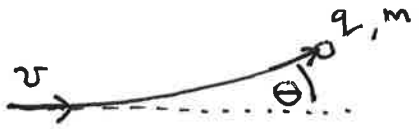
Ex 3.2



By what angle, θ, will an electron be deflected when traveling through a uniform magnetic field.?

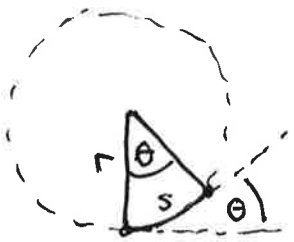
The deflection is caused by a Lorentz force $F_L = qvB$ This supplies a centripetal force. So using Newton's second law: $F = ma$

$$qvB = m\left(\frac{v^2}{r}\right) \qquad (\text{since } a_c = \frac{v^2}{r})$$

$$qB = mv/r \quad \text{or} \quad \frac{qB}{mv} = \frac{1}{r}$$

Now notice that the deflection angle is, for small angles, approximately equal to the angle that appears in an arc length:

where $s = r\theta$



Taking s to be the distance traveled ($s = \ell$ in our problem), we arrive at the formula

$$\ell = r\theta \Rightarrow \theta = \frac{\ell}{r} = \ell\,\frac{qB}{mv}$$

This is precisely the formula we were seeking:

$$\theta \approx \frac{e\ell B}{mv}, \text{ where } q = e \text{ & } v = u.$$