## Answer on Question #75754, Chemistry / Inorganic Chemistry

Using Bohr atomic model drive expression for calculating orbits in He+ using this expression calculate the radius of fourth orbital of he+ion

**Solution**

1. Expression for calculating orbits in He+.

Coulomb force is centripetal when electron moves in orbit. Then

$$\frac{Ze\cdot e}{4\pi\varepsilon_0 r^2}=\frac{m\upsilon^2}{r};$$

$$r=\frac{Ze^2}{4\pi\varepsilon_0 m\upsilon^2}.$$

According to Bohr postulates the angular momentum of stationary electron is quantized:

$m\upsilon r = nh/2\pi; \quad \Rightarrow \upsilon = nh/2\pi mr.$

Then

$$r=\frac{Ze^2}{4\pi\varepsilon_0 m\upsilon^2}=\frac{Ze^2 4\pi^2 m^2 r^2}{4\pi\varepsilon_0 m n^2 h^2}=\frac{Ze^2\pi m r^2}{\varepsilon_0 n^2 h^2}\Rightarrow r=\frac{\varepsilon_0 h^2}{Ze^2\pi m}\cdot n^2$$ , where n = 1,2,3,…

$Z(He^+) = 2$, then

$$r=\frac{\varepsilon_0 h^2}{2e^2\pi m}\cdot n^2$$ , where n = 1,2,3,…

2. The radius of fourth orbital of $He^+$ ion

$$r_4=\frac{\varepsilon_0 h^2}{Ze^2\pi m}\cdot n^2=\frac{8.85\cdot10^{-12}\cdot(6.626\cdot10^{-34})^2}{2\cdot(1.6\cdot10^{-19})^2\cdot3.14\cdot9.1\cdot10^{-31}}\cdot4^2=4.25\cdot10^{-10}\ (m).$$

**Answer:** 1. $$r=\frac{\varepsilon_0 h^2}{2e^2\pi m}\cdot n^2$$ , where n = 1,2,3,…

2. $r_4 = 4.25\cdot10^{-10}$ m