

$$\Delta E = h\nu = \frac{Nhc}{\lambda}$$

(4)

Where, 'c' is the velocity of light.

λ is the wave length

h = plank's constant = 6.626×10^{-34} J sec.

The energy absorbed per mole of the reacting substance is called one Einstein.

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* Quantum Efficiency or Quantum yield

The quantum yield (ϕ) of a photochemical process is defined as:

$$\phi = \frac{\text{Number of molecules that react}}{\text{Number of quanta of radiation absorbed}}$$

$$\text{or } \phi = \frac{\text{Number of moles that react}}{\text{Number of Einstein of radiation absorbed}}$$

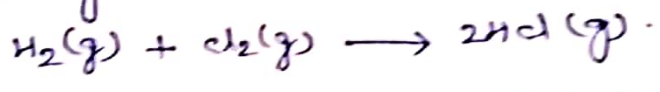
similarly,

$$\phi = \frac{\text{Number of molecules of product formed}}{\text{Number of quantum of radiation absorbed}}$$

$$\text{or } \phi = \frac{\text{Number of moles of product formed}}{\text{Number of Einstein of radiation absorbed}}$$

$$\text{or } \phi = \frac{\text{Rate of Process}}{\text{Intensity of light absorbed}} = \frac{x}{I_0 h \nu}$$

Q. Calculate the number of moles of HCl (g) produced by the absorption of one joule of radiant energy of wavelength 480 nm in the reaction -



If the quantum yield of the photochemical reaction is 1.0×10^6 .

Solⁿ

The Energy of einstein associated with radiation is -

$$E = \frac{Nhc}{\lambda} = \frac{(6.022 \times 10^{23} \text{ mol}^{-1})(6.626 \times 10^{-34} \text{ J s})(3 \times 10^8 \text{ m s}^{-1})}{480 \times 10^{-9} \text{ m}}$$

$$= \left(\frac{6.022 \times 6.626 \times 3}{480 \times 10^{-9}} \right) \times 10^{31} \times 10^{-34} \text{ J mol}^{-1}$$

$$= \frac{119.70 \times 10^{-3} \text{ J mol}^{-1}}{480 \times 10^{-9}}$$

$$= \frac{119.70 \times 10^{-3} \times 10^9 \text{ J mol}^{-1}}{480}$$

$$= \frac{119.70}{480} \times 10^6 \text{ J mol}^{-1}$$

$$= \frac{1197}{480} \times 10^5 \text{ J mol}^{-1}$$

$$E = 2.49 \times 10^5 \text{ J mol}^{-1}$$

Number of einstein corresponding to 1J of radiant energy absorbed = $\frac{1 \text{ J}}{2.49 \times 10^5 \text{ J}} = 0.40 \times 10^{-5}$

Given, $\phi = 1 \times 10^6$

\therefore No. of moles of HCl (g) produced = $1 \times 10^6 \times 0.40 \times 10^{-5}$
= 4.0 Ans.