Sem 1 (2003/2004) : Quantum Theory

Q4(d) Given: $\frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g) \longrightarrow HCl(g)$; $\Delta H_f = -432\ kJmol^{-1}$

$$HCl(g) \longrightarrow \frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g)\ ;\ \Delta H = +432\ kJmol^{-1}$$

ie. To break-up 1 mol (6.022×10^{23}) HCl molecule, we require 432 kJ energy.

∴ Energy required to break-up 1 molecule of HCl, E

$$= \frac{432.0}{N_A} = \frac{432.0}{6.022 \times 10^{23}} = 7.17 \times 10^{-22}\ kJ\,molecule^{-}$$

$$= 7.17 \times 10^{-22} \times 10^{3}\ J\,molecul$$

$$= 7.17 \times 10^{-19}\ J\,molecule^{-}$$

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

$$7.17 \times 10^{-19}\,J = \frac{(6.626 \times 10^{-34}\,Js)(2.998 \times 10^{8}\,ms^{-1})}{\lambda}$$

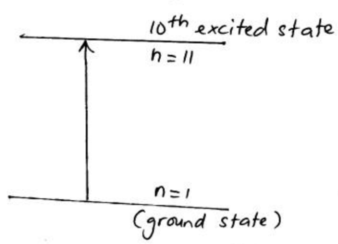
$$\therefore \lambda = \frac{(6.626 \times 10^{-34}\,Js)(2.998 \times 10^{8}\,ms^{-1})}{(7.17 \times 10^{-19}\,J)}$$

$$= 2.77 \times 10^{-7}\,m$$

$$= 2.77 \times 10^{-7} \times 10^{9}\,nm$$

$$\lambda = 277\,nm\ \text{(Ans)}$$

Q4(e) Rydberg equation : $\frac{1}{\lambda} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$



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

$$\Delta E = R_H hc\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$$\Delta E = (6.626 \times 10^{-34}\,Js)(2.998 \times 10^{8}\,ms^{-1})(1.09678 \times 10^{7}\,m^{-1})\left(\frac{1}{1^2} - \frac{1}{11^2}\right)$$

$$\Delta E = 2.162 \times 10^{-18}\,J\,particle^{-1}$$

$$= (2.162 \times 10^{-18})(6.022 \times 10^{23})(10^{-3})\ kJmol^{-1}$$

$$\Delta E = 1302\ kJmol^{-1}\ \text{(Ans)}$$

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