12. Atoms

1. Using Bohr's postulates, derive the expression for the frequency of radiation emitted when electron in hydrogen atom undergoes transition from higher energy state (quantum number ni) to the lower state, (nf). When electron in hydrogen atom jumps from energy state ni = 4 to nf = 3, 2, 1. Identify the spectral series to which the emission lines belong.

2. Define ionisation energy. What is its value for a hydrogen atom?

3. Derive an expression for the frequency of radiation emitted when a hydrogen atom de-excites from level n to level (n – 1). Also show that for large values of n, this frequency equals to classical frequency of revolution of an electron.

4. A monochromatic radiation of wavelength 975 Å excites the hydrogen atom from its ground state to a higher state. How many different spectral lines are possible in the resulting spectrum? Which transition corresponds to the longest wavelength amongst them.

5. (i) State Bohr's quantization condition for defining stationary orbits. How does de-Broglie hypothesis explain the stationary orbits?
(ii) Find the relation between the three wavelengths λ1, λ2 and λ3 from the energy level diagram shown below.

6. State the basic assumptions of Rutherford model of atom. Explain in brief why this model cannot account for stability of an atom?

7. Show that the radius of the orbit in hydrogen atom varies as n2 where n is the principal quantum number of the atom.

8. Using Rutherford model of the atom, derive the expression for the total energy of the electron in hydrogen atom. What is the significance of total negative energy possessed by the electron?

9. (i) In hydrogen atom, an electron undergoes transition from third excited state to the second excited state and then to the first excited state. Identify the spectral series to which these transitions belong.
(ii) Find out the ratio of the wavelengths of the emitted radiations in the two cases.

10. Find the ratio of energies of photons produced due to transition of an electron of hydrogen atom from its second permitted energy level to the first permitted level and the highest permitted energy level to the first permitted level.