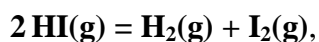


Problem 3-07 Quantum yield of a photochemical reaction

The study of the photolysis of gaseous hydrogen iodide,



induced by light of wavelength of 253.7 nm, revealed that absorption of energy of 307 J brought about the decomposition of $1.3 \cdot 10^{-3}$ mol HI. Calculate the quantum yield of this photoreaction.

[$\phi = 2$]

Solution:

$$\lambda = 253.7 \text{ nm} = 2.537 \cdot 10^{-7} \text{ m}$$

$$E = 307 \text{ J}$$

$$n_{\text{HI}} = 1.3 \cdot 10^{-3} \text{ mol HI}$$

$$c = 3 \cdot 10^8 \text{ m s}^{-1}$$

$$\text{Number of light quanta: } N_{\epsilon} = \frac{E}{\epsilon} = \frac{E}{h \cdot \frac{c}{\lambda}} = \frac{307}{6.625 \cdot 10^{-34} \cdot \frac{3 \cdot 10^8}{2.537 \cdot 10^{-7}}} = 3.9188 \cdot 10^{20}$$

$$\text{Number of decomposed molecules HI: } N_{\text{HI}} = 1.3 \cdot 10^{-3} \cdot 6.022 \cdot 10^{23} = 7.8286 \cdot 10^{20}$$

$$\text{Quantum yield: } \phi = \frac{N_{\text{HI}}}{N_{\epsilon}} = \frac{7.8286 \cdot 10^{20}}{3.9188 \cdot 10^{20}} = 2$$