3.3LogProperties

In section 3.3 you will learn to:

- Use properties to evaluate or rewrite logarithmic expressions.
- Use properties of logarithms to expand or condense logarithmic expressions.
- Use the change of base formula to rewrite and evaluate logarithmic expressions.
- Use logarithmic functions to model and solve real-life problems.

Properties of Logarithms

Your calculator has only two keys that compute logarithmic values.

log x means log10x

In x means log_x

Suppose you need to compute a logarithm in some other base, a

log_ax = y

Change of base formula: $\log_{a} x = \frac{\log_{b} x}{\log_{b} a}$

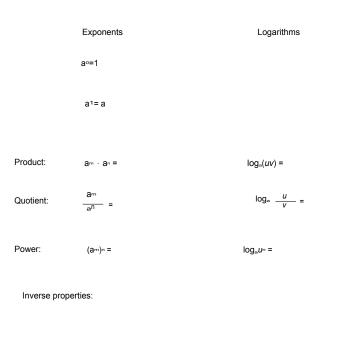
Examples:

a) log₂ 254 =

b) log_e 0.008 =

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Since a logarithm is an exponent, the properties of logarithms are just like the properties of exponents.



One-to-one properties:

Let's apply the properties of logarithms.

- a) log₄ 5 + log₄ 6 =
- b) log (12a) log (2a) =
- c) log₄ x₄ =
- d) e^{In(5x)} =
- e) log $10^{(x+2)}$ =

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Expand these:

a) log₄5x₃y =

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b) In \frac{\sqrt{3x-5}}{7} =
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c) log $\left(\frac{b^3}{1+a^2}\right)^5 =$

Condense these into a single logarithmic expression:

a) $1/2 \log x + 3 \log (x+1) =$

b) $2 \ln (x+2) - \ln x =$

Suppose we know that $\log_{b} 2 = 0.41$ and $\log_{b} 3 = 0.54$, use the properties of logarithms to find:

a) log_b 6 =

b) $\log_{10} 2/9 =$

c) $\log_{\scriptscriptstyle b} 8\sqrt{3} =$

Logarithms are useful in reporting a broad range of data by converting it into a more manageable form. Consider the intensity of earthquakes.

Let I₀ = the intensity of a "standard" earthquake that is agreed upon as minimal (barely detectable.)

Let I = The intensity of a much larger earthquake.

The magnitude M of the latter quake I relative to I_{o} is defined by

 $M = \log \frac{I}{I_o}$

You may have heard of the Richter scale that measures the intensity of an earthquake.

What is the magnitude M of an earthquake measured to be 10,000 times more intense than a standard quake?

Example:

On October 17, 1989 a major earthquake struck the San Francisco Bay area only minutes before Game 3 of the World Series in Candlestick Park. Its intensity was measured as 7.I on the Richter scale.

How many times more intense was it than a minimal quake?

- a) 12, 500 times more intense?
- b) 1,250,000 time more intense?
- c) 12,500,000 times more intense?