

# Logarithmic vs. Exponential

Examples:

Log form equals

EXP form

$$\textcircled{1} \log_{10} 100,000 = 5 \rightarrow 10^5 = 100,000$$

to the

$$\textcircled{2} \log_2 (1/8) = -3 \rightarrow 2^{-3} = \frac{1}{8}$$

$$\textcircled{3} \log_5 S = r \rightarrow 5^r = S$$

## Evaluating Logarithms

Examples:

$$\textcircled{1} \log_{10} 1000 = x \rightarrow 10^x = 1000 = 10^3$$

~~$10^x = 10^3$~~

$x = 3$

$$\textcircled{2} \log_2 32 = x \rightarrow 2^x = 32 = 2^5$$

~~$2^x = 2^5$~~   
 $x = 5$

$$\textcircled{3} \log_{10} (1/10) = x \rightarrow 10^x = \frac{1}{10} = 10^{-1}$$

~~$10^x = 10^{-1}$~~   
 $x = -1$

$$\textcircled{4} \log_{16} 4 = x \rightarrow 4^2 = 16$$

$4^x = 4$   
 $(4^2)^x = 4$   
 ~~$4^{2x} = 4^1$~~   
 ~~$2x = 1$~~   
 $x = \frac{1}{2}$

# Properties of Logarithms

Natural Logarithm

- ①  $\log_a 1 = 0$  b/c  $a^0 = 1 \rightarrow \ln e^0 = 0$
- ②  $\log_a a = 1$  b/c  $a^1 = a \rightarrow \ln e = 1$
- ③  $\log_a a^x = x$  b/c  $a^x = a^x \rightarrow \ln e^x = x$
- ④  $a^{\log_a x} = x$  b/c  $\log_a x = \log_a x \rightarrow e^{\ln x} = x$

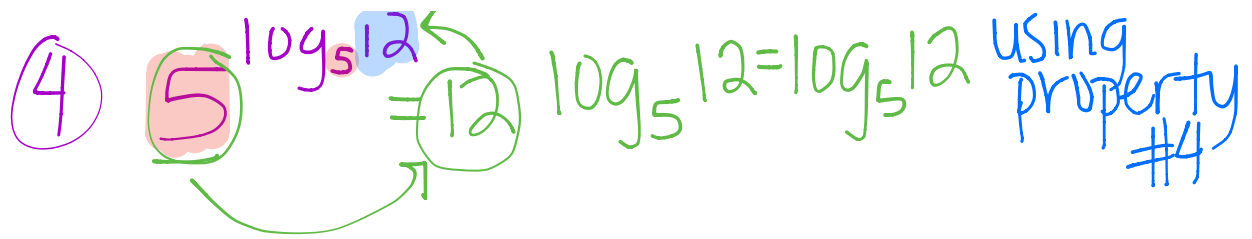
Examples:

①  $\log_5 1 = 0$   $5^0 = 1$  using property #1

②  $\log_5 5^8 = 8$   $5^8 = 5^8$  using property #3

③  $\log_5 5 = 1$   $5^1 = 5$  using property #2

④  $\log_5 12 = \log_5 12$  using property #4



\*Remember:

→ Common logarithm

$$\log x = \log_{10} x$$

→ Natural logarithm

$$\ln x = \log_e x$$

$$e = 2.718 \dots$$