Algebra 1 Unit 5: Comparing Linear, Quadratic, and Exponential Functions Notes

Day 3 – Function Transformations

Standard(s): MGSE9-12.F.BF.3
Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. (Focus on vertical translations of graphs of linear and exponential functions. Relate the vertical translation of a linear function to its y-intercept.)

Function Notation	Transformation	Function Rule (from $f(x)=x^2$)
h $f(x + k)$	shift/translation left k units	$f(x) = (x + k)^2$ h
h $f(x - k)$	shift/translation right k units	$f(x) = (x - k)^2$ h
$f(x) + k$	shift/translation up k units	$f(x) = x^2 + k$
$f(x) - k$	shift/translation down k units	$f(x) = x^2 - k$
a $kf(x)$ where $k > 1$	vertical stretch	$f(x) = kx^2$ a
a $kf(x)$ where $k < 1$	vertical shrink/compression	$f(x) = kx^2$ a
a $-f(x)$	reflection over x-axis	$f(x) = -x^2$ a

$f(-x)$ – reflect over y-axis

h

1. Suppose the generic function f(x) is transformed such that $g(x) = f(x - 2)$. What transformation best describes the transformation of f(x) to generate g(x)?

Shift right by 2 units.

a h k

2. Consider the parent function $f(x) = x^2$. The graph of the function $g(x) = -(x + 3)^2 + 5$ is the same as the function f(x) after what transformations?

① Reflects over x-axis
② Shift left by 3 units
③ Shift up by 5 units

3. Consider the parent function $f(x) = x^2$. What would be the function rule for g(x) if the graph of g(x) is the same as f(x) after being transformed in the following ways: vertically stretched by a factor of 2, a
h translated left 5 units and down 6 units? k

$$g(x) = 2(x+5)^2 - 6$$

4. Think about the function $f(x) = (x+4)^2 - 7$. What would be the function rule for g(x) if it is translated
h left 2 units and down 3 units? k

$$g(x) = (x+6)^2 - 10$$

8

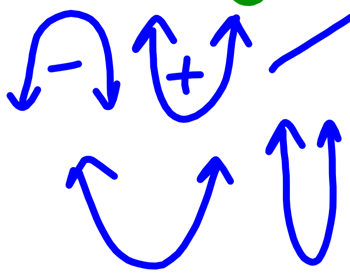
$$y = a(x-h)^2 + k$$

up $+$

$-$ down

left $+$

right $-$



$a > 1$
Vertical stretch

$0 < a < 1$
Vertical compress

These transformations is the same for all three functions.

$y = 2^x + 3$ — Asymptote

5. Think about what the asymptote would be for the function $f(x) = 2^x$. What would be the asymptote of the function $g(x) = 2^x - 4$

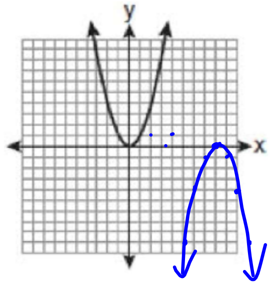
$y=0$

$y=-4$

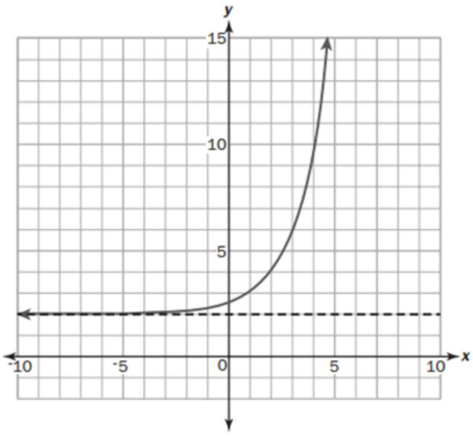
6. The graph to th[illegible]ows the function f(x). Graph $-f(x-5)$.

a h

- shift right by 5 units
- Reflects over x-axis



7. **Look at the graph.**



Which equation represents this graph?

A. $y = 2^{(x+1)} - 2$
B. $y = 2^{(x-1)} + 2$
C. $y = 2^{(x+2)} - 1$
D. $y = 2^{(x-2)} + 1$

$y=2$

h

8. **Which function shows the function $f(x) = 3^x$ being translated 5 units to the left?**

A. $f(x) = 3^x - 5$
B. $f(x) = 3^{(x+5)}$
C. $f(x) = 3^{(x-5)}$
D. $f(x) = 3^x + 5$

k

9. **Which function shows the function $f(x) = 3^x$ being translated 5 units down?**

A. $f(x) = 3^x - 5$
B. $f(x) = 3^{(x+5)}$
C. $f(x) = 3^{(x-5)}$
D. $f(x) = 3^x + 5$

h

10. **Which statement BEST describes the graph of $f(x + 6)$?**

A. The graph of $f(x)$ is shifted up 6 units.
B. The graph of $f(x)$ is shifted left 6 units.
C. The graph of $f(x)$ is shifted right 6 units.
D. The graph of $f(x)$ is shifted down 6 units.

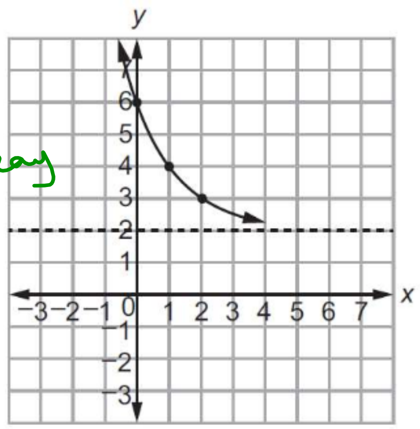
9

11. **Which statement BEST describes how the graph of $g(x) = -3x^2$ compares to the graph of $f(x) = x^2$?**

A. The graph of $g(x)$ is a vertical stretch of $f(x)$ by a factor of 3.
B. The graph of $g(x)$ is a reflection of $f(x)$ across the x-axis.
C. The graph of $g(x)$ is a vertical shrink of $f(x)$ by a factor of $\frac{1}{3}$ and a reflection across the x-axis.
D. The graph of $g(x)$ is a vertical stretch of $f(x)$ by a factor of 3 and a reflection across the x-axis.

12. **The graph of the exponential function $f(x) = 4(0.5)^x + 2$ is shown.**

decay



Part A

Which function has the same end behavior as $f(x)$ for large, positive values of x?

~~A.~~ $g(x) = 4(1.1)^x + 3$
B. $g(x) = 0.5(1.1)^x + 2$ — growth
~~C.~~ $g(x) = 4(0.8)^x + 3$
D. $g(x) = 0.5(0.8)^x + 2$ — decay

Part B

Which function's graph has a y-intercept of 1?

when $x = 0$

A. $h(x) = 5(2)^x$
B. $h(x) = 5(0.5)^x + 0.5$
C. $h(x) = (0.5)^x + 1$
D. $h(x) = 0.5(2)^x + 0.5$

$h(0) = 5(2)^0 = 5$
$h(0) = 5(0.5)^0 + 0.5 = 5.5$
$h(0) = (0.5)^0 + 1 = 2$
$h(0) = 0.5(2)^0 + 0.5 = 1$