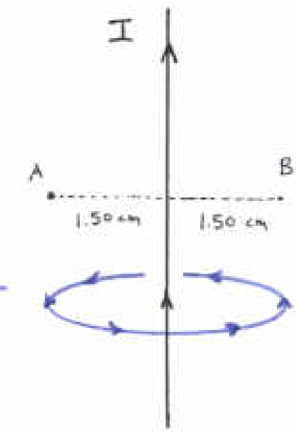
Name______________________________

Phys 122 — Section 4

Quiz #3

1. At a distance of 1.50 cm from a long straight wire the magnetic field has magnitude 6.7×10^{-3} T.



a) Find the current in the wire.

Magnitude of mag. field around a long wire is $B = \frac{\mu_0 I}{2\pi r}$

Then

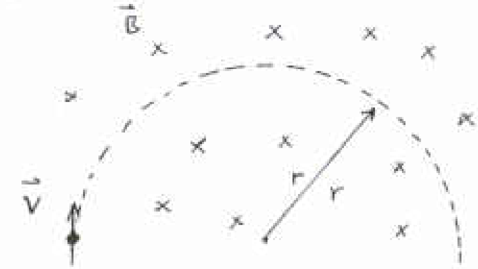
$$I = \frac{2\pi r B}{\mu_0} = \frac{2\pi(1.50\times10^{-2}\,\text{m})(6.7\times10^{-3}\,\text{T})}{4\pi\times10^{-7}\,\text{T}\cdot\text{m}/\text{A}}$$

$$= \boxed{503\ \text{A}}$$

b) If the wire and the points A and B lie in the plane of the page as shown, and the direction of the current is as shown tell me the direction of the magnetic field at A and at B. A magnetic field line goes around the wire as shown, by the RHR-2.

This means that at A the field is out of the page and at B the field is into the page.

2. An ion of mass 26.42×10^{-27} kg and a charge of magnitude e enters the bending region of a mass spectrometer with a speed of $5.25\times10^{5}\ \frac{\text{m}}{\text{s}}$. The radius of tha ion's circular path is 18.0 cm.



($\vec{B}$ goes into page.)

$r = 18.0$ cm

a) Find the magnitude of the magnetic field.

Relation between r, v, q and B is $r = \frac{mv}{qB}$, so

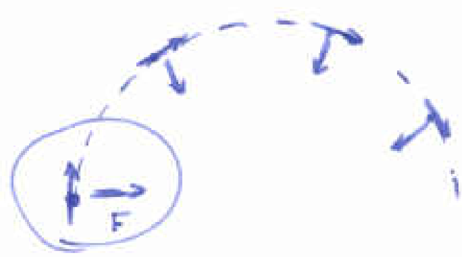
$$B = \frac{mv}{qr} = \frac{(26.42\times10^{-27}\,\text{kg})(5.25\times10^{5}\,\frac{\text{m}}{\text{s}})}{(1.60\times10^{-19}\,\text{C})(0.180\,\text{m})} = \boxed{0.48\ \text{T}}$$

b) When the ion is at the position marked in the figure (with the velocity vector) in what direction does the magnetic force point? Determine the sign of the ion's charge from the information given in the figure.

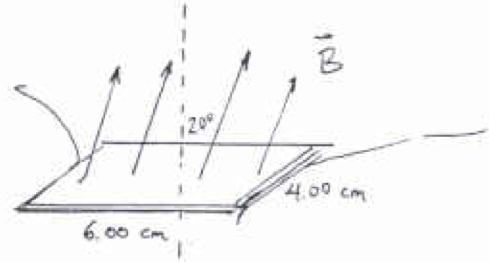
The centripetal force points to the right (and this is the magnetic force.

RHR-1 says that if the charge were positive the mag force would go to the left.

So the charge must be negative.



Phys 122, Sec 4: Quiz #3



$t = 0,\ B = 0.250\,T$

$t = 0.030\,s,\ B = 0.460\,T$

$N = 20$

3. A rectangular loop of wire with sides 6.00 cm and 4.00 cm and made of 20 turns of wire sits in a uniform which is uniform and points at an angle of 20° from the normal to the loop, but whose magnitdue varies in time. At $t = 0$ the magnitude of the magnetic field is 0.250 T and at $t = 0.030$ s its magnitude is 0.460 T.

a) Find the area of the coil in units of m^2.

$$A = (6.00\,\text{cm})(4.00\,\text{cm})$$
$$= (6.00\times10^{-2}\,\text{m})(4.00\times10^{-2}\,\text{m}) = \boxed{2.4\times10^{-3}\,\text{m}^2}$$

b) Find the flux through the coil at $t = 0$ and at $t = 0.030$ s.

$t=0 \quad \Phi = BA\cos\phi = (0.250\,T)(2.4\times10^{-3}\,\text{m}^2)\cos 20° = \boxed{5.64\times10^{-4}\,\text{Wb}}$

$t = 0.030\,s \quad \Phi = BA\cos\phi = (0.$ [illegible] $0\,T)(2.4\times10^{-3}\,\text{m}^2)\cos 20° = \boxed{1.04\times10^{-3}\,\text{Wb}}$

c) Find the avergage emf induced in the coil for the time interval between $t = 0$ and at $t = 0.030$ s.

$$\mathcal{E}_{av} = N\frac{\Delta\Phi}{\Delta t} = (20)\frac{(1.04\times10^{-3} - 5.64\times10^{-4})\,\text{Wb}}{(0.030\,s)} = \boxed{0.32\ \text{Volts}}$$

Just find magnitude of $\mathcal{E}$

You must show all your work!

$\epsilon_0 = 8.8\cancel{4}5\times10^{-12}\,\frac{\text{C}^2}{\text{N}\cdot\text{m}^2}$ $\quad \mu_0 = 4\pi\times10^{-7}\,\frac{\text{T}\cdot\text{m}}{\text{A}}$ $\quad V = IR$ $\quad P = IV$

$C = 2\pi R \quad A = \pi R^2$ $\quad F = qvB\sin\theta \quad F = ILB\sin\theta \quad \tau = IAB\sin\phi \quad r = \frac{mv}{qB}$

RHR-1: Thumb: **v**, Fingers: **B**, Palm: **F**, or Thumb: I, Fingers: **B**, Palm:**F**
RHR-2: Thumb: I, Fingers: Wrap in dir of **B**.

$B_{\text{wire}} = \frac{\mu_0 I}{2\pi r} \quad B_{\text{loop}} = N\frac{\mu_0 I}{2R} \quad B_{\text{sol}} = \mu_0 nI \quad \Phi = BA\cos\phi \quad \mathcal{E}_{\text{av}} = -N\frac{\Delta\Phi}{\Delta t}$

Some EM units: Coulomb, Volt, Farad, Ampere, Tesla, Weber, Henry, Ohm