Logarithms:

The logarithm (log to the base 10 or just log on your calculator) is a mathematical functions used in science. You need to be able to manipulate these functions for many reasons, in particular, pH. **$pH = -\log[H^+]$**

log (base 10) are essentially short-hand way to express orders of magnitude. For example:

$$\log(1) = \log(10^0) = 0$$

$$\log(10) = \log(10^1) = 1$$

$$\log(100) = \log(10^2) = 2$$

$$\log(10^a) = a$$

Make sure you know how to use your calculator using the logarithm function. Try the mathematical expression to see if you get the correct answer:

$$\log(3.60) = 0.556$$

$$\log(36.0) = 1.556$$

$$\log(360.0) = 2.556$$

(Note that the significant figures shown are correct. If you take the log of a number, the numbers past the decimal point in the log should equal the significant figures in the original number. The first number is just shows the order of magnitude.)

$$\log a + \log b = \log(a \cdot b)$$

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

$$\log(a^n) = n\log(a)$$

Try these examples:

$$\log(3.60 \times 10^7) = \log(3.60) + \log(10^7)$$
$$= 0.556 + 7$$
$$= 7.556$$ (Prove with your calculator !!!!

1. Determine the following WITHOUT using a calculator

a. $\log(1 \times 10^{7})$

b. $\log(1 \times 10^{-7})$

c. $-\log(1 \times 10^{-7})$

d. $\log(1 \times 10^{5})$

e. $\log(1 \times 10^{-5})$

f. $-\log(1 \times 10^{-5})$

2.Determine the following WITH using a calculator

g. log (3)

h. log (7)

3. Determine the following WITHOUT using a calculator

a. $\log(3 \times 10^{7})$

b. $\log(3 \times 10^{-7})$

c. $-\log(3 \times 10^{-7})$

d. $\log(7 \times 10^{5})$

e. $\log(7 \times 10^{-5})$

f. $-\log(7 \times 10^{-5})$

4. Find the following solutions WITHOUT using a calculator.

a) log(1000)

b) log(5)=0.699

1. What is log (50)?

2. What is log(500)?

3. What is log(0.5)?

4. What is log(0.05)?

5. What is the pH of a solution that has a $[H^{+}]$ of 5×10^{-2} M ?

How would you determine the $[H^+]$ of a solution with a pH of 7?

There is also an inverse log function (10^x)

$$10^1 = 10$$
$$10^2 = 100$$

Try some numbers on your calculator to prove to yourself that the expressions below are valid.

$$10^{0.556} = 3.60$$
$$10^{1.556} = 36.0$$
$$10^{2.556} = 360.0$$

Problems

Which is more acidic? How much more?

1. A sample of rain with a pH of 5 and a sample of lake water with a pH of 4.

2. A tomato juice sample with a pH of 4.5 and a sample of milk with a pH of 6.5