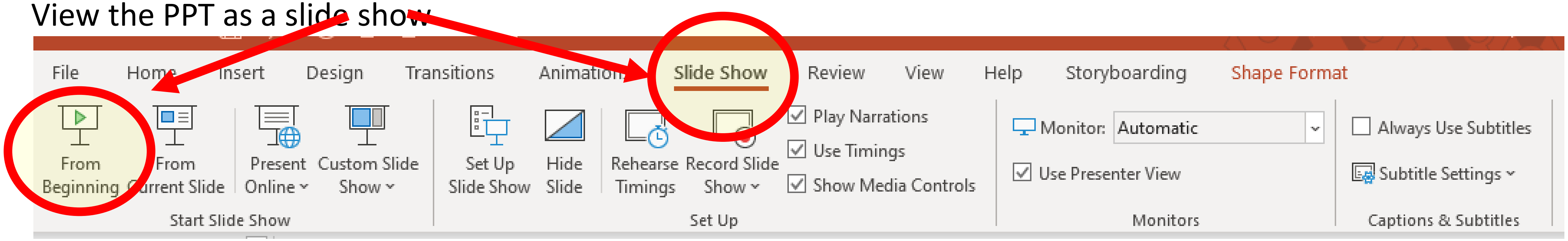
How to best use these slides…

- View the PPT as a slide show



- Then click through every step
  - Mouse clicks will advance the slide show
  - Left/right arrow keys move forward/backward
  - Mouse wheel scrolling moves forward/backward
- When a question is posed, stop and think it through, try to answer it yourself before clicking
- If you have questions, use PS discussion boards, email me, and/or visit us in a Teams class session!

LESSON 7.2a

Graphing Inverse Variation Functions

Today you will:

- Graph inverse variation
- Practice using English to describe math processes and equations

Core Vocabulary:

- Rational function, p. 366

Prior:

- Domain
- Range
- Polynomial
- Inverse variation
- Parent function
- Asymptote

Lots of terms to remember! Let's do a quick review…

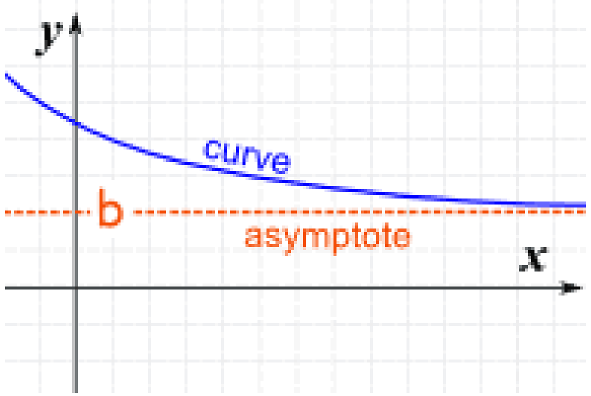
- Domain
  - You know this … all the input or x values
- Range
  - …and this one … all the output or y values
- Polynomial
  - An equation or function where the exponents on the variable are all whole numbers (positive integers)
  - General form: $y = a_n x^n + a_{n-1} x^{n-1} + \cdots + a_2 x^2 + a_1 x + a_0$
  - Example: $y = 3x^5 - x^3 + 2x^2 + 5x - 1$
- Inverse variation
  - A relationship between two value sets where in as one increases the other proportionally decreases
  - General form: $y = \frac{a}{x}$
  - a is the ***constant of variation*** … the scaling factor
  - Example: $y = \frac{2}{3x}$ where $a = \frac{2}{3}$
- Parent function
  - The base, non-transformed function for a given type/family of functions (linear, quadratic, etc)
  - Linear: $y = x$ Quadratic: $y = x^2$

… and a REALLY important one … ASYMPTOTES

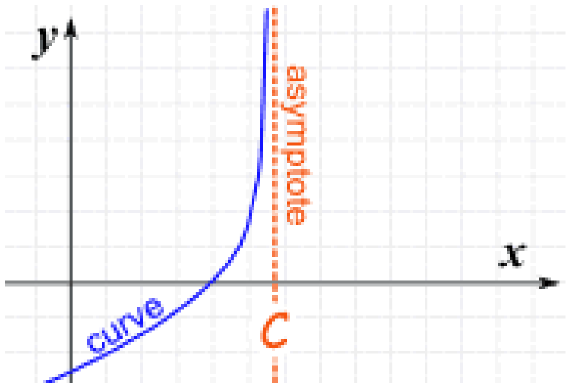
What is an asymptote?

- A straight line that a curve approaches (gets closer and closer to) but never touches
- We say the curve gets “infinitely” close to the asymptote
- It can be horizontal, vertical or slanted (you’ll study slant asymptotes in Math Anal)

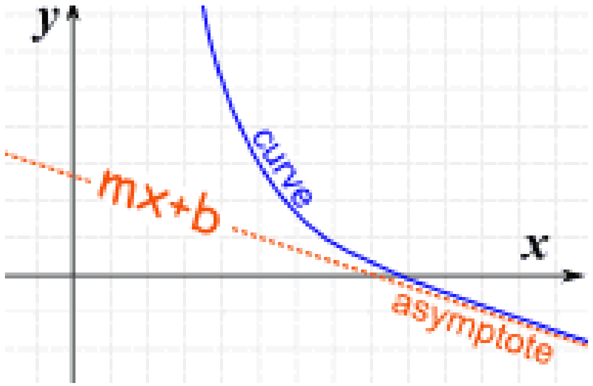
Horizontal asymptote



Vertical asymptote



Slant asymptote



Who cares?

- Asymptotes are super important
- They tell us what happens with the data as time goes on
- ... tells us what the limit/maximum value for the data set is

What is the parent function for inverse variation functions?

Remember, the parent function is the one that has no transformations…

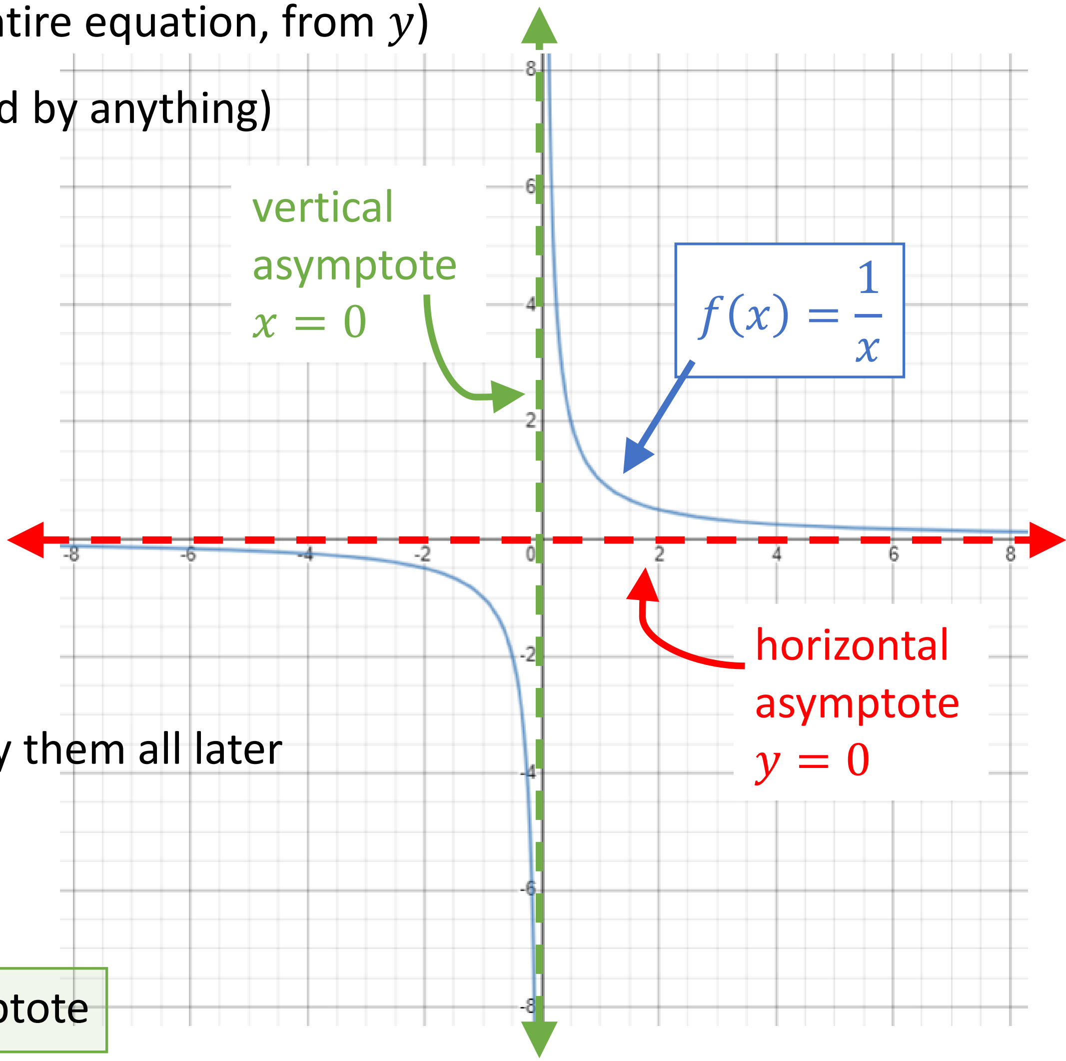
- It is not shifted left or right (nothing added to/subtracted from x)
- It is not shifted up or down (nothing added to/subtracted from the entire equation, from y)
- It is not scaled in any way (x has a coefficient of 1 … x is not multiplied by anything)

Inverse variation parent function

- $y = \frac{1}{x}$
- Graph is what we call a ***hyperbola***

Hyperbola

- Basically looks like an inside-out ellipse
- …or two parabolas facing opposite directions
- In fact, hyperbolas, ellipses, and parabolas are all related - you'll study them all later
- In a hyperbola, the two symmetrical parts are called ***branches***
- The domain and range of a hyperbola are all nonzero real numbers
- The x-axis is a horizontal asymptote, and the y-axis is a vertical asymptote



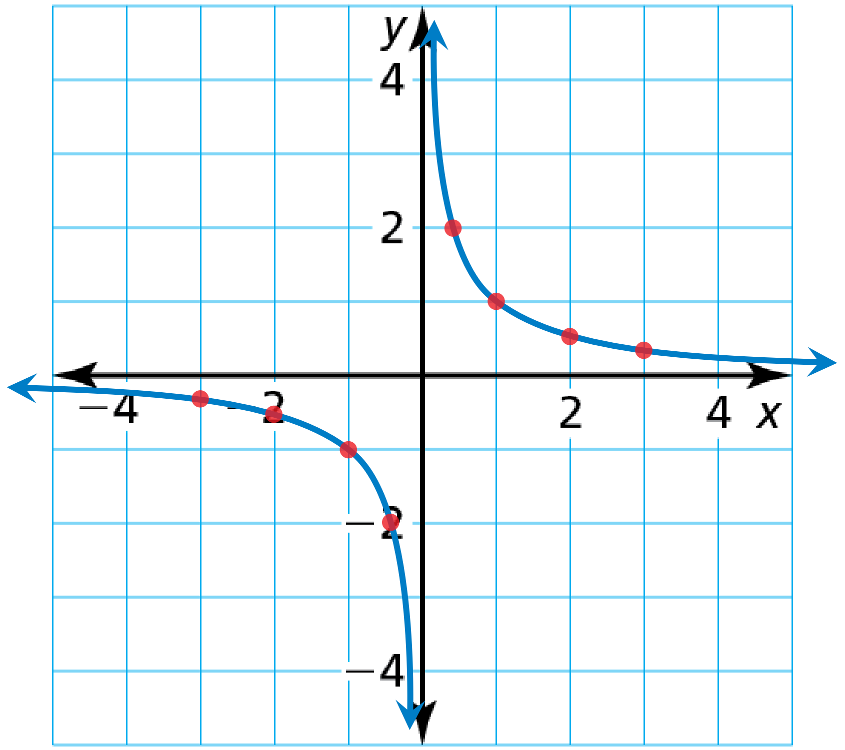
How would we graph the inverse variation parent function?

Just like we would any other function…

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

1. Create a table of values
   - Trick is picking "good" values
   - For this, pick positive and negative numbers around zero
2. Plot the points
   - Draw the graph (don't forget to label axes & use arrow heads!)
   - Then the points themselves
3. Connect the dots!

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



And now the new term … Rational Function

- A rational function is one polynomial divided by another
- Generic form: $f(x) = \frac{p(x)}{q(x)}$, where $p(x)$ and $q(x)$ are polynomials and $q(x) \neq 0$

What is the generic form for inverse variation functions?

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

Are inverse variation functions also rational functions?

- If so, what would $p(x)$ and $q(x)$ be?
- $p(x) = a$ … remember a polynomial can be just a number (a constant)!
- $q(x) = x$
- Yes, inverse variation functions are an example of simple rational functions!

Let's graph a simple Rational Function!

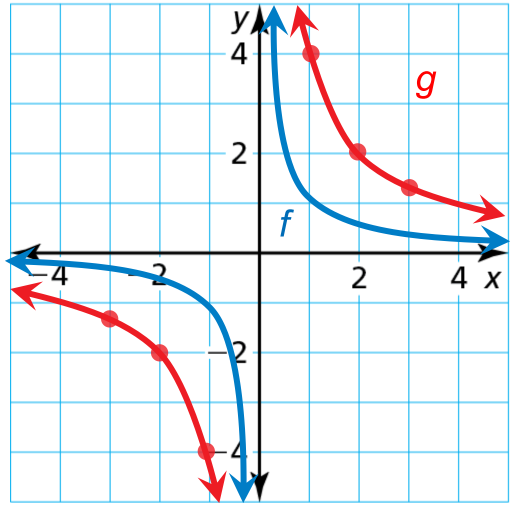
Graph $g(x) = \frac{4}{x}$. Compare the graph with the graph of $f(x) = \frac{1}{x}$.

SOLUTION

Step 1 The function is of the form $g(x) = \frac{a}{x}$, so the asymptotes are $x = 0$ and $y = 0$. Draw the asymptotes.

Step 2 Make a table of values and plot the points. Include both positive and negative values of x.

x	−3	−2	−1	1	2	3
y	$-\frac{4}{3}$	−2	−4	4	2	$\frac{4}{3}$



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

The graph of g lies farther from the axes than the graph of f. Both graphs lie in the first and third quadrants and have the same asymptotes, domain, and range.

LOOKING FOR STRUCTURE

Because the function is of the form $g(x) = a \cdot f(x)$, where $a = 4$, the graph of g is a vertical stretch by a factor of 4 of the graph of f.

Review/Recap

Rational Function

- One polynomial divided by another
- $f(x) = \frac{p(x)}{q(x)}$, where $p(x)$ and $q(x)$ are polynomials and $q(x) \neq 0$
- Inverse variation functions are actually simple rational functions!

To graph ***any*** function:

1. Create a table of values … pick "good" values around the "center" of the data set
2. Plot the points from the table of values
3. Connect the dots
4. Don't forget to label the axes and use arrow heads!

Asymptotes

- The straight line a curve gets closer and closer to but never touches
- Can be horizontal, vertical, or slanted
- Can be the x-axis (horizontal) or the y-axis (vertical)
- Help us know the limits of the data set

Parent function

- The "base" function for a family of functions
- Has absolutely no transformations
- All other functions in the family are transforms of the parent

Homework

Pg 370, #3-10