QUANTUM THEORY/PERIODIC TABLE SYLLABUS

Quantum Theory and the Electronic Structure of Atoms

Periodic Relationships & Reactivity Among the Elements

I. Major Topics:

Quantum Theory and the Electronic Structure of Atoms

A. The History of the Atom
B. Electromagnetic Radiation
C. The Photoelectric Effect and Quantization
D. Emission Spectra, Energy Transitions in the Hydrogen Atom
E. The Dual Nature of an Electron
F. Quantum Mechanics & the Uncertainty Principle
G. Quantum Numbers
H. Electron Configurations

Periodic Relationships & Reactivity Among the Elements

I. Development of the Periodic Table
J. Structure of P.T and e' Configurations of Ions
K. Atomic Radii and Ionic Radius
L. Ionization Energy
M. Electron Affinity
N. General Trends in Reactivity

II. Objectives/Guidelines:

Quantum Theory and the Electronic Structure of Atoms

1. Know the basic history of the development of the atom - Democritus, Dalton, J.J. Thomson, and Rutherford.
2. Know and be able to recognize the characteristics of a wave (wavelength, frequency, amplitude, etc)
3. Be able to convert between wavelength and frequency, $c=\lambda.\upsilon$.
3. Know what electromagnetic radiation is, how it is represented, and the relationships between the different types of radiation on the electromagnetic spectrum (in terms of energy, frequency, wavelength, and some general properties.)
4. What does it mean to be quantized? What is a photon? Be able to calculate the energy, wavelength or frequency of a photon.
5. What is the photoelectric effect? Go over the "thought provoking questions" concerning this topic in your Quantum Theory notes. Make sure you are familiar with the idea of "binding energy." Be able to calculate E per photon and E per mole.
6. What is an emission spectra? What causes it? What are examples of the two different types? Be familiar with the colored light emitted from FLAME TESTS!
7. Be familiar with Bohr's model of the hydrogen atom. Be able to calculate the amount of energy released or absorbed in any electron transfer in the hydrogen atom (using Rhyberg's equation).
8. Know and be able to distinguish among the four Hydrogen Emission Sets - Lyman, Balmer, etc....
9. Understand the basic idea behind de Broglie's "Matter Wave Equation." Under what conditions is the wavelength of a particle significant?
10. Understand the Heisenberg Uncertainty Principle. How does this idea shape how we view atoms? Be familiar with the variables in the mathematical representation of this principle.
11. What are the four quantum numbers and what do they represent? (names, shapes, orientations, spin, capacity for electrons, etc)
12. Be able to determine possible sets of quantum numbers for any given e' in a given orbital (like we did in the notes). Be able to look at sets of proposed quantum numbers for provided e's and pick out ones that don't work.
13. Know the general shapes of the 4 orbitals.

14. Know the filling order of the orbitals both by using that electron configuration diagram and by just looking at the periodic table. (Draw an Aufbau diagram if necessary).
15. Remember and understand why the energies of the orbitals in the hydrogen atom are only dependent on the n quantum number where as in multi-electron atoms, the energies of the orbitals is dependent on both n and l.
16. Be able to write noble-gas or long-hand electron configurations for any atom on the P.T. (except for the actinides).
17. For any element or ion, be able to determine how many unpaired electrons an element/ion has and whether it's diamagnetic or paramagnetic.
18. Be familiar with the names and concepts behind the different rules that guide electron configuration writing.
19. Know where the orbital blocks are on the periodic table and how they were established.
20. Be able to determine valance electrons and most common ionic charge for the representative elements using the P.T.
21. Have memorized the D-block electron configuration exceptions given in the notes.
22. Know how to write e- configurations for any atom in the lanthanide series.
23. Be prepared to provide reasoning for why various given electron configuration exceptions occur on the basis of increased stability and close energies of certain orbitals (for example, the s and d orbitals, and the d and f).

Periodic Relationships & Reactivity Among the Elements
24. Know what orbital blocks are represented by the representative elements.
25. Know the relationship between valence electrons and the P.T.
26. Know the most stable way to represent most elements. (For example, the "Magic Seven.")
27. Be able to write electron configurations for cation/anions for both the representative and transition metals.
28. Be familiar with the idea of Z_{eff} /shielding/Coulomb's Law and how these ideas are the basis of the periodic trends.
29. Know the Periodic Trends (Atomic Radii, Ionic Radii, Ionization Energy (1st, 2nd, 3rd, etc), Electron Affinity, Electronegativity, Metallic Character, etc) and be able to logically explain why they are arranged. Be able to look at given ions/atoms and put them in increasing/decreasing order in reference to all four trends.
30. Be able to make sense out of the periodic trend graphs (electronegativity increases as you move up & right)
31. Be familiar with the general properties given for each family on the P.T.
32. Be familiar with properties going across a period especially oxide/hydride formation.
33. Practice reaction writing for oxide formation, hydride formation, and reactions with water (review of ch.4).

Complete the following problems from your Brown, LeMay & Bursten chemistry text. Show all of your work! (No Work = No Credit). The answers to the odd numbered problems are in the back of your text. It is your responsibility to get yourself in an academic position to answer ALL of these problems. If needed – PLEASE ASK ME FOR HELP!

Problem Set #7: problems 6.4, 6.6, 6.8, 6.11, 6.12, 6.16, 6.25, 6.28, 6.33, 6.38

Due Date:_____

Problem Set #8: problems 6.41, 6.42, 6.43, 6.46, 6.51, 6.52, 6.53, 6.59, 6.60, 6.66

Due Date:_____

Problem set #9: problems 6.88, 6.90, 7.1, 7.2, 7.4, 7.5, 7.8, 7.14, 7.16, 7.19, 7.20, 7.23, 7.27, 7.28

Due Date:_____

Problem set #10: problems 7.30, 7.32, 7.33, 7.37, 7.38, 7.45, 7.46, 7.49, 7.52, 7.54, 7.56, 7.58, 7.59, 7.60, 7.65, 7.70

Due Date:_____