a new week

a new font

and new material

Do now:

1. What is the *domain* of $f(x) = \dfrac{1}{x-3}$

2. Using the quadratic formula, find the zeros of $f(x)=x^2+4$. What do you notice about the zeros?

even homework answers from **3.4**

(56) (a) rational: 1

other: $\pm\sqrt{3}$

(b) $f(x)=(x-1)(x-\sqrt{3})(x+\sqrt{3})$

(58) (a) rational: -2

other: $1\pm i$

(b) $f(x)=(x+2)(x-1-i)(x-1+i)$

(28) $1+i$

homework questions?*

*reminder: *homework solutions to section 3.4 were posted on the course conference.*

today's math menu:

(a) finish the last tiny delicious *math morsels* of 3.4
(b) dig into rational functions

if $a + bi$ is a zero of a function, then $a - bi$ is a zero of the function also.

if $a + b\sqrt{c}$ is a zero of a function, then $a - b\sqrt{c}$ is a zero of the function also.

"conjugates"

Suppose that a polynomial of degree 4 has the following zeros:

$-4-3i$

$2-\sqrt{3}$

Find the remaining zeros.

Suppose that a polynomial of degree 4 has the following zeros:

$-4-3i$ $-4+3i$

$2-\sqrt{3}$ $2+\sqrt{3}$

Find the remaining zeros.

check yo'self:

Suppose that a polynomial function fo degree 5 has the given numbers as zeros:

$-1/2$ $\sqrt{5}$ $-4i$

Find the other zeros.

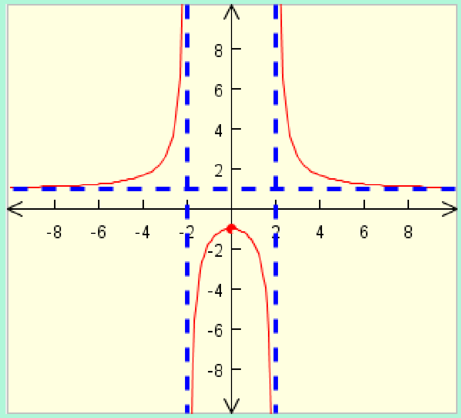
check yo'self:

Suppose that a polynomial function fo degree 5 has the given numbers as zeros:

$-1/2$ $\sqrt{5}$ $-\sqrt{5}$ $-4i$ $4i$

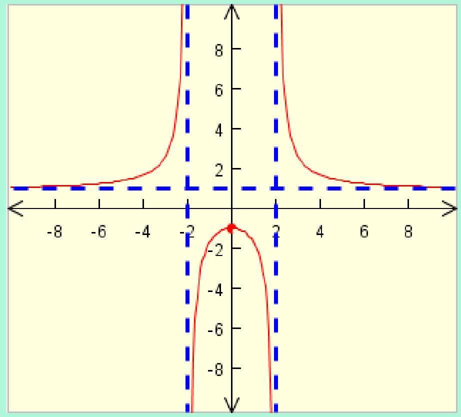
Find the other zeros.

rational functions



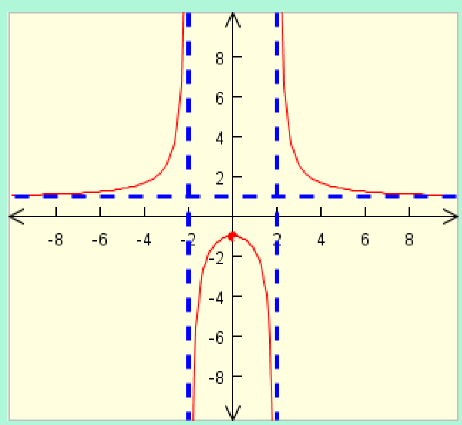
"rational number" $-\frac{3}{5}$

"rational function" $\frac{x^2+2x-3}{x^2-x-2}$



we've learned how to sketch polynomials

we're going to learn how to sketch rational functions



rational function

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

Domain:

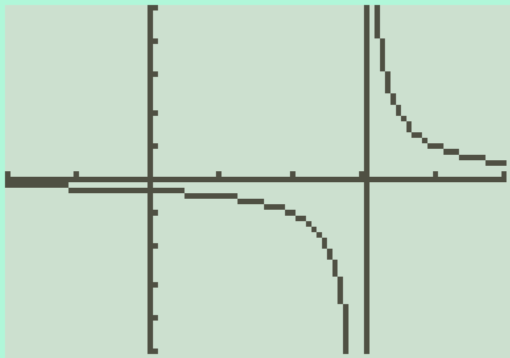
$$f(x) = \frac{1}{x-3}$$

Graph:

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

Domain: (-∞,3)∪(3,∞)

Graph:

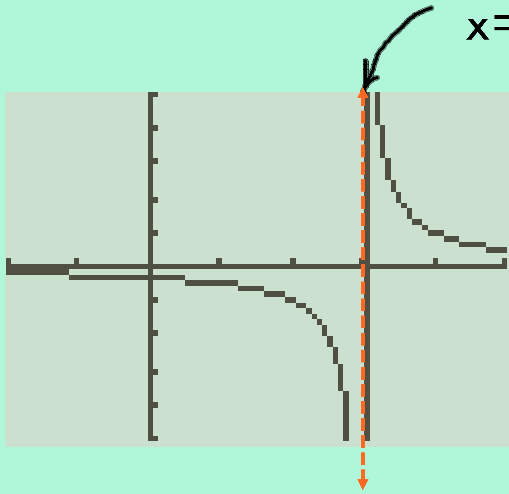


$$f(x) = \frac{1}{x-3}$$

x	2	2.5	2.99	2.9999	2.999999
f(x)					

x	4	3.5	3.01	3.0001	3.000001
f(x)					

x=3 is a **vertical asymptote**



vertical asymptotes appear when you have a zero in the denominator of a rational function

Let's try:

Determine the domain *and* the vertical asymptotes for the following function: $f(x) = \frac{2x - 11}{x^2 + 2x - 8}$

Let's try:

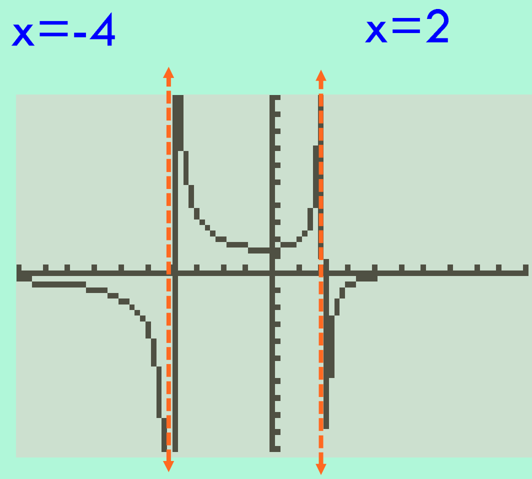
Determine the domain *and* the vertical asymptotes for the following function: $f(x) = \frac{2x - 11}{x^2 + 2x - 8}$

To find the domain, we need to factor the denominator. $f(x) = \frac{2x - 11}{(x + 4)(x - 2)}$

So x cannot be -4 or 2. So the domain is:
$(-\infty,-4)\cup(-4,2)\cup(2,\infty)$

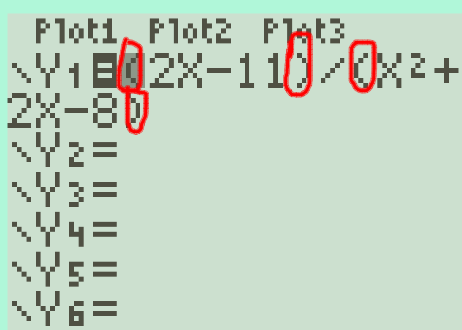
The vertical asymptotes are easy now!
x=-4 and x=2

$$f(x) = \frac{2x - 11}{x^2 + 2x - 8}$$



don't forget **parentheses** when graphing!

$$f(x) = \frac{2x - 11}{x^2 + 2x - 8}$$



check yo'self:

Determine the domain and the vertical asymptotes of the following function: $f(x) = \frac{x-2}{x^3 - 5x}$

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Determine the domain and the vertical asymptotes of the following function: $f(x) = \frac{x-2}{x^3 - 5x}$

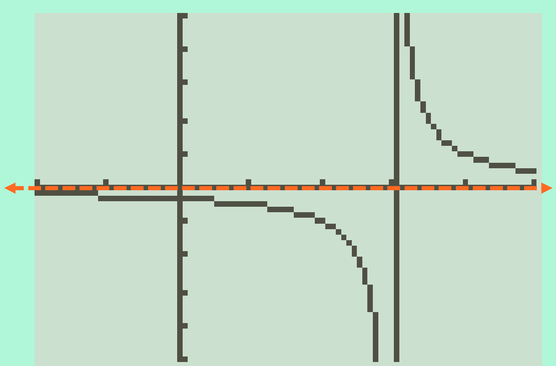
time for a break

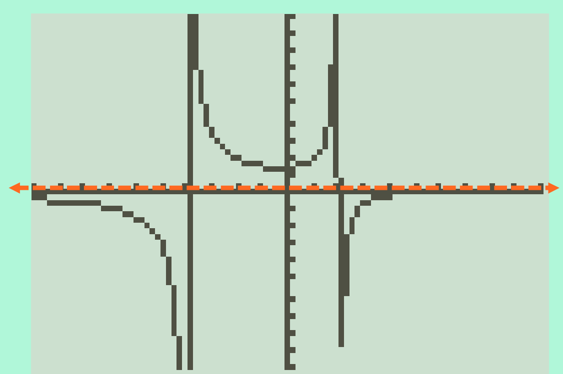
Now we have **vertical asymptotes** taken care of.

What about **horizontal asymptotes?**

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

$$f(x) = \frac{2x-11}{x^2+2x-8}$$





what is the horizontal asymptote?

When the *degree of the numerator* is **less than** the *degree of the denominator*...

the horizontal asymptote is y=0 (the x-axis)

Why?

Why is the horizontal asymptote of this function $f(x) = \frac{x-2}{x^3-5x}$ **y=0?**

Because...

$$f(x) = \frac{x-2}{x^3-5x}$$

as x gets very large, the numerator is large but the denominator is **way larger**!

plug in 20. what is the numerator? denominator?

plug is -20. what is the numerator? denominator?

Because...

$$f(x) = \frac{x-2}{x^3-5x}$$

as x gets very large, the numerator is large but the denominator is **way larger**!

plug in 20. what is the numerator? denominator?

num: 18 den: 7900

plug is -20. what is the numerator? denominator?

num: -22 den: -7900

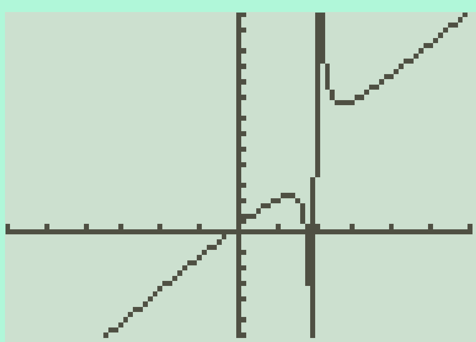
If the *degree of the numerator* is **greater than** the *degree of the denominator*…

there is no horizontal asymptote.

no horizontal asymptotes!

(but there is a vertical asymptote **at x=2)**

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



If the *degree of the numerator* is **equal to** the *degree of the denominator*…

the horizontal asymptote is y=a/b*

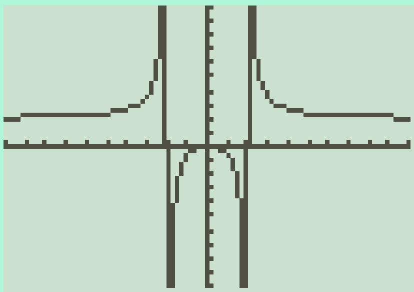
***a and b are the leading coefficients of the numerator and the denominator respectively.**

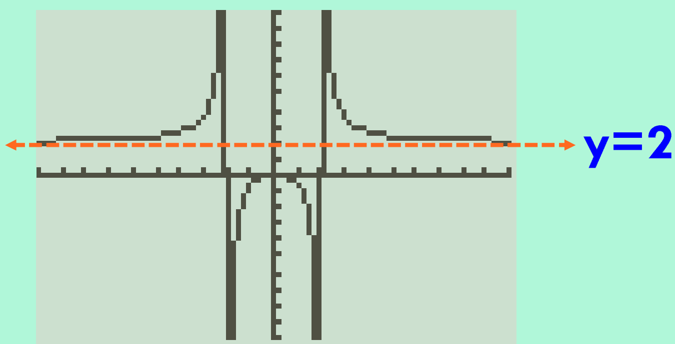
Find the horizontal asymptote of the following function:

$$f(x) = \frac{8x^2}{4x^2 - 16}$$

Find the horizontal asymptote of the following function: $f(x) = \dfrac{8x^2}{4x^2 - 16}$

$$\frac{\textbf{degree of numerator}}{\textbf{degree of denominator}} \qquad \frac{8}{4} \qquad \mathbf{2}$$





X	Y1
13	2.0485
14	2.0417
15	2.0362
16	2.0317
17	2.0281
18	2.025
19	2.0224

X=19

check yo'self!

Find the horizontal asymptotes of the following:

$$f(x) = \frac{x^2}{4x+2}$$

$$g(x) = \frac{5x^9}{2x^{10}+30}$$

$$h(x) = \frac{7x^9}{-3x^9-3}$$

check yo'self!

Find the horizontal asymptotes of the following:

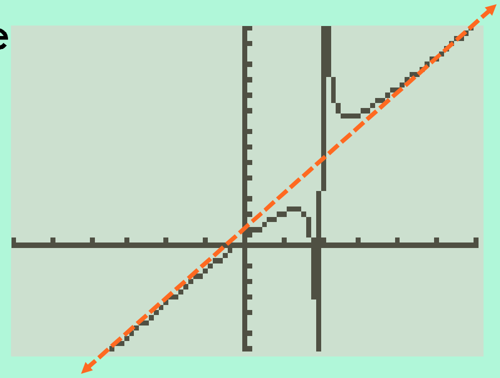
$$f(x) = \frac{x^2}{4x+2}$$ none (num > den)

$$g(x) = \frac{5x^9}{2x^{10}+30}$$ y=0 (num < den)

$$h(x) = \frac{7x^9}{-3x^9-3}$$ y=-7/3 (num = den)

the last type of asymptote

when the *degree of the numerator* is **one more** than *the degree of the denominator*, you have an **oblique asymptote**



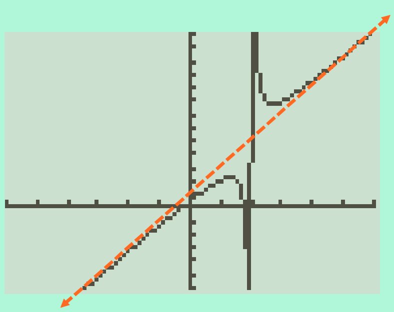
$$f(x) = \frac{2x^2 - 3x - 1}{x - 2}$$

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

2 | 2 -3 | -1
4 | 2
2 1 | 1

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

y=2x+1



Homework:

Section 3.5:
part I: 1-6
part II: 7-13odd
part III: 15-20
part IV: 21-25odd