

FOURTH MIDTERM

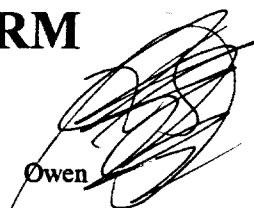
1

Name: Cheng-Yu Li

Discussion Instructor (circle): Andrade El-Gendy Mimoto Owen

Discussion Section # _____

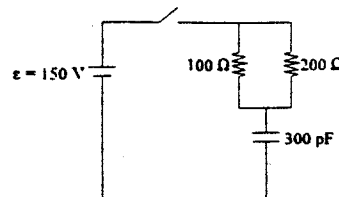
Student ID #: _____



REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!

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

- (a) Calculate the time constant for charging the capacitor in the circuit shown.



$$\tau = RC = (R_1 \parallel R_2) \cdot C = \frac{100 \times 200}{100 + 200} \cdot 300 \times 10^{-12} = 2 \times 10^{-8} \text{ (s)}$$

- (b) Calculate the magnitude of the magnetic field, in Tesla, at the exact center of a circular loop of wire carrying a current of 14.5 A. The diameter of the loop is 17.0 cm.

$$B = \frac{\mu_0 I}{2a} = \frac{1.26 \times 10^{-6} \times 14.5}{2 \times \frac{1}{2} \times 17 \times 10^{-2}} = 1.08 \times 10^{-6} \text{ (T)}$$

- (c) Assume the earth's magnetic field is exactly 1.00 gauss. Calculate the radius of the orbit of an electron moving perpendicular to this field at a velocity of 2.1×10^6 m/s.

$$\frac{mv^2}{R} = evB \Rightarrow R = \frac{mv}{eB} = \frac{9.11 \times 10^{-31} \times 2.1 \times 10^6}{1.6 \times 10^{-19} \times 10^{-4}} = 0.12 \text{ (m)}$$

- (d) Two parallel wires carry a DC current of 55.0 amperes. If the wires are 4.00 m apart, calculate the magnitude of the force on each meter of wire.

$$\frac{\mu_0 I^2}{2\pi r} = \frac{1.26 \times 10^{-6} \times (55.0)^2}{2 \times 3.14 \times 4} = 1.52 \times 10^{-4}$$

- (e) Calculate the capacitance of a parallel plate capacitor if the plates are circular with diameter 17.0 cm. The plates are 0.25 mm apart (in air).

$$C = \frac{\epsilon_0 S}{d} = 9 \times \frac{8.85 \times 10^{-12} \times \left(\frac{17}{2} \times 10^{-2}\right)^2}{2.5 \times 10^{-4}} = 8.06 \times 10^{-10} \text{ (F)}$$