Exponential Functions

$f(x) = a\,b^x$

$b \neq 0 \quad a \neq 1$

$b > 1$ Growth

$0 < b < 1$ Decay

Ex Growth or Decay?

* $f(x) = 2(3)^x$ Growth
* $f(x) = 2\left(\frac{1}{2}\right)^x$ Decay
* $f(x) = \frac{1}{2}\left(\frac{3}{2}\right)^x$ Growth
* $f(x) = 2^{-x}$ Decay

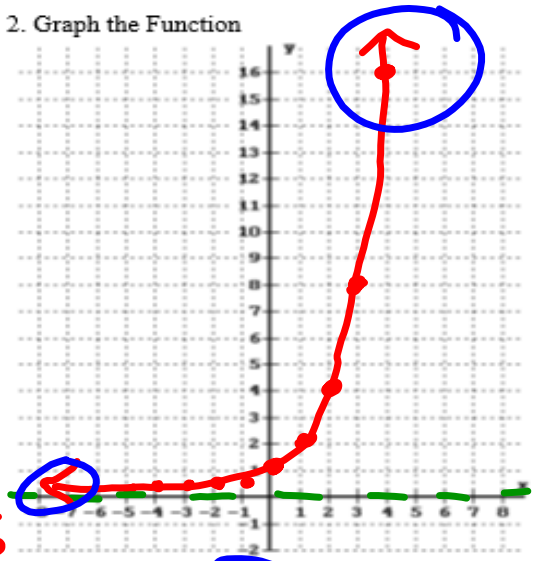
$x^{-1} = \frac{1}{x} \qquad \left(\frac{1}{x}\right)^{-1} = x$

Graph the Exponential Function: $f(x) = 2^x$

1. Complete the Table

X	Y
5	32
4	16
3	8
2	4
1	2
0	1
-1	$\frac{1}{2}$: .5
-2	$\frac{1}{4}$: .25
-3	$\frac{1}{8}$: .125
-4	$\frac{1}{16}$: .0625
-5	$\frac{1}{32}$: .03125

2. Graph the Function



Asymptote $y = 0$

D: $\mathbb{R}$

R: $y > 0$

Inc: $(-\infty, \infty)$

3. Where does the graph of $y = 2^x$ cross the y-axis? (This means to find the y-intercept) $(0,1)$

4. Where does the graph of $y = 2^x$ cross the x-axis (This means to find the x-intercept(s)) none

5. In your own words, describe what happens to the graph.

As $x \to +\infty$, $f(x) \to +\infty$

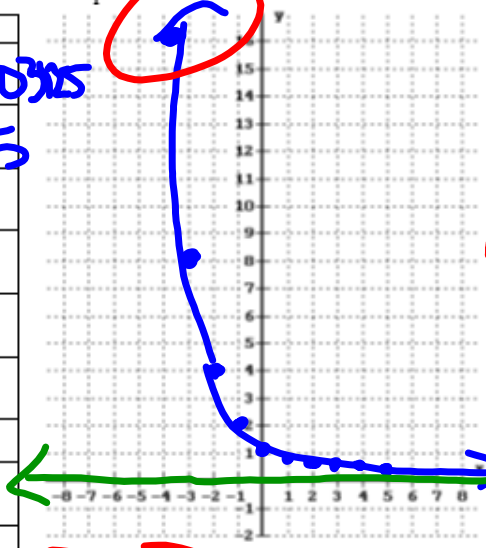
$x \to -\infty$, $f(x) \to 0$

Graph the Exponential Function: $f(x)=\left(\frac{1}{2}\right)^x$

1. Complete the Table

X	Y
5	1/32 = .0325
4	.0625
3	.125
2	.25
1	.5
0	1
-1	2
-2	4
-3	8
-4	16
-5	32

2. Graph the Function



As $x \to +\infty, f(x) \to 0$

$x \to -\infty, f(x) \to +\infty$

$\to y=0$ asymptote

D: $\mathbb{R}$

R: $y>0$

Dec: $(-\infty, \infty)$

3. Where does the graph of $y=\left(\frac{1}{2}\right)^x$ cross the y-axis? (This means to find the y-intercept) (0,1)

4. Where does the graph of $y=\left(\frac{1}{2}\right)^x$ cross the x-axis (This means to find the x-intercept(s)) never

5. In your own words, describe what happens to the graph.

Steps for Graphing

1. Decide Growth or Decay
2. Find + plot "h"
3. Make a t-table
   Pick a # on each side of h
4. Plot the points

$$y = -a(b)^{x-h} + k$$

- Reflect: $-$
- Stretch: $a > 1$, shrink: $0 < a < 1$
- Growth or decay: b
- left/right: opposite of h
- k: * up/down * Asymptote * # for Range

Domain : $\mathbb{R}$

Range : $y > 0$

Increasing $(-\infty, \infty)$

Decreasing none

Asymptote : Graph approaches this line but never crosses $y=0$

y-int - where the graph crosses the y-axis $(0,1)$

zeros none

End Behavior - Look at the arrows

As $x \to +\infty$, $f(x) \to \infty$

$x \to -\infty$, $f(x) \to 0$

h: 0

1. Graph the Function: $y = (2)^x - 4$

x	y
-1	-3.5
0	-3
1	-2	

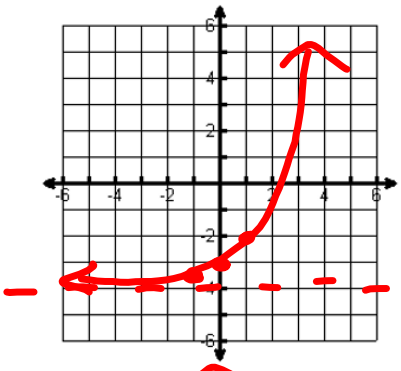
Asymptote: y = -4

D: ℝ Inc: $(-\infty, \infty)$

R: $y > -4$

As $x \to +\infty$, $f(x) \to +\infty$

$x \to -\infty$, $f(x) \to -4$



2. Graph the Function: $y = 6\left(\frac{1}{3}\right)^x$

h: 0 k: 0

x	y
-1	18
0	6
1	2

Asymptote: y = 0

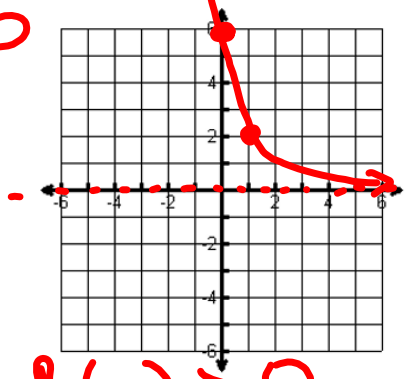
Dec. $(-\infty, \infty)$

D: ℝ

R: $y > 0$

As $x \to +\infty$, $f(x) \to 0$

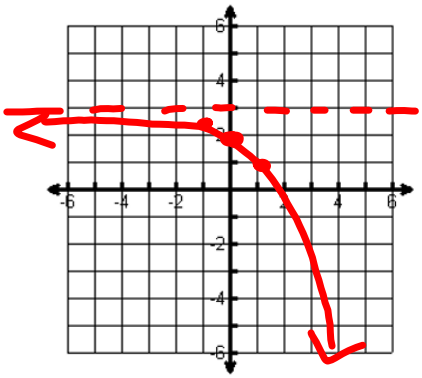
$x \to -\infty$, $f(x) \to +\infty$



3. Graph the Function: $y = -(2)^x + 3$

Asymptote: $y = 3$

x	y
0	2
-1	2.5
1	1



D: $\mathbb{R}$

R: $y < 3$

Dec: $(-\infty, \infty)$

As $x \to +\infty$, $f(x) \to -\infty$

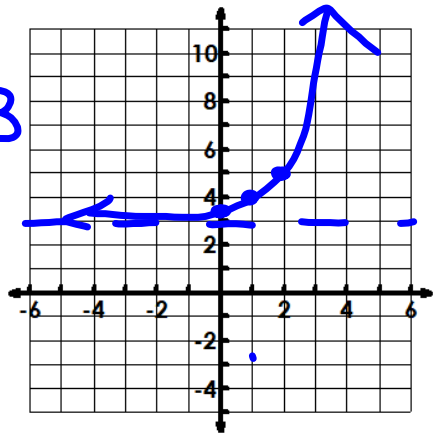
$x \to -\infty$, $f(x) \to 3$

2^{x-1} $h=1$

4. $y = 2^{x-1} + 3$

X	$y = 2^{x-1} + 3$
-4	
-3	
-2	
-1	
0	3.5
1	4
2	5
3	
4	

$2 \wedge (0-1)+3$



Transformations: up 3. Right 1

Domain: R Range: $y > 3$

Asymptote: $y = 3$ Increasing Decreasing

5) What transformations would be applied to the following equations?

a) $y = 2^{x-4}$ Rt. 4

b) $y = 4^{x-3} - 7$ Rt 3; down 7

c) $y = -3^{x+2} + 5$ left 2 ups Reflect

6) Determine if the following functions are growth or decay? Increasing or decreasing?

a) $y = 3^x + 4$

G

b) $y = \left(\frac{2}{5}\right)^{x-5}$

D

c) $y = \left(\frac{5}{3}\right)^x$

G

d) $y = 4^{-x} + 8$

D

e) $y = -2(8)^x + 16$

G

f) $y = \frac{1}{4}\left(\frac{9}{2}\right)^x$

G