IIT-JEE-2011

(61) The wavelength of the first spectral line in the Balmer series of hydrogen atom is 6561 Å. The wavelength of the second spectral line in the Balmer series of singly ionized helium atom is-

(A) 1215 Å (B) 1640 Å (C) 2430 Å (D) 4678 Å

Soln:-

$$\frac{1}{\lambda} = RZ^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$n_2 = 3 \quad n_1 = 2$

wavelength of first spectral line in Balmer series of H-atom is 6561 Å.

So

$$\frac{1}{6561} = R(1)^2\left[\frac{1}{4} - \frac{1}{9}\right] = \frac{5R}{36} \quad -①$$

For second spectral line in Balmer series of singly ionised helium ion $n_2 = 4$ & $n_1 = 2$ $Z = 2$

$$\frac{1}{\lambda} = R(2)^2\left[\frac{1}{4} - \frac{1}{16}\right] \quad -②$$

dividing eq ① and ②

$$\frac{\lambda}{6561} = \frac{5R}{36} \times \frac{4}{3R} = \frac{5}{27}$$

$$\boxed{\lambda = 1215\,Å}$$

option (A) matches.