

# D6 - Translating and Reflecting Exponential Functions

April 11, 2018 3:19 PM



## MCR 3UI - U4 - D6 - Translating and Reflecting Exponent...

Warm Up:

$$a) \left(\frac{2x^{-3}}{x^4}\right)^{-5} = \left(\frac{x^7}{2}\right)^5 = \frac{x^{35}}{32}$$

$$b) \sqrt[3]{125a^6b^{-4}} = (125a^6b^{-4})^{\frac{1}{3}} = 125^{\frac{1}{3}} a^{\frac{6}{3}} b^{-\frac{4}{3}} = \sqrt[3]{125} a^2 b^{-\frac{4}{3}} = \frac{5a^2}{b^{\frac{4}{3}}}$$

MCR3UI

### TRANSLATIONS AND REFLECTIONS OF EXPONENTIAL FUNCTIONS

U4D6

Warm Up:

Describe the transformations that have occurred to  $f(x)$  to obtain the following function:

$$y = -f(x+3) - 7$$

- reflect in x-axis  
- shift left 3  
- shift down 7

If  $f(x) = \frac{1}{x}$ , what would be the horizontal and vertical asymptote equations for the transformed function above? HA:  $y = -7$  VA:  $x = -3$

#### Translations and Reflections of Exponential Functions

1. Each function given below is a translation and/or reflection of the exponential function  $f(x) = 3^x$ . For each of these transformations, write the equation as a transformation of  $f(x) = 3^x$  in function notation. Then, describe how  $f(x) = 3^x$  should be shifted and/or reflected to obtain the new graph of the transformed function.

| Function                      | $y = 3^{x+1}$ | $y = 3^{x-2}$  | $y = 3^{x+4}$ |
|-------------------------------|---------------|----------------|---------------|
| Function Notation             | $y = f(x+1)$  | $y = f(x-2)$   | $y = f(x+4)$  |
| Description of Transformation | shift up 1    | sh. ft right 2 | sh. ft left 4 |

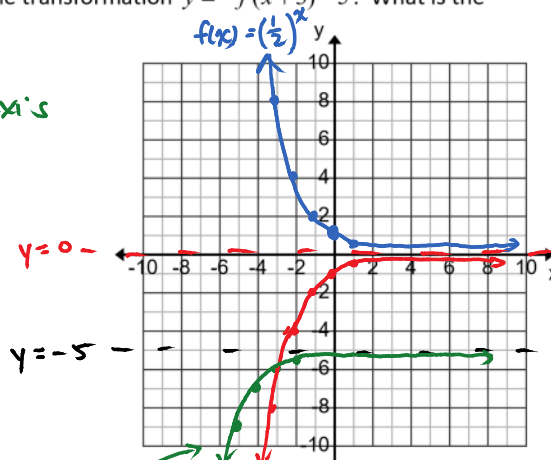
| Function                      | $y = -3^x$        | $y = 3^{-x}$      | $y = -3^{x+3} - 1$                          |
|-------------------------------|-------------------|-------------------|---|
| Function Notation             | $y = -f(x)$       | $y = f(-x)$       | $y = -f(x+3) - 1$                           |
| Description of Transformation | reflect in x-axis | reflect in y-axis | - reflect in x-axis<br>- left 3<br>- down 1 |

2. Draw the graph of  $f(x) = \left(\frac{1}{2}\right)^x$  and the transformation  $y = -f(x+3) - 5$ . What is the equation of the transformed function?

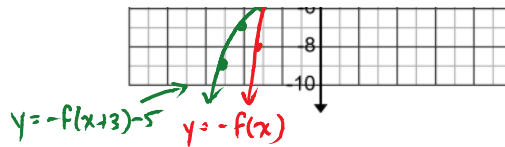
| x  | y             |
|----|---------------|
| -3 | 8             |
| -2 | 4             |
| -1 | 2             |
| 0  | 1             |
| 1  | $\frac{1}{2}$ |

- reflect in x-axis  
- shift left 3  
- down 5

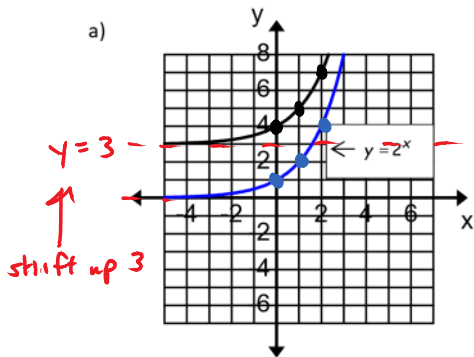
$$y = -\left(\frac{1}{2}\right)^{x+3} - 5$$



$$y = -\left(\frac{1}{2}\right)^{x+3} - 5$$

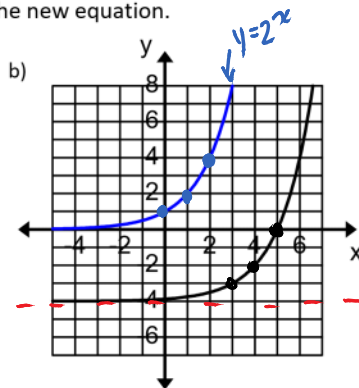


3. Given the original graph  $y = 2^x$  and each of the following four transformations, Describe each of the transformations and write the new equation.



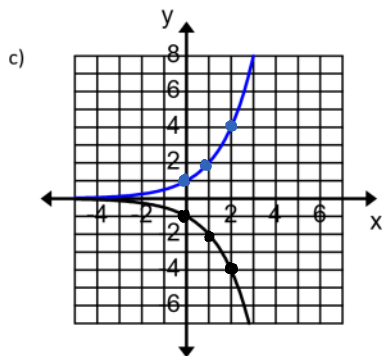
Description: *shift up 3*

New Equation:  $y = 2^x + 3$



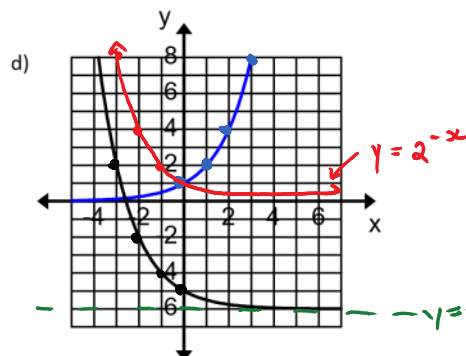
Description: *- shift down 4  
- shift right 3*

New Equation:  $y = 2^{x-3} - 4$



Description: *reflection in x-axis*

New Equation:  $y = -2^x$



Description: *reflection in y-axis  
shift down 6*

New Equation:  $y = 2^{-x} - 6$

General Equation of Exponential Functions:

$$y = ab^{k(x-d)} + c$$

$a < 0 \Rightarrow$  reflection in x-axis

$k < 0 \Rightarrow$  reflection in y-axis

$d \Rightarrow$  shift right/left ( $d > 0 \Rightarrow$  right,  $d < 0 \Rightarrow$  left)

$c \Rightarrow$  shift up/down ( $c > 0 \Rightarrow$  up,  $c < 0 \Rightarrow$  down)