

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) Calculate the cyclotron frequency (in Hz) for electrons in a magnetic field of 1.75 T.

$$f = (1/2\pi) \cdot eB/m = (1.6 \cdot 10^{-19} \cdot 1.75) / (2\pi \cdot 9.1 \cdot 10^{-31}) = 4.89 \cdot 10^{10} \text{ Hz}$$

- (b) A galvanometer is built with a plane circular coil of radius 3.75 cm and 750 turns of wire. If the magnetic field is in the plane of the coil, calculate the torque (in N·m) for a current of 175 milliamperes and a field of 0.450 T.

$$\tau = nIAB = 750 \cdot 0.175 (\pi (0.0375)^2) \cdot 0.450 = 0.261 \text{ Nm}$$

$$n = \frac{6 \cdot 10^{23} \text{ e/mol} \cdot 8.5 \text{ g/cc} \cdot 10^6 \text{ cc/m}^3}{65 \text{ g/mol}} = \dots \text{ e/m}^3$$

- (c) Determine the drift velocity for electrons in a round copper wire of radius 0.75 mm. The current is 15.0 A, the wire is 6.00 m long, the density of copper is 8.50 grams/cc. The atomic mass of copper is 65.0.

$$v = I/enA = 15 \text{ A} \cdot 65 \cdot 10^6 / (1.6 \cdot 10^{-19} \cdot 6 \cdot 10^2 \cdot 8.5) \approx (0.73 \cdot 10^{-3})^2 = 0.674 \text{ m/s}$$

- (d) A 12.0 volt battery has an internal resistance of 1.50 Ω . What is the power it can deliver to a load of 1.00 Ω ?

$$P = I^2 R = \left(\frac{\mathcal{E}}{R+r} \right)^2 \cdot R = \left(\frac{12}{1.5+1.0} \right)^2 \cdot 1.0 = 23 \text{ W}$$

- (e) If the earth's magnetic field is 1.00×10^{-4} T, calculate the force on 10.0 m of wire which is perpendicular to the field and carries a current of 1,750 A.

$$F = BIL = 10^{-4} \cdot 1750 \cdot 10 = 1.75 \text{ N}$$