How can I meet today's standards?

*I can **graph exponential functions** and **identify key features** of the graph*

Warm Up: Evaluate each function at the given values of x.

1. $f(x) = -2(x+4)$, when $x = 1$
2. $g(x) = 3.3x = 2$, when $x = 10$
3. $h(x) = 3(x+1)^2$, when $x = -6$
4. $j(x) = 4^x$, when $x = 0$

Quick Question: Which allowance would you rather have?

Option A: You get $10,000 total over the next 20 days, paid out any way you'd like.

Option B: You start with $0.01 on Day 0, and your allowance doubles every day:

Which one do you choose and why?

Speak Like A Mathematician:

exponential function: a function in which the _________________ variable is an ________________.

exponential growth: happens when a quantity _________________ in proportion to its _________________ size, meaning the ______________ it becomes, the ________________ it grows.

exponential decay: happens when a quantity _________________ in proportion to its _________________ size, meaning the ______________ it becomes, the ________________ it declines.

asymptote: a line that a graph _________________________ as it heads toward ____________________.

Example 1: Identify Exponential Behavior

A) The Richter Scale measures the energy that an earthquake releases and assigns a magnitude to it. These orders of magnitude can be approximated by comparing them to the explosive power of TNT. Determine whether the set of data displays exponential behavior.

Magnitude	TNT (tons)
1	0.6
2	6
3	60
4	600
5	6000
6	60,000
7	600,000
8	6,000,000

B) After World War II, the television became a major consumer product in the United States. The percentage of households with a TV for each year in the 1950's is provided in the table. Determine whether the set of data displays exponential behavior.

Year	% of Households with a TV
1950	9
1951	24
1952	34
1953	45
1954	56
1955	65
1956	72
1957	79

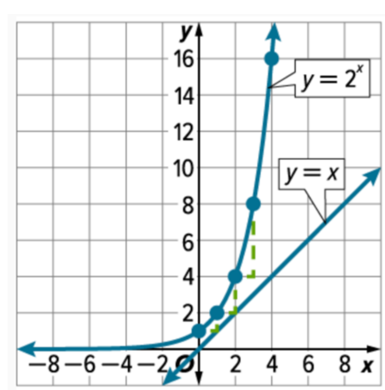
C) In the 19th century, psychologist Hermann Ebbinghaus created a formula to approximate how quickly people forget information over time. The approximate percentage of the newly learned information a person retains over time is shown on the table. Determine whether the data displays exponential behavior.

Time (days)	% Retained
0	100
1	80
2	64
3	51.2
4	40.96
5	32.768

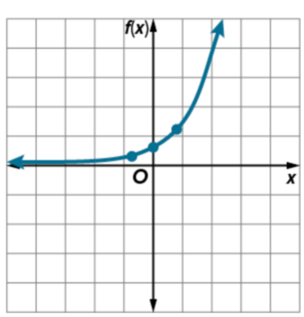
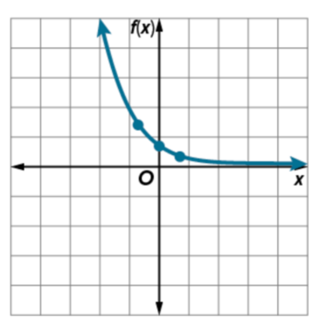
Source: Indiana University

Key Concept: Exponential Function

$$y = a(b)^x$$



Key Concept: Types of Exponential Functions

Exponential Growth	**Exponential Decay**
Equation	
Domain and Range	
Intercepts	
End Behavior	
Graph	
	

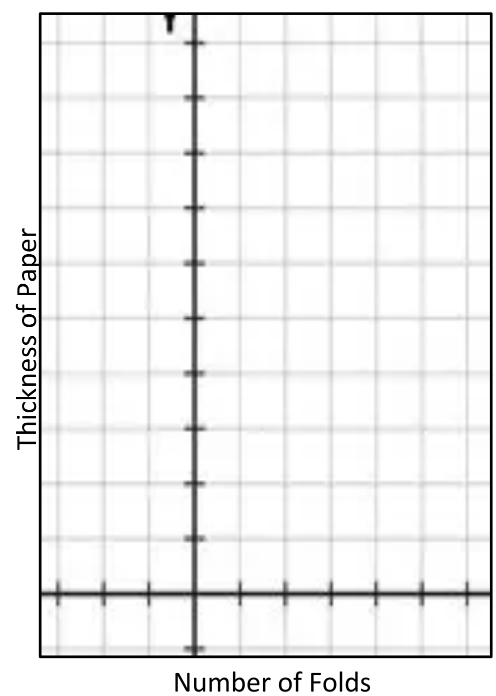
Example 2: Exponential Growth

Each time you fold a piece of paper in half, it doubles in thickness. If a piece of paper is 0.05 millimeter thick, then you can determine the thickness y of a piece of paper given the number of folds x with the function $y = 0.05(2)^x$. Identify the key features of the function, graph it, and then identify the relevant domain and range in the context of the situation.

A) Key Features:
- Domain and Range:
- y-intercept:
- End Behavior:

B) Graph the function:

x	$y = 0.05(2)^x$	y
-2	$y = 0.05(2)^{-2}$	
-1	$y = 0.05(2)^{-1}$	
0	$y = 0.05(2)^{0}$	
1	$y = 0.05(2)^{1}$	
2	$y = 0.05(2)^{2}$	
3	$y = 0.05(2)^{3}$	
4	$y = 0.05(2)^{4}$	



C) Identify the relevant domain and range in context.

Let's Sweeten the Deal: Which allowance would you rather have?

Option A: You get $1,000,000 total over the next **30** days paid out any way you'd like.

Option B: You start with $0.01 on Day 0, and your allowance doubles every day for 30 days:

Which one do you choose now and why?

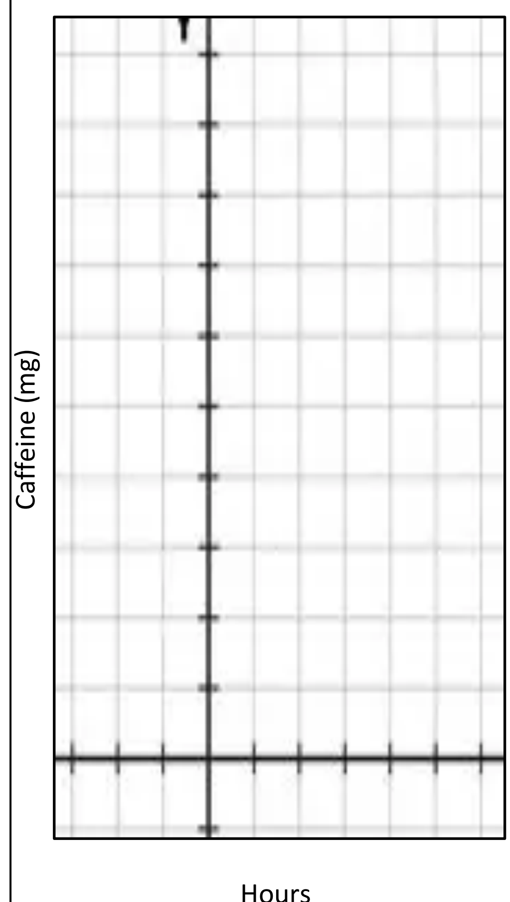
Example 3: Exponential Decay

The half-life of a substance describes how long it takes for the substance to deplete by half. The half-life of caffeine in the body of a typical 14 year old is approximately 5 hours, meaning that it takes 5 hours for the body to break down half of the caffeine. Suppose an energy drink contains 160 milligrams of caffeine. The amount of caffeine y left in your system after x hours is modeled by the function $y = 160\left(\frac{1}{2}\right)^{\frac{x}{5}}$. Identify the key features of the function, graph it, and then identify the relevant domain and range in the context of the situation.

A) Key Features:
- Domain and Range:
- y-intercept:
- End Behavior:

B) Graph the function:

x	$y = 160\left(\frac{1}{2}\right)^{\frac{x}{5}}$	y
-2	$y = 160\left(\frac{1}{2}\right)^{\frac{-1}{5}}$	
-1	$y = 160\left(\frac{1}{2}\right)^{\frac{0}{5}}$	
0	$y = 160\left(\frac{1}{2}\right)^{\frac{1}{5}}$	
1	$y = 160\left(\frac{1}{2}\right)^{\frac{2}{5}}$	
2	$y = 160\left(\frac{1}{2}\right)^{\frac{3}{5}}$	
3	$y = 160\left(\frac{1}{2}\right)^{\frac{4}{5}}$	



C) Identify the relevant domain and range in context.