Chapter 2 Homework pages 62 – 65 – **Set 1**:64 - 68; **Set 2**: 78b, 78e, 79c, 79f, 80a, 80f, (in class 81-84); **Set 3** : 91a, 91f, 92b, 92d, 93c, 94b; **Set 4**: 98, 104, 105, 112, 120; **Set 5** : 122, 128, 129, 130.

I. Measurement
   A. A unit of measurement is a physical quantity of defined size containing a number and label
   B. When we measure something we are comparing an objects size to a standard, which is an object(s) or natural phenomena of constant values, easy to preserve and reproduce and practical in size
   C. The accepted measurement system is the SI measurement (Le System International d'Unites)
   D. SI fundamental units - defined by a physical standard of measurement (overhead)

Physical (Fundamental) Quantity	Unit Name and Symbol
mass	kilogram , kg
length	meter , m
time	second , s
amount , quantity	mole , mol
temperature	kelvin , K (non SI unit - Celsius, C^0
electric current	ampere , A
luminous intensity	candela , cd

   E. SI derived units - obtained by combinations of fundamental unit (overhead)

Physical (Derived) Quantity	Unit Name and Symbol	Non SI units used
area *(l x w)*	square meters , m^2	
volume *(l x w x h)*	cubic meter , m^3	liter , L
density *(mass per volume)*	kilograms per cubic meter , kg / m^3	grams per milliliter , g / mL
molar mass	kilograms per mole , kg / mol	grams per mole , g / mole
concentration(molarity)	moles solute per liter solution , mole / L or M	
force *(mass x acceleration)*	newton , N ($kg\ m / s^2$)	
pressure *(force per area)*	pascal , Pa (N / m^2)	atmosphere,atm or millimeters of mercury, mmHg
energy	joule , J	calories , cal
power	watt , W	
voltage	volt , V	
frequency	hertz , Hz (cycles per second)	
electric charge	coulomb , C	

   F. Quantitative measurements - deal with actual numbers of measurements
   G. Qualitative measurements - deal with descriptive measurements
   H. Metric system
      1. Developed in France in 1790
      2. All units are related

3. Length measured in meters
4. Volume measured in cubic decimeters - a box that is 1 dm x 1 dm x 1 dm
5. Mass measured in grams comes from a cubic centimeter box (1 cm x 1 cm x 1 cm) filled with water at 4^0C is designated as 1 gram thus the density of water is 1 g / cm^3 (1 cm^3 = 1 mL)
6. Based on 10 the hardest part is learning the prefixes (overhead)

Prefix	Symbol	Power of 10 (10^x)
tera -	T	10^{12}
giga -	G	10^{9}
mega -	M	10^{6}
kilo -	k	10^{3}
hecto -	h	10^{2}
deka -	da	10^{1}
		10^{0}
deci -	d	10^{-1}
centi -	c	10^{-2}
milli -	m	10^{-3}
micro -	μ	10^{-6}
nano -	n	10^{-9}
pico -	p	10^{-12}
femto -	f	10^{-15}
atto -	a	10^{-18}

II. Uncertainty in measurement
1. The measurement of any physical quantity is subject to some uncertainty
2. Accuracy denotes the nearness of a measurement to the accepted value
    a. Absolute error = observed value - accepted value
    b. % error = (absolute error / accepted value) x 100
3. Precision is the agreement between the numerical values of a set of measurements that have been made the same way. Also the ability to reproduce a measurement. Precision conveys nothing about accuracy!
    a. It is possible to have good precision yet poor accuracy; poor precision and poor accuracy; and good precision and good accuracy. Example of shooting at a bulls eye
    b. Absolute deviation = observed value - arithmetic mean
    c. Used for precision measurements of instruments; given as $\pm$ values
4. Significant figures are all the numbers in a measurement that are certain plus one that is estimated (overhead)
    a. All non zero numbers are significant
    b. All zeros between two non zero numbers are sig..
    c. Zeros at the end of a number and to the right of a decimal are sig..
    d. In numbers < 1, zeros to the right of a decimal that are to the left of the first nonzero digit are never sig. figs. They are place holders.
    e. Zeros at the end of a number but to the left of a decimal may or may not be sig.. If such a zero has been measured or is the first estimated digit, it is sig. and decimal is placed to right. On the other hand, if the zero has not been measured or estimated but is just a place holder, it is not sig..
    f. It is easier to determine the number of sig. figs when the measurement is in scientific notation

(1) the only rule for scientific notation is that there must be only one non zero number to left of the decimal and there must be a power of ten accompanying the measurement. Ex. 3.45×10^{12}

(2) to determine the proper number of sig. figs when multiplying or dividing the measurement with the least number of sig. figs is boss

g. If all this is confusing, use the (A)tlantic – (P)acific rule.

If the decimal point is (A)bsent – start counting significant figures from the Atlantic side (right) side of the measurement, traveling left. The first non-zero number is significant and every digit passed that digit is also significant. 60500 m has 3 significant figures – the 5, 0, and 6.

If the decimal is (P)resent – start counting significant figures from the Pacific side (left) of the measurement traveling right. The first non-zero digit is significant and every digit following that digit is also significant. 0.00605 m has 3 significant figures – the 6, 0, and 5.

5. Rounding rules (overhead)
   a. If the digit immediately to the right of the last sig. fig. you want to retain is > 5 then round up.
   b. If the digit immediately to the right of the last sig. fig. you want to retain is < 5 then round down (doesn't change)
   c. If the digit immediately to the right of the last sig. fig. you want to retain is 5 followed by a nonzero digit then round up
   d. If the digit immediately to the right of the last sig. fig. you want to retain is 5 not followed by nonzero digit and preceded by an odd digit then round up
   e. If the digit immediately to the right of the last sig. fig. you want to retain is 5 not followed by nonzero digit and preceded by an even digit then round down (doesn't change)

J. Measuring heat and temperature

1. Heat is the energy that is transferred between two systems, associated with a difference in temperature. Heat is transferred from high heat content to low heat content
   a. As heat is transferred to a material the temperature increases and vice versa. Only true if neither heat transfer process is accompanied by a phase change, measured in calories or joules
   b. Measured in calories or joules
   c. A calorie is the quantity of heat required to raise the temperature of 1 g of water $1C^0$. A kilocalorie or Calorie (food) is the quantity of heat required to raise the temperature of 1 kg of water $1C^0$
   d. A joule is related to a calorie as follows 1 cal = 4.19J ; 1 kcal = 4.19 kJ
2. Temperature is the measure of a systems ability to transfer heat to or acquire heat from other systems. Also the measure of the average kinetic energy of the particles in a substance
   a. Determines the direction of heat transfer
   b. Measured as heat intensity
   c. Heat flows from high heat intensity to low heat intensity
   d. Measured in degrees. A degree is an arbitrary unit that was internationally agreed on

e. Celsius scale was developed by a Swedish astronomer Anders Celsius
   (1) he established two fixed points 1 - freezing point of pure water to be 0^0 and 2 - boiling point of pure water to be 100^0
   (2) he marked these points on a blank thermometer and divided the thermometer into 100 equal parts (degrees)
   (3) he then measured the distance between two degrees and extended his scale above and below his two fixed points
f. The absolute scale for the SI is the Kelvin scale. At 0 Kelvin all motion theoretically stops. (no degree just Kelvin)
   (1) 0^0C = 273 K

3. Specific heat and heat capacities (overhead)
   a. Heat capacity is the quantity of heat required to change an objects temperature by exactly $1C^0$. Depends partly on mass present
   b. Specific heat capacity or specific heat is more useful. It is the amount of heat required to raise the temperature of 1 g of a substance $1C^0$
   c. Measured in cal/g C^0 or J/g C^0
   d. Water's specific heat (C_p) = 1 cal/g C^0 = 4.18 J/g C^0