

21. The acceleration of the electron is vertical and for all practical purposes the only force acting on it is the electric force. The force of gravity is negligible. We take the  $+x$  axis to be in the direction of the initial velocity and the  $+y$  axis to be in the direction of the electrical force, and place the origin at the initial position of the electron. Since the force and acceleration are constant, we use the equations from Table 2-1:  $x = v_0 t$  and

$$y = \frac{1}{2} a t^2 = \frac{1}{2} \left( \frac{F}{m} \right) t^2 .$$

The time taken by the electron to travel a distance  $x$  ( $= 30$  mm) horizontally is  $t = x/v_0$  and its deflection in the direction of the force is

$$y = \frac{1}{2} \frac{F}{m} \left( \frac{x}{v_0} \right)^2 = \frac{1}{2} \left( \frac{4.5 \times 10^{-16}}{9.11 \times 10^{-31}} \right) \left( \frac{30 \times 10^{-3}}{1.2 \times 10^7} \right)^2 = 1.5 \times 10^{-3} \text{ m} .$$