Chemistry 102 Summary June 9th

Steps in Scientific Method

(1) Make observations- there are two types of observations, qualitative (does not involve a #) and quantitative (number and a unit).
(2) Formulate a hypothesis- possible explanation for an observation.
(3) Perform experiments to test hypothesis.

*See Figures 1.4 and 1.5 in text.

Scientific Models

Theory: Set of tested hypotheses that gives an overall explanation of some natural phenomenon, tells us WHY.

Law: Summary of observed measurable behavior, summarizes WHAT.

- We use SI units in science, see Table 1.1 for fundamental SI units. Please memorize the prefixes in Table 1.2.

Precision vs. Accuracy

Precision: degree of agreement among several measurements of the same quantity, REPRODUCIBILITY.

Accuracy: refers to the agreement of a particular value to a true value.

Types of Errors

Random Error: measurement has an equal value of being high or low. Occurs in estimating the last value of the last digit of a measurement.

Systematic Error: always high or always low, usually a defect in instrumentation.

*Figure 1.10 illustrates these concepts very well.
Significant Figures

- important that uncertainty in measurements is known.

(1) Nonzero integers always count as significant. Example: 32 has two significant figures.

(2) Zeros:
   i. leading zeros: zeros that precede integers, are NOT significant. Example: 0.0025 has two significant figures.
   ii. captive zeros: zeros contained between integers ARE significant. Example: 1.008 has four significant figures.
   iii. trailing zeros: zeros that fall after integers, are only significant if the number contains a decimal point. Example: 100 has one significant figure but $1.00 \times 10^3$ has three significant figures.

(3) Exact numbers: numbers not obtained by measuring devices but by counting, contain an infinite number of significant figures. Example: 10 experiments, 2 cats.

Significant Figures and Calculations

(1) For multiplication or division the number of significant figures in the result should be the same as the number in the least precise measurement in the calculation.

(2) For addition and subtraction the number of significant figures in the result should have the same number of decimal places as the least precise measurement used in the calculation.

Dimensional Analysis

- relationship between units.
- You do NOT need to memorize conversion factors, we will always provide them to you.

Density

- density = mass/volume, where the units are typically g/mL.
Classification of Matter

**Matter:** anything occupying a space and having a mass, has many levels of organization, see Figure 1.16.

- Matter exists in three states: (a) solid – fixed volume and shape.
  (b) liquid – definite volume no specific shape.
  (c) gas – no fixed volume or shape.

*See Figure 1.13.

- Most matter consists of mixtures of pure substances, these mixtures can either be homogeneous or heterogeneous.

**Homogeneous mixture:** having visibly indistinguishable parts.
**Heterogeneous mixture:** having visibly distinguishable parts.

- Mixtures can be separated through physical changes and pure substances can be broken down through chemical changes.

**Physical Change:** does not change formula of compound or elements but changes the physical state.
**Chemical Change:** involves making or breaking chemical bonds.