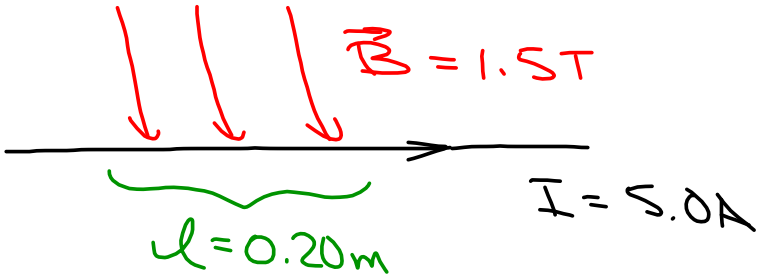
Currents and Magnetism Examples

1. Force on a current carrying wire in a perpendicular magnetic field



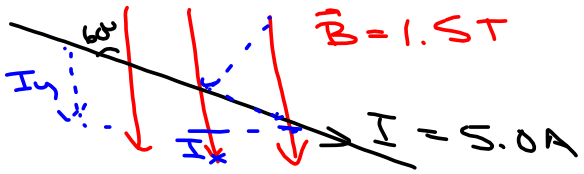
$F = \ell I B \sin\theta^{1}$

$= (0.20\text{m})(5.0\text{A})(1.5\text{T})$

$= 1.5\text{N}$ ⊗

$1\text{T} = \frac{\text{N}}{\text{A}\cdot\text{m}}$

2. Force on a current carrying wire in a non-perpendicular magnetic field

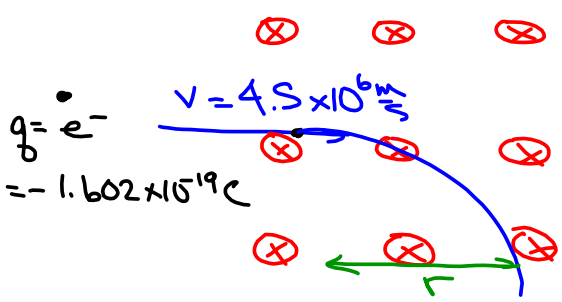


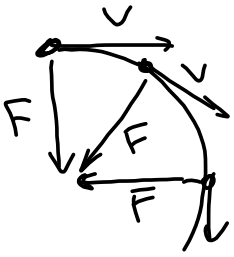
$\ell = 0.20\,m$

$$F = \ell I B \sin\theta$$
$$= (0.20\,m)(5.0\,A)(1.5\,T)\sin 60°$$
$$= 1.3\,N \otimes$$

$0.866 \approx \frac{\sqrt{3}}{2}$

3. Force on an electron moving through a perpendicular magnetic field





Projectile

parabola

a) circular path

b) $F = qvB$

$= (1.602\times10^{-19}\,C)(4.5\times10^{6}\,m/s)(0.75\,T)$

$= 5.4\times10^{-13}\,N$

c) $F_c = F_B$

$\frac{mv^2}{r} = F_B$

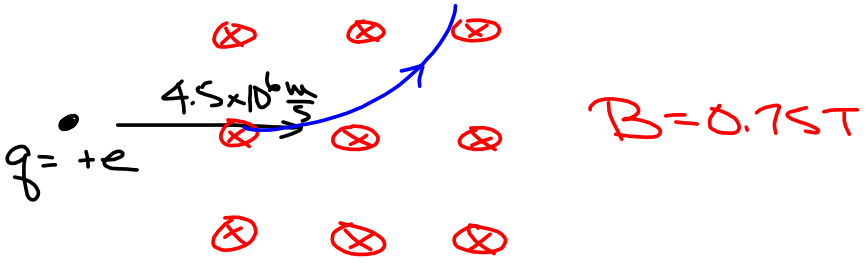
$\frac{(9.11\times10^{-31}\,kg)(4.5\times10^{6}\,m/s)^2}{r} = 5.4\times10^{-13}\,N$

$\frac{(9.11\times10^{-31})(20.25\times10^{12})}{5.4\times10^{-13}} = r$

$r = 3.4\times10^{-5}\,m$

$= 0.034\,mm$

4. Force on a proton moving through a perpendicular magnetic field



a) circle (initially upward)

b) $F = 5.4 \times 10^{-13}\ N$

c) $\frac{mv^2}{r} = F_B$

$$\frac{(1.67\times10^{-27}\ kg)(4.5\times10^{6}\ m/s)^2}{5.4\times10^{-13}\ N} = r$$

$r = 0.063\ m$

$(63\ mm)$

5. Force on an electron moving through a non-perpendicular magnetic field