Answer on Question #65016-Physics-Other

The Bohr Model of the hydrogen atom has a fixed (non-moving) proton in the nucleus and an electron traveling around that proton in a circular orbit. The Coulomb force between the two charges supplies the centripetal acceleration necessary to keep the electron in circular motion. If the distance between the proton and the electron is 5.29 × 10−11 m (a value known as the "Bohr radius"), what is the tangential velocity of the electron? The mass of an electron is 9.11 × 10−31 kg and the fundamental unit of charge is 1.60 × 10−19 C (positive for a proton, negative for an electron).

Solution

$$F_{el} = ma$$

$$\frac{ke^2}{r^2} = \frac{mv^2}{r}$$

$$v = e\sqrt{\frac{k}{mr}} = (1.6 \cdot 10^{-19})\sqrt{\frac{(8.99 \cdot 10^9)}{(9.11 \cdot 10^{-31})(5.29 \cdot 10^{-11})}} = 2.19 \cdot 10^6 \frac{m}{s}.$$

Answer: $\mathbf{2.19 \cdot 10^6 \frac{m}{s}}$.