University of Bahrain

Physics Department

Electricity and Magnetism – PHYCS 102

Fall 2002-03

Test 2

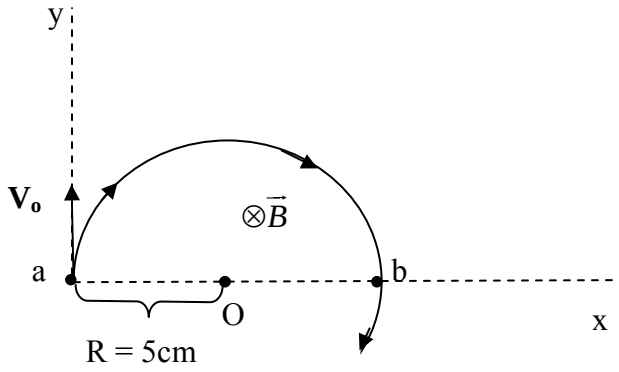
Name:	**I.D.:**
Instructor:	**Sec.:**

No.	Score	Initial
1		
2		
3		
4		
5		
Total		

Useful constants: Electron charge, $e = -1.6 \times 10^{-19}$ C

Answer all problems in the space provided.

1- An electron with an initial speed $V_o = 4 \times 10^6$ m/s and moving in the y-direction enters a uniform magnetic field at point "a" (see the figure). Determine the magnitude and direction of the magnetic field that will cause the electron to follow the circular path shown in the figure. **(20 points)**
(Note: the distance from "a" to "b" is 10 cm and is the diameter of the circular path.)



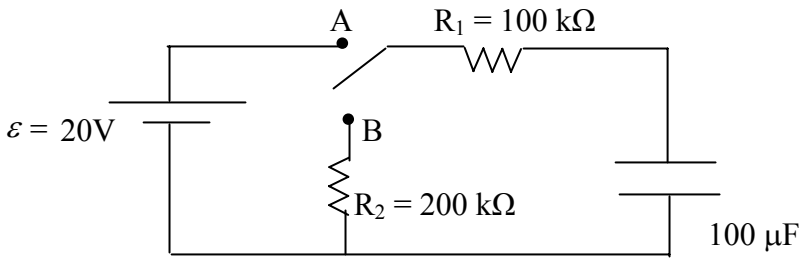
$$B = \frac{mv}{Rq}$$

$$B = 455.5\,\mu T$$

$$\otimes = \left(-\vec{k}\right)$$

$$\vec{B} = -455.5\vec{k}\ \ \mu T$$

2- The switch in the circuit shown has been in position A for a long time. If at time t = 0 the switch is moved to position B, find the charge on the capacitor at time t = 1 second. **(15 points)**



Charging: $Q_o = c\varepsilon = 2000 \ \mu C$

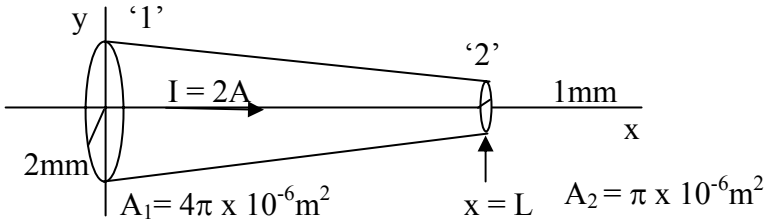
Discharging: $\tau = (R_1 + R_2)C = 30s$

$Q = Q_o \ e^{-t/\tau} = 2000 \ \mu e^{-1/30}$

$= 1934.4 \ \mu C$

3- A conducting wire of non-uniform thickness is placed on the x-axis as shown in the figure. The wire's diameter at x = 0 is 4 mm, and its diameter at x = L is 2 mm. If the current at x = 0 is 2 A, find: **(20 points)**

a) The current density, J, at x = 0.
b) The current, I, and the current density, J, at x = L.



a) $J_1 = \dfrac{I}{A_1}$

$= 1.59 \times 10^5 \ A/m^2$

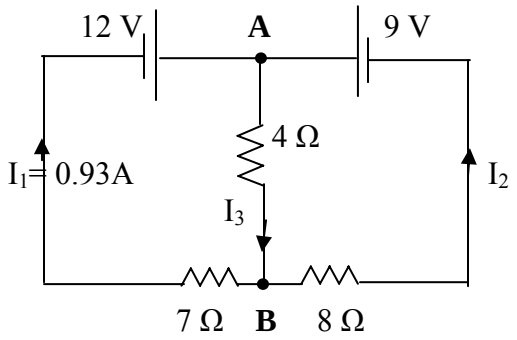
b) I = 2A (also)

$J_2 = \dfrac{2}{A_2} = 6.36 \times 10^5 \ A/m^2$

4- For the circuit shown, determine:

a) The currents I_2 and I_3 given that $I_1 = 0.93$ A.

b) Find the potential difference $(V_B - V_A)$. **(25 points)**



a) $V_{AB} = -I_1(7) - (-12) = +5.49V$

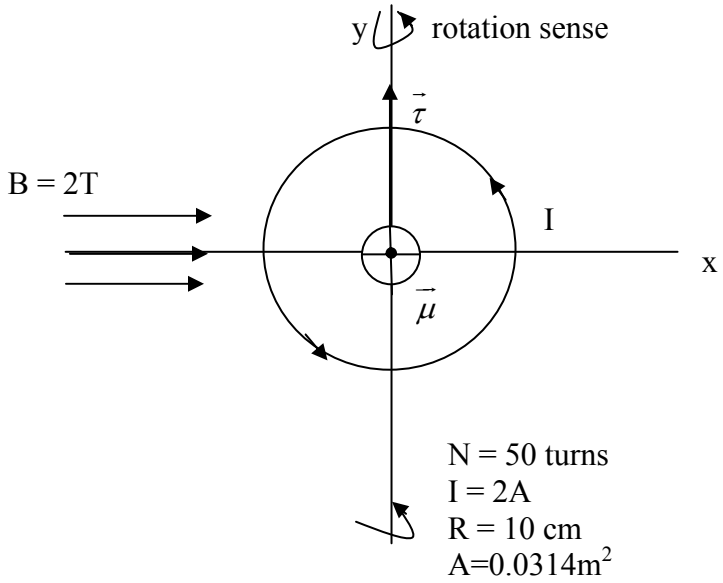
$$\therefore I_3 = \frac{V_{AB}}{4} = 1.37A$$

$$I_2 = I_3 - I_1 = 0.44A$$

b) $V_{BA} = -5.49V$

5- A circular loop of radius 10 cm consists of 50 turns and carries a current of 2 A. The loop is placed in the xy-plane with the current running counter-clockwise, as shown in the figure.

a) Determine the magnitude and direction of the magnetic dipole moment, $\boldsymbol{\mu}$.
b) If the loop is subjected to an external magnetic field **B** = (2 **i**) Tesla, find the magnitude and direction of the torque, $\boldsymbol{\tau}$, experienced by the loop.
c) Specify the axis about which the loop will rotate. **(20 points)**



a) $\vec{\mu} = NIA\ \vec{k} = 3.14\ \vec{k}$ □

b) $\vec{\tau} = \vec{\mu} \wedge \vec{B} = (3.14)(2)(\vec{k} \wedge \vec{i})$

$\vec{\tau} = 6.28\ \vec{j}$

c) about y axis.