University of Bahrain
College of Science
Department of Physics

PHYCS 102
Test (II)

Time: 11:00 – 11:50 am

Date: 22nd May 2001

Name:---ID#--------------------------Sec:-------------

Qts	Marks	
1		
2		
3		____
4		100
Total	**100**	

Important data:

$e^- = e^+ = 1.6 \times 10^{-19}$C $m_e = 9.1 \times 10^{-31}$ kg

$m_p = 1.67 \times 10^{-27}$kg $k = \frac{1}{4\pi\varepsilon_o} = 9 \times 10^9 \frac{Nm^2}{C^2}$

g = 10 m/s^2

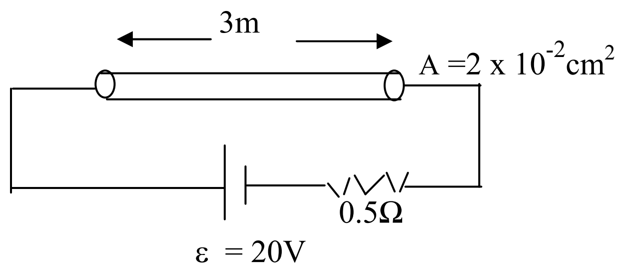
1. A tungsten wire of length 3m and cross section area of $2 \times 10^{-2} cm^2$ is connected with a source of emf = 20V, and internal resistance of 0.5Ω, find:

a. The resistance of the wire assuming ($\rho = 5.6\ \mu\ \Omega.\ cm$)

b. The current density in the tungsten wire.

c. The electric field in the wire.

d. The electron drift velocity. The concentration of electrons in the tungsten wire is $n = 6.32 \times 10^{22}/cm^3$.



a)

$$R = \frac{\rho \ell}{A} = \frac{(5.6 \times 10^{-8})(3)}{2 \times 10^{-6}} = 8.4 \times 10^{-2}\ \Omega$$

b)

$$I = \frac{\varepsilon}{R + r} = 34.24\ A$$

$$J = \frac{I}{A} = 1.712 \times 10^{7}\ A/m^2$$

c) $E = \rho J = 0.958\ V/m$

/or/

$$\left.\begin{aligned} 20 &= V_R + V_r \\ \frac{V_R}{8.4 \times 10^{-2}} &= \frac{V_r}{0.5} \end{aligned}\right\} \quad V_R = 2.876V, \quad E = \frac{V_r}{L} = 0.958\ V/m$$

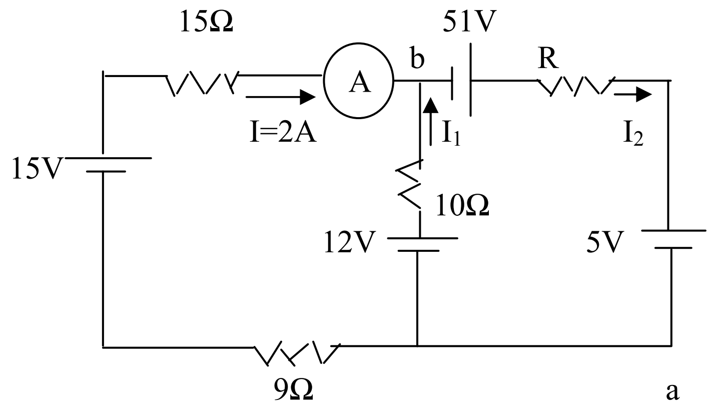
d) $J = ne\upsilon_d$, $\upsilon_d = 1.69 \times 10^{-3}\ m/s$

Q2. The ammeter reads 2A, find the following:

a. I_1, I_2 and R.

b. The power dissipated in the 10Ω resistor.

c. The potential difference V_{ab}.



a) $V_{ab} = \sum_K I_K R_K - \sum_K \varepsilon_K = (9+15)\,(2) - 15 = 33V$

$\therefore 33 = 10I_1 - 12 \qquad \therefore I_1 = 4.5A \text{ and } I_2 = 6.5A$

/or/loop: $15 \text{ x } 2 - 10I_1 + 9 \text{ x } 2 = -12 + 15 \Rightarrow I_1 = 4.5A$

$R : 33 = (-6.5)R - (5-51) \Rightarrow R = 2\Omega$

/or/ $(6.5)R + (4.5)\ 10 = -5 + 12 + 51 \Rightarrow R = 2\Omega$

b) $P = I_1^2\ R = (4.5)^2\ (10) = 202.5\,W$

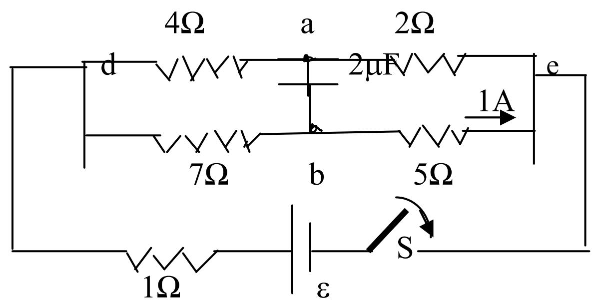
c) $V_{ab} = 33V$

Q3. Consider the circuit shown below. Calculate, after a long time of connection, the

a. Voltage V_{ab}

b. Charge of the capacitor.

c. If the switch (s) is opened, how long does it take for the capacitor to discharge to $\left(\frac{1}{5}\right)$ of its initial charge?



a) $V_{de} = (7 + 5) \times 1 = 12V$, $12 = 6I_2 \Rightarrow I_2 = 2A$

$V_{ab} = V_{ad} + V_{db} = (-2)(4) + (1)(7) = -1V$

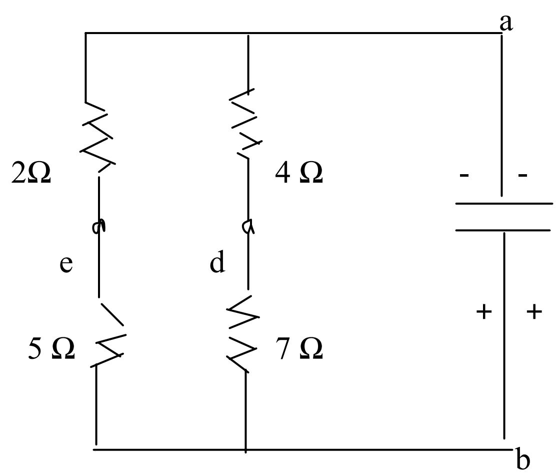
$\therefore V_{ba} = 1V$

b) $q_o = CV_c = 2\ \mu C$

c) $q = q_o e^{-t/\tau}$

$\frac{1}{5} = e^{-t/\tau}$

$t = \tau - \ell n\ 5 = 13.77\ \mu s$



$R = \frac{(11)(7)}{11+7} = 4.28\Omega$

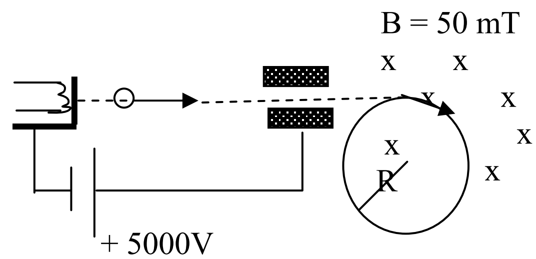
$\tau = RC = 8.56\,\mu S$

4. The accelerating voltage that is applied to an electron beam is 5000V. The beam enters a region of uniform magnetic field of 50 mT perpendicular to the page as shown. Determine:

a. The velocity of electrons in the beam.

b. The radius of the electron trajectory.

c. Draw the path of the electron in the region of the external magnetic field.



a) $$eV = \frac{1}{2}mv^2$$

$$v = 4.193\ x\ 10^7 m/s$$

b) $$R = \frac{mv}{eB} \Rightarrow R = 0.47\ cm$$