GRADE 11
Functions 2 ANSWERS
WEBSITE NOTES

TOPIC:

- Revise the effect of *a* and *q* and investigate the effect of p on the graphs of the functions defined by:
- $y = f(x) = a(x + p) + q$
- $y = f(x) = a(x + p)^2 + q$
- $y = f(x) = a(x + p)^2 + q$
- $y = f(x) = \dfrac{a}{x + p} + q$

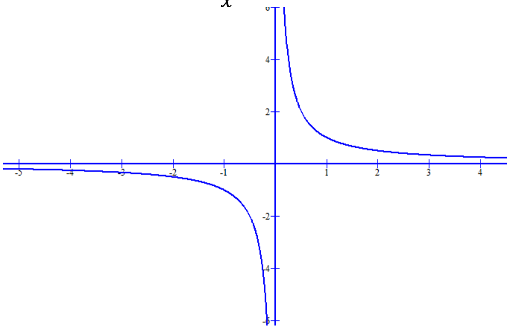
REMEMBER THE FOLLOWING

Function change	Shift
f(x) + c	Shift the graph of f(x) up c units
f(x) - c	Shift the graph of f(x) down c units
f(x + c)	Shift the graph of f(x) left c units
f(x - c)	Shift the graph of f(x) right c units
-f (x)	Reflect the graph of f(x) about the x-axis
f (-x)	Reflect the graph of f(x) about the y-axis
f(c.x)	Compress the graph of f(x) horizontally by a factor of c.
c.f(x)	Stretch the graph of f(x) vertically by a factor of c.

Hyperbola
VERTICAL SHIFTS

$$f(x) = \frac{a}{x+p} + q$$

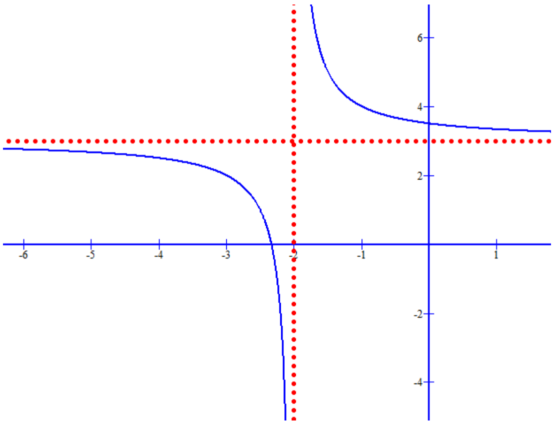
$$consider\ f(x) = \frac{1}{x}$$



The Vertical asymptote is x = 0
The Horizontal asymptote y = 0

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

If p = 2 the hyperbola will shift 2 units to the left. The vertical asymptote is x = -2 now.
If q = 3 the hyperbola will shift 3 units up. The Horizontal Asymptote is y = 3 now.

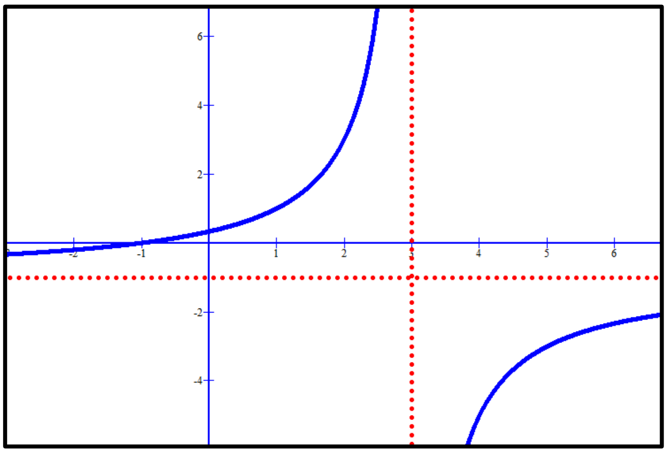


Example 1 (Try yourself)

1. Consider $f(x) = \frac{4}{x-2} + 4$
   a. Describe the shift from the origin
   b. Write down the asymptotes of the function.
2. Consider $f(x) = -\frac{4}{x-3} - 1$
   a. Describe the shift from the origin
   b. Write down the asymptotes of the function.
3. Consider $f(x) = \frac{1}{x+2} - 3$
   a. Describe the shift from the origin
   b. Write down the asymptotes of the function.
4. Consider $f(x) = -\frac{3}{x-1} + 2$
   a. Describe the shift from the origin
   b. Write down the asymptotes of the function.
   c. Write down h(x) if h(x) is the reflection of f(x) about the x-axis
   d. Write down k(x) if k(x) is the reflection of f(x) about the y-axis

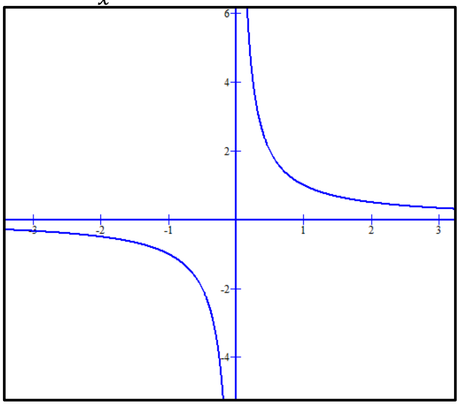
Answers

1.
   a. 2 units right and 4 units up
   b. x = 2 (Vertical Asymptote) and y = 4 (Horizontal Asymptote)
2.
   a. Rewrite as $f(x) = \frac{-4}{x-3} - 1$. The shift is 3 units right and 1 unit down. The -4 at the top indicates the quadrants the graph will be in. In other words, it influences the shape.



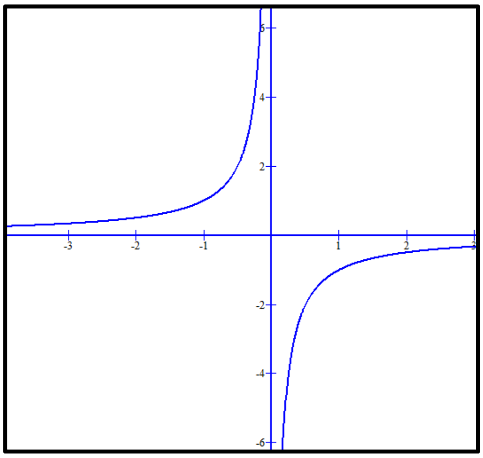
If a is positive, then the graph will be in the first and third quadrants.

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



If a is negative, then the graph will be in the second and forth quadrant.

$f(x) = \frac{-1}{x}$



b. x = 3 and y = -1

3.

a. 2 units left and 3 units down

b. x=-2 and y = -3

4.

a. 1 unit right and 2 units up

b. x = 1 and y = 2

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

The Reflection about x-axis leaves x as is but changes the sign of the entire function. -f(x)

$g(x) = -f(x) = -\left(-\frac{3}{x-1} + 2\right)$

The asymptotes are now x=1 and y= -2

$g(x) = \frac{3}{x-1} - 2$

d. The Reflection about y-axis leaves y as is but changes the sign of the x-value. f(-x)

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

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

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

The asymptotes are now x=-1 and y= 2