

Day 2 – Transformations of Exponential Functions

Transformations of exponential functions is very similar to transformations with quadratic functions. Do you remember what a, h, and k do to the quadratic function?

A: shrink/stretch - reflect H: ← → K: ↑ ↓

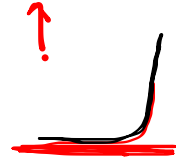
Summary of Exponential Transformations

The general form of an exponential function is:

$f(x) = a(b)^{x-h} + k$

*When your graph is shifted vertically, the y-intercept becomes $a + k$.

*When the graph is shifted vertically, the asymptote becomes $y = k$.



If **a** is **negative**, the graph...
reflect

If **h** is **positive**, the graph... →
In the equation, I would see... $X - h$
If **h** is **negative**, the graph... ←
In the equation, I would see... $X + h$

$y = a(b)^{x-h} + k$

Handwritten notes: 'a' is circled in green, 'b' is circled in green, 'x-h' is circled in red, and 'k' is boxed. A red arrow points to 'b' with the label 'hyp'.

If **a** is **between 0 and 1**, the graph...
shrink
Grows slow

If **a** is **greater than 1**, the graph...
stretch
Grows fast

If **b** is **greater than 1**...
grow
If **b** is **between 0 & 1**...
decay

If **k** is **positive**, the graph...
↑ up
If **k** is **negative**, the graph...
↓ down
Asymptote: $y = k$

Practice Identifying Transformations

Example: Describe the transformations from the parent function to the transformed function:

A. $f(x) = 3^x \rightarrow f(x) = 3^{x+3} + 0$

$-a: +$
 $h: -3 = \text{left } 3$
 $k: 0$

D. $f(x) = 3^x \rightarrow f(x) = \frac{3}{4}(3)^{x-2}$

$a: \frac{3}{4} = \text{shrink}$
 $h: +2 \rightarrow 2$

B. $y = (5)^x \rightarrow y = \frac{1}{2}(5)^{x-4}$

$a: \frac{1}{2} \text{ shrink}$
 $k: -4 \downarrow 4$

E. $y = 5^x \rightarrow y = -\frac{1}{2}(5)^{x-2}$

$a: -\frac{1}{2}: \text{reflect shrink}$
 $h: -2: \text{left } 2$

C. $y = (0.4)^x \rightarrow y = -3(0.4)^{x+8}$

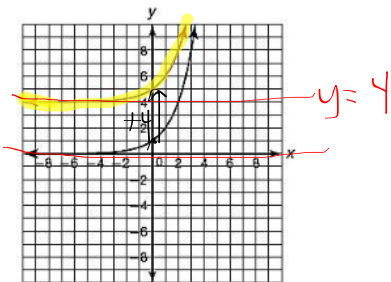
$a: - \text{reflect}$
 3 stretch
 $k: +8 \uparrow 8$

F. $y = 0.4^x \rightarrow y = 2(0.4)^{x-6}$

$a: 2 \text{ stretch}$
 $k: -6 \downarrow 6 \text{ units}$

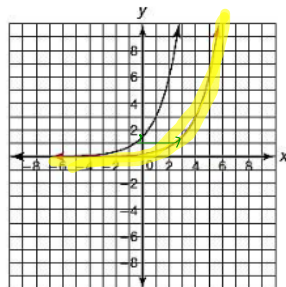
Example: Using the graphs of $f(x)$ and $g(x)$, described the transformations from $f(x)$ to $g(x)$:

A.



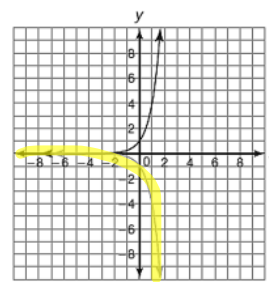
$k: +4$

B.



$h: +3$

C.



$a: -$

Example: Using the function $g(x) = 5^x$, create a new function $h(x)$ given the following transformations:

A. up 4 units

$h(x) = 5^x + 4$

D. stretch by 3

$y = 3(5)^x$

B. left 2 units

$y = 5^{x+2}$

E. reflect over x-axis and left 3

$y = -5^{x+3}$

C. down 7 units and right 3 units

$y = 5^{x-3} - 7$

F. Shrink by $\frac{1}{2}$ and reflect over x-axis

$y = -\frac{1}{2}(5)^x$

$y = a \cdot b^{x-h} + k$

$y = k$