For n^x where the base n is a natural number, the exponent x tells us how many times n will be multiplied by itself.

A function that grows exponentially grows at an increasing slope and goes towards infinity faster than any other polynomial function. $y = e\hat{}x$

The base of an exponential determines whether the number will <u>increase or decrease</u>

When base 0<b<1 it decreases

When b>1 it increases

<u>Exponential rules</u>

<u>Product</u> $a^x * a^y = a^{x+y}$

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

<u>Quotient</u> $a^n/a^m = a^{n-m}$

$$a^n/b^n = (a/b)^n$$

<u>Power</u> $(b^n)^m = b^{n*m}$

$$b^{n^m} = b^{(n^m)}$$

<u>Negative</u> $b^{-n} = 1/b^n$

<u>Derivative</u> $(x^n)' = nx^{n-1}$

$$(b^x)' = ln(b) * b^x$$

<u>Integral</u> $\int x^n dx = \frac{x^{n+1}}{n+1} + c$

Definition: $ln(x) = \int_1^x 1/t \, dt$

Observations:

ln(1)=0

ln(x)<0 if o<x<1

ln(x)>0 if 1<x

x<0, doesn't work

$$ln(xy) = \int_1^{xy} 1/t \, dt$$

$$ln(x) + ln(xy) = \int_1^{x} 1/t \, dt + \int_1^{xy} 1/t \, dt$$

We let the first term be ln(x) and use u substitution for the second term and let u=t/x

We get $ln(xy) = ln(x) + ln(y)$

Definition: e^y is the inverse function of ln(x)

ln(x)=y

x=e^y

Properties of e^y

e^0=1

ln(e)=1

e=e^1

ln(e^y)'=y'

$1/e^y * (e^y)' = 1; (e^y)' = e^y$

From before, we know $ln(xy) = ln(x) + ln(y)$

We want to show that $e^{x+y} = e^{x}e^{y}$

$ln(e^{x}) + ln(e^{y}) = ln(e^{x}e^{y})$

$x + y = ln(e^{x+y})$