Lesson 2: Standard Units of Measurement Used in Calculations

When the times come to putting the values into equations, it is important that the values conform to an international standard known as the *KMS system* or *SI* (System Internationale) system. *KMS* is an acronym for *k*ilogram, *m*eter, *s*econd, and applies to the primary units used in physics calculations – mass, length, and time. There are other *KMS* units, and we will explore them throughout the course. At this juncture, however, students need to be familiar with the following units.

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*	Time	second	s
temperature	*T*	Relative heat/cold	Kelvin	K

Many of the other measurements are applications of two or more of these basic ones. For example, velocity is the displacement divided by time, and thus is *m/s*. These are the standard units, agreed upon by the scientific community. Thus, all students must learn how to convert other units of measurement into these.

The equations in physics depend on unit agreement. This is quite convenient, actually. Setting up problems in such a fashion that the units can cancel each other out will serve as a check on the mathematics. For example, suppose a person walks at a rate of 0.85 *m/s* for 2.0 hours, and we want to know how far the person walked, with the units in the proper place. Suppose the problem was set up as follows, using the proper conversions of the time unit:

$$\frac{0.85\ m}{1\ s} \times \frac{2hr}{} \times \frac{1\ hr}{60\ min} \times \frac{1\ min}{60\ s} = \frac{0.00047\ m\ hr^2}{s^2}$$

Because the *min* units cancel, the answer would be $4.7\text{x}10^{-4}\ mhr^2/s^2$, which is utter and complete nonsense. There is no unit of distance called meter-hours-squared-per-second-squared. However, suppose we set up the problem as follows:

$$\frac{0.85\ m}{1\ s} \times \frac{2hr}{} \times \frac{60\ min}{1\ hr} \times \frac{60\ s}{1\ min} = 6120\ m$$

Thus, we get an answer that makes intuitive sense – 6120 meters. The time units each cancel out and the only unit remaining is the proper one for measurement of length. Thus, setting up the problem with the proper conversion matrix allows for a measure to check one's answers, and generally insure that one's units properly agree.

You must convert to *KMS* units in order to get answers that are accurate and agree with others. The following conversions will be provided in a table of information used during all tests including the AP exam. The summer is a great time to master conversions so that the entire year is easier. The *KMS* system is really very easy and convenient. Everything is ultimately in

delineated in magnitudes of 10. Thus, there are 10 decigrams in a gram, 10 centigrams in a decigram, and to milligrams in a centigram. Multiplying these, we see that there are 1000 milligrams in a gram. Similarly, there are 10 grams in a dekagram, 10 dekagrams in a hectogram, and 10 hectograms in a kilogram; or 1000 grams in a kilogram. Below is a table of the most commonly used metric prefixes, their factors, and their symbols.

	Metric prefixes	
Factor	***Prefix***	***Symbol***
10^9	giga	G
10^6	mega	M
10^3	kilo	k
10^2	hector	H
10^1	deka	D
10^0 Base unit	base unit	(gram, liter, meter, etc.)
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	µ
10^{-9}	nano	n
10^{-12}	pico	p

One other conversion that is important to keep in mind is the conversion from Celsius to Kelvin. To convert from Celsius to Kelvin, one must add 273.

Problem Set #2

Example:

Convert 0.745 km to meters $\frac{.0745 \text{ km}}{} \times \frac{1000 \text{ m}}{1 \text{ km}} \times 74.5 \text{ m}$

1. Convert 1.2 km to meters.
2. Convert 1.2 km to centimeters
3. Convert 894 cm to meters
4. Convert 894 cm to kilometers
5. Convert 712 nm to kilometers
6. Convert 0.623 km to meters
7. Convert 345 µg to g.
8. Convert 15 g to kg.
9. Convert 12º C to Kelvin.
10. Convert 100 º C to Kelvin.
11. Convert 100 º K to C