ATOMS

I. Introduction: *Read Independently
II. Classification of Matter – anything that has mass and occupies space
   A. Matter can be divided into two classes
      a. Pure substances – matter that always has definite and constant composition
         i. Elements – pure substance that cannot be broken down into simpler substances by ordinary chemical means.
         ii. Compound – pure substance that can be broken down into two or more simpler substance by chemical means. Eg) NaCl
      b. Mixtures – physical combination or collection, with variable composition, of two or more pure substances
         i. Homogeneous – uniform composition
         ii. Heterogeneous – non-uniform composition

III. Dalton’s Atomic Theory
   1. All matter is made up of atoms. Interactions among atoms account for properties of matter.
   2. All atoms of the same element have the same chemical properties.
   3. Compounds are formed by the chemical combination of two or more different kinds of atoms.
   4. A molecule is a tightly bound combination of two or more atoms that acts as single unit.
   A. Atom – the smallest particle of an element that retains all of the chemical properties of the element.
   B. Evidence for Dalton’s Atomic Theory
      a. Law of Conservation of Mass – matter can neither be created nor destroyed.
         Example: \( CO + PbO \rightarrow CO_2 + Pb \)
      b. Law of Constant Composition – any compound is always made up of elements in the same proportion by mass.
Handout – Lecture 2

IV. Inside an Atom

A. Subatomic Particles:

<table>
<thead>
<tr>
<th>Subatomic Particle</th>
<th>Charge</th>
<th>Mass (g)</th>
<th>Mass (amu)</th>
<th>Mass (amu): rounded to 1 Sig Fig</th>
<th>Location in an Atom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proton</td>
<td>+1</td>
<td>$1.6726 \times 10^{-24}$</td>
<td>1.0073</td>
<td>1</td>
<td>In nucleus</td>
</tr>
<tr>
<td>Electron</td>
<td>-1</td>
<td>$9.1094 \times 10^{-28}$</td>
<td>5.4859 $\times 10^{-4}$</td>
<td>0.0005</td>
<td>Outside nucleus</td>
</tr>
<tr>
<td>Neutron</td>
<td>0</td>
<td>$1.6749 \times 10^{-24}$</td>
<td>1.0087</td>
<td>1</td>
<td>In nucleus</td>
</tr>
</tbody>
</table>

amu = atomic mass unit – a unit of the scale of relative masses of atoms; 
$1\text{amu} = 1.66 \times 10^{-24}\text{g}$

Notes:
1. Protons and Neutrons masses are considered equal; but are ~2000 times heavier than an electron.
2. Electrons and protons possess the same amount of charge (neg versus pos)
3. Interaction of charged particles
   a. Opposite or unlike charges attract
   b. Like charges repel
4. Atoms as a whole are neutral (same number of protons and electrons)

B. Mass Number = # of Protons + # of Neutrons in the nucleus of an atom

C. Atomic Number = # of Protons in the nucleus of an atom, or # of Electrons

D. Isotopes: have same number of protons and electrons (therefore, they are of the same element), but differ in number of neutrons.

E. Atomic Weight – the atomic weight of an element given in the Periodic Table is an average of the masses (in amu) of its isotopes found on Earth.
   c. Despite the variance in mass of the isotopes, the atoms of an element are treated as a common mass – a weighted average mass.
      i. This depends upon:
         1. natural / percent abundance data for each isotope
         2. atomic masses of each isotope
         3. number of different isotopes that exist

Question / Answer Review:
1. True or False:
   a. Free isolated atoms are rarely encountered in nature?
   b. Atoms may be decomposed by chemical change?
   c. Only one kind of atom may be present in a homoatomic molecule?
   d. An atom is the smallest piece of an element that can exist and still have the properties of the element.

2. Identify the elements and add up the total number of atoms in each of the following formula units?
   a. POCl$_3$
   b. B$_2$H$_8$
   c. S$_4$N$_2$Cl
   d. NaOH