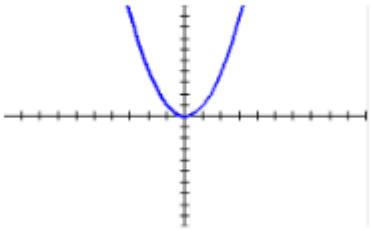


# Graphing Quadratic Equations in Standard Form:

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

**As you complete this worksheet you will be comparing graphs to this parent graph of $y = x^2$.**

## Section 1 – The Role of "a."

**Graph each equation on a graphing calculator. Complete the table to describe each graph. When entering fractions, be sure to enter the fractions in parentheses. Use a standard window: (Zoom:6)**

| Equation | a = | Compare to parent graph: Wider Narrower Same | Opens: Up or Down | Vertex is: Minimum or Maximum |
|---|---|---|---|---|
| $y = 3x^2$ | *3* | *Narrower* | *Up* | *Minimum* |
| $y = 7x^2$ | | | | |
| $y = \frac{1}{2}x^2$ | | | | |
| $y = -\frac{1}{6}x^2$ | | | | |
| $y = -3x^2$ | | | | |

**Graph the following equations on the same set of axes:**

$y_1 = x^2$ $y_2 = 7x^2$ $y_3 = \frac{1}{2}x^2$

1. Order the equations from widest to narrowest:

**Graph the following equations on the same set of axes:**

**$y_1 = -x^2$ $y_2 = -3x^2$ $y_3 = -\frac{1}{6}x^2$**

2. Order the equations from widest to narrowest:

3. Summarize the effect of **a** on the appearance of the graph compared to **$y = x^2$**.

**Section 2: The Role of "c."** $y = ax^2 + c$

Graph each pair of equations. Record the value of **c** and the y-intercept of the graph. (Example: In the equation $y = x^2 - 4$ the "c" value is -4.)

There are two ways to find the y-intercept:
**Method 1:** Substitute x = 0 into the equation and solve for y.
**Method 2:** Use the table on your calculator to find the *y-value when x = 0.*

4. $y = x^2$ c = _____ y-intercept: _____

   $y = x^2 + 2$ c = _____ y-intercept: _____

5. $y = 2x^2$ c = _____ y-intercept: _____

   $y = 2x^2 - 5$ c = _____ y-intercept: _____

6. $y = -\frac{1}{2}x^2$ c = _____ y-intercept: _____

   $y = -\frac{1}{2}x^2 + 6$ c = _____ y-intercept: _____

7. $y = -x^2$ c = _____ y-intercept: _____

   $y = -x^2 - 7$ c = _____ y-intercept: _____

7. $y = -x^2$ c = _____ y-intercept: _____

   $y = -x^2 + 4$ c = _____ y-intercept: _____

8. Summarize the effect that **c** has on the graph:

**Work through the example shown below:** **( A similar example is shown on page 244 of your book.)**

**QUESTION** How can you use a graphing calculator to find the maximum or minimum value of a function?

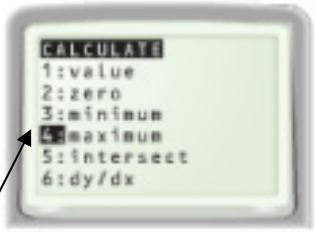
**EXAMPLE** Find the maximum value of a function

**Find the maximum value of $y = -2x^2 - 10x - 5$ and the value of $x$ where it occurs.**

***NOTE: IF YOUR GRAPH OPENS UPWARD (HAS A MINIMUM) BE SURE TO SELECT OPTION 3:MINIMUM IN THE "CALCULATE" MENU.***

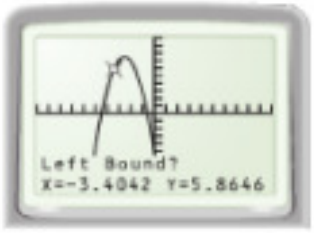
**STEP 1** ***Graph function***

Graph the given function and select the *maximum* feature.




**STEP 2** ***Choose left bound***

Move the cursor to the left of the maximum point. Press ENTER.

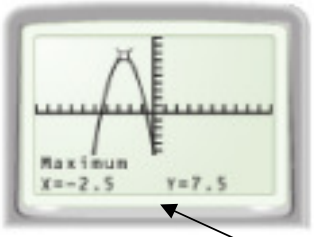



**STEP 3** ***Choose right bound***

Move the cursor to the right of the maximum point. Press ENTER.


**STEP 4** ***Find maximum***

Put the cursor approximately on the maximum point. Press ENTER.




***The vertex is (-2.5, 7.5)***

**Section 3: The role of "b."**

**Graph each equation on a graphing calculator. Complete the table to describe each graph. When entering fractions, be sure to enter the fractions in parentheses.**

| Equation | a = b= c= | $\frac{-b}{2a}$ *(This is the x-coordinate of the vertex)* | y-coordinate of the vertex *(Substitute the x-coordinate of the vertex into the equation and solve for y.)* | Vertex |
|---|---|---|---|---|
| $y = x^2 - 6x + 4$ | *a = 1, b = -6, c = 4* | $\frac{-(-6)}{2(1)} = 3$ | $y = (3)^2 - 6(3) + 4 = -5$ | *(3, -5)* |
| $y = x^2 - 2x + 3$ | | | | |
| $y = -2x^2 + 8x + 2$ | | | | |
| $y = 0.5x^2 + 0.8x - 2$ | | | | |
| $y = \frac{1}{2}x^2 - 3x + 2$ | | | | |
| $y = -\frac{3}{8}x^2 + 6x - 5$ | | | | |
| $y = x^2 - 4x + 5$ | | | | |
| $y = \frac{1}{2}x^2 + 3x - 4$ | | | | |
| $y = 2x^2 - 6x + 5$ | | | | |
| $y = -3x^2 + 3x + 7$ | | | | |
| $y = \frac{1}{4}x^2 - 2x + 1$ | | | | |
| $y = 3x^2 + 9x + 2$ | | | | |
| $y = 5x^2 - 8x - 1$ | | | | |

**<u>Without graphing</u>, give the following information about each equation on the next page.**

**a. Whether it opens up or down**
**b. Whether it is wider or narrower than $y = x^2$**
**c. What the y-intercept is**
**d. The coordinates of the vertex. (First find the x-coordinate using $-\frac{b}{2a}$. Then substitute this x-coordinate into the equation to find the y-coordinate of the vertex.**

**Then *roughly* sketch the graph based on your answers above.**

**1.** $y = 3x^2 - 6x + 4$ Rough sketch:

**Opens:** *up* or *down*

***Wider*** or ***narrower*** than $y = x^2$

y-intercept_____

*x-coordinate of vertex:*_____ *y-coordinate of vertex:*_____ *vertex:*_____

**2.** $y = 0.5x^2 - 2x + 3$ Rough sketch:

**Opens:** *up* or *down*

***Wider*** or ***narrower*** than $y = x^2$

y-intercept_____

*x-coordinate of vertex:*_____ *y-coordinate of vertex:*_____ *vertex:*_____

**3.** $y = -5x^2 - 10x - 1$ Rough sketch:

**Opens:** *up* or *down*

***Wider*** or ***narrower*** than $y = x^2$

y-intercept_____

*x-coordinate of vertex:*_____ *y-coordinate of vertex:*_____ *vertex:*_____

**4.** $y = -x^2 - 4x - 5$ Rough sketch:

**Opens:** *up* or *down*

***Wider*** or ***narrower*** than $y = x^2$

y-intercept_____

*x-coordinate of vertex:*_____ *y-coordinate of vertex:*_____ *vertex:*_____

**5.** $y = \frac{1}{3}x^2 - 2x - 5$ Rough sketch:

**Opens:** *up* or *down*

***Wider*** or ***narrower*** than $y = x^2$

y-intercept_____

*x-coordinate of vertex:*_____ *y-coordinate of vertex:*_____ *vertex:*_____