

## Bases other than $e$

Exponential:  $y = a^x \rightarrow$  Ex:  $y = e^x$

Logarithm:  $y = \log_a x \rightarrow$  Ex:  $y = \log_e x = \ln(x)$

Properties:

1.  $a^{\log_a x} = x$ , for  $x > 0$

2.  $\log_a a^x = x$ , for all  $x$

Ex: Solve for  $x$

$$4^x = \frac{1}{64}$$

Apply the logarithmic function base 4 to each side.

$$\log_4 4^x = \log_4 \frac{1}{64}$$

$$x = \log_4 4^{-3}$$

$$x = -3$$

Change of base:  $\log_a x = \frac{\ln(x)}{\ln(a)} \rightarrow$  (put in calculator)

Derivatives:

1.  $\frac{d}{dx}[a^x] = (\ln(a)) \cdot a^x$

$$2. \frac{d}{dx}[a^u] = (\ln(a)) \cdot a^u \cdot \frac{du}{dx} \leftarrow \text{(chain rule)}$$

$$3. \frac{d}{dx}[\log_a x] = \frac{1}{\ln(a)} \cdot \frac{1}{x}$$

$$4. \frac{d}{dx}[\log_a u] = \frac{1}{\ln(a)} \cdot \frac{1}{u} \cdot \frac{du}{dx}$$

\*\*Big difference in  $x^a$  and  $a^x$ !