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Get the 4.1 checkpoint from the brown table and answer the questions.

Nov 3-4:18 PM

1 Do you plan on doing chapter 3 test corrections?

Yes

No

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Algebra 2 4-2 and 4-3 GRAPH SIMPLE and GENERAL RATIONAL FUNCTIONS

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

Objective: Students will be able to graph rational functions of the form

$$y = \frac{a}{x-h} + k \quad \text{and} \quad y = \frac{ax+b}{cx+d}$$

h : horizontal shift
 V : Asymptote Set the denominator = 0 Solve for x .
 k : V. Shift & H. Asymptote

A2.9.1 Write the symbolic form and sketch the graph of simple rational functions.

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Rational Functions

• A **RATIONAL FUNCTION** has the form $f(x) = \frac{p(x)}{q(x)}$, where $p(x)$ and $q(x)$ are polynomials and $q(x) \neq 0$.

• The inverse variation function $f(x) = \frac{a}{x}$ is a rational function.

• The Parent Function for Simple Rational Functions

• The function $f(x) = \frac{1}{x}$ is a split graph.

• The two symmetrical parts are called

• branches.

• Domain: All Real numbers except 0

• Range: All Real numbers except 0

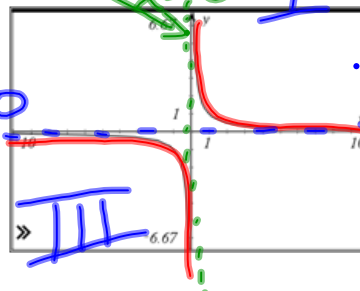
• Vertical Asymptote $x = 0$

• Horizontal Asymptote $y = 0$

• Any function of the same form has the same asymptotes, domain, and range of the parent function.

QUADRANTS!!

$\frac{a}{0}$ undefined



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EXAMPLE 1 Graph a rational function of the form $y = \frac{a}{x}$

Graph the function $y = \frac{6}{x}$ Compare the graph with the graph of $y = \frac{1}{x}$

$a = 6$
v. stretch BAO 6

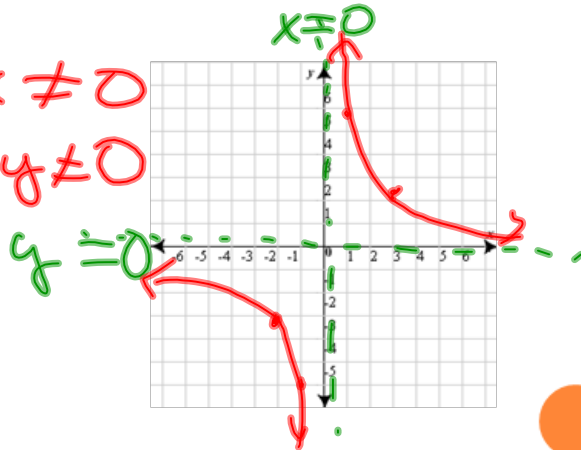
STEP 1 Draw the asymptotes $x = 0$ and $y = 0$.

STEP 2 Plot points to the left and to the right of the vertical asymptote, such as $(-3, -2)$, $(-2, -3)$, $(2, 3)$, and $(3, 2)$.

STEP 3 Draw the branches of the graph so that they pass through the plotted points and approach the asymptotes.

-2	-3
-1	-6
3	2
1	6

D: $x \in \mathbb{R} : x \neq 0$
R: $y \in \mathbb{R} : y \neq 0$



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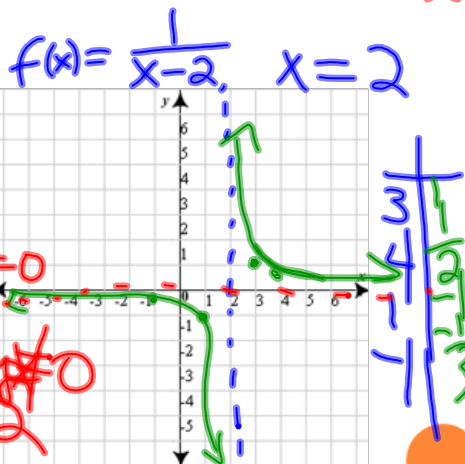
Graphing Translations of Simple Rational Functions

- To graph a rational function of the form $y = \frac{a}{x-h} + k$
- DRAW** the asymptote $x = h$ and $y = k$.
Notice that h changed signs! ** set the denominator = 0 solve for

$x - 2 = 0$
 $+ 2 \quad + 2$
 $x = 2$

PLOT the points to the left and the right of the vertical asymptote.

- DRAW** the two branches of the graph so they pass through the plotted points and approach the asymptotes.



- Give the domain & range!!
- Transformations!!

$x \in \mathbb{R} : x \neq 2$
 $y \in \mathbb{R} : y \neq 0$
H. Shift $\rightarrow 2$

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EXAMPLE 2 Graph a rational function of the form $y = \frac{a}{x-h} + k$

Graph $y = \frac{-4}{x+2} - 1$ State the domain and range.

STEP 1 Draw the asymptotes. $x = -2$, $y = -1$

STEP 2 Plot points to the left of the vertical asymptote and points to the right.

STEP 3 Draw the two branches of the hyperbola so that they pass through the plotted points and approach the asymptotes.

STEP 4 State the Domain and Range. The asymptotes are x and y values that can not be used!
Transformations

-4	-4
3	$-\frac{4}{-6+2} - 1 = \frac{-4}{-4} - 1 = 1 - 1 = 0$
2	$-\frac{4}{-3+2} - 1 = \frac{-4}{-1} - 1 = 4 - 1 = 3$
1	$-\frac{4}{2+2} - 1 = \frac{-4}{4} - 1 = -1 - 1 = -2$
0	$-\frac{4}{6+2} - 1 = \frac{-4}{8} - 1 = -\frac{1}{2} - 1 = -\frac{3}{2} = -1.5$

D: $x \in \mathbb{R}$
R: $y \in \mathbb{R}$

D: $x \neq -2$
R: $y \neq -1$

Reflection
H. Shift $\leftarrow 2$
V. Shift $\downarrow 1$
V. Stretch BAFO 4

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GUIDED PRACTICE for Examples 1 and 2

Graph the function. State the domain and range. Transformations

1. $f(x) = \frac{-4}{x}$ $x=0$ $y=0$

2. $y = \frac{8}{x} - 5$ $x=0$ $y=-5$

-2	2
-1	4
1	-4
2	-2

XER: $x \neq 0$
YER: $y \neq 0$

Reflection \downarrow V. stretch BAFO 4

-4	-7
-2	-9
2	-1
4	-3

XER: $x \neq 0$
YER: $y \neq -5$

V. stretch BAFO 8
V. Shift $\downarrow 5$

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GUIDED PRACTICE for Examples 1 and 2

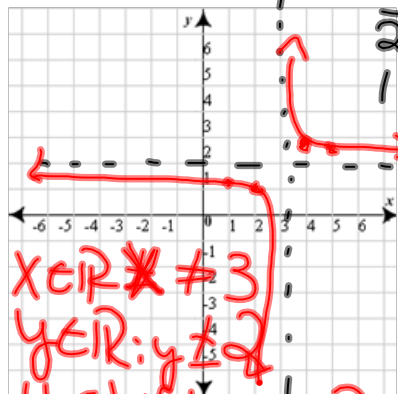
Graph the function. State the domain and range. Transformations

3. $y =$

$$\frac{1}{x-3} + 2$$

$$x=3$$

$$y=2$$



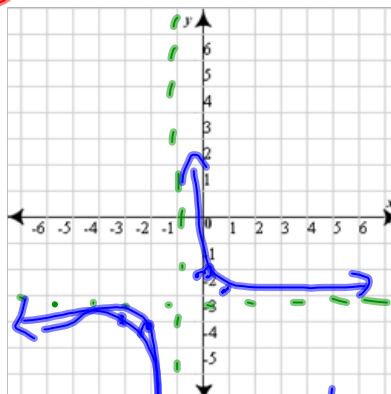
$x \in \mathbb{R} : x \neq 3$
 $y \in \mathbb{R} : y \neq 2$
 H. shift $\rightarrow 3$
 V. shift $\uparrow 2$

4. $y =$

$$\frac{1}{x+1} - 3$$

$$x=-1$$

$$y=-3$$



$x \in \mathbb{R} : x \neq -1$
 $y \in \mathbb{R} : y \neq -3$
 H. shift $\leftarrow 1$
 V. shift $\downarrow 3$

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Other Rational Functions

- All rational functions of the form $y = \frac{ax+b}{cx+d}$ also have graphs that are split.
-
- The vertical asymptote is the line $x = -\frac{d}{c}$ because the denominator is undefined when $cx+d$ is zero.
- To find the vertical asymptote set the denominator equal to zero and solve for x.
- The horizontal asymptote is the line $y = \frac{a}{c}$
 Notice these are the coefficients!

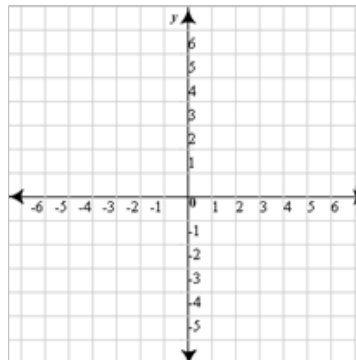
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EXAMPLE 3 Graph a rational function of $\frac{ax + b}{cx + d}$
 Graph $y = \frac{2x + 1}{x - 3}$. State the domain and range.

STEP 1 Find and draw the asymptotes solving for x and finding $y = \frac{a}{c}$

STEP 2 Plot points.

STEP 3 Draw the two branches of the hyperbola so that they pass through the plotted points and approach the asymptotes.



STEP 4 Find the domain and range. The denominator is undefined when it is equal to zero.

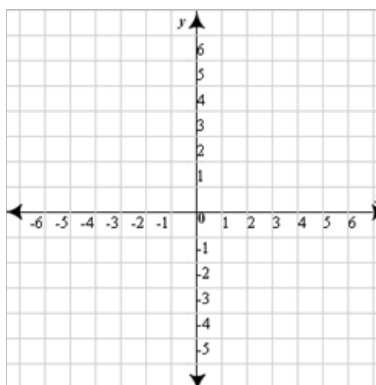
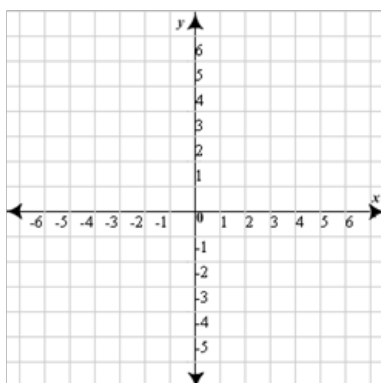
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GUIDED PRACTICE for Examples 3 and 4

Graph the function. State the domain and range.

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

5. $y = \frac{2x + 1}{4x - 3}$

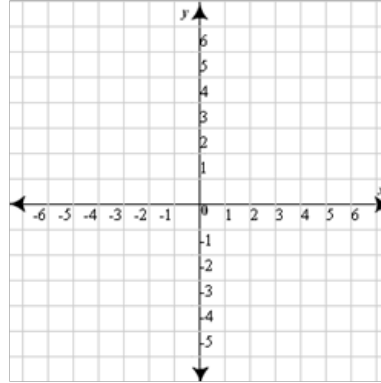
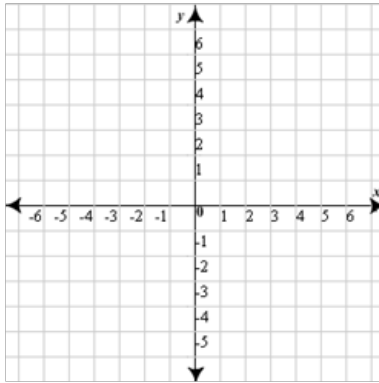


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GUIDED PRACTICE for Examples 3 and 4**Graph the function. State the domain and range.**

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

7. $f(x) = \frac{-5x}{2x+6}$



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