

# UNIT 3 Lessons 5-6

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PRECALCULUS A

## LESSONS:

- Linear, Absolute Value, & Reciprocal Functions
- Power, Root, Exponential, Logarithmic Functions

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our class website: [nca-patterson.weebly.com](http://nca-patterson.weebly.com)

book a call time: [jpattersonmath.youcanbook.me](http://jpattersonmath.youcanbook.me)

**Identify for each parent function:**

- **Domain & Range**
- **Intervals where increasing, decreasing, or constant**
- **The x-intercepts & y-intercepts**
- **Even, Odd, or neither**
- **Continuous or Discontinuous**
- **Asymptotes**
- **End Behavior**

The Specs

**Yes, doing the “specs” can get monotonous . . .**

**But just like shopping for a phone and checking on the gigahertz, megapixels, RAM, etc.**

**Knowing the “specs” helps you make a better decision.**

**And if a function describes the situation you have to make a decision about,**

**Knowing the “specs” helps you make a better decision!**

**So, here we go . . .**

The Specs

Oh, and remember that

## PARENT FUNCTIONS

are the basic version of each type of function

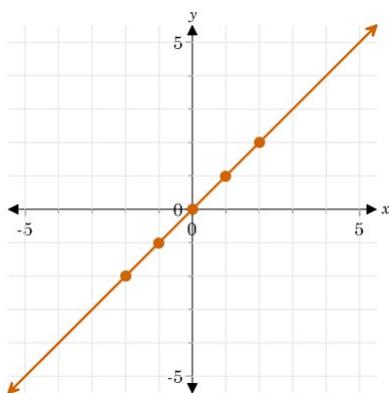
without any transformations.

(not yet! . . . that's next week)

The Specs

### LINEAR PARENT FUNCTION

$$y = x$$

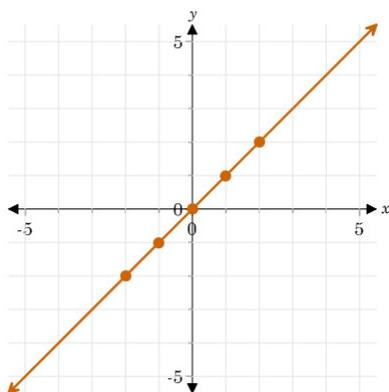


Identify for each parent function:

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- End Behavior

## LINEAR PARENT FUNCTION

$f(x) = x$



### Key Concept

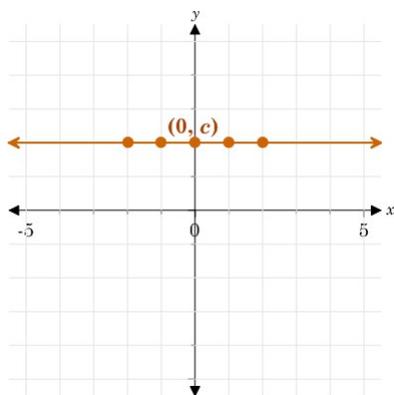
Characteristics of the Parent Linear Function:  $f(x) = x$

- domain:  $(-\infty, \infty)$
- range:  $(-\infty, \infty)$
- increasing intervals:  $(-\infty, \infty)$
- decreasing intervals: none
- constant intervals: none
- x-intercept:  $(0, 0)$
- y-intercept:  $(0, 0)$
- even, odd, neither: odd
- continuous or discontinuous: continuous
- asymptotes: none
- end behavior:  $f(x) \rightarrow \infty$  as  $x \rightarrow \infty$ ;  $f(x) \rightarrow -\infty$  as  $x \rightarrow -\infty$

## CONSTANT FUNCTION

... a type of linear function

$y = c$

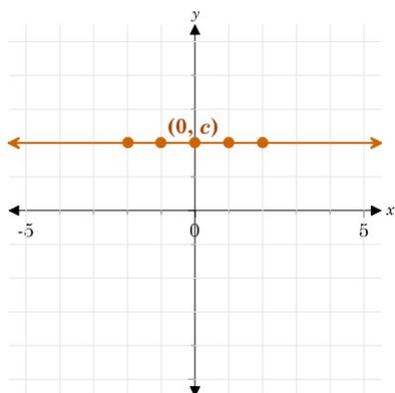


Identify for each parent function:

- Domain & Range
- Intervals where increasing, decreasing, or constant
- The x-intercepts & y-intercepts
- Even, Odd, or neither
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- Asymptotes
- End Behavior

## CONSTANT FUNCTION

... a type of linear function

$$f(x) = c$$


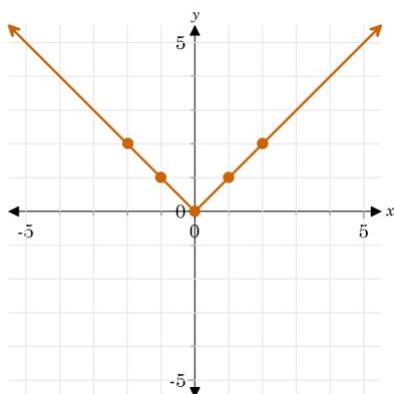
### Key Concept

Characteristics of the Constant Function:  $f(x) = c$

- domain:  $(-\infty, \infty)$
- range:  $\{c\}$
- increasing intervals: none
- decreasing intervals: none
- constant intervals:  $(-\infty, \infty)$
- x-intercept: none if  $c \neq 0$ ; if  $c = 0$ , the function's graph is the x-axis
- y-intercept:  $(0, c)$
- even, odd, neither: even; if  $c = 0$  the function is also odd
- continuous or discontinuous: continuous
- asymptotes: none
- end behavior:  $f(x) \rightarrow c$  as  $x \rightarrow \infty$ ;  $f(x) \rightarrow c$  as  $x \rightarrow -\infty$

Notice that the range cannot be written as an interval.

## ABSOLUTE VALUE FUNCTION

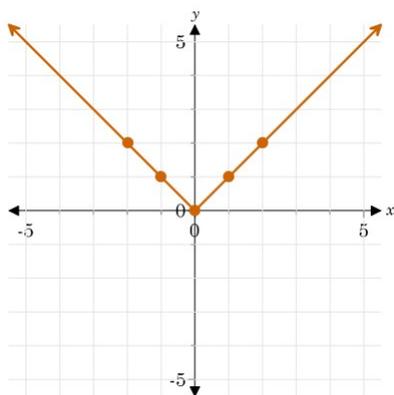
$$y = |x|$$


Identify for each parent function:

- Domain & Range
- Intervals where increasing, decreasing, or constant
- The x-intercepts & y-intercepts
- Even, Odd, or neither
- Continuous or Discontinuous
- Asymptotes
- End Behavior

## ABSOLUTE VALUE FUNCTION

$f(x) = |x|$



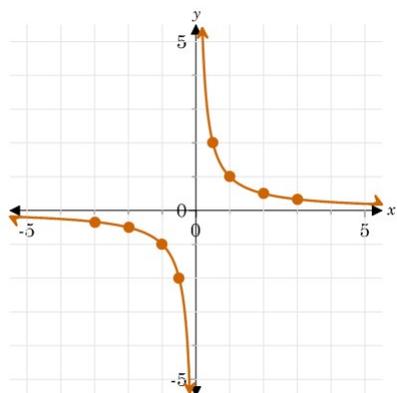
### Key Concept

Characteristics of the Parent Absolute Value Function:  $f(x) = |x|$

- domain:  $(-\infty, \infty)$
- range:  $[0, \infty)$
- increasing intervals:  $(0, \infty)$
- decreasing intervals:  $(-\infty, 0)$
- constant intervals: none
- x-intercept:  $(0, 0)$
- y-intercept:  $(0, 0)$
- even, odd, neither: even
- continuous or discontinuous: continuous
- asymptotes: none
- end behavior:  $f(x) \rightarrow \infty$  as  $x \rightarrow \infty$ ;  $f(x) \rightarrow \infty$  as  $x \rightarrow -\infty$

## RECIPROCAL FUNCTION

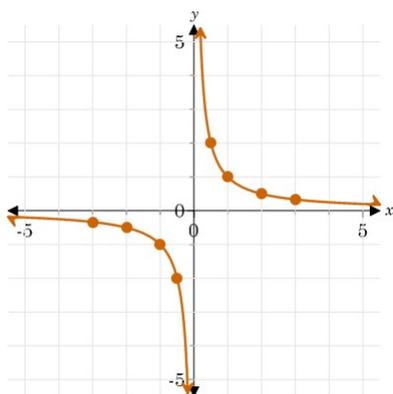
$y = 1/x$



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

## RECIPROCAL FUNCTION

$$y = 1/x$$

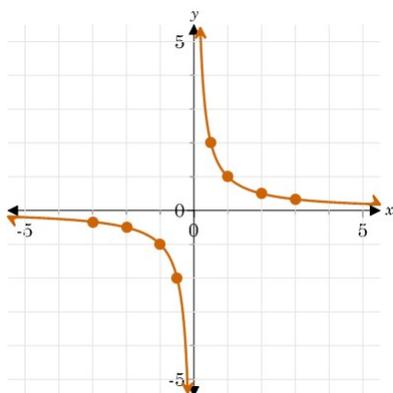


Identify for each parent function:

- Domain & Range
- Intervals where increasing, decreasing, or constant
- The x-intercepts & y-intercepts
- Even, Odd, or neither
- Continuous or Discontinuous
- Asymptotes
- End Behavior

## RECIPROCAL FUNCTION

$$f(x) = 1/x$$



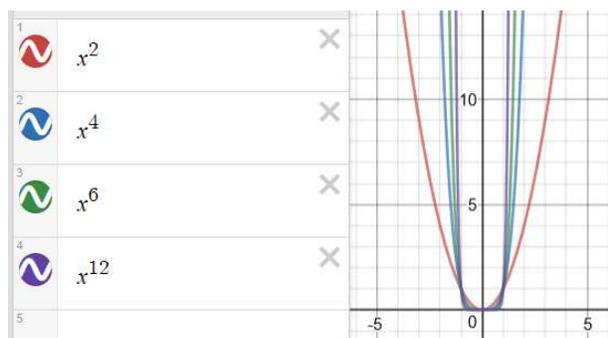
### Key Concept

Characteristics of the Parent Reciprocal Function:  $f(x) = \frac{1}{x}$

- domain:  $(-\infty, 0) \cup (0, \infty)$
- range:  $(-\infty, 0) \cup (0, \infty)$
- increasing intervals: none
- decreasing intervals:  $(-\infty, 0) \cup (0, \infty)$
- constant intervals: none
- x-intercept: none
- y-intercept: none
- even, odd, neither: odd
- continuous or discontinuous: discontinuous
- asymptotes:  $x = 0$  and  $y = 0$
- end behavior:  $f(x) \rightarrow 0$  as  $x \rightarrow \infty$ ;  $f(x) \rightarrow 0$  as  $x \rightarrow -\infty$

## POWER FUNCTION – EVEN $n$

$$y = x^n$$

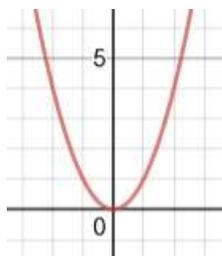


Identify for each parent function:

- Domain & Range
- Intervals where increasing, decreasing, or constant
- The x-intercepts & y-intercepts
- Even, Odd, or neither
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- End Behavior

## POWER FUNCTION – EVEN $n$

$$f(x) = x^n$$



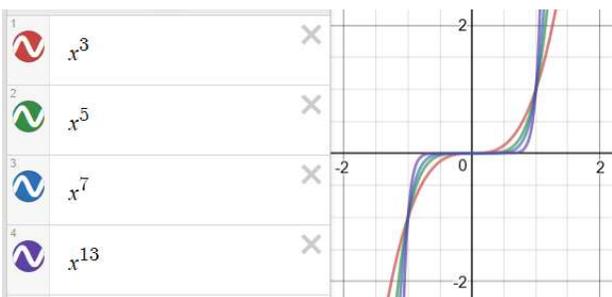
### Key Concept

Characteristics of Even-Degree Power Functions:  $f(x) = x^n$ , where  $n$  is an even integer greater than zero

- domain:  $(-\infty, \infty)$
- range:  $[0, \infty)$
- increasing intervals:  $(0, \infty)$
- decreasing intervals:  $(-\infty, 0)$
- constant intervals: none
- x-intercept:  $(0, 0)$
- y-intercept:  $(0, 0)$
- even, odd, neither: even
- continuous or discontinuous: continuous
- asymptotes: none
- end behavior:  $f(x) \rightarrow \infty$  as  $x \rightarrow \infty$ ;  $f(x) \rightarrow \infty$  as  $x \rightarrow -\infty$

### POWER FUNCTION – ODD $n$

$$y = x^n$$

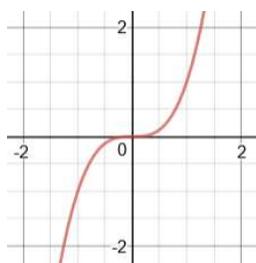


Identify for each parent function:

- Domain & Range
- Intervals where increasing, decreasing, or constant
- The x-intercepts & y-intercepts
- Even, Odd, or neither
- Continuous or Discontinuous
- Asymptotes
- End Behavior

### POWER FUNCTION – ODD $n$

$$f(x) = x^n$$

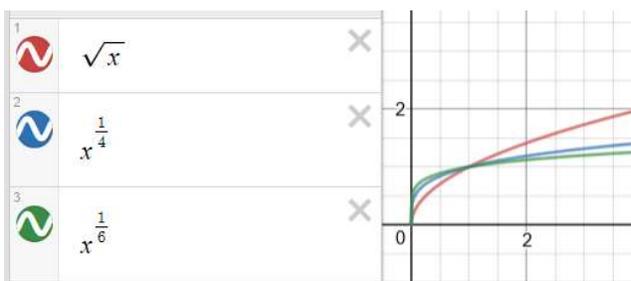


Characteristics of Odd-Degree Power Functions:  $f(x) = x^n$ , where  $n$  is an odd integer greater than zero

- domain:  $(-\infty, \infty)$
- range:  $(-\infty, \infty)$
- increasing intervals:  $(-\infty, \infty)$
- decreasing intervals: none
- constant intervals: none
- x-intercept:  $(0, 0)$
- y-intercept:  $(0, 0)$
- even, odd, neither: odd
- continuous or discontinuous: continuous
- asymptotes: none
- end behavior:  $f(x) \rightarrow \infty$  as  $x \rightarrow \infty$ ;  $f(x) \rightarrow -\infty$  as  $x \rightarrow -\infty$

## ROOT FUNCTION – EVEN $n$

$$y = n\sqrt{x}$$



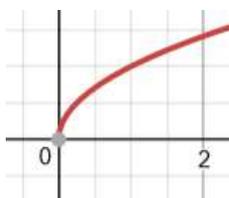
Identify for each parent function:

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- End Behavior

Remember, roots can be written as rational (fraction) exponents!

## ROOT FUNCTION – EVEN $n$

$$f(x) = n\sqrt{x}$$



### Key Concept

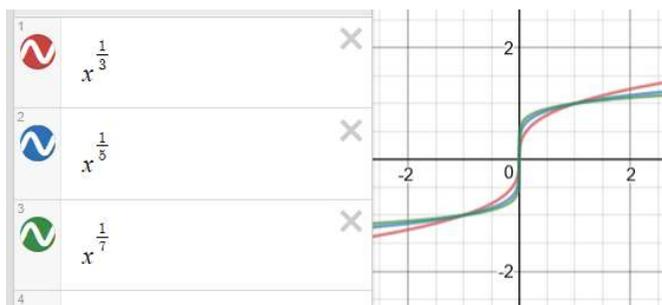
Characteristics of Even-Index Root Functions:  $f(x) = \sqrt[n]{x}$ , where  $n$  is an even integer greater than zero

- domain:  $[0, \infty)$
- range:  $[0, \infty)$
- increasing intervals:  $(0, \infty)$
- decreasing intervals: none
- constant intervals: none
- x-intercept:  $(0, 0)$
- y-intercept:  $(0, 0)$
- even, odd, neither: neither
- continuous or discontinuous: continuous
- asymptotes: none
- end behavior:  $f(x) \rightarrow \infty$  as  $x \rightarrow \infty$

Remember, we can't use the negative side of an even root, or it won't qualify as a function!

## ROOT FUNCTION – ODD $n$

$$y = n\sqrt{x}$$

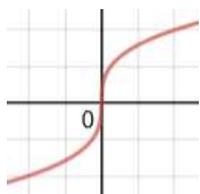


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- End Behavior

## ROOT FUNCTION – ODD $n$

$$f(x) = n\sqrt{x}$$

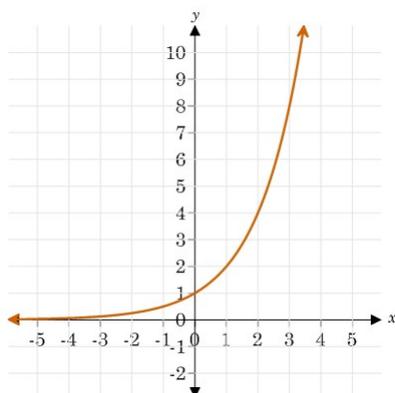


Characteristics of Odd-Index Root Functions:  $f(x) = \sqrt[n]{x}$ , where  $n$  is an odd integer greater than zero

- domain:  $(-\infty, \infty)$
- range:  $(-\infty, \infty)$
- increasing intervals:  $(-\infty, \infty)$
- decreasing intervals: none
- constant intervals: none
- x-intercept:  $(0, 0)$
- y-intercept:  $(0, 0)$
- even, odd, neither: odd
- continuous or discontinuous: continuous
- asymptotes: none
- end behavior:  $f(x) \rightarrow \infty$  as  $x \rightarrow \infty$ ;  $f(x) \rightarrow -\infty$  as  $x \rightarrow -\infty$

**EXPONENTIAL FUNCTION**

$$y = b^x$$

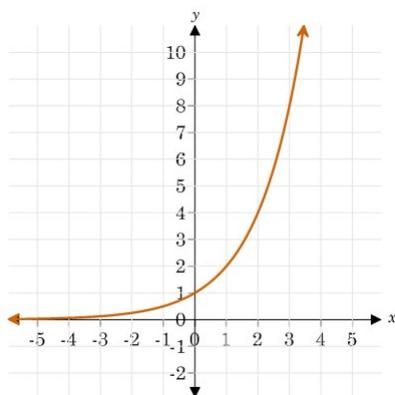
**Growth when  $b > 1$** 

Identify for each parent function:

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- End Behavior

**EXPONENTIAL FUNCTION**

$$f(x) = b^x$$

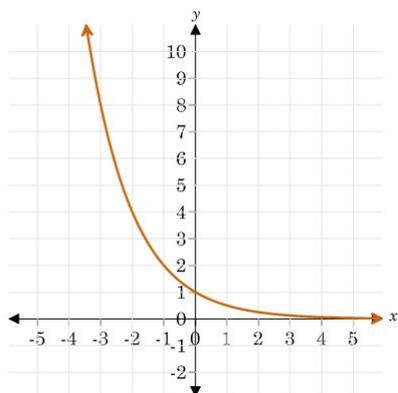
**Growth when  $b > 1$** **Key Concept**Characteristics of Exponential Functions:  $f(x) = b^x$ ,  $b > 1$ 

- domain:  $(-\infty, \infty)$
- range:  $(0, \infty)$
- increasing intervals:  $(-\infty, \infty)$
- decreasing intervals: none
- constant intervals: none
- x-intercept: none
- y-intercept:  $(0, 1)$
- even, odd, neither: neither
- continuous or discontinuous: continuous
- asymptotes:  $y = 0$
- end behavior:  $f(x) \rightarrow \infty$  as  $x \rightarrow \infty$ ;  $f(x) \rightarrow 0$  as  $x \rightarrow -\infty$

How do you know there's no vertical asymptote? Zoom in on Desmos. Now you know that to be true for all transformations of this function!

**EXPONENTIAL FUNCTION**

$$y = b^x$$

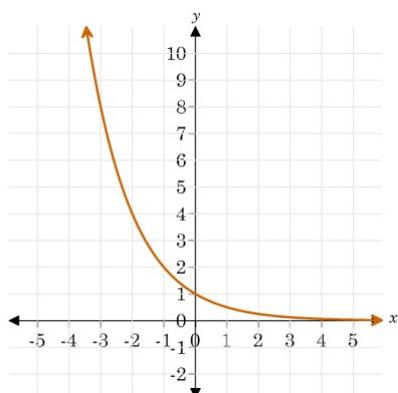
Decay when  $0 < b < 1$ 

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**EXPONENTIAL FUNCTION**

$$f(x) = b^x$$

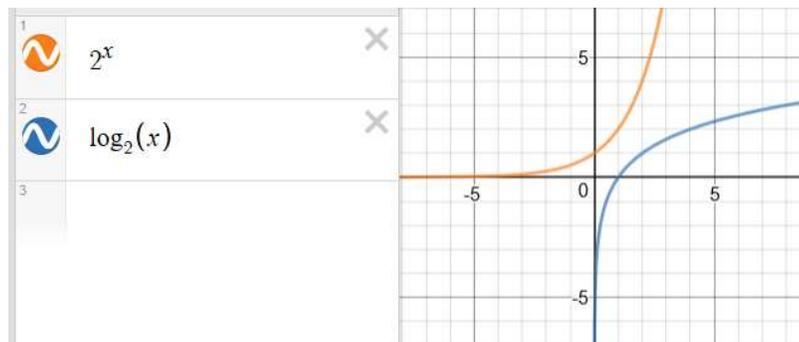
Decay when  $0 < b < 1$ Characteristics of Exponential Functions:  $f(x) = b^x, 0 < b < 1$ 

- domain:  $(-\infty, \infty)$
- range:  $(0, \infty)$
- increasing intervals: none
- decreasing intervals:  $(-\infty, \infty)$
- constant intervals: none
- x-intercept: none
- y-intercept:  $(0, 1)$
- even, odd, neither: neither
- continuous or discontinuous: continuous
- asymptotes:  $y = 0$
- end behavior:  $f(x) \rightarrow 0$  as  $x \rightarrow \infty$ ;  $f(x) \rightarrow \infty$  as  $x \rightarrow -\infty$

Remember, these functions are inverses . . .

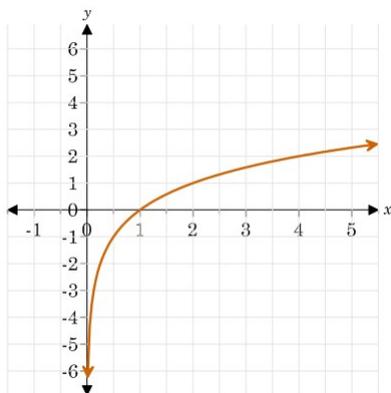
EXPONENTIAL FUNCTION  
 $f(x) = b^x$

LOGARITHMIC FUNCTION  
 $f(x) = \log_b x$



LOGARITHMIC FUNCTION

$y = \log_b x$   
 when  $b > 1$



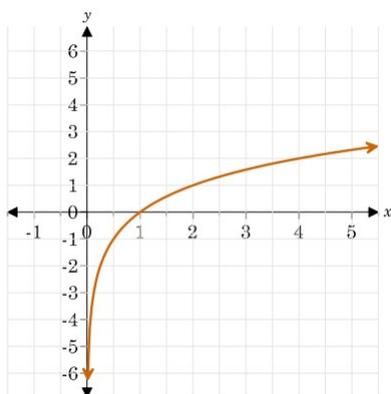
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**LOGARITHMIC FUNCTION**

$$f(x) = \log_b x$$

when  $b > 1$

**Key Concept**

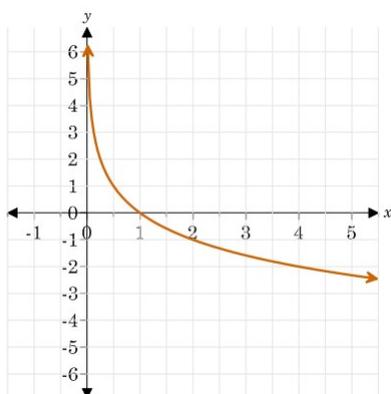
Characteristics of the Parent Logarithmic Function:  $f(x) = \log_b x$ ,  $b > 1$

- domain:  $(0, \infty)$
- range:  $(-\infty, \infty)$
- increasing intervals:  $(0, \infty)$
- decreasing intervals: none
- constant intervals: none
- x-intercept:  $(1, 0)$
- y-intercept: none
- even, odd, neither: neither
- continuous or discontinuous: continuous
- asymptotes:  $x = 0$
- end behavior:  $f(x) \rightarrow \infty$  as  $x \rightarrow \infty$ ;  $f(x) \rightarrow -\infty$  as  $x \rightarrow 0$

**LOGARITHMIC FUNCTION**

$$y = \log_b x$$

when  $0 < b < 1$



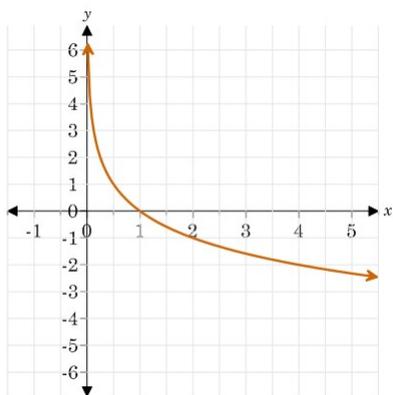
Identify for each parent function:

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- Even, Odd, or neither
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**LOGARITHMIC FUNCTION**

$$f(x) = \log_b x$$

when  $0 < b < 1$



Characteristics of the Parent Logarithmic Function:  $f(x) = \log_b x$ ,  $0 < b < 1$

- domain:  $(0, \infty)$
- range:  $(-\infty, \infty)$
- increasing intervals: none
- decreasing intervals:  $(0, \infty)$
- constant intervals: none
- x-intercept:  $(1, 0)$
- y-intercept: none
- even, odd, neither: neither
- continuous or discontinuous: continuous
- asymptotes:  $x = 0$
- end behavior:  $f(x) \rightarrow -\infty$  as  $x \rightarrow \infty$ ;  $f(x) \rightarrow \infty$  as  $x \rightarrow 0$

... then next week ...

**TRANSFORMATIONS!!!**

??what "specs" will change??

## Questions??

Review the Key Terms and Key Concepts documents for this unit.

Look up the topic at [khanacademy.org](https://www.khanacademy.org) and [virtualnerd.com](https://www.virtualnerd.com)

Check our class website at [nca-patterson.weebly.com](https://nca-patterson.weebly.com)

\*Reserve a time for a call with me at  
[jpattersonmath.youcanbook.me](https://jpattersonmath.youcanbook.me)  
We can use the LiveLesson whiteboard  
to go over problems together.

