

10-1 Exponential Functions

Objective: Graph exponential functions.

Solve exponential equations and inequalities.

I. Intro: Discuss NCAA Women's Tourney P.523.

graph $y=2^x$ then state domain: All Real #s $(-\infty, \infty)$
 $2^6 = \underline{64}$ range: All (+) real #s $\rightarrow y > 0$

Then graph $y=3^x$, $y=(1/3)^x$, $y=-1(2^x)$ and discuss.

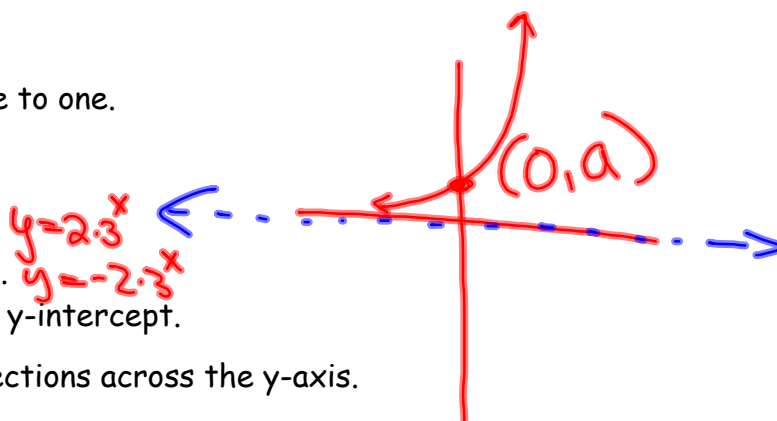
Exponential Functions:

$$y=ab^x$$

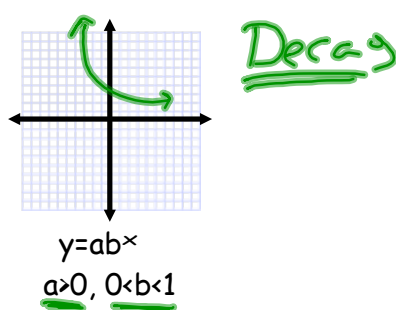
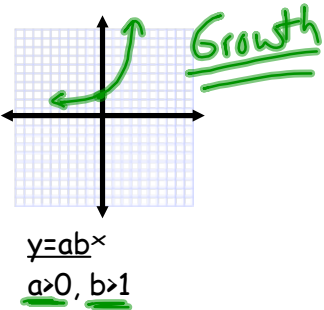
where a does not equal 0 $b > 0$, and b does not equal 1.

Characteristics

1. Function is continuous and one to one.
2. D: all real numbers.
3. x-axis is an asymptote.
4. R: all positive numbers if $a > 0$.
 R: all negative numbers if $a < 0$.
5. $(0, a)$ is a point where a is the y-intercept.
6. $y=ab^x$ and $y=a(1/b)^x$ are reflections across the y-axis.



II. Growth vs. Decay



Growth or Decay, or Neither.

Ex 1. $y=(1/5)^x$

$a=1, b=1/5$ Decay

$y=3(4)^x$
 $a=3, b=4$ Growth

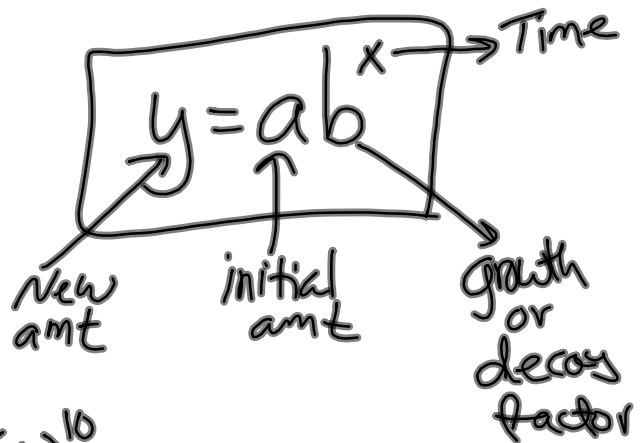
$y=7(1.2)^x$
 $a=7, b=1.2$ Growth

Example of Neither
 $y=-2(2)^x$
 $a=-2$

EX 2. In Dec. of 1990, there were 5,283,000 cell phone subscribers while in Dec of 2000 there were 109,478,000.

a. Write an exponential function to model this.

$y=ab^x$
 $y=5,283,000(1.354)^x$



$$\frac{109,478,000}{5,283,000} = \frac{5,283,000(b)^{10}}{5,283,000}$$

$$(20.72269)^{1/10} = (b^{10})^{1/10}$$

$1.354 = b$

III. Simplify

EX 3. $2^{\sqrt{5}} \times 2^{\sqrt{3}} = 2^{\sqrt{5} + \sqrt{3}}$

EX 4. $(6^{\sqrt{3}})^{\sqrt{6}} = 6^{\sqrt{30}}$

EX 5. $5^{\sqrt{3}} / 5^{\sqrt{2}} = \frac{5^{\sqrt{3}}}{5^{\sqrt{2}}} = 5^{\sqrt{3} - \sqrt{2}}$

Recall

- ① $a^2 \cdot a^5 = a^{10}$
- ② $(a^2)^5 = a^{10}$
- ③ $\frac{a^2}{a^5} = a^{2-5} = a^{-3} = \frac{1}{a^3}$

IV. Solve

EX 6. $3^{2n+1} = 81$

$3^{2n+1} = 3^4$

$2n+1 = 4$

$2n = 3$

$n = \frac{3}{2} \checkmark$

EX 7. $4^{9n-2} = 256$

$4^{9n-2} = 4^4$

$9n-2 = 4$

$9n = 6$

$n = \frac{6}{9} = \frac{2}{3} = n \checkmark$

EX 8. $3^{5x} = 9^{2x-1}$

$$3^{\boxed{5x}} = (3^{\boxed{2}})^{2x-1}$$

$$\begin{aligned} 5x &= 2(2x-1) \\ 5x &= 4x-2 \\ \boxed{x &= -2} \end{aligned}$$

EX 9. $4^{3p-1} > (1/256)$

$$\begin{aligned} 4^{3p-1} &> 256^{-1} \\ 4^{3p-1} &> (4^4)^{-1} \end{aligned}$$

$$\begin{aligned} 3p-1 &> 4(-1) \\ 3p-1 &> -4 \\ 3p &> -3 \end{aligned}$$

Recall

$$\frac{1}{6^2} = 6^{-2}$$

$$\frac{1}{5} = 5^{-1}$$

EX 10. $5^{3-2k} > (1/625)$

$$5^{3-2k} > 625^{-1}$$

$$5^{3-2k} > (5^4)^{-1}$$

$$5^{3-2k} > 5^{-4}$$

$$\begin{array}{r} 3-2k > -4 \\ \underline{-3 \quad -3} \\ -2k > -7 \\ \underline{-2 \quad -2} \\ k < \frac{7}{2} \end{array}$$

$$p > -1$$