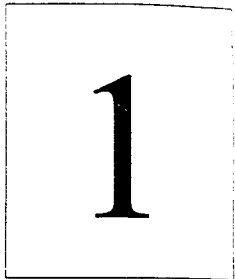


# FOURTH MIDTERM



Name: Lihong Jin

Discussion Instructor (circle): Billeter    Diwekar    Kennedy    Murray    Whitaker

Discussion Section # \_\_\_\_\_

Student ID #: \_\_\_\_\_

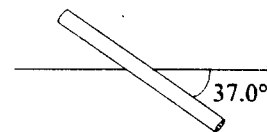
**REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!**

**Use the conversion constants and data given on the front page.**

- (a) Electrons are moving with a velocity of  $3.30 \times 10^6$  m/s perpendicular to a magnetic field of 0.119 T. Calculate the magnitude of the electric field perpendicular to their path such that they move in a straight line.

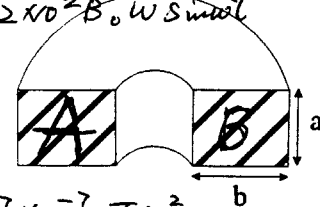
$$E\mathbf{q} = q\mathbf{v}B \quad E = vB = 3.30 \times 10^6 \times 0.119 = 3.93 \times 10^5 \text{ N/C} \quad \text{or } v/m$$

- (b) Show is a top view of a circular coil of 12 turns and radius 3.27 cm. If the magnetic field can be represented as  $B = B_0 \cos \omega t$ , calculate an expression for the EMF induced on the coil.



$$\begin{aligned} \mathcal{E} &= -\frac{d\phi}{dt} = -\frac{d}{dt} [NBA \cos(90^\circ - 37^\circ)] = -\frac{d}{dt} (12 \times B_0 \cos \omega t \times \pi \times (3.27 \times 10^{-2})^2 \times \cos 53^\circ) \\ &= -\frac{d}{dt} (2.42 \times 10^{-2} B_0 \cos \omega t) = 2.42 \times 10^{-2} B_0 \omega \sin \omega t \end{aligned}$$

- (c) The drawing shows a rectangular cross section of a toroid of 375 turns with a current of 1.75 A. The inner radius of the toroid is 12.65 cm. Calculate the flux crossing the hatched area.  $a = 1.15$  cm;  $b = 2.35$  cm



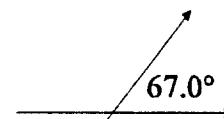
Two situations: ① just consider A or B area:

$$\phi = \int B dA = \int_c^{c+b} \frac{\mu_0 I}{2\pi r} a dr = \frac{375 \times \mu_0 \times 1.75}{2 \times 3.14} \times 1.15 \times 10^{-2} \ln \frac{c+b}{c} = 2.57 \times 10^{-7} \text{ T}\cdot\text{m}^2$$

② consider A and B area:

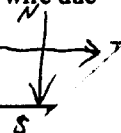
$$\phi = \phi_A + \phi_B = \phi_A + (-\phi_B) = 0$$

- (d) If the earth's magnetic field is  $1.10 \times 10^{-4}$  T and is directed at an angle of  $67.0^\circ$  from the horizontal, calculate the flux through an area  $10.0$  m  $\times$   $15.0$  m of the physics parking lot.



$$\phi = BA \cos \theta = 1.10 \times 10^{-4} \times (10.0 \times 15.0) \cos(90^\circ - 67^\circ) = 1.52 \times 10^{-2} \text{ T}\cdot\text{m}^2$$

- (e) A wire carries a current from west to east horizontal to the ground. What is the direction of the force on this wire due to the earth's magnetic field (assumed to be in a north-south direction).

Two considers: ① if B is north  $\rightarrow$  south, direction of  $\mathbf{F}$  is down or into page. 

② if B is south  $\rightarrow$  north, direction of  $\mathbf{F}$  is up or out of page