Note taking guide for De Broglie, Rutherford, and Bohr

**1. De Broglie** – postulates that matter can manifest wave behavior. $\lambda = h/p = h/mv$

## 2. Early models of the atom:

JJ Thomson – Plum pudding. Electrons imbedded in a positive goo (to make the atom neutral)

Rutherford – Sends Alpha particles ("bullets" – 2 protons – 2 Neutrons – a He nucleus) through thin Gold foil. Some bounce back. Thomson's model won't explain this. Rutherford's model introduces the nucleus of the atom as a large dense positively charged thing, with electrons in orbit around it.

Closest approach problems: set Ke = Pe: $1/2mv^2 = Vq = (kq/r)q = (kZe/r)2e$
So $1/2mv^2 = (kZe/r)2e$ where m and v = mass and velocity of the alpha, Ze = atomic number * electron charge = Nucleus charge, and 2e = the charge on the alpha
$m = 2m_p + 2\,m_n = (2*1.673E-27+2*1.675E-27)$

## 3. Bohr Atom:

**Rydberg's formula predicts the spectral lines of Hydrogen**
Balmer's series (visible) $1/\lambda = R(1/2^2 - 1/n^2)$ n = 3, 4, 5, middle wavelength, middle energy
Lymns's series (UV ) $1/\lambda = R(1/1^2 - 1/n^2)$ n = 2, 3, 4 short wavelength, high energy
Paschen's series (IR ) $1/\lambda = R(1/3^2 - 1/n^2)$ n = 4, 5, 6 long wavelength, low energy

$R = 1.097E7\ m^{-1}$

**Bohr's model needed to explain the Rydberg formula.**

Bohr's quantum hypothesis: $L = nh/2\pi$ since $L = I\omega$ and $I = mr^2$, and $\omega = v/r$, then you get $mrv = nh/2\pi$

So $v = nh/2\pi mr$

Orbit condition: $mv^2/r = kqq/r^2$ since q = e, and q = Ze, this becomes: $mv^2/r = kZe^2/r^2$ so then $r = n^2h^2/4\pi^2kZe^2m$ which is the formula for the Bohr Radius if Z = 1, and n = 1

Energy: the energy of a state is given by $En = 1/2mv^2 - Vq = 1/2mv^2 - (kZe/r)e$ Then all heck breaks loose.