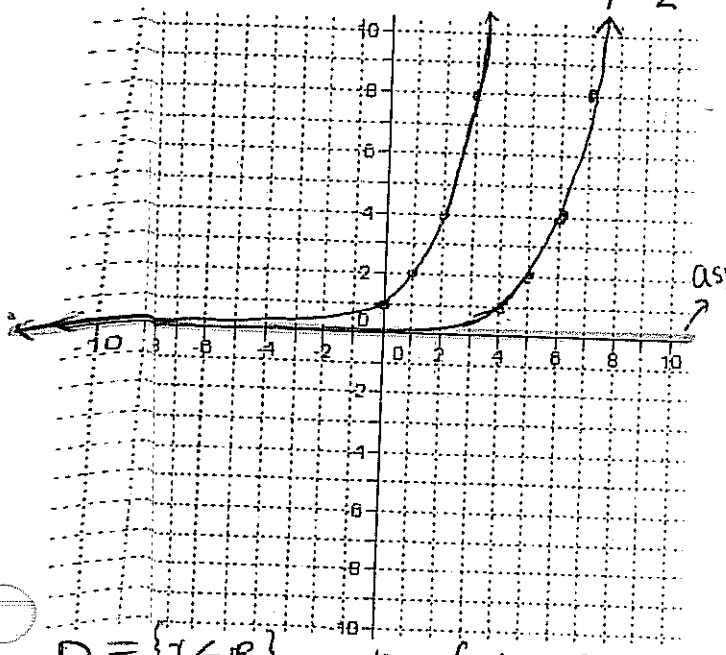
Recall: If a number is added to or subtracted from x, what happens?
For example, what transformations are applied to the graph of $y = x^2$ to get
$y = (x-2)^2$ It shift the graph by 2 units (to the right)

What makes $(x-2) = 0$? $\rightarrow$ $x = 2$

$y = 2^x$

$y = 2^{(x-4)}$ $\rightarrow$ shift it by 4 to the right.

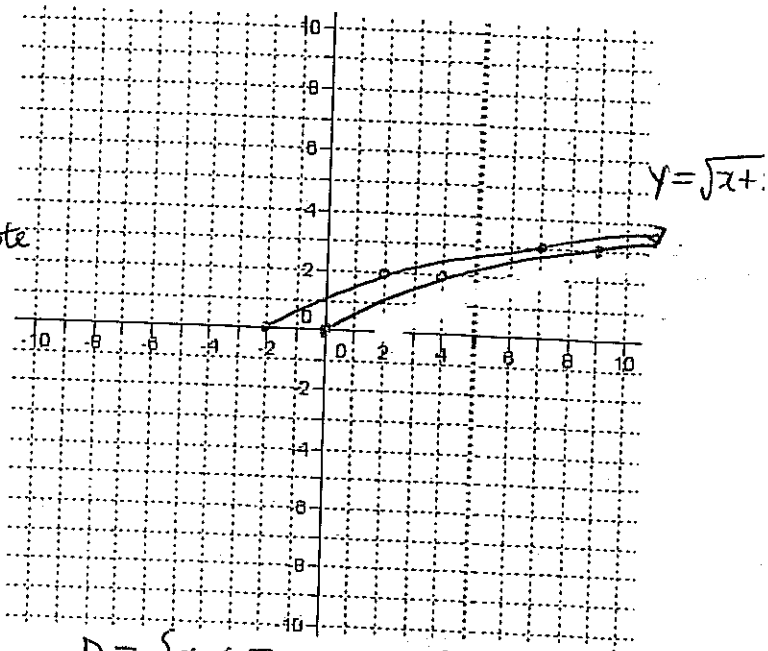
$Y = 2^{x-4}$



$D = \{x \in \mathbb{R}\}$ $R = \{y \in \mathbb{R}, y > 0\}$

$y = \sqrt{x}$

$y = \sqrt{x+2}$ shift by 2 to the left

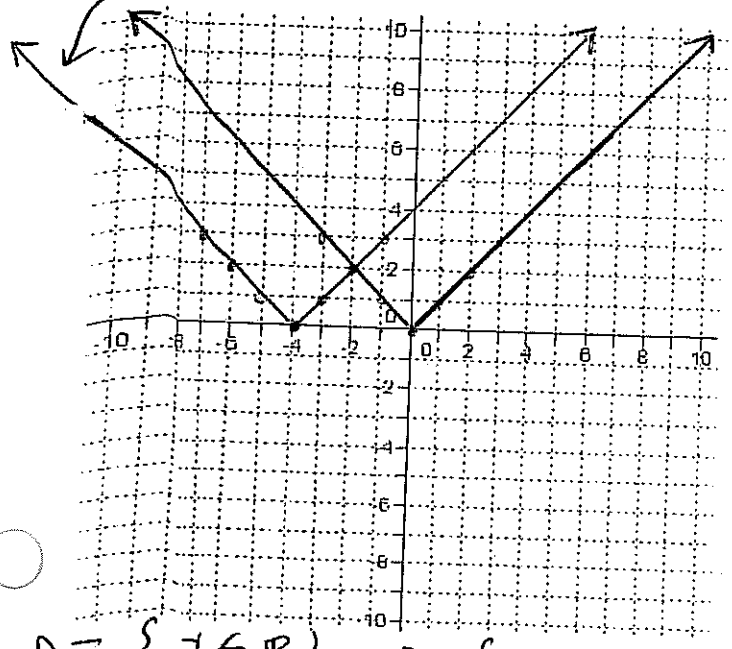


$D = \{x \in \mathbb{R}, x \geq -2\}$ $R = \{y \in \mathbb{R}, y \geq 0\}$

parent function

$y = |x|$

offspring function $y = |x+4|$ $\rightarrow$ shift the graph by 4 to the left.

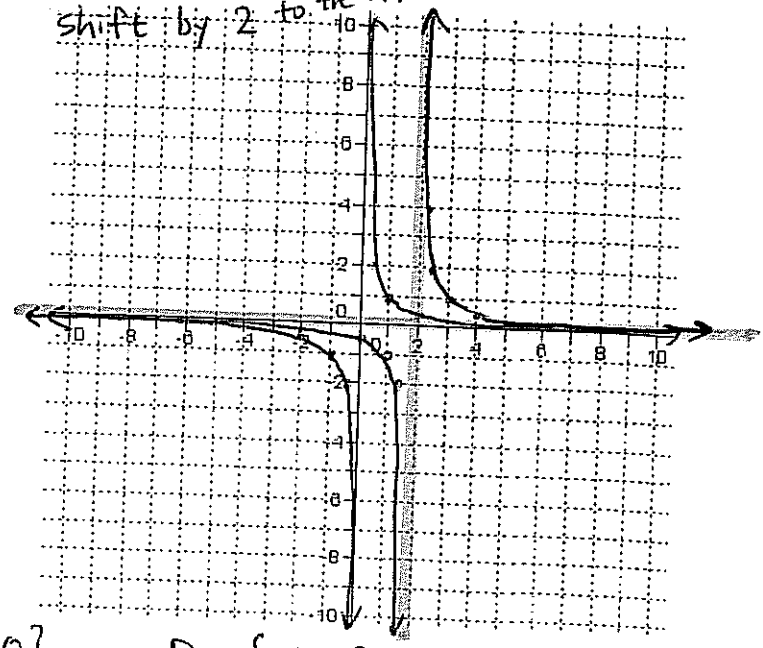


$D = \{x \in \mathbb{R}\}$ $R = \{y \in \mathbb{R}, y \geq 0\}$

$y = \frac{1}{x}$

$y = \frac{1}{x-2}$ 2 assymtotes: $x = 2$ and $y = 0$

shift by 2 to the right.



$D = \{x \in \mathbb{R}, x \neq 2\}$

$R = \{y \in \mathbb{R}, y \neq 0\}$

Feb 26

SUMMARY (Translation)

$f(x) + c$ moves the graph of $f(x)$ up or down (by c)

↳ Vertical Translation

$f(x - d)$ moves the graph of $f(x)$ left or right (by a number which makes $x - d = 0$) → Horizontal Translation

Combining Vertical and Horizontal Translations

a. $y = |x + 3| + 1$ is a translation of $y = |x|$.

Offspring function ↙ ↘ parent function

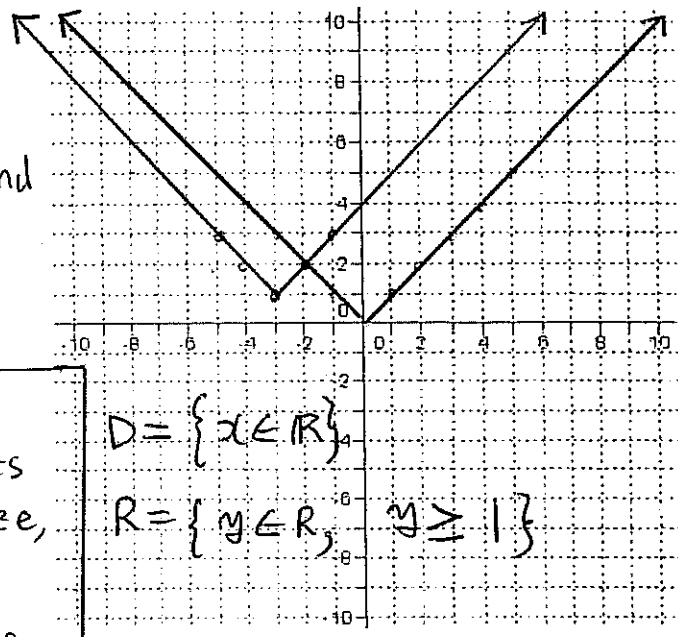
Describe the translations

shift the graph to left by 3 units and

// // up by 1 unit.

Graph both functions

$y = |x+3| + 1$



$D = \{x \in \mathbb{R}\}$

$R = \{y \in \mathbb{R}, y \geq 1\}$

Def of Translation: It shifts a graph horizontally, vertically or both. It results in a graph of the same shape and size, but in a different position.

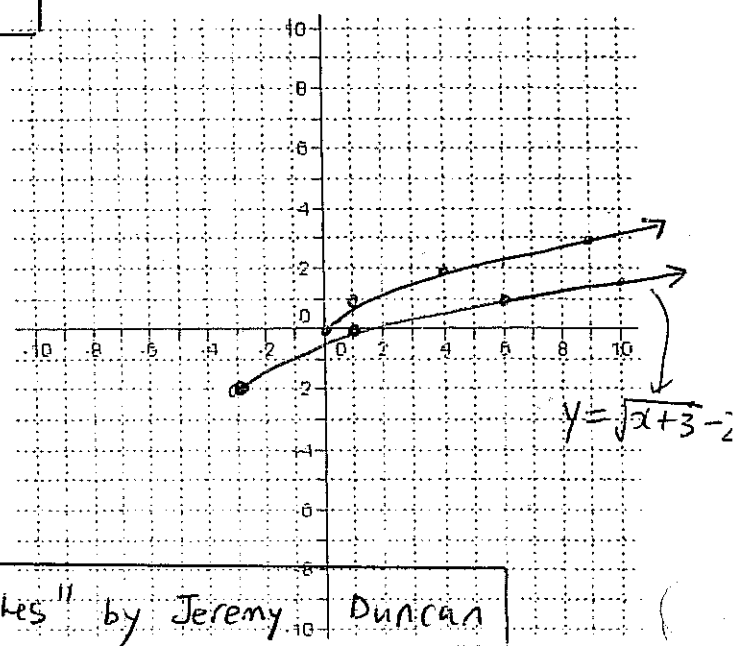
* Transformation includes transalation (or shifting) stretches and reflections.

b. $y = \sqrt{x+3} - 2$ is a translation of $y = \sqrt{x}$.

Describe the translations.

It shifts 3 units to the left and

it shifts 2 units down.



$D = \{x \in \mathbb{R}, x \geq -3\}$

$R = \{y \in \mathbb{R}, y \geq -2\}$

Youtube: ① "Transformations of Functions — Algebra Tutorial" → Review of Grade 10 Math

② "Graphing Transformations" by integral calc

③ "Parent Functions, Translations, Stretches" by Jeremy Duncan

Homework: pg. 102 #(2-5)ac, 6bdfhj, 8, 13*, 15, 17*

↓

For Feb 26

Quiz on March 4 (Wed) and Unit Test on March 9 (Monday)

Comparing functions of the form $y = f(x)$ and $y = -f(x)$.

1. Draw and label each graph on the grid provided. Use a table of values if necessary.

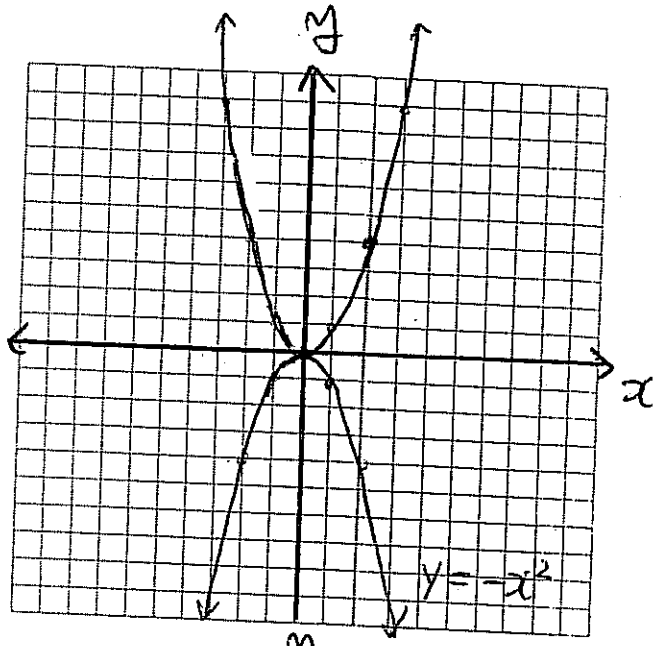
(1a) $y = x^2 \rightarrow f(x)$

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

* Offspring function is a reflection of parent function in x axis, if we add − sign in front of f(x)

$D = \{x \in \mathbb{R}\}$

$R = \{y \in \mathbb{R},\ y \leq 0\}$



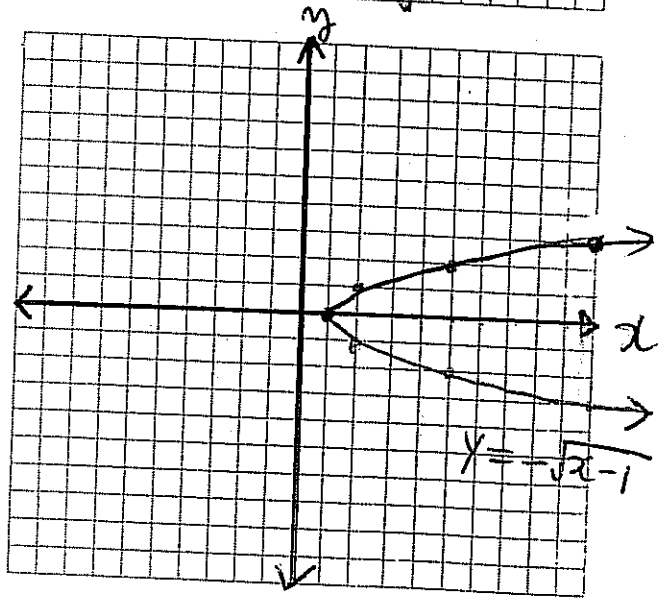
(1b) $y = \sqrt{x-1} = f(x)$

$y = -\sqrt{x-1} = -f(x)$

* Offspring function is a reflection of parent function in x axis.

$D = \{x \in \mathbb{R},\ x \geq 1\}$

$R = \{y \in \mathbb{R},\ y \leq 0\}$



Which axis were the above equations reflected in? x axis

Which points were unchanged in the reflection? Vertex point

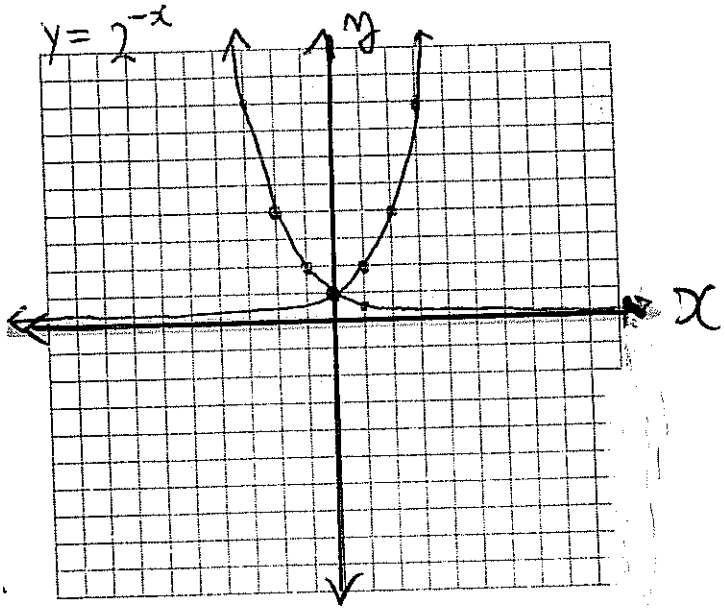
Points that remain unchanged in a transformation are said to be *invariant.*

Where are the unchanged points found? x axis

2. **Comparing functions of the form $y = f(x)$ and $y = f(-x)$.**

Graph and label each equation on the grid provided. Use a table of values if necessary.

(2a) $y = 2^x \rightarrow f(x)$
$y = 2^{-x} \rightarrow f(-x)$



* offspring function is a reflection of parent function in y axis.

$D = \{x \in \mathbb{R}\}$

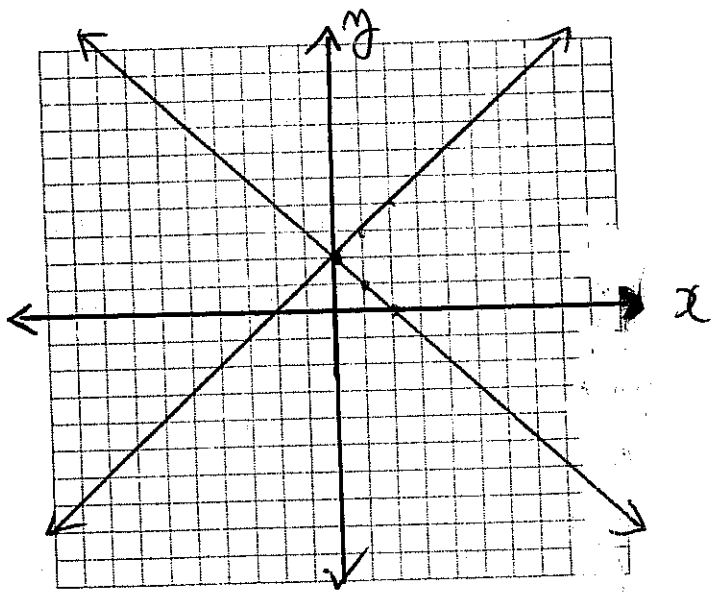
$R = \{y \in \mathbb{R},\ y > 0\}$

* → $y = 2^{-x}$

x	y
0	1
2	$\frac{1}{4}$
-2	4

(2b) $y = x + 2$
$y = (-x) + 2$

x	y
0	2
1	1
2	0



$D = \{x \in \mathbb{R}\}$

$R = \{y \in \mathbb{R}\}$

Which axis were the above equations reflected in? y axis

Which points are invariant? (0, 2) and (0, 1)

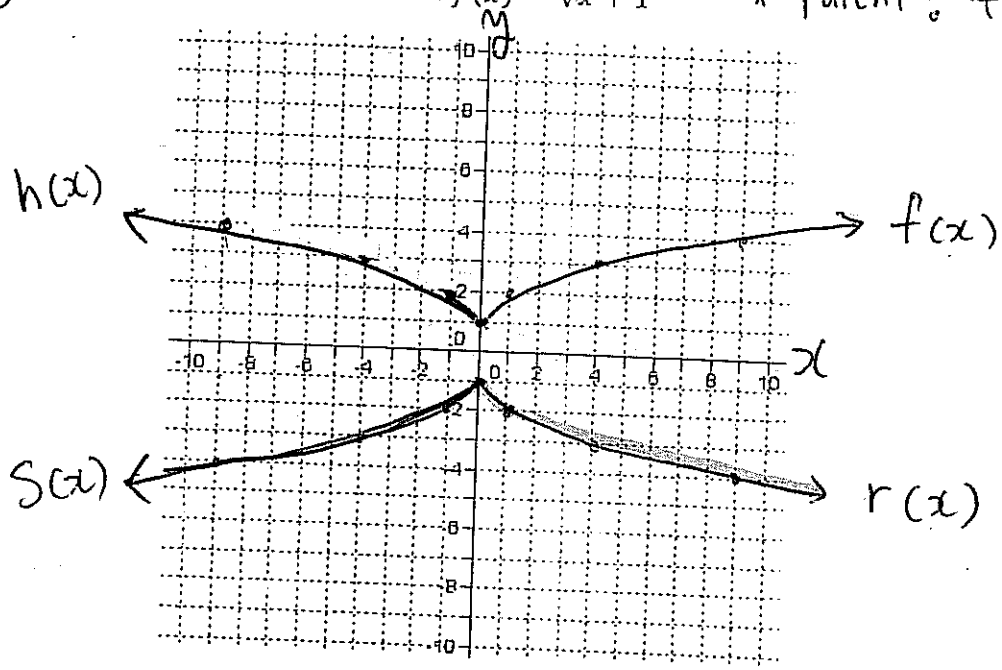
Where are the invariant points found? y axis

The graph of $f(-x)$ is a reflection of the graph of $f(x)$ in y-axis $(-x, y)$
↳ example is (2a) and (2b)

The graph of $-f(x)$ is a reflection of the graph of $f(x)$ in x-axis $(x, -y)$
↳ example is (1a) and (1b)

The graph of $-f(-x)$ is a reflection of the graph of $f(x)$ in x-axis and $(-x, -y)$ y-axis.

Example 1 Graph and label the reflections of $f(x) = \sqrt{x} + 1$ * parent: $f(x) = \sqrt{x}$



State the domain and range of each function. and Graph them.

a) $f(x)$ $D = \{x \in \mathbb{R},\ x \geq 0\}$

$R = \{y \in \mathbb{R},\ y \geq 1\}$

b) $h(x)$: a reflection in the y-axis of $f(x)$.

↳ $D = \{x \in \mathbb{R},\ x \leq 0\}$, $R = \{y \in \mathbb{R},\ y \geq 1\}$

c) $r(x)$: a reflection in the x-axis of $f(x)$

$D = \{x \in \mathbb{R},\ x \geq 0\}$, $R = \{y \in \mathbb{R},\ y \leq -1\}$

d) $s(x)$: a reflection in the y-axis and then a reflection in the x-axis

$D = \{x \in \mathbb{R},\ x \leq 0\}$, $R = \{y \in \mathbb{R},\ y \leq -1\}$

Example 2 For each function $f(x)$, determine the equation for $g(x)$.

a) $f(x) = \sqrt{x-3} + 2$ $\quad g(x) = -f(x)$

$g(x) = -(\sqrt{x-3} + 2)$

$= -\sqrt{x-3} - 2$

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

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

c) $f(x) = (x-3)^2 + 1$ $\quad g(x) = -f(-x)$

$g(x) = -[(-x-3)^2 + 1]$

$=$

d) $f(x) = (x-1)^2 - 1$ $\quad g(x) = -f(x)$

$g(x) = -[(x-1)^2 - 1]$

$= -(x-1)^2 + 1$

e) $f(x) = \sqrt{x+4} - 2$ $\quad g(x) = f(-x)$

$g(x) = \sqrt{-x+4} - 2$

f) $f(x) = \frac{1}{x+1} + 4$ $\quad g(x) = -f(-x)$

$g(x) = -(\frac{1}{-x+1} + 4)$

$g(x) =$

Homework: pg. 110 #(2-4)EOO, 5, 6, 7, 12, 13,14*, 15*

HW for Feb 27

Feb 21 (Thursday) MCR3U 11:10

P102 #2. a) $b(x) = f(x)$ → only y value will shift up by 5

$A' = (-4, 7)$ $B' = (-2, 7)$ $C' = (-1, 3)$

$D' = (1, 3)$ $E' = (2, 4)$ $F' = (4, 4)$

#2 c) $h(x) = f(x-8)$ → only x coordinate will be shift to the right by 8.

$A' = (4, 2)$ $B' = (6, 2)$ $C(7, -2)$

$D' = (9, -2)$, $E'(10, -1)$, $F'(12, -1)$

#3 a) $n(x) = f(x-3) + 6$

* x coordinates will shift to the right by 3.
* y coordinate will more up by 6.

$A'(-1, 8)$, $B'(1, 8)$ $C'(2, 4)$

$D'(4, 4)$, $E'(5, 5)$ $F'(7, 5)$

#4 a) $b(x) = f(x) + 3$

↳ only y coordinate will move up by 3.

$A(-4, -2) \rightarrow A' = (-4, 1)$

c) $h(x) = f(x-4)$

↳ only x coordinate will move to the right by 4

$A(-4, -2) \rightarrow A' = (0, -2)$

#5 a) $m(x) = f(x-2) + 10$

* x coordinate will move to the right by 2.
* y // // up by 10.

$A(-4, -2) \rightarrow A' = (-2, 8)$

c) $s(x) = f(x+8) + 9$

* x coordinate will move to the left by 8
* y // // // up by 9.

$A(-4, -2) \rightarrow A' = (-12, 7)$

#6.

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

parent function is $f(x) = \frac{1}{x}$ so $g(x) = f(x-2)$

so you translate it 2 units to right. Asymptote ($x=0$)

will move to the right by 2. New Asymptote $x=2$

#6j) $g(x) = \frac{1}{x+3} - 8$

parent function is $f(x) = \frac{1}{x}$ so $g(x) = f(x+3) - 8$

so you shift it 3 units to the left and 8 units down.

New asymptote $x = -3$