UNDERSTAND
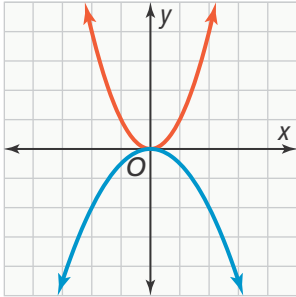
10. Generalize The graph of the parent quadratic function $f(x) = x^2$ and that of a second function of the form $g(x) = ax^2$ are shown. What conclusion can you make about the value of a in the equation of the second function?

11. Error Analysis Describe and correct the error a student made in finding the average rate of change for $f(x) = 0.5x^2$ over the interval $-4 \leq x \leq -2$.

> Find the slope of the line that passes through $(-4, -8)$ and $(-2, -2)$.
>
> $\frac{-2 - (-8)}{-2 - (-4)} = \frac{6}{2} = 3$ ✗

12. Use Structure Use the table shown below to describe the intervals over which $f(x) = 15x^2$ is increasing and decreasing.

x	$f(x) = 15x^2$	(x, y)
-2	60	$(-2, 60)$
-1	15	$(-1, 15)$
0	0	$(0, 0)$
1	15	$(1, 15)$
2	60	$(2, 60)$

13. Higher Order Thinking Tell whether each statement about a function of the form $f(x) = ax^2$ is *always true, sometimes true,* or *never true.*

a. The graph is a parabola that opens upward.

b. The vertex of the graph is $(0, 0)$.

c. The axis of symmetry of the graph is $x = 0$.

PRACTICE

How does the value of a in each function affect its graph when compared to the graph of the quadratic parent function? SEE EXAMPLES 1 AND 2

14. $g(x) = 6x^2$ **15.** $f(x) = 0.6x^2$

16. $f(x) = -7x^2$ **17.** $h(x) = -0.15x^2$

18. $C(x) = 0.04x^2$ **19.** $g(x) = 4.5x^2$

Over what interval is each function increasing and over what interval is each function decreasing? SEE EXAMPLE 3
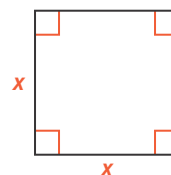
20.

x	$f(x) = -0.3x^2$	(x, y)
-2	-0.6	$(-2, -0.6)$
-1	-0.3	$(-1, -0.3)$
0	0	$(0, 0)$
1	-0.3	$(1, -0.3)$
2	-0.6	$(2, -0.6)$

21.

x	$f(x) = 13x^2$	(x, y)
-2	52	$(-2, 52)$
-1	13	$(-1, 13)$
0	0	$(0, 0)$
1	13	$(1, 13)$
2	52	$(2, 52)$

Write a quadratic function for the area of each figure. Then find the area for the given value of x. SEE EXAMPLE 4

**22.** $x = 13$ **23.** $x = 2.5$
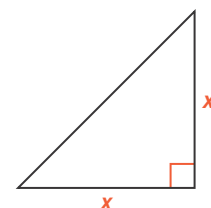
**How do the average rates of change for each pair of functions compare over the given interval?** SEE EXAMPLE 5

24. $f(x) = 0.1x^2$
$g(x) = 0.3x^2$
$1 \leq x \leq 4$

25. $f(x) = -2x^2$
$g(x) = -4x^2$
$-4 \leq x \leq -2$

PRACTICE & PROBLEM SOLVING

APPLY

26. Reason Some students can plant 9 carrots per square foot in the community garden shown. Write a function f that can be used to determine the number of carrots the students can plant. Give a reasonable domain for the function. How many carrots can the students plant in a garden that is square with 4-ft side lengths?
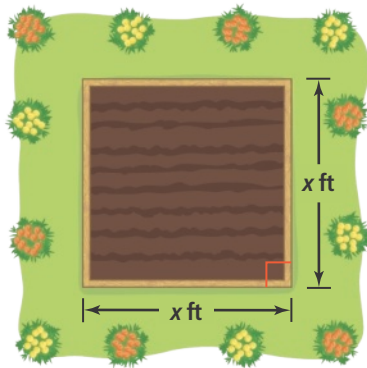

27. Make Sense and Persevere A burrito company uses the function $C(x) = 1.74x^2$ to calculate the number of calories in a tortilla with a diameter of x inches.

a. Find the average rates of change for the function over the intervals $6 < x < 8$ and $9 < x < 11$.

b. Interpret the average rates of change.

c. What does the difference in the average rates of change mean in terms of the situation?

28. Reason An architect uses a computer program to design a skateboard ramp. The function $f(x) = ax^2$ represents the shape of the ramp's cross section. A portion of the design is shown. On the ramp, a person can skateboard from point A through point B and over to a point C. If point C is the same distance above the x-axis as point B, what are its coordinates? Explain.
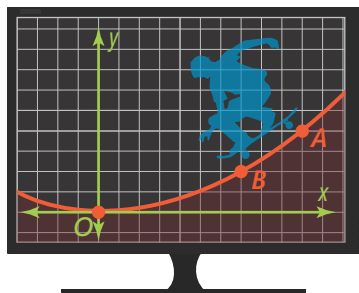
ASSESSMENT PRACTICE

29. The total cost, in dollars, of a square carpet can be determined by using $f(x) = 15x^2$, where x is the side length in yards. Which of the following are true? Select all that apply.

Ⓐ The cost of a carpet increases and then decreases as the side length increases.

Ⓑ The cost of the carpet is $15 per square yard.

Ⓒ The cost of a carpet with a side length of 3 yd is $135.

Ⓓ The cost of a carpet with 6-ft sides is twice the cost of a carpet with 3-ft sides.

Ⓔ The cost of a carpet increases at a constant rate as the side length increases.

30. SAT/ACT The graph of $f(x) = ax^2$ opens downward and is narrower than the graph of the quadratic parent function. Which of the following could be the value of a?

Ⓐ −2   Ⓑ −0.5   Ⓒ 0.5   Ⓓ 1   Ⓔ 2

31. Performance Task A manufacturer has two options for making cube-shaped boxes. The cost is calculated by multiplying the surface area of the box by the cost per square inch of the cardboard.
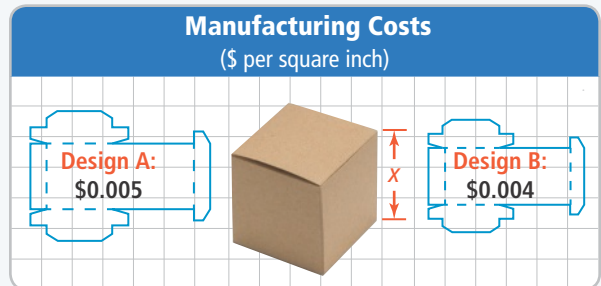
Part A Write a quadratic function of the form $f(x) = ax^2$ for each design that can be used to determine the total cardboard cost for cubes with any side length. Interpret the value of a in each function.

Part B How do the average rates of change for the designs compare for cubes with side lengths greater than 6 in., but less than 8 in.?

Part C Make a conjecture about the packaging costs for each design when the side length of the cube is greater than 36 in. Explain your conjecture.