

9-1 Study Guide and Intervention

Graphing Quadratic Functions

Characteristics of Quadratic Functions

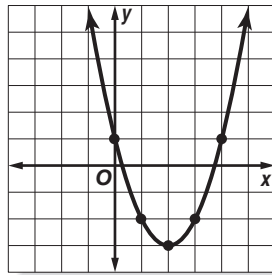
Quadratic Function	a function described by an equation of the form $f(x) = ax^2 + bx + c$, where $a \neq 0$	Example: $y = 2x^2 + 3x + 8$
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The parent graph of the family of quadratic functions is $y = x^2$. Graphs of quadratic functions have a general shape called a **parabola**. A parabola opens upward and has a **minimum point** when the value of a is positive, and a parabola opens downward and has a **maximum point** when the value of a is negative.

Example 1

- a. Use a table of values to graph $y = x^2 - 4x + 1$.

x	y
-1	6
0	1
1	-2
2	-3
3	-2
4	1



Graph the ordered pairs in the table and connect them with a smooth curve.

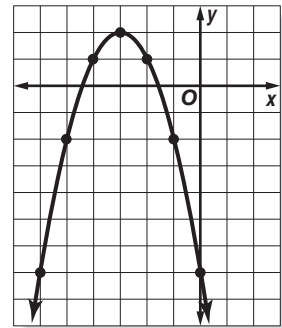
- b. What are the domain and range of this function?

The domain is all real numbers. The range is all real numbers greater than or equal to -3 , which is the minimum.

Example 2

- a. Use a table of values to graph $y = -x^2 - 6x - 7$.

x	y
-6	-7
-5	-2
-4	1
-3	2
-2	1
-1	-2
0	-7



Graph the ordered pairs in the table and connect them with a smooth curve.

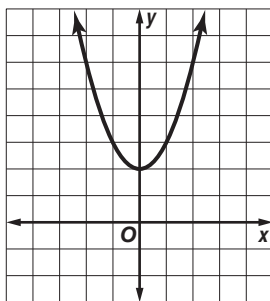
- b. What are the domain and range of this function?

The domain is all real numbers. The range is all real numbers less than or equal to 2 , which is the maximum.

Exercises

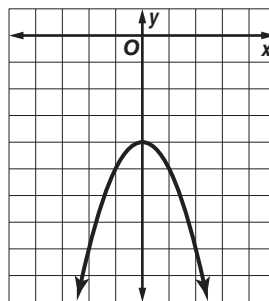
Use a table of values to graph each function. Determine the domain and range.

1. $y = x^2 + 2$



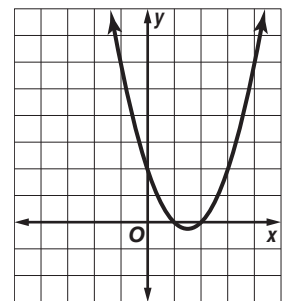
D: {all real numbers}
R: $\{y \mid y \geq 2\}$

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



D: {all real numbers}
R: $\{y \mid y \leq -4\}$

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



D: {all real numbers}
R: $\{y \mid y \geq -\frac{1}{4}\}$

9-1 Study Guide and Intervention *(continued)*

Graphing Quadratic Functions

Symmetry and Vertices Parabolas have a geometric property called **symmetry**. That is, if the figure is folded in half, each half will match the other half exactly. The vertical line containing the fold line is called the **axis of symmetry**. The axis of symmetry contains the minimum or maximum point of the parabola, the **vertex**.

Axis of Symmetry	For the parabola $y = ax^2 + bx + c$, where $a \neq 0$, the line $x = -\frac{b}{2a}$ is the axis of symmetry.	Example: The axis of symmetry of $y = x^2 + 2x + 5$ is the line $x = -1$.
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Example Consider the graph of $y = 2x^2 + 4x + 1$.

a. Write the equation of the axis of symmetry.

In $y = 2x^2 + 4x + 1$, $a = 2$ and $b = 4$.
Substitute these values into the equation of the axis of symmetry.

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

$$x = -\frac{4}{2(2)} = -1$$

The axis of symmetry is $x = -1$.

b. Find the coordinates of the vertex.

Since the equation of the axis of symmetry is $x = -1$ and the vertex lies on the axis, the x -coordinate of the vertex is -1 .

$$y = 2x^2 + 4x + 1 \quad \text{Original equation}$$

$$y = 2(-1)^2 + 4(-1) + 1 \quad \text{Substitute.}$$

$$y = 2(1) - 4 + 1 \quad \text{Simplify.}$$

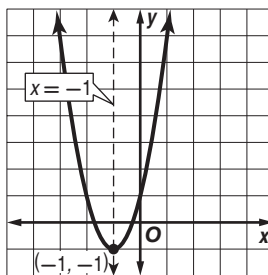
$$y = -1$$

The vertex is at $(-1, -1)$.

c. Identify the vertex as a maximum or a minimum.

Since the coefficient of the x^2 -term is positive, the parabola opens upward, and the vertex is a minimum point.

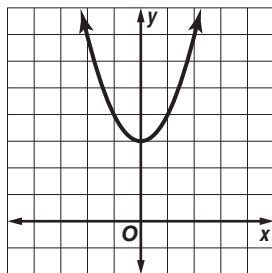
d. Graph the function.



Exercises

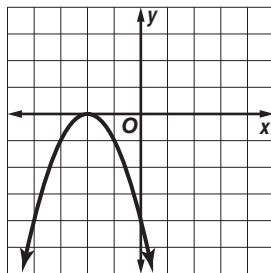
Consider each equation. Determine whether the function has *maximum* or *minimum* value. State the maximum or minimum value and the domain and range of the function. Find the equation of the axis of symmetry. Graph the function.

1. $y = x^2 + 3$



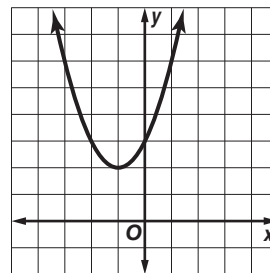
min.; $(0, 3)$;
D: {all real numbers},
R: $\{y \mid y \geq 3\}$; $x = 0$

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



max.; $(-2, 0)$;
D: {all real numbers},
R: $\{y \mid y \leq 0\}$; $x = -2$

3. $y = x^2 + 2x + 3$



min.; $(-1, 2)$;
D: {all real numbers},
R: $\{y \mid y \geq 2\}$; $x = -1$