

**UNIT 6**

**Exponential Functions**

6.1/6.2: Characteristics of Exponential Functions

We will explore exponential functions of the form:  $y = a(b)^x$

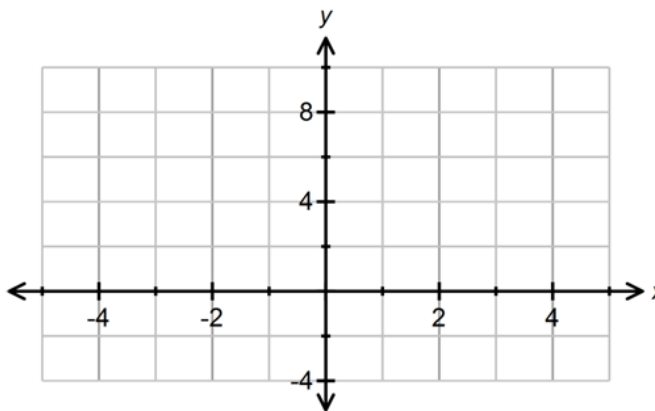
where  $b > 1$  or  $0 < b < 1$  and  $a > 0$

the variable is in the exponent

**Investigation:**

1. a. Complete the table of values and sketch the graph of:  $y = 2^x$

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



b. Identify the characteristics.

x-intercept	_____
y-intercept	_____
End Behaviour	_____
Increasing/Decreasing	_____
Horizontal Asymptote	_____
Domain	_____
Range	_____

c. Compare the pattern in the table of values with the b-value.



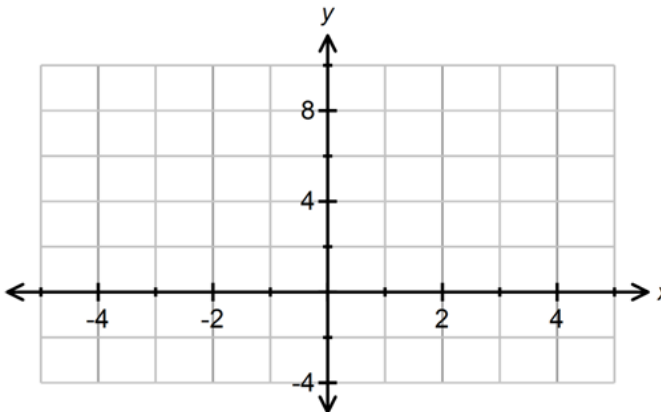
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All exponential functions of the form  $y = a(b)^x$  gets very close to the x-axis but will never touch or cross it.

This line that the graph gets close to is called the **horizontal asymptote** and has an equation of  $y = 0$ .

2. a. Complete the table of values and sketch the graph of:  $y = \left(\frac{1}{2}\right)^x$

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



b. Identify the characteristics.

x-intercept \_\_\_\_\_

y-intercept \_\_\_\_\_

End Behaviour \_\_\_\_\_

Increasing/Decreasing \_\_\_\_\_

Horizontal Asymptote \_\_\_\_\_

Domain \_\_\_\_\_

Range \_\_\_\_\_

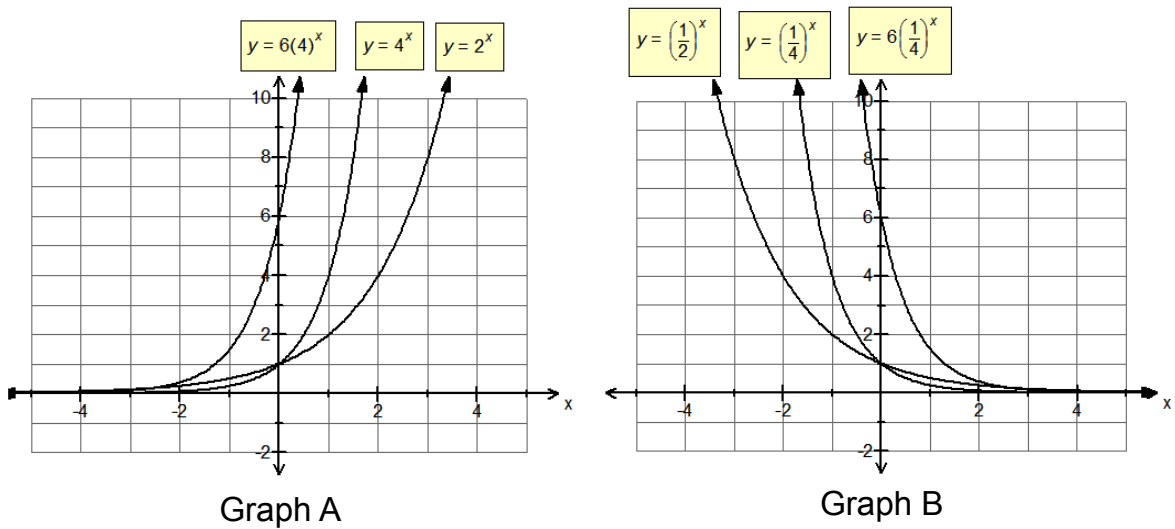
c. Compare the pattern in the table of values with the b-value.

3. How are the graphs of  $y = 2^x$  and  $y = \left(\frac{1}{2}\right)^x$  alike and how are they different?



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4. Given the following graphs in the form:  $y = a(b)^x$



a. Complete the table.

	a	b	y-intercept	increasing/ decreasing
$y = 2^x$				
$y = 4^x$				
$y = 6(4)^x$				
$y = (\frac{1}{2})^x$				
$y = (\frac{1}{4})^x$				
$y = 6(\frac{1}{4})^x$				

b. Compare the **a-value** with the **y-intercept**.

What conclusion can you make?

c. Compare the **b-value** with the **shape** of the graph.

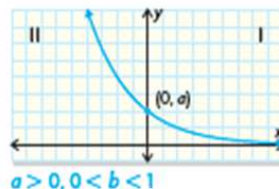
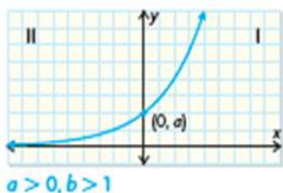
What conclusion can you make?



**Characteristics of Exponential Functions of the Form:**

$$y = a(b)^x \text{ where } a > 0 \text{ and } 0 < b < 1 \text{ or } b > 1$$

- the number of x-intercepts: none
- y-intercept = a
- end behaviour: extends from Q2 to Q1
- equation of asymptote:  $y = 0$
- domain:  $x \in R$
- range:  $y > 0$
- as x-values increase by 1, the y-values will increase/ decrease by a constant ratio equal to the b-value
- if  $b > 1$  OR if  $0 < b < 1$   
 increasing from Q1 to Q1      decreasing from Q2 to Q1



1. What will happen if  $b = 1$  ?

x					
y					

2. What will happen if  $b = 0$ ?

x					
y					

3. What will happen if  $b < 0$ ?

x					
y					

**Journal Question:**

How are the functions  $y = x^2$  and  $y = 2^x$  alike/different?

**Example 1:**

State the characteristics of each exponential function.

a)  $y = 9\left(\frac{2}{3}\right)^x$

b)  $y = \frac{1}{2}(3)^x$

x-intercept \_\_\_\_\_  
 y-intercept \_\_\_\_\_  
 end behaviour \_\_\_\_\_  
 inc/dec \_\_\_\_\_  
 Equation of Asymptote \_\_\_\_\_  
 Domain \_\_\_\_\_  
 Range \_\_\_\_\_

x-intercept \_\_\_\_\_  
 y-intercept \_\_\_\_\_  
 end behaviour \_\_\_\_\_  
 inc/dec \_\_\_\_\_  
 Equation of Asymptote \_\_\_\_\_  
 Domain \_\_\_\_\_  
 Range \_\_\_\_\_

c)  $y = e^x$

x-intercept \_\_\_\_\_  
 y-intercept \_\_\_\_\_  
 end behaviour \_\_\_\_\_  
 inc/dec \_\_\_\_\_  
 Equation of Asymptote \_\_\_\_\_  
 Domain \_\_\_\_\_  
 Range \_\_\_\_\_

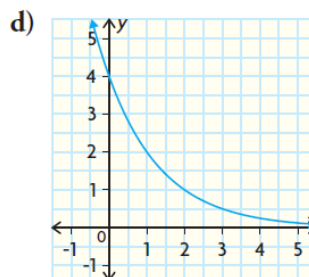
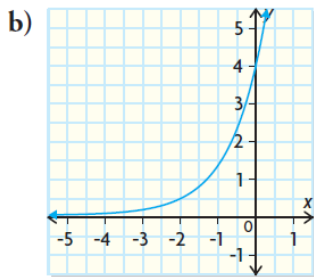
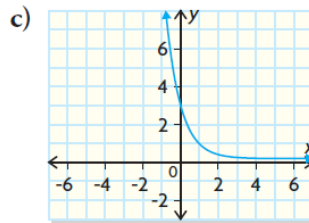
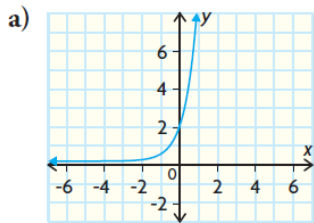
NOTE:  
 e is a constant known  
 as Euler's number.  
 e = 2.718....

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Example 2: (Ex. 3, p. 343)

Which exponential function matches each graph below? Explain why.

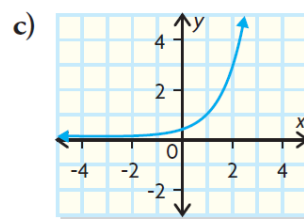
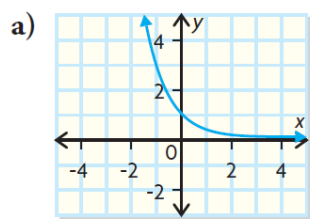
- i)  $y = 3(0.2)^x$     ii)  $y = 4(3)^x$     iii)  $y = 4(0.5)^x$     iv)  $y = 2(4)^x$



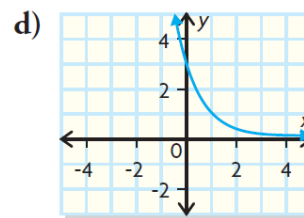
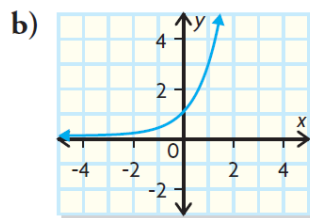
YOUR TURN: p. 345

Which exponential function matches each graph below? Explain why.

i)  $y = (3)^x$  \_\_\_\_\_



ii)  $y = \frac{1}{3}(3)^x$  \_\_\_\_\_



iii)  $y = 3\left(\frac{1}{3}\right)^x$  \_\_\_\_\_

iv)  $y = \left(\frac{1}{3}\right)^x$  \_\_\_\_\_

Practice:

p. 347 - 350, #3, 4abcd, 5abcd, 9, 11, 12ace, 13, 15