Scientific Measurements Notes

I. Metric (SI) Measurements

A. The goal was a uniform world-wide system of measurements

B. It was decimal-based to make for easy conversions.

C. Metric **Base Units**

1. **Time** - second - (s)
   a. Was 1/86,400 of an average length of a solar day
   b. Now - frequency of radiation from a cesium-133 atom.
2. **Length** - meter - (m)
   a) Was one ten-millionth of the distance from the equator to the North Pole
   b) Then, length of platinum-iridium bar in Paris
   c) Now, the distance traveled by light in a vacuum in 1/299,792,458 of a second.
3. **Mass** - kilogram - (kg)
   a) Mass of a platinum-iridium cylinder kept at a controlled temperature and humidity
4. **Temperature** - kelvin - (K) (or ˚C in the classroom)
   a) 0˚ C = freezing point of water, 100˚C is boiling
   b) 1˚C equals 1/100 of the distance between the boiling and freezing points of H_2O
   c) kelvin scale, 0 K = absolute zero (-273 ˚C),
   d) temperature increase of 1 K = temperature increase of 1 ˚C
5. **Amount of a substance** - mole - (mol)
6. **Electric Current** - ampere - (A)
7. **Luminous Intensity** - candela - (cd)

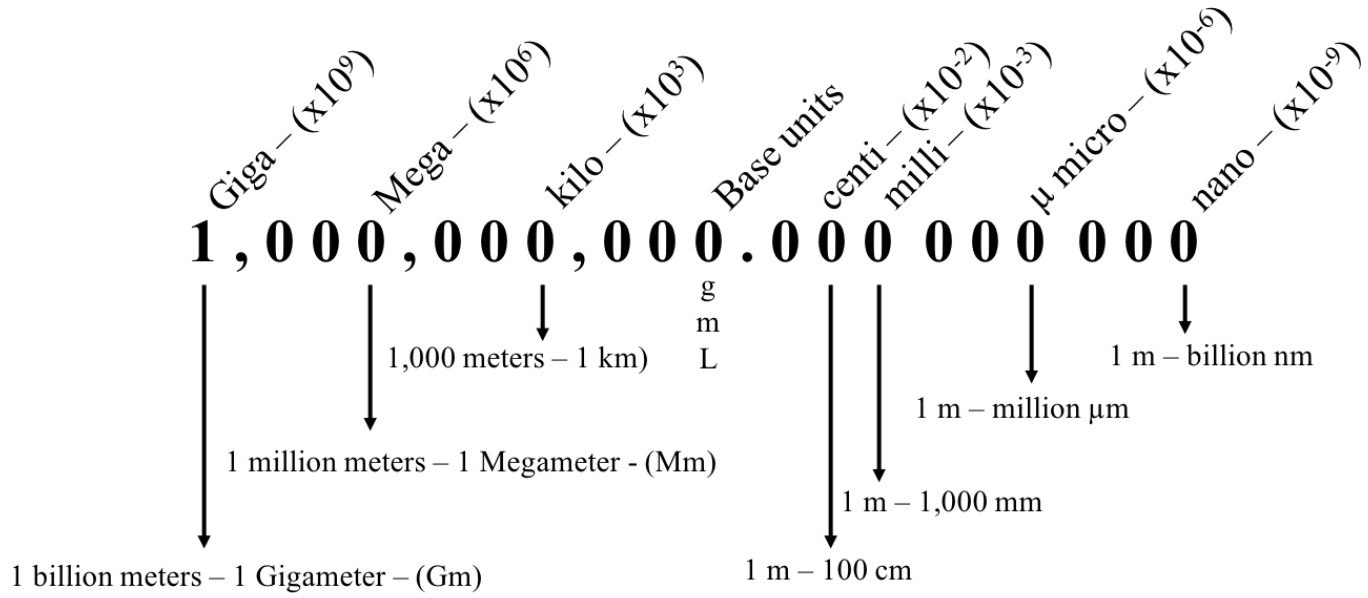
B. **Derived units** - units formed from a combination of base units

1. Examples - m/s – speed volume – ml or cm^3
   g/ml – density m^2 - area

II. Metric Prefixes

Prefix	Symbol	Scientific Notation
nano-	n	1×10^{-9}
micro-	μ	1×10^{-6}
milli-	m	1×10^{-3}

centi-	c	0.01
deci-	d	0.1
none	g, l, m	
kilo-	k	1×10^3
mega-	M	1×10^6
giga-	G	1×10^9
tera-	T	1×10^{12}



III. Making Measurements

A. **Accuracy vs. Precision**

1. **Accuracy** – how close a measurement is to a known or accepted value
2. **Precision** – how consistent repeated measurements are, or how exact our measurements are.

B. **Uncertainty** – all measurements have a degree of uncertainty.

1. When reading a measurement, read it to the closest mark and estimate one more number.

C. **Parallax** – apparent change in position of an object when viewed from different angles. Car examples

1. Measurements must be read directly in line with measuring device.

D. **Significant digits** – tell us how many digits should be in an answer so it is no more or less precise than our measurements.

1. ~~Four~~ 3 Rules for determining significant digits
    a. Nonzero digits are always significant.
    b. All **final** zeros used to the right of the decimal point are significant.
    c. Zeros between two other significant digits are always significant.

E. **Scientific Notation** - always written with one number in the ones column times an exponent of 10.
1. Used to write very large or very small numbers.
2. Used to write numbers with the correct number of significant digits.