Theoretical Physics
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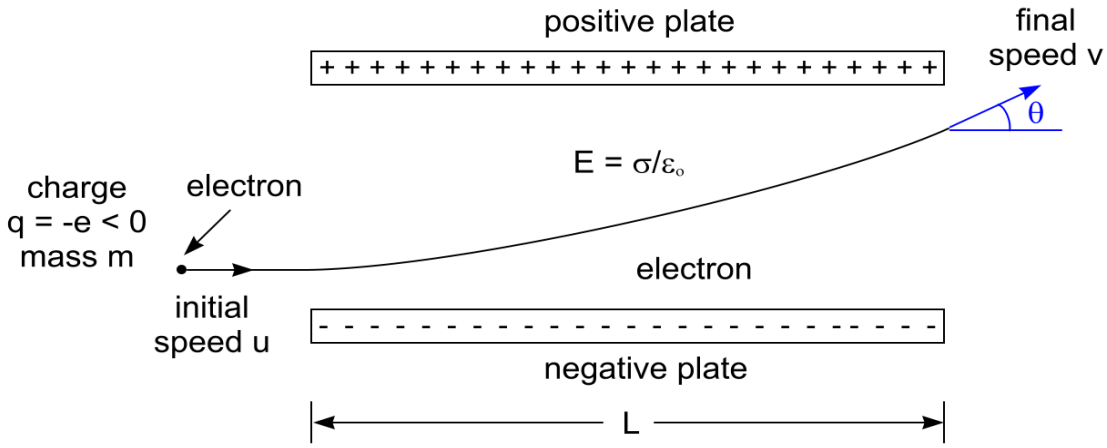
Chapter D Homework. "Derivation of the Maxwell Equations"

HW-D1. Electric Field. An electron is traveling East at constant speed u. It enters a region between 2 large plates, where only the plate edges are shown in the figure. The magnitude of the electric field between the plates, as derived in class, is $E = \sigma/\varepsilon_o$, where σ is the absolute magnitude of the charge density on each plate. When the electron enters the region between the plates, its trajectory becomes parabolic. The horizontal length of the plates is L. When the electron leaves with final speed v, it once again travels in a straight line. Use Newton's Law F = ma to show that the angle θ is given by

$$\tan\theta = \frac{e\sigma L}{\varepsilon_o m u^2}.$$

Hint. The kinematics formulas involving acceleration in Chapter 0 are applicable.



HW-D2. Magnetic Field. A particle with mass m and charge q is traveling East at a constant speed v. It then enters a magnetic field region where the magnetic field is perpendicular to the traveling charge as shown in the figure. The particle then begins a circular path since $\vec{F} = q\vec{v}\times\vec{B}$.

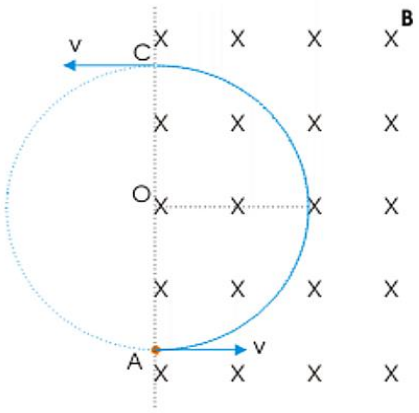


Figure Courtesy OpenStax CNX, Rice University.

Show that the radius of the circular path is given by

$$r = \frac{mv}{qB}.$$

Hint. Newton's 2nd Law and the formula for acceleration where motion is circular, both found in Chapter 0, are applicable.