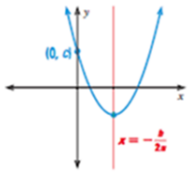
Graphing Parabola's
Uh-Oh, there's a b term!

10.2- Graph $y = ax^2 + bx + c$

Properties of the Graph of a Quadratic Function:

The graph of $y = ax^2 + bx + c$ is a parabola that:

$y = ax^2 + bx + c,\ a > 0$



- Opens up if $a > 0$ and down if $a < 0$
- Is **narrower** than the graph of $y = x^2$ **if lal > 1** and **wider if lal < 1**
- Has an axis of symmetry of $x = -\frac{b}{2a}$
- Has a vertex with an x-coordinate of $-\frac{b}{2a}$
- Has a y-intercept of c. So, the points (0,c) is on **the parabola**

Example 1

IDENTIFY THE VALUES OF A, B, AND C IN THE QUADRATIC FUNCTIONS

A. $y = 4x^2 + 5x - 2$ $a=4$ $b=5$ $c=-2$

B. $y = x^2 + 28$ $a=1$ $b=0$ $c=28$

C. $y = -7x^2 - 3x$ $a=-7$ $b=-3$ $c=0$

Example 2

Consider the function $y = -2x^2 + 12x - 7$

a. Tell whether the graph opens upward or downward — downward, a is negative

b. Find the axis of symmetry of the graph of the function $x = \frac{-b}{2a} = \frac{-12}{2(-2)} = \frac{-12}{-4} = 3$ $x=3$

c. Find the vertex of the graph of the function

$y = -2(3)^2 + 12(3) - 7$
$y = -2(9) + 36 - 7$
$y = -18 + 36 - 7$
$y = 11$

$(3, 11)$

Example 3

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

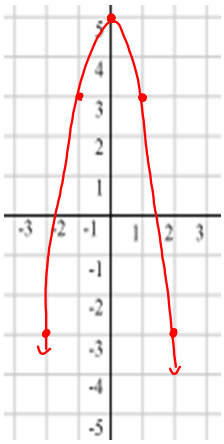
a. Find the vertex of the graph of the function. $x = \frac{-b}{2a} = \frac{0}{2(-2)} = \frac{0}{-4} = 0$ $(0,5)$

$y = -2(0)^2 + 5$
$y = 5$

b. Make a table

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

c. Graph



Example 4

Given $y = x^2 + 2x + 4$

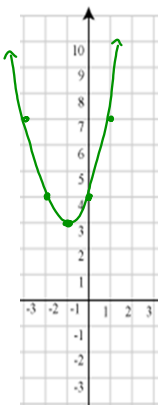
a. Find the vertex of the graph of the function. $x = \frac{-b}{2a} = \frac{-2}{2(1)} = -1$ $(-1, 3)$

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

b. Make a table

c. Graph

x	-3	-2	-1	0	1
y	7	4	3	4	7



Example 5

Given $y = 3x^2 - 6x + 2$

a. Find the vertex of the graph of the function.

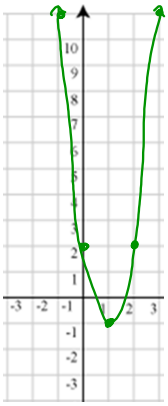
$x = \frac{-b}{2a} = \frac{6}{2(3)} = 1$ $\quad y = 3(1)^2 - 6(1) + 2$

$y = -1 \quad (1, -1)$

b. Make a table

c. Graph

x	-1	0	1	2	3
y	11	2	-1	2	11

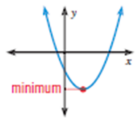


KEY CONCEPT *For Your Notebook*

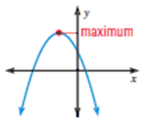
Minimum and Maximum Values

For $y = ax^2 + bx + c$, the y-coordinate of the vertex is the **minimum value** of the function if $a > 0$ or the **maximum value** of the function if $a < 0$.

$y = ax^2 + bx + c, a > 0$



$y = ax^2 + bx + c, a < 0$



Example 6

- Tell whether the function $f(x) = -3x^2 - 12x + 10$ has a *minimum* value or a *maximum* value. Then find the minimum or maximum value.

Maximum Value

$x = \frac{-b}{2a} = \frac{12}{-6} = -2$

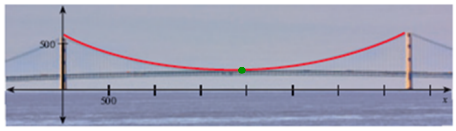
$y = -3(-2)^2 + 24 + 10$

$y = -12 + 24 + 10$

$y = 22$

Example 7

SUSPENSION BRIDGES The suspension cables between the two towers of the Mackinac Bridge in Michigan form a parabola that can be modeled by the graph of $y = 0.000097x^2 - 0.37x + 549$ where x and y are measured in feet. What is the height of the cable above the water at its lowest point?



Minimum Value

$x = \frac{-b}{2a} = \frac{0.37}{.000194}$

$x = 1,907$

$y = .000097(1,907)^2$

$y = 352 - 706 + 549$

$y = 195 \text{ ft}$