

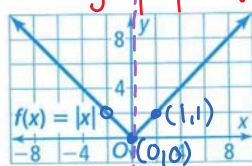
8-1

Key Features of a Quadratic Function

PearsonRealize.com

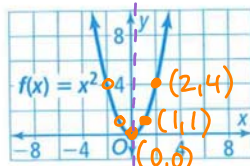
"V"

EXPLORE & REASON



abs

$$y = |x| \text{ absolute value}$$



axis of symmetry $x=0$

$$\text{parabola } y = x^2$$

$$\begin{array}{r} x \ y \\ 0 \ 1 \\ 1 \ 1 \\ 2 \ 4 \end{array}$$

A. **Look for Relationships** How is the graph of $f(x) = |x|$ similar to the graph of $f(x) = x^2$? How is it different? © MP.7

- Symmetric
 - Vertex @ $(0,0)$
 - axis of symmetry
- |
- "V" vs. "U"

B. What do you notice about the axis of symmetry in each graph?

- vertical line
- $x=0$

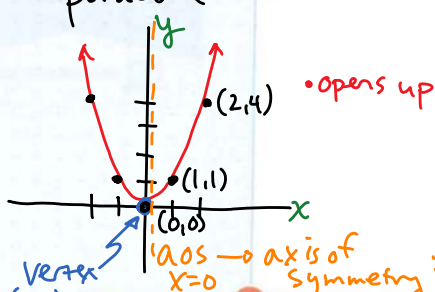
HABITS OF MIND

Construct Arguments Why is the graph of $y = x^2$ always positive? © MP.3

square

EXAMPLE 1

$f(x) = x^2$
parabola



Try It! Identify a Quadratic Parent Function

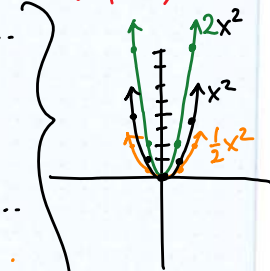
1. When are the values of $f(x)$ positive and when are they negative?

$y = a \cdot x$ -----

$f(x) > 0$ when $a > 0$ pos
 $f(x) < 0$ when $a < 0$ neg

$a(x-h)^2 + k$

EXAMPLE 2 (lowest point)



From book, ex 2)
 When $a > 1$ -----
 • vertical stretch
 ex) $a: 2$
 When $0 < a < 1$ -----
 • vertical compression (shrink)
 ex) $a: \frac{1}{2}$

Try It! Understand the Graph of $f(x) = ax^2$

2. How does the sign of a affect the domain and range of $f(x) = ax^2$?

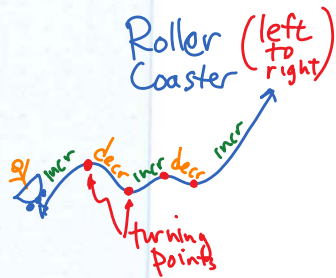
When $a < 0$ negative
 domain: same
 range: \rightarrow opposite
 Vertical reflection ...



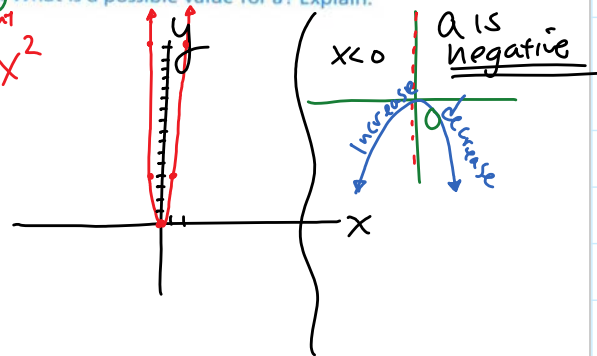
$a < 0$: all values become negative

EXAMPLE 3 Try It! Interpret Quadratic Functions from Tables

3. A function of the form $g(x) = ax^2$ increases over the interval $x < 0$ and decreases over the interval $x > 0$. What is a possible value for a ? Explain.



$g(x) = 4x^2$
 Vert stretch



HABITS OF MIND

Reason Suppose you are comparing rates of change for two quadratic functions of the form $f(x) = ax^2$ over the interval $2 < x < 5$. One function has a positive rate of change and the other function has a negative rate of change over this interval. What can you conclude about the value of a in each function? Which function has a maximum value and which has a minimum value? Explain. © MP.2

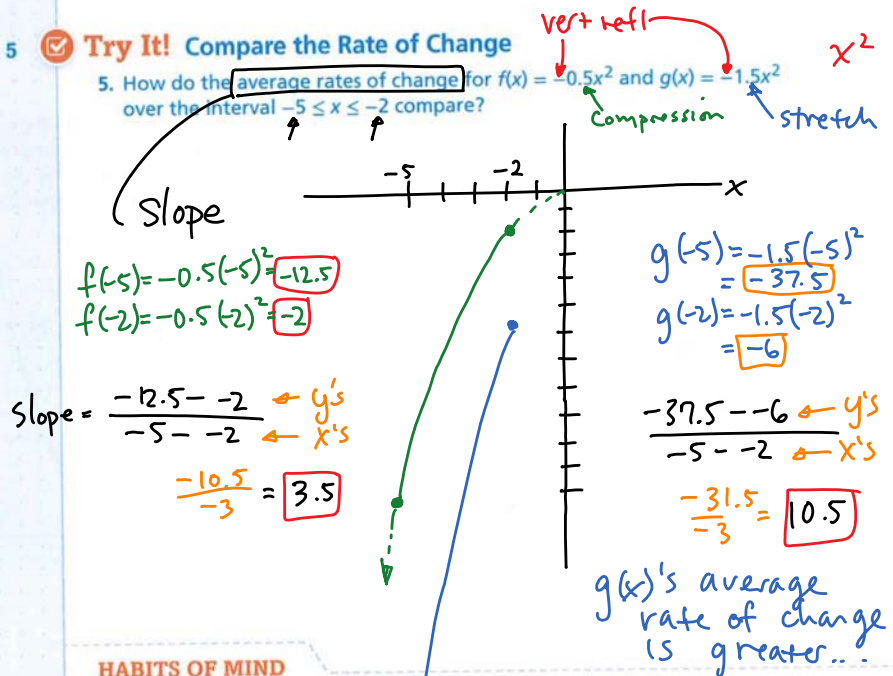
EXAMPLE 4 Try It! Apply Quadratic Functions

4. By how much will the cost increase if the side length of the dance floor is increased by 2 ft?



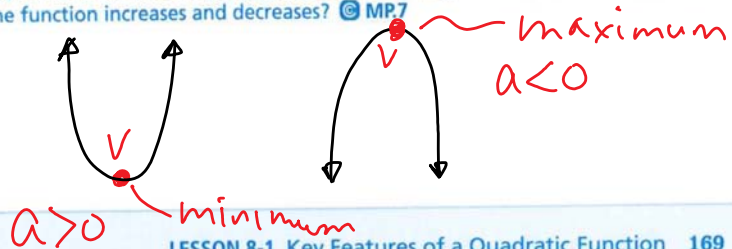
EXAMPLE 5 Try It! Compare the Rate of Change

5. How do the average rates of change for $f(x) = -0.5x^2$ and $g(x) = -1.5x^2$ over the interval $-5 \leq x \leq -2$ compare?



HABITS OF MIND

Look for Relationships How does knowing whether a function of the form $f(x) = ax^2$ has a maximum or minimum value help you know over what intervals the function increases and decreases? © MP7



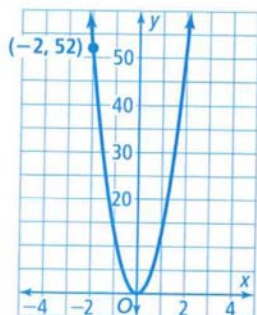
Do You UNDERSTAND?

1. **ESSENTIAL QUESTION** What is the quadratic parent function and how can you recognize the key features of its graph?

2. **Communicate Precisely** How is the graph of $f(x) = ax^2$ similar to the graph of $f(x) = x^2$? How is it different? **MP.6**

3. **Vocabulary** Make a conjecture about why the term *quadratic parent function* includes the word "parent."

4. **Error Analysis** Abby graphed the function $f(x) = -13x^2$ by plotting the point $(-2, 52)$. Explain the error Abby made in her graph. **MP.3**



Do You KNOW HOW?

How does the value of a in each function affect its graph when compared to the graph of the quadratic parent function?

5. $g(x) = 4x^2$

Vert stretch

6. $h(x) = 0.8x^2$

Vert shrink/compress

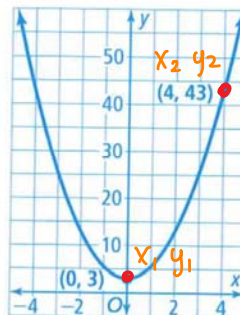
7. $j(x) = -5x^2$

Vert stretch & refl.

8. $k(x) = -0.4x^2$

Vert compress & refl.

9. Given the function $f(x) = 2.5x^2 + 3$, find the average rate of change over the interval $0 \leq x \leq 4$. What does the average rate of change tell you about the function?



$$\text{slope} = \frac{43 - 3}{4 - 0} = \frac{40}{4} = 10$$