# Logarithms

Example 1: What power of 3 is 43046721? Is 56033284?

We are looking for a solution to $3^x = 43046721$. After playing with the calculator for a bit, we find that 16 is the solution.

As for $3^x = 56033284$, that's a bit trickier, as 56033284 is not a "nice" power of 3. We can guess with the calculator, or perhaps you are familiar with the "trick" of

$$\frac{\ln 56033284}{\ln 3} \text{ or } \frac{\log 56033284}{\log 3} = 16.2399935$$

So what are these log and ln things, anyway?

Definition: The **logarithmic function** is the inverse of the exponential function.
If $y = \log_a x$, then $x = a^y$.
(read "$y$ equals the logarithm of $x$ to the base $a$.")

Example 2: Express each of the following in logarithmic form.

1. $x = 5^y$ $(y = \log_5 x)$
2. $1000 = 10^3$ $(3 = \log_{10} 1000)$
3. $1/8 = 2^{-3}$ $(-3 = \log_2 1/8)$

Example 3: Express in exponential form.

1. $\log_{10} 10000 = 4$ $(10000 = 10^4)$
2. $\log_4 1/4 = -1$ $(1/4 = 4^{-1})$

Example 4: Evaluate the following logarithms.

1. $\log_2 32$ (5)
2. $\log_7 343$ (3)
3. $\log_3 \frac{1}{27}$ (-3)
4. $\log_x 1$ (0)

Your calculator "automatically" uses base 10. ("The common logarithm.")
i.e. $\log 0.001 = -3$

Practice: pg. 75 #1ace, 3ace, 4ace, 5, 7, 8ace