Standard Units of Measurement Used in Calculations/Factor Label Methods

When it comes time to plug actual values into the equations, you must use values that match an international standard, known as the *KMS system* or *SI* (System Internationale) system. *KMS* stands for kilogram, meter, second. We will learn many other *KMS* quantities during the course. At this time students should be familiar with the following measurements.

Variable	Variable Symbol	Definition	KMS Unit	Unit Symbol
mass	m	Quantity of matter	kilogram	kg
distance	d	Total path length	meter	m
displacement	x	Straight line distance	meter	m
time	t	Difficult to define	second	S
temperature	T	Relative hot and cold	Kelvin	K

Many of the other measurements and units are derived from these. As an example: speed is distance divided by time and has the units m/s. These are the agreed upon units that are used in Physics calculations. Therefore, students must learn how to convert other units of mass, distance, and time to these.

The equations in physics depend on unit agreement. You must convert to *KMS* units in order to get answers that agree with those of others. The following conversions will be provided in a table of information used during all tests including the AP exam. Now is the time to master conversions so that the entire year is easier. Using the table to get base units is easy. Simply replace the *symbol* with the *factor* in the table. Some examples are shown below. Converting from base units to other units requires you to divide by the factor. This is most frequently done from grams to kilograms, which is the only unit used in Physics that is not plugged into equations in base unit form.

Metric prefixes

Factor	Prefix	Symbol
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p

The more difficult conversion is from base units to a prefix unit. In Physics, the most common conversion of this type is grams to kilograms. Don't let the symbol μ confuse you. It is a Greek letter and stands for micro. Just learn to recognize it and write it like any other letter.

All physical quantities have units so that we can communicate their measurement. In the metric system, the base units are called SI units. The base SI units for the fundamental quantities as talk about above. Any unit which is a combination of these fundamental units is called a derived unit. An example of a derived unit would be *meter/second* or *kilometer/hour*, which are both units of speed. Sometimes we will need to convert from one unit to another.

For Example: Convert 80.0 km/h to m/s $80.0\frac{km}{h}\left(\frac{1000m}{1km}\right)\left(\frac{1h}{3600s}\right)=22.2\frac{m}{s}$ Note that we multiplied 80.0 km/h by two quotients which were each equal to one, so we didn't change the value of speed, we only expressed it in different units

Solving Problems Using Conversion Factors: The Factor-Label Method

Units may be used as a guide in solving problems (Chang, pgs 25-29). First decide what units you need for your answer. Then determine what units you are given in the problem, and what conversion factors will take you *from* the given units *to* the desired units. The basic set up is

$$?\ \text{units desired} = \text{units given}\left(\frac{x\ \text{new units}}{y\ \text{units given}}\right)\left(-...\right)$$

Conversion factors are added until the *new units* are the same as the *units desired*. Each conversion factor has a denominator *equivalent* to the numerator *but in different units*.