



FOURTH MIDTERM

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

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

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

- (a) Take the Earth's magnetic field as being along a N-S direction. What is the direction of the force on a wire carrying current from E to W?

$\vec{F} = I \vec{l} \times \vec{B} \Rightarrow \vec{F}$  is downwards ( $\vec{B}$  is S to N)

- (b) Calculate the maximum value of the torque on a circular coil of wire carrying 11.0 A, if the coil has 17.0 turns and radius of 1.5 cm. The magnetic field is 1700 gauss.

$\tau_{\max} = \pi r^2 N I B = \pi (0.015 \text{ m})^2 (17) (11 \text{ A}) (0.17 \text{ T}) = 2.25 \times 10^{-2} \text{ N}\cdot\text{m}$

- (c) A capacitor of  $C = 175 \mu\text{F}$  charged to 100 V is discharged through a  $11,000 \Omega$  resistor. Calculate the voltage on the capacitor after 2 time constants have passed (from the beginning of discharge).

$V = V(0) e^{-t/\tau} = V(0) e^{-2} = 13.53 \text{ V}$

- (d) Calculate the magnitude of the magnetic flux, in Wb, through the lecture table in 101 JFB. Assume the table is horizontal. Take the Earth's field as 0.500 gauss, at an angle of  $70^\circ$  from the horizontal. The table is 1.00 m wide and 6.00 m long.

$\phi = \vec{B} \cdot \vec{A} = (0.5 \times 10^{-4} \text{ T}) (6 \text{ m}^2) \cos(90^\circ - 70^\circ) = 2.82 \times 10^{-4} \text{ Wb}$

- (e) Calculate the radius of the orbit of an electron of  $v = 1.2 \times 10^3 \text{ m/s}$ , in a magnetic field of 150 gauss, if the field is perpendicular to the plane of the orbit.

$e v B = \frac{m_e v^2}{r} \Rightarrow r = \frac{m_e v}{e B} = 4.56 \times 10^{-7} \text{ m}$