M Math Application

Unit Factor Analysis

Every physical measurement has three parts: a value, a unit, and a precision. The value is the numeric part of the measurement. The unit is the part that comes after the value: grams, feet, or Joules, for example. The precision indicates the confidence we have in the measurement.

Rules for Unit Factor Analysis

1. Write the units of the answer to the left of an equal sign, leaving room for a value to be added later.
2. Find a unit conversion factor "hotdog" (a student once mentioned that the fraction surrounded by parentheses resembles a hotdog in a bun) that match the units of the answer and write it to the right of the equal sign. You may have to flip it upside down. If the units don't agree, continue adding "hotdogs" on the right attempting to cancel units that don't belong and add units that do until the units on the left and right agree.
3. Now you're ready to do arithmetic. Enter the numbers into your calculator *without rounding any of them off* If your calculator has memory, you may want to store intermediate results., otherwise, write down intermediate results using *all the digits your calculator gives you.*
4. Finally round off your answer to the same amount of digits as the least precise hotdog in the chain (do not include exact values in your determination of significant figures.

Convert the following:

A. 5.00 L to cm^3

$$\underline{\textbf{5000}}\ \text{cm}^3\ =\ 5.00L \times \left(\frac{1000ml}{L}\right) \times \left(\frac{cm^3}{ml}\right)$$

$$\boxed{5000\,\text{cm}^3\ \text{or}\ 5.00 \times 10^3\ \text{cm}^3}$$

"hotdogs"

B. 30 m/s to mi/h

$$\underline{\textbf{170}}\ \text{mi/h}\ =\ 30\tfrac{m}{s} \times \left(\frac{km}{1000m}\right) \times \left(\frac{mi}{1.6km}\right) \times \left(\frac{3600s}{h}\right)$$

$$\boxed{170\ \text{mi/h}\ \text{or}\ 1.7 \times 10^2\ \text{mi/h}}$$

The *answer was rounded to two significant figures because 1.6 mi/km is an approximate value.*

C. 4 C to L

$$\underline{\textbf{1}}\ \text{L}\ =\ 4C \times \left(\frac{250ml}{C}\right) \times \left(\frac{L}{1000ml}\right)$$

$$\boxed{1\ \text{L or}\ 1 \times 10^0\ \text{L}}$$

Only one significant figure could be kept in the answer.

Generally speaking, conversion factors from the conventional system of measurement to the SI (metric system), are never exact numbers, only approximations. Watch for these to help determine the correct number of significant figures in your answer.