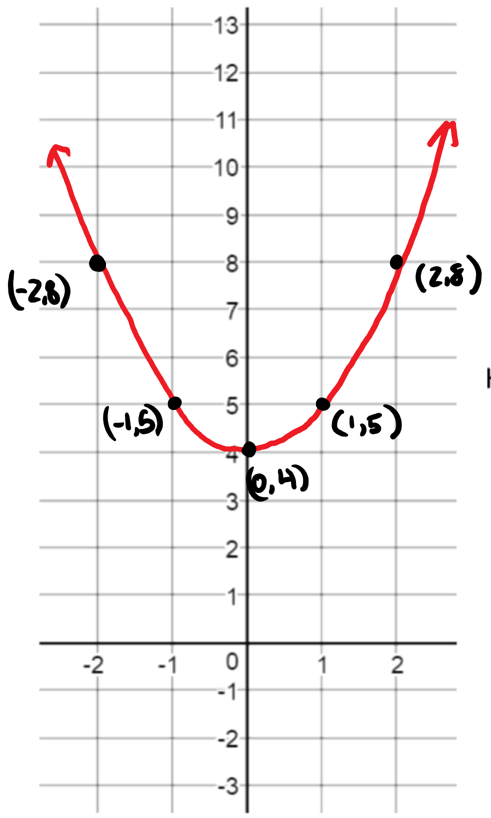
| x | y |
|---|---|
| -2 | 8 |
| -1 | 5 |
| 0 | 4 |
| 1 | 5 |
| 2 | 8 |

$x = -2$
$y = x^2 + 4$
$y = (-2)^2 + 4$
$y = 4 + 4$
$y = 8$

$x = 0$
$y = x^2 + 4$
$y = (0)^2 + 4$
$y = 0 + 4$
$y = 4$

$x = 2$
$y = x^2 + 4$
$y = (2)^2 + 4$
$y = 4 + 4$
$y = 8$
etc...

$(-2, 8)$, $(-1, 5)$, $(0, 4)$, $(1, 5)$, $(2, 8)$




How would you describe the shape of this graph?

Non linear,
U-shaped,
curved

How is it different than the last graph? The same?

Different

Both graphs go on forever.

The **domain** of a function is all the possible values for which the independent variable (x) can be. You can think of it as "What values of x does the graph cover?"

The **range** of a function is all the possible values for which the dependent variable (y) can be. You can think of it as "What values of y does the graph cover?"

For our first graph, we could pick any value for *x* and the graph would span the entire x-axis. When this happens, we say that "x is an element of the real number set." The real number set contains **all** numbers from negative infinity to positive infinity, so this is a mathematical way of saying "x can be any number," and we write it like this:

$$x \in R$$

Knowing this, how do you think we would write the range of our first graph?

$y \in R$

Now in our second graph, what is the domain? What values of x does the graph cover?

$x \in R$

↳ all of them

What about the range? Notice there are some numbers on the y-axis that the graph cannot cover. Therefore, we cannot say y is an element of the real numbers.

From what value of y does the graph start?

4

From there, does the graph go up or down?

Up! (bigger)

Because **larger** numbers go up and right on graphs (and **smaller** numbers go down and left) we say that in this case, the range goes from 4 and gets **larger**, all the way to infinity.

To describe this mathematically, we use inequality symbols:

≤ means "Less than and equal to"

≥ means "Greater than and equal to"

So, because our graph covers values of y that start at 4 and get bigger, we say that y is **greater than and equal** to 4, and we would write it like:

$$y \geq 4$$

So all together, we would describe the domain & range of this graph as:

Domain: $x \in R$
Range: $y \geq 4$

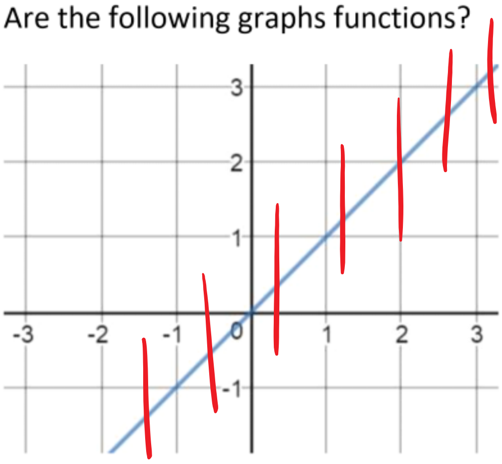
Both of these equations are **relations** because they compare 2 variables. A **function** is a special type of relation where one number of the domain is associated with **only one** number of the range.

We use the **vertical line test** to help us determine whether a graph is a function or not.

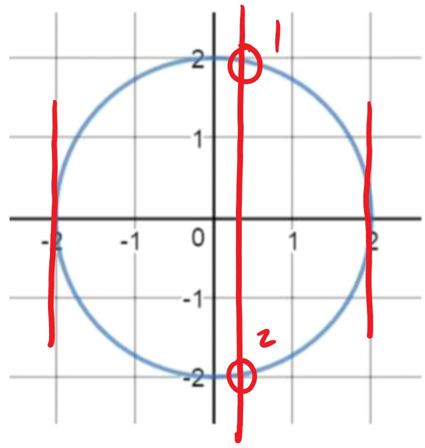
If you can draw a vertical line at any point on the graph and it touches the graph more than once, it is **not** a function.

**Example:**

Are the following graphs functions?



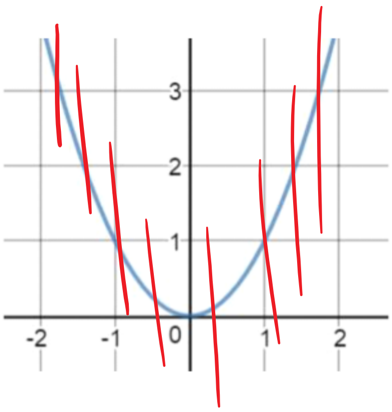
no line touches more than once, ∴ it's a function.

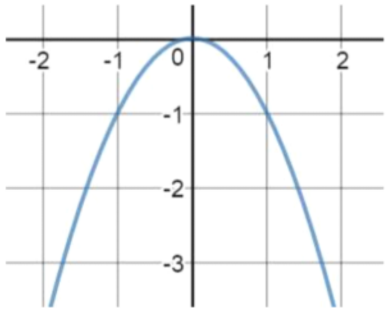


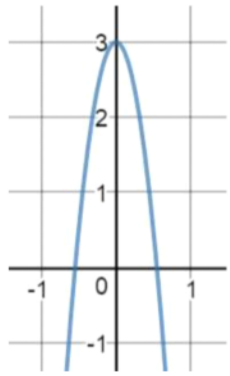
touches more than once, ∴ it's not a function.

A **quadratic function** is the kind of function we saw in our second graph at the beginning of this chapter. It is the "U-shaped" graph the opens either perfectly up, or perfectly down. Another name for this shape is a "**parabola**".

The following graphs are all quadratic:







How can you tell that these quadratics are functions and not simply relations?

They all pass the vertical line test.

Quadratic functions can have the form:

$$f(x) = ax^2 + bx + c$$

where a, b, and c can be any value, except *a* **cannot** be 0. Or, alternatively in equation form:

$$y = ax^2 + bx + c$$

What are some examples you can come up with that are quadratic equations?

$y = 8x^2 + 5x + 11$ $y = 0.7q^2 - 1.8q + 0.1$

$y = -9x^2 + 2x - 17$ $y = \frac{1}{6}k^2$ $(b = 0, c = 0)$.

$y = 2x + 5x^2 - 2$

Are all Quadratic.