Answer on Question #54368 – Chemistry – General chemistry

Assume that the electron in He + ion is excited to the second orbit (n = 2). Calculate the following:

(i) the radius of the orbit

(ii) the velocity of the electron

(iii) the potential energy of the electron, and

(iv) the kinetic energy of the electron.

Hint: Use equations derived for hydrogen atom in Unit 1.

Solution

(i) the radius of the orbit

$$r = \frac{h^2 n^2}{4\pi m k Z e^2} = \frac{(6.6 \cdot 10^{-34})^2 \cdot (2)^2}{4\pi \cdot 9.1 \cdot 10^{-31} \cdot 9 \cdot 10^9 \cdot 2(1.6 \cdot 10^{-19})^2} = 3.3 \cdot 10^{-10} m.$$

(ii) the velocity of the electron

$$v = \frac{2\pi k Z e^2}{hn} = \frac{2\pi \cdot 9 \cdot 10^9 \cdot 2(1.6 \cdot 10^{-19})^2}{6.6 \cdot 10^{-34} \cdot 2} = 2.2 \cdot 10^6 \frac{m}{s}.$$

(iii) the potential energy of the electron

$$PE = -\frac{k Z e^2}{r} = -\frac{9 \cdot 10^9 \cdot 2(1.6 \cdot 10^{-19})^2}{3.3 \cdot 10^{-10}} = -1.4 \cdot 10^{-18} J.$$

(iv) the kinetic energy of the electron

$$KE = \frac{1}{2}\frac{k Z e^2}{r} = \frac{1}{2}\frac{9 \cdot 10^9 \cdot 2(1.6 \cdot 10^{-19})^2}{3.3 \cdot 10^{-10}} = 7 \cdot 10^{-19} J$$