Density – A Dual Process of Conversion

Converting one type of density unit to another density unit involves two different unit conversions.

One conversion deals with changing mass units and the other deals with changing volume units. Both changes are done simultaneously – that is the problem setup will contain both conversions.

Like changing any other units we will be using the Metric Conversion Table which you have downloaded and all problems will involve the multiplication of ratios.

Example 1:
A metal has a mass of 2.0 g/cm^3. What is its density in hg/dm^3

First find the ratio that will change the mass in **grams** (g) to the mass in **hg**

$$\frac{2.0\ \cancel{g}}{cm^3} \times \frac{\mathbf{1\ hg}}{\mathbf{100\ \cancel{g}}} \times ?$$

Grams (g) will cancel out and the mass is converted to hectogram (**hg**), but you are not finished with the problem. The volume has to be changed.

From Table # 4, the conversion factor that changes **cm^3** to **dm^3** is used in the setup.
Notice that 2.0 g/cm^3 is really 2.0 g/ **1 cm^3**

$$\frac{2.0\ \cancel{g}}{\cancel{1\ cm^3}} \times \frac{\mathbf{1\ hg}}{\mathbf{100\ \cancel{g}}} \times \frac{\mathbf{1000\ \cancel{cm^3}}}{\mathbf{1\ dm^3}} = 20\ hg/dm^3$$

Notice that the cubic centimeters (**cm^3**) now cancel out and the final answer is in units of **hg/dm^3**

Example 2:
A gas has a density of .005 g/ml. What is the density of the gas in kg/m^3?
Notice that **.005** g/ml is really **.005** g/**1 ml**

$$\frac{\mathbf{.005\ \cancel{g}}}{\mathbf{\cancel{1\ ml}}} \times \frac{1\ kg}{1000\ \cancel{g}} \times \frac{10^3}{1000\ \cancel{ml}} \times \frac{1\ \cancel{cm^3}}{1\ \cancel{ml}} \times \frac{1\ \cancel{dm^3}}{1000\ \cancel{cm^3}} \times \frac{1\ m^3}{1000\ \cancel{dm^3}} = \frac{.005 \times 10^3}{1 \times 10^9}$$

$$\frac{.005 \times 10^3}{1 \times 10^9} = .005 \times 10^{-6} = 5.00 \times 10^{-9}\ kg/m^3$$

Notice two things from this example:
1. Scientific Notation plays an important part in the problem. Actually by using scientific notation you really do not have to use a calculator. The problem becomes one of addition and subtraction of exponents.
2. The setup is long. There are ways to shorten the setup. As you progress in mastering the task of solving such problems, it is expected that you will find ways to shorten up the process.
   However, the longest way possible was given here because if you become unsure of how to set problems up (using shortened methods) you can always revert to the basic long form which involves using all of the necessary basic ratios given in the **Metric Conversion Chart** that have a relationship to the units you are working with..

Some general points to consider:
1. The conversion of density units is set up as one continuous problem. No calculations are done till the end after all units have properly canceled out.
2. Always convert the mass units first. This is the easiest conversion and it is not involved in the volume conversion.
3. Use scientific notation with very large or very small numbers. Powers of 10 are easy to work with once you get used to using them. And eventually you may find that you really do not need a calculator.

For more examples and practice problems with answers, download the PDF file*, More Examples of Density Problems, *from the Density Index Table.