Characteristics of Rational Functions

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Intro to the parent function

A simple intro to rational functions!

Welcome to the wonderful world of rational functions!

So far, you might have heard of linear, quadratic, or exponential functions, but **rational is a whole new ball game**. Let’s get right into it

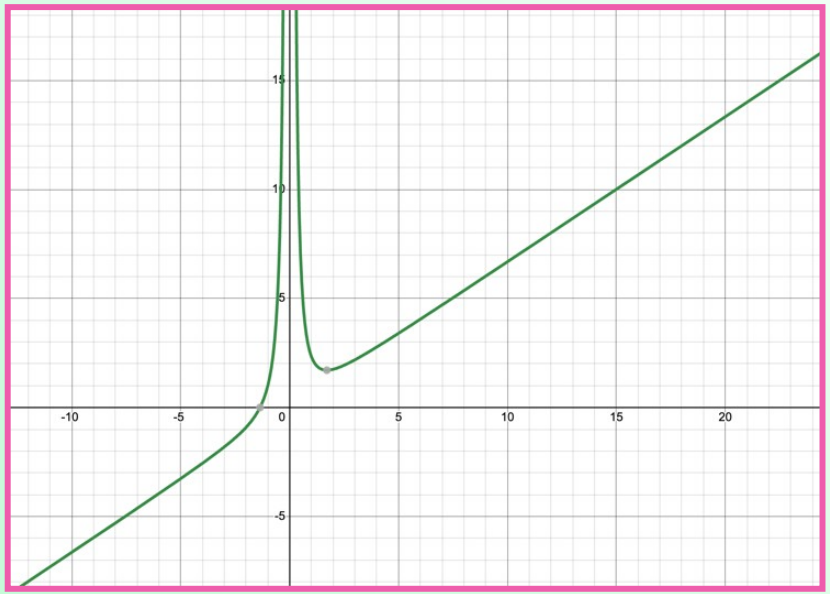
A rational function is any function that is a RATIO of 2 polynomials

A ratio can be written like a fraction, with a polynomial in the numerator and a polynomial in the denominator

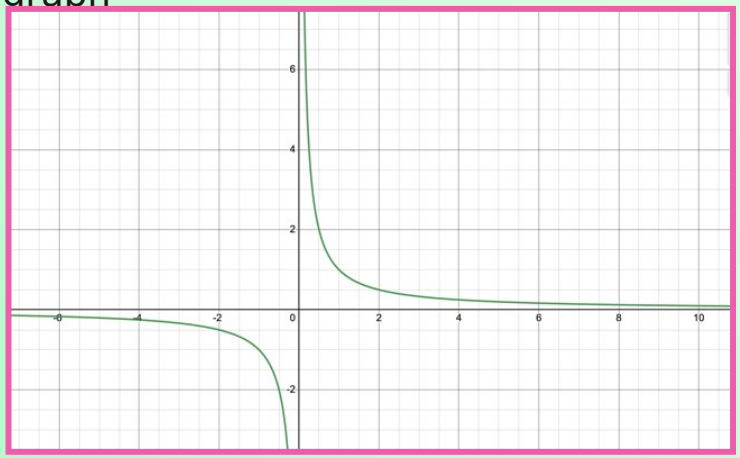
However, the denominator cannot equal zero

Rational function equations

Here are some examples of rational function equations:



The parent function of a rational function can be written as **y = 1/x**, and this is what it looks like as a table and as a graph



x	1/x
-2	-0.5
-1	-1
0	undefined
1	1
2	0.5
3	0.333333
4	0.25

The function is **NOT continuous at x = 0**, meaning there is **no (x, y) pair with x = 0** for this function

→

This is because as we mentioned earlier, **dividing by 0 is undefined**

The function is **approaching x = 0**, and it is getting closer and closer and closer, but **never quite reaches it**

Why?

Try plugging in:

- x values slightly larger than 0
- Values slightly smaller than 0

See what happens to the y value of your coordinate pair

The values either skyrocket to:

- Positive infinity
- Negative infinity in the opposite case

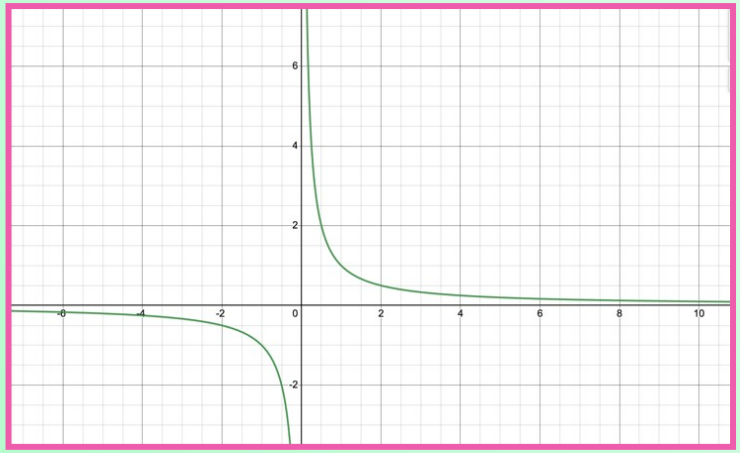
The function **approaches y = 0** but **never quite reaches that line**

Why?

- Because the **denominator increases a lot faster than the numerator**
- As the value we plug in for x increases, **the denominator gets larger so the fraction gets smaller and smaller**
- No matter how small our value is, **it will never become zero**
- If you plug in **smaller values for x**, you will end up getting **super large values** because the **numerator is higher now**. Either way you **do not reach y = 0**

There’s actually a special name for **this phenomenon** happening **with the x and y** values that we cannot reach. This will be covered in the **“Important Terms”** section

Before we move on to “important terms”, the last characteristic of the parent function we will cover is **domain and range of 1/x**



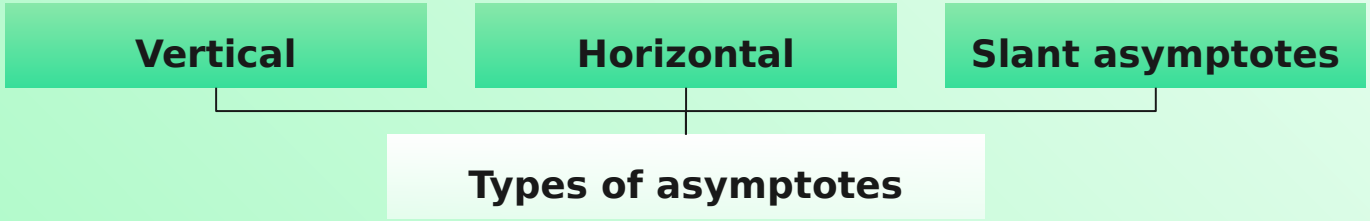
- We know that **x = 0 is not part of the domain** because you can’t divide by 0
- The domain is **all x values except for x = 0**
- For the range, we covered earlier that **y = 0 is not part of the function either**
- So the **range is all y values except for y = 0**

02

Important terms you need to know

Pay very close attention to the upcoming terms

- In section 1, we talked about certain x and y values **(x = 0 and y = 0) that our parent function was never able to reach**. Those are called **asymptotes**
- An asymptote occurs when you try to approach a certain line or curve but never quite reach it, **only get infinitely close**



Vertical | Horizontal | Slant asymptotes

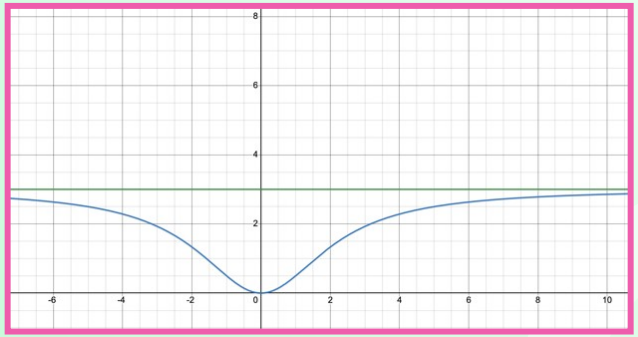
- Occurs at an x value that causes the **denominator to equal 0**
- The **numerator cannot also be zero** for this x value. For our parent function, this was x = 0
- If we take another example, 1/(x – 3), the vertical asymptote would be x= 3, because if you plug 3 into the function, you get 0 for the denominator

Vertical | **Horizontal** | Slant asymptotes

- Occurs at a y value that the function gets close to but never reaches
- If the **denominator polynomial has a higher degree than the numerator**, like y = x/(x^2 + 5), the **horizontal asymptote is ALWAYS 0**

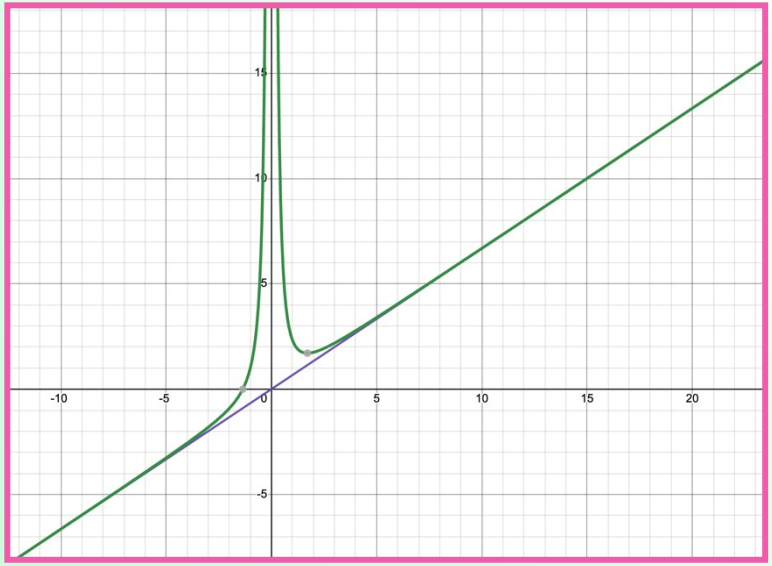
- If the **denominator and numerator have equal degrees**, the **horizontal asymptote is the ratio of the 2 leading coefficients**
- if we have **3x^2/(x^2 + 5)**, the horizontal asymptote would be **y = 3** because dividing the leading coefficients would be 3 /1 = 3

3x^2/(x^2 + 5)
y = 3



Vertical | Horizontal | **Slant asymptotes**

- **If the numerator has a higher degree than the denominator**, you have a slant asymptote which is your third type
- You find your slant by **dividing your numerator by your denominator**
- We will go more in depth about this in another lesson



Rational function with a slant asymptote

Thanks

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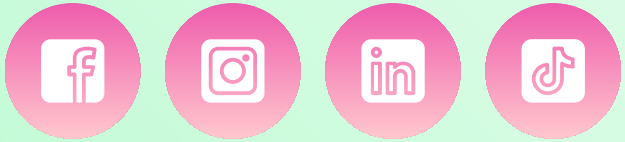

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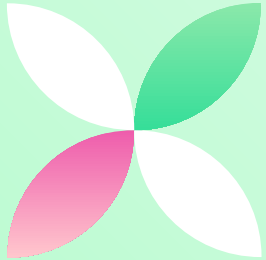

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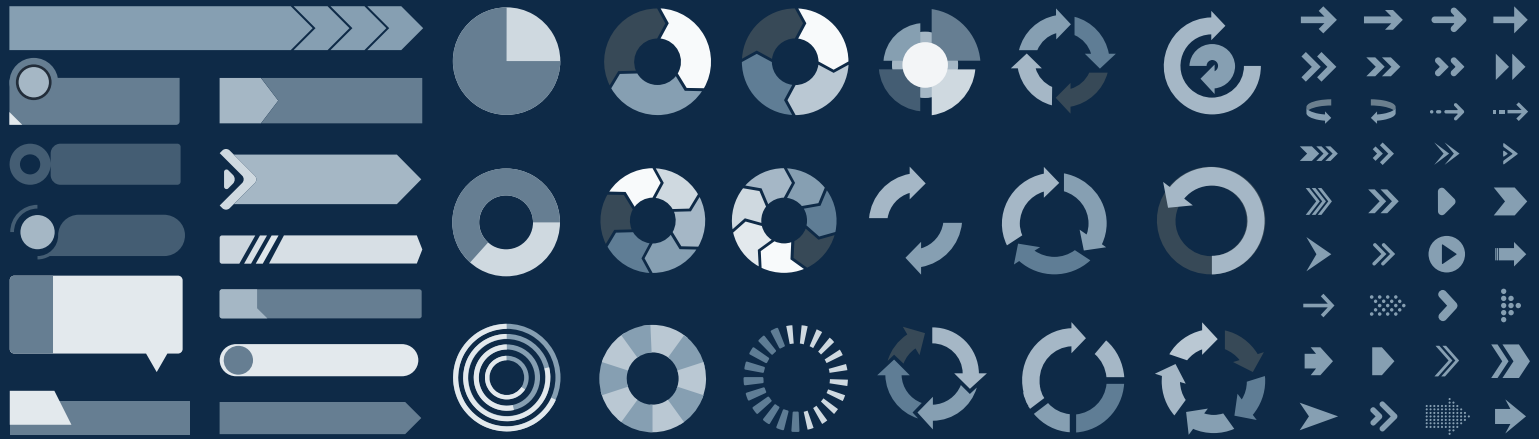






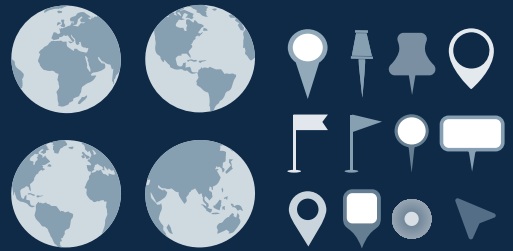

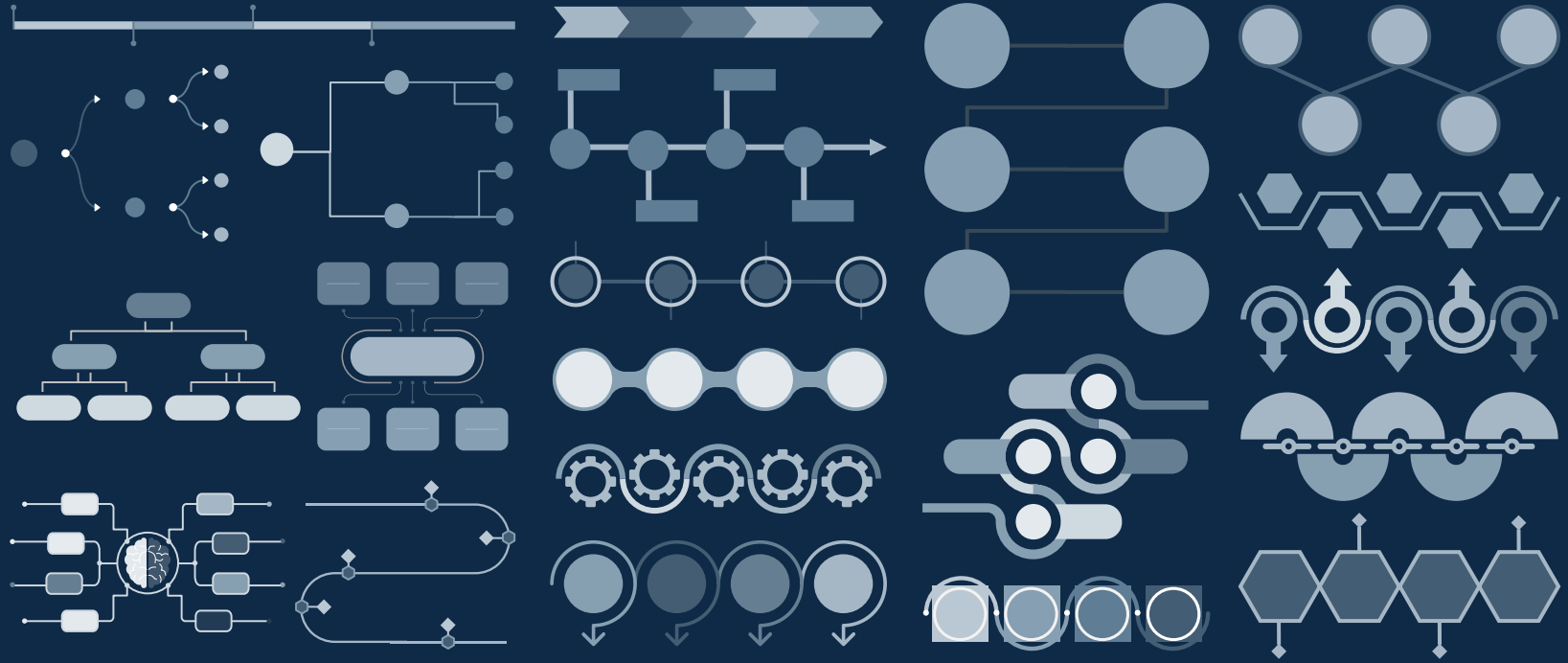

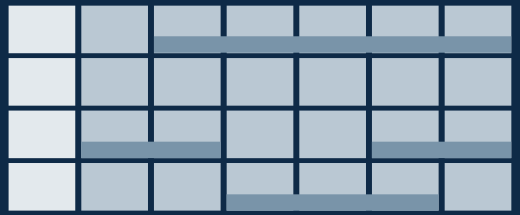

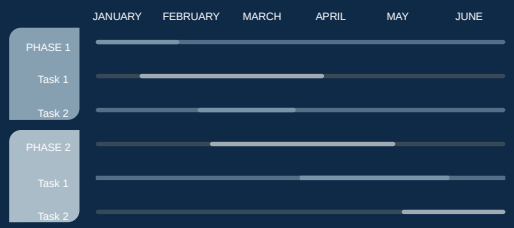
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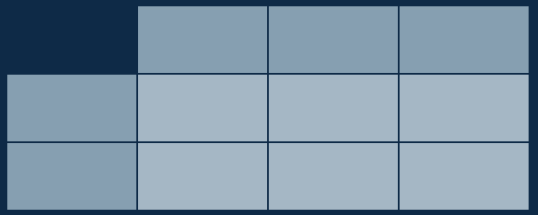

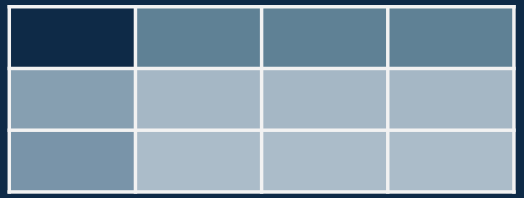

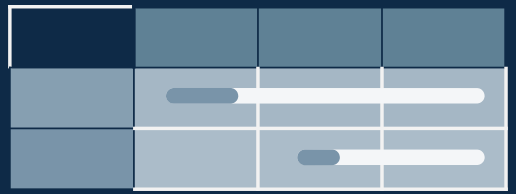

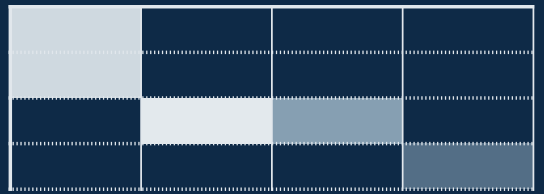

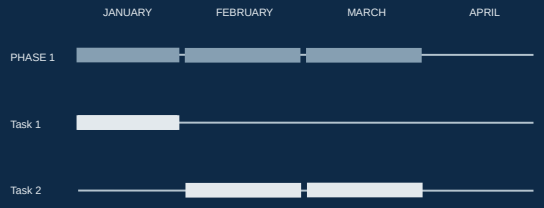
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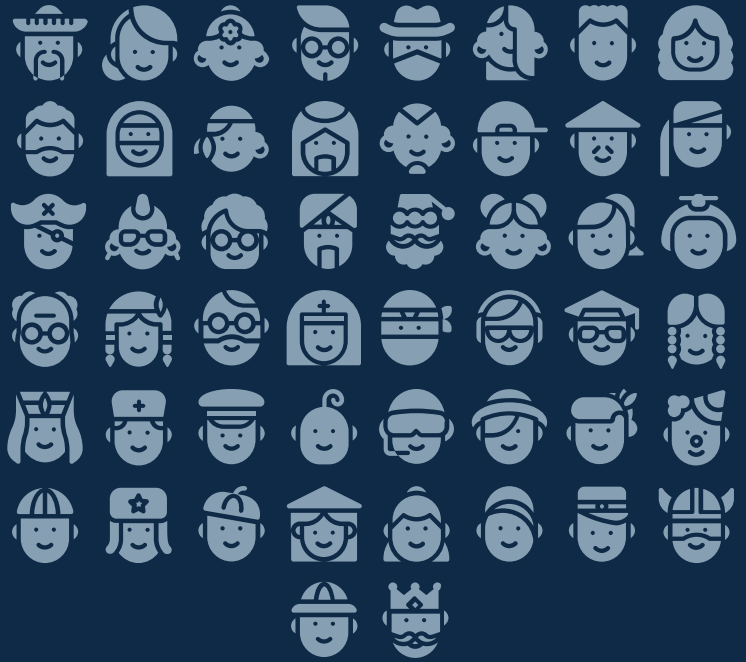

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