UNIVERSITY OF BAHRAIN
COLLEGE OF SCIENCE
PHYSICS DEPARTMENT

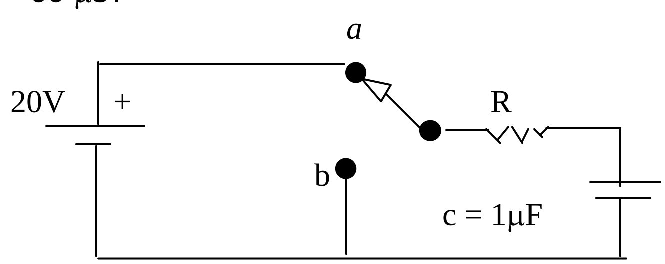
PHYCS 102
TEST 3

DATE: **2/1/2001** TIME:**55 MIN.**

NAME:	ID#:	SECTION:

Q1. In the circuit shown the capacitor is fully charged. Then, at t = 0 the switch is thrown from "a" to "b". This causes the current to decrease to 0.5 of its initial value in 40 μs.

a) Calculate the value of R.
b) What is the value of the capacitor charge Q at t =0?
c) What is the value of Q at t = 60 μs?

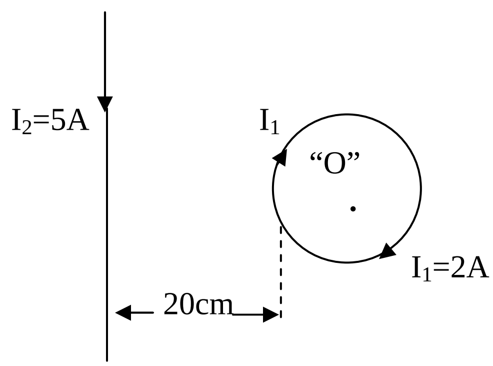


a) $I = I_o e^{-t/RC}, 0.5 I_o = I_o e^{-\frac{40\mu}{R(1\mu)}} \Rightarrow R = 57.7\Omega$

b) $Q_o = c\varepsilon = 20\ \mu c$

c) $Q = Q_o \bar{e}^{t/RC} = 20 e^{-\frac{60\mu}{57.7\ x(1\mu)}} = 7.1\mu\ c$

Q2. In the figure shown below, a circular loop of radius R=20cm carries a current $I_1 = 2A$ and a very long straight wire carries a current $I_2 = 5A$. Use superposition method to determine the magnitude and direction of the total magnetic field at the center "O" of the loop.



$B_1 = \frac{\mu_o I_1}{2R} = 6.28 \times 10^{-6} T \otimes,\ B_2 = \frac{\mu_o I_2}{2\pi\ r} = \frac{M_o I_2}{2\pi(0.4)} = 2.5\ x\ 10^{-6} T \odot$

$B = B_1 - B_2 = 3.78\ mT\ \otimes$

Q3. A proton is accelerated by 56KV, enters a uniform magnetic field $(\vec{B})$ in a direction perpendicular to $(\vec{B})$. The proton moves in a circular path of radius 8m. Determine:

a) the magnitude of $\vec{B}$,

b) the time required to make 5 revolutions.

a) $$eV = \frac{1}{2} m_p v^2, v = \left[\frac{2x1.6\,x10^{-19}\,x\,56\,x10^3}{1.67\,x10^{-27}}\right]^{1/2} = 3.276\,x10^6\,m/s$$

$$R = mv/qB, \quad 8 = \frac{1.67\,x10^{-27}\,x\,3.276\,x10^6}{1.6\,x10^{-19}\,B} \therefore B = 4.274mT.$$

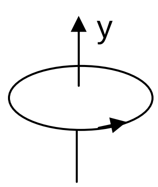
b) T= $\frac{2\pi m}{qB} = 1.534\,x10^{-5}\,S, \qquad t = 5T = 7.67\,x10^{-5}\,S.$

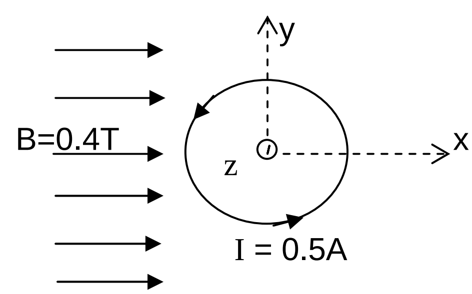
Q4. A circular loop of radius R = 10 cm consists of 50 closely wrapped turns in which each carries a current of 0.5A. The loop is placed in a uniform magnetic field of B = 0.4T directed in the positive x-axis, as shown in the figure.

a) What is the resultant magnetic force on the loop?

b) Calculate the magnitude of the torque $\vec{\tau}$ on the loop.

c) What is the direction of $\vec{\tau}$? Describe the expected rotation of the loop?





The rotation is around y-axis

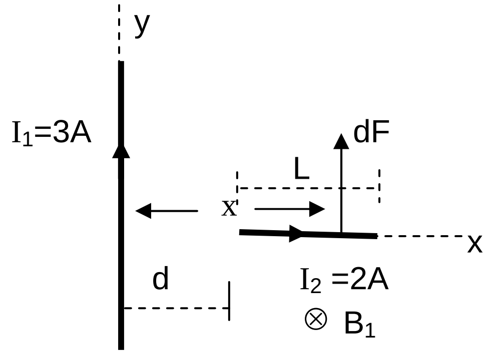
a) $\sum \vec{F} = 0$

b) $\vec{\tau} = \vec{\mu} \wedge \vec{B} = NI\vec{A} \wedge \vec{B}\ , \tau = NIAB = 50(0.5)(\pi\,x\,0.1^2)(0.4)$

= 0.314 N.m

c) $\vec{\mu} = \mu\vec{k}\ ,\ \vec{B} = B\vec{i}\ \therefore \vec{\tau} = \tau\ \vec{j}$ (i.e. in positive y– direction)

Q5. A short straight wire of length L=0.3m carries a current I_2 = 2A is placed perpendicular at a distance d= 0.1m near a long straight wire that carries a current I_1 = 3A as shown in the figure. Determine the magnitude and direction of magnetic force that exerted on the short wire.



$$dF = I_2 dx\ B_1 = I_2 \frac{\mu_o I_1}{2\pi\ x}\ dx$$

$$F = \frac{\mu_o I_1 I_2}{2\pi} \int_{0.1}^{0.4} \frac{dx}{x} = 1.66\ \mu N \ \text{ in y– direction}$$

m_p = 1.67 x 10^{-27}Kg.

E = 1.6 x 10^{-19}C

<u>Good luck</u>

3. A charged spherical shell of radius R has a total charge Q placed inside an uncharged conducting spherical shell that has an inner radius a and outer radius b. **Find :**

a) The electric field every where, i.e. in each region 1,2,3 and 4.

b) The induced surface charge densities on the inner and outer surfaces of the uncharged conducting spherical shell.