Bohr Model of Hydrogen

Shell Model explains absorption/emission spectra of hydrogen.

Bohr's Model

- 1. All forms of energy are quantized (only fixed, discrete amounts or quanta).
- 2. Electron can only occupy certain specific CIRCULAR orbits of fixed radius and none other.
- 3. Electron can jump from one orbit to a higher one by absorbing the EXACT quantum of energy in form of a photon.
- 4. Each allowed orbit corresponds to a specific amount of energy.

Ground State

- (n = 1) is the ground state. This is the lowest energy state. E = -13.6 eV.
- Whenever an electron is in any level above n = 1, the atom is “excited.”
- Whenever an electron gains 13.6 eV, the electron is excited so much it is removed from the atom and an ion is formed.

Absorption

- An electron will absorb a PHOTON only if the photon possesses the EXACT energy required to raise the atom to a higher energy level.

Emission

- 1. As electrons in excited atoms return to lower energy levels, they produce a specific series of unique frequencies of light called the atomic spectrum.
- 2. Atomic spectra may be used to identify atoms in unknown samples.
- 3. Emitted photons are EXACTLY THE SAME as the absorbed photons for a given transition.

Analysis of Emission Spectra

- 1. E(photon, eV) = Ei – Ef (eV)
- 2. E(photon, J) = (Ephoton, eV) x 1.6 x 10^(-19) J/eV (J)
- 3. E(photon, J) = hf
- solve for f = E(Joule)/h (Hz)
- 4. color of light from frequency (see p. 2)

Example

- 1. transition from n = 4 to n = 1. electron falls back down to ground state and emits photon.
- Ei = -0.85 eV; Ef = -13.60 eV
- E(photon, eV) = -.85 - -13.6 = 12.75 eV
- E(photon, J) = (12.75)(1.6 x 10^(-19)) = 2.04 x 10^(-18) J
- f = 2.04 x 10^(-18)/6.63 x 10^(-34) = 3.07 x 10^15 Hz (ultraviolet)