

# GENERAL MATHEMATICS 11

Name of Learner: \_\_\_\_\_ Grade Level: \_\_\_\_\_  
Section: \_\_\_\_\_ Date: \_\_\_\_\_

## LEARNING ACTIVITY SHEET

### INTERCEPTS, ZEROES AND ASYMPTOTES OF AN EXPONENTIAL FUNCTION

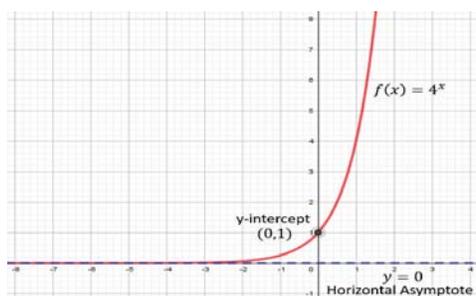
#### Background Information for Learners

What are intercepts, zeroes and asymptotes of a function? *Intercepts* are the points at which a graph intersects with either the x or y axis. The *x-intercepts* or *zeroes* of a function are the values of  $x$  which make the function zero, while the *y-intercepts* of a function are the function values when  $x = 0$ . *Asymptotes* are lines that continually approach a given curve but do not meet it at any finite distance. The vertical line  $x = a$  is a *vertical asymptote* of a function  $f$  if the graph of  $f$  either increases or decreases without bound as the x-values approach  $a$  from the right or left. The horizontal line  $y = b$  is a *horizontal asymptote* of the function  $f$  if  $f(x)$  gets closer to  $b$  as  $x$  increases or decreases without bound.

The y-intercept of an exponential function with base  $b$  of the form  $f(x) = b^x$  or  $y = b^x$  is always 1. The horizontal asymptote is the line  $y = 0$ . There are no x-intercept, zeroes and vertical asymptote.

**Example:** Determine the horizontal asymptote and y-intercept of  $f(x) = 4^x$ .

Graph the exponential function in a Cartesian plane.



Since y-intercept is the function value when  $x = 0$ , therefore the y-intercept is 1.

It can be observed that the function is defined for all values of  $x$ , is strictly increasing, and attains only positive y-values. As  $x$  decreases without bound, the function approaches 0 but never meet it, thus, the line  $y = 0$  is a horizontal asymptote.

## Learning Competency

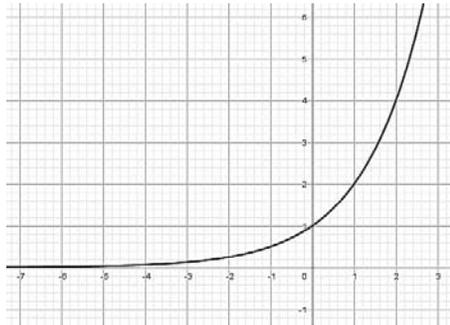
Determines the intercepts, zeroes, and asymptotes of an exponential function (M11GM-If-4).

### Directions/Instructions

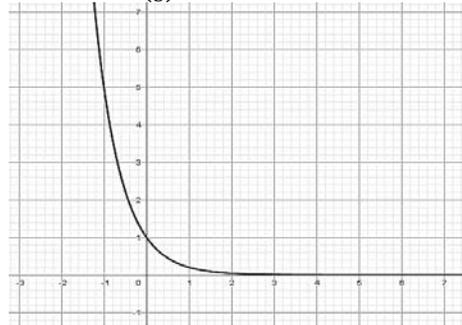
#### Activity 1. “Stop, Look and Answer!”

Direction: Determine the  $y$ -intercept and horizontal asymptote of the following graphs of exponential functions. [1 point each]

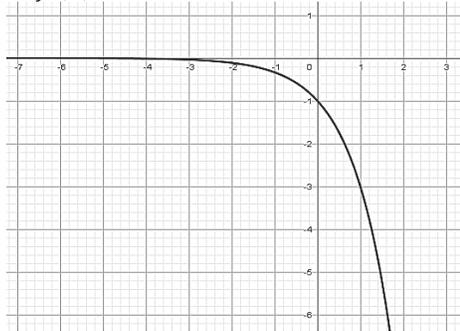
1.  $f(x) = 2^x$



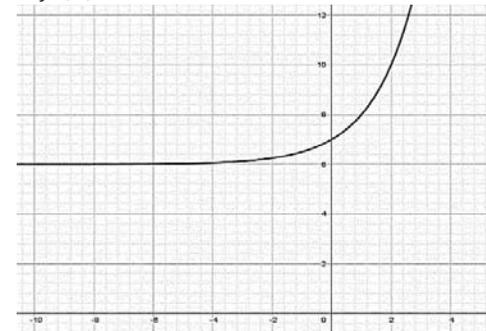
2.  $f(x) = \left(\frac{1}{5}\right)^x$



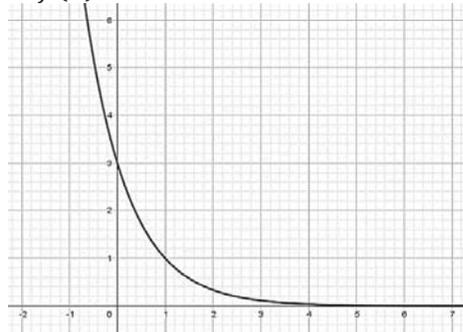
3.  $f(x) = -3^x$



4.  $f(x) = 2^x + 6$



5.  $f(x) = 3^{-x+1}$



**Activity 2. “Construct, Sketch and State!”**

Direction: In each of the following functions, construct a table of values using  $x = -3, -2, -1, 0, 1, 2, 3$ , sketch the graph on a Cartesian plane, and state the y-intercept and horizontal asymptote.

1.  $f(x) = 8^x$

$x$							
$f(x)$							

2.  $g(x) = 3^{x+2}$

$x$							
$g(x)$							

y-intercept: \_\_\_\_\_  
Horizontal Asymptote: \_\_\_\_\_

y-intercept: \_\_\_\_\_  
Horizontal Asymptote: \_\_\_\_\_

3.  $y = -\left(\frac{3}{4}\right)^x$

$x$							
$y$							

4.  $y = 7(5)^{x-1} + 1$

$x$							
$y$							

y-intercept: \_\_\_\_\_  
Horizontal Asymptote: \_\_\_\_\_

y-intercept: \_\_\_\_\_  
Horizontal Asymptote: \_\_\_\_\_

5.  $d(x) = 0.45(7)^x$

$x$							
$d(x)$							

6.  $h(x) = 5\left(\frac{1}{10}\right)^x + 3$

$x$							
$h(x)$							

y-intercept: \_\_\_\_\_  
 Horizontal Asymptote: \_\_\_\_\_

y-intercept: \_\_\_\_\_  
 Horizontal Asymptote: \_\_\_\_\_

Rubrics for Scoring the Table of Values and Graph

	0 Point	1 Point	2 Points	3 Points
Table of Values	Learner gives no correct answers.	Learner gives 1 to 3 correct answers.	Learner gives 4 to 6 correct answers.	Learner gives all correct answers.
Graph	Learner gives no graph/graph is not accurate.	Learner graphs the function less neatly and organize, and a little accurate.	Learner graphs the function neatly and organized, and accurate.	Learner graphs the function very neatly and organized and very accurate.

**Activity 3. “Match Me!”**

Direction: Match the following function with their corresponding y-intercept located in the **y-intercept Column**, and with their corresponding horizontal asymptote located in the **Horizontal Asymptote Column**. Draw a line in matching. *Note: any of the choices can be used as an answer multiple times.*

y-intercept
26
38880
1
$\frac{13}{10}$
45
-45
-11
$\frac{3}{10}$

Function
1. $y = 12^{-x}$
2. $y = 1.3(7)^x - 1$
3. $y = -7^{-x+2} + 4$
4. $y = 5\left(\frac{1}{6}\right)^{x-5}$
5. $y = -0.80^x - 10$
6. $y = 2^{4-x} + 10$

Horizontal Asymptote
$y = 1$
$y = 10$
$y = -5$
$y = 4$
$y = 0$
$y = -1$
$y = 1.3$
$y = -10$

**Activity 4. “Solve Me!”**

Direction: Solve the following problems. Show complete solution in separate sheet of paper.

In items 1-2, (a) use transformations to describe how the graph is related to its base exponential function  $y = b^x$ , (b) sketch the graph, (c) identify its y-intercept and horizontal asymptote.

1.  $f(x) = \left(\frac{1}{8}\right)^{x-1} + 4$

2.  $g(x) = 3(2)^{x-1}$

3. Find an exponential function of the form  $f(x) = a(b)^x + d$  such that the y-intercept is -4, the horizontal asymptote is  $y = -8$ , and  $f(3) = 24$ . Show solution.

4. Find an exponential function of the form  $f(x) = b^{x-c} + d$  such that the y-intercept is 29, the horizontal asymptote is  $y = 4$ , and  $f(-1) = 9$ . Show solution.

5. A cup of hot chocolate is ordered from a coffee shop. The temperature  $y(t)$  of the hot chocolate  $t$  minutes after receiving it is given by  $y(t) = 70(1.071)^{-t} + 15$  degree Celsius. Determine the y-intercept and horizontal asymptote of the exponential model.

Rubrics for Scoring the Transformation and Graph in Items 1 and 2.

	0 Point	1 Point	2 Points	3 Points
Transformation	Learner shows no understanding of using transformations to describe how the graph is related to its base exponential function $y = b^x$ .	Learner shows limited understanding of using transformations to describe how the graph is related to its base exponential function $y = b^x$ .	Learner shows partial understanding of using transformations to describe how the graph is related to its base exponential function $y = b^x$ .	Learner shows thorough understanding of using transformations to describe how the graph is related to its base exponential function $y = b^x$ .
Graph	Learner gives no graph/graph is not accurate.	Learner graphs the function less neatly and organize, and a little accurate.	Learner graphs the function neatly and organized, and accurate.	Learner graphs the function very neatly and organized and very accurate.

Rubrics in Scoring Items 3-5.

	0 Point	1 Point	2 Points	3 Points
Amount of Work	Learner gives no answer.	Learner gives answer but no solution.	Learner gives answer with partial solution.	Learner gives answer with complete solution.
Understanding	The learner shows no understanding in solving the problem.	The learner shows limited understanding in solving the problem.	The learner shows partial understanding in solving the problem.	The learner shows thorough understanding in solving the problem.

Reflection

What did you learn about asymptotes, intercepts and zeroes of exponential functions?

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References

General Mathematics Textbook, Chapter 4: Exponential Functions (Teachers Guide), General Mathematics Textbook, Chapter IV: Exponential Functions (Learner's Materials), eSolutions Manual

## Answer Key:

### Activity 1.

1. y-intercept: **1**  
Horizontal Asymptote:  **$y = 0$**
2. y-intercept: **1**  
Horizontal Asymptote:  **$y = 0$**
3. y-intercept: **-1**  
Horizontal Asymptote:  **$y = 0$**
4. y-intercept: **7**  
Horizontal Asymptote:  **$y = 6$**
5. y-intercept: **3**  
Horizontal Asymptote:  **$y = 0$**

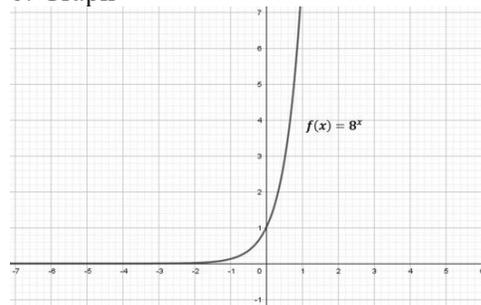
### Activity 2.

1.  $f(x) = 8^x$

a. Table of Values

$x$	-3	-2	-1	0	1	2	3
$f(x) = 8^x$	$\frac{1}{512}$	$\frac{1}{64}$	$\frac{1}{8}$	1	8	64	512

b. Graph



c. Intercepts and Asymptotes

x-intercept: no x-intercept

y-intercept: 1

Horizontal Asymptote:  $y = 0$

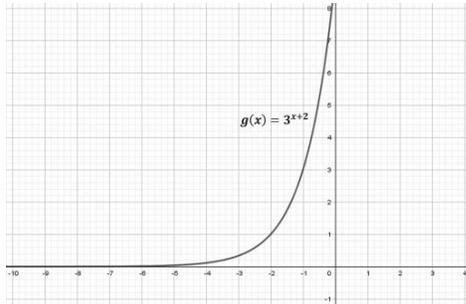
Vertical Asymptote: no vertical asymptote

2.  $g(x) = 3^{x+2}$

a. Table of Values

$x$	-3	-2	-1	0	1	2	3
$g(x) = 3^{x+2}$	$\frac{1}{3}$	1	3	9	27	81	243

b. Graph



c. Intercepts and Asymptotes

x-intercept: no x-intercept

y-intercept: 9

Horizontal Asymptote:  $y = 0$

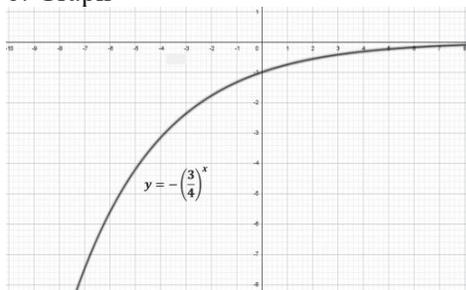
Vertical Asymptote: no vertical asymptote

3.  $y = -\left(\frac{3}{4}\right)^x$

a. Table of Values

$x$	-3	-2	-1	0	1	2	3
$y = -\left(\frac{3}{4}\right)^x$	$-\frac{64}{27}$	$-\frac{16}{9}$	$-\frac{4}{3}$	-1	$-\frac{3}{4}$	$-\frac{9}{16}$	$-\frac{27}{64}$

b. Graph



c. Intercepts and Asymptotes

x-intercept: no x-intercept

y-intercept: -1

Horizontal Asymptote:  $y = 0$

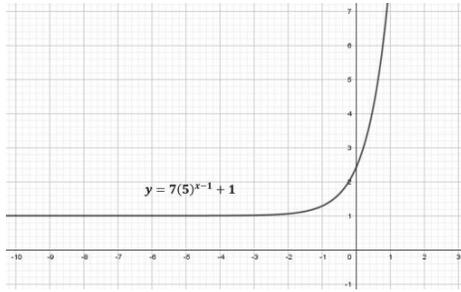
Vertical Asymptote: no vertical asymptote

4.  $y = 7(5)^{x-1} + 1$

a. Table of Values

$x$	-3	-2	-1	0	1	2	3
$y = 7(5)^{x-1} + 1$	$\frac{632}{625}$	$\frac{132}{125}$	$\frac{32}{25}$	$\frac{12}{5}$	8	36	176

b. Graph



c. Intercepts and Asymptotes

x-intercept: no x-intercept

y-intercept:  $\frac{12}{5}$

Horizontal Asymptote:  $y = 1$

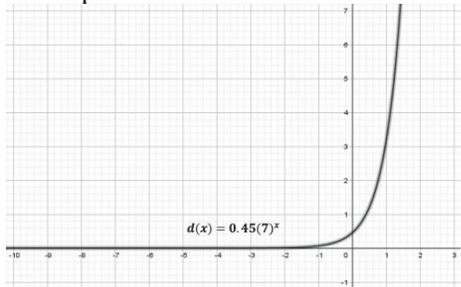
Vertical Asymptote: no vertical asymptote

5.  $d(x) = 0.45(7)^x$

a. Table of Values

$x$	-3	-2	-1	0	1	2	3
$d(x) = 0.45(7)^x$	$\frac{9}{6860}$	$\frac{9}{980}$	$\frac{9}{140}$	$\frac{9}{20}$	$\frac{63}{20}$	$\frac{441}{20}$	$\frac{3087}{20}$

b. Graph



c. Intercepts and Asymptotes

x-intercept: no x-intercept

y-intercept:  $\frac{9}{20}$

Horizontal Asymptote:  $y = 0$

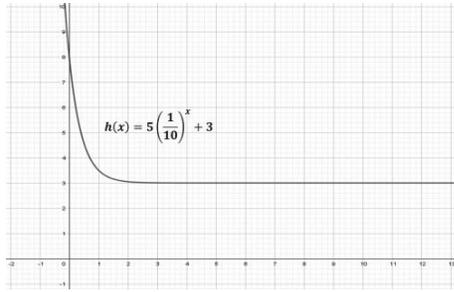
Vertical Asymptote: no vertical asymptote

6.  $h(x) = 5\left(\frac{1}{10}\right)^x + 3$

a. Table of Values

$x$	-3	-2	-1	0	1	2	3
$h(x) = 5\left(\frac{1}{10}\right)^x + 3$	5003	503	53	8	$\frac{7}{2}$	$\frac{61}{20}$	$\frac{601}{200}$

b. Graph



c. Intercepts and Asymptotes

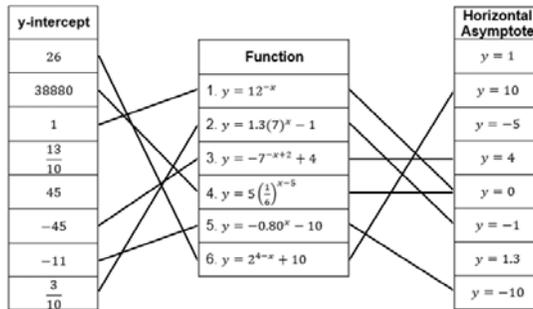
x-intercept: no x-intercept

y-intercept: 8

Horizontal Asymptote:  $y = 3$

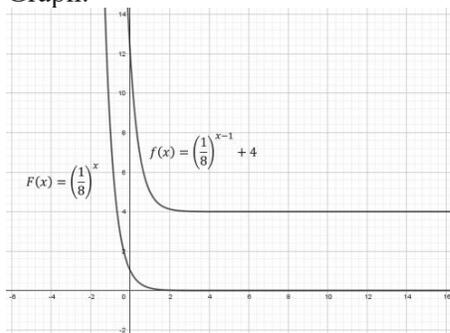
Vertical Asymptote: no vertical asymptote

Activity 3.



Activity 4.

- Transformation: The base function  $F(x) = \left(\frac{1}{8}\right)^x$  will be shifted 1 unit to the right, then it will be shifted 4 units up.  
Graph:

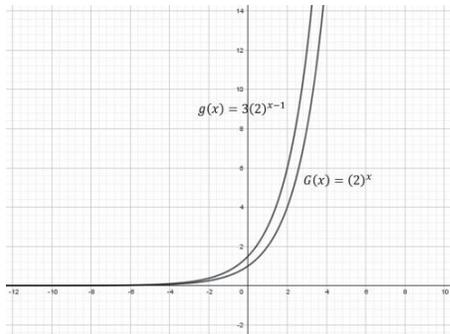


y-intercept: 12

Horizontal Asymptote:  $y = 4$

- Transformation: The base function  $G(x) = 2^x$  will be stretched 3 units (that is every y-value will be multiplied by 3), then it will be shifted 1 unit to the right.

Graph:



y-intercept:  $\frac{3}{2}$   
 Horizontal Asymptote:  $y = 0$

3.  $f(x) = 4(2)^x - 8$
4.  $f(x) = 5^{x+2} + 4$
5. y-intercept: 85  
 Horizontal asymptote:  $y = 15$