Chem 001A Notes
Week 4

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1 Monday Lecture: Oct 20th

1.1 Emissions Spectra and the Bohr Model

- We are now struggling with the emission spectrum of atoms to solve that question
- Every atom or molecule has a discrete emission spectrum
- They are unique to each atom, treat them as a bar code
- Then Rydberg Equation developed a formula to predict the emission spectrum of atomic hydrogen:

$$\frac{1}{\lambda} = R(\frac{1}{n_1^2} - \frac{1}{n_2^2})$$

- Including Rydberg's constant to make it make sense
- Postulate Bohr model to figure out the spectrum model

1. Called hydrogen atoms to only allow certain energy levels, called **stationary states**.
2. Atom does not radiate energy while in a stationary state. (violation of classical physics)
3. Atom changes to another stationary state (another orbit) only by obsorbing or emitting a photon. Energy of photon (hv)...

- There is something about how atoms absorb photon to increase in energy level
- When they emit the photon, they decrease a level of energy (as observed in emission spectrum)

- Assuming this is actually happens, you can explain the emission spectrum, hence, why it is a postulate
- The energy level can be calculated as

$$E = const(\frac{1}{n_{final}^2} - \frac{1}{n_{init}^2})$$

- Looks a lot like Rydberg's equation

$$\Delta E = E_{final} - E_{init}$$

1.2 Limitations of Bohr Model

- Only predicts transition energyies for atoms

$$E = -2.18 \times 10^{-18} J \frac{Z}{n^2}$$

- This model requires quantum mechanics to fully understand the gaps

1.3 Quant descryption of hydrogen

- Going from Bohr model of "Orbits" $\rightarrow$ Quantum model of "Orbitals"
- F = ma = m $\frac{d^2x}{dt^2}$, "position function" x(t)

  This is a differential equation (I mean, both of them are). This is a time domain
- Wave Function, Ψ. H$\psi = E\psi$

  This is a frequency domain
- When it comes to these, there is an infinite number of solutions
- Orbitals can be identifies using combination of three integers called quantum numbers
- Ech orbital has a methamtically defined shape
- Each orbital has a probabilistic "location"(?)
- n = Principle Quantum Number

  n = 1, 2,3, .., inf
- L = Angular Momentum quantum number

  L = 0,,1,2,...,n-1
- m_I = Magnetic Quantum Number -l, -l, + 1, ..., 0, ..., l - 1, l
- Go to office hours to solve these differential equations
- When it comes for the # of orbitals, 2l + 1 = # of orbitals
- l = n-1, 0, -l, +l

1.4 Terms and definitions for QUant

- **Shell**: Given value of principle quantum number n. There are inf # of shells labelled n = 1,2,..,inf

- **Subshell:** each shell divided into subshells, determined by angular momentum quantum number l. For given shell with principle quantum number n, there are $n-1$ different subshells. Associated with each subshell is a letter designation.

(n, l, m$_I$)	**Orbital Name**	**# of orbitals**
(2,0,m$_I$)	2s	1
(2,1,m$_I$)	2p	3
(4,2,m$_I$)	4d	5
(4,3,1)	4f	1

Table 1: Orbital Information

- Electrons go down, orbitals are in a square

- Electrons have some mass, they have a charge

- Electrons also have a spin

- We had no idea where mass came from until a few years ago.

  Mass comes from the large hydron collider, and with sufficient energy. We get the Higgs field (Higgs boson). Particles interacting with the Higgs field makes mass.

- Spin exists, and use these properties to figure out how to put electrons into orbitals