

Fourth Midterm

Name (print) _____ Name (signed) _____

Discussion Instructor (circle): Brown Chakhbazian Condella Portnoi Zhukov

Discussion Section # _____

REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!

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

(a) Calculate the cyclotron frequency for electrons in a magnetic field of 0.010 T.

$\omega = \frac{qB}{m}$; $\omega = 1.756 \times 10^9 \text{ rad/s}$ $2.80 \times 10^8 \text{ Hz}$ 5 pts.

(b) Protons are measured to travel in a circular path of radius 6.00 cm in a magnetic field of 1.50 T. Calculate their velocity.

$r = \frac{mv}{qB} \Rightarrow v = \frac{qBr}{m} = 8.62 \times 10^6 \text{ m/s}$ 5 pts.

(c) If a DC power line is carrying a steady current of 12,500 A in the earth's magnetic field which is assumed to be 0.500 gauss, what is the maximum possible force on 1000 meters of this wire?

$F = IlB = (12,500 \text{ A})(1000 \text{ m})(0.500 \text{ gauss}) \times \left(\frac{1 \text{ T}}{10,000 \text{ gauss}}\right) = 625 \text{ N}$ 5 pts.

(d) A square coil is constructed with 250 turns of wire. Each side is 3.75 cm. Calculate the torque on this coil which has a current of 1.24 A, a magnetic field of 575 gauss, and the direction of the field is in the plane of the loop.

$\tau = nIAB = (250)(1.24)(0.0375)^2 \left(\frac{575}{10,000}\right) = 2.51 \times 10^{-2} \text{ N}\cdot\text{m}$ 5 pts.

(e) If each resistor has a value of R, calculate the effective resistance between a and b.

