Name: ______________________________ Date: ______________

INTRODUCTION TO QUADRATIC FUNCTIONS!

We have now studied **linear** and **exponential** functions. These functions were relatively simple because they were either **always increasing** or **always decreasing** for their entire **domains.** We now will start to study other functions, most notably **quadratic functions**, which are a type of **polynomial function**. Their definition is shown below:

> **QUADRATIC FUNCTIONS**
>
> Any function that can be placed in the form: $y = ax^2 + bx + c$ where $a \neq 0$, but b and c can be zero.

***Exercise* #1:** Read the definition above for quadratic functions and answer the following questions.

(a) Why is it important for the **leading coefficient** to be nonzero?

If the a-term is 0, it goes away and the function becomes linear.

(b) Circle the choices below that are quadratic functions.

$y = x^2 - 3$ $\quad$ $y = x^3 + 2x^2 - 4$ X

$y = x^2 + \sqrt{x} + 7$ X $\quad$ $y = 10 - x^2$ $\quad$ $y = -x^2 + 10$

(c) Given the quadratic function $y = 10 - 3x^2 + 7x$, write it in standard form and state the value of the leading coefficient.

$y = -3x^2 + 7x + 10$

(d) If $f(x) = 2x^2 - 3x + 1$, then find, without using your calculator, the value of $\boxed{f(-2)}$.

$2x^2 - 3x + 1$

$2(-2)^2 - 3(-2) + 1$

$2(4) + 6 + 1$

$8 + 6 + 1 = 15$

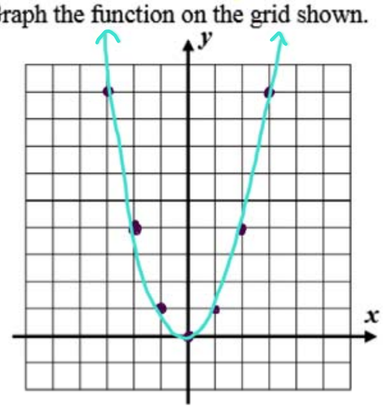
Quadratics still behave in similar ways to other functions. Inputs go in, outputs come out. But, they start to behave differently from **linear** and **exponential** functions because sometimes **outputs repeat** for quadratics.

***Exercise* #2:** Consider the simplest of all quadratic functions, $\boxed{f(x) = x^2}$. $\longrightarrow$ $y = x^2$

(a) Fill out the table below without using your calculator.

x	x	-3	-2	-1	0	1	2	3
y	$y = x^2$	9	4	1	0	1	4	9

(b) Graph the function on the grid shown.



(c) What is the **range** of this quadratic function?

$[0, \infty)$

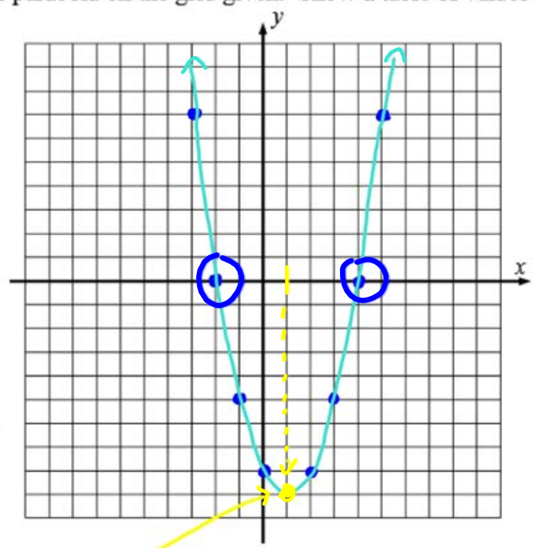
Quadratic functions can obviously be more complicated than our last example, but, strangely enough, they all have the same general shape, which is known as a **parabola**. Let's explore the next quadratic function with the help of technology. We will also introduce some important terminology.

***Exercise* #3:** Consider the quadratic function $y = x^2 - 2x - 8$.

(a) Using your calculator to help generate a table, graph this parabola on the grid given. Show a table of values that you use to create the plot.

x	y
−3	7
−2	0
−1	−5
0	−8
1	−9

x	y
2	−8
3	−5
4	0
5	7



(b) State the **range** of this function.

y-values

$[-9, \infty)$

(c) Over what $\boxed{\textbf{domain i}}$**nterval** is the function **increasing**?

$(1, \infty)$

(d) State the coordinates of the parabola's turning point (also known as its vertex and its minimum point).

$(1, -9)$

(e) What are the ***x*-intercepts** of this function? These are also known as the function's **zeroes**. Why does this name make sense? As a suggestion, write out their full *xy*-pair coordinates.

$(-2, 0)$ and $(4, 0)$

$x = -2$
$x = 4$

***Exercise* #4:** The quadratic function $f(x)$ has selected values shown in the table below.

x	$f(x)$
−1	4
0	9
1	12
2	13
3	12
4	9
5	4
6	−2

(a) What are the coordinates of the turning point?

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Introduction to Quadratic Functions
Homework

1. Which of the following is a quadratic function?

   (1) $y = 3x - 2$ (3) $y = x^2 - 4$

   (2) $y = x^3 + 2x^2 - 1$ (4) $y = 6(2)^x$

2. The quadratic function $y = 9 - x^2 + 4x$ written in standard form would be

   (1) $y = -x^2 + 4x + 9$ (3) $y = x^2 - 4x + 9$

   (2) $y = x^2 - 9x + 4$ (4) $y = -x^2 - 4x + 9$

3. Which of the following would be the leading coefficient of $f(x) = 6 - x + 7x^2$? → the a term

   (1) -1 (3) 7 $7x^2 - x + 6$

   (2) 6 (4) -7

4. Which of the following points lies on the graph of $y = x^2 - 5$?

   (1) $(3, -2)$ (3) $(5, 0)$

   (2) $(-2, -1)$ (4) $(-1, -6)$

5. A quadratic function is partially given in the table below. Which of the following are the coordinates of its turning point?

   (1) $(0, 6)$ (3) $(3, 15)$

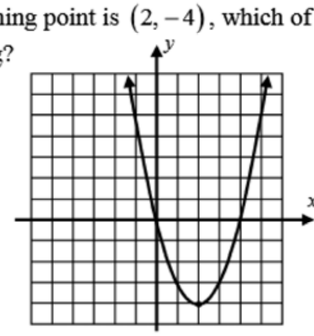
   (2) $(10, 2)$ (4) $(7, -1)$

x	-2	-1	0	1	2	3
y	10	7	6	7	10	15

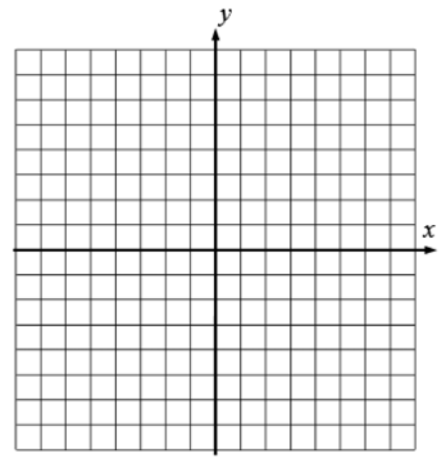
6. Given the quadratic function shown below whose turning point is $(2, -4)$, which of the following gives the domain interval over which this function is decreasing?

   (1) $x > -4$ (3) $x > 2$

   (2) $x < -4$ (4) $x < 2$



7. Consider the function $f(x) = x^2 + 2x - 3$.



(a) Using your calculator, create an accurate graph of $f(x)$ on the grid provided.

(b) State the coordinates of the turning point of $f(x)$. Is this point a maximum or minimum?

(c) State the range of this quadratic function.

(d) State the **zeroes** of this function (the x-intercepts).

(e) Over what interval is this function **increasing**?

(f) Determine the average rate of change of this function over the interval $-2 \le x \le 4$.