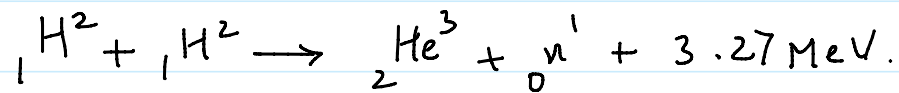


How long can an electric lamp of 100W be kept glowing by fusion of 2.0 kg of deuterium? Take the fusion reaction as :



Solution:-

$$\text{Mass of deuterium} = 2.0\text{Kg} = 2000\text{g}$$

No. of nuclei

$$n = \frac{N_A \times m}{A}$$

$$\therefore n = \frac{6.023 \times 10^{23} \times 2000}{2}$$

$$\therefore n = 6.023 \times 10^{26} \text{ nuclei.}$$

Energy released per fusion reaction = 3.27 MeV.

In a fusion reaction, two deuterium nuclei are involved.

$$\therefore \text{Energy released per deuterium nucleus} = \frac{3.27}{2} \text{ MeV.}$$

$$\therefore \text{Total energy released in fusion of } 2.0\text{Kg of deuterium} \\ E = 6.023 \times 10^{26} \times \frac{3.27}{2}$$

$$\therefore E = 9.843 \times 10^{26} \text{ MeV.}$$

$$\therefore E = 9.843 \times 10^{26} \times 1.6 \times 10^{-13} \text{ J}$$

$$\therefore E = 1.574 \times 10^{14} \text{ J}$$

Now, power of lamp = 100W

$$\text{Power} = \frac{\text{energy (E)}}{\text{time}}$$

$$\left[P = \frac{\text{Work}}{\text{time}} \right]$$

$$\therefore \text{time} = \frac{E}{P}$$

$$\therefore \text{time } t = \frac{1.574 \times 10^{14}}{100}$$

$$\therefore \text{time } t = 1.574 \times 10^{12} \text{ s}$$

$$\therefore \text{time } t = \frac{1.574 \times 10^{12}}{365 \times 24 \times 60 \times 60}$$

$$\therefore t = 5.0 \times 10^4 \text{ years. Ans}$$

-X-