CHAPTER 7: HW Pp.303-310 **Set 1**: 8, 10, 16; **Set 2**:20, 28, 32; **Set 3**: 34, 40, 58; **Set 4**: 70, 78, 90; **Set 5:** 102, 104, 110; **Set 6:** 124, 130, 132.

I. Arrangement of the electrons in the atom
   A. Properties of Light
      1. Light is a type of ____
      2. EM radiation is energy traveling in waves at the speed of ______________________
      3. Examples are: ____
   B. Terminology of waves :
      1. _________- tops of waves
      2. _________- bottoms of waves
      3. _________- distance from crest to crest , λ, measured in cm, nm
      4. _________- how often a wave travels past a certain point, ν, measured in cycles per second, seconds^{-1}, Hertz
      5. _________- the height of the wave from the origin
      6. If the frequency of a wave is multiplied by its wavelength we get the speed of light (**c**). ___________________Frequency and wavelength are inversely proportional.
      7. Visible light is a continuous spectrum of colors, ___________________. In order of decreasing wavelength and increasing frequency.
   C. Particle Description
      1. _________Quantum Theory
         a. Metals heated emit ____________________________over wide range of ___________________.
         b. Could not explain the ___________________ wavelengths of light.
         c. ___________________suggested that the energy was emitted in small, definite amounts called a ___________________.
         d. A ___________________is the minimum quantity of energy that is lost or gained by an atom. A small _________of energy.
      2. The relationship between energy and frequency was developed by Max Planck ___________________, where *h* is Planck's constant ___________________
      3. ___________________proposed duality of light, exhibits both wave and particle properties. Each particle of light carries a quantum of energy. These quanta are called ___________________.
         a. Einstein explained the ___________________by stating that the EM radiation is absorbed in whole numbers of ___________________, like climbing a ladder. In order for electrons to be ejected from a metal, the photons striking the electrons must possess the minimum amount of energy to kick out electron. $E_{photon} = h\nu$, this corresponds to min. frequency of the light. **The Photoelectric Effect** – _________ ____ ____
         b. If frequency is greater than threshold frequency then the electrons gain the excess energy. ____________________________where KE is the kinetic energy of the ejected electron and BE is the binding energy of the electron ion the metal. Rearrange the equation and __________________________

thus the more energy the photon has the greater the kinetic energy of the ejected electron.

Use – solar cells on calculators

D. _________Theory

1. __________________spectrums
   a. When elements are sufficiently charged they also emit light but not ____.
   b. When the electrons have absorbed enough energy they _________into a _________E-level and are said to be _________. In order for the electrons to fall back to their __________________they emit the energy as ___________________________. (___________________________)
   c. The amount of energy absorbed _________corresponds to a specific wavelength of light which __________________to definite frequency. By splitting the light emitted into its components we can determine the __________________and thereby determine how much energy was given off and thus know where the electron came from and its arrangement.
2. This is the basis for the Bohr model of the atom. Good but only works for hydrogen. Electrons exist in orbits of __________________energy. This energy is calculated using

   ____

   R_H (Rydberg consant) = 2.18 x 10^{-18} J n = principal quantum number,1,2,3 …
3. This same idea can be used to explain how things glow in the dark. - ____
   ____
   ____
4. By looking at the bright line spectrum we can determine the energy level jumps by corresponding them with the _________series(pg 278) and use Bohr's theory to determine the energy. (See derivation page 277).

____

E. ___________________________Argument

1. __________________related the wave and particle properties using

   ____

   where λ = wavelength of particle (m); *h* = Planck's Constant (6.68 x 10^{-34} Js); *m* = mass of particle (kg) and *u* = velocity of particle (m/s).

F. Quantum Mechanics

1. __________________Uncertainty Principle
   a. __________________are detected by their interaction with _________and since _________have about the same energy as _________, the _________tend to move the electrons from its original location.
   b. His principle states that it is __________________to determine simultaneously both the position and velocity of an electron or any other particle.

c. __________________treated electrons as __________________and by combining with Heisenberg's uncertainty principle, quantum theory (mathematical description of the wave properties of electrons and other very small particles) was born.

2. Brief review of atomic structure
   a. Electrons exist in _________levels (regions where electrons of the same energy exist)
   b. As distance from nucleus _________the energy in the energy level _________
   c. Designated by letters __________________. . .then the word shell
   d. Within these levels are _________ (highly probable location where electrons might exist
3. The energy state of an electron in an atom may be described by a set of _________ "numbers" called __________________
4. __________________describe the space orbital the electron occupies in terms of _________from the nucleus, _________, _________about the three axes in space, and the direction of the electron _________
5. _________quantum number, symbolized by n
   a. Indicated the most __________________of the electron from the nucleus of the atom
   b. Positive _________ _________ (1,2,3. . .)
   c. Corresponds directly with __________________designation, or identifying number, of an orbital
   d. The principal quantum number of 1 corresponds to the first energy level, or the K shell, which is the closest to the nucleus and has the lowest energy. All others are at increasing distance and energy
6. __________________quantum number, symbolized by ℓ *($\ell = n-1$)*
   a. Indicated the _________of the orbital the electron occupies
   b. Shapes are designated by ___________________________
   c. s has the _________energy, h has the _________
   d. The number of different possible shapes in an energy level is equal to the value of the _________quantum number
   e. n = 1 then 1 shape, s; n = 2 then 2 shapes, s and p; n = 3 then 3 shapes, s, p, d and so on
   f. Website for orbital pictures http://micro.magnet.fsu.edu/electromag/java/atomicorbitals/index.html
7. __________________number, symbolized by m_ℓ
   a. There are $(2\ell + 1)$ values of m_ℓ which equal ________________________
   b. Thus if $\ell = 2$ then m_ℓ = ___________________________
   c. Indicated the orientation of the orbitals about the three axes in space
   d. s orbitals have _________orientation $\ell = 0$
   e. p orbitals have _________orientations $\ell = 1$
   f. d orbitals have _________orientations $\ell = 2$
   g. f orbitals have _________orientations $\ell = 3$
   h. The first (K) energy level has __________________orbital

i. The second (L) energy level has ________ s, and _______ p's for a total of _________
j. The third (M) energy level has _________s, _________p's and _________d's for a total of _________

8. Spin quantum number, symbolized by m_s
   a. Indicates the electron's _________; electrons like to be in _________
   b. Referred to as __________________or __________________ ($+\frac{1}{2}$ or $-\frac{1}{2}$)
   c. No two electrons in the same energy level, the same orbital and the same orientation can have __________________spin
9. Relationships
   a. The total number of orbitals in an energy level is equal to _________
   b. The maximum number of electrons that may occupy an energy level can be determined by _________
   c. To determine the total number of electrons an orbital can hold equals __________________

G. Putting it all together in one notation called orbital notation
1. This notation applies all ____________________________________and describes energy and distance
2. Must apply the __________________principle - electrons will enter the lowest energy orbital first
3. Must apply __________________rule - electrons fill orbital evenly before pairing
4. Must apply ____________________________________principle - paired electrons must have opposite spins; no two electrons may have the exact same set of four quantum numbers
5. Diamagnetic vs Paramagnetic –
   a. __________________have single electrons unpaired are attracted by magnet
   b. __________________have all electrons paired are repelled by magnet (dissed)
6. Practice diagram - to remember placement of orbitals and the order in which the electron fill use the "magic D"

II.	a.	7s	7p		
III.		6s	6p	6d	
IV.		5s	5p	5d	5f
V.		4s	4p	4d	4f
VI.		3s	3p	3d	
		2s	2p		
		1s			

a. Fill diagonally from bottom right to upper left

Other notations

2. ____________________________________**notation** - shorthand method from orbital notation
   a. Uses the __________________, __________________and number of electrons

b. $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^6, 4d^{10}, 4f^{14}$

c. Keep ______________________________________together

d. Noble gas notation – shorthand of electron configuration notation.

   i. use the closest ___________________as shorthand

   ii. Example – Na – $1s^2, 2s^2, 2p^6, 3s^1$ would become [Ne] $3s^1$

3. ___________________**notation** - only represents the outer shell, valence, electrons

   a. Each atom can only have eight valence electrons, these are the s and p electrons

   b. Electrons are placed around the element symbol with the two _____electrons to the left, _____electron top, _____electron left, _____electron below, _____electron top, _____left, _____bottom. See diagram below

   c. All electron notations represent the ___________________possible energy state, ground state of the atoms

   d. Ionic notations are done the same except ______________________________________

VII. X

EXCEPTIONS TO THE RULES