

# FOURTH MIDTERM

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

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

- (a) Calculate the magnetic flux (in  $T \cdot m^2$ ) through a section of the physics parking lot that is  $5 \text{ m} \times 10 \text{ m}$ . Take the earth's field as 0.75 gauss, and its direction as  $70^\circ$  from the horizontal.

$$\Phi = B \cdot S \cdot \cos \theta = 0.75 \times 10^{-4} \cdot 5 \times 10 \times \cos(90^\circ - 70^\circ) = 3.52 \times 10^{-3} T \cdot m^2$$

- (b) Find the magnitude of the magnetic force per unit length on a power line if the current is 150,000 A and the earth's magnetic field is 0.75 gauss and is perpendicular to the wire.

$$F/l = I \cdot B = 150000 \times 0.75 \times 10^{-4} = 11.3 \text{ N/m}$$

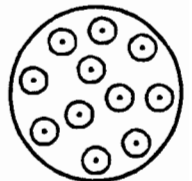
- (c) Calculate the cyclotron frequency, in Hertz, for electrons in a magnetic field of 0.75 gauss.

$$f = \frac{q \cdot B}{2\pi m} = \frac{1.6 \times 10^{-19} \cdot 0.75 \times 10^{-4}}{2 \cdot 3.14 \times 9.11 \times 10^{-31}} = 2.10 \times 10^6 \text{ Hz}$$

- (d) A circular loop of wire has 11 turns, carries a current of 1.50 A, and has a diameter of 7.50 cm. Calculate the magnetic field at the exact center of the loop.

$$B = \frac{\mu_0 \cdot I \cdot N}{2r} = \frac{4\pi \cdot 10^{-7} \cdot 11 \cdot 1.5}{0.075} = 2.76 \times 10^{-4} \text{ T}$$

- (e) For the circular loop shown the magnetic field is perpendicular to and out of the paper. If the loop is a conductor and the magnetic field is increasing, is the induced current clockwise or counterclockwise? ( $B = \odot$  means out of the paper.)



clockwise