Factor Label Method for converting units (Dimensional Analysis)
A very useful method of converting one unit to an equivalent unit is called the factor label method of unit conversion. To do this conversion, you want to cancel out the units you do not want, and leave the units you do want. Sometimes you will have to perform multiple steps to get the right answer.
Example: Convert 25 km/hr to m/s ?

(25 km/1 hr)(1000 m/1 km)(1 hr/3600 sec)=

Complete the following conversions using the factor label method: **SHOW ALL OF YOUR WORK!**

1. How many seconds are in one year?

2. Convert 28 km to cm.

3. Convert 45 kg to mg.

4. Convert 85 cm/min to m/s.

5. Convert 8.5 cm^3 to m^3 .

Calculating pH

Understanding pH is essential in chemistry and biology. pH is defined by the following equation,

$$pH = -\log [H^+] ,$$

where $[H^+]$ denotes the molar hydrogen ion concentration. Notice that we are required to take the common (base 10) logarithm of the hydrogen ion concentration in order to calculate pH.

Because pH is a measure of hydrogen ion concentration, it is used to quantitatively characterize solutions as acidic, neutral, or basic (alkaline). The typical pH scale runs from 0 - 14. A pH of 7 is neutral, a pH < 7 is called acidic while pH > 7 is called basic.

A note of caution while working with pH.

Remember that pH is calculated on a logarithmic scale, therefore small differences in pH represent much larger differences in hydrogen ion concentration.

For example,

a solution with pH 3 (i.e. $[H^+] = 1 \times 10^{-3}$ *M*)

is ten times more acidic than

a solution with pH 4 (i.e. $[H^+] = 1 \times 10^{-4}$ *M*)

In fact, for each unit increase in pH, there is a 10 fold increase in the hydrogen ion concentration.

To go from pH to [H+] you need to undo the math that was done to go from [H+] to pH, namely, inverse the log function and undo the sign change. For example, a pH of 4 = inv log(-4) = 1×10^{-4} M. So, you type in second function log on your calculator and then place in the negative value of your pH before hitting enter to determine the [H+] concentration. The same math can be done when dealing with [OH-] and pOH..

6. If the [H+] is 2.1×10^{-12} M $HClO_4$, what is the pH? Is the solution ACIDIC, BASIC, or NEUTRAL?

7. If the pH of a solution is 10.3, what is the [H+] concentration?

8. What is the hydrogen ion concentration of a solution with a pH = 8.25?

9. What is the pH if [H+] = 4.0×10^{-8}M? What is the [OH-]?

10. What is the pH and pOH of a 1.2×10^{-3} M HBr solution? Assume that the HBr dissociates 100% and the [H+] = 1.2×10^{-3} M.

Significant Figures in Biology

Throughout secondary school science and in your exams, you will be aked to write values as significant figures. Significant figures (or sig figs) are a way of rounding numbers to get an approximate value. This method accounts for errors that may have been introduced in scientific experiments.

There are a few simple rules that you need to know when doing significant figures in biology, and other sciences. With practice, it will become second nature.

RULE 1: NON-ZERO NUMBERS ARE ALWAYS SIGNIFICANT.

This is the main rule you need to know when rounding numbers to significant figures. If the number is anything other than zero, i.e. 1 to 9, this is a significant figure. To round your figure to a certain significant number, you'll need to start counting as soon as you reach that number.

Example 1 – Round 0.728109 to 4s.f

We'll need to start counting from the first non-zero number which is 7 up until our fourth number; number 1. As we do when rounding decimals, we'll look at the next number after 1. If the number is five or more, we round up and if it's four or less we do nothing. The next number is zero. That means our answer is 0.728100 to 4s.f. But we don't need the last two zeros – they are not significant, so we write 0.7281

Example 2 – Round 0.006274 to 2s.f

Again, we start with the first non-zero number. This number is 6. The second significant figure after that is 2. The number after 2 is five or more. So, we round up and we get 0.006300. Again, we don't need the last 2 zeros so we can write 0.0063

RULE 2: ZEROS, BETWEEN NON-ZERO DIGITS ARE ALWAYS SIGNIFICANT.

Example 3 – Round 0.02085 to 2s.f

From using the first rule, we know that we need to start counting from the first non-zero number. That number is 2. Then we notice a zero between the 2 and the 8. We'll need to count this as a significant figure because it's between two non-zero numbers.

Since the number after 0 is 8 (5 or more), we can therefore round up the second significant figure (the 0).

So, the final number will be 0.02100. We don't need the last two zeros; they are not significant so we write 0.021 (to 2s.f)

Example 4 – Round 0.02085 to 3s.f

The first sig fig is 2, the second is 0 and the third is 8. The number after 8 is 5 or more. Therefore, we'll need to round up the number 8.

So, the final number is 0.02090. But we don't need the last zero so it's 0.0209

RULE 3: LEADING ZEROS (i.e. zeros before non-zero numbers) ARE NEVER SIGNIFICANT.

Example 5 – Round 0.74593582 to 2s.f

We start counting from number 7 as the leading zero is not significant. So, the first significant figure is 7 and the second is 4. The number after 4 is 5, so we need to round up the number 4.

We get 0.75000000 and we write the answer as 0.75 to 2s.f.

Example 6 – Round 0.006127 to 3s.f

The first significant figure is 6, the second is 1 and the third is 2.

Because the number after 2 is 5 or above, that means we'll need to round it up. If it was 4 or less, we'll keep the number the same.
So, we write 0.006130 and then we remove the last zero as it's not significant. The final number will be 0.00613.

Indicate how many significant figures there are in each of the following measured values and cite the rule(s) from the tutorial above that refined your answer.

11. 246.32 ________________

12. 107.854________________

13. 100.30_________________

14. 0.678__________________

15. 1.008__________________

Multiplication and Division
The general rule is that the significant figures in the answer cannot be more than the smallest amount of significant figures used in the equation.

Addition and Subtraction
Answers of addition and subtraction cannot be more precise (go farther to the right in decimal places) than the least precise number in the calculation. For example, 4.0 +1.11111 = 5.1 because the first number (4.0) did not go into the $1/100^{th}$ decimal place, neither can your answer. This is when rounding becomes necessary.

Calculate the answers to the appropriate number of significant figures and justify why you chose that number of significant figures.

16. 200 x 3.58 =

17. 5000 / 55 =

18. $(6.8 \times 10^3) \times (4.54 \times 10^6) =$

19. 12.653 +100 =

20. 134.87 – 10.5 =

Graduated cylinders are the tools commonly used to make measurements of volumes in the laboratory. The cylinders come in a variety of sizes. Common sense and availability dictate which size to use. The graduation (i.e., divisions) on different sized cylinders have different values. Reading the volume measurements with a graduated cylinder is essentially the same as reading length measurements with a meter stick: the reading will always be comprised of digits that can be read with certainty (because of the graduations) plus an estimated digit based on the fractional part of the smallest division.

Record the volumes of the liquids shown shaded in the graduated cylinders below. Remember measurements include all the known digits (graduations on the cylider) and one estimate (your best guess how far along the liquid is between the ticks or graduations—this will be the next decimal place beyond the finest graduation). For instance, the second cylinder has the finest tick at the 1 ml decimal place. Therefore, your answer for the measurement of that liquid should go to the 0.1 ml decimal place (that is the decimal place of your estimate).