(COMMON IONS AND THEIR CHARGES QUIZZES BEGIN)

Chapter 2 Homework Problems on Pages 70 – 75; **Set 1**: Watch Khan Academy videos at http://www.khanacademy.org/#chemistry "Elements and Atoms, "Introduction to the Atom" 8, 16, 18, 34, 36; **Set 2**: 50, 58, 60, 64, 65; **Set 3**: 70, 71, 90, 99, 100.

VII. Atomic Structure

A. Particles of Matter

1. Greeks - 400 B.C.
   a. Idea that matter could not be destroyed
   b. Believed that matter could be divided into smaller particles until a basic particle was reached
   c. Democritus called these particles "Atomos" for indivisible thus the name atoms
2. Atoms
   a. The smallest unit of an element that can exist either alone or in combinations with other atoms of the same or different elements, and retains the properties of the element. They are neutral particles.
   b. Are so small we can't see them but we know they exist. Simple proof - sugar in water or natural gas; we can taste or smell them but can't see them
   c. So small the distances are measured in Angstroms, Å,
      (1) 1 Å = 1 x 10^{-8} cm
      (2) 1cm is the same fractional part of 1000km (600 miles) as 1 Å is of 1cm
   d. Two main parts
      (1) positively charged central part - nucleus
         (a) diameter is approx. 1 x 10^{-12}cm or 1 x 10^{-4} Å
         (b) this is one ten thousandth the diameter of the whole atom
         (c) density is 20 metric tons/cm^3
         (d) proven by Rutherford's gold foil experiment
         (e) Nucleus contains protons
            i) positively charged particles with a mass of 1.673 x 10^{-24}g. Diameter = 10^{-5} Å. Charge is equal and opposite to that of an electron (+1)
         (f) Nucleus contains neutrons also
            i) neutral particles with a mass of 1.675 x10^{-24}g
         (g) Nuclei of different elements are different
         (h) The forces that hold these particles together are called nuclear forces
      (2) negatively charged outer part - electron cloud
         (a) contains electrons
            i) negatively charged particles with a mass of 9.11 x 10^{-28}g (determined by Millikan's oil drop experiment)
            ii) exist in shells and energy levels
            iii) all electrons are identical
            iv) discovered by J.J. Thompson – 1897 using cathode ray tubes.

v) Neils Bohr (1913) compared the electron movement to the orbit of planets. More like bees buzzing around a hive, constantly fluctuating

(b) gives the atom volume

(c) keeps out other atoms

3. Radioactivity – spontaneous emission of particles or energy coming from one source / atom travelling in waves.
   a. William Röntgen – discovered x-rays
   b. Antoine Becquerel – uranium = radiation
   c. Marie Curie – named phenomenon radioactivity
      (1) alpha (α) particle – helium nucleus
      (2) beta (β) particle – high speed electron from nucleus
      (3) gamma (γ) – high energy rays

B. Atomic Theory
   1. John Dalton - 1803 - postulated the existence of a different kind of atom for each element
   2. Revised and expanded on the following
   3. All matter is made of very small particles called atoms, and are in constant motion.
   4. Atoms of the same element are chemically alike; atoms of different elements are chemically different
   5. Individual atoms of an element may not all have the same mass. However, the atoms of an element as it occurs naturally, have, for practical purposes, a definite average mass that is characteristic of the element
   6. Individual atoms of different elements may have nearly identical masses. However, the atoms of different naturally occurring elements have different average masses
   7. Atoms are not subdivided during chemical reactions, just rearranged and combined in different orders

C. Atomic Number and Mass Number
   1. Atomic number of an Atom is the number of protons in the nucleus of that atom. (Whole number on the periodic table)
   2. Atoms of the same element that have different masses are called isotopes. They differ in the number of neutrons.
   3. The simplest atom - hydrogen has 3 isotopes
      a. Protium - 1 proton, 1 electron, 0 neutron (Hydrogen – 1)
      b. Deuterium - 1 proton, 1 electron, 1 neutron (Hydrogen – 2)
      c. Tritium - 1 proton, 1 electron, 2 neutron (Hydrogen – 3)
   4. Each different variety of atom as determined by the number of protons and neutrons in its nucleus is called a nuclide, i.e. C-12, C-13, C-14
   5. The sum of the number of protons and the number of neutrons is called the mass number
   6. The most common isotope of an element can be determined by rounding the atomic weight to the nearest whole number. This is the most common element's mass number, thus the number of neutrons can be determined

7. The atomic number is placed to the lower left of the elemental symbol, while the mass number is placed to upper left of the elemental symbol, i.e. $^{13}_{6}C$

D. Atomic Mass
   1. Based on a relative, arbitrary scale since the actual masses are too small
      a. Choose the wt. of a pupil and assign it a value of 5.00 units. Compare other students actual weight to this one pupil
   2. Chemists based the elements on carbon-12 having an atomic mass of exactly 12.000 amu (amu = atomic mass unit). 1 amu = 1/12 a C-12 atom = 1.66 x 10^{-24}g.
   3. Atomic mass is the mass of one particular nuclide expressed in amu's
   4. How can we use this to our advantage? To make it easy let's determine how many atoms are in exactly 12.000g of C-12
      a. 12.000gC x 1 amu/1.6605055 x 10^{-24}g x 1 atom C/12 amu's = 6.022 x 10^{23} atoms. Try with 15.9994g of O-16
      b. This number is called Avogadro's number and this quantity of atoms is called a mole

E. Atomic weight (average atomic mass)
   1. The average mass of all the isotopes of an element
   2. The number with a decimal on the periodic table

F. Molar mass
   1. Mass in grams of 1 mole of atoms, molecules of an element. Label is g/mole
   2. Round the atomic weight to nearest 0.1g
   3. Also called the gram atomic weight

VIII Chemical Nomenclature (Naming System)

A. Ionic Compounds
   1. Formulas from names
      a. Write the ion and charge, cation (positive ion) first
      b. Adjust the number of ions so that the total charge of the compound is zero.
      c. Write the formula with appropriate subscripts and parentheses
      d. barium chloride

	Ba^{+2}	Cl^{-1}
need	1	2

$BaCl_2$

ammonium phosphate

	NH_4^{+1}	PO_4^{-3}
need	3	1

$(NH_4)_3PO_4$

      e. practice - potassium nitride, aluminum sulfide, calcium nitrate,
   2. Names from formulas
      a. Just write the appropriate names of the cation and anion.
      b. Old cation names with Roman numerals – the larger of the two charges use an ***–ic*** suffix the smaller of the two charges uses an ***–ous*** suffix added to old name. Example: iron (III) is called ferric while iron (II) is called ferrous; copper (II) is cupric while copper (I) is cuprous.

B. Binary nomenclature
   1. A prefix system is used to name these nonmetal - nonmetal molecules

2. The name has two words
    a. First word is the element name plus a prefix if there is more than one of that element
    b. Second word is the element's -ide name plus a prefix ALWAYS
    c. Prefixes
        (1) mono- =1
        (2) di- =2
        (3) tri- =3
        (4) tetra- =4
        (5) penta- =5
        (6) hexa- =6
        (7) hepta- =7
        (8) octa- =8
        (9) nona- =9
        (10) deca- =10
    d. Examples :
        (1) CO_2 carbon dioxide
        (2) P_2O_5 di phosphorus pentoxide (drop the a)
        (3) NI_3 nitrogen triiodide (keep the I)
3. Stock Names
    a. Roman numeral is used for first element and corresponds to oxidation number determined by assigning ox #.
    b. Example – NI_3 = nitrogen (III) iodide; P_2O_5 = phosphorus (V) oxide

C. Acid Nomenclature
1. Binary Acids
    a. Conatins hydrogen and one eother non metal.
    b. Always begins with hydro- then anion root + -ic acid
    c. HBr = hydrobromic acid
    d. Problems - HF, H_2S, HI
2. Oxyacids
    a. Contains hydrogen and oxygen polyatomic anion.
    b. Anion root name add -ic if anion is -ate add -ous if anion is -ite
    c. H_3PO_4 is hydrogen phosphate becomes phosphoric acid
    Practice : HClO, $HClO_2$, $HClO_3$, $HClO_4$, H_2SO_3

D. Naming Hydrates
1. Contains water of crystallization. The water is physically combined not chemically combined. To get rid of this water just heat and evaporate the water.
2. Name ionic compound then add the word hydrate with an appropiate prefix for the number of hydrates.
3. $CuSO_4 \cdot 5H_2O$ is named copper (II) sulfate pentahydrate
Practice - $Na_3BO_3 \cdot 10\ H_2O$, barium sulfate trihydrate

E. Introduction to Organic Nomenclature
1. Alkanes

a. Simplest hydrocarbons only contain hydrogens singling bonded to carbons
b. also called saturated hydrocarbons
c. have the general formula C_nH_{2n+2}
d. named by prefix system denoting the number of carbons present adding a suffix of **–ane** denoting saturated hydrocarbon

Number of carbons	Prefix	Formula	Name
1	Meth -	CH_4	Methane
2	Eth -	C_2H_6	Ethane
3	Prop -	C_3H_8	Propane
4	But -	C_4H_{10}	Butane
5	Pent -	C_5H_{12}	Pentane
6	Hex -	C_6H_{14}	Hexane
7	Hept -	C_7H_{16}	Heptane
8	Oct -	C_8H_{18}	Octane
9	Non -	C_9H_{20}	Nonane
10	Dec -	$C_{10}H_{22}$	Decane