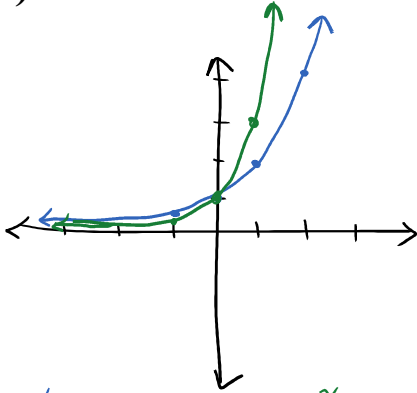


## Characteristics of Exponential Functions

An exponential function is a function where  $x$  is in the exponent. It can be written in the form  $y = c^x$  *Basic form*

Ex: Consider the functions  $y = 2^x$ ,  $y = 3^x$ ,  $y = 0.5^x$  &  $y = 0.1^x$

- a) State the domain and range
- b) Any intercepts
- c) Equation of the asymptote
- d) Whether it is increasing or decreasing



$$y = 2^x$$

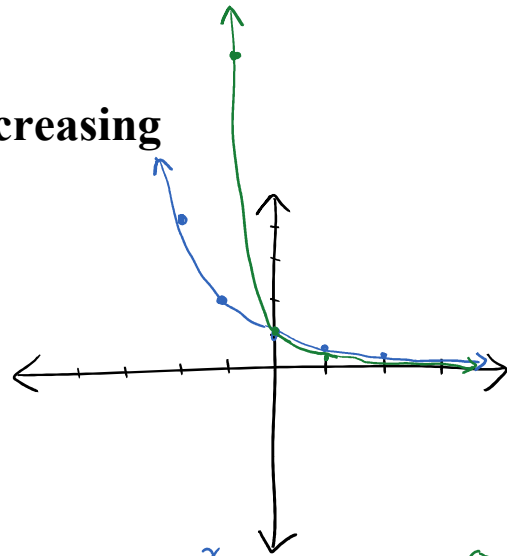
x	y
-1	1/2
0	1
1	2
2	4

$$y = 3^x$$

x	y
-1	1/3
0	1
1	3
2	9

Domain:  $x \in \mathbb{R}$   
 Range:  $y > 0$   
 y-intercept:  $(0, 1)$   
 horizontal asymptote:  $y = 0$

\* increasing function  
 \* exponential growth functions  
 ↳ bacteria



$$y = 0.5^x$$

x	y
-2	4
-1	2
0	1
1	0.5
2	0.25

$$y = 0.1^x$$

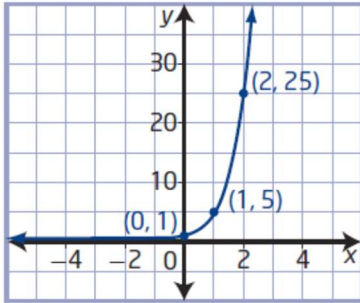
x	y
-2	100
-1	10
0	1
1	0.1

Domain:  $x \in \mathbb{R}$   
 Range:  $y > 0$   
 y-intercept:  $(0, 1)$   
 asymptote:  $y = 0$

\* decreasing function  
 \* exponential decay function.  
 ↳ radioactive decay  
 half life → amt of time it takes for a substance to be half of original amt.

**NOTE:** The graph of an exponential function such as,  $y = c^x$ , is **increasing for  $c > 1$** , **decreasing for  $0 < c < 1$** , and neither increasing nor decreasing for  $c = 1$ .

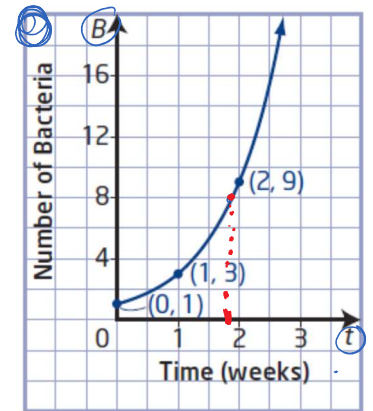
**Example:** What function of the form  $y = c^x$  can be used to describe the graph shown?



x	y
0	1
1	5
2	25

$y = c^x$   
 $y = 5^x$

**Example:** Under ideal circumstances, a certain bacteria population triples every week. This is modelled by the following exponential graph.



- What are the domain & range of this function?
- Write the exponential growth model that relates the number,  $B$ , bacteria to the time,  $t$ , in weeks.
- Determine approximately how many days it would take for the number of bacterial to increase to eight times the quantity on day 1.

a) Domain:  $x \geq 0$   
Range:  $y \geq 1$

b)  $y = c^x$   
 $B = 3^t$

x	y
0	1
1	3
2	9

c) we are looking for when this will be 8 times as big

x	y
0	1
1	3
2	9

in between 1 & 2

Test:  $B = 3^{1.8} = 7.22$   
 $B = 3^{1.9} = 8.06$   
 $B = 3^{1.893} = 8.0018$

$\therefore 1.893 \text{ wks} \times 7 = \underline{13.251 \text{ days}}$