Name:

UNIT 2 LEARNING GUIDE – TRANSFORMATIONS

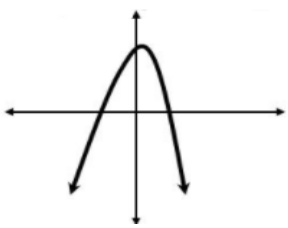
INSTRUCTIONS:

Using a pencil, complete the following questions as you work through the related lessons. Show ALL of your work as is explained in the lessons. Do your best and always ask questions if there is anything that you don't understand.

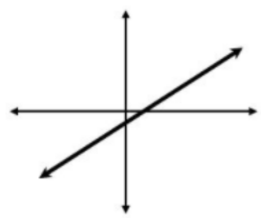
2.1 GRAPH TRENDS

1. Provide the name of each polynomial relation shown (include neg/pos) and degree:

eg) neg quadratic (d = 2)



a) ____________________



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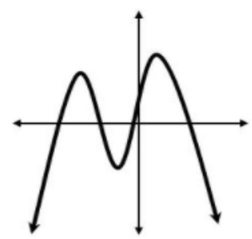

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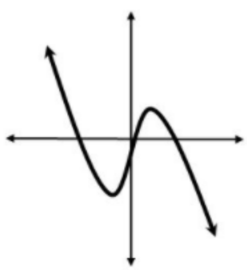
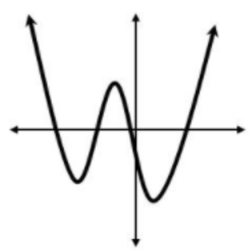
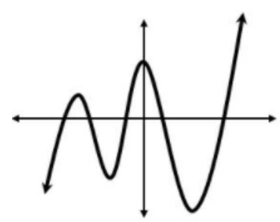


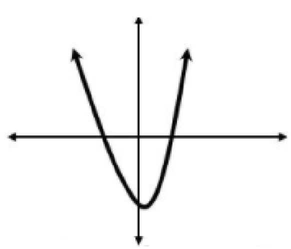
d) ____________________



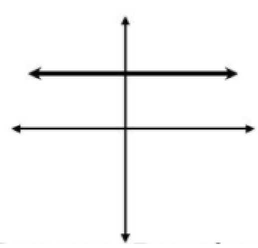
e) ____________________



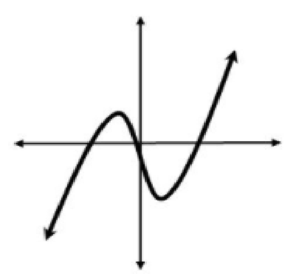
f) ____________________



g) ____________________



h) ____________________



2. Describe the known starting and ending points for each of the following polynomials:

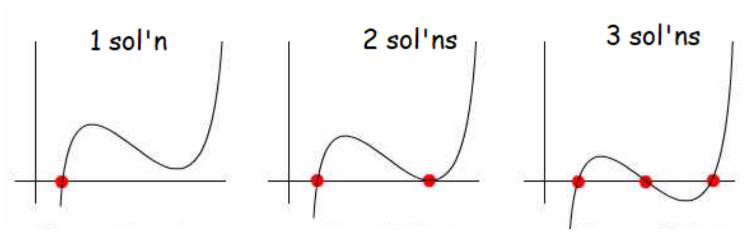
   a. Positive even degree: ____.

   b. Positive odd degree: ____.

   c. Negative even degree: ____.

   d. Negative odd degree: ____.

3. Sketch and show all the possible scenarios for the number of solutions. First is done for you.
   ex) Positive cubic:



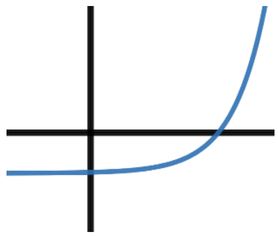
   a. Negative quartic:

   b. Positive quadratic:

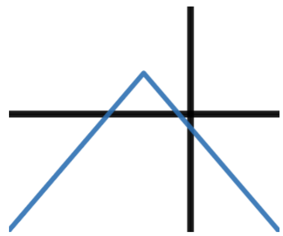
   c. Negative quintic:

4. Identify the family of functions each graph belongs to

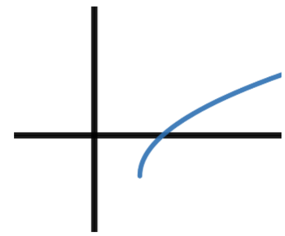
eg) exponential



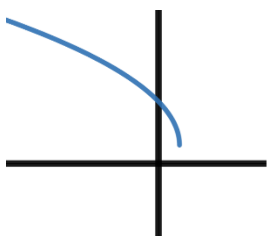
a) ____________________



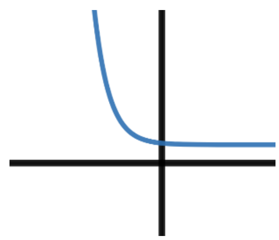
b) ____________________



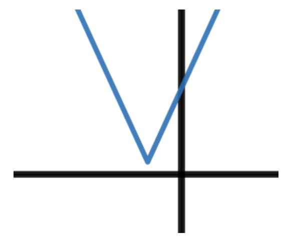
c) ____________________



d) ____________________



e) ____________________



5. Identify the family of functions that each equation belong to

eg) Absolute Value

$f(x) = |x + 3| - 2$

a) ____________________

$f(x) = \sqrt{2x} + 5$

b) ____________________

$f(x) = 3^{x-1}$

c) ____________________

$f(x) = \frac{1}{2}\sqrt{x + 3}$

d) ____________________

$f(x) = 10^x + 5$

e) ____________________

$f(x) = |3x|$

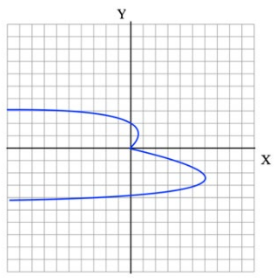
2.2 FUNCTIONS, DOMAIN & RANGE

1. What's the main way to determine whether a relationship shown as a graph is also a function?

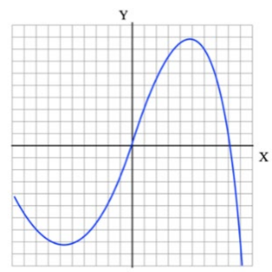
2. What's the main way to determine whether a relationship in equation form is also a function?

3. Which of the following graphs are functions? Note Yes or No. If your answer is "No," show how the vertical line test proves that your answer is correct.

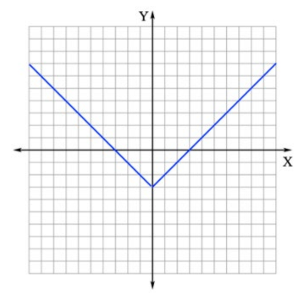
a) _____



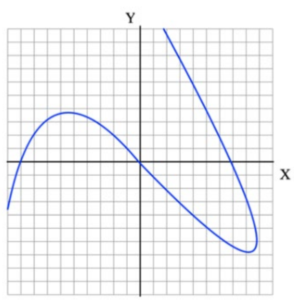
b) _____



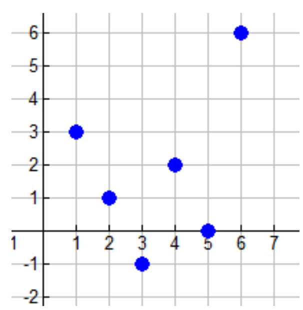
c) _____



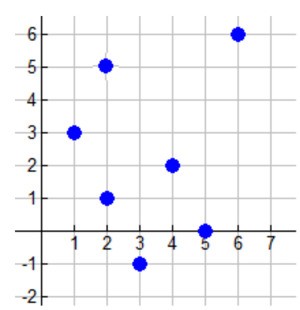
d)_____



e)______



f)______



4. Identify which relationships are functions and which are not functions. How do you know?

   a. { (9, -8), (8, -9), (-9, 5), (3, 8), (7, 8) }

   b. { (-7, 3), (9, 4), (3, -7), (6, -4), (6, -1) }

5. Circle any part of the following equations that would make them not functions then briefly explain each circle.

a) $y = x^2$

b) $x^2 + y^2 = 25$

c) $3y = 2x + 9$

d) $y = 2x^3 - 7$

e) $y = 2x^3 - 7$

f) $y^2 - 2x^2 = 4$

6. Write the function notation for each description of a function.

Ex. Function f in terms of 6.

$\boldsymbol{f(6)}$

a. Function f in terms of18.

b. Function f in terms of n.

c. Function g in terms of -5.

d. Function f in terms of $7x$.

e. Function h in terms of $x + 3$.

7. Evaluate the following expressions given the functions below.

$$\boldsymbol{f(x) = 3x - 5} \qquad \boldsymbol{g(x) = \frac{24}{x} + 10} \qquad \boldsymbol{h(x) = x^2 - 1}$$

Ex. $f(7)$

$$\begin{aligned} \boldsymbol{f(7)} &= \boldsymbol{3(7) - 5} \\ &= \boldsymbol{21 - 5} \\ &= \boldsymbol{16} \end{aligned}$$

a. $f(8)$

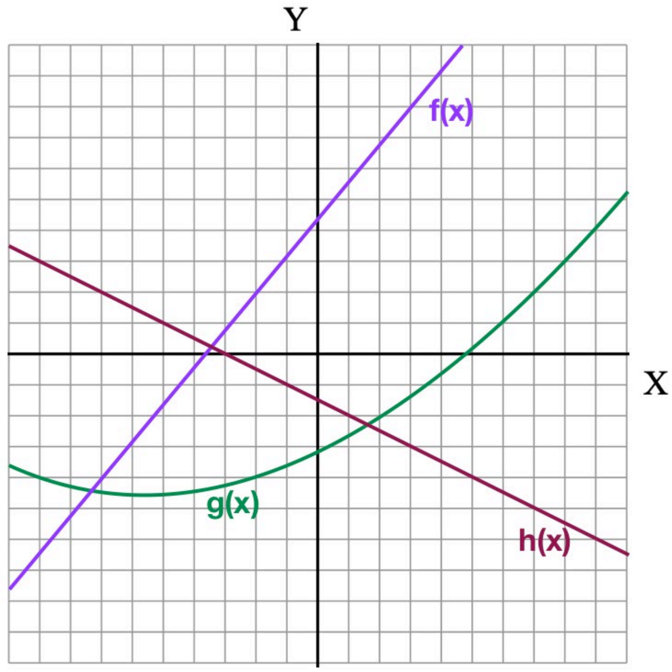
b. $h(6)$

c. $h(5)$

d. $g(-12)$

e. $g(-4)$

8. Use the graph below to answer the following questions.



Ex. Determine f(3).
When x=3, y=8. **f(3) = 8**

a. Determine f(-7)

b. Determine g(6).

c. Determine h(-3).

d. What is *x* when f(*x*)=2 (show on graph)

e. What is *x* when g(*x*)=-4 (show on graph)

f. What is *x* when h(*x*)=1 (show on graph)

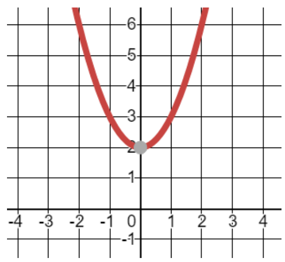
g. Determine f(-2) + f(3).

9. Briefly describe what domain and range are in a way that means something to you! How are you going to remember that x goes with domain and y goes with range?

10. State the domain and range of the following relations and decide if it is a function or not. (the first is done for you).

a) D: $x \in R$ or $(-\infty, \infty)$

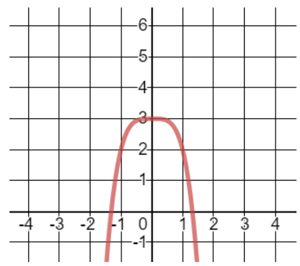
R: $y \geq 2$ or $[2, \infty)$



Function: yes no

b) D: ________________

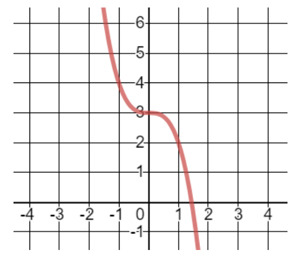
R: ________________



Function: yes no

c) D: ________________

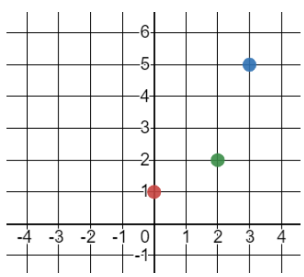
R: ________________



Function: yes no

d) D: ________________

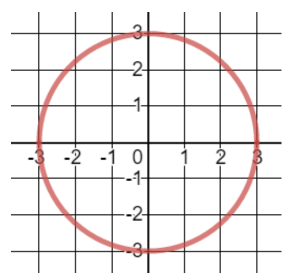
R: ________________



Function: yes no

e) D: ________________

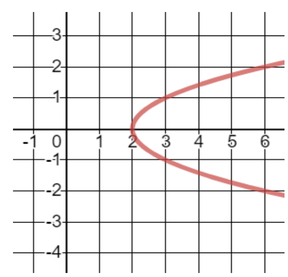
R: ________________



Function: yes no

f) D: ________________

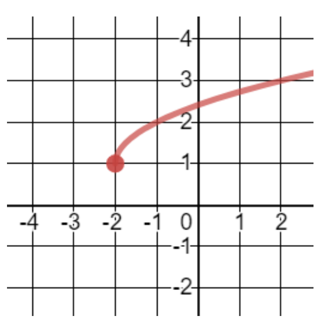
R: ________________



Function: yes no

g) D: ________________

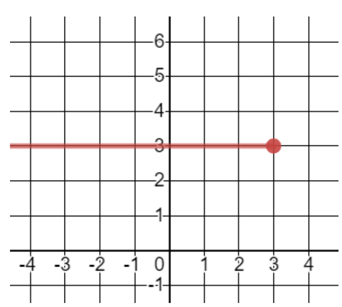
R: ________________



Function: yes no

h) D: ________________

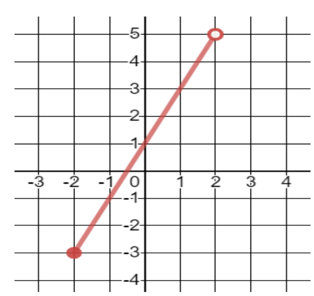
R: ________________



Function: yes no

i) D: ________________

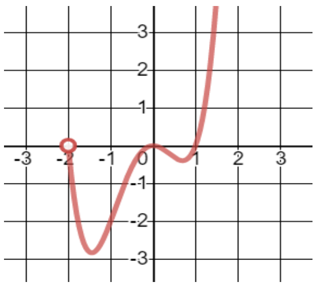
R: ________________



Function: yes no

j) D: ________________

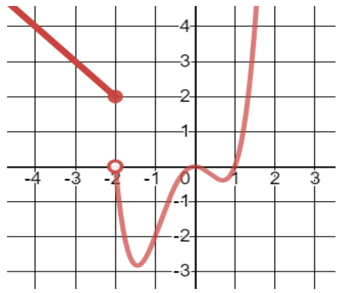
R: ________________



Function: yes no

k) D: ________________

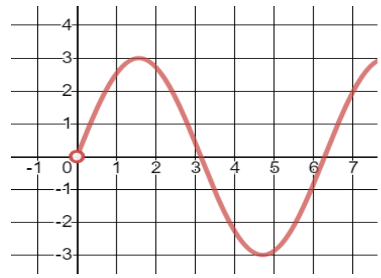
R: ________________



Function: yes no

l) D: ________________

R: ________________



Function: yes no

2.3 Translations

1. Complete the following table, filling in the empty cells with appropriate information.

Base Equation	Transformed Equation	Vertical Change	Horizontal Change
	$y = \sqrt{x+2} - 5$		
$y = x^2$		1 down	4 right
$y = 2^x$		3 up	1 left
	$y = \lvert x - 1\rvert + 2$		
$y = x^3$		2 up	3 left
$y = \sqrt{x}$		2 down	1 right
	$y - 7 = (x+5)^2$		
$y = f(x)$		1 up	2 left
	$y= g(x+2) - 3$		

2. Determine the new equation for each function if its graph is translated the given amount. The actual math is simple so no need to show work nor use a calculator.

a) $y = x^2 + 1$ is translated down 3 and 2 left ____________________

b) $y = \sqrt{x-1}$ is translated up 2 and 1 left ____________________

c) $y = \lvert x+2\rvert$ is translated down 7 and 1 right ____________________

d) $y = f(x-6)$ is translated right 5 ____________________

e) $y = f(x+1) + 2$ is translated left 3 ____________________

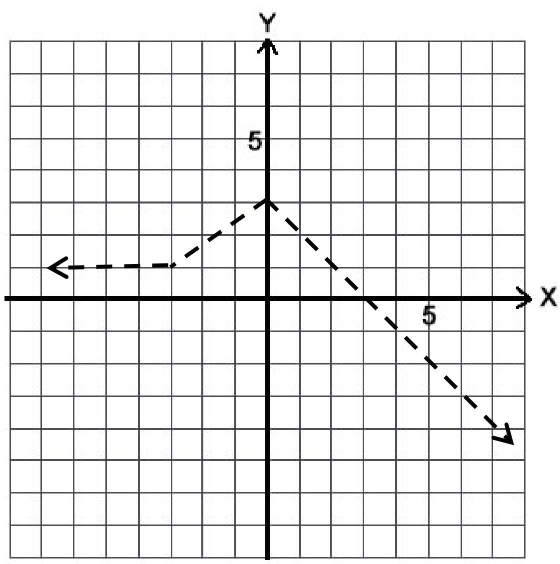
f) $y = f(x-3) + 4$ is translated right 1 and down 7 ____________________

3. Complete the following table, filling in the empty cells with appropriate information.

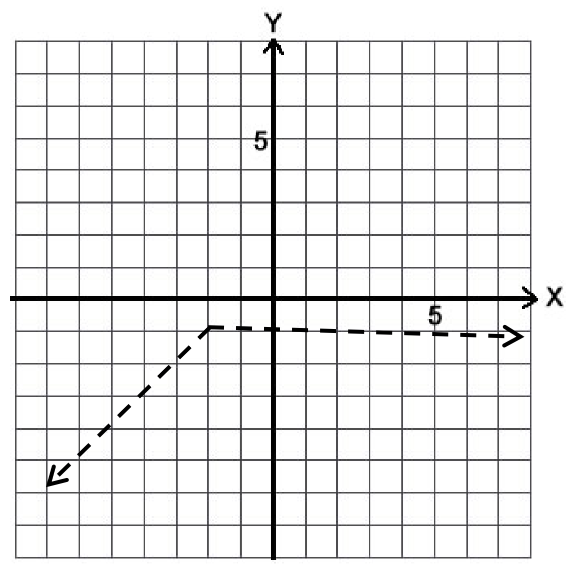
Base Equation	Transformed Equation	Example Point	Point's New Location
	y = f(x+1) + 1	(-1, 1)	
y = g(x)		(0, -1)	(2, -4)
	y = f(x+2) + 1	(-3, 4)	
	y = g(x-1) - 3		(1,5)

4. Given the dotted f(x), sketch the transformed function.

a) $y = f(x - 1) + 2$

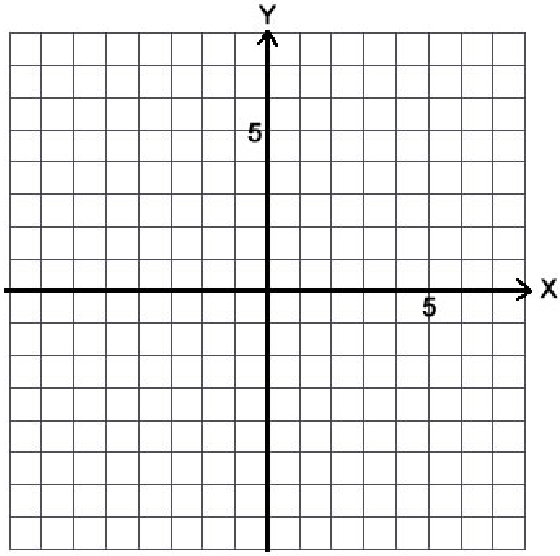


b) $-y = f(x + 1) - 3$

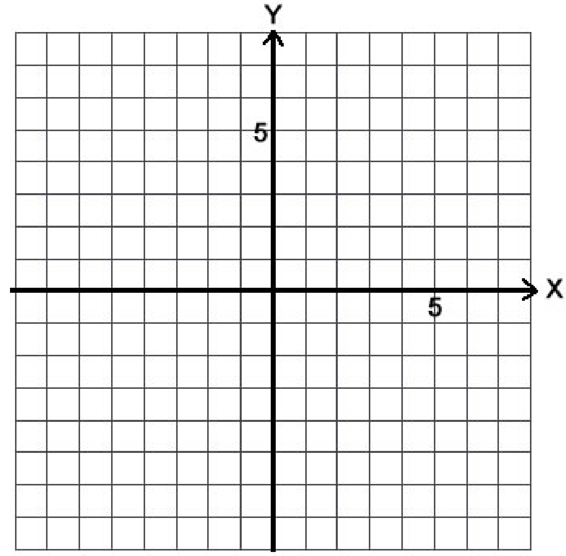


5. Sketch the transformed functions without using technology (or a table).

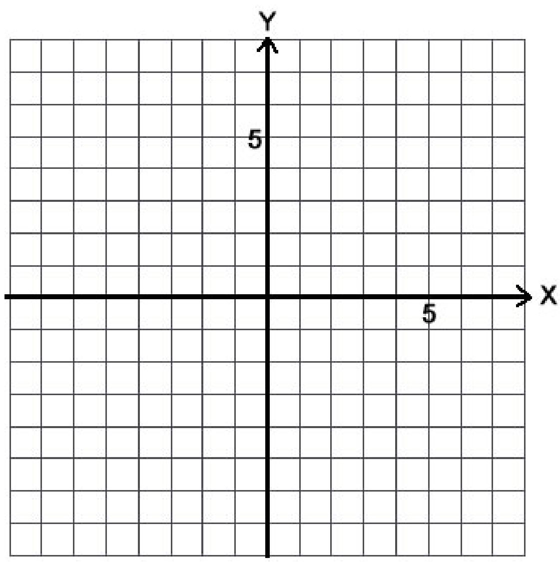
a) $y = |x + 2| - 3$



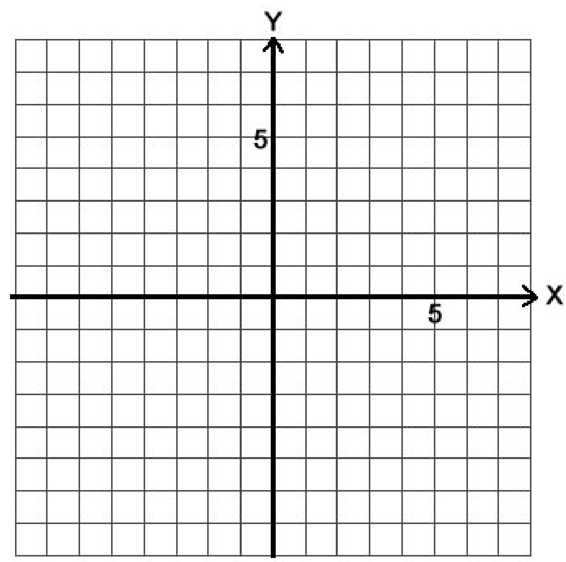
b) $y = -\sqrt{x - 1} + 2$



c) $y = (x - 3)^2 - 3$

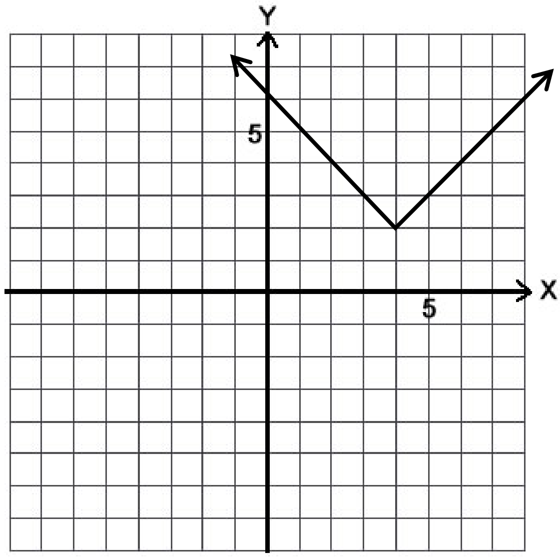


d) $y = -2^x - 2$

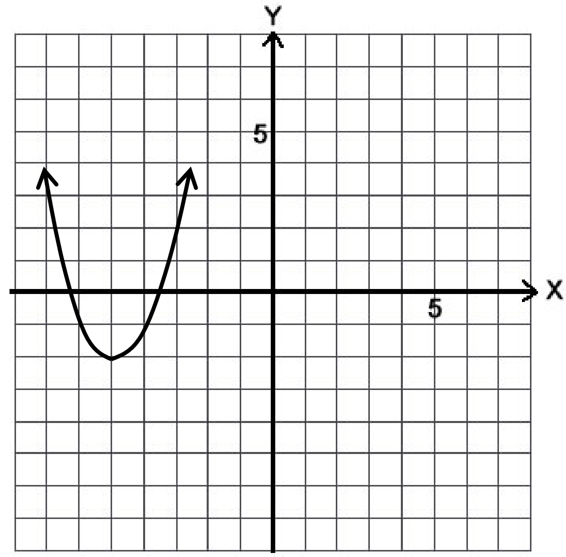


6. Determine the equation of the relation shown in the graphs below.

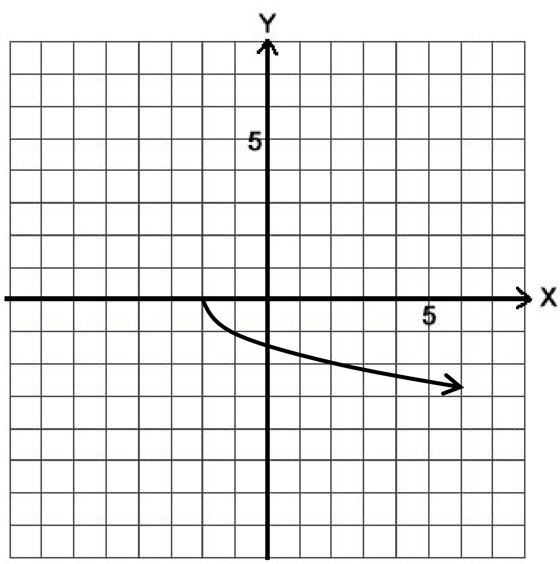
a) y = ____________________________



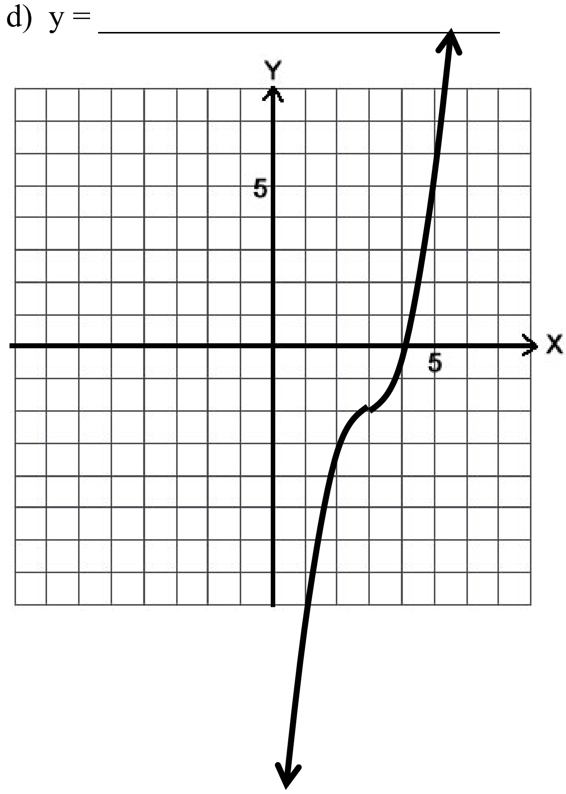
b) y = ____________________________



c) y = ____________________________



d) y = ____________________________



2.4 VERTICAL COMPRESSIONS & EXPANSIONS

1. Complete the following table, filling in the empty cells with appropriate information.

Base Equation	**Transformed Equation**	**Vertical Exp. or Comp.?**	**By a Factor of?**
	$y = 2\sqrt{x+2} - 5$		
$y = x^2$		V Expansion	3
$y = 2^x$		V Compression	2
	$3y = \lvert x - 1\rvert + 2$		
$y = x^3$		V Expansion	5
$y = \sqrt{x}$		V Compression	4
	$\frac{1}{4}y = (x+5)^2$		
$y= f(x)$		V Compression	2
	$y=2g(x+2) - 3$		

2. Determine the new equation for each function if its graph is expanded/compressed by the given amount. The actual math is simple so no need to show work nor use a calculator.

a) $y = x^2 + 4$ is vertically expanded by factor of 2 ________________________

b) $y = \lvert 3x\rvert$ is vertically compressed by factor of 2 ________________________

c) $y = (x+6)^3 + 8$ is vertically compressed by factor of 4 ________________________

d) $y = f(x-6)$ is vertically expanded by factor of 3 ________________________

e) $y = 2f(x-1)$ is vertically expanded by 5 ________________________

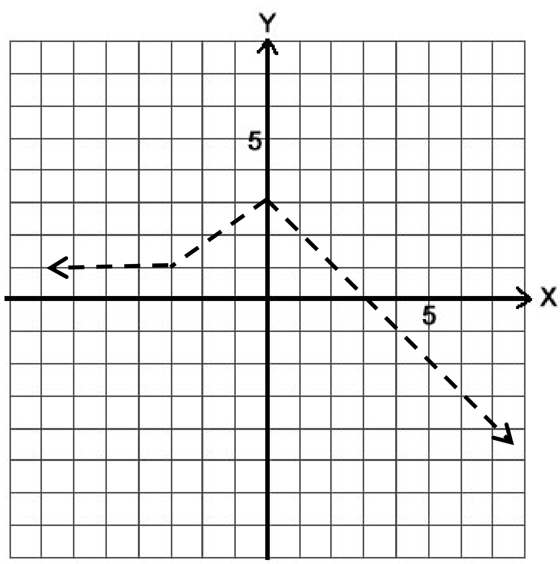
f) $y = f(x-3) + 4$ is vertically compressed by factor of 1 ________________________

3. Complete the following table, filling in the empty cells with appropriate information.

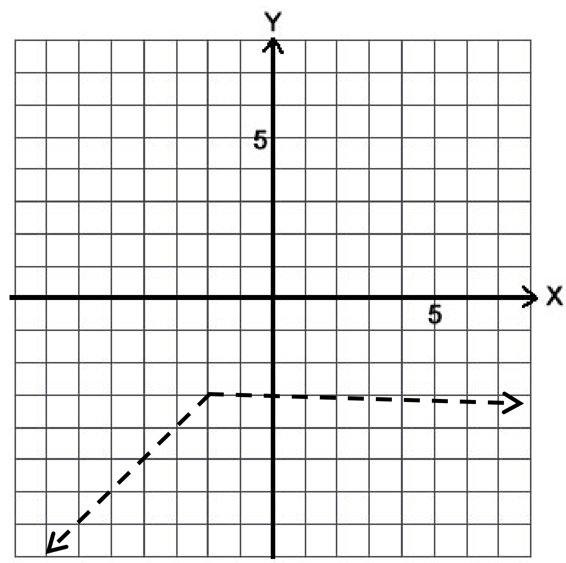
Base Equation	Transformed Equation	Example Point	Point's New Location
	y = 3f(x)	(-1, 1)	
y = g(x)		(0,-2)	(0, -1)
y = f(x)		(-3, 4)	(3,-8)
	$y = \frac{1}{3}g(x)$		$(-2, \frac{2}{3})$

4. Given the dotted f(x), sketch the transformed function.

a) y = 2f(x)

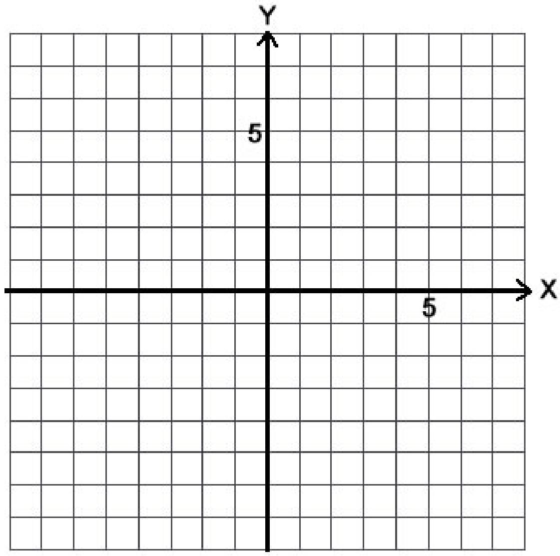


b) 3y = f(x)

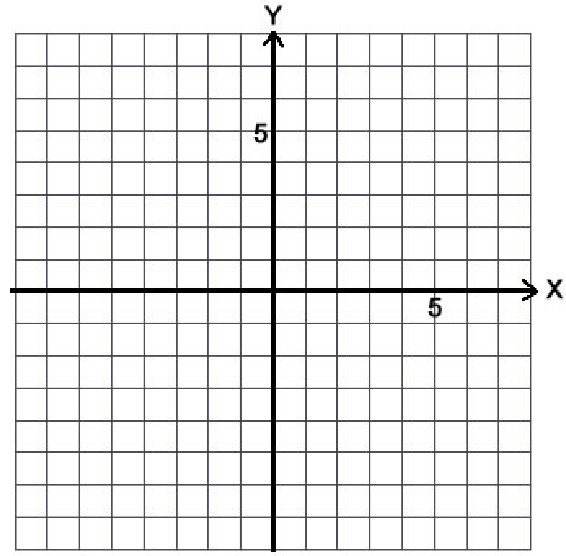


5. Sketch the transformed functions without using technology (or a table).

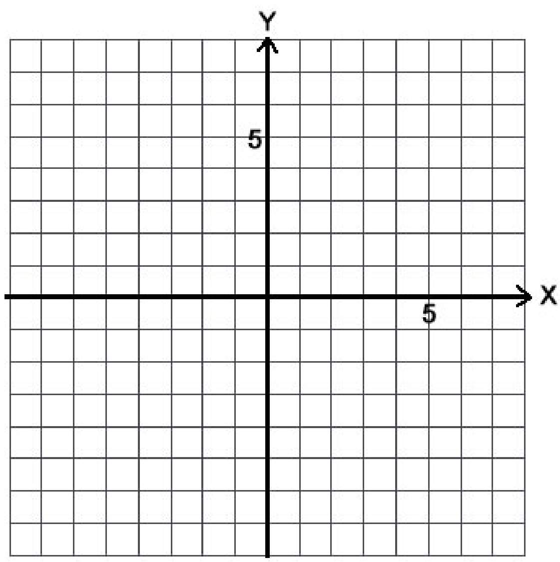
a) $y = 2|x|$



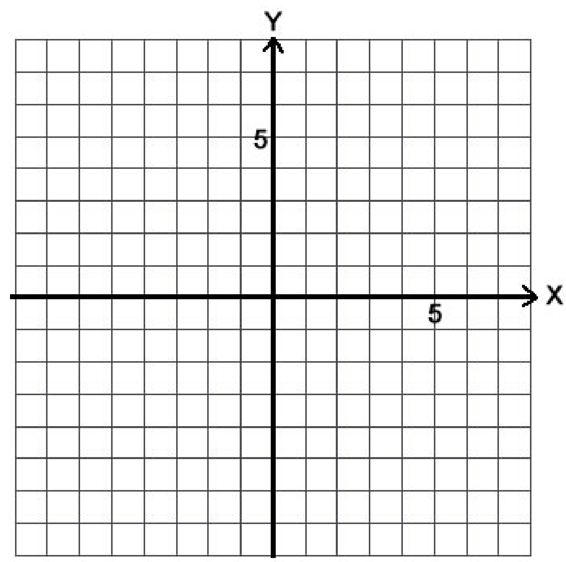
b) $y = -3\sqrt{x}$



c) $2y = x^2$

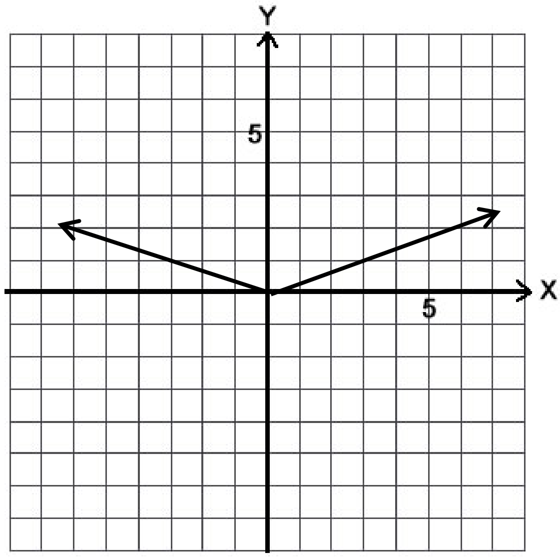


d) $-y = \frac{1}{4}x^3$

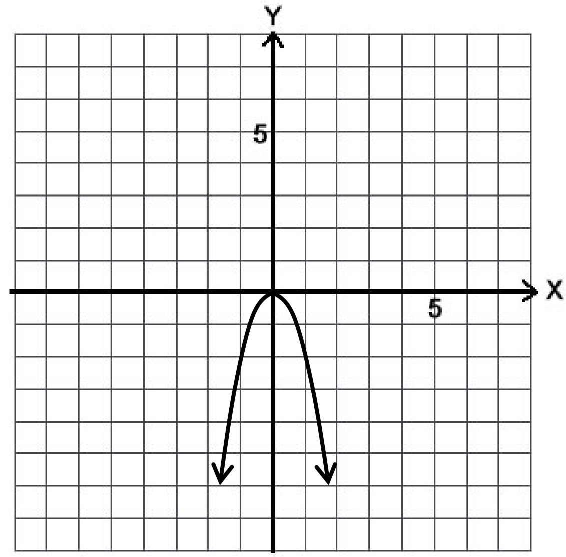


6. Determine the equation of the relation shown in the graphs below.

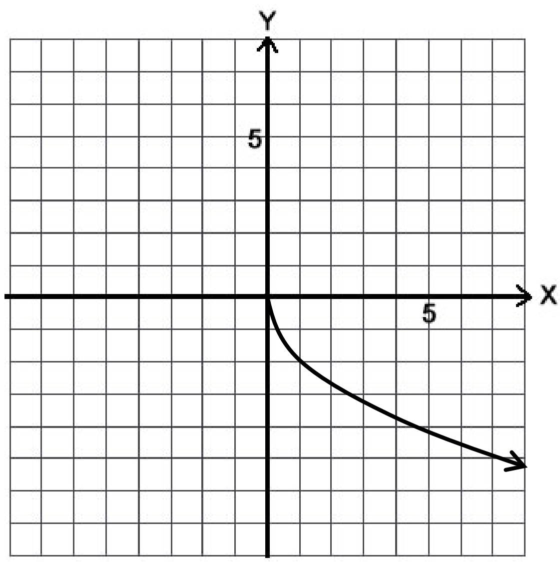
a) y = ____________________________



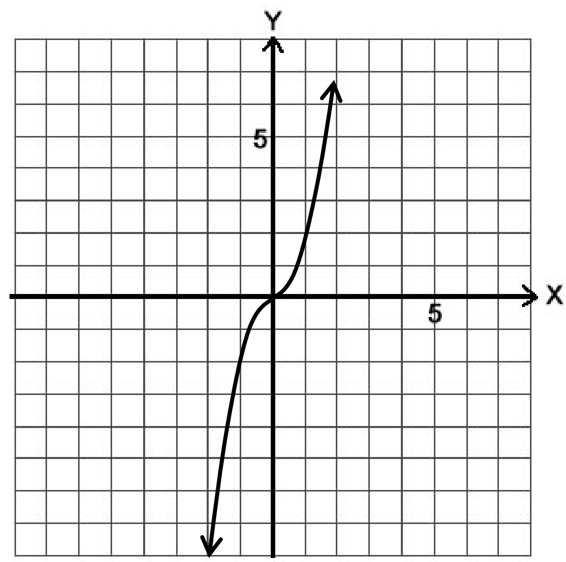
b) y = ____________________________



c) y = ____________________________



d) y = ____________________________



2.5 Reflections & Inverse

1. Describe what happens to the graph of the function if you make each change to its equation.

   a) Replace x with –x ________________________________

   b) Replace y with –y ________________________________

   c) Switch x and y ________________________________

2. Define the term Invariant Point.

3. For each of the following transformations, where would you find the invariant points?

   a) $y = f(-x)$ ________________________________

   b) $y = -f(x)$ ________________________________

   c) $x = f(y)$ ________________________________

4. Determine the new equation if the function undergoes a reflection in the given line. First, make the appropriate replacement then simplify so you end up with y isolated again. Brackets are helpful when first doing a replacement. Be careful with how you handle negative signs!

   a) Reflect $y = x^2$ in the x-axis

   b) Reflect $y = x^3 + 4$ in the y-axis

   c) Reflect $y = |x| - 2$ in the x-axis

   d) Reflect $y = \sqrt{16 - x^2}$ in the x-axis

   e) Reflect $y = \sqrt{9 - x^2}$ in the y-axis

   f) Reflect $y = f(x) + 5$ around y=x

   g) Reflect $y = 2f(x + 3)$ in *both* axes

   h) Reflect $y = f(x - 1) + 2$ around y=x

5. Given that the point (2, 7) is on the graph of $y = f(x)$ then what point must be on the following graphs? Explain your answer in terms of transformations.
   a) $y = -f(x)$ b) $y = f(-x)$ c) $y = -f(-x)$ d) $x = f(y)$

   ____________ ____________ _____________ _____________

6. Describe how to recognize the difference between inverse notation and reciprocal notation.

7. How do you find the "invariant points" for each of the following transformations? Include a quick sketch to demonstrate each.
   a) Reflection around the y-axis:

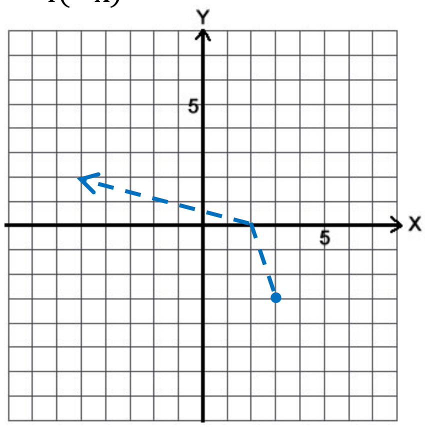
   b) Reflection around the x-axis:

   c) Reflection around y=x:

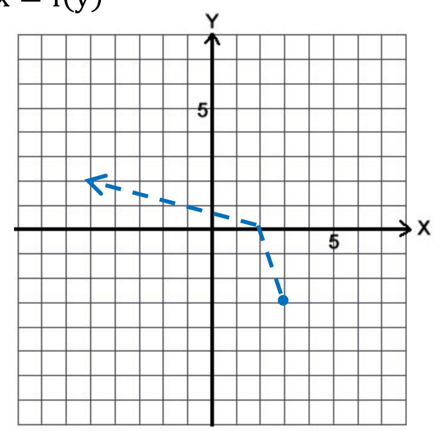
8. Determine the inverse equation for the following, with the y isolated.
   a) $y = x - 5$
   c) $f(x) = 2x - 6$
   b) $y = \frac{1}{x-1}$
   d) $g(x) = x^3 + 2$

9. Given the graph of y = f(x) as the dotted graph, sketch the desired function. Put a star on one invariant point within each transformation, and identify whether the result is still a function.

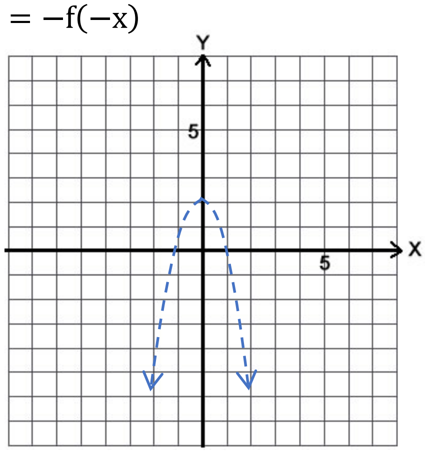
a) y = f(−x)



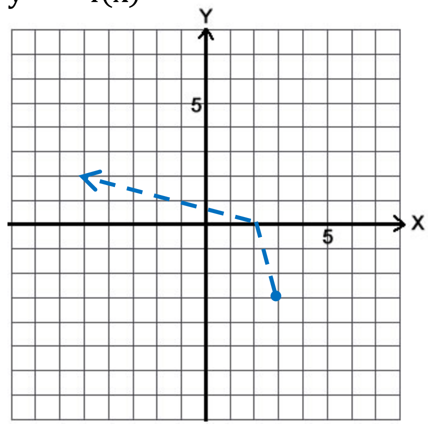
b) x = f(y)



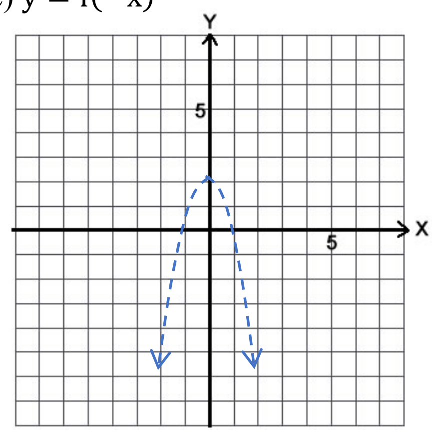
c) y = −f(−x)



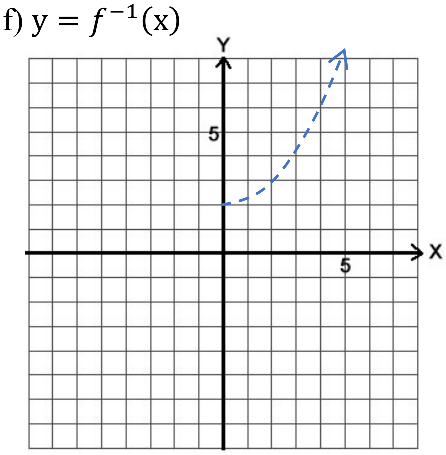
d) y = −f(x)



e) y = f(−x)



f) y = f^{-1}(x)



2.6 HORIZONTAL COMPRESSIONS & EXPANSIONS

1. Complete the following table, filling in the empty cells with appropriate information.

Base Equation	Transformed Equation	Horizontal Exp. or Comp.?	By a Factor of?
	$y = \sqrt{2x+2} - 5$		
$y = x^2$		H Expansion	3
$y = 2^x$		H Compression	2
	$y = \lvert 3x - 1 \rvert + 2$		
$y = x^3$		H Expansion	5
$y = \sqrt{x}$		H Compression	4
	$y = \left(\frac{1}{4}x + 5\right)^2$		
y= f(x)		H Compression	2
	$y = g(\frac{1}{2}x+2) - 3$		

2. Determine the new equation for each function if its graph is translated the given amount. The actual math is simple so no need to show work nor use a calculator.

a) $y = x^2 + 4$ is horizontally expanded by factor of 2 _________________________

b) $y = |3x|$ is horizontally compressed by factor of 2 _________________________

c) $y = (x+6)^3 + 8$ is horizontally compressed by factor of 4 _________________________

d) $y = f(x-6)$ is horizontally expanded by factor of 3 _________________________

e) $y = 2f(x-1)$ is horizontally expanded by 5 _________________________

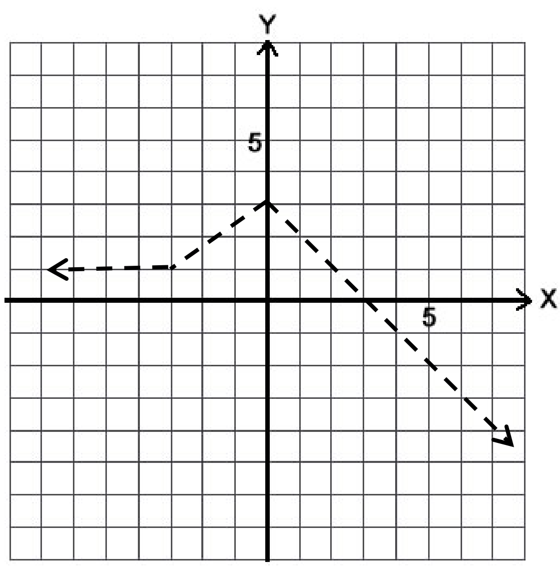
f) $y = f(x-3) + 4$ is horizontally compressed by factor of 1 _________________________

3. Complete the following table, filling in the empty cells with appropriate information.

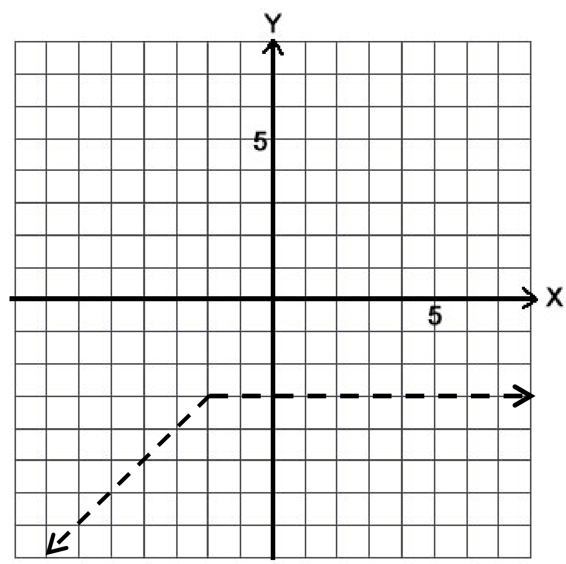
Base Equation	Transformed Equation	Example Point	Point's New Location
	y= f(2x)	(-2, 2)	
	$\boldsymbol{y = g(\frac{x}{3})}$		(0, -1)
y= f(x)		(-3, 4)	(-1,4)
	y= $\boldsymbol{g(\frac{x}{2})}$		(-4, 0)

4. Given the dotted f(x), sketch the transformed function.

a) $y = f(2x)$

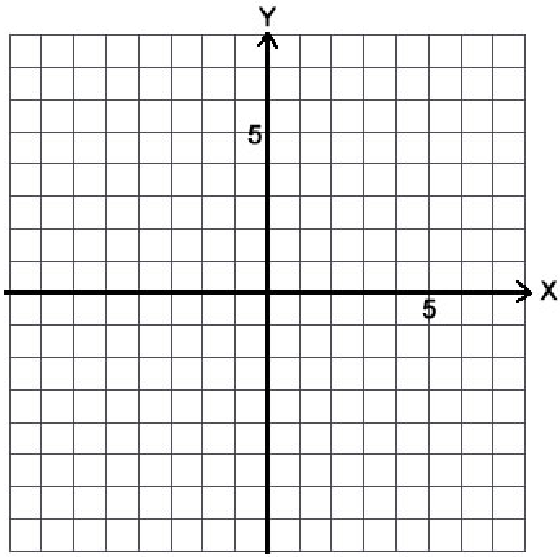


b) $y = f\left(\frac{1}{3}x\right)$

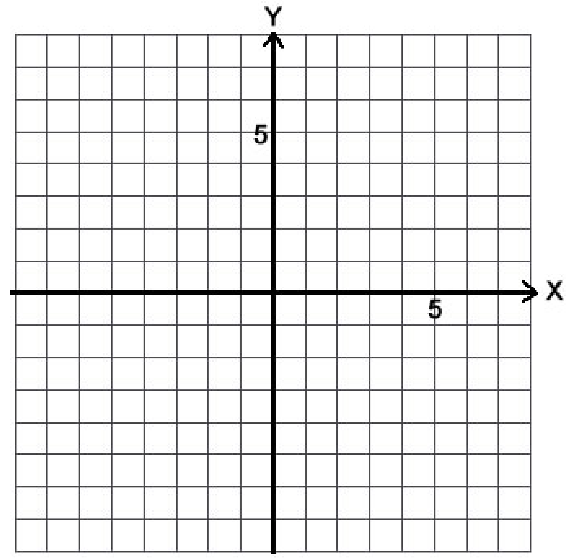


5. Sketch the transformed functions without using technology or a table.

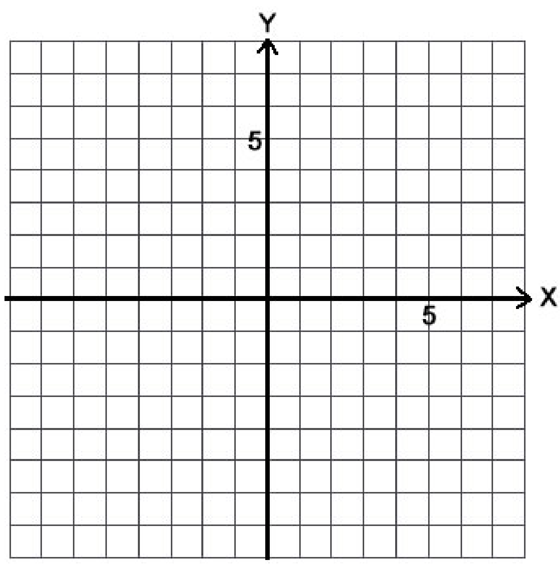
a) $y = |2x|$



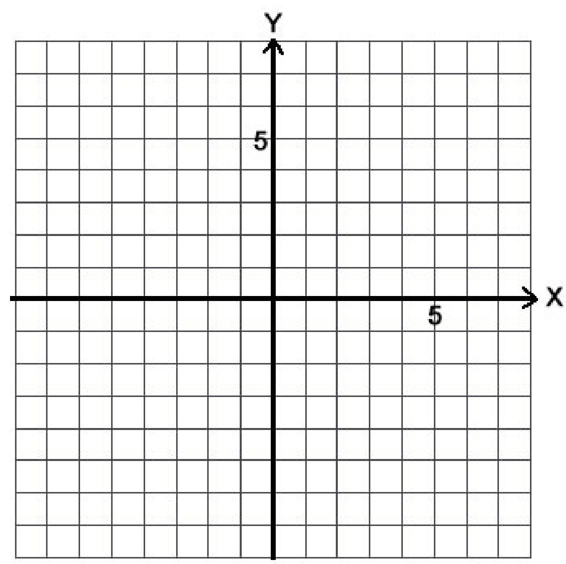
b) $y = -\sqrt{\frac{1}{2}x}$



c) $y = (2x)^2$

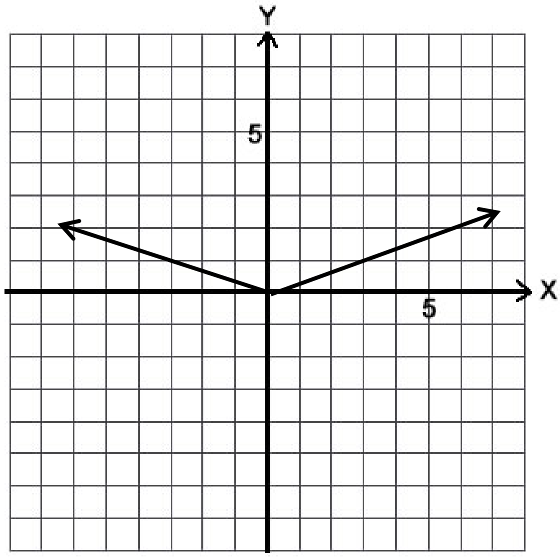


d) $-y = (\frac{1}{3}x)^3$

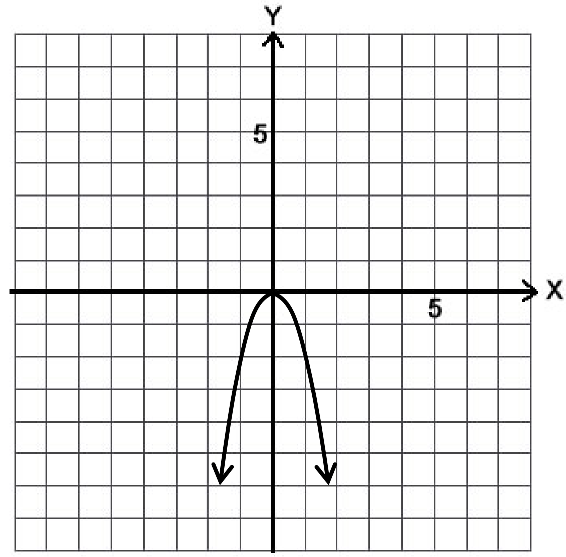


6. Determine the equation of the relation shown in the graphs below.

a) y = ____________________________

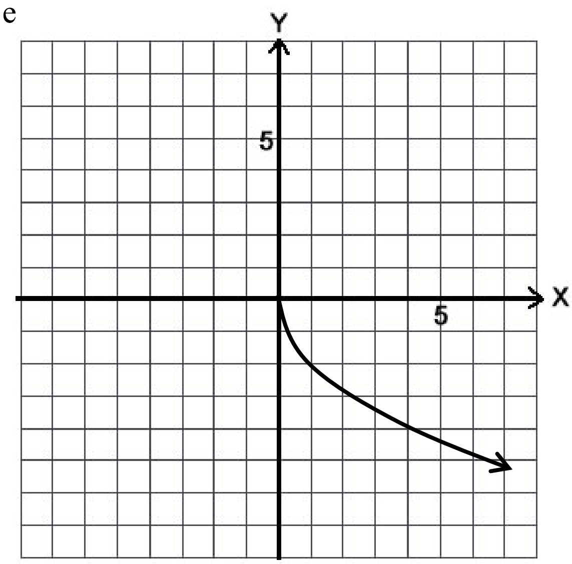


b) y = ____________________________

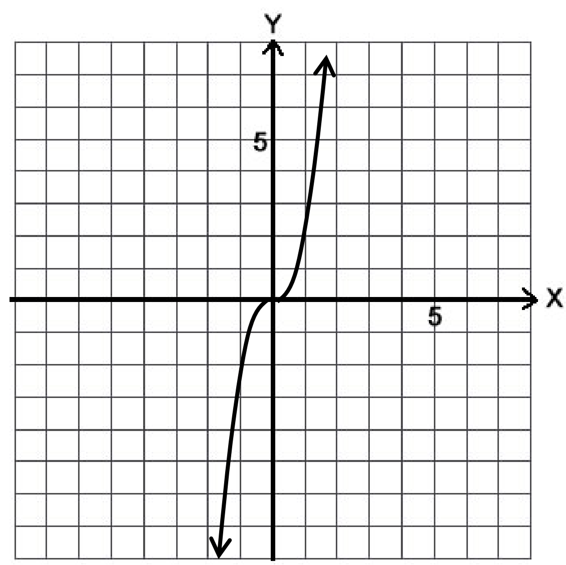


d) y = ____________________________

e



d) y = ____________________________



2.7 COMBINATIONS

1. Complete the following table, attempting to fill-in all the missing gaps without referring to your lessons, then refer to your notes to check. You may wish to try this a few times to get it perfect, as this table holds the key ideas for this unit.

Transformation	Equation y= f(x) becomes	Point (x,y) becomes	Graph becomes
Vertical Translation (up) by a			
Vertical Translation (down) by a			
Horizontal Translation (left) by a			
Horizontal Translation (right) by a			
Vertical Reflection			
Horizontal Reflection			
Vertical Expansion (|a| > 1)			
Vertical Compression (0 < |a| < 1)			
Horizontal Expansion (0< |b| < 1)			
Horizontal Compression (|b| > 1)			

2. What is the order that transformations should be done?

3. Consider the function $y = f(x)$. Show the results of each transformation in the order given and finish by simplifying so each new equation begins with y=.

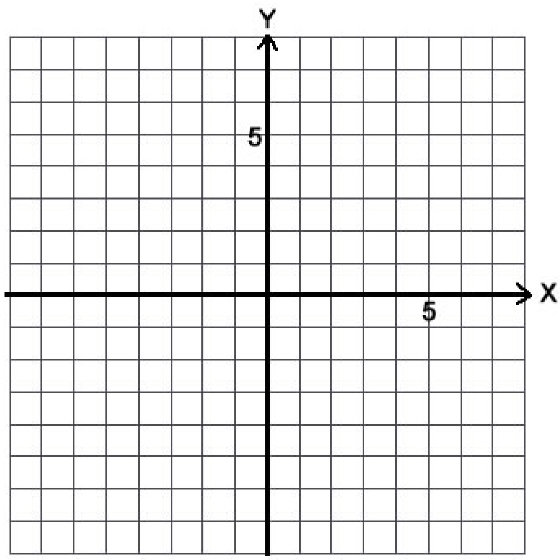
   a) a horizontal expansion by 3, then a translation 2 units left

   b) a reflection in the x-axis, a vertical expansion by 2, and a translation 3 units down.

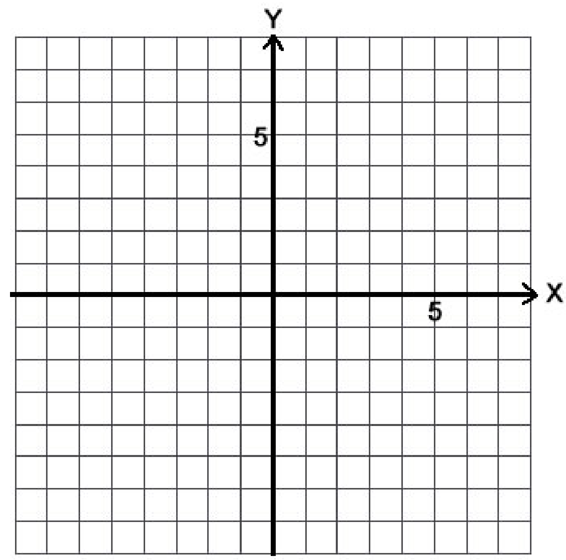
   c) a reflection in the y-axis, a horizontal compression by 3, then a translation 4 units right and 2 units up.

4. Sketch the transformed functions without using technology (or a table).

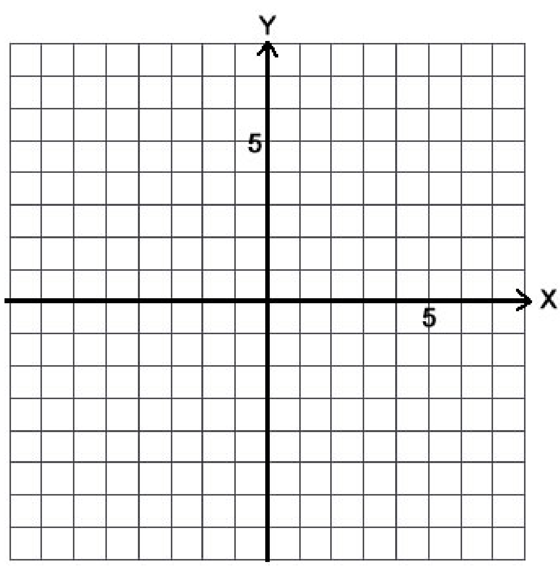
a) $y = 2|x - 1| + 3$



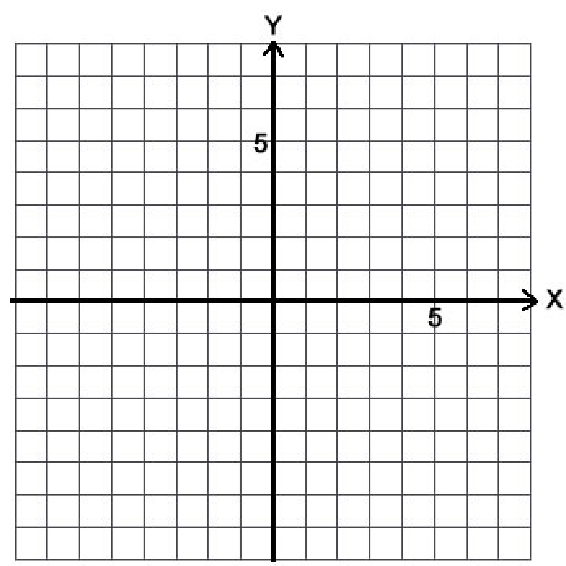
b) $-y = \sqrt{\frac{1}{2}x} - 2$



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

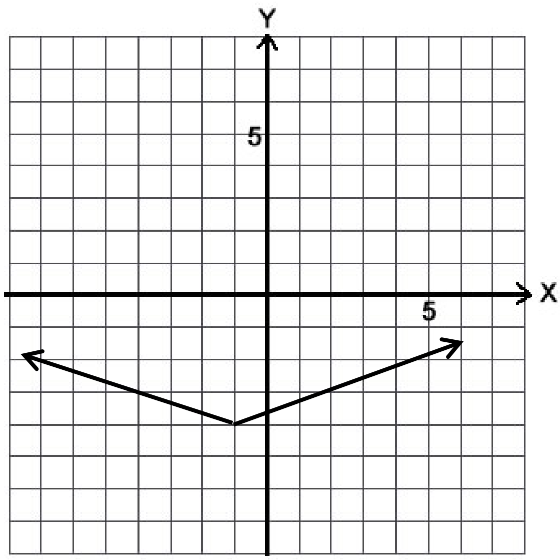


d) $-y = (3x)^3 + 2$

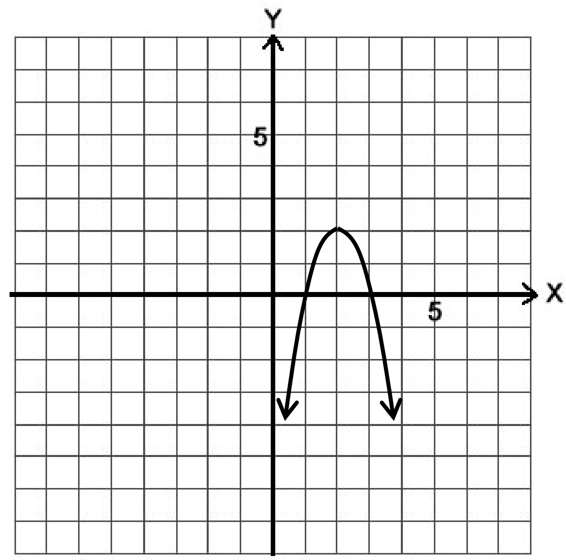


5. Determine the equation of the relation shown in the graphs below.

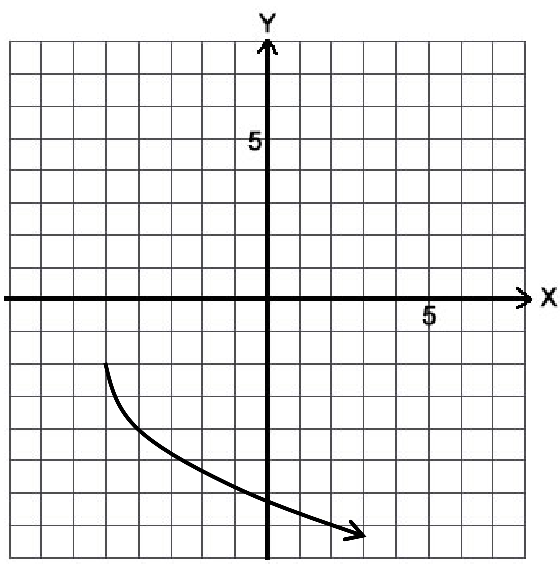
a) y = ____________________________



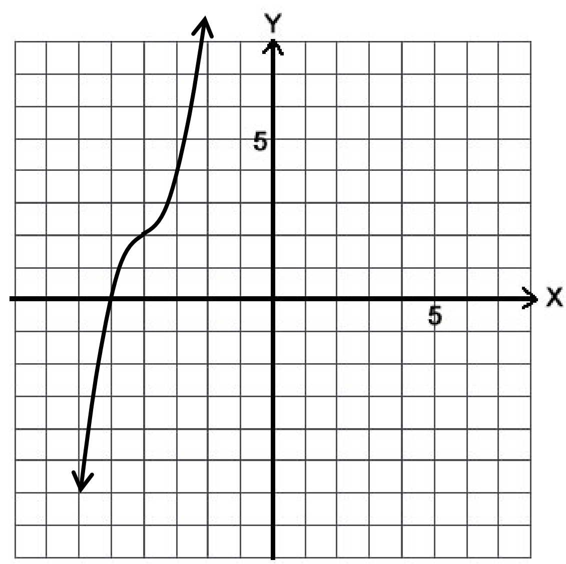
b) y = ____________________________



c) y = ____________________________



d) y = ____________________________



6. Prepare these equations for transformations.

a) $y = \sqrt{2x - 6} + 7$ ____________________________

b) $y = 2|3x + 12|$ ____________________________

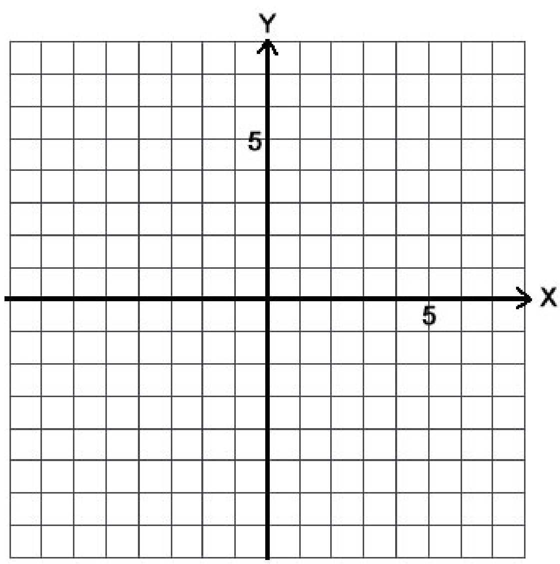
c) $y = -f\left(\frac{1}{3}x + 3\right)$ ____________________________

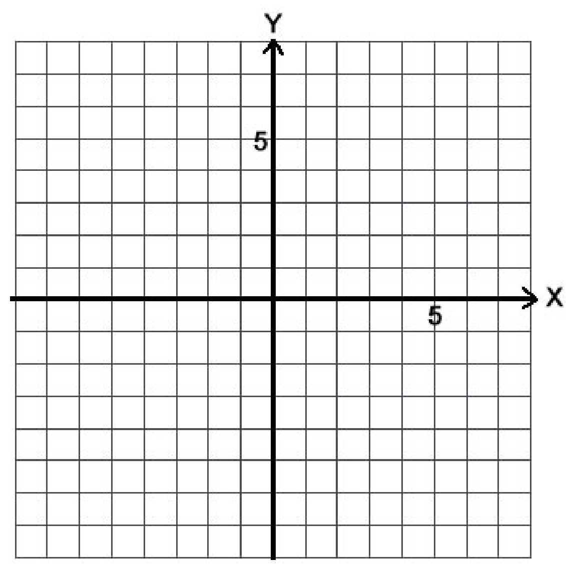
d) $y = f(-x + 2) - 1$ ____________________________

7. Sketch the transformed functions without using technology (or a table).

a) $y = |2x - 6| + 1$

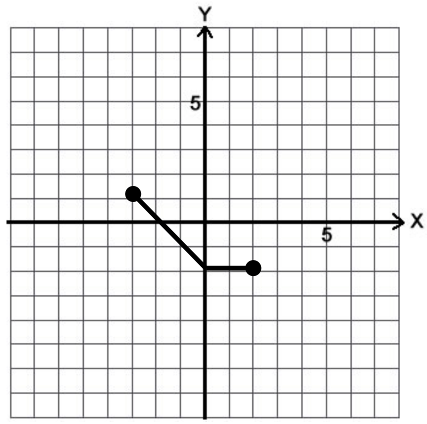
b) $y = -\sqrt{\frac{1}{2}x - 1} + 2$

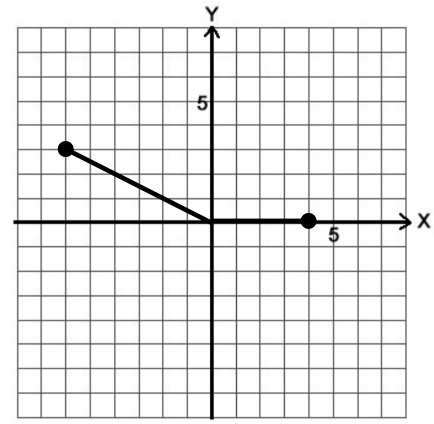




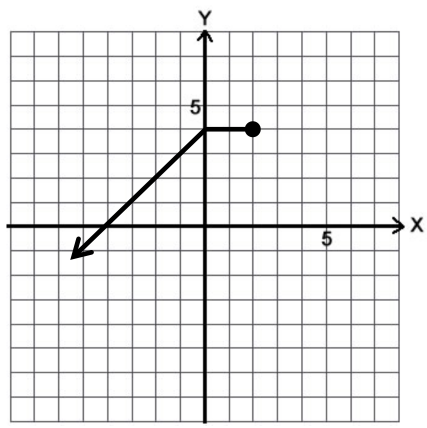
8. The graph of the function y = f(x), on the left, has been transformed to generate the graph on the right. Determine the transformations and the equation of the graph on the right.

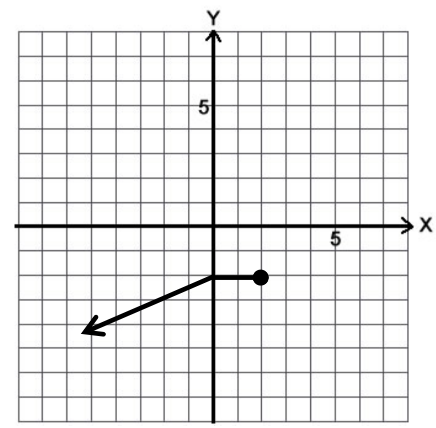
a)



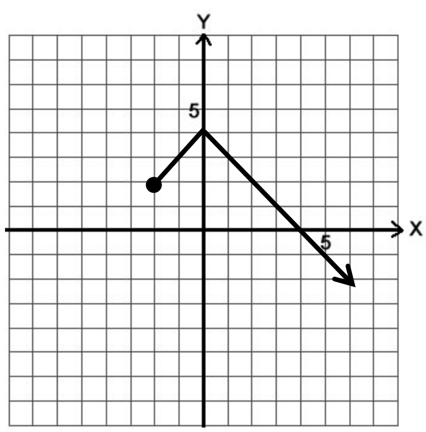


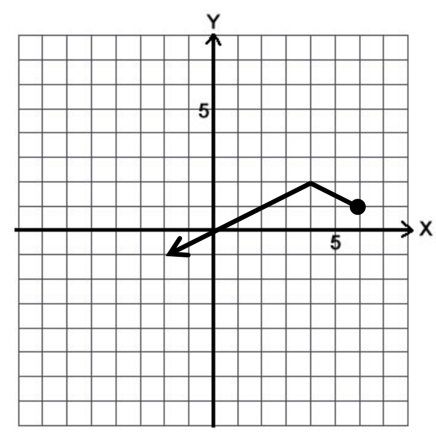
b)





c)





9. If the point (12, 24) is on the graph of $y = f(x)$, then what point must be graphs of each of the following functions? Explain your answer in terms of transformations!

a) $y = -f(x) + 5$

b) $y = f(2x) - 7$

c) $y = \frac{1}{3}f(x + 5) - 2$

d) $y = -2f(x) + 10$

e) $y = -f(2x - 8) + 2$

ANSWER KEY

Lesson 2.1 Graph Trends

1. a) pos Linear (d=1) b) neg Quartic (d=4) c) neg cubic (d=3) d) pod Quartic (d=4)
   e) pos Quintic (d=5) f) Pos Quadratic (d=2) g) pos Constant (d=0) h) pos Cubic (d=3)
2. a) Start Q2 -> End Q1 b) Start Q3 -> End Q1 c) Start Q3 -> End Q4 d) Start Q2 -> End Q4
3. a) 0-4 Solutions, graphs may vary b) 0-2 Solutions, graphs may vary c) 1-5 Solutions, graphs may vary
4. a) Absolute Value b) Square Root c) Square Root d) Exponential e) Absolute Value
5. a) Square Root b) Exponential c) Square Root d) Exponential e) Absolute Value

Lesson 2.2 Functions, Domain & Range

1. Vertical Line Test 2. Watch for y^2 or |y| within the equation.
3. a) no b) yes c) yes d) no e) yes f) no
4. a) yes b) No 5. a) yes b) no, y^2 c) yes d) yes e) yes f) no, y^2
6. a) f(18) b) f(n) c) g(-5) d) f(7x) e) h(x+3)
7. a) f(8)=19 b) h(6)=35 c) h(5)=24 d) g(-12)=8 e) g(-4)=4
8. a) When x=-7, y=-4 f(-7) = -4 b) When x=6, g=1 f(6) = 1 c) When x=-3, h=0 f(-3) = 0
   d) When f=2, x=-2 f(-2) = 2 e) When g=-4, x=-2,-9 f(-2)= -4 and f(-9)= -4 f) When h=1, x=-5 f(-5)=1
   g) 2 + 8 = 10 9. Answers may vary
10. a) Domain: $x \in R$ Range: $y \geq 2$ Func: yes b) Domain: $x \in R$ Range: $y \leq 3$ Func: yes
   c)Domain: $x \in R$ Range: : $y \in R$ Func:: yes d)Domain: {0,2,3} Range{1,2,5} Func: yes
   e) Domain: $-3 \leq x \leq 3$Range: $-3 \leq y \leq 3$ Func: yes f) Domain: - $x \geq 2$ Range: - $y \in R$
   Func: no g)Domain: $x \geq -2$ Range: $y \geq 1$ Func: yes h) Domain: $x \leq 3$ Range: $y = 3$Func: yes
   i) Domain: $-2 \leq x < 2$ Range$-3 \leq y < 5$ Func: yes j) domain: x > -2, range: y ≥ -2.8, Function: yes
   k) domain: x Î R, range: y ≥ -2.8, Function: yes l) domain: x > 0, range: -3 ≤ y ≤ 3, Function: yes

Lesson 2.3 Translations

1.

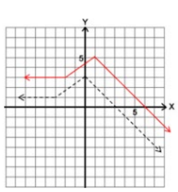
Base Equation	Transformed Equation	Vertical Change	Horizontal Change
$\mathbf{y = \sqrt{x}}$	$y = \sqrt{x+2} - 5$	**5**	**2 left**
$y = x^2$	$\mathbf{y = (x-4)^2 - 1}$	1	4 right
$y = 2^x$	$\mathbf{y = 2^{x+1} + 3}$	3 up	1 left
$\mathbf{y = \lvert x \rvert}$	$y = \lvert x - 1 \rvert + 2$	**2 up**	**1 right**
$y = x^3$	$\mathbf{y = (x+3)^3 + 2}$	2 up	3 left
$y = \sqrt{x}$	$\mathbf{y = \sqrt{x-1} - 2}$	2	1 right
$\mathbf{y = x^2}$	$y - 7 = (x+5)^2$	**7 up**	**5 left**
y=f(x)	**y=f(x+2) + 1**	1 up	2 left
y=g(x)	y=g(x+2) - 3	**3**	**2 left**

2. a) $y = (x+2)^2 - 2$ b) $y = \sqrt{x} + 2$
   c) $y = |x + 1| - 7$ d) y = f(x-11)
   e) y = f(x+4) + 2 f) y = f(x-4) - 3

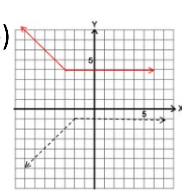
3.

Base	Transformed	Example Point	Point's New
y = f(x)	y = f(x+1) + 1	(-1, 1)	(-2, 2)
y = g(x)	y = g(x-2) - 3	(0, -1)	(2, -4)
y = f(x)	y = f(x+2) + 1	(-3, 4)	(-5, 5)
y = g(x)	y = g(x-1) - 3	(0,8)	(1, 5)

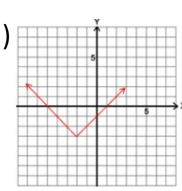
4. a)



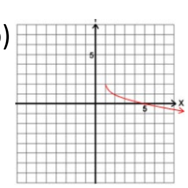
b)



5.a)



b)



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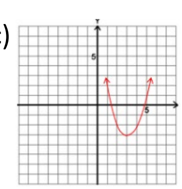
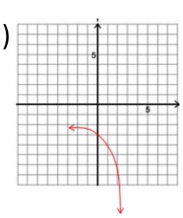


d)



6. a) y = |x-4| + 2 b) y = $(x+5)^2 - 2$ c) $y = -\sqrt{x+2}$ d) y = $(x-3)^3$ - 2

Lesson 2.4 Vertical Compressions & Expansions

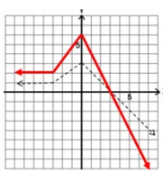
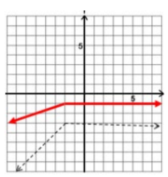
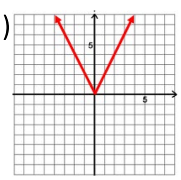
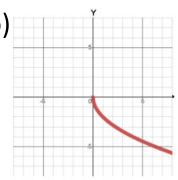
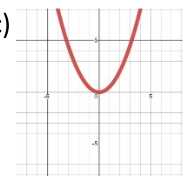
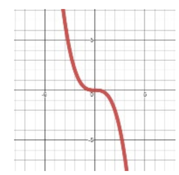
1.

Base Equation	Transformed Equation	Vertical Exp. or	By a Factor
$y = \sqrt{x}$	$y = \sqrt{x+2} - 5$	V Exp	2
$y = x^2$	$y = 3x^2$	V Exp	3
$y = 2^x$	$2y = 2^x$	V	2
y = |x|	3y = |x − 1| + 2	V	3
$y = x^3$	$y = 5x^3$	V Exp	5
$y = \sqrt{x}$	$4y = \sqrt{x}$	V	4
$y = x^2$	$\frac{1}{4}y = (x+5)^2$	V Exp	4
y=f(x)	y = ½ f x)	V	2
y=g(x)	y=2g(x+2) - 3	V Exp	2

2. a) $y = 2x^2 + 8$ b) $y = 1/2|3x|$
c) $y = 1/4(x+6)^3 + 2$ d) $y = 3f(x-6)$
e) $y = 10f(x-1)$ f) $y = f(x-3) + 4$

3.

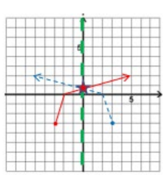
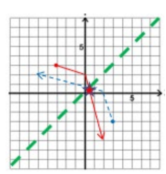
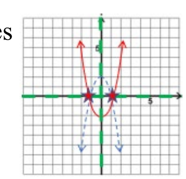
Base Equation	Transformed Equation	Example Point	Point's New Location
y=f(x)	y-3f(x)	(-1, 1)	**(-1, 3)**
y=g(x)	**y=** $\frac{g(x)}{2}$ **ory=** $\frac{1}{2}$g(x)	**(0, -2)**	(0, -1)
y=f(x)	**y=-2f(x)**	(-3, 4)	**(-3, -8)**
y=g(x)	$y = \frac{1}{3}g(x)$	**(-2, 2)**	(-2, $\frac{2}{3}$)

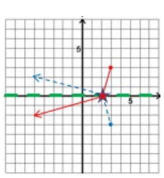
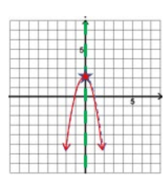
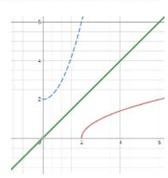
4. a)  b)  5.a)  b)  c)  d) 

6. a) $y = \frac{1}{3}|x|$ b) $y = -2x^2$ c) $y = -2\sqrt{x}$ d) $y=2x^3$

Lesson 2.5 Reflections and Inverse

1. a) Horizontal Reflection in the y axis b) Vertical Reflection in the x axis c) Inverse, Reflection in the line y=x
2. answers may vary 3. a) Invar pts on the y axis b) Invar pts on the x axis c) Invar pts are on the line y=x
4. a) $y = -x^2$ b) $y = (-x)^3$+4 c) $y = -|x| + 2$ d) $y = -\sqrt{16 - x^2}$ e) $y = \sqrt{9 - (-x)^2}$
   f) $x = f(y) + 5$ *or* $f(y) = x - 5$ g) $y = -2f(-x+3)$ h) $x = f(y-1) + 2$
5. a) (2,-7) b) (-2,7) c) (-2,-7) d) (7,2) 6. Answers may vary
7. a) Invariant points lie on the line of reflection, the y-axis, when x=0
   b) Invariant points lie on the line of reflection, the x-axis, when y=0
   c) Invariant points lie on the line y = x
8. a) y = x+5 b) $\boldsymbol{y = \frac{1+x}{x}}$ c) $\boldsymbol{f^{-1}(x) = \pm\sqrt{x+3}}$ d) $\boldsymbol{g^{-1}(x) = \sqrt[3]{x-2}}$

9. a) yes  b) yes  c) yes 

d) yes  e) yes  f) yes 

Lesson 2.6 Horizontal Compressions & Expansions

1.

Base Equation	Transformed Equation	Horiz Exp. or	By a Factor
$y=\sqrt{x}$	$y=\sqrt{2x+2}-5$	H Comp	2
$y=x^2$	$y=(\frac{1}{3}x)^2$	H Exp	3
$y=2^x$	$y=2^{2x}$	H Comp	2
$y=\lvert x\rvert$	$y=\lvert 3x-1\rvert+2$	H Comp	3
$y=x^3$	$y=(\frac{1}{5}x)^3$	H Exp	5
$y=\sqrt{x}$	$y=\sqrt{4x}$	H Comp	4
$y=x^2$	$y=\left(\frac{1}{4}x+5\right)^2$	H Exp	4
f(x)	y = f(1/2 x)	H Comp	2
$g(x)$	$g(\frac{1}{2}x+2)-3$	H Exp	2

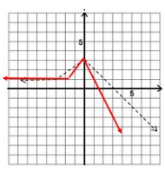
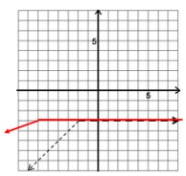
2. a) $y=(\frac{1}{2}x)^2+4$ b) $y=\lvert 6x\rvert$

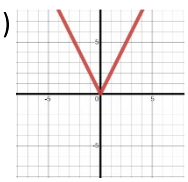
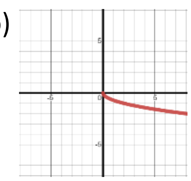
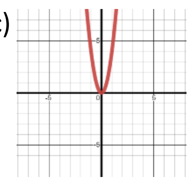
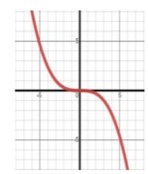
c) $y=(4x+6)^3+8$ d) $y=f(\frac{1}{3}(x-18))$

e) $y=2f\left(\frac{1}{5}(x-5)\right)$ f) $y=f(x-3)+4$

3.

Base Equation	Transformed Equation	Example Point	Point's New Location
y=f(x)	y= f(2x)	(-2, 2)	**(-1, 2)**
y= g(x)	$y=g(\frac{x}{3})$	(0, -1)	(0, -1)
y=f(x)	**y = f(3x)**	(-3, 4)	(-1, 4)
y= g(x)	$y=g(\frac{x}{2})$	**(-2, 0)**	(-4, 0)

4. a)  b) 

5.a)  b)  c)  d) 

6. a) $y=\lvert\frac{1}{3}x\rvert$ b) $y=-(\sqrt{2}x)^2$ c) $y=-\sqrt{4x}$ d) $y=(\sqrt[3]{2}x)^3$

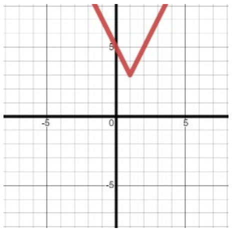
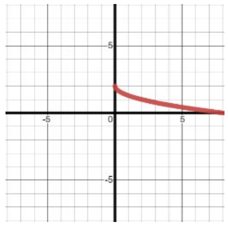
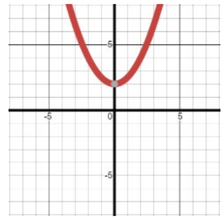
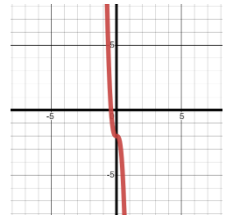
Lesson 2.7 Combinations

1.

Transformation	Equation y=f(x) becomes	Point (x,y) becomes	Graph becomes
Vertical Translation (up) by a	y=f(x) + a	(x, y+a)	shift up by a
Vertical Translation (down) by a	y=f(x) - a	(x, y-a)	shift down by a
Horizontal Translation (left) by a	y=f(x+a)	(x-a, y)	shift left by a
Horizontal Translation (right) by a	y=f(x-a)	(x+a, y)	shift right by a
Vertical Reflection	y=-f(x)	(x, -y)	reflect x-axis
Horizontal Reflection	y=f(-x)	(-x, y)	reflect y-axis
Vertical Expansion (|a| > 1)	y=af(x)	(x, ay)	v expand by a
Vertical Compression (0 < |a| < 1)	y=af(x)	(x, ay)	v compr by 1/a
Horizontal Expansion (0< |b| < 1)	y=f(bx)	(x/b, y)	h expand by 1/b
Horizontal Compression (|b| > 1)	y= f(bx)	(x/b, y)	h compr by b

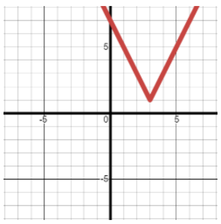
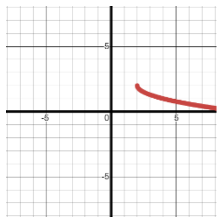
2. Reflections -> Expansion/Compressions -> Translations

3. a) $y=f\left(\frac{1}{3}(x+2)\right)$ b) $y=-2f(x)-3$ c) $y=f(-3(x-4))+2$

4. a)

b)

c)

d)


5. a) $y = \frac{1}{3}|x+1| - 4$ b) $y = -2(x-2)^2 + 2$ c) $y = -2\sqrt{x+5} - 2$ d) $y = 2(x+4)^3 + 2$

6. a) $y = \sqrt{2(x-3)} + 7$ b) $y = 2|3(x+4)|$ c) $y = -f\left(\frac{1}{3}(x+9)\right)$ d) $y = f(-(x-2)) - 1$

7. a)

b)


8. a) $y = f\left(\frac{1}{2}x\right) + 2$ b) $y = \frac{1}{2}f(x) - 4$ c) $y = \frac{1}{2}f(-(x-4))$

9. a) (12,-19) b) (6,17) c) (7,6) d) (12,-38) e) (10,-22)