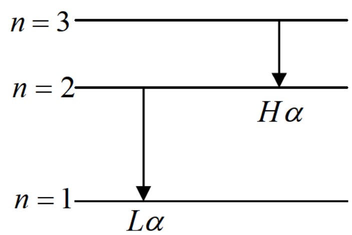
Chapter 4 Semi Classical Theory and Introduction to Quantum Mechanics
Solution of PYQ [IIT-JAM]

Ans. 1: (c)

Solution: $B.E. = \left(M_p + M_e - M_H\right)c^2 \Rightarrow M_H = M_p + M_e - \frac{B.E.}{c^2}$ where $B.E. = -13.6eV$.

Ans. 2: 0.185

Solution: According to Bohr Theory $\frac{1}{\lambda_L} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$



The longest wavelength in the Lyman series is

$$\Rightarrow \frac{1}{\lambda_L} = R\left(\frac{1}{1} - \frac{1}{2^2}\right) = R\left(\frac{3}{4}\right) \Rightarrow \lambda_L = \frac{4}{3R}$$

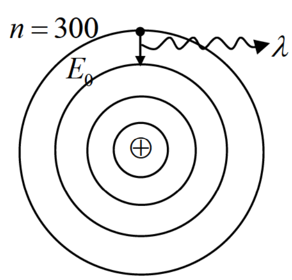
The longest wavelength in the Balmer series is

$$\Rightarrow \frac{1}{\lambda_B} = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right) = R\left(\frac{1}{4} - \frac{1}{9}\right) = R\left(\frac{9-4}{36}\right) \Rightarrow \frac{1}{\lambda_B} = R\left(\frac{5}{36}\right) \Rightarrow \lambda_B = \frac{36}{5R}$$

$$\Rightarrow \frac{\lambda_L}{\lambda_B} = \frac{4}{3R} \times \frac{5R}{36} = \frac{5}{27} = 0.185$$

Ans. 3: (d)

Solution: $\frac{1}{\lambda} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$, where $R = 1.097 \times 10^7 m^{-1}$



$n_f = 299$ and $n_i = 300 \Rightarrow \frac{1}{\lambda} = R\left[\frac{n_i^2 - n_f^2}{n_i^2 n_T^2}\right]$

$$\Rightarrow \lambda = \frac{1}{R}\left(\frac{n_i^2 n_f^2}{n_i^2 - n_f^2}\right) = \frac{1}{R}\left[\frac{(300)^2(299)^2}{(300)^2 - (299)^2}\right]$$

$$= \frac{1}{1.097 \times 10^7}\left[\frac{(300)^2(299)^2}{599}\right] = \frac{1.34 \times 10^7}{1.097 \times 10^7} = 1.22m \Rightarrow \lambda = 1.22m$$

This wavelength corresponds to RF Thus correct option is (d)

Ans. 4: (d)

Solution: From Bohr model the kinetic energy and Total energy $\langle E \rangle$ and kinetic energy $\langle T \rangle$

$\langle T \rangle = -\frac{\langle E \rangle}{2}$ where $E_g = \frac{E_0}{1}$, $E_e = \frac{E_0}{16} \Rightarrow \frac{T_g}{T_e} = \frac{E_g}{F_e} = \frac{16}{1} = 16:1$