4.1 Graph Quadratic Functions in Standard Form

Goal • Graph quadratic functions.

Your Notes

VOCABULARY

Quadratic function

Parabola

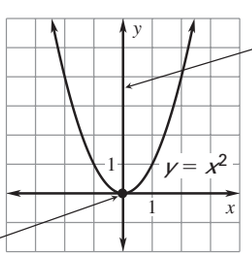
Vertex

Axis of symmetry

Minimum and maximum value

PARENT FUNCTION FOR QUADRATIC FUNCTIONS

The parent function for the family of all quadratic functions is $f(x) =$ ____. The graph is shown below.



The axis of symmetry divides the parabola into mirror images and passes through the vertex.

The lowest or highest point on a parabola is the vertex. The vertex for $f(x) = x^2$ is (0, 0).

For $f(x) = ax^2$, and for any quadratic function $g(x) = ax^2 + bx + c$ where $b = 0$, the vertex lies on the _____ and the axis of symmetry is $x =$ ___.

Your Notes

Example 1 ***Graph a function of the form $y = ax^2 + c$***

Graph $y = -2x^2 + 2$. Compare the graph with the graph of $y = x^2$.

Solution

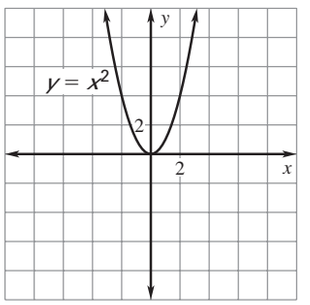
1. Make a table of values for $y = -2x^2 + 2$.

Choose values of x on both sides of the axis of symmetry $x = 0$.

x	-2	-1	0	1	2
y	_____	___	___	___	_____

2. Plot the points from the table.

3. Draw a smooth _____ through the points.



4. Compare the graphs of $y = -2x^2 + 2$ and $y = x^2$. Both graphs have the same _____. However, the graph of $y = -2x^2 + 2$ opens _____ and is _____ than the graph of $y = x^2$. Also, its vertex is ___ units higher.

PROPERTIES OF THE GRAPH OF $y = ax^2 + bx + c$

Characteristics of the graph of $y = ax^2 + bx + c$:

- The graph opens up if a ___ 0 and opens down if a ___ 0.
- The graph is narrower than the graph of $y = x^2$ if $|a|$ ___ 1 and wider if $|a|$ ___ 1.
- The axis of symmetry is $x =$ _____ and the vertex has x-coordinate _____.
- The y-intercept is ___. So, the point (0, ___) is on the parabola.

Your Notes

Example 2 ***Graph a function of the form $y = ax^2 + bx + c$***

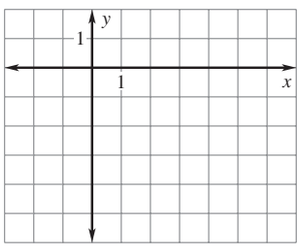
Graph $y = -x^2 + 4x - 3$.

Solution

1. **Identify** the coefficients of the function. The coefficients are $a =$ _____, $b =$ ___, and $c =$ _____. Because a ___ 0, the parabola opens _____.

Be sure to include the negative sign before the fraction when calculating the x-coordinate of the vertex.

2. **Find** the vertex. First, calculate the x-coordinate.



$$x = -\frac{b}{2a} = \_\_\_\_\_ = \_\_\_$$

Then find the y-coordinate.

$y =$ _____ = ___

The vertex is (___, ___). Plot this point.

3. **Draw** the axis of symmetry $x =$ ___.

4. **Identify** the y-intercept c, which is _____. Plot the point (0, _____). Then reflect this point in the axis of symmetry to plot another point (4, _____).

5. **Evaluate** the function for another value of x, such as $x = 1$.

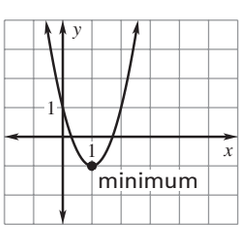
$y =$ _____ = ___

Plot the point (1, ___) and its reflection (3, ___) in the axis of symmetry.

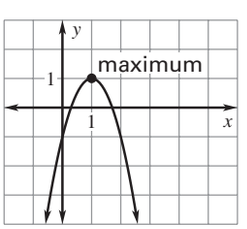
6. **Draw** a parabola through the plotted points.

MINIMUM AND MAXIMUM VALUES

Words For $y = ax^2 + bx + c$, the vertex's y-coordinate is the minimum value of the function if a ___ 0 and the maximum value if a ___ 0.



a is positive



a is negative.

Your Notes

Example 3 ***Find the minimum or maximum value***

Tell whether the function $y = -3x^2 + 12x - 6$ has a *minimum value* or a *maximum value*. Then find the minimum or maximum value.

Solution

Because a ___ 0, the function has a _____ value. To find it, calculate the coordinates of the vertex.

$x = -\frac{b}{2a} =$ _____ $=$ ___

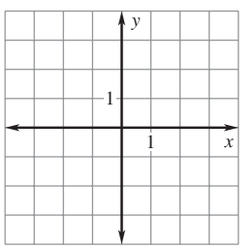
$y =$ _____ $=$ ___

The maximum value is $y =$ ___.

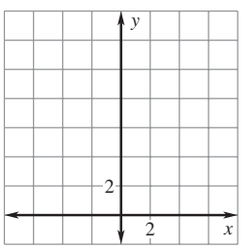
✔ ***Checkpoint*** **Complete the following exercises.**

Graph the function.

1. $y = -x^2$

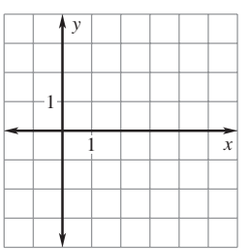


2. $y = \frac{1}{3}x^2 + 3$



3. Graph the function. Label the vertex and axis of symmetry.

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



4. Find the minimum value of $y = 2x^2 - 6x + 6$.

Homework