**Essential Math Tutorial for Chemistry: Topic 2  
Converting Between Units of Measurement**

**Part 1.** You must memorize the following prefixes since I will **not** give them to you on a test:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Giga- | Billion (1,000,000,000) |  | Centi- | Hundredth (1/100 or 0.01) |
| Mega- | Million (1,000,000) | Milli- | Thousandth (1/1000 or 0.001) |
| Kilo- | Thousand (1000) | Micro- | Millionth (1/1,000,000 or 0.000001) |
| Deci- | Tenth (1/10 or o.1) | Nano- | Billionth (1/1,000,000,000 or 0.000000001) |

**Part 2.**  Converting between units of measurement is an essential skill in mathematics, science, engineering, finance, culinary arts, and other fields.

It is important to account for units that are both cancelled and introduced during a calculation. This method is called dimensional analysis or the factor-label method.

Here’s an easy example:

**How many quarts in a gallon?** That’s easy – there are 4 quarts in a gallon if you happen to have that memorized. If you have 3 gallons, then you have 3 x 4 = 12 quarts.   
**If you have ½ quart, how many gallons do you have?** It’s not so easy now. This is why we use dimensional analysis for unit conversion problems.

|  |  |
| --- | --- |
| 0.5qt | 1gal |
| 1 | 4qt |

= (0.5 x 1gal) ÷ 4 = 0.5/4 gal = 0.125gal

In this grid, we are multiplying the original quantity (expressed as a fraction to be consistent) with the conversion factor (which is a type of fraction called a ratio – a ratio is the relationship between two quantities).

The horizontal line means divide.  
The vertical line means multiply.  
In the above example, we are multiplying two fractions by each other.   
The qt units cancel since anything divided by itself = 1. This leaves gal, which is what we were after.

If you had set up the problem like this:

|  |  |
| --- | --- |
| 0.5qt | 4qt |
| 1 | 1gal |

Then qt does not cancel. You know immediately that you are doing this wrong.

If you had set up the problem like this:

|  |  |
| --- | --- |
| 0.5qt | 1qt |
| 1 | 4gal |

Then you are wrong, wrong, wrong not to mention certifiably insane since 4 gallons is a lot more than 1 quart (and the qt units don’t cancel).

Try these problems using dimensional analysis (even if you can do the conversion in your head):

1) 5 kg = ? g

|  |  |
| --- | --- |
|  |  |
|  |  |

2) 3mg = ? g

|  |  |
| --- | --- |
|  |  |
|  |  |

Try these multi-step problems

3) 25 kg = ? mg

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  |  |  |

4) 15mg = ? kg

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  |  |  |

5) Given 1 inch = 2.54 cm

1 yard = ? mm

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  |  |  |  |  |

6) Given 1 mile = 5280 feet  
  
 120mi/hr = ? in/sec

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  |  |  |  |  |