## Lesson 9-2
The Reciprocal Function Family

We all know what the reciprocal of a number is: one over the number, the reciprocal of a is $\frac{1}{a}$, the reciprocal of 5 is $\frac{1}{5}$.   Well, functions like inverse variations, are in a reciprocal form, hence we call these functions **reciprocal functions.**   Generally speaking we will see the **x** variable in the denominator: $f(x) = \frac{1}{x}$. Of course reciprocal functions can and will be more complicated so we need to be familiar with the complete form of a reciprocal function which is: $y = \frac{a}{x-h} + k$ (note the restriction on the domain of $x \neq h$). Here again are h and k which translate the parent function.

Graphing
Graph $y = \frac{8}{x}$ and identify vertical and horizontal asymptotes.
1. Make a table of values that include both positive and negative values
2. Graph the points and draw a line
3. Asymptotes will be at domain restrictions, that is where **x c**annot be equal to zero is a vertical asymptote.* No matter how big or small x becomes, y will never be equal to zero, hence, the horizontal asymptote.

X	-3	-2.5	-2	-1.5	-1	1	1.5	2	2.5	3
Y	-2.7	-3.2	-4	-5.3	-8	8	5.3	4	3.2	2.7
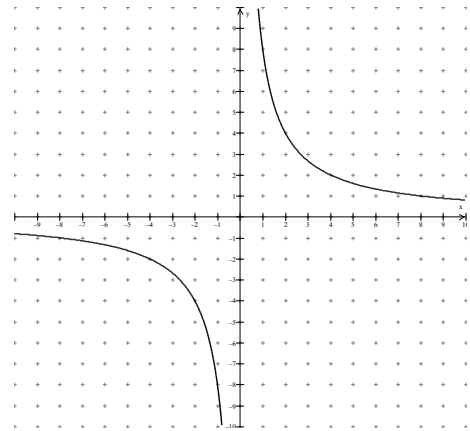
Asymptotes at x=0 and y=0

Asymptotes
Often we can see on the graph what the asymptotes are, but how can we look at the equation and determine the asymptotes? Let's take a look at that general form of a reciprocal function; the "h and k" are significant: $y = \frac{a}{x-h} + k$ The denominator cannot be equal to zero, so set it to zero and solve for x. At $x = h$ we have a vertical asymptote and at $y = k$ we have a horizontal asymptote. So by putting the function into our general form, we can pluck off the asymptotes.

Also, if given a parent reciprocal function and asymptotes, we can develop an equation with the given asymptotes *that will be a translation of the parent function*.

Identify the asymptotes for:
$y = -\frac{2}{x} - 3$

$y = -\frac{2}{x-0} - 3$

$h = 0 \ \ and \ k = -3$

1. write in general form:
2. identify values for **h** and **k**
3. label as asymptotes.

vertical asymptote: $x = 0$
horizontal asymptote $y = -3$
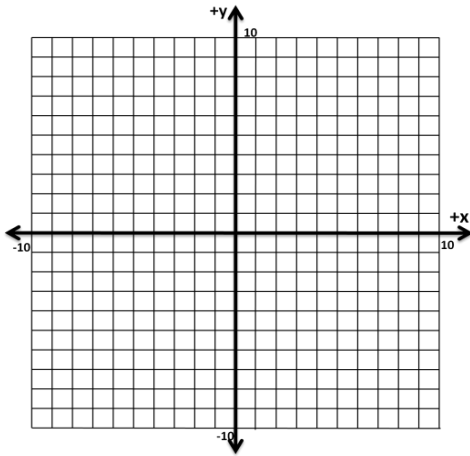
Now try and sketch:
$y = -\frac{10}{x+1} - 8$

1. identify **h** and **k**

2. put reciprocal function **h** and **k** into the general equation

For the reciprocal function of $\frac{2}{x}$ **write the translation given asymptotes of**

$x = -2 \; and \; y = 3$

$h = -2 \; and \; k = 3$

$$y = \frac{2}{x-(-2)} + 3 \; \therefore \; y = \frac{2}{x+2} + 3$$

Graph:

Note: on the graph how the curves shift 2 units to the left and 3 units up

Now try:

Graph the functions and find the approximate point (s) of intersection:

$$y = \frac{3}{x+1} \; , \; y = -4$$