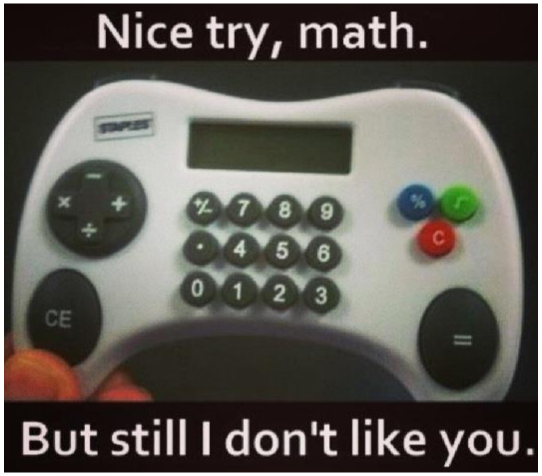


Properties of Logarithms:

For M and N positive numbers and r a real number,

Product Rule:

Expansion →

$$log_b(MN) = log_b M + log_b N$$

← **Compression**

Expand and simplify:

$$log_5(25x)$$

Compress(or Condense) and simplify:

$$log_6 9 + log_6 4$$

Quotient Rule:

Expansion →

$$log_b\left(\frac{M}{N}\right) = log_b M - log_b N$$

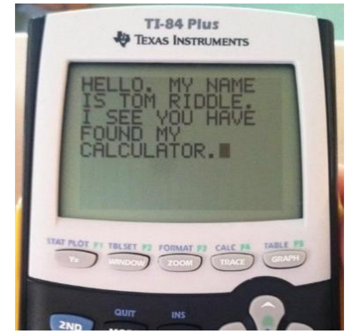
← **Compression**

Expand and simplify:

$$log_3\left(\frac{x}{9}\right)$$

Compress and simplify:

$$log_3 2 - log_3 6$$



<u>Power Rule:</u>

Expansion →

$$log_b\left(M^r\right) = r\,log_b M$$

← **Compression**

Expand and simplify:

$$log_7\left(7x^5\right)$$

Compress:

$$2\,log_3 x - 4\,log_3 y$$

$\ln(ab) = \ln(a) + \ln(b)$

$\ln\left(\frac{a}{b}\right) = \ln(a) - \ln(b)$

$\ln(a^b) = b\ln(a)$

Expand: $log_2\left[\frac{x^3(x+2)}{(x+3)^2}\right]$

$\log_b x + \log_b y = \log_b(x \cdot y)$

$\log_b x - \log_b y = \log_b\left(\frac{x}{y}\right)$

$z \cdot \log_b x = \log_b(x^z)$

Compress: $3log_5(3x+1) - 2log_5(2x-1) - log_5 x$

Change of Base Formula:

Suppose that $y = log_b x$**. Then** $b^y = x$ **and therefore** $log_a\left(b^y\right) = log_a x$**. From the Power Rule, you get** $y\,log_a b = log_a x$**, and solving for *y* yields** $y = \dfrac{log_a x}{log_a b}$**. So**

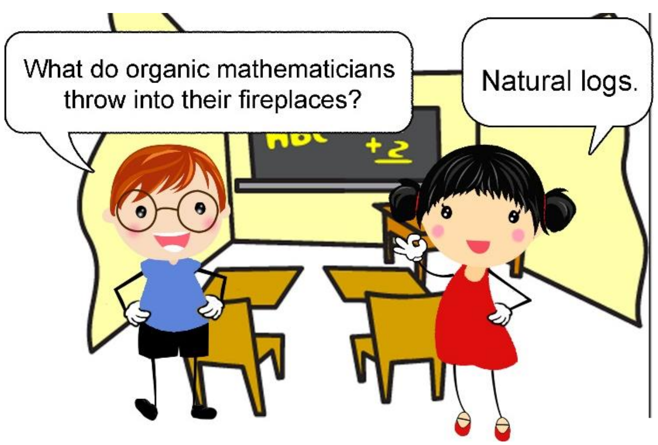
$$log_b x = \frac{log_a x}{log_a b}.$$

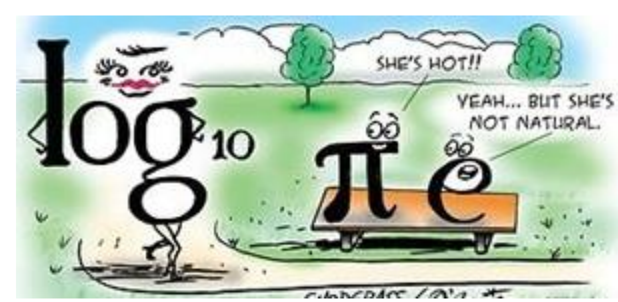
Calculators have a logarithm key for base 10, log, called the common logarithm. They also have a logarithm key for base *e*, ln, called the natural logarithm. $e = 2.7182818...$

$$log_b x = \frac{log\,x}{log\,b}$$

Or

$$log_b x = \frac{ln\,x}{ln\,b}$$





Example:

Calculate $log_3 5$ **to 3 decimal places.**

$$log_3 5 = \frac{log\,5}{log\,3}$$

Or

$$log_3 5 = \frac{ln\,5}{ln\,3}$$