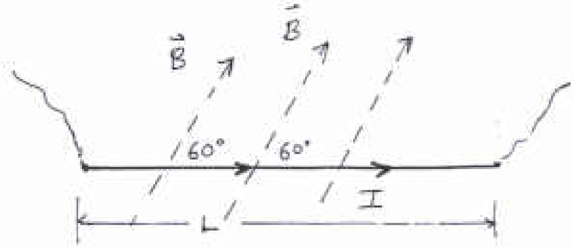
Name________________________________

Phys 122 — Section 1
Quiz #3



1. A 20.0 cm length of wire carries a current of 3.00 A. It sits in a uniform magnetic field whose magnitude is 2.00×10^{-2} T and whose direction is 60° away from the direction of the current.

a) Find the magnitude of the magnetic force on the wire.

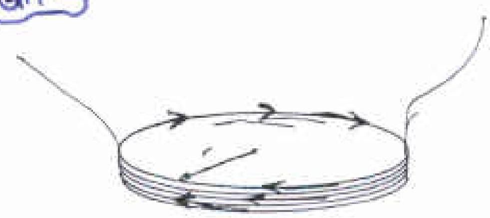
$B = 2.00 \times 10^{-2}\,T$
$I = 3.00\,A$
$L = 20.0\,cm$

Magnitude of magnetic force on wire is

$$F = ILB\sin\theta = (3.00\,A)(0.200\,m)(2.00\times10^{-2}\,T)\sin 60^\circ$$
$$= \boxed{1.04\times10^{-2}\,N}$$

b) If the current and the magnetic field lie in the plane of the page as shown, find the *direction* of the magnetic force on the wire.

By the RHR-1 for current the dir of the force is $\boxed{\text{out of the page}}$



2. A circular planar loop of radius 10.0 cm and 30 turns gives a magnetic field of 3.1×10^{-3} T at its center.

a) Find the current in the loop.

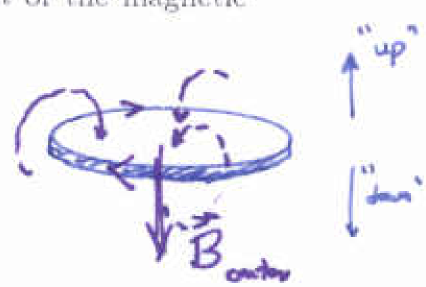
For a loop, $B_{center} = N\dfrac{\mu_0 I}{2R}$ so

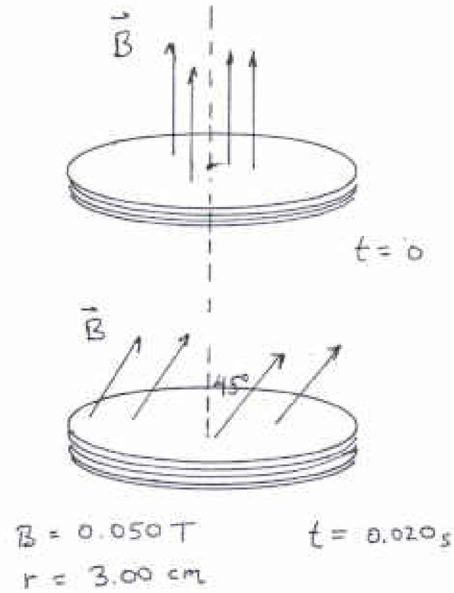
$B_{center} = 3.1\times10^{-3}\,T$
$r = 10.0\,cm$
$N = 30$

$$I = \frac{2RB_{ctr}}{N\mu_0} = \frac{2(0.100\,m)(3.1\times10^{-3}\,T)}{(30)(4\pi\times10^{-7}\,\frac{T\cdot m}{A})} = \boxed{16.4\,A}$$

b) If the direction of the current is as shown in the figure (with the front edge of the coil coming directly *out* at you from the page, as shown, find the *direction* of the magnetic field at the center of the coil.

From the RHR-2 the direction of the $\vec{B}$ field from the ring must point $\boxed{\text{downward}}$ thru the ring, as shown.





3. A circular planar coil of radius 3.00 cm with 30 turns lies in a uniform magnetic field whose magnitude is always 0.050 T but whose direction changes in time. At $t = 0$ the magnetic field points along the direction of the normal to the plane of the coil. At $t = 0.020$ s it has turned by 45.0° away from the direction of the normal.

a) What is the area of the coil in units of m^2?

$$\text{Area} = \pi r^2 = \pi (3.00\ \text{cm})^2 = \pi (3.00 \times 10^{-2}\ \text{m})^2 = 2.83 \times 10^{-3}\ \text{m}^2$$

b) What is the flux at $t = 0$ and at $t = 0.020$ s?

$$t = 0: \quad \Phi = BA\cos\phi = (0.050\ \text{T})(2.83 \times 10^{-3}\ \text{m}^2)\cos 0^\circ = 1.41 \times 10^{-4}\ \text{Wb}$$

$$t = 0.020\ \text{s}: \quad \Phi = BA\cos\phi = (0.050\ \text{T})(2.83 \times 10^{-3}\ \text{m}^2)\cos 45^\circ = 1.00 \times 10^{-4}\ \text{Wb}$$

c) Find the average emf induced in the wire during the 0.020 s interval.

$$\mathcal{E} = -N\frac{\Delta\Phi}{\Delta t} = -(30)\frac{(1.00 \times 10^{-4} - 1.41 \times 10^{-4})\ \text{Wb}}{0.020\ \text{s}} = 6.2 \times 10^{-2}\ \text{Volts}$$

(Sign is actually not important here since a direction for the current wasn't given.)

You must show all your work!

$\epsilon_0 = 8.85 \times 10^{-12}\ \frac{C^2}{N \cdot m^2}$ $\quad \mu_0 = 4\pi \times 10^{-7}\ \frac{T \cdot m}{A}$ $\quad V = IR$ $\quad P = IV$

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

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**.

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

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