## CHM 1045 Exam 4 Study Sheet and Sample Problems

The following facts will be on Exam 4 in some form. If you do not know and understand the meaning of these concepts you have not prepared properly for the exam. You are responsible for all information indicated on the objectives, these facts are just the basics. Do not make the mistake of assuming this is all that is on the exam.

1. Radio waves, microwaves, infrared radiation, visible light, ultraviolet light, x-rays, and gamma rays are all examples of electromagnetic radiation (EMR). All travel at "c" or $2.99X10^8$m/sec.
2. The higher the frequency and shorter the wavelength the greater the amount of energy of electromagnetic radiation.
3. The velocity of a wave is equal to the wavelength times the frequency. For EMR, $c=\lambda\nu$
4. The energy of a photon is equal to Planck's constant times the frequency and also equal to Planck's constant times the speed of light divided by the wavelength.
5. Electromagnetic energy comes in "packets" of energy called quanta or photons.
6. Bohr's model of an atom's electronic structure was developed from studies of the spectral lines produced by different elements.
7. An electron's lowest energy state on an atom is called the ground state.
8. When an electron moves from one energy level to another (undergoes a transition), a photon of EMR is either absorbed or released.
9. Both EMR and moving objects have both particle and wave properties.
10. The current model of atomic electronic structure describes orbitals as statistical areas of high probability of finding an atom's electrons. These statistical calculations were derived using the wave nature and quantum properties of electrons.
11. There are four quantum numbers (Q.N.) applied to electrons: Principle Q.N., Azimuthal Q.N., Magnetic Q.N., and Spin Q.N.
12. You cannot know the location , speed and direction of an electron all at the same time.
13. No two electrons can have the same four Q.N.'s.
14. The azimuthal Q.N. describes the shape of the electron's orbital.
15. Any orbital can hold a maximum of two electrons.
16. Degenerate orbitals have the same energy.
17. Electrons add to polyelectronic atoms into "hydrogen-like" orbitals.
18. Electrons in degenerate orbitals remain unpaired as long as possible.
19. The chemical properties of elements are determined by the electron configuration of the element.
20. Atoms within a specific Group on the Periodic Table (PT) all have similar outer electron configurations.
22. The Group "A" numbers on the PT can be used to determine the number of valence electrons in an atoms outer energy level.
23. The Period number of an atom on the PT indicates the highest energy level that contains electrons in the atom's ground state.
24. As you go down a Group atoms tend to get larger, the ionization energy gets lower (easier to pull an electron off), and the electron affinity gets higher (more energy required to put an electron on the atom).
25. As you go across a Period atoms tend to get smaller, the ionization energy tends to become higher, and the electron affinity tends to become lower.
26. The electron configurations of transition and rare earth elements are difficult to predict because of exceptions to the Aufbau Principle.
27. Common monoatomic ions are generally unreactive because they tend to have a noble gas configuration.

You should know the following equations and values:

$c=\lambda\nu$ $\qquad$ $c = 2.99X10^{10}cm/sec$

$E_{electron}= - 2.180X10^{-18}J(1/n^2)$ $\qquad$ $h = 6.63X10^{-34}J\bullet sec$

$1/\lambda = 109{,}700cm^{-1}(1/n^2_{lower} - 1/n^2_{upper})$ $\qquad$ Rydberg's $R = 109{,}700cm^{-1}$

$E_{photon}=h\nu$

Examples of the kinds of problems you should be able to solve:

What is the wavelength of the photon of light produced when an electron on a hydrogen atom falls from the 4th energy level to the 2nd energy level? (Plank's constant = $6.63X10^{-34}$ J•Sec)

What is the energy of an electron in the 6th energy level of a hydrogen atom?

What is the wavelength of radio waves whose frequency is 99.5 mHz?

What is the energy of the photon of light produced when an electron on a hydrogen atom falls from the 4th energy level to the 2nd energy level? (Planks constant = $6.63X10^{-34}$ J•Sec)

Write the complete electron configuration of copper.

Describe the shapes of s, p, and d orbitals.