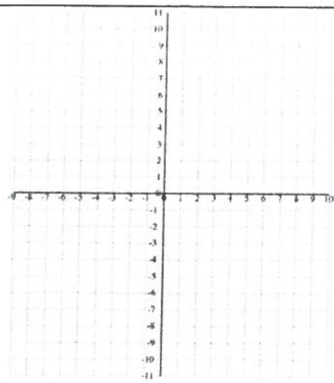
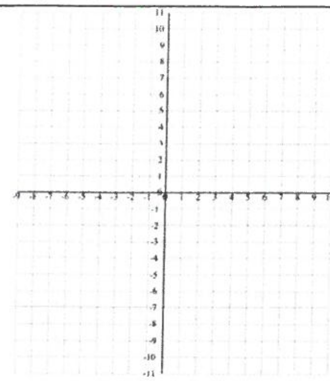
Rewrite $y=\sqrt{4x+16}$ to make it easy to graph using a translation (hint…get it in the form $y=a\sqrt{x-h}$).

11. $y=\sqrt{4x+16}$	12. $y=\sqrt[3]{8x+32}-5$
	

Extra Practice:

1) Given $f(x) = 3x - 2x^2$
Evaluate $f(2x + 2) - f(x)$

2) Given $g(x) = 2x^2 + 4$
Evaluate $g(x - 1) + g(3)$

Day 3: Graphing Inverse Variation

Warm-Up:

$y_1 = 4/(x-3)-1.5$

1) Fill in the following table using the function $y=\dfrac{4}{x-3}-1.5$

x	y
-5	-2
-3	$-13/6 \approx 2.16$
-1	$-5/2 = -2.5$
1	$-7/2 = -3.5$
3	undef. (can't ÷ by 0)
5	$1/2 = 0.5$
7	$-1/2 = -0.5$

← use to check if typed properly in calc

2) Given $f(x)=\sqrt{9x-36}+16$ $=\sqrt{9(x-4)}+16$ factor out 9 (the coeff. on x)

a. Find the vertex form of f(x) $\sqrt{9}\sqrt{x-4}+16$ $y=3\sqrt{x-4}+16$ "opp, same"

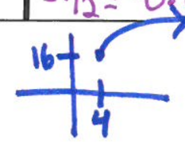
Then, find

b. Its vertex (4, 16)

c. How it is translated from the parent graph stretch vert by 3, translate right 4 + up 16

d. Its domain [4, ∞)

e. Its range [16, ∞)

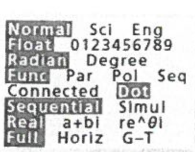


Graphing Inverse Variation

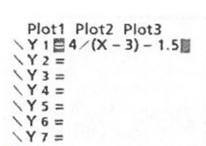
You can use your graphing calculator to graph rational functions. It is sometimes preferable to use the Dot plotting mode rather than the connected plotting mode. The Connected mode can join branches of a graph that should be separated. Try both modes to get the best graph.

Graph $y=\frac{4}{x-3}-1.5$. → $y_1=$

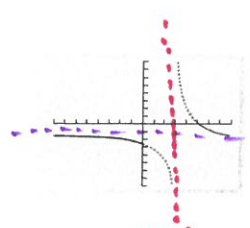
Step 1 Press the MODE key. Scroll down to highlight the word Dot. Then press ENTER.



Step 2 Enter the function. Use parentheses to enter the denominator accurately.



Step 3 Graph the function.

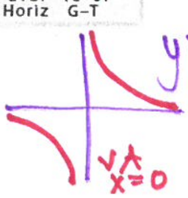


What's happening at x = 3? V. A. (vertical asymptote)

at y = -1.5? H. A. (horizontal asymptote.)

Why? because if x=3, we'd be ÷ by 0 (not ok)

ALSO parent graph translated right 3

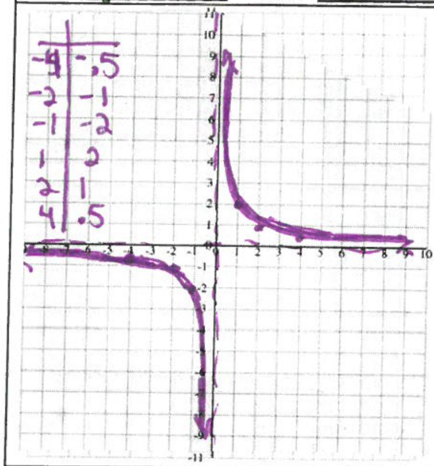


AND only way for y = -1.5 is if $\frac{4}{x-3}=0$ which can't happen ← HA y=-1.5 because translate parent down 1.5

Use your calculator to graph the following. Graph at least 3 points for each branch. Write the equations for the vertical and horizontal asymptotes. Discuss any patterns with your neighbors.

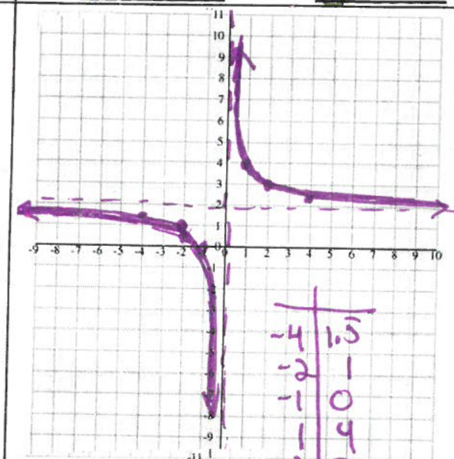
1. $y = \frac{2}{x}$

VA: $x = 0$ HA: $y = 0$



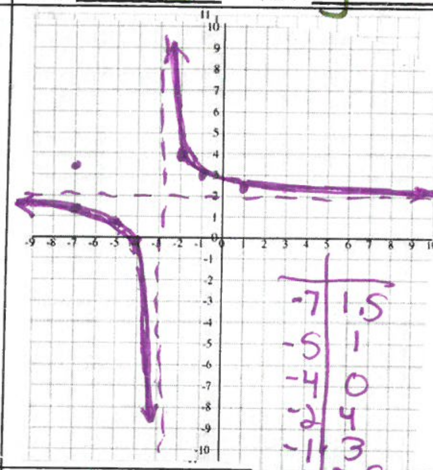
2. $y = \frac{2}{x} + 2$

VA: $x = 0$ HA: $y = 2$



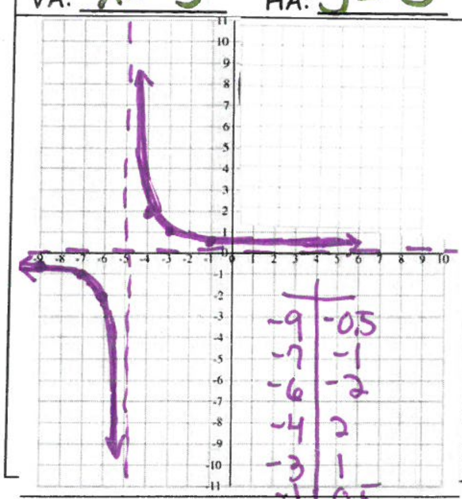
3. $y = \frac{2}{(x+3)} + 2$

VA: $x = -3$ HA: $y = 2$



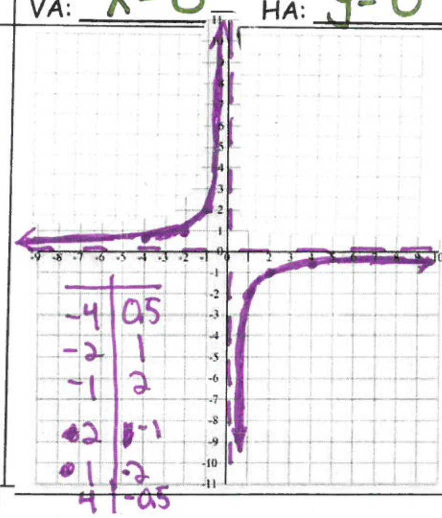
4. $y = \frac{2}{(x+5)}$

VA: $x = -5$ HA: $y = 0$



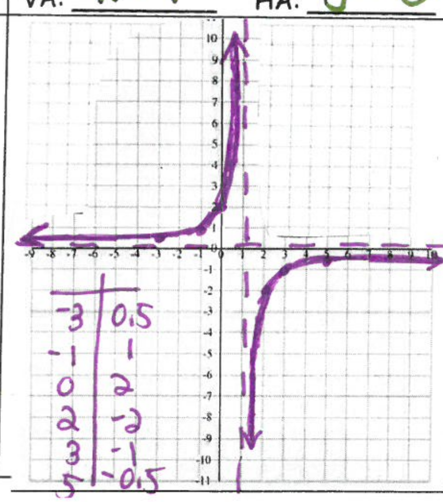
5. $y = -\frac{2}{x}$

VA: $x = 0$ HA: $y = 0$



6. $y = -\frac{2}{(x-1)}$

VA: $x = 1$ HA: $y = 0$



The asymptotes of these graphs can help us to write the domain and range. Let's discuss #3, then #4 together.

3) Domain: $(-\infty, -3) \cup (-3, \infty)$ Range: $(-\infty, 2) \cup (2, \infty)$

$x \neq -3$ ← old way $y \neq 2$ ← old way ← could see this in M.C. (multiple choice)

4) Domain: $(-\infty, -5) \cup (-5, \infty)$ Range: $(-\infty, 0) \cup (0, \infty)$

You Try ~

2) Domain: $(-\infty, 0) \cup (0, \infty)$ Range: $(-\infty, 2) \cup (2, \infty)$

6) Domain: $(-\infty, 1) \cup (1, \infty)$ Range: $(-\infty, 0) \cup (0, \infty)$

What is an "inverse variation?"

- A relationship that can be written in the form $y=\frac{k}{x}$, where k is a nonzero constant and $x \neq 0$
- Inverse variation implies that one quantity will increase while the other quantity will decrease (the inverse, or opposite, of increase).

Examples • temperature on stove + time to cook
• speed traveling + time to get there

Example:
Suppose that putting on the prom at the certain high school costs $4000.

- How much should you charge per ticket if 100 people will come? 200 people? 400 people?
  4000/100 **$40** 4000/200 **$20** 4000/400 **$10**
- What equation could represent this scenario if we let y represent the cost of a ticket and x be number of tickets sold?
  $y=\frac{4000}{x}$

You Try ~
Suppose that hosting a family reunion costs $1000.

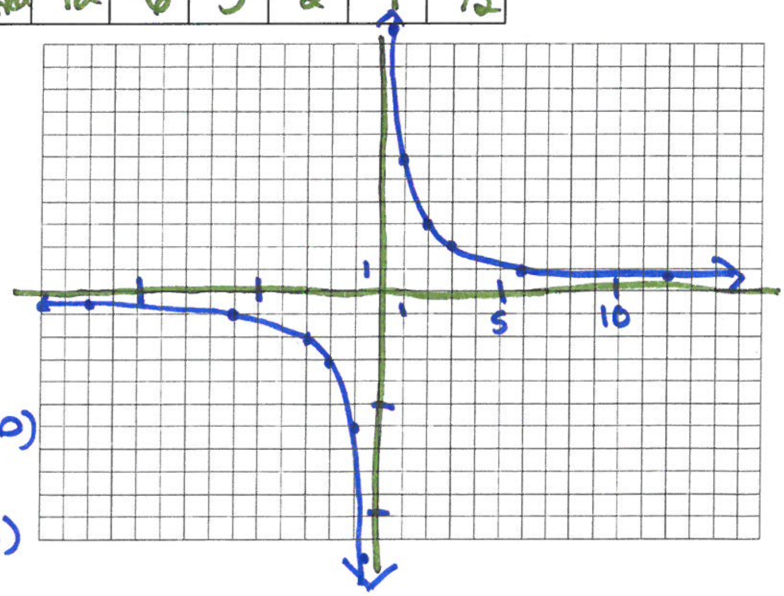
- How much should you charge per ticket if 100 people will come? 200 people? 500 people?
  1000/100 **$10** 1000/200 **$5** 1000/500 **$2**
- What equation could represent this scenario if we let y represent the cost of a ticket to the reunion and x represent number of tickets sold?
  $y=\frac{1000}{x}$
- What is the value of k, the constant?
  K=1000 $1000 cost does not change

How do you graph these by hand? Let's look at $y=\frac{6}{x}$.

pick x-values that are multiples of 6 or factors of 6

First, make a table of values that includes positive and negative values of x.

x	12	6	3	2	1	1/2	0	-1/2	-1	-2	-3	-6	-12
y	$\frac{1}{2}$	1	2	3	6	12	undefined	-12	-6	-3	-2	-1	-1/2
	6/12	6/6	6/3	6/2	6/1	6/(1/2)							



Graph the points and connect them with a smooth curve.
The graph has two parts.
Each part is called a branch.

The $y=0$ is a horizontal asymptote.

The $x=0$ is a vertical asymptote.

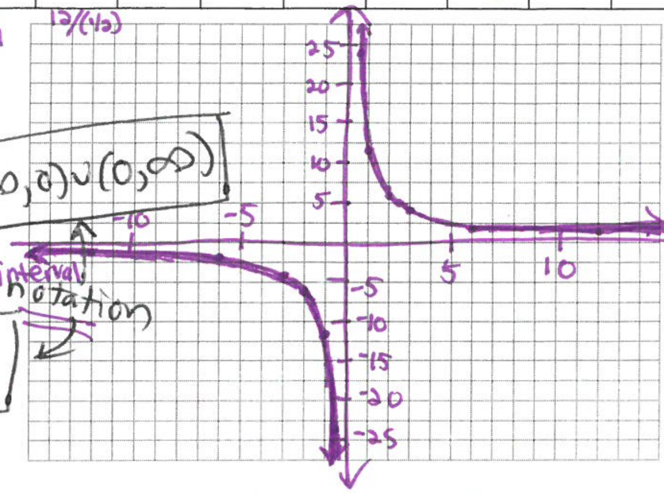
The Domain of the function is all real numbers except for 0. So, $(-\infty,0)\cup(0,\infty)$
$x \neq 0$

The Range of the function is all real numbers except for 0. So, $(-\infty,0)\cup(0,\infty)$
$y \neq 0$

Let's look at $y=\frac{12}{x}$.

x	12	6	3	2	1	1/2	0	-1/2	-1	-2	-3	-6	-12
y	1	2	4	6	12	24	undef.	-24	-12	-6	-4	-2	-1

12/12 12/6 12/3 12/2 12/1 12/(1/2)



Compare this graph to the previous graph.
vertical stretch by 2 (y-values doubled)

What are the asymptotes? H.A: y=0
VA: x=0

What is the Domain? x>0, x<0 or x≠0 or (-∞,0)∪(0,∞)

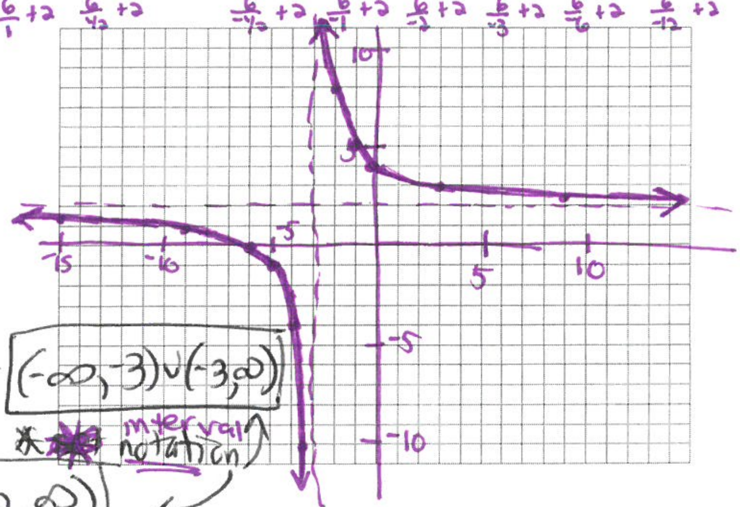
What is the Range? y>0, y<0 or y≠0 or (-∞,0)∪(0,∞) * interval notation

Let's look at $y=\frac{6}{(x+3)}+2$.

translated left 3, up 2 from parent y=6/x

x	9	3	0	-1	-2	-2.5	-3	-3.5	-4	-5	-6	-9	-15
y	2.5	3	4	5	8	14	undef	-10	-4	-1	0	1	1.5

6/12+2 6/6+2 6/3+2 6/2+2 6/1+2 6/(1/2)+2 6/(-1/2)+2 6/-1+2 6/-2+2 6/-3+2 6/-6+2 6/-12+2



Compare this graph to the previous graphs.
compared to y=6/x, it's moved up 2 + left 3

Where is the horizontal asymptote? y=2

Where is the vertical asymptote? X=-3

What is the Domain? x<-3, x>-3 or x≠-3 or (-∞,-3)∪(-3,∞)

What is the Range? y<2, y>2 or y≠2 or (-∞,2)∪(2,∞) * interval notation

Properties	**Translations of Inverse Variations**

The graph of $y = \frac{k}{x-b} + c$ is a translation of $y = \frac{k}{x}$ by b units horizontally and c units vertically. The vertical asymptote is $x = b$. The horizontal asymptote is $y = c$.

Shifting graphs...Write an equation for the translation of $y=\frac{6}{x}$ that has asymptotes at:

Together a. x = 4 and y = -3 — right 4 + down 3 — $y=\frac{6}{x-4}-3$

You Try b. x = -4 and y = 3 — left 4 + up 3 — $y=\frac{6}{x+4}+3$

You Try c. x = 0 and y = 2 — right or left 0 + up 2 — $y=\frac{6}{x}+2$

* use "opposite sign, same sign" * as we did with our other functions → sign by x is opposite, outside sign is same