

47. We use conservation of energy, taking the potential energy to be zero when the moving electron is far away from the fixed electrons. The final potential energy is then $U_f = 2e^2/4\pi\epsilon_0 d$, where d is half the distance between the fixed electrons. The initial kinetic energy is $K_i = \frac{1}{2}mv^2$, where m is the mass of an electron and v is the initial speed of the moving electron. The final kinetic energy is zero. Thus $K_i = U_f$ or $\frac{1}{2}mv^2 = 2e^2/4\pi\epsilon_0 d$. Hence

$$v = \sqrt{\frac{4e^2}{4\pi\epsilon_0 d m}} = \sqrt{\frac{(8.99 \times 10^9 \text{ N} \cdot \text{m}^2/\text{C}^2)(4)(1.60 \times 10^{-19} \text{ C})^2}{(0.010 \text{ m})(9.11 \times 10^{-31} \text{ kg})}} = 3.2 \times 10^2 \text{ m/s} .$$