Metrics

The metric system or "The International System of Units"(SI from the French- Le Systéme International d' Unités) was developed beginning in 1790 and officially accepted by the US court system in 1866. Since 1893 the metric system has served as the "official" measurement systems of the United States.

Here are some definitions from NIST:

A **physical quantity** is a quantity that can be used in the mathematical equations of science and technology.

A **unit** is a particular physical quantity, defined and adopted by convention, with which other particular quantities of the same kind are compared to express their value.

The **value of a physical quantity** is the quantitative expression of a particular physical quantity as the product of a number and a unit, the number being its numerical value. Thus, the numerical value of a particular physical quantity depends on the unit in which it is expressed.

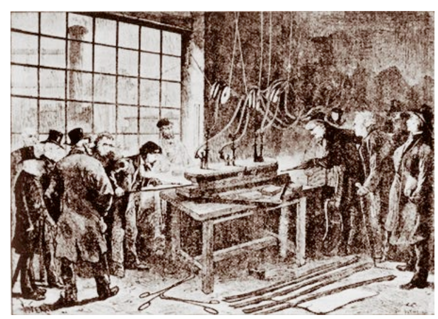
The SI system has two basic types of units:

Base units- which are defined by international treaty.

Derived units- which are created from base units.

Base Units

Until 1960 the base unit of length, the meter, was defined by a platinum iridium standard.



In 1983 the definition was changed to:

The meter(m) is the length of the path traveled by light in a vacuum during a time interval of 1/299,792,458 of a second.

The kilogram(kg) is the unit of mass; it is equal to the mass of the international prototype of the kilogram.

The base unit of time, the second(s), was initial defined as a fraction of a day, but is now defined based on the electronic transition of cesium.

The base unit of temperature is the kelvin(K), and is defined based on the triple point of water.

The base unit for the amount of substance is the mole and is defined based on carbon-12

Derived Units

There are many units that can be created by combining the 7 base units. The most common units that we will use in this class are:

Volume- The liter is the unit of volume most often used in chemistry. 1 L = 1 dm^3

Degree Celsius- degrees Celsius is often used in place of kelvins. °C=K-273.15

Energy- The joule is the unit most often used in chemistry to measure energy in it's various forms. 1 J = 1 m^2 kg s^{-2}

Frequency- The Hertz is the unit used to measure frequency. 1 Hz = 1 s^{-1}

Prefixes

All of the base and derived units can be modified by using prefixes. The prefixes represent power of ten multiples of the base unit. You need to memorize all the multiples in blue in table 1.2.

Table 1.2 The Prefixes Used in the SI System (Those most commonly encountered are shown in blue.)

Prefix	*Symbol*	*Meaning*	*Exponential Notation**
exa	E	1,000,000,000,000,000,000	10^{18}
peta	P	1,000,000,000,000,000	10^{15}
tera	T	1,000,000,000,000	10^{12}
giga	G	1,000,000,000	10^{9}
mega	M	1,000,000	10^{6}
kilo	k	1,000	10^{3}
hecto	h	100	10^{2}
deka	da	10	10^{1}
—	—	1	10^{0}
deci	d	0.1	10^{-1}
centi	c	0.01	10^{-2}
milli	m	0.001	10^{-3}
micro	μ	0.000001	10^{-6}
nano	n	0.000000001	10^{-9}
pico	p	0.000000000001	10^{-12}
femto	f	0.000000000000001	10^{-15}
atto	a	0.000000000000000001	10^{-18}

*See Appendix 1.1 if you need a review of exponential notation.

Unit Conversions

When we are converting from one unit to another we set up a series of conversion ratios. We put the units we have on the bottom of the ratio and the units we are converting to on the top.

$$0.03125\text{mm} \;\frac{1\text{cm}}{10\text{mm}} = 0.3125\text{cm}$$

Ex:

Significant Figures

Every time we take a measurement or work with measured values we need to take in to account the precision of the tools we are using.

The first thing we need to do is count the number of significant figures in a number. There are only a few rules that we need to do that:

Non-zero integers are always significant.

0.0210300

Leading zeros are never significant.

Captured zeros are always significant.

Trailing zeros are significant if there is a decimal point.

Ex:

Significant Figure Calculations

When we are doing calculations with significant figures we need to make sure that we are neither gaining nor loosing precision.

When we are doing multiplication or division with significant figures the result should have then same number of significant figures as the value with the least number of significant figures.

$$2.5 \bullet 2.005 = \quad 5.0125 \qquad \boxed{5.0}$$

When we are doing addition or subtraction with significant figures the result should have the same decimal place as the value with the least precise decimal place.

$$\begin{array}{r} 2.55 \\ +\ \ 2.4 \\ \hline 4.95 \end{array} \qquad \boxed{5.0}$$

If we are doing a series of calculations then we must keep track of where we would round off, but no numbers are rounded off till the very end.

$$10.67(2.8+3.29) = \boxed{65}$$

$$10.67(6.\overset{2}{0}9) = \ 64.980$$