Logarithms and Slide Rules

The slide rule, once almost a cartoon trademark of a scientist, was nothing more than a device built for doing various computations quickly, using logarithms. Today, slide rules are no longer used in routine number crunching. But there are still good reasons for studying how they worked.

What can we use Logarithms for, anyway?

- *To measure the pH or acidity of a chemical solution. The pH is the negative logarithm of the concentration of free hydrogen ions.*

- *To find the number of payments on a loan or the time to reach an investment goal.*

- *To model many natural processes, particularly in living systems. We perceive loudness of sound as the logarithm of the actual sound intensity, and dB (decibels) are a logarithmic scale. We also perceive brightness of light as the logarithm of the actual light energy, and star magnitudes are measured on a logarithmic scale.*

- *To measure and compare earthquake intensity we use the Richter scale.*

- *To analyze exponential processes. We often analyze an exponential curve by means of logarithms. The set of measured points on a log graph can reveal hidden relationships. Applications include cooling of a dead body, growth of bacteria, and decay of a radioactive isotopes. The spread of an epidemic in a population might seem random, but it follows a modified logarithmic curve called a "logistic".*

- *To solve some forms of area problems in calculus.*
  (The area under the curve 1/x, between x = 1 and A, equals $\log_e A$.)

Short Check?

On the logarithmic scale the numbers represent:

a. …the values of the equation.
b. …the bases.
c. …the exponents.

How Valuable are Logarithms?

You only have to come a few minutes from your home to school to hear all about the wonders of logarithms, but on the 10 March 1615, Briggs wrote in a letter to a friend: "*Napper, lord of Markinston, hath set my head and hands a work with his new and admirable logarithms. I hope to see him this summer, if it please God, for I never saw a book which pleased me better or made me more wonder.* And, in the summer of 1615, Sir Henry Briggs made the difficult journey from London to Edinburgh to see Napier (would he have dreamed that now it takes 4 hours by train, rather than the more than 4 days by horse and coach required in those times) to hear about his logarithms.

For his contributions, Napier will always be remembered for making one of the most important contributions to the advance of knowledge. It was through the use of logarithms that Kepler was able to reduce his observations and make his breakthrough which then in turn underpinned Newton's theory of gravitation…

Example 1:

Evaluate and simplify the following Logarithms.

$$\boldsymbol{log_3 27}$$

Step 1: We want to change to exponential form. Identify the Base number.

B = 3

Step 2: There is no exponent, so we will give it a variable of x.

E = x

Step 3: Identify the value (Answer) of the exponential term.

A = 27

Step 4: Rewrite using the reverse pattern of $B^E=A$

$3^x = 27$

Step 5: We need to find what value of x will gives us 27, so we test values.

x = 1 $3^1 = 3$

x = 2 $3^2 = 9$

x = 3 $3^3 = 27$!!!

The value of $log_3 27$ will be 3.

HOMEWORK:

Evaluate and simplify the following logarithms:

1. $\log_2 32$	**2.** $\log_5 125$	**3.** $\log_3 27$
4. $\log_2 4$	**5.** $\log_9 3$	**6.** $\log_{64} 4$
7. $\log_3 1$	**8.** $\log_4 4$	**9.** $\log_4 \frac{1}{4}$