

***Factsheet:* Laws of Logarithms**

Converting between exponential and logarithmic equations

The exponential equation $y = a^x$ is equivalent to the logarithmic equation $\log_a y = x$ where a is the **base** of the logarithm.

$$y = a^x \Leftrightarrow \log_a y = x$$

Useful formulas

$\log_a(1) = 0$ the logarithm to the base a of 1 is 0.

$\log_a(a) = 1$ the logarithm to the base a of a is 1.

Changing base

The two most common bases for logarithms are 10 and e (where e is Napier's constant, $e = 2.71828 \dots$). A logarithm in base e is generally called a **Natural Logarithm** and is written **ln**. You can change any logarithm in any base to either base 10 or base e by using the following formulas:

To change from base a to base 10: $\log_a b = \frac{\log_{10}(b)}{\log_{10}(a)}$

To change from base a to natural logarithm: $\log_a b = \frac{\ln(b)}{\ln(a)}$

The laws of logarithms

The following three laws hold for logarithms of any base but the base must be same throughout.

The First Law of Logarithms $\log(AB) = \log A + \log B$

The Second Law of Logarithms $\log\left(\frac{A}{B}\right) = \log A - \log B$

The Third Law of Logarithms $\log(A^n) = n \log A$



Want to know more?

If you have any further questions about this topic you can make an appointment to see a **Learning Enhancement Tutor** in the **Student Support Service**, as well as speaking to your lecturer or adviser.

- 📞 Call: 01603 592761
- ✉ Ask: ask.let@uea.ac.uk
- 🖱 Click: <https://portal.uea.ac.uk/student-support-service/learning-enhancement>

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For this topic, there is a [webcast](#).

Your comments or suggestions about our resources are very welcome.

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