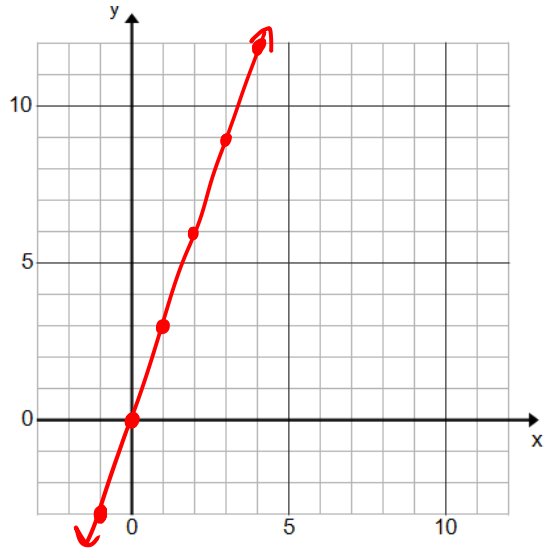
Unit 6 Day 8 Notes on Linear vs Exponential

Let's do a comparison:

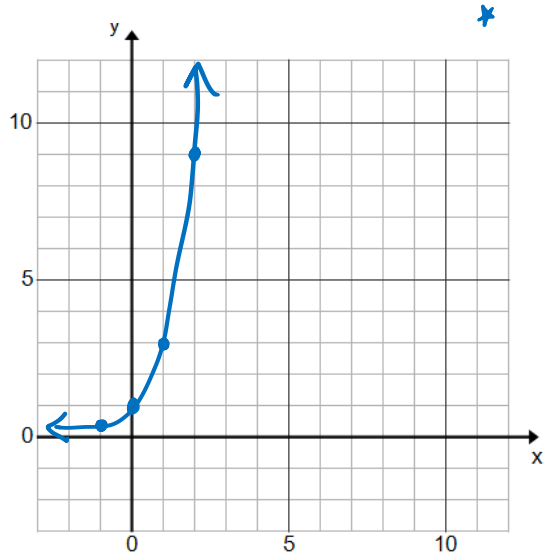
$y = 3x$ (Linear)

x	-1	0	1	2	3	4
y	-3	0	3	6	9	12



$y = 3^x$ (Exponential) $3^{-1} = \frac{1}{3^1} = \frac{1}{3}$

x	-1	0	1	2	3	4
y	$\frac{1}{3}$	1	3	9	27 *	81 *



Compare the two graphs. How are they similar? How are they different? (Pay attention to how the y values "grow")

made of points
both are increasing

(Linear) one is growing at a constant rate (slope)

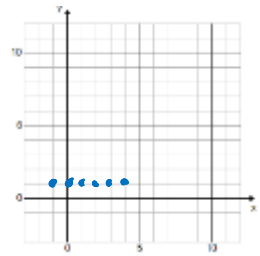
(Exp) one is growing faster

variable in the exponent

In general, an exponential is of the form $y = b^x$. Let's agree on two restrictions on b.

1) $\boxed{b \neq 1}$. Consider $y = 1^x$

x	-1	0	1	2	3	4
y	1	1	1	1	1	1

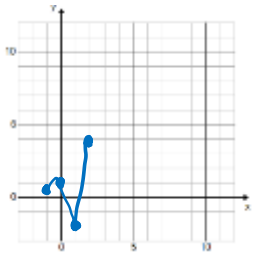


$y = x^2$

☆ not exponential

2) $\boxed{b \not\leq 0}$. Consider $y = (-2)^x$

x	-1	0	1	2	3	4
y	-.5	1	-2	4	-8	16



zigzag - not exp.

$$\boxed{y = a \cdot b^x}$$

a = y-intercept (starting pt.)
b = rate of exp. growth or decay

Linear or Exponential?

Decide if the equation is linear or exponential and then write an equation that represents the "rule" for the table.

x	-2	-1	0	1	2	3
y	2	4	8	16	32	64

+1 +1 +1 +1 +1

×2 ×2 ×2 ×2 ×2 ← b

a

add/multiply property EXP.

$$\boxed{y = 8 \cdot 2^x}$$

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

×2 ×2 ×2 ×2 ×2 ← b

a

$y = 1 \cdot 2^x$ OR $\boxed{y = 2^x}$

x	-2	-1	0	1	2	3
y	-4	-1	2	5	8	11

+3 +3 +3 +3 +3

* not exponential

LINEAR
$y = mx + b$

$$\boxed{y = 3x + 2}$$

x	-2	-1	0	1	2	3
y	5	10	20	40	80	160

×2 ×2 ×2 ×2 ×2

$$\boxed{y = 20 \cdot 2^x}$$

x	-2	-1	0	1	2	3
y	$\frac{32}{9}$	$\frac{8}{3}$	2	$\frac{3}{2}$	$\frac{9}{8}$	$\frac{27}{32}$

$\times\frac{3}{4}$ $\times\frac{3}{4}$ $\times\frac{3}{4}$ $\times\frac{3}{4}$ $\times\frac{3}{4}$ ← b

* decay problem *

$$\boxed{y = 2 \cdot \left(\frac{3}{4}\right)^x}$$

x	-2	-1	0	1	2	3
y	-1	$\frac{1}{2}$	2	$\frac{7}{2}$	5	$\frac{13}{2}$

$+\frac{3}{2}$ $+\frac{3}{2}$ $+\frac{3}{2}$ $+\frac{3}{2}$ $+\frac{3}{2}$

LINEAR

$$\boxed{y = \frac{3}{2}x + 2}$$