Chemistry
STUDY GUIDE #2

Updated 1/8 /2011

The Atom and Atomic Structure

A student who completes this unit should be able to do all of the following:

1) Explain three fundamental laws:
   a) Law of conservation of mass
   b) Law of definite proportions (for compounds)
   c) Law of multiple proportions (for different compounds of the same two elements)
2) Explain the history and development of modern atomic theory
   a) Dalton and Dalton's atomic theory
      Know Dalton's 5 postulates and his atomic model
   b) Thomson and the discovery of the electron
      Know his experiment, results, conclusions, and his "plum pudding" atomic model
   c) Rutherford and the discovery of the nucleus
      Know his experiment, results, conclusions, and his "solar system" atomic model
3) Explain the further development of atomic theory
   a) Three subatomic particles (proton, neutron, electron):
      Know their names, location in the atom, charge, relative mass (in amu)
   b) Explain the octet rule and ion formation
   c) Use periodic table to identify atomic number and average atomic mass
   d) Use periodic table to identify the mass number of the most abundant isotope of an element
   e) Use periodic table to determine the number of protons, neutrons, and electrons in a neutral atom
   f) Discovery of isotopes and what they are
   g) Calculate average atomic mass of an element from mass number & fractional abundance of isotopes.
   h) Estimate fractional abundances of isotopes, given their mass numbers

4) Explain the development of Bohr's quantum atomic model
   a) Understand the relation of matter to light energy
   b) Observation of continuous spectrum of white light through a spectroscope
   c) Matter heated to incandescence glow a particular color
      i) Flames tests for various elements
      ii) Observation of line emission spectra for various elements using a spectroscope
      iii) Bohr experiment
         (1) Line emission spectrum of hydrogen
            (i) Describe observations and conclusions
            (ii) Ground state vs. excited state
            (iii)Bohr model of hydrogen atom
               1. Did not prove true for multi-electron atoms
               2. Did not explain the chemical behavior of atoms
         (2) Explain why matter emits light when heated
            (a) Calculate the energy of light (aka. photon) if given the wavelength
5) Explain the dual properties of matter
   a) Matter as particles (atoms, protons, electrons, neutrons)
      i) Already established by Dalton, Thomson, Rutherford

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b) Matter as a wave
    i) Observations of matter that can explained only by wave theory
        (1) De Broglie – hypothesized that electrons can behave as waves
            (a) Proven true by showing diffraction patterns of electrons
        (2) Heisenberg – Heisenberg uncertainty principle
        (3) Schrodinger – Schrodinger wave equation

6) Explain the Quantum Model of the Atom (Current/Modern Atomic Model)
    a) Quantum mechanics / quantum theory
    b) Atomic orbitals – electron behavior, definition, meaning
        i) Principle quantum number (n) - meaning
        ii) Angular momentum quantum number (ℓ) – meaning, shapes (s, p orbitals)
        iii) Magnetic quantum number (m_ℓ) – meaning
        iv) Spin quantum number (m_s) – meaning
        v) How many electrons allowed per orbital / per sublevel / per main energy level
    c) Writing electron configurations (*s,p,d,f*)
        i) Three rules
            (1) Aufbau principle
            (2) Pauli exclusion principle
            (3) Hund's Rule
        ii) Electron configuration notation
        iii) Noble gas notation
        iv) Orbital notation
            (1) How many electrons total?
            (2) How many valence electrons?
            (3) How many inner-shell electrons?
            (4) How many unpaired electrons?

TEXT CHAPTERS: Ch. 3 and Ch. 4
MASSACHUSETTS CURRICULUM FRAMEWORKS, content standard #2

STUDY EVERY NIGHT. COME TO CLASS PREPARED.
ASK FOR HELP IF YOU NEED HELP.
YOU CAN DO WELL IF YOU WANT TO.