

11/7/16

Assign: 22, 25-30, 33-40,  
41, 43, 49, 51, 53,  
61-79 odd

## 4.3 Exponential Fxns

$$a^x$$

$a$  is a (+) real #

$x$  is a rational #

### Laws of Exp

$$a^x a^y = a^{x+y}$$

$$(a^x)^y = a^{xy}$$

$$(ab)^x = a^x b^x$$

$$a^0 = 1$$

$$1^x = 1$$

$$a^{-x} = \frac{1}{a^x}$$

### Exponential Fxn

$$f(x) = Ca^x$$

$C$  = initial value

$a$  = growth/decay factor

$x$  = time

↓  
 $f(x) = c(1+r)^x$  growth

$$f(x) = c(1-r)^x$$
 decay/deprec.

\*  $a \neq 1, c \neq 0$

When  $x=0$ , this is the initial time

Consider  $f(x) = 5 \cdot 2^x$

initial value = 5  
 $a = 2$

$$\left. \begin{array}{l} f(0) = 5 \cdot 2^0 = 5 \cdot 1 = 5 \\ f(1) = 5 \cdot 2^1 = 10 \end{array} \right\} \frac{f(1)}{f(0)} = \frac{10}{5} = 2$$

$$f(2) = 5 \cdot 2^2 = 5 \cdot 4 = 20 \quad \frac{f(2)}{f(1)} = \frac{20}{10} = 2$$

$$f(3) = 5 \cdot 2^3 = 5 \cdot 8 = 40 \quad \frac{f(3)}{f(2)} = \frac{40}{20} = 2$$

$$\text{So, } \frac{f(x+1)}{f(x)} = a$$

given that  
 $f(x)$  is an  
exponential  
fxn

PROOF

If  $f(x) = Ca^x$ , then  $f(x+1) = Ca^{x+1}$

$$\frac{Ca^{x+1}}{Ca^x} = \frac{a^{x+1}}{a^x} = \frac{a^x a^1}{a^x} = a$$

# Linear vs Exponential

x	y
-1	5
0	2
1	-1
2	-4
3	-7

constant change  
= constant slope

linear

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

change is exponential

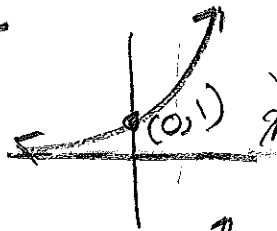
Exponential

x	y
-1	2
0	4
1	7
2	11
3	16

neither

## Graphing

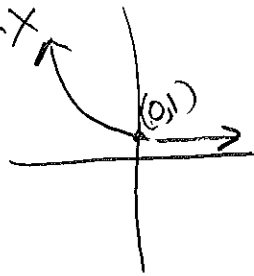
$$f(x) = 2^x$$



horiz asymptote (H.A.)

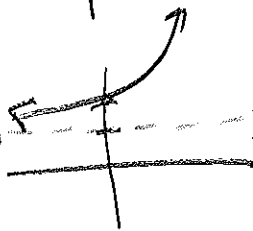
$$j(x) = 2^{-x}$$

reflection y-axis



$$g(x) = 2^x + 1$$

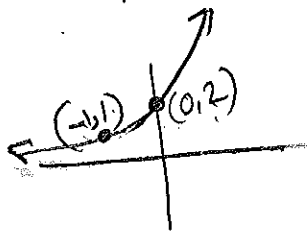
v.s. up 1 unit



y = 1 is H.A.

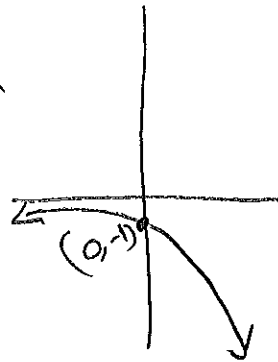
$$h(x) = 2^{x+1}$$

h. shift left



$$k(x) = -2^x$$

reflection x-axis



# Solving Exponentials

If  $a^x = a^y$ , then  $x = y$

ex)  $5^x = 5^{-6}$

$$x = -6$$

ex)  $3^{-x} = 81$

$$3^{-x} = 3^4$$

$$\frac{-x}{-1} = \frac{4}{-1}$$

$$\boxed{x = -4}$$

$$\begin{array}{c} 81 = 3^4 \\ \wedge \\ 9 \quad 9 \\ \wedge \quad \wedge \\ 3 \quad 3 \quad 3 \quad 3 \end{array}$$

ex)  $\left(\frac{1}{4}\right)^x = \frac{1}{64}$

$$\left(\frac{1}{4}\right)^x = \frac{1}{4^3}$$

$$\left(\frac{1}{4}\right)^x = \left(\frac{1}{4}\right)^3$$

$$\boxed{x = 3}$$

$$64 = 4^3$$

