Quantum Mechanical Model of the Atom and Electronic Structure

1. Most of the atom's mass, in the form of protons and neutrons, is concentrated in the positively-charged nucleus. The nuclear charge depends on the number of protons.

2. Electrons can assume only specific energies (their energy is quantized). The lower the electron energy the more tightly bound the electron is to the nucleus, and the closer (on the average) the electron is to the nucleus.

3. When electrons change from a higher energy state to a lower one, energy is released by the atom in the form of photons. This change in energy ($\Delta E$) is related to the wavelength ($\lambda$) of the emitted photon by $\Delta E = E_{\text{fin}} - E_{\text{init}} = \frac{hc}{\lambda}$.

4. Electrons of a particular energy occupy (move about) in regions of space around the nucleus called atomic orbitals. Electron motion for a particular energy is unknown. QM theory can only describe where the electron is likely to be found.

5. Atomic orbitals are described mathematically by a wave function $\psi$ (psi) that depends on the quantum numbers $n$, $l$, and $m$. $\psi^2$ represents the probability of finding the electron at a certain place with respect to the nucleus.

6. For each principal energy level designated by the principal quantum number $n$ ($n = 1, 2, 3, ...$) there are $n$ sublevels. The sublevels are characterized by the angular momentum quantum number $l$ and are designated s, p, d, f, g ... For a given value of $n$, sublevel energy varies $s < p < d < f ...$

7. With each sublevel there are $(2l + 1)$ atomic orbitals. Orbital shape and orientation vary with the sublevel and are characterized by the magnetic quantum number $m$. 

8. No more than 2 electrons can occupy the same atomic orbital. Each electron in a given orbital has a different spin state designated by the spin quantum number $m_s$ ($m_s = \pm \frac{1}{2}$).