COLLEGE OF ENGINEERING & TECHNOLOGY

Department : Basic and Applied Sciences
Lecturers : Prof. Mohamed Abd Elzaher & Dr. Eman Shafik
Course : Physics I
Course Code : BA 113   **Marks: 40**
Date : Monday 6ᵗʰ Jan. 2014   **Time : 9 – 11 am (2 hours)**

Final Exam

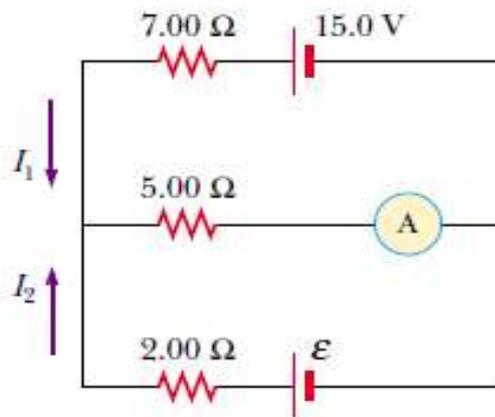## *Answer the following Questions*

Question (1):   [**Total 10 marks**]

a) If the ammeter shown in the figure reads **2.00** Amper, by using Kirchhoff s rules. C**alculate**:
   i.   The **current passing** in the 7 Ω resistor (**I_1**).
   ii. The **current passing** in the 2 Ω resistor (**I_2**).
   iii. The **electromotive force** of the battery (**ε**).

(6 marks) {A5}

b) A **25-turn** circular coil **6.00 cm** in diameter is placed in and perpendicular to, a magnetic field that is changing at a rate of **2.50×10^{-2} T/s**.
   i. Find the **induced emf** in the coil.
   ii. If the resistance of the coil is **20 Ω,** find the **induced current** in the coil.

(4 marks)   {C1}

Question (2):   [**Total 10 marks**]

a) Four capacitors are connected as shown in the figure below.   (5 marks)   {A5}
   i. Find the **equivalent capacitance**.
   ii. Calculate the **charge** on each capacitor.

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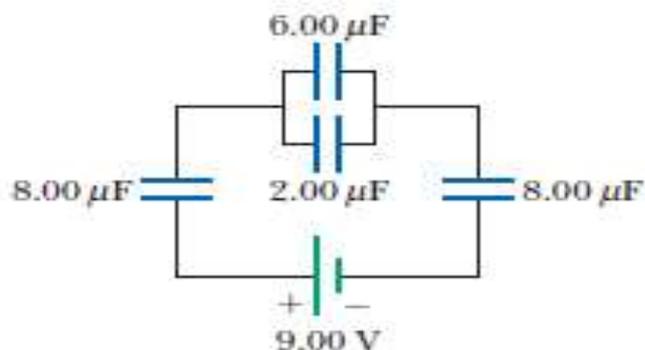
b) An electron starts from rest and accelerated through potential difference of 500V, then it enters perpendicular to a uniform magnetic field of **95 mT**. Calculate:
   i.   The **magnetic force** exerted on the electron.
   ii. The **electron's acceleration**.
   iii. The **radius** of curvature of the electron inside the magnetic field.

(5 marks) {C1}

Question (3):   [Total 10 marks]

a) Three charged particles are located at the corners of an equilateral triangle as shown in the figure. Calculate the **total electric potential at a point P**, <u>midpoint</u> of the base. [q_1=2.00µc, q_2=7.00 µc & q_3= − 4.00 µc (d=60 cm)]
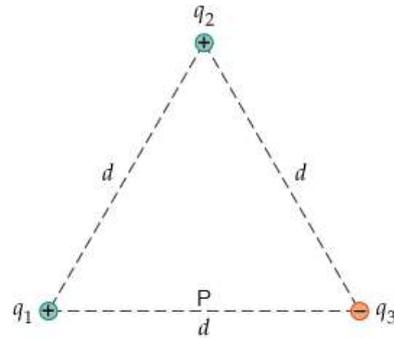
(3 marks) {C1}

b) A **34.5 m** length of copper wire at temperature **(20 ºC)** has a radius of **0.25 mm**. If a potential difference of **9 V** is applied across the wire. (Resistivity of copper= **1.7×10⁻⁸ Ω.m,** Temperature coefficient of resistivity= **3.9×10⁻³ C⁻¹).**
   i. What is the **current density**?
   ii. What is the value of **resistivity** of a wire when the temperature increased to **55ºC**?
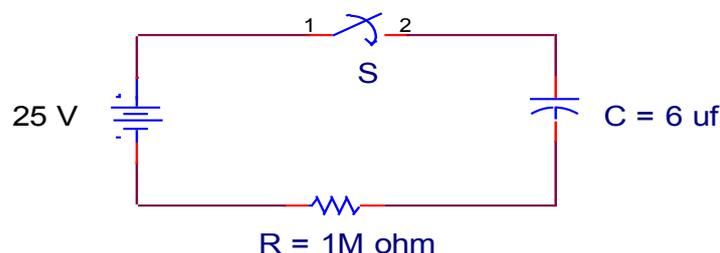
(4 marks) { A5, C1}

c) Two parallel wires are separated by **5.5 cm**, each carrying current of 2.5 A in the same direction. What is the magnitude of the **force per unit length** exerted on each wire?

(3 marks)   {C1}

Question (4):   [Total 10 marks]

a) Consider a series **RC** circuit shown in the Figure below,

Find:
   i.   The **time constant** of the circuit.
   ii. The **current** in the resistor R and the **charge** in the capacitor **C** at a time **15 sec** after the switch is closed.   (4 marks)   {C1}

a) <u>Rewrite the following sentences after correcting them</u>:

1- According to Coulomb's law, the electric force between two point charges is directly proportional to the square of distance between them.

2- The charges on capacitors connected in series are different.

3- Gauss's law relates the net electric flux Φ_E through any closed surface area (**A**) with enclosed charge (**q**), by the equation [$\Phi_E = q/A$].

4- The current density (**J**) in a conductor is defined as the current per unit length.

5- Two parallel wires each carry a steady current, each exert a magnetic force on the other. If the currents are flowing in the same direction, then the force is repulsive.

6- Faraday's law of induction states that the induced emf in a loop is directly proportional to the rate of change of electric flux through it.

7- The magnetic field strength **B** inside a solenoid with **n** turns per unit length ℓ and current I is equal to $\dfrac{\mu_0 nI}{\ell}$.   (6 marks)   {A1}

<u>Constants:</u>

$\mu_o = 4\pi \times 10^{-7}$ Tm/A , k= 9×10^9 N.m^2/c^2 , $\varepsilon_o = 8.85 \times 10^{-12}$ c^2/Nm^2
mass of the electron = 9.1×10^{-31} Kg , charge of electron = 1.6×10^{-19} C.