INVESTIGATION: Type $y = af(x)$
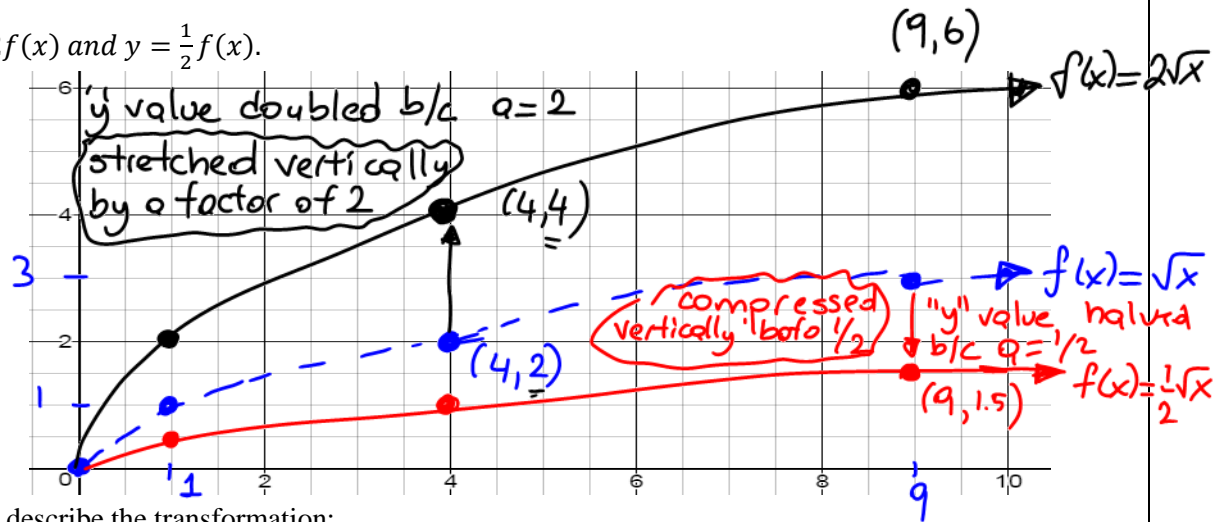
1. On the same set of axes, sketch the graphs of $f(x) = \sqrt{x}$, $y = 2f(x)$ and $y = \frac{1}{2}f(x)$.

x	$\sqrt{x}$	$2\sqrt{x}$	$\frac{1}{2}\sqrt{x}$
0	$\sqrt{0} = 0$	$2\sqrt{0} = 0$	$0.5\sqrt{0} = 0$
1	$\sqrt{1} = 1$	$2\sqrt{1} = 2$	$0.5\sqrt{1} = 0.5$
4	$\sqrt{4} = 2$	$2\sqrt{4} = 4$	$0.5\sqrt{4} = 1$
9	$\sqrt{9} = 3$	$2\sqrt{9} = 6$	$0.5\sqrt{9} = 1.5$

(9,6)

$f(x) = 2\sqrt{x}$

y value doubled b/c a=2 stretched vertically by a factor of 2

(4,4)

compressed vertically b4fo ½

"y" value halved b/c a=½

(4,2)

(9,1.5)

$f(x) = \sqrt{x}$

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

2. If $y = f(x)$ is transformed to $y = af(x)$, where a is a number, describe the transformation:
   a) If $|a| > 1$, then the parent function is __stretched__ **vertically** by a factor of "$|a|$".
   b) If $0 < |a| < 1$, then it is __compressed__ **vertically** __b4fo $|a|$__

   Any point (x, y) under this transformation becomes (x, ay **)** ★ MAPPING NOTATION

INVESTIGATION: Type $y = f(kx)$
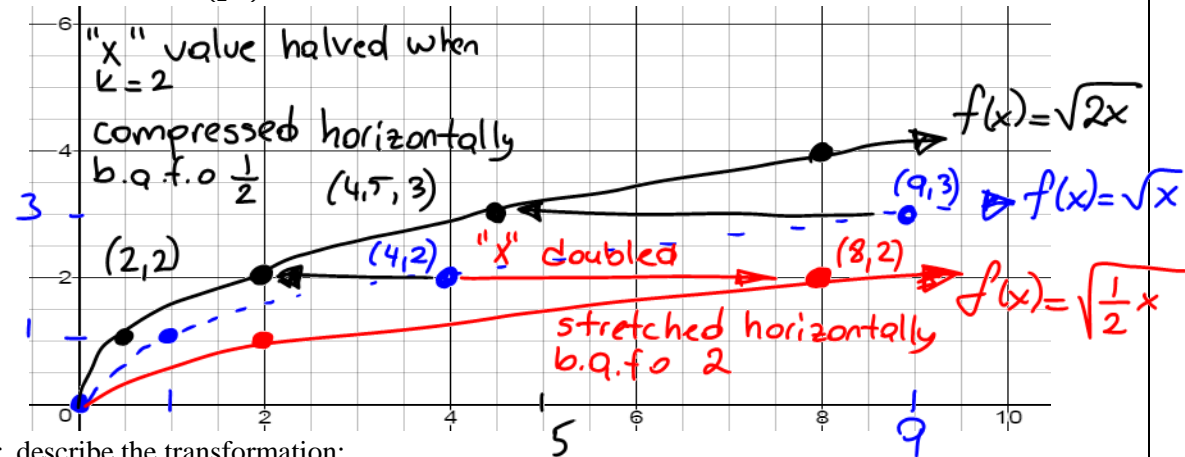
1. On the same set of axes, sketch the graphs of $f(x) = \sqrt{x}$, $y = f(2x)$ and $y = f\left(\frac{1}{2}x\right)$.

a)

x	$\sqrt{2x}$
0	$\sqrt{2 \cdot 0} = 0$
0.5	$\sqrt{2 \times 0.5} = 1$
2	$\sqrt{2 \cdot 2} = 2$
4.5	$\sqrt{2 \times 4.5} = 3$

b)

x	$\sqrt{\frac{1}{2}x}$
0	$\sqrt{0.5 \times 0} = 0$
2	1
8	2
18	3

"x" value halved when k=2 compressed horizontally b.q f.o ½ (4.5,3)

(2,2) (4,2) "x" doubled (8,2)

$f(x) = \sqrt{2x}$

(9,3)

$f(x) = \sqrt{x}$

stretched horizontally b.q.fo 2

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

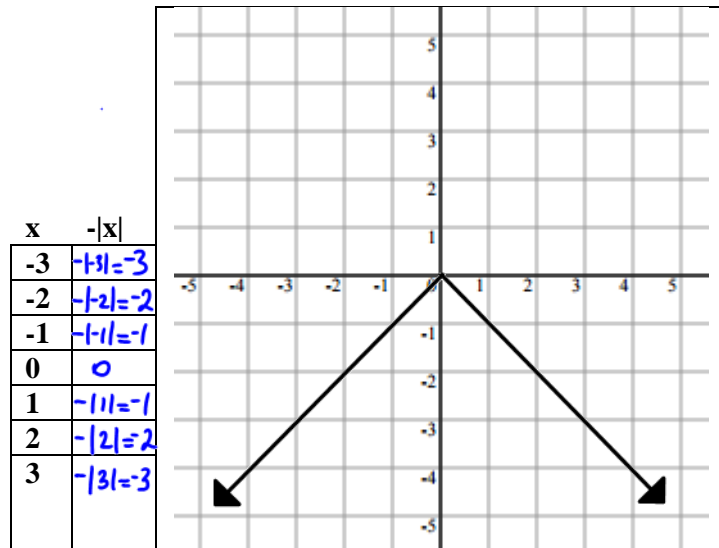4. If $y = f(x)$ is transformed to $y = f(kx)$, where k is a number, describe the transformation:
   a) If $|k| > 1$, then the parent function is __compressed__ **horizontally** by factor of "$\frac{1}{|k|}$".
   b) If $0 < |k| < 1$, then it is __stretched horizontally__ __b4fo $\frac{1}{|k|}$__

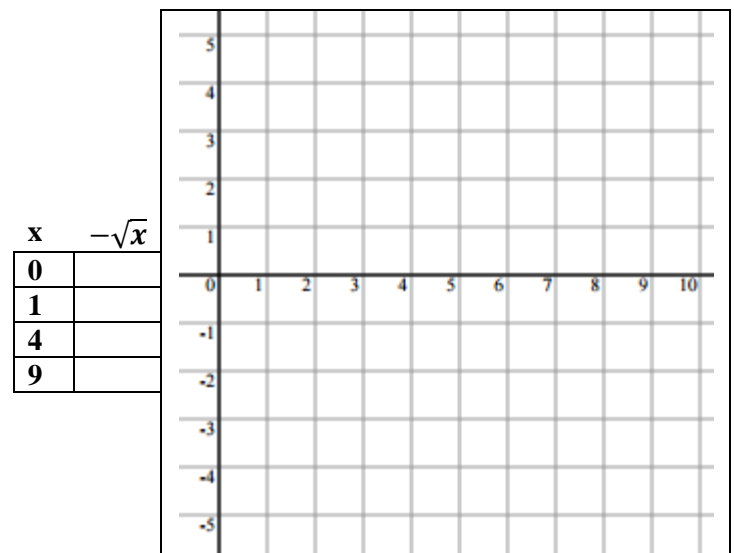   **Any point (x, y) under this transformation becomes (** $\frac{x}{k}, y$ **).**

INVESTIGATION: Type $y = -f(x)$
1. On the same set of axes, sketch the graphs of $f(x)$ and $-f(x)$.

a. $f(x) = |x|$

x	-|x|
-3	-|-3|=-3
-2	-|-2|=-2
-1	-|-1|=-1
0	0
1	-|1|=-1
2	-|2|=-2
3	-|3|=-3

b. $f(x) = \sqrt{x}$

x	$-\sqrt{x}$
0	
1	
4	
9	

2. If $y = f(x)$ is transformed to $y = -f(x)$, where a is a negative number, describe the transformation:
I noticed that the graph is reflected about the "__" axis.

Any point (x, y) under this transformation becomes (,   ).

INVESTIGATION: Type $y = f(-x)$
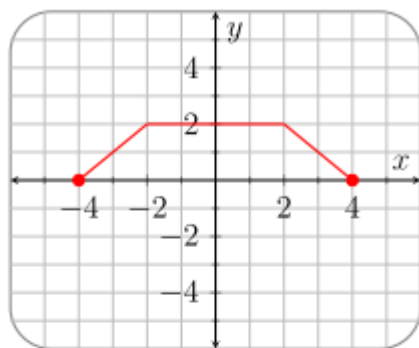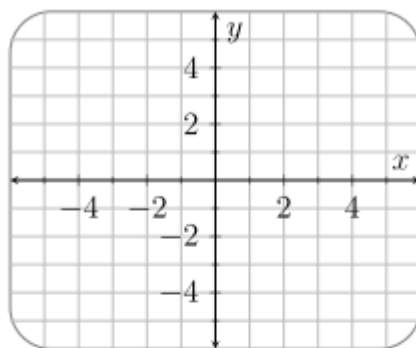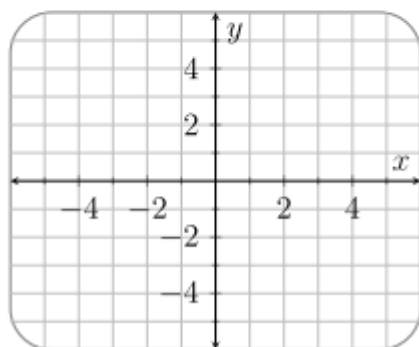3. On the same set of axes, sketch the graphs of $f(x)$ and $f(-x)$.
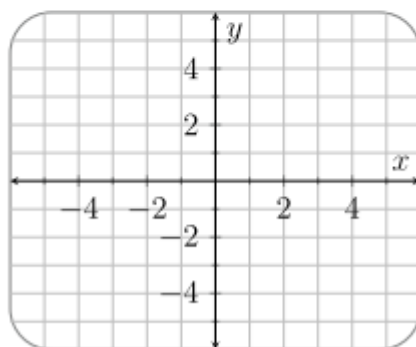
a. $f(x) = x^2$

x	$(-x)^2$
-2	
-1	
0	
1	
2	

b. $f(x) = \sqrt{x}$

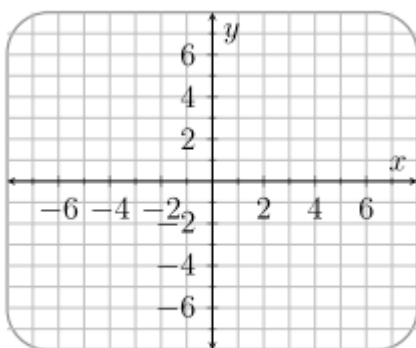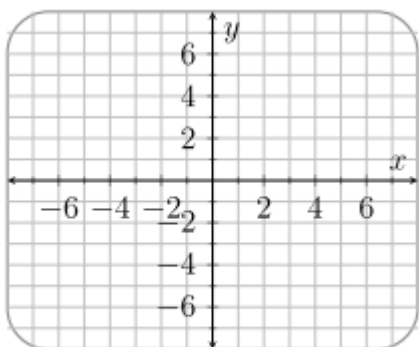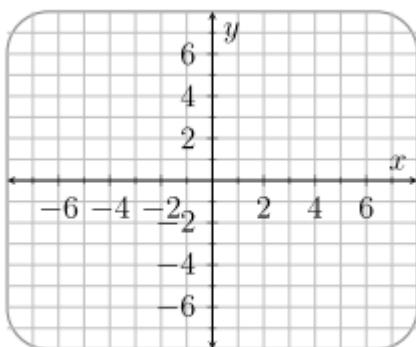| x	$\sqrt{-x}$
-9	
-4	
1	
0	
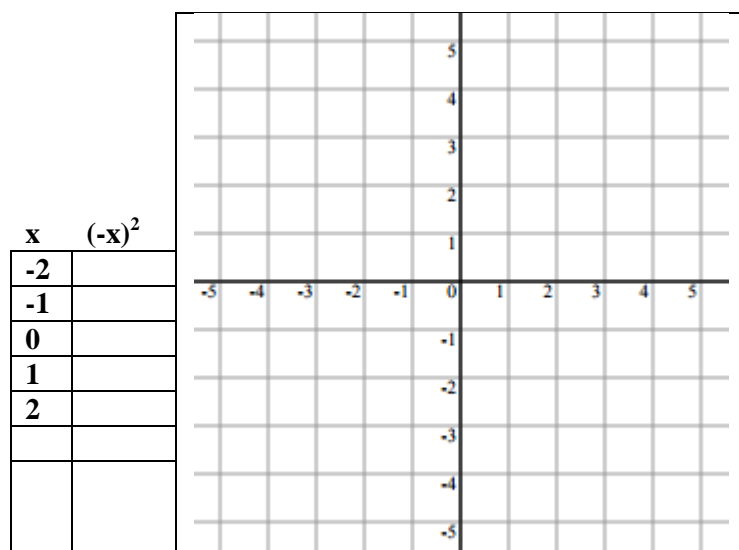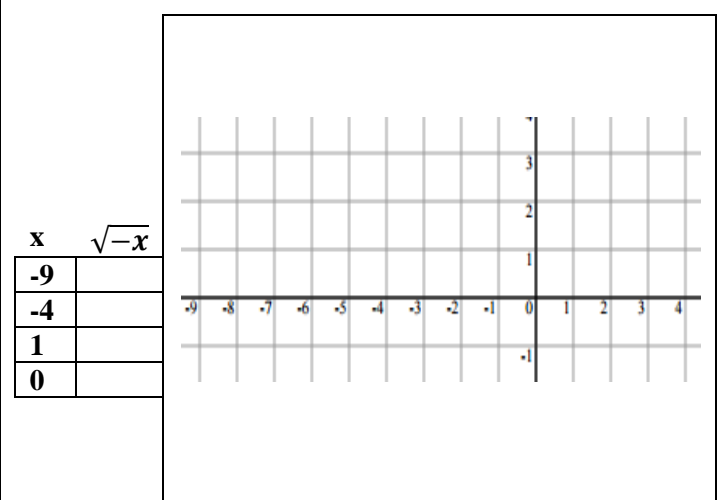
4. If $y = f(x)$ is transformed to $y = f(kx)$, describe the transformation:
a) If k = -1, then the graph is **reflected** about the "__" axis.
Any point (x, y) under this transformation becomes (,   ).

Vertical stretches of $f(x)$

(a) $f(x)$

(b) $g(x) = 2f(x)$

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

(d) $g(x) = -3f(x)$

Horizontal Stretches of $f(x)$
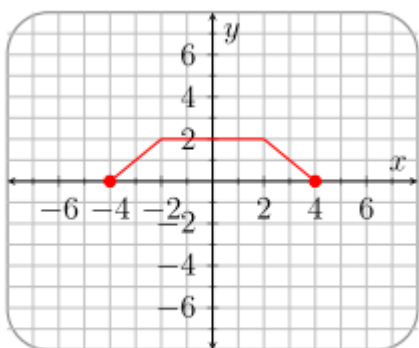
(a) $f(x)$

(b) $g(x) = f(2x)$

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

(d) $g(x) = -f(2x)$

Let $f(x) = x^2$.

What do the following transformations represent in terms of stretches, reflections, and shifts?

a. $2f(x)$ d. $-f(2x)$

b. $3f(x)$ e. $f\left(\frac{1}{3}x\right) + 4$

c. $\frac{1}{2}f(x)$ f. $-2f(x-1)$

Verify your answers using DESMOS or graphing calculator.