

## Chapter 7: EXPONENTIAL FUNCTIONS

### 7.1 – Characteristics of Exponential Functions

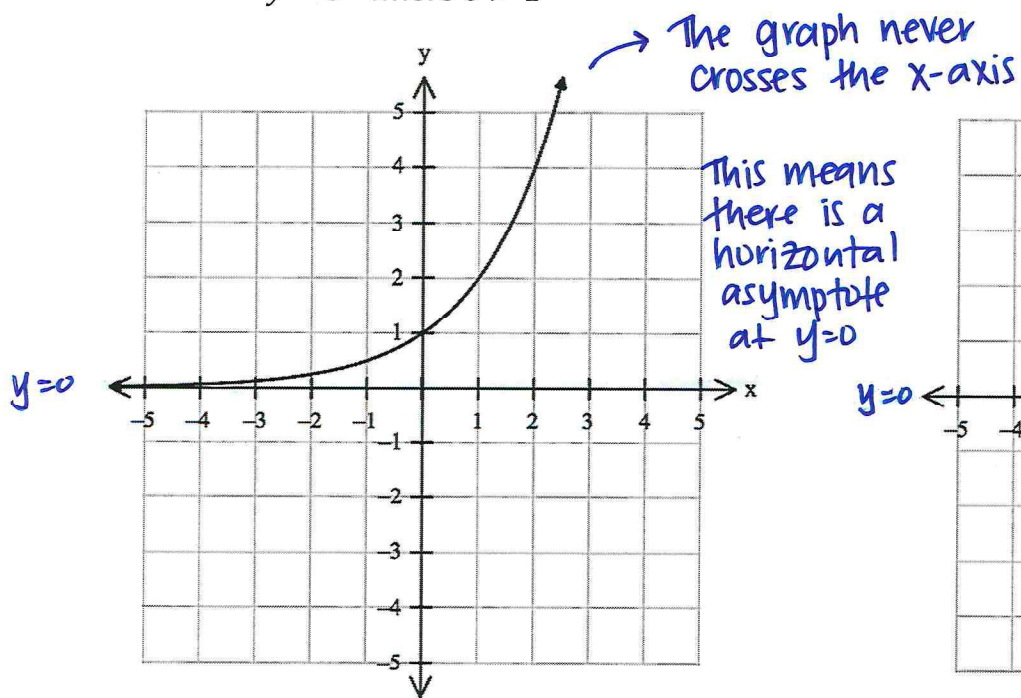
**Exponential Function:** A function of the form  $y = c^x$  (or  $f(x) = c^x$ ) where  $c$  is a constant ( $c > 0$ ) and  $x$  is a variable.

Constant  $\rightarrow$  Base

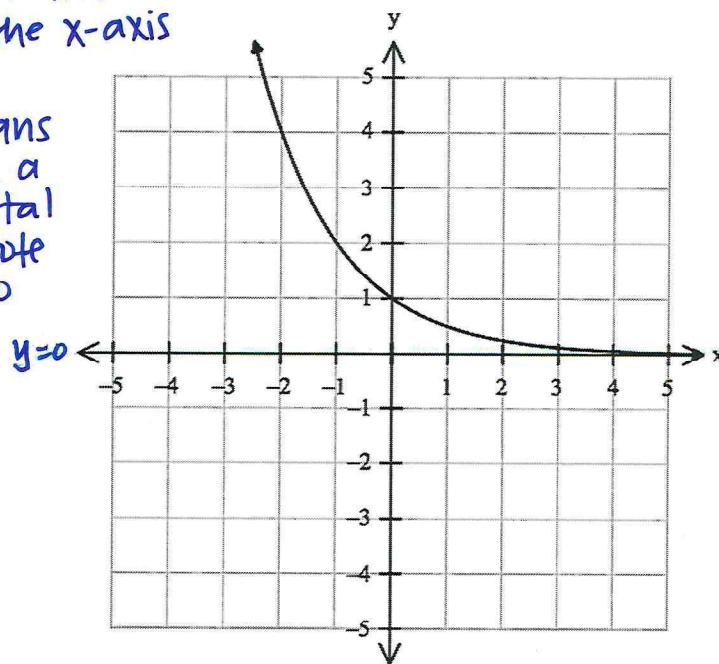
Variable  $\rightarrow$  Exponent

Let's look at some graphs of exponential functions.

$$y = c^x \text{ where } c > 1$$



$$y = c^x \text{ where } 0 < c < 1$$



#### Increasing Function

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

Range:  $(0, \infty)$

Asymptote:  $y = 0$

Point on the graph:  $(0,1)$

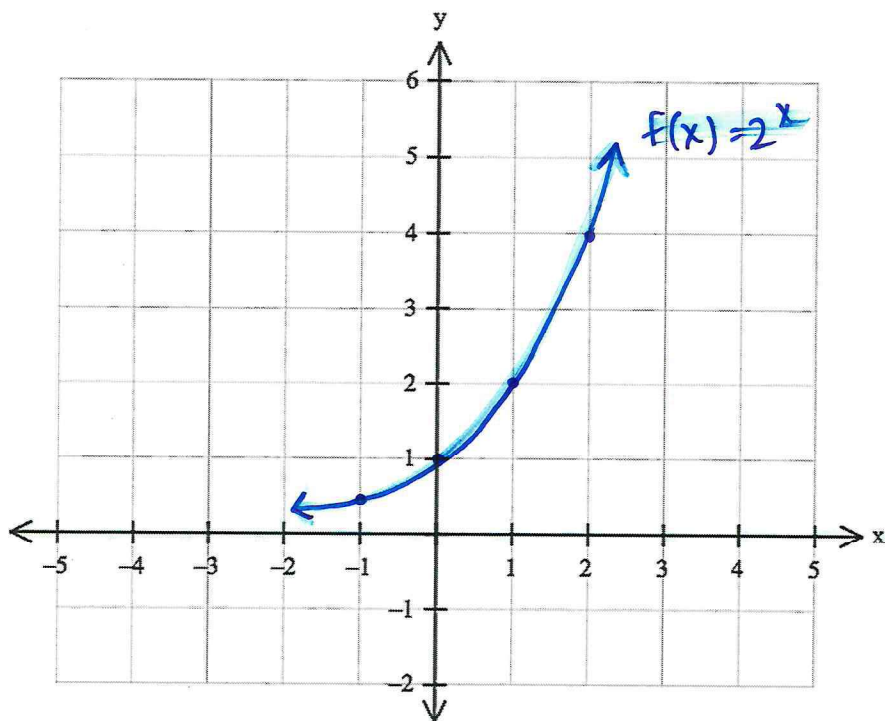
#### Decreasing Function

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

Range:  $(0, \infty)$

Asymptote:  $y = 0$

Point on the graph:  $(0,1)$

Example #1Sketch the graph of  $f(x) = 2^x$ 

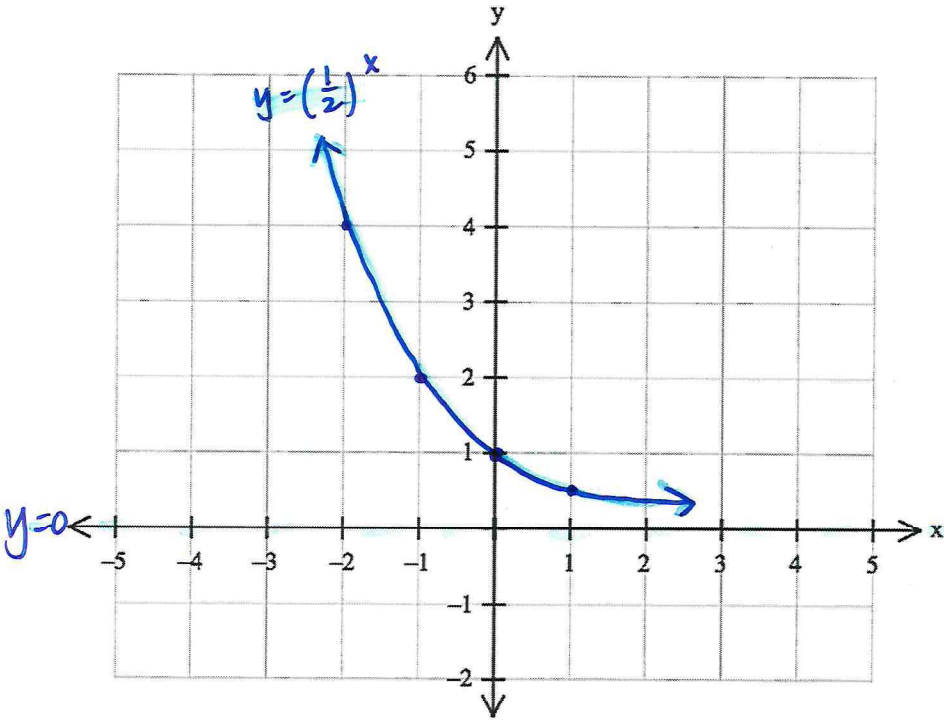
$x$	$y$
-3	$2^{-3} = \frac{1}{8}$
-2	$2^{-2} = \frac{1}{4}$
-1	$2^{-1} = \frac{1}{2}$
0	$2^0 = 1$
1	$2^1 = 2$
2	$2^2 = 4$
3	$2^3 = 8$

Notes:

- The **base** of this exponential function is 2
- Thus, the function is increasing (base > 1)
- The graph passes through the point (0, 1) (y-int)
- There is a **horizontal asymptote** at  $y=0$  (since  $y$  cannot be negative)
- The **domain** is  $(-\infty, \infty)$
- The **range** is  $(0, \infty)$  or  $y > 0$
- The graph approaches  $y=0$  when  $x \rightarrow -\infty$   
when  $x$  approaches  $-\infty$

Example #2

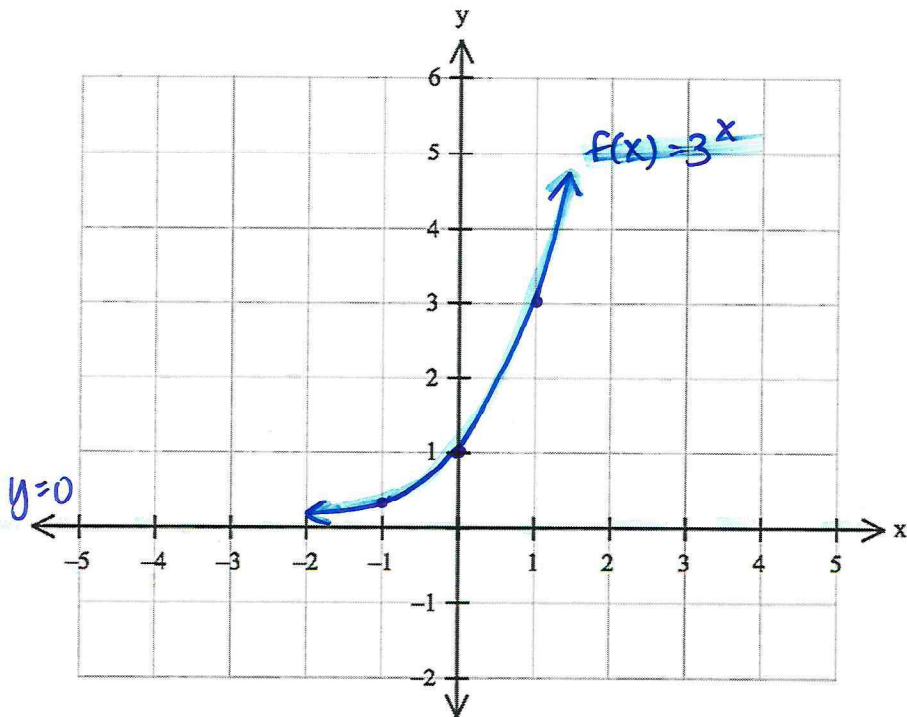
Sketch the graph of  $y = \left(\frac{1}{2}\right)^x$



x	y
-3	$\left(\frac{1}{2}\right)^{-3} = 8$
-2	$\left(\frac{1}{2}\right)^{-2} = 4$
-1	$\left(\frac{1}{2}\right)^{-1} = 2$
0	$\left(\frac{1}{2}\right)^0 = 1$
1	$\left(\frac{1}{2}\right)^1 = \frac{1}{2}$
2	$\left(\frac{1}{2}\right)^2 = \frac{1}{4}$
3	$\left(\frac{1}{2}\right)^3 = \frac{1}{8}$

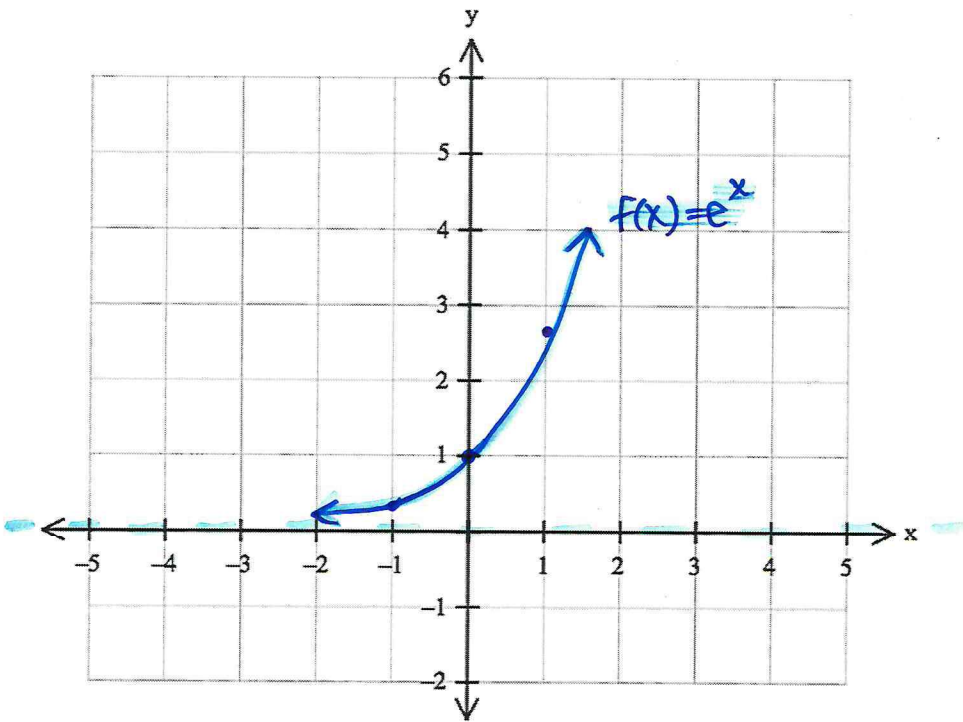
Example #3

Sketch the graph of  $f(x) = 3^x$



Example #4

Sketch the graph of  $f(x) = e^x$



$$e^1 = 2.718$$

$$e^0 = 1$$

$$e^{-1} = 0.368$$

↳ Base "e" is a constant number

↳ Is an irrational number