SUBJECT - CHEMISTRY

CLASS - B.Sc(Hons) PART-III

PAPER — V

TOPIC - Relation between frequency, wavelength, wave number and energy

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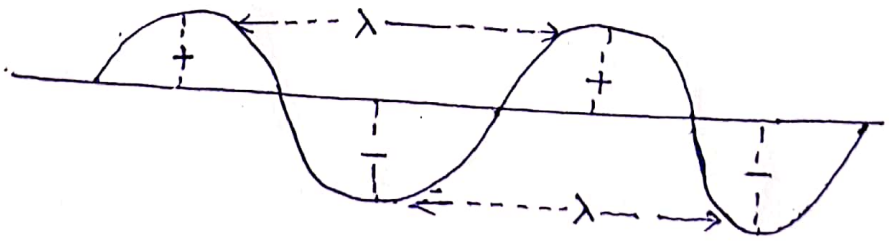
Q Show the relationship between frequency, wavelength, wave number and energy.

Ans. Relation between frequency, wavelength, wave number and energy: The distance between two Consecutive crests or troughs of a wave is called wavelength of that wave. It is denoted by λ. Since it is the length, hence in Spectroscopy it is usually expressed in nanometer i.e nm (10^{-9}m). The number of wave passing a given point per second is called frequency of the radiation. It is denoted by ν. $\nu = \frac{c}{\lambda} = \frac{cm}{\frac{sec}{cm}} = sec^{-1}$

It is expressed in cycle per second or Hertz. The wave That Constitute the radiation have various frequencies.



The number of waves per centimeter is called the wave number. It is denoted by $\bar{\nu}$. $\bar{\nu} = \frac{1}{\lambda} = \frac{1}{cm} = cm^{-1}$ in spectroscopy, It is usually expressed in cm^{-1}.

we still commit a universal sign of referring to a vibration as frequency $x\ cm^{-1}$ rather than wave number $x\ cm^{-1}$

According to the famous planck's equation, the energy (E) is given as -

$$E = h\nu \quad \text{---} \quad (1)$$

Since $\bar{\nu} = \frac{1}{\lambda}$

$\therefore E = h\bar{\nu}c = \frac{hc}{\lambda}$, where c = velocity of light. --- (2)

Therefore from equation (1 & 2), one can have the following relation -

$$E \propto \nu \propto \bar{\nu} \propto \frac{1}{\lambda}$$

In other words, the energy increases, frequency increases, wave number increases, but wavelength decreases.

This is the desired relation.