Investigating Exponential Relationships

The temperature data collected by a temperature probe has been recorded in the following table.

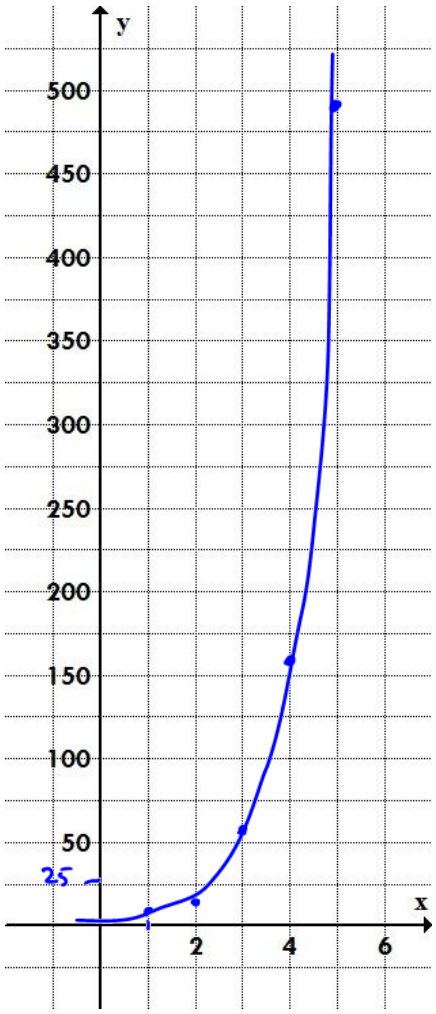
a) Calculate the 1st Differences → $(y_2 - y_1)$

b) Calculate the 2nd Differences →$(1^{st}\ Diff_2 - 1^{st}\ Diff_1)$

c) Calculate the Ratio of Successive y-values →$(y_2 \div y_1)$

d) Plot the (x, y) coordinates and draw the graph.

x	y	1st Differences	2nd Differences	Ratio of Successive y-values
0	2			
1	6	4		$6 \div 2 = 3$
2	18	12	8	$18 \div 6 = 3$
3	54	36	24	$54 \div 18 = 3$
4	162	108	72	$162 \div 54 = 3$
5	486	$486 - 162 = 324$	216	$486 \div 162 = 3$



In an exponential relation, for equal steps of x, neither the 1st or 2nd differences are constant, but the ratios of consecutive y-values are constant.

The graph increases rapidly as you move to the right on the x-axis, and approaches a vertical line.

This is an example of exponential GROWTH.

TERMINOLOGY

Exponential Growth: Non-linear growth represented by an exponential relation and a graph with a rapidly increasing upward curve

Exponential Decay: Non-linear growth represented by an exponential relation and a graph with a rapidly decreasing downward curve

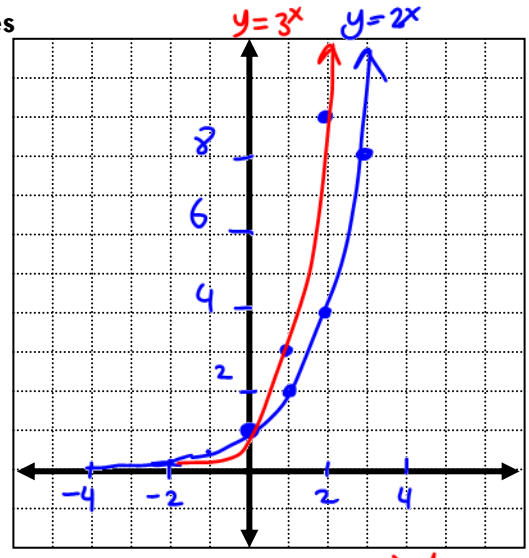
An **EXPONENTIAL FUNCTION** is a function with a variable in the exponent. $y = a^x$

Some examples would be $y = 2^x$ $y = 10^x$ $y = \left(\frac{2}{3}\right)^x$

1. Sketch the graphs of $y = 2^x$ and $y = 3^x$ on the same axes

x	$y = 2^x$
-3	0.125
-2	0.25
-1	0.5
0	1
1	2
2	4
3	8

x	$y = 3^x$
-3	0.037
-2	0.111
-1	0.333
0	1
1	3
2	9
3	27



a) Comparing to the general exponential function $y = a^x$, is $a > 1$ or is $0 < a < 1$? a>1 .

b) What is the *y-intercept* ? (0,1) . Is there an *x-intercept* ? no .

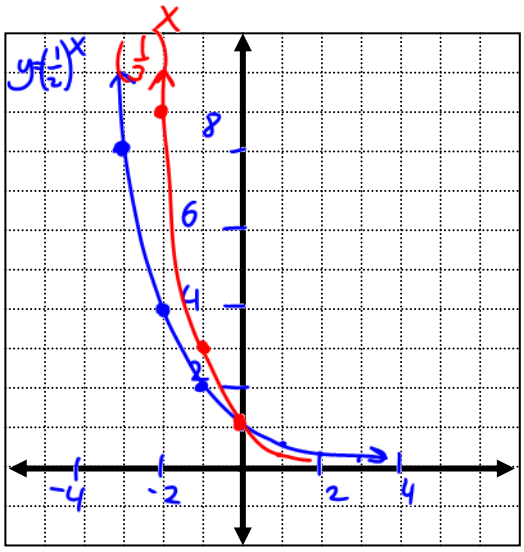
c) Are the functions increasing or decreasing? increasing .

2. Sketch the graphs of $y = \left(\frac{1}{2}\right)^x$ and $y = \left(\frac{1}{3}\right)^x$ on the same axes

x	$y = \left(\frac{1}{2}\right)^x$
-3	8
-2	4
-1	2
0	1
1	0.5
2	0.25
3	0.125

y-int

x	$y = \left(\frac{1}{3}\right)^x$
-3	27
-2	9
-1	3
0	1
1	0333
2	0.111
3	0.037



a) Comparing to the general exponential function $y = a^x$, is $a > 1$ or is $0 < a < 1$? 0<a<1 .

b) What is the *y-intercept* ? (0,1) . Is there an *x-intercept* ? no .

c) Are the functions increasing or decreasing? decreasing .