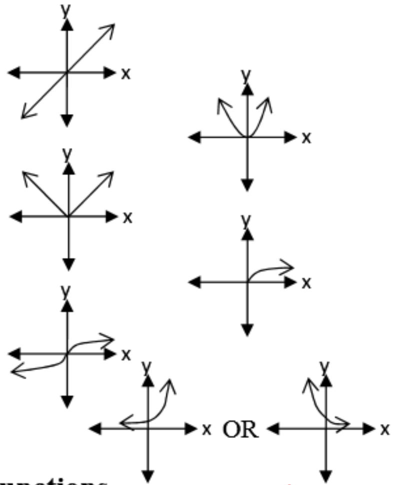
Pg. 119-122 (Green Review Book)

Name ______________ Date ________ Class__________ Regents Review # ___
Algebra 1

Transformations with Various Functions

Parent Functions:

- Linear: $y = x$ $f(x) = x$
- Quadratic: $y = x^2$ $f(x) = x^2$
- Absolute Value: $y = |x|$ $f(x) = |x|$
- Square Root: $y = \sqrt{x}$ $f(x) = \sqrt{x}$
- Cube Root: $y = \sqrt[3]{x}$ $f(x) = \sqrt[3]{x}$
- Exponential: $y = a^x$ $f(x) = a^x$



Translations of the Parent Functions

Abs. Val. — Math → Num → 1: Abs

The vertex or y-intercept can shift from the origin (0, 0) left or right and/or up or down.

$y = \sqrt{x+4}$ $y = \sqrt{x-h}$ $y = \sqrt{x+(+4)}$

Vertical Translations-

Rule: If you *add* k ($k > 0$) to a function, the function will shift k units UP.

$y = f(x) + k$ Write each of these parent functions after a translation where $k = 4$.

Linear	Quadratic	Absolute Value	Square Root	Cube Root
	$y=x^2+4$	$y=\|x\|+4$	$y=\sqrt{x}+4$	

Rule: If you *subtract* k ($k > 0$) to a function, the function will shift k units DOWN.

$y = f(x) - k$ Write each of these parent functions after a translation where $k = 7$.

Linear	Quadratic	Absolute Value	Square Root	Cube Root
	$y=x^2-7$	$y=\|x\|-7$	$y=\sqrt{x}-7$	

Horizontal Translations-

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

Rule: If you *add* h ($h > 0$) to a function, the function will shift h units LEFT.

$y = f(x + h)$ Write each of these parent functions after a translation where $h = 2$.

Quadratic	Absolute Value	Square Root	Cube Root
$y=(x+2)^2$	$y=\|x+2\|$	$y=\sqrt{x+2}$	

Rule: If you *subtract* h ($h > 0$) to a function, the function will shift h units RIGHT.

$y = f(x - h)$ Write each of these parent functions after a translation where $h = 9$.

Quadratic	Absolute Value	Square Root	Cube Root
$y=(x-9)^2$	$y=\|x-9\|$	$y=\sqrt{x-9}$	$y=\sqrt[3]{x-9}$

$2000

(35)

Let x = Adv. tickets
Let y = Door tickets

$x + y \leq 200$
$50 + y \leq 200$
$-50 \qquad -50$
$y \leq 150$

$8.5x + 12y \geq 1000$
$8.5(50) + 12y \geq 1000$
$425 + 12y \geq 1000$
$-425 \qquad -425$
$\frac{12y}{12} \geq \frac{575}{12}$
$y \geq 47.92$
48 tickets

36

$$0 = 64x^2 + 16x - 3$$

$$16x = 2B \quad \frac{16x}{2} = \frac{2B}{2} \quad 8x = B$$

$$\sqrt{B^2} = \sqrt{64x^2} \quad B = 8x$$

$$0 = B^2 + 2B - 3$$

$$0 = (B+3)(B-1)$$

$$B + 3 = 0 \quad | \quad B - 1 = 0$$

$$B = -3 \quad | \quad B = 1$$

$$B = 8x$$

$$\frac{8x}{8} = \frac{-3}{8} \quad | \quad \frac{8x}{8} = \frac{1}{8}$$

$$x = -3/8 \qquad x = \frac{1}{8}$$

Write the new function after each translation described.

1) The graph of the function $y = |x|$ undergoes a translation of 6 units left and 5 units up. What is the new function?

2) The graph of the function $f(x) = x^2$ undergoes a translation of 2 units right and 7 units down. What is the new function?

3) The graph of the function $f(x) = \sqrt{x}$ undergoes a translation of 4 units left and 10 units down. What is the new function?

4) The graph of the function $y = \sqrt[3]{x}$ undergoes a translation of 5 units right and 8 units up. What is the new function?

Horiz. Scaling

$f(3x)$: Horiz. Comp.

$f(\frac{1}{3}x)$: Horiz. Stretch

Scaling of the Parent Functions

The shape of the function is vertically stretched/ made narrower or compressed/ made wider

Rule: If you *multiply* a function by a value *greater than 1* ($a > 1$), the function will become NARROWER (vertically *stretched* by a scale factor a).

$\boxed{x}^2$

$(3x)^2$

Horiz. Comp.

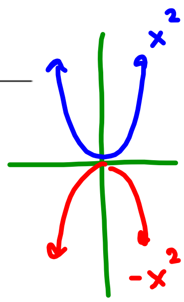
$y = a \cdot f(x)$ Write each of these parent functions after a vertical scaling where $a = 3$.

Linear	Quadratic	Absolute Value	Square Root	Cube Root
	$y = 3 \cdot x^2$	$y = 3 \cdot \lvert x \rvert$	$y = 3 \cdot \sqrt{x}$	

Rule: If you *multiply* a function by a value *between 0 and 1* ($0 < a < 1$), the function will become WIDER (vertically *compressed* by a scale factor a).

$y = a \cdot f(x)$ Write each of these parent functions after a vertical scaling where $a = ½$.

Linear	Quadratic	Absolute Value	Square Root	Cube Root
	$y = \frac{1}{2}x^2$	$y = \frac{1}{2}\lvert x \rvert$	$y = \frac{1}{2}\sqrt{x}$	



Reflecting the Parent Functions

Rule: If you *multiply* a function by "-1", the function will *reflect over the x-axis*

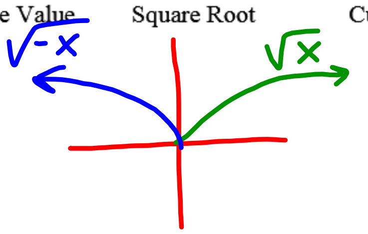
$y = -f(x)$ Write each of these parent functions after a reflection over the x-axis.

Linear	Quadratic	Absolute Value	Square Root	Cube Root
	$y = -x^2$	$y = -\lvert x \rvert$	$y = -\sqrt{x}$	

Rule: If you *multiply* "x" in a function by "-1", the function will *reflect over the y-axis*.

$y = f(-x)$ Write each of these parent functions after a reflection over the y-axis.

Linear	Quadratic	Absolute Value	Square Root	Cube Root
	$y = (-x)^2$	$y = \lvert -x \rvert$	$y = \sqrt{-x}$	



$\sqrt{x} - 3$

Write each function after the transformation(s) described.

1) The graph of the function $y = x^2$ is vertically stretched (made narrower) by a scale factor of 4. What is the new function?

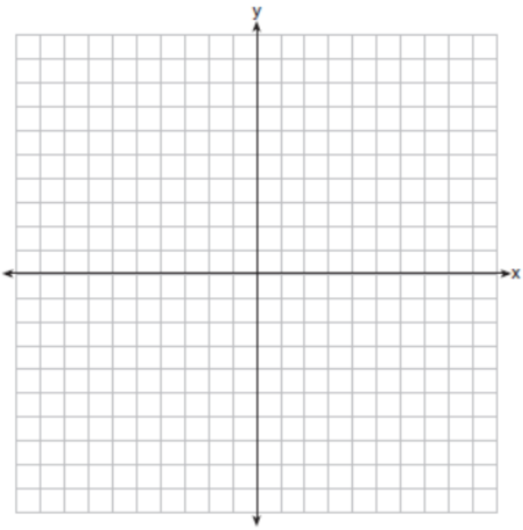
2) The graph of the function $f(x) = |x|$ is vertically compressed (made wider) by a scale factor of $\frac{2}{3}$. What is the new function?

3) The graph of the function $y = \sqrt{x}$ is vertically stretched by a scale factor of $\frac{1}{4}$ and reflected across the x-axis. What is the new function?

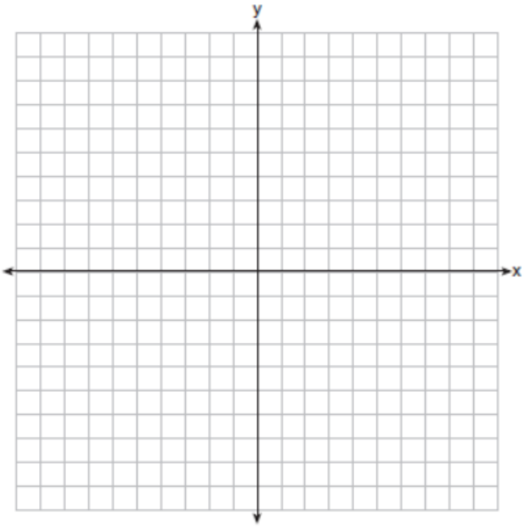
4) The graph of the function $f(x) = \sqrt[3]{x}$ is vertically compressed by a scale factor of 7 and reflected across the x-axis. What is the new function?

Answer the following extended response regents questions.

1. The vertex of the parabola represented by $f(x) = x^2 - 4x + 3$ has coordinates (2, –1). Find the coordinates of the vertex of the parabola defined by $g(x) = f(x - 2)$. Explain how you arrived at your answer. [The use of the set of axes below is optional.]



2. On the axes below, graph $f(x) = |3x|$.

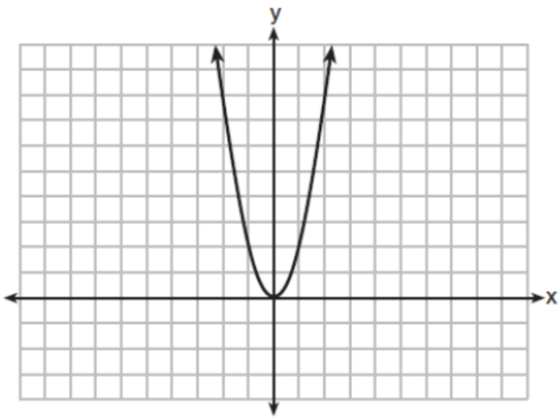


If $g(x) = f(x) - 2$, how is the graph of $f(x)$ translated to form the graph of $g(x)$?

If $h(x) = f(x - 4)$, how is the graph of $f(x)$ translated to form the graph of $h(x)$?

Multiple choice regents questions.

3. The graph of the equation $y = ax^2$ is shown below.



If a is multiplied by $-\frac{1}{2}$, the graph of the new equation is

(1) wider and opens downward
(2) wider and opens upward
(3) narrower and opens downward
(4) narrower and opens upward

4. How does the graph of $f(x) = 3(x-2)^2 + 1$ compare to the graph of $g(x) = x^2$?

(1) The graph of $f(x)$ is wider than the graph of $g(x)$, and its vertex is moved to the left 2 units and up 1 unit.

(2) The graph of $f(x)$ is narrower than the graph of $g(x)$, and its vertex is moved to the right 2 units and up 1 unit.

(3) The graph of $f(x)$ is narrower than the graph of $g(x)$, and its vertex is moved to the left 2 units and up 1 unit.

(4) The graph of $f(x)$ is wider than the graph of $g(x)$, and its vertex is moved to the right 2 units and up 1 unit.

Write each function after the transformations described.

1) $y = x^2$ is translated 4 units right and 2 units down, reflected across the x-axis and stretched by a factor of 3.

2) $f(x) = |x|$ is translated 3 units left and 5 units up and compressed by a factor of $\frac{3}{4}$.

3) $y = \sqrt{x}$ is translated 1 unit right, reflected across the x-axis and compressed by a factor of $\frac{1}{3}$.

4) $f(x) = \sqrt[3]{x}$ is translated 7 units up and stretched by a factor of 2.

Describe the transformations that have been applied to the graphs of the parent functions of each.

5) $y = (x+9)^2 - 8$

6) $y = -4x^2 + 1$

7) $y = \frac{1}{2}\sqrt{x-5} - 3$

8) $f(x) = -\sqrt[3]{x-1} + 6$

9) $f(x) = -\frac{2}{3}|x| + 10$

10) $f(x) = 3|x+4|$

11) The vertex of the absolute value function $f(x)$ is at (3, 5). Find the coordinates of the vertex of the absolute value graph defined by $g(x) = f(x+1) - 5$. Explain how you arrived at your answer.

12) Function $f(x) = x^2$ is transformed to $g(x) = -2(x-4)^2 - 5$. Circle the correct transformations and fill in the blanks.

- Shifted **left** / **right** / **neither** _____ units.
- Shifted **up** / **down** / **neither** _____ units.
- Vertically **stretched** / **compressed** / **neither** scale factor of ______
- Made **narrower** / **wider** / **neither**
- Reflected over the ***x*-axis** / ***y*-axis** / **neither**