

Engineering Chemistry - 2  
Spectroscopy - Tutorial 1

Q. 1) Calculate energy associated with radiation having  $\lambda = 5000 \text{ \AA}$  in Kcal/mole.

Ans  $\lambda = 5000 \text{ \AA} = 5000 \times 10^{-8} \text{ cm}$

$$\therefore E = \frac{hc}{\lambda} = \frac{(6.628 \times 10^{-27}) \times (2.998 \times 10^{10})}{(5000 \times 10^{-8})}$$

$$= 3.974 \times 10^{-12} \text{ ergs}$$

$$= \frac{3.974 \times 10^{-12} \times 6.023 \times 10^{23}}{4.18 \times 10^{10}}$$

$$= 57.262 \text{ Kcal/mole}^{-1}$$

$\therefore$  The energy associated with given radiation is 57.262 Kcal/mole

Q. 2) Calculate the smallest amount of energy that can be emitted or absorbed at  $n = 2.5 \times 10^{12} \text{ sec}^{-1}$ . Also calculate wavelength of this radiation.

Ans Given:

$$n = 2.5 \times 10^{12} \text{ sec}^{-1}$$

$$E = \frac{hc}{\lambda} = hn$$

$$= (6.628 \times 10^{-34}) \times (2.5 \times 10^{12})$$

$$= 1.657 \times 10^{-22} \text{ J}$$

$$E = 1.657 \times 10^{-21} \text{ J}$$

$$n = \frac{c}{\lambda} \Rightarrow \lambda = \frac{c}{n} = \frac{3 \times 10^8}{2.5 \times 10^{12}} = 1.2 \times 10^{-4} \text{ m}$$

$\therefore$  Amount of energy emitted or absorbed  $= 1.657 \times 10^{-21} \text{ J}$   
 Wavelength of radiation  $= 1.2 \times 10^{-4} \text{ m} = 120 \mu\text{m}$

Q. 3) Give characteristics of electromagnetic radiations.

Ans Important characteristics of electromagnetic radiations are :

- 1) These radiations are produced by the oscillations of electric charge and magnetic field residing on the atom. The electric and magnetic components are mutually perpendicular and co-planar.
- 2) These are characterised by their wavelength or frequency or wave numbers.
- 3) The energy carried by a electromagnetic radiation is directly proportional to its frequency. The emission or absorption of radiation is quantized and each quantum of radiation is called a photon.
- 4) All types of radiations travel with the same velocity and no medium is required for their propagation. They can travel through vacuum.
- 5) When visible light is passed through prism, it is split up through seven colours which correspond to definite wavelengths. This phenomenon is called dispersion. Thus, a gap of electromagnetic radiations can be split up into various components for analysis.