# Related Problems

**Question 14.**

**How much energy is required to ionise a hydrogen atom if an electron occupies n = 5 orbit ? Compare your answe r with the ionisation energy of H atom (energy required to remove the electron from n = 1 orbit)**

**Answer:**

Energy for a hydrogen electron present in a particular energy shell,

$$E_n = -\frac{13{\cdot}12}{n^2} \times 10^5 \text{ J mol}^{-1} = -\frac{13{\cdot}12 \times 10^5}{n^2 \times 6{\cdot}022 \times 10^{23}} \text{ J atom}^{-1}$$

$$= \frac{-2{\cdot}18 \times 10^{-18}}{n^2} \text{ J atom}^{-1}$$

**Step I.** *Ionisation energy for hydrogen electron present in orbit n = 5*

$$IE_5 = E_\infty - E_5 = 0 - \left(\frac{-2{\cdot}18 \times 10^{-18}}{25}\right) \text{J atom}^{-1} = \mathbf{8{\cdot}72 \times 10^{-20} J\ atom^{-1}}$$

**Step II.** *Ionisation energy for hydrogen electron present in orbit n = 1.*

$$IE_1 = E_\infty - E_1 = 0 - \left(\frac{-2{\cdot}18 \times 10^{-18}}{1}\right) = 2{\cdot}18 \times 10^{-18} \text{ J atom}^{-1}$$

On comparing : $\frac{IE_1}{IE_5} = \frac{(2{\cdot}18 \times 10^{-18} \text{ J atom}^{-1})}{(8{\cdot}72 \times 10^{-20} \text{ J atom}^{-1})} = \mathbf{25}$

The energy required to remove an electron from first orbit in a hydrogen atom is 25 times the energy needed to remove an electron from fifth orbit.