

5.1 Graphing Exponential Functions

MATH LAB

5.1 Graphing Exponential Functions

FOCUS Investigate the graphs of exponential functions.

Get Started

Evaluate each power.

$$\begin{array}{l}
 5^3 = 5 \times 5 \times 5 \\
 = 125
 \end{array}
 \quad
 \begin{array}{l}
 2^{-3} = \left(\frac{1}{2}\right)^3 \\
 = \frac{1^3}{2^3} \\
 = \frac{1}{8}
 \end{array}
 \quad
 \begin{array}{l}
 4^0 = 1 \\
 -4^0 = -1 \\
 (-4)^0 = 1
 \end{array}
 \quad
 \begin{array}{l}
 \left(\frac{1}{3}\right)^{-2} = \left(\frac{3}{1}\right)^2 \\
 = \frac{3^2}{1^2} \\
 = \frac{9}{1} \\
 = 9
 \end{array}$$

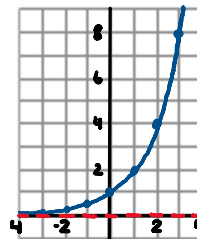
Construct Understanding

A. Complete the table of values for the function $y = 2^x$.

Graph the function.

Describe the graph; include characteristics such as intercepts, equations of the asymptotes, domain, and range.

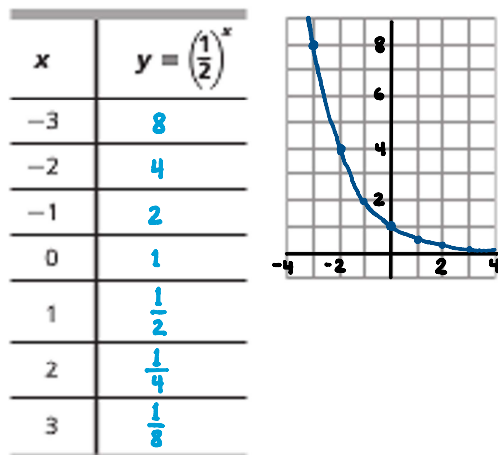
x	$y = 2^x$
-3	$\frac{1}{8}$
-2	$\frac{1}{4}$
-1	$\frac{1}{2}$
0	1
1	2
2	4
3	8



x -intercept: none
 y -intercept: $y = 1$
 asymptote: $y = 0$

domain: $\{x \in \mathbb{R}\}$
 range: $\{y \mid y > 0, y \in \mathbb{R}\}$

B. Repeat Part A for the function $y = \left(\frac{1}{2}\right)^x$.



x-intercept: none
 y-intercept: $y=1$
 asymptote: $y=0$

domain: $\{x \in \mathbb{R}\}$
 range: $\{y \mid y > 0, y \in \mathbb{R}\}$

C. How are the functions in Parts A and B alike? How are they different?

Both functions have the same y-intercept. ($y=1$)
 Both functions are entirely above the x-axis. (no x-intercept)
 Same domain $\{x \in \mathbb{R}\}$ and range $\{y \mid y > 0, y \in \mathbb{R}\}$
 Same asymptote ($y=0$)

The functions are reflections in the y-axis.

$y = 2^x$ rises to the right ; $y = \left(\frac{1}{2}\right)^x$ falls to the right

Assess Your Understanding

DESMOS

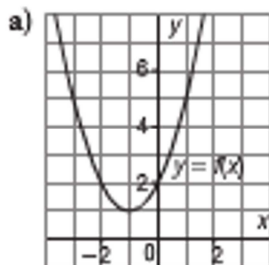
1. Use graphing technology. Graph each function below, then complete the table.

Function	x-intercept	y-intercept	Equation of asymptote	Domain	Range
$y = 4^x$	none	1	$y = 0$	$\{x \in \mathbb{R}\}$	$\{y \mid y > 0, y \in \mathbb{R}\}$
$y = \left(\frac{5}{3}\right)^x$	none	1	$y = 0$	$\{x \in \mathbb{R}\}$	$\{y \mid y > 0, y \in \mathbb{R}\}$
$y = \left(\frac{1}{3}\right)^x$	none	1	$y = 0$	$\{x \in \mathbb{R}\}$	$\{y \mid y > 0, y \in \mathbb{R}\}$
$y = \left(\frac{2}{5}\right)^x$	none	1	$y = 0$	$\{x \in \mathbb{R}\}$	$\{y \mid y > 0, y \in \mathbb{R}\}$

2. The functions in *Construct Understanding* and question 1 are **exponential functions**. Why do you think this name is appropriate?

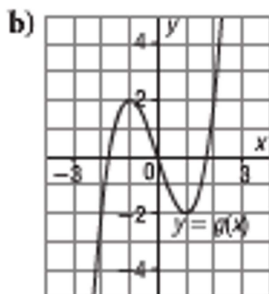
These functions have a variable exponent.

3. The graphs of three functions are shown. Which graphs might represent exponential functions? How do you know?



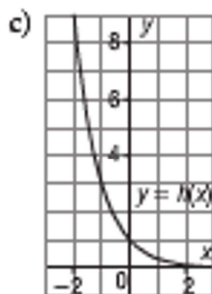
Not exponential – the graph does not continually rise (or continually decrease)

(This is a quadratic function.)



Not exponential

(This is a polynomial function.)



Exponential

- continuous decrease
- asymptote at $y=0$

4. Could each table of values describe an exponential function?

Justify your answer.

a)

x	y
-2	0.01
-1	0.1
0	1
1	10
2	100

*compare each ratio
 Yes, these ratios are the same.

This table represents the function $f(x) = 10^x$.

b)

x	y
-2	25
-1	5
0	1
1	0.2
2	0.04

Yes, this represents an exponential function.

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

c)

x	y
-2	9
-1	4
0	1
1	0
2	1

Because these ratios are different,
 this table does not represent an
 exponential function.

ANSWERS

3. graph c 4. a) yes b) yes c) no

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