

Learning Guide Module

Subject Code	Math 3	Mathematics 3
Module Code	5.0	<i>Other Types of Functions</i>
Lesson Code	5.1.2	<i>Square Root Functions 2</i>
Time Limit		30 minutes



TARGET

Time Allocation: 1 minute

Actual Time Allocation: _____ minutes

By the end of this learning guide, the student will have been able to:

1. sketch the graph of square root function and describe its behavior.



HOOK

Time Allocation: 4 minutes

Actual Time Allocation: _____ minutes

A **square root function** is a function that has a square root sign having an independent variable in the radicand. We have discussed that this function is denoted by $f(x) = \sqrt{x}$. This form is considered as the parent function of the family of square root functions. The *parent function* is the simplest or most basic function that satisfies the definition of a certain type of function. Looking at the graph of $f(x) = \sqrt{x}$ below, its domain is $x \geq 0$, and the range is $y \geq 0$.

In lesson 5.1.1, we have already explored the graph of $y = \sqrt{x}$.

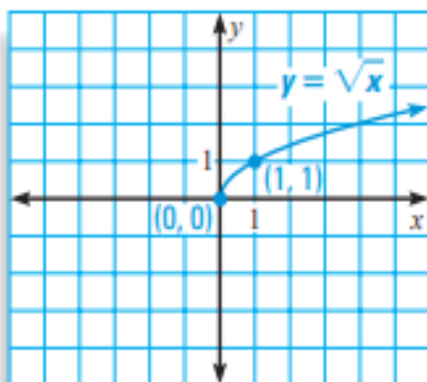


Figure 1 Domain: $x \geq 0$, Range: $y \geq 0$

Image Source: <https://www.classzone.com/eservices/home/pdf/student/LA207EAD.pdf>

What are the other characteristics of the graph of $y = \sqrt{x}$ aside from its domain and range?

In this lesson, we will learn to graph square root functions of the form $f(x) = a\sqrt{x-h} + k$, where (h, k) is the initial or starting point of the graph of the square root function.



Time Allocation: 15 minutes
Actual Time Allocation: _____ minutes

Let us start exploring our topic!

INVESTIGATING GRAPHS OF SQUARE ROOT FUNCTIONS

Tasks:

1. Make a table of values for each function.
2. Use the table to sketch the graph of each function.
3. Describe the domain and range of each function.
4. Then, compare this graph to the graph of $f(x) = \sqrt{x}$.

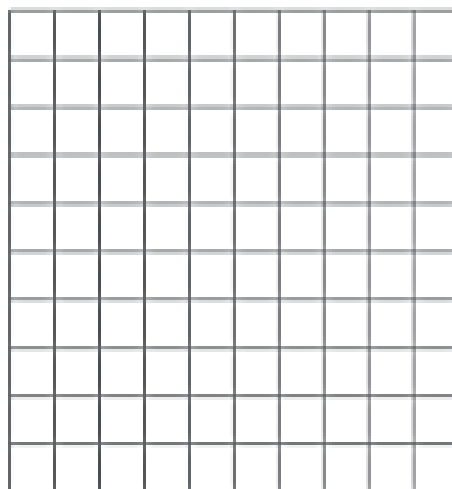
a. $g(x) = \sqrt{x-2}$

x						
y						

Domain:

Range:

Compare the graph of $g(x)$ to the graph of $f(x)$.



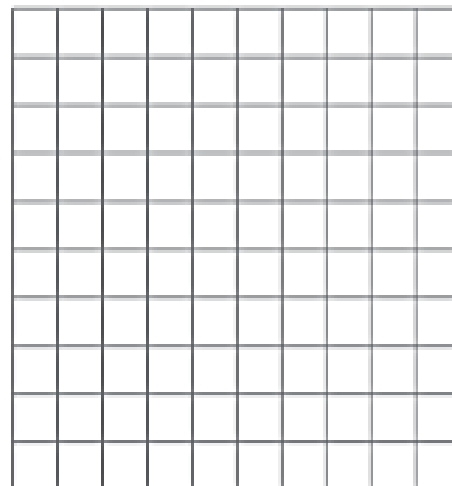
b. $s(x) = \sqrt{x} - 2$

x						
y						

Domain:

Range:

Compare the graph of $s(x)$ to the graph of $f(x)$.



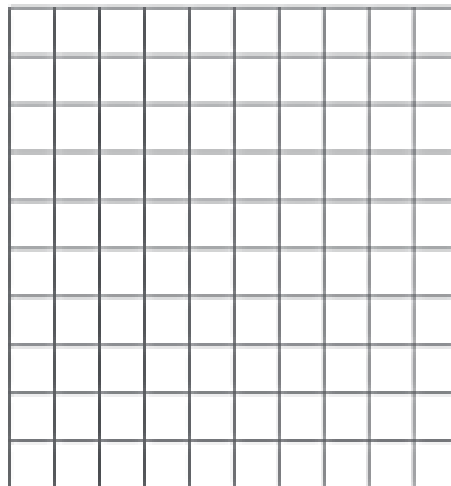
c. $h(x) = 3\sqrt{x}$

x						
y						

Domain:

Range:

Compare the graph of $h(x)$ to the graph of $f(x)$.



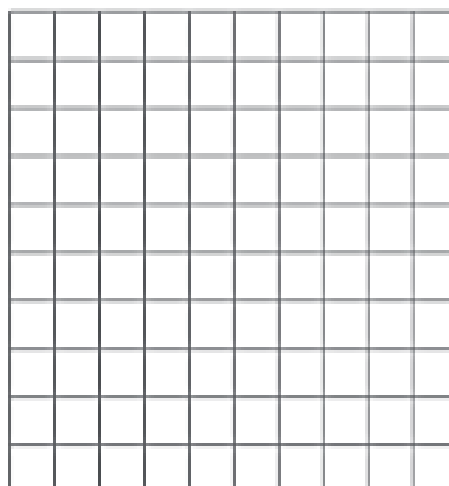
d. $k(x) = -3\sqrt{x}$

x						
y						

Domain:

Range:

Compare graph of $k(x)$ to the graph of $f(x)$.



What have you learned?

Let us explore the following examples.

Example 1 Comparing Graphs

Describe how to find the graph of $g(x) = \sqrt{x+1} - 3$ from the graph of $f(x) = \sqrt{x}$.

Solution

Take note that $g(x)$ can be written in the form $g(x) = a\sqrt{x-h} + k$ as $g(x) = \sqrt{x-(-1)} + (-3)$. Thus, $h = -1$ and $k = -3$. To find the graph of $g(x) = \sqrt{x+1} - 3$, we will shift the graph of $f(x)$ 1 unit to the left and 3 units down.

Example 2 Graphing Square Root Functions

Sketch the graph of $y = -3\sqrt{x-2} + 1$.

Solution: Let us first determine the domain.

$$x - 2 \geq 0$$

$$x \geq 2$$

Thus, the domain of function is $[2, +\infty)$.

Let us create a table of values. The values of x will start from 2 to any positive real number. To get Integral y values, let us assign x values that will make $x - 2$ a perfect square.

x	2	3	6	11	27
y	1	-2	-5	-8	-14

Then, plot the points. Observe the graphs of $y = -3\sqrt{x}$ and $y = -3\sqrt{x-2} + 1$ in Figure 2.

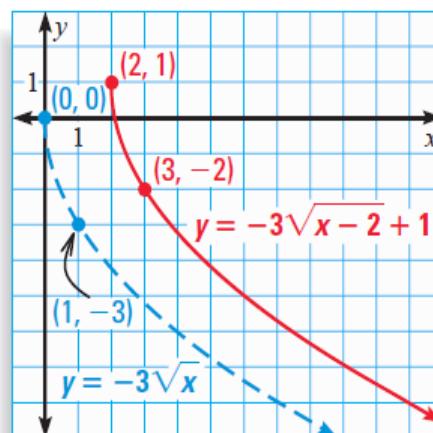


Figure 2

Image Source:

<https://www.classzone.com/eservice/s/home/pdf/student/LA207EAD.pdf>

What have you discovered from the graphs in **Figure 2**?

Example 3 Finding Domain and Range of the Graphs of Square Root Functions

Given are square roots functions together with their graphs, find the domain and range of the functions.

a. $g(x) = \sqrt{-x}$

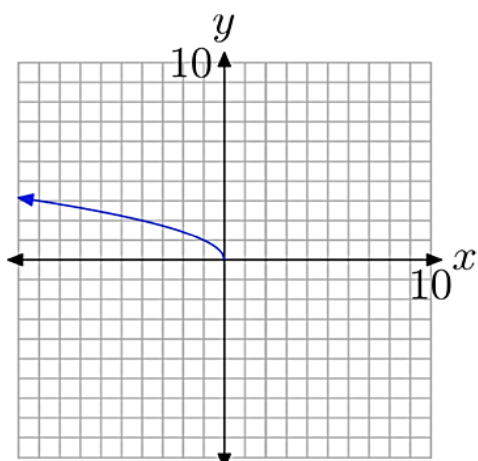


Figure 3(a) Graph of $g(x) = \sqrt{-x}$

b. $h(x) = \sqrt{4-x}$

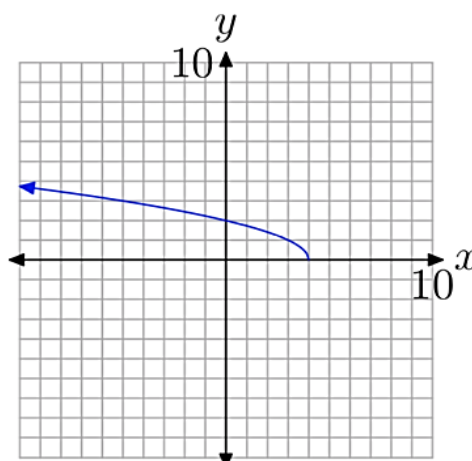


Figure 3(b) Graph of $h(x) = \sqrt{4-x}$

Image Source: https://static.bigideasmath.com/protected/content/sj/hssc/alg1_10_01_student_journal.pdf

As we can observe from the graph, $g(x) = \sqrt{-x}$ is a reflection of $f(x) = \sqrt{x}$ about the y -axis. Its domain is $(-\infty, 0]$ and the range is $[0, +\infty)$ (see Figure 3(a)).

As to the graph of $h(x) = \sqrt{4-x}$, this is the graph of $g(x) = \sqrt{-x}$ moved 4 units to the right as presented in Figure 3(b). Since we can rewrite $h(x)$ into $h(x) = \sqrt{-(x-4)}$; therefore, its domain is $(-\infty, 4]$ and the range is $[0, +\infty)$.



NAVIGATE

Time Allocation: 8 minutes
Actual Time Allocation: _____ minutes

Note: Items marked with an asterisk (*) will be graded.

A. CHECK YOUR UNDERSTANDING!

Directions: Sketch the graph of each square root function. Then, determine the following:

- domain
- range
- x – intercept, if any
- y – intercept, if any
- increasing/decreasing on what interval

1. $f(x) = -\sqrt{4x-1}$

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

3. $f(x) = 2\sqrt{3-2x} + 1$

* 4. $f(x) = \frac{3}{4}\sqrt{x+2} - 3$

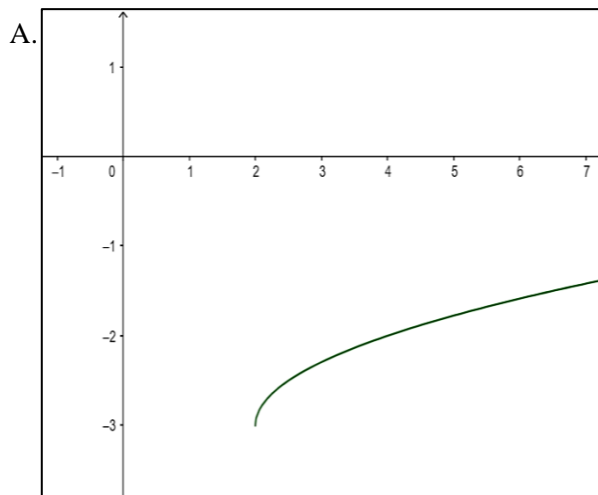
B. MATCH-THEM-ATICS!

Directions: Match the square root function (Column A) with its graph (Column B). Write the letter of your answer on the space provided before the number.

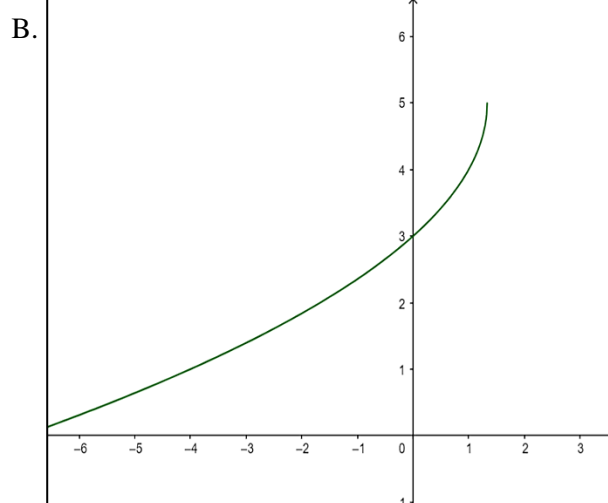
Column A

_____ 1. $f(x) = -\frac{1}{4}\sqrt{x-1}$

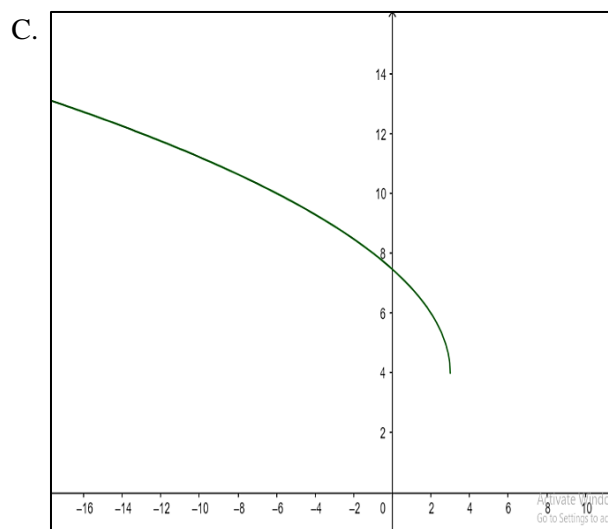
Column B



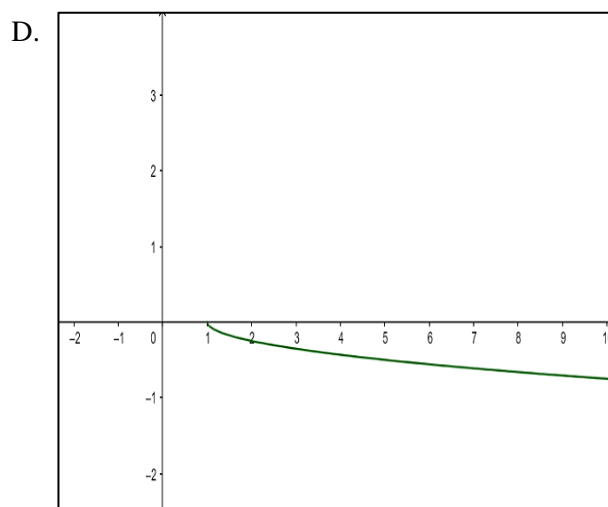
_____ * 2. $f(x) = 2\sqrt{3-x} + 4$



_____ 3. $f(x) = \sqrt{\frac{1}{2}x - 1} - 3$

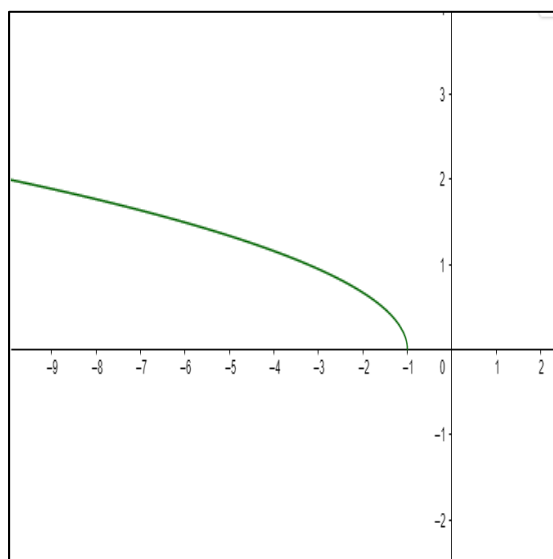


_____ * 4. $f(x) = -\sqrt{4-3x} + 5$

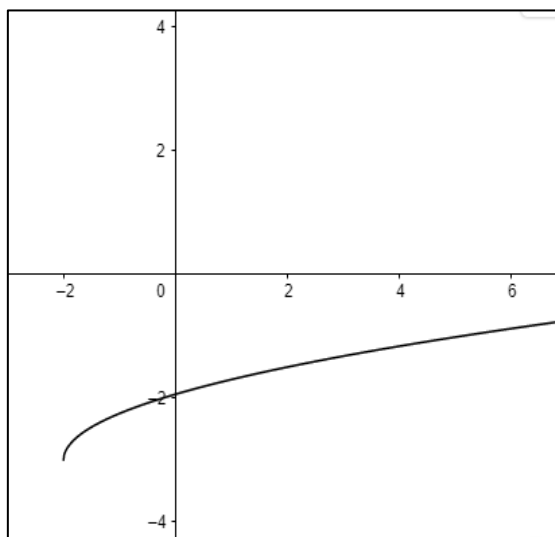


_____ 5. $f(x) = \frac{2}{3}\sqrt{-x-1}$

E.



F.



Time Allocation: 2 minutes
Actual Time Allocation: _____ minutes

Let us summarize!

It is very important to determine the domain and range of a square root function. These will aid us to sketch the graph of the function properly. Comparing the equation of a square root function to its parent function $f(x) = \sqrt{x}$ and using a table of values are also beneficial.

To determine whether a square root function is increasing or decreasing on an interval, we look at the sign of a in $f(x) = a\sqrt{x-h} + k$. If a is positive, this means that the graph of $f(x)$ is increasing while if a is negative, its graph is decreasing on an interval.

References:

- Albarico, J.M. (2013). THINK Framework. (Based on Ramos, E.G. and N. Apolinario. (n.d.) *Science LINKS*. Rex Bookstore, Inc.)
- Big Ideas Learning Website (n.d). Graphing Square Root Functions . Retrieved from https://static.bigideasmath.com/protected/content/sj/hssc/alg1_10_01_student_journal.pdf
- Classzone Website (n.d). Graphing Square Root and Cube Root Functions. Retrieved from <https://www.classzone.com/eservices/home/pdf/student/LA207EAD.pdf>
- Franklin, Scott R. (2016). *Geogebra – 2D Graphing* [Software]. Retrieved from <https://www.geogebra.org/m/Adc44ZZq>

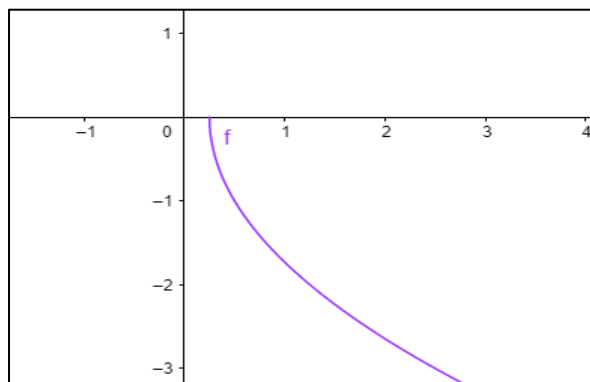
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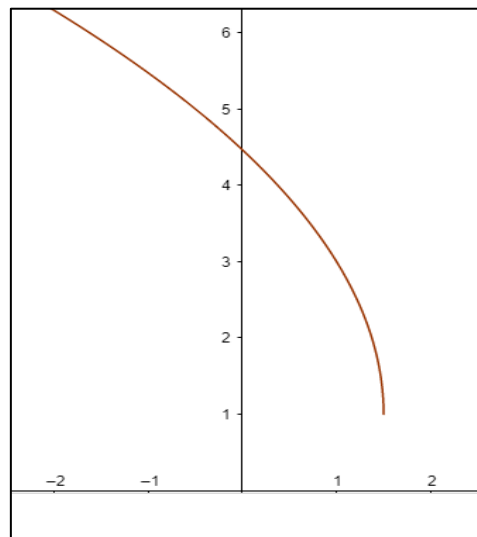
ANSWER KEY:

Check Your Understanding!

- $x \geq \frac{1}{4}$
 - $y \geq 0$
 - $(\frac{1}{4}, 0)$
 - none
 - decreasing, $x \geq \frac{1}{4}$



- $x \leq \frac{3}{2}$
 - $y \geq 1$
 - none
 - $(0, 4.46)$
 - increasing, $x \leq \frac{3}{2}$



B. MATCH-THEM-ATICS!

- D
- A
- E