

Families of Quadratic Functions

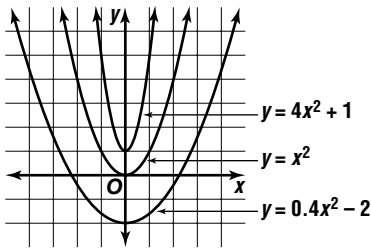
(Pages 464–467)

Families of parabolas share the same vertex, the same axis of symmetry, or have the same shape.

EXAMPLES

Graph each group of equations on the same axes, or on the same screen if you are using a graphing calculator. Compare and contrast the graphs.

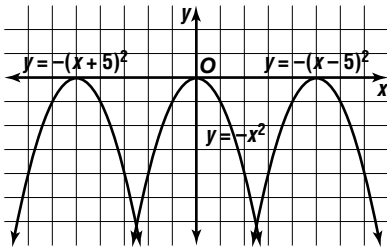
A $y = x^2$, $y = 4x^2 + 1$, $y = 0.4x^2 - 2$



Each graph opens upward. The graph of $y = 4x^2 + 1$ is more narrow than $y = x^2$ and has shifted up one unit on the y -axis. The graph of $y = 0.4x^2 - 2$ is wider than the graph of $y = x^2$ and has shifted down 2 units on the y -axis.

The shape of the parabola narrows as the coefficient of x^2 becomes greater, and widens as it becomes smaller. A constant term greater than 0 shifts the graph upward, and less than 0 shifts the graph downward along the y -axis.

B $y = -x^2$, $y = -(x + 5)^2$, $y = -(x - 5)^2$



Each graph opens downward and has the same shape as the graph of $y = x^2$. However, each graph has a different vertex along the x -axis. The graph of $y = -(x + 5)^2$ has shifted left 5 units, and the graph of $y = -(x - 5)^2$ has shifted right 5 units.

The number for x that results in 0 inside the parentheses is the number of units the graph shifts to the left or right.

PRACTICE

Graph each group of equations on the same axes or on the same screen. Compare and contrast the graphs.

1. $y = x^2$

$y = 3x^2$

$y = 5x^2$

2. $y = -(x - 1)^2$

$y = -(x - 2)^2$

$y = -(x - 3)^2$

3. $y = x^2 + 1$

$y = x^2 + 4$

$y = x^2 + 6$

Describe how each graph changes from the parent graph of $y = x^2$. Then name the vertex of each graph.

4. $y = -4x^2$

5. $y = 0.1x^2$

6. $y = (x + 6)^2$

7. $y = x^2 - 3$

8. $y = (x - 1)^2 + 2$

9. $y = -0.3x^2 - 4$



10. **Standardized Test Practice** Which graph is wider than the graph of $y = x^2$?

A $y = x^2 + 1$

B $y = 0.5x^2$

C $y = 2x^2$

D $y = (x + 1)^2$

Answers: 1. opens up, same vertex, narrows 2. opens down, shifts right 3. opens up, shifts up 4. narrows, opens down; (0, 0) 5. widens; (0, 0) 6. shifts left 6 units; (0, -6) 7. shifts down 3 units; (0, -3) 8. shifts right 1 unit and up 2 units; (1, 2) 9. widens, opens down, shifts down 4 units; (0, -4) 10. B