Exponential Functions

- *Students will be able to solve exponential equations using One-to-One Properties*

Day One

KEY

HPC/RPC

What is an exponential function?

All exponential functions can be written in the form:

$$f(x) = ab^x$$

Where: $a \neq 0, b \neq 0, b \neq 1$

The constant (a), is the <u>initial value</u> of the function f (<u>when $x = 0$</u>) y-intercept

b is the <u>base</u> of the <u>exponent</u>, x

Some examples of exponential functions (except for one . . .)

(Which one is <u>not</u> exponential?)

a) $m(x) = 1.3(0.2)^{-x}$

$a = 1.3$ $b = 0.2$

b) $g(x) = 9^x$

$a = 1$ $b = 9$

c) $h(x) = 6x^{-4}$

Not exponential

$a =$ $b =$

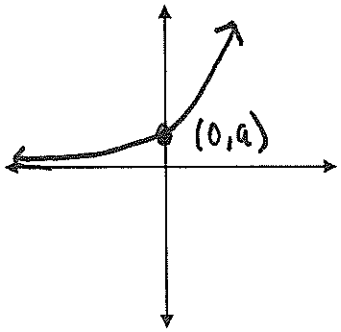
d) $k(x) = -2\left(\frac{1}{2}\right)^{5x}$

$a = -2$ $b = \frac{1}{2}$

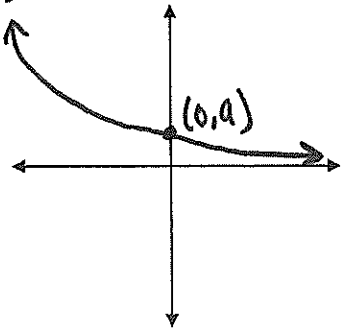
<u>The most common uses for Exponential Equations are growth and decay</u>

<u>For $f(x) = ab^x$:</u>

If $a > 0$ and $b > 1$,
f is <u>increasing</u>,
so $f(x)$ is an exponential <u>growth</u> function



If $a > 0$ and $b < 1$,
f is <u>decreasing</u>,
so $f(x)$ is an exponential <u>decay</u> function



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How do you solve exponential equations?

One-to-One Property

For any exponential function $f(x) = b^x$

If $b^u = b^v$, then $u = v$

(As long as the bases match on both sides of the equal sign, then the exponents must be equal.)

****Use Algebra solving techniques (when necessary) to isolate the exponential part (b^x) of the function****

Example 1: Solve

a. $3^x = 9$

$3^x = 3^2$

$x = 2$

b. $2^x = 16$

$2^x = 2^4$

$x = 4$

c. $121^x = 11$

$11^{2x} = 11^1$

$2x = 1$

$x = \frac{1}{2}$

d. $5^{3x-6} = 125$

$5^{3x-6} = 5^3$

$3x - 6 = 3$

$3x = 9$

$x = 3$

e. $\frac{36}{36}\left(\frac{1}{6}\right)^x = \frac{6}{36}$

$\left(\frac{1}{6}\right)^x = \frac{1}{6}^1$

$x = 1$

f. $8^{x+2} = 4^{x-3}$

$2^{3(x+2)} = 2^{2(x-3)}$

$3x + 6 = 2x - 6$

$x = -12$

g. $9\left(\frac{1}{5}\right)^{x-7} + 3 = 48$

$\frac{9\left(\frac{1}{5}\right)^{x-7}}{9} = \frac{45}{9}$

$\left(\frac{1}{5}\right)^{x-7} = 5$

$5^{-1(x-7)} = 5^1$

$-x + 7 = 1$

$-x = -6$

$x = 6$