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Chapter 7

1. In an electron microscope, there is an electron gun that contains two charged metallic plates 2.80 cm apart. An electric force accelerates each electron in the beam from rest to 9.60% of the speed of light over this distance a) Determine the kinetic energy of the electron as it leaves the electron gun. Electrons carry this energy to a phosphorescent viewing screen where the microscope's image is formed, making it glow. For an electron passing between the plates in the electron gun, determine (b) the magnitude of the constant electric force acting on the electron, (c) the acceleration of the electron, and (d) the time interval the electron spends between the plates.

Ans: a) $v_f = 0.096(3.00 \times 10^8 \text{ m/s}) = 2.88 \times 10^7 \text{ m/s}$

$$K_f = \frac{1}{2}mv_f^2 = \frac{1}{2}(9.11 \times 10^{-31} \text{ kg})(2.88 \times 10^7 \text{ m/s})^2 = \boxed{3.78 \times 10^{-16} \text{ J}}$$

(b) $K_i + W = K_f : 0 + F\Delta r \cos\theta = K_f$

$$F(0.028 \text{ m})\cos 0^\circ = 3.78 \times 10^{-16} \text{ J}$$

$$F = \boxed{1.35 \times 10^{-14} \text{ N}}$$

(c) $\sum F = ma: a = \frac{\sum F}{m} = \frac{1.35 \times 10^{-14} \text{ N}}{9.11 \times 10^{-31} \text{ kg}} = \boxed{1.48 \times 10^{16} \text{ m/s}^2}$

(d) $v_{xf} = v_{xi} + a_x t: 2.88 \times 10^7 \text{ m/s} = 0 + (1.48 \times 10^{16} \text{ m/s}^2)t$

$$t = \boxed{1.94 \times 10^{-9} \text{ s}}$$