

Exponential Functions and Their Graphs

Precalculus

Students will review the properties of common, base 10, and natural logarithmic functions and their graphs.

KEY

How do you transform the graphs of exponential functions?

Transforming Graphs

	Equation	Description
Vertical Translation (shift) $(x, y \pm c)$	$y = f(x) + c$ or $y = f(x) - c$	The function, $f(x)$, is shifted up (+) or (-) by a distance of "c".
Horizontal Translation (shift) $(x \pm c, y)$	$y = f(x+c)$ or $y = f(x-c)$	The function is shifted left (+) or right (-) "c" units.
Reflection $(-x, -y)$	$y = -f(x)$ or $y = f(-x)$	The function reflects over the x-axis ($-f(x)$) or the y-axis ($f(-x)$)
Vertical Stretch or Shrink (x, cy)	$y = c f(x)$	IF $c > 1$, $f(x)$ stretches vertically. IF $0 < c < 1$, $f(x)$ shrinks vertically.
Horizontal Stretch or Shrink $(\frac{x}{c}, y)$	$y = f(cx)$	IF $c > 1$, $f(x)$ shrinks horizontally. IF $0 < c < 1$, $f(x)$ stretches horizontally.

Exponential Functions and Their Graphs

Precalculus

Students will review the properties of common, base 10, and natural logarithmic functions and their graphs.

Example 1: Describe how to transform the graph of $f(x) = e^x$ into the graphs of the given functions:

a. $g(x) = 3e^x$ ($x, 3y$)

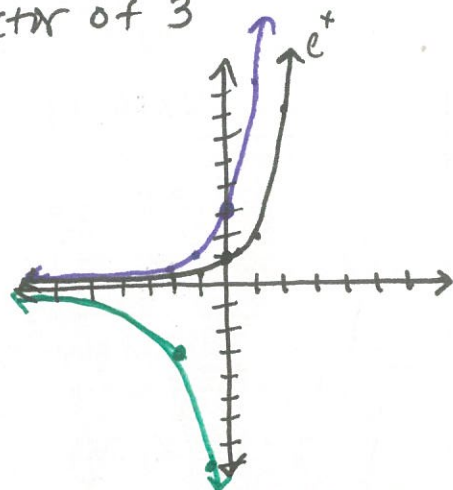
$(0, 1) \rightarrow (0, 3)$
 $(1, 2.7...) \rightarrow (1, 7...)$
 $(2, 7.3) \rightarrow (2, 21...)$
 The graph of e^x is stretched vertically by a factor of 3.

b. $h(x) = 3e^{-x}$

- Vertical stretch by factor of 3
- Reflect over y-axis

c. $k(x) = -3e^{x+2}$ ($x-2, -3y$)

- Vertical stretch...
- Reflect over x-axis
- Left 2 units



$(-2, -3)$
 $(-1, -8...)$
 $(0, -22...)$

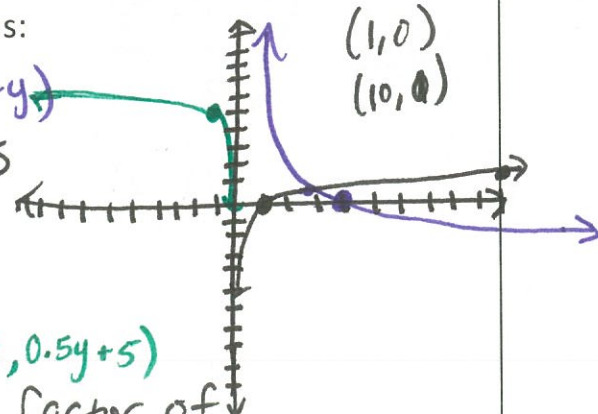
Example 2: Describe how to transform the graph of $f(x) = \log x$ into the graphs of the given functions:

a. $g(x) = -\log(x-3)$ ($x+3, -y$)

- $(4, 0)$ - Reflect over x-axis
- $(13, -1)$ - Right 3 units

b. $h(x) = 0.5 \log(-x) + 5$ ($-x, 0.5y+5$)

- $(-1, 5)$ - Vertical shrink by factor of 0.5
- $(-10, 5.5)$ - Reflect over y-axis
- up 5 units



Day 2

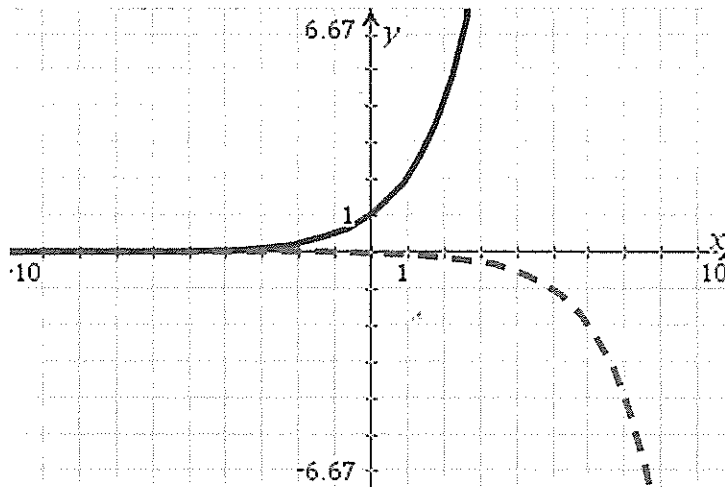
Exponential Functions and Their Graphs

Precalculus

Students will review the properties of common, base 10, and natural logarithmic functions and their graphs.

Example 3: Given the graph below, determine transformations that have occurred and write the new equation. (Original is solid)

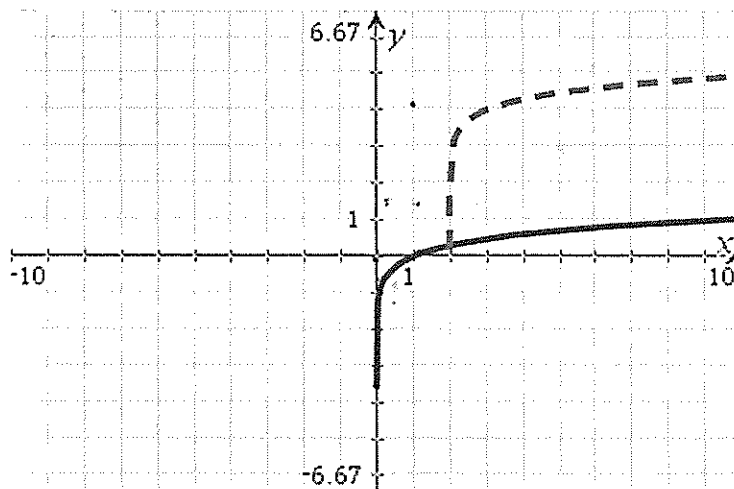
a. $f(x) = 2^x$ $g(x) = \underline{-2^{x-5}}$



- Reflect over x

- Right 5 units

b. $f(x) = \log(x)$ $g(x) = \underline{\log(x-2)+4}$



- Right 2

- Up 4

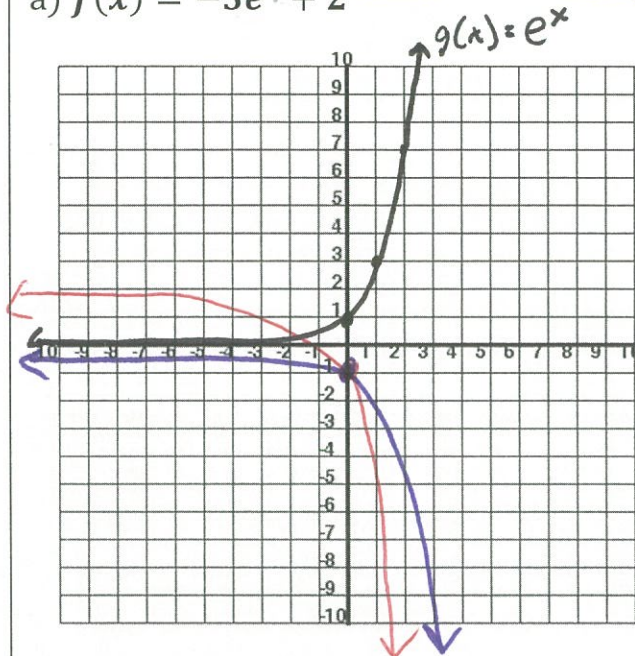
Exponential Functions and Their Graphs

Precalculus

Students will review the properties of common, base 10, and natural logarithmic functions and their graphs.

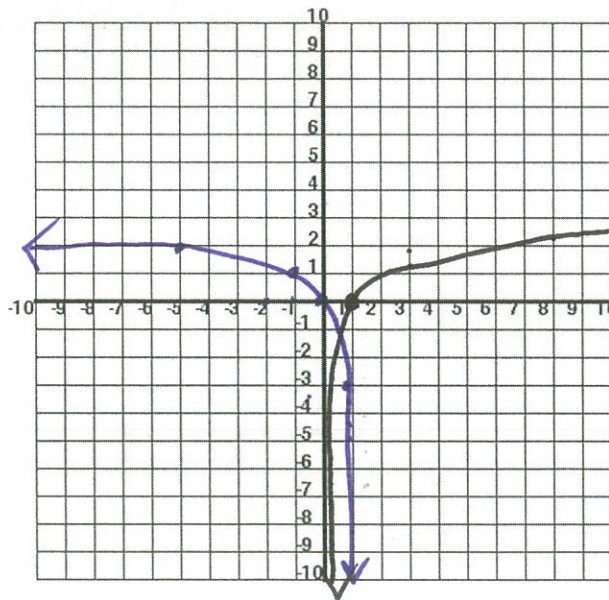
Example 3.4 Graph the function and analyze it for domain, range, asymptotes, intercepts and end behavior.

a) $f(x) = -3e^x + 2$



→ Reflect over x
vert. stretch by 3
up 2
 $(0, 1) \rightarrow (0, -3x+2)$
* Red is right

a) $f(x) = \ln(-x + 1)$



→ Reflect over y
left 1
 $(1, 0) \rightarrow (-x-1, y)$

Horizontal
* ← first
then reflect