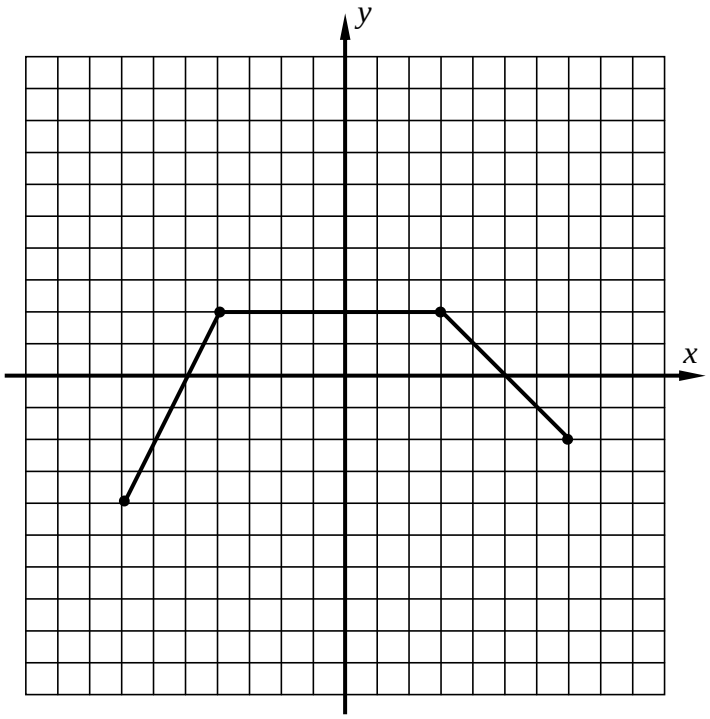
Name: _____ Date: _____

FUNCTION TRANSFORMATIONS
COMMON CORE ALGEBRA I

We have transformed many functions this year by **shifting them** and **stretching them**. These transformations occur on a general basis and we will explore them in the next two lessons by looking almost exclusively at functions defined graphically. Still, we will rely heavily on function notation.

***Exercise* #1:** The function $y = f(x)$ is defined by the graph below. Answer questions based on this definition. Selected points are marked on the graph.



(a) Evaluate each of the following:

$f(3) =$ $f(7) =$

$f(-4) =$ $f(-7) =$

(b) State the zeroes of $f(x)$.

(c) Why is it impossible to evaluate $f(9)$?

(d) State the domain and range of $f(x)$.

Domain: Range:

O.k. Now that we have a bit of a feel for $f(x)$ we are going to start to create other functions by **transforming** the function *f*.

***Exercise* #2:** Let's now define the function $g(x)$ by the formula $g(x) = 2f(x)$.

(a) Evaluate each of the following. Show the work that leads to your answer. Remember, just follow the function's rule.

$g(-7) =$ $g(-4) =$

$g(3) =$ $g(7) =$

(b) How can you interpret the function rule in terms of the graph of $f(x)$?

(c) Sketch a graph of $g(x)$ on the grid above in Exercise #1. Write down points that you know are on $g(x)$ based on your answers to (a).

(d) State the domain and range of the function $g(x)$.

Domain: Range:

So, we see from the last exercise that when a function gets multiplied by a constant, all of the *y*-values get multiplied by the same constant. This has the effect of "stretching" a function.

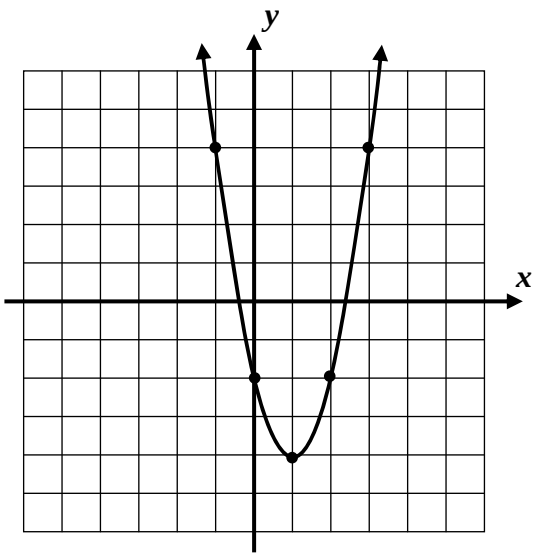
VERTICAL STRETCH

If the function $g(x)$ is defined by $g(x) = k \cdot f(x)$, then the graph of *g* will be stretched (or compressed) depending on the value of *k*. If *k* is negative, it will also **reflect** the function across the *x*-axis.

Exercise #3: A quadratic $f(x)$ is shown below. The function $g(x)$ is defined by $g(x) = -\frac{1}{2} f(x)$.

(a) Calculate the values of $g(0)$ and $g(3)$. Show your work.

Explain the effect of multiplying by $-\frac{1}{2}$.



(b) Sketch an accurate graph of $g(x)$ on the same grid as $f(x)$.

(c) State the range of $g(x)$.

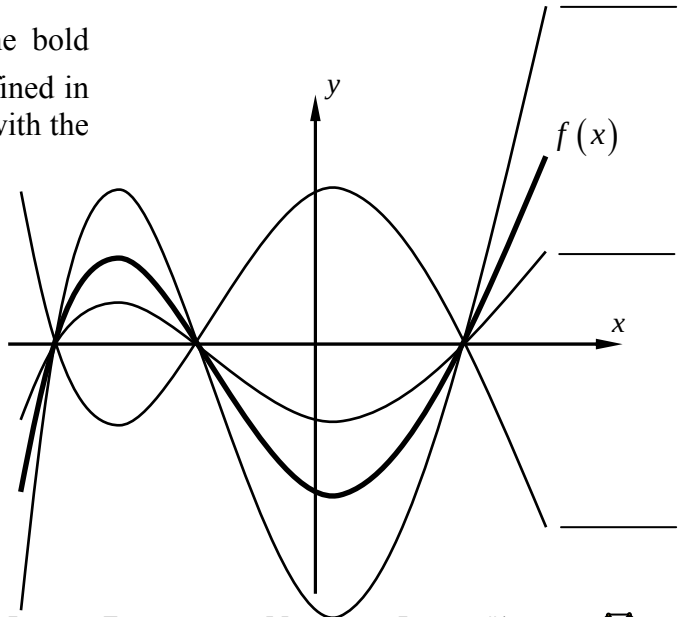
Let's do one final problem to see how well you understand what happens to the graph of a function when it has been multiplied by a constant.

Exercise #4: The function $f(x)$ is graphed as the bold curve shown below. Three other functions are all defined in terms of *f* and are graphed as well. Label each curve with the appropriate function.

$g(x) = \frac{1}{2} f(x)$

$h(x) = -f(x)$

$k(x) = 2f(x)$



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FUNCTION TRANSFORMATIONS
COMMON CORE ALGEBRA I HOMEWORK

FLUENCY

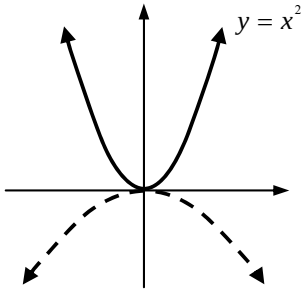
1. Given the function $f(x)$ shown in the table below, which of the following represents the value of $g(4)$ given that $g(x)=5f(x)+1$?

x	$f(x)$
2	−8
3	−1
4	3
5	7

(1) 16 (3) 35

(2) 40 (4) 0

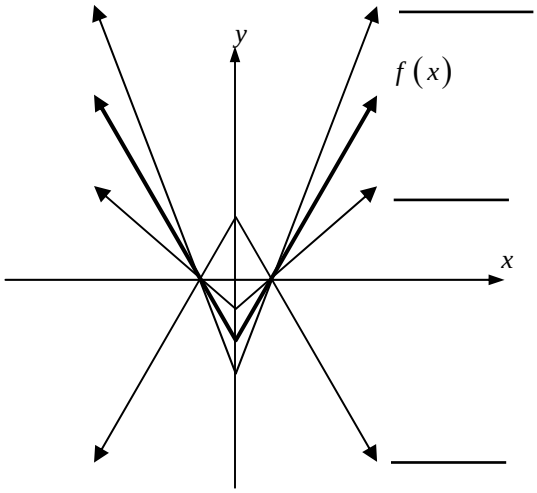
2. The graph of $y=x^2$ is shown below in bold and labeled. Which of the following could be the equation of the graph shown in dashed?



(1) $y=2x^2$ (3) $y=\frac{1}{3}x^2$

(2) $y=-\frac{1}{2}x^2$ (4) $y=-4x^2$

3. The graph of $f(x)$ is shown below in bold. Three other equations of functions are also given. Match each equation with the appropriate graph.



$g(x)=-f(x)$

$h(x)=\frac{3}{2}f(x)$

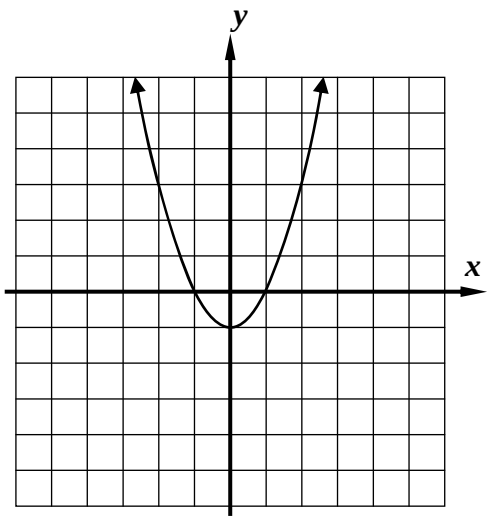
$k(x)=\frac{1}{2}f(x)$

4. The function $f(x)$ has x-intercepts of -3 and 5 and a y-intercept of 4. If $g(x)=3f(x)$, then which of the following will be true about the graph of $g(x)$?

(1) It will have x-intercepts of -9 and 15 and a y-intercept of 12.
(2) It will have x-intercepts of -3 and 5 and a y-intercept of 12.
(3) It will have x-intercepts of -9 and 15 and a y-intercept of 4.
(4) It will have x-intercepts of 0 and 8 and a y-intercept of 7.

5. The quadratic function $f(x) = x^2 - 1$ is shown graphed on the grid below. Two additional functions are defined as:

$$g(x) = 2f(x) \quad \text{and} \quad h(x) = f(x) + 2$$



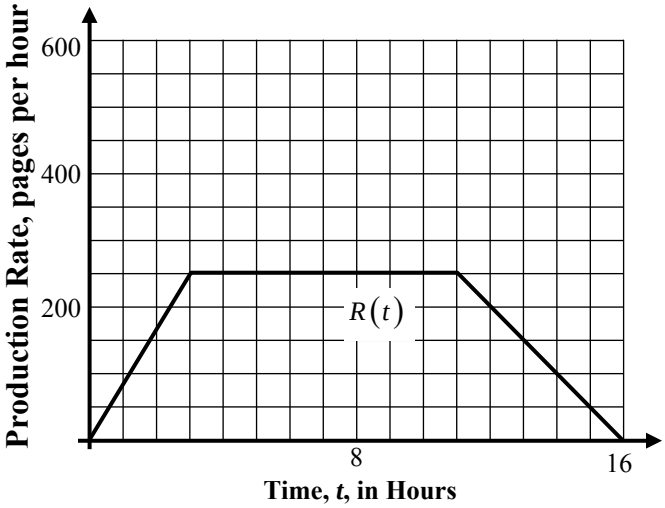
(a) Graph $g(x)$ on the grid and label it. What is the effect of multiplying $f(x)$ by 2?

(b) Graph $h(x)$ on the grid and label it. What is the effect of adding 2 to $f(x)$?

6. Find equations for the functions $g(x)$ and $h(x)$ in terms of x.

APPLICATIONS

7. A factory operated a printing press that produced pages of text at a rate that rises over the span of a 16 hour schedule, plateaus and then decreases. The rate can be modeled by the function $R(t)$ shown.



If the factory adds another printing press of the same size, it will now have a production rate of:

$$2R(t)$$

Graph the factory's new rate on the same grid.

What is the peak rate of the factory after it adds the second printing press? For how many hours does it maintain this peak rate?

REASONING

8. If both a vertical stretch and a vertical shift occurred to a function in the form of $a \cdot f(x) + k$, which transformation occurred first? How can you tell?