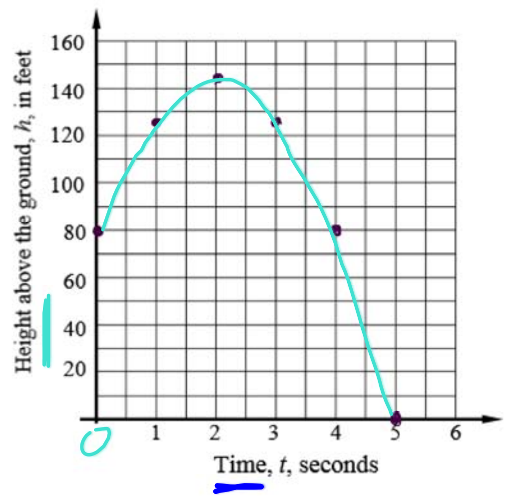
Applications

6. The height of an object that is traveling through the air can be well modeled by a quadratic function that opens downward. An object is fired upward and its height in feet above the ground is given by:

$\boxed{h(t) = -16t^2 + 64t + 80}$ where the input, t, is the time, in seconds, the object has been in the air

(a) Using your calculator, sketch a graph of the object's height for all times where it is at or above the ground.



(b) What is its maximum height in feet?

144 ft

(c) At what time does it hit the ground?

5 seconds

(d) Over what time interval is its height increasing?

(0, 2)

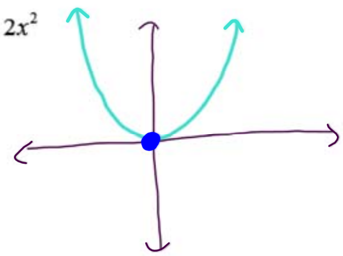
Name: ______________________________ Date: ________________

THE SHIFTED FORM OF A PARABOLA ⇧Shift

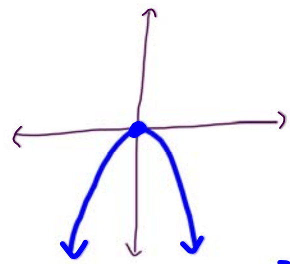
Although the standard form of a parabola has advantages for certain applications, it is not helpful locating the most important point on the parabola, the **turning point**. In this lesson, we will learn about a form of a parabola where the turning point is fairly obvious. First, though, a review of simple parabolas.

Do Now: Without using your calculator, sketch each of the parabolas shown below on your own set of axes. State the coordinates of the turning point of both.

(a) $y=2x^2$



(b) $y=-3x^2$

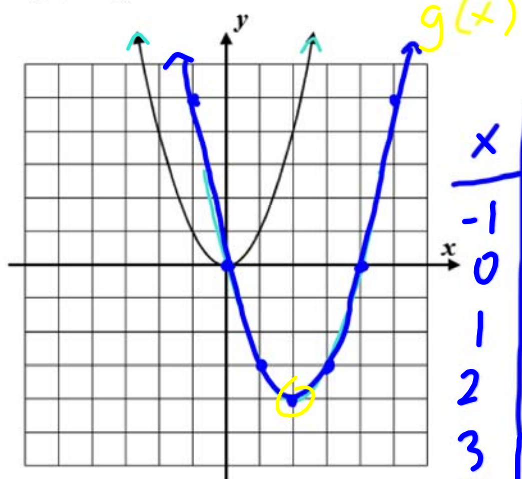


(c) If we have a parabola in the form $y=ax^2$ then it has a turning point at (0,0) → the origin.

Now we would like to try to develop a pattern to see how a function can have its graph **shifted**.

Exercise #2: Consider the basic quadratic function $f(x)=x^2$ ($y=x^2$) and the more complex quadratic function $g(x)=(x-2)^2-4$ ($y=(x-2)^2-4$). The graph of $f(x)=x^2$ is shown on the grid already.

(a) Using your calculator to generate a table, sketch a graph of g.



x	y
-1	5
0	0
1	-3
2	-4
3	-3
4	0

(b) How would you need to shift the graph of $f(x)$ to get the graph of $g(x)$?

Down 4 units
Right 2 units

(c) What is the turning point of $g(x)$? Where do you "see" the turning point in the function's equation?

(2, -4)
x y

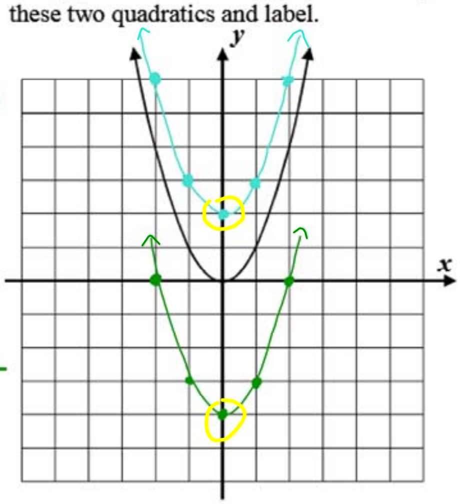
Let's keep looking at this pattern but more simply.

***Exercise* #3:** The parabola $y=x^2$ is again shown on the grid below. Consider the quadratic functions $y=x^2+2$ and $y=x^2-4$.

(a) Using your calculator to generate tables, sketch these two quadratics and label.

x	y
-2	6
-1	3
0	2
1	3
2	6

x	y
-2	0
-1	-3
0	-4
1	-3
2	0



(b) What was the effect of adding a constant to the overall function?

It shifted the parabola up/down.

(c) State the coordinates of the turning points of each of the parabola you drew in (a).

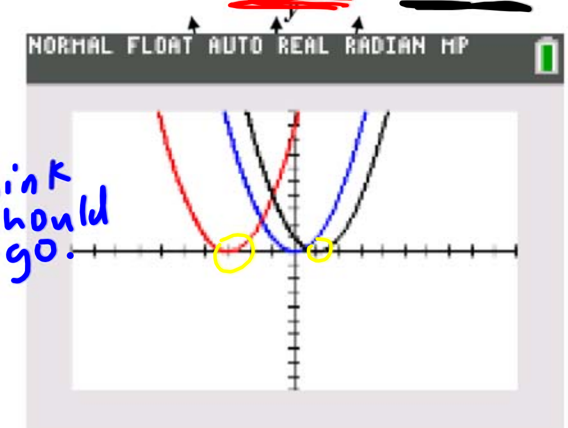
$y=x^2+2$ $(0,2)$ $y=x^2-4$ $(0,-4)$

(d) What would the coordinates of the turning point of the parabola $y=x^2-150$ be?

$(0,-150)$

Now let's see about that number added and subtracted from the input variable, x, before it is even squared.

***Exercise* #4:** Yet (again), the parabola $y=x^2$ is graphed below. Now consider $y=(x+3)^2$ and $y=(x-1)^2$.



(a) Using your calculator to generate tables, sketch these two quadratics and label.

(b) Why is the horizontal shift counterintuitive?

The horizontal shift is opposite of where we think the graph should go.

(c) State the coordinates of the turning points of each of the parabola you drew in (a).

$y=(x+3)^2$ $(-3,0)$ $y=(x-1)^2$ $(1,0)$

(d) Determine the coordinate of the turning points of each of the following quadratics. Note that the value of a is irrelevant.

1. $y=(x-8)^2+5$ $(8,5)$

$y=5(x+1)^2-4$ $(-1,-4)$

$y=-2(x-3)^2-10$ $(3,-10)$