

## Lesson 9-1 Quadratic Graphs and Their Properties

Take note

### Key Concept Standard Form of a Quadratic Function

A **quadratic function** is a function that can be written in the form  $y = ax^2 + bx + c$ , where  $a \neq 0$ . This form is called the **standard form of a quadratic function**.

**Examples**  $y = 3x^2$        $y = x^2 + 9$        $y = x^2 - x - 2$

The highest or lowest point of a parabola is its **vertex**, which is on the axis of symmetry.

If  $a > 0$  in  $y = ax^2 + bx + c$ ,  
the parabola opens upward.



The vertex is the **minimum** point,  
or lowest point, of the parabola.

If  $a < 0$  in  $y = ax^2 + bx + c$ ,  
the parabola opens downward.

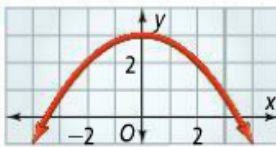


The vertex is the **maximum** point,  
or highest point, of the parabola.

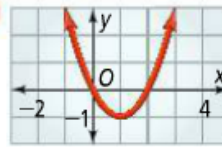
### Problem 1 Identifying a Vertex

What are the coordinates of the vertex of each graph? Is it a minimum or a maximum?

A



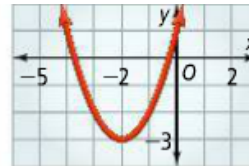
B



What is the equation of the axis of symmetry for each graph above?

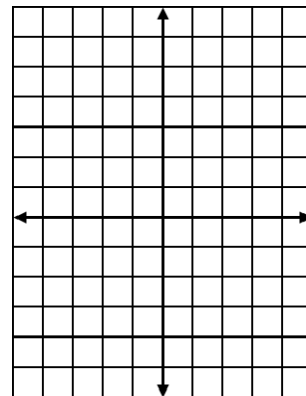
Now you try:

What is the vertex of the graph at the right? Is it a minimum or a maximum?



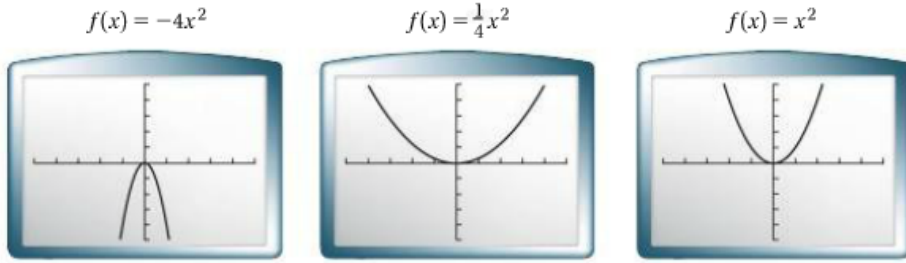
### Problem 2 Graphing $y = ax^2$

Graph the function  $y = x^2$ . Make a table of values. What are the domain and range?



**Problem 3** Comparing Widths of Parabolas

Use the graphs below. What is the order, from widest to narrowest, of the graphs of the quadratic functions  $f(x) = -4x^2$ ,  $f(x) = \frac{1}{4}x^2$ , and  $f(x) = x^2$ ?



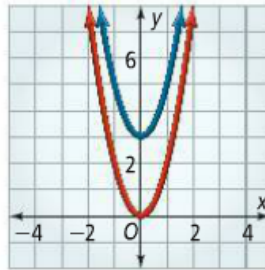
**Got It?** 3. What is the order, from widest to narrowest, of the graphs of the functions  $f(x) = -x^2$ ,  $f(x) = 3x^2$ , and  $f(x) = -\frac{1}{3}x^2$ ?

**Problem 4** Graphing  $y = ax^2 + c$

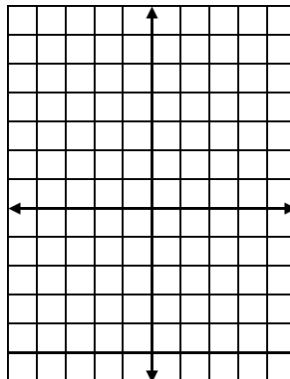
**Multiple Choice** How is the graph of  $y = 2x^2 + 3$  different from the graph of  $y = 2x^2$ ?

- A It is shifted 3 units up.
- B It is shifted 3 units down.
- C It is shifted 3 units to the right.
- D It is shifted 3 units to the left.

x	$y = 2x^2$	$y = 2x^2 + 3$
-2	8	11
-1	2	5
0	0	3
1	2	5
2	8	11



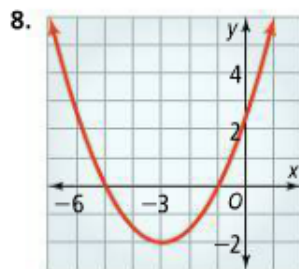
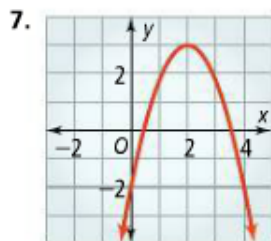
**Got It?** 4. Graph  $y = x^2$  and  $y = x^2 - 3$ . How are the graphs related?



Book work for 9-1 is p 550: 7-8, 16-19, 21-23. Do these problems in the blank space below, or on separate paper.

Identify the vertex of each parabola. Tell whether it is a minimum or a maximum.

See Problem 1.



9. 

x	y
0	8
1	2
2	0
3	2
4	8

Find the equation of the axis of symmetry, too, in questions 7 & 8.

Graph each function. Then identify the domain and range of the function.

See Problem 2.

10.  $y = -4x^2$

11.  $f(x) = 1.5x^2$

12.  $f(x) = 3x^2$

13.  $f(x) = \frac{2}{3}x^2$

14.  $y = -\frac{1}{2}x^2$

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

Order each group of quadratic functions from widest to narrowest graph.

See Problem 3.

16.  $y = 3x^2, y = 2x^2, y = 4x^2$

17.  $f(x) = 5x^2, f(x) = -3x^2, f(x) = x^2$

18.  $y = -\frac{1}{2}x^2, y = 5x^2, y = -\frac{1}{4}x^2$

19.  $f(x) = -2x^2, f(x) = -\frac{2}{3}x^2, f(x) = -4x^2$

Graph each function. Then identify the domain and range of each graph.

See Problem 4.

20.  $f(x) = x^2 + 4$

21.  $y = x^2 - 7$

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

23.  $f(x) = -x^2 - 3$

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

25.  $f(x) = 4x^2 - 5$