LESSON 11-5

Practice A

Square-Root Functions

The function $y = 12\sqrt{x}$ gives the total amount of framing needed, in feet, for a four-pane square window if x is the area of one window pane.

1. Find the amount of framing needed if the area of one window pane is 9 square feet. **36 feet**
2. Find the amount of framing needed if the area of one window pane is 5 square feet. Round your answer to the nearest tenth. **≈26.8 feet**

Find the domain of each square-root function.

3. $y = \sqrt{x - 7}$
   $x - 7 \geq 0$
   $x \geq$ **7**
4. $y = \sqrt{4x - 2} + 3$
   $4x - 2 \geq 0$
   $x \geq$ **$\frac{1}{2}$**
5. $y = \sqrt{x + 4}$
   $x + 4$ ≥ 0
   $x \geq$ **-4**
6. $y = 3 + \sqrt{\frac{1}{3}x}$ **$x \geq 0$**
7. $y = 4\sqrt{5 - x}$ **$x \leq 5$**
8. $y = 10 - \sqrt{6x - 12}$ **$x \geq 2$**

Complete each function table. Then, graph each square-root function.

9. $f(x) = \sqrt{x + 3}$

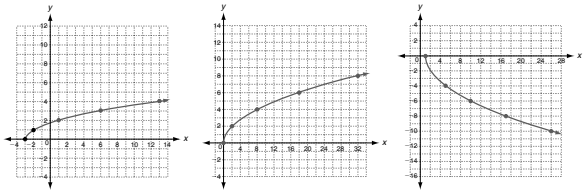
x	$f(x)$
-3	$\sqrt{-3 + 3} = \sqrt{0} = 0$
-2	$\sqrt{-2 + 3} = \sqrt{1} = 1$
1	$\sqrt{1 + 3} = \sqrt{4} = 2$
6	$\sqrt{6 + 3} = \sqrt{9} = 3$
13	$\sqrt{13 + 3} = \sqrt{16} = 4$

10. $f(x) = \sqrt{2x}$

x	$f(x)$
0	$\sqrt{2(0)} = 0$
2	$\sqrt{2(2)} = 2$
8	$\sqrt{2(8)} = 4$
18	$\sqrt{2(18)} = 6$
32	$\sqrt{2(32)} = 8$

11. $f(x) = -2\sqrt{x - 1}$

x	$f(x)$
1	$-2\sqrt{1 - 1} = 0$
5	$-2\sqrt{5 - 1} = -4$
10	$-2\sqrt{10 - 1} = -6$
17	$-2\sqrt{17 - 1} = -8$
26	$-2\sqrt{26 - 1} = -10$



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LESSON 11-5

Practice B

Square-Root Functions

1. An apartment manager needs to order wallpaper border for the remodeled bathrooms. The function $y = 640\sqrt{x}$ gives the amount of border needed, in feet, if x is the square footage of each bathroom. Find the amount of border needed if each bathroom is 100 ft^2. **6400 feet**
2. The current I, in amps, flowing through a household appliance is given by $I = \sqrt{\frac{P}{R}}$, where P is the power required in watts and R is the resistance in ohms. What is the current in an electric skillet when the power required is 1500 watts and the resistance is 75 ohms? Round your answer to the nearest tenth. **≈4.5 amps**

Find the domain of each square-root function.

3. $y = \sqrt{x + 6}$
   $x \geq$ **-6**
4. $y = \sqrt{-3x}$ **$x \leq 0$**
5. $y = \sqrt{2x + 8}$ **$x \geq -4$**
6. $y = \sqrt{\frac{2}{3}x - 6}$ **$x \geq 9$**
7. $y = -2\sqrt{10 - 5x}$ **$x \leq 2$**
8. $y = \sqrt{7(x - 3)}$ **$x \geq 3$**

Complete each function table. Then graph each square-root function.

9. $f(x) = \sqrt{4x}$

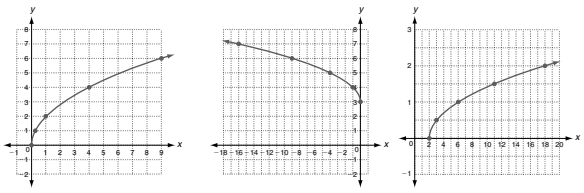
x	$f(x)$
0	0
$\frac{1}{4}$	1
1	2
4	4
9	6

10. $f(x) = \sqrt{-x} + 3$

x	$f(x)$
0	3
-1	4
-4	5
-9	6
-16	7

11. $f(x) = \frac{1}{2}\sqrt{x - 2}$

x	$f(x)$
2	0
3	$\frac{1}{2}$
6	1
11	$\frac{3}{2}$
18	2



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LESSON 11-5

Practice C

Square-Root Functions

1. A frame maker needs to make identical square frames to ship to a museum for a photography exhibit. The function $y = 80\sqrt{x}$ gives the amount of framing, in inches, needed to make the frames if x is the area of each photo. Find the amount of framing needed when each photo has an area of 625 in^2. **2000 in.**

The surface area S of a cone can be found using the formula $S = \pi r^2 + \pi r(\sqrt{r^2 + h^2})$, where r is the radius of the base and h is the height.

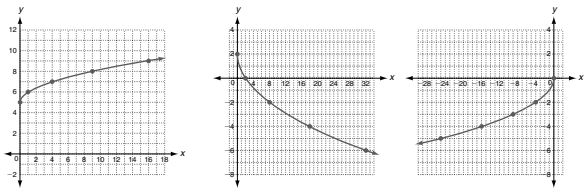
2. What is the surface area of a cone with radius 9 inches and height 12 inches? Use 3.14 for π. Round your answer to the nearest hundredth. **≈678.24 in^2**
3. What is the surface area of a cone with radius 6 inches and height 15 inches? Use 3.14 for π. Round your answer to the nearest hundredth. **≈417.41 in^2**

Find the domain of each square-root function.

4. $y = \sqrt{x - 5}$ **$x \geq 5$**
5. $y = \sqrt{6x + 12}$ **$x \geq -2$**
6. $y = 4\sqrt{3x - 9}$ **$x \geq 3$**
7. $y = \sqrt{8 - \frac{x}{2}}$ **$x \leq 16$**
8. $y = \sqrt{-3(x - 4)}$ **$x \leq 4$**
9. $y = \frac{8 - \sqrt{\frac{1}{3}(x + 5)}}{2}$ **$x \geq -5$**

Graph each square-root function.

10. $f(x) = \sqrt{x} + 5$
11. $f(x) = 2 - \sqrt{2x}$
12. $f(x) = -\sqrt{-x}$



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LESSON 11-5

Reteach

Square-Root Functions

A square-root function is a function in which the independent variable is under the square-root sign.

Square-root functions	Not square-root functions
$y = \sqrt{2x + 3}$	$y = 2x + \sqrt{3}$
$y = 4 + \sqrt{x}$	$y = \sqrt{4}x$

Determine whether $y = 5 + \frac{\sqrt{x}}{2}$ is a square root function. Explain.

Because x is under the square-root sign, this is a square root function.

The square root of a negative number is not a real number. Therefore, the x-values must be restricted to numbers that make the value under the radical sign greater than or equal to 0.

Find the domain of $y = \sqrt{x + 5}$.

$x + 5$ is under the radical sign.
$x + 5$ must be greater than or equal to zero.
$x + 5 \geq 0$
$-5 \quad -5$ *Add -5 to both sides.*
$x \geq -5$

The domain is the set of all real numbers greater than or equal to -5.

Find the domain of $y = 3 - \sqrt{4x - 12}$.

$4x - 12$ is under the radical sign.
$4x - 12$ must be greater than or equal to zero.
$4x - 12 \geq 0$
$+12 \quad +12$ *Add 12 to both sides.*
$4x \geq 12$
$\frac{4x}{4} \geq \frac{12}{4}$ *Divide each side by 4.*
$x \geq 3$

The domain is the set of all real numbers greater than or equal to 3.

Determine whether the following are square-root functions. Explain.

1. $y = \sqrt{8} + x$ **no, x is not under the square-root sign.**
2. $y = \sqrt{8 + x}$ **yes, x is under the square-root sign.**

Find the domain of each square root function.

3. $y = \sqrt{5x - 8}$ **$x \geq \frac{8}{5}$**
4. $y = 6 + \sqrt{x}$ **$x \geq 0$**
5. $y = \sqrt{3x} - 5$ **$x \geq 0$**
6. $y = \sqrt{2(x - 5)}$ **$x \geq 5$**
7. $y = \sqrt{\frac{x}{5}} - 8$ **$x \geq 0$**
8. $y = \sqrt{\frac{x}{3} + 2}$ **$x \geq -6$**

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LESSON 11-5

Reteach

Square-Root Functions (continued)

You can use the domain of the square-root function to help you graph.

Graph $f(x) = \sqrt{3x - 6}$.

Step 1: Find the domain of the function.

$3x - 6 \geq 0$ — *3x – 6 must be greater than or equal to zero.*

$+6 \quad +6$

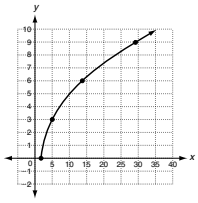
$3x \geq 6$

$\frac{3x}{3} \geq \frac{6}{3}$

$x \geq 2$

The domain is the set of all real numbers greater than or equal to 2.

x	$f(x) = \sqrt{3x - 6}$
2	0
5	3
14	6
29	9



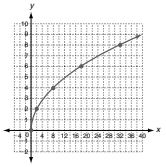
Step 2: Choose x-values greater than or equal to 2 to generate ordered pairs.

Graph each square-root function.

9. $y = \sqrt{2x}$

Domain: $x \geq 0$

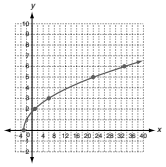
x	$f(x) = \sqrt{2x}$
0	0
2	2
8	4
18	6
32	8



10. $y = \sqrt{x + 3}$

Domain: $x \geq -3$

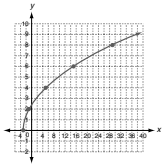
x	$f(x) = \sqrt{x + 3}$
−3	0
1	2
6	3
22	5
33	6



11. $y = \sqrt{2x + 6}$

Domain: $x \geq -3$

x	$f(x) = \sqrt{2x + 6}$
−3	0
−1	2
5	4
15	6
29	8



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LESSON 11-5

Challenge

Inverses of Relations

If you start with 5 and add 2, you get 7. Then if you take 7 and subtract 2, you get 5 again. That's because addition and subtraction are *inverse operations* that "undo" each other. Notice that what you start with and what you end with flip-flop.

Start with 5. End with 7.

$5 \quad +2 = \quad 7$

$7 \quad -2 = \quad 5$

Start with 7. End with 5.

Relations also have inverses that undo each other. Two **inverse relations** will flip-flop inputs and outputs.

So, one way to find the inverse of a relation is to flip-flop the input (x) and the output (y).

Input 5. Output 13.

$y = 2x + 3 \longrightarrow y = 2(5) + 3 = 10 + 3 = 13$

Input 13. Output 5.

$y = \frac{x - 3}{2} \longrightarrow y = \frac{13 - 3}{2} = \frac{10}{2} = 5$

Find the inverse of $y = x - 6$.

$x = y - 6$ — *Flip-flop x and y.*

$+6 \quad +6$ — *Use inverse operations.*

$x + 6 = y$ — *Solve for y.*

The inverse relation is $y = x + 6$.

Flip-flop x and y to find the inverse of each relation.

1. $y = x + 10$

$y = x - 10$

2. $y = \frac{x}{5}$

$y = 5x$

3. $y = -3x + 6$

$y = -\frac{1}{3}x + 2$

4. $y = x^2$ *Hint:* Review Lesson 9-7.

$y = \pm\sqrt{x}$

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

$y = \pm\sqrt{x} - 2$

6. $y = \frac{1}{4}x^2 - 2$

$y = \pm\sqrt{4x + 8}$

7. On a graphing calculator, enter each relation into **Y1** and its inverse into **Y2**, and graph in a square window (**ZOOM Zsquare**). (For 4–6, enter each inverse as two halves in **Y2** and **Y3**.) Describe any patterns.

The line or curve of each original relation is reflected across the line $y = x$ to create the line or curve of the inverse relation.

8. Notice that all of the original relations in 1–6 are functions. For which are the inverses also functions?

1, 2, and 3

9. In Lesson 11–5, you may have noticed that the graph of the function $f(x) = \sqrt{x}$ looks like half of a sideways parabola. Explain why this is.

The graph of $y = x^2$ is a parabola, and the inverse relation $y = \pm\sqrt{x}$ is the same parabola reflected across the line $y = x$. The graph of $f(x) = \sqrt{x}$ is the top (positive) half of $y = \pm\sqrt{x}$.

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LESSON 11-5

Problem Solving

Square-Root Functions

Write the correct answer.

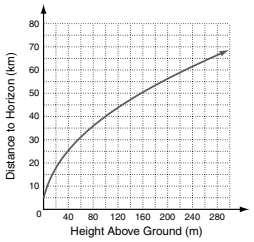
1. Use the formula $r = \sqrt{\frac{A}{\pi}}$ to find the radius of a circular fountain with an area of 200 square feet. Use 3.14 for π. Round your answer to the nearest foot.

8 ft

2. The manager of a magazine gives a rating to each article written using $y = \sqrt{10x}$ where x is the number of positive responses received about that article. What rating would the manager give an article if it received 21 positive responses? (Round to the nearest tenth.)

14.5

3. The distance to the horizon (in km) from an aircraft can be roughly approximated using $y = 4\sqrt{x}$ where x is the aircraft's altitude in meters. Graph this function.



4. The amount of water flowing through a hose in gallons per minute is given by $y = 35\sqrt{x}$ where x is the nozzle pressure in pounds per square inch. What is the water flow in the hose if the pressure is 25 pounds per square inch?

175 gal/min

Select the best answer.

5. The diameter of a can of tuna is found by $d = 2\sqrt{\frac{V}{\pi h}}$ where V is volume and h is height. To the nearest cm, what is the radius of a tuna can with a volume of 150 cm^3 and a height of 3 cm?

A 2 cm **C** 8 cm

B 4 cm **D** 16 cm

6. The side length of the base of a square pyramid can be found by $s = \sqrt{\frac{3V}{h}}$ where V is volume and h is height. To the nearest meter, what is the side length of the base of a square pyramid if its volume is 13,653 m^3 and its height is 40 m?

F 3 m **H** 32 m

G 18 m **J** 55 m

7. The radius of a ball is found by $r = \sqrt{\frac{S}{4\pi}}$ where S is surface area. To the nearest tenth of an inch, what is the radius of a ball with a surface area of 154 in^2?

A 3.5 in. **C** 7.0 in.

B 6.2 in. **D** 12.3 in.

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LESSON 11-5

Reading Strategies

Use a Concept Map

The concept map below will help you understand square-root functions.

Square-Root Function

Definition

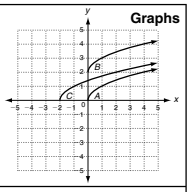
A function whose rule contains a variable under the square-root sign.

Graphs

A: $y = \sqrt{x}$

B: $y = \sqrt{x} + 2$

C: $y = \sqrt{x + 2}$



Examples

$y = \sqrt{x}$; $y = \sqrt{x + 3}$; $y = 2\sqrt{x} - 4$

Non-Examples

$y = \sqrt{2}x$; $y = 3x^2 + 1$; $y = x - \sqrt{6}$

Domain

The domain of a square-root function is all values of x which make the expression under the radical sign ≥ 0.

Complete the following.

1. Tell whether each function is a square-root function by writing *yes* or *no*.

a. $y = \sqrt{3x}$ — yes

b. $y = \sqrt{5}x$ — no

c. $y = \frac{\sqrt{6}}{x}$ — no

d. $y = \frac{2\sqrt{x}}{3}$ — yes

2. Describe the change in the graph of $y = \sqrt{x}$ to the graph of $y = \sqrt{x} + 2$.

The graph is shifted up 2 units.

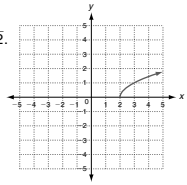
3. Describe the domain of the function $y = 3\sqrt{x + 5}$.

all real numbers greater than or equal to −5

4. The function $y = 8\sqrt{x}$ gives the speed of a falling object in ft/s after falling x seconds. Find the speed of an object after it has fallen 100 feet.

80 ft/s

5. Sketch the graph of $y = \sqrt{x - 2}$.



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