# MACHAKOS UNIVERSITY

**Supplementary University Examinations 2018/2019**

**SCHOOL OF PURE AND APPLIED SCIENCES**

**DEPARTMENT OF PHYSICAL SCIENCES**

**FIRST YEAR SECOND SEMESTER SUPPLEMENTARY EXAMINATION FOR BACHELOR OF SCIENCE (APPLIED PHYSICS AND TECHNOLOGY)**
**SPH 108: ELECTRICITY AND MAGNETISM**

**DATE: 25/7/2019** **TIME: 11:00 – 1:00 PM**

***INSTRUCTIONS TO CANDIDATES***

Answer **QUESTION ONE** and **ANY OTHER TWO** questions.

Question 1 carries **30** marks and the others carry **20** marks each.

***YOU MAY USE:***

You may need to use the following constants

$\varepsilon_O = 8.85\times10^{-12}$F/m; $K=1/(4\pi\varepsilon_O) = 9\times10^9$, Electron charge, $q_e=-1.6\times10^{-19}$C, $q_p=+1.6\times10^{-19}$C,

Mass of an electron, $M_e=9.11\times10^{-31}$Kg, $\mu_O=4\pi\times10^{-7}$Tm/A, 1eV= $1.6\times10^{-19}$J

**QUESTION ONE**

a) Define a capacitor and list any four (4) uses of a capacitor 5mks
b) Identify the two types of charges 2mks
c) While writing its expression, state Ampere's law 2mks
d) Two charges $Q_1(4\mu C)$ and $Q_2(-7\mu C)$ are located at coordinates (0,0) and (40,0) respectively. Assuming distance in metres, calculate the electric field associated with these charges at (40,30). 4mks

e) i)Sketch the electric field and equipotential lines associated with interacting positive and negative point charges. 3mks

ii)Two charges Q1 $(5\mu C)$ and $Q_2$ $(8\mu C)$ are placed 1m apart. Determine the electric field at the neutral point. 4mks

f) The magnetic field density of a bar magnet is 0.05T. Calculate its magnetic intensity. 3mks

g) A battery has an emf of 12 V and an internal resistance of 0.5 Ω. Its terminals are connected to a load resistor of 3 Ω.

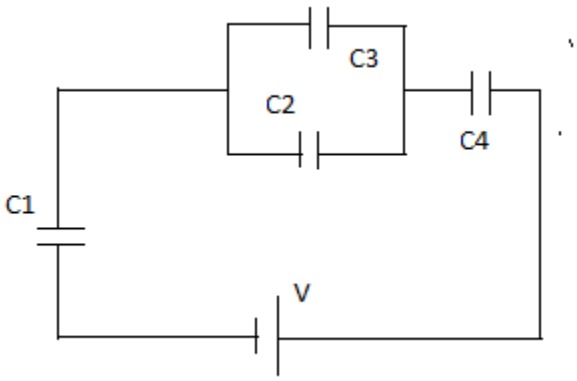
i) Find the current in the circuit and the terminal voltage of the battery. 3mks

ii) Calculate the power delivered to the load resistor and the power delivered to the internal resistor of the battery. 2mks

**QUESTION TWO**

a) With aid of diagrams, state Kirchoff's laws of electricity 4mks

b) Consider the circuit below. Given that V=48V, $C1 = 6\mu F, C2 = 1\mu F, C3 = 3\mu F$ and $C4 = 12\mu F$, Calculate;




i) The equivalent capacitance 3mks

ii) The charge and the p.d. of each capacitor 4mks

c) Three-point charges $Q_1$(5μC), $Q_2$(-2μC) and $Q_3$ (3μC) are located at coordinates (0,0), (2,0) and (6, 0) respectively. Determine;

i) The force that $Q_1$ and $Q_3$ exert on each other 4mks

ii) The net force exerted on $Q_2$ 5mks

**QUESTION THREE**

a) An infinite straight solid wire of radius R carries a current I. Find the magnetic field $\vec{B}$ at a distance r from the centre of the wire for;

i) r>R 3mks

ii) r<R 3mks

iii) r=R 2mks

iv) Plot a graph $\vec{B}$ vs r 2mks

a) Sketch the field lines associated with an isolated pole of a magnet 2mks

b) Write the differential forms of Maxwell's equations while indicating which physical laws they

represent. 8mks

**QUESTION FOUR**

a) Distinguish between Faraday's and Lenz's laws. 4mks

b) Derive the expression of resistivity in terms of length (L), resistance (R) and area of cross-section (A) of a conductor. 6mks

c) The radius of a copper wire is 1.47mm. A potential difference (p.d.) of 44 V is applied across a 3m length of this wire. Resistivity of copper=$1.1\times10^{-8}\Omega$m. Find,

   i) Its resistance 2mks

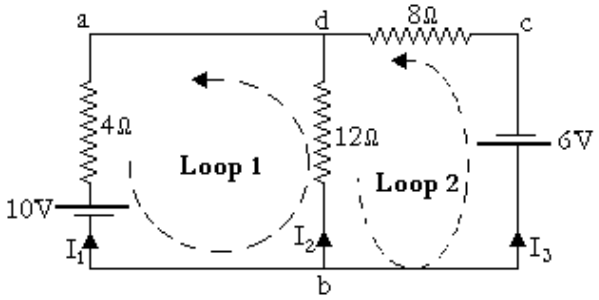
   ii) The current 2mks

   iii) The electric field 2mks

d) Sketch a graph of the magnitude of electric charge on either plate of a capacitor versus the magnitude of the potential difference between the plates. What does its slope indicate? And based on this curve, provide the two SI units representing this relationship. 4mks

**QUESTION FIVE**

a) Consider the following circuit. Calculate the current $I_1$, $I_2$ and $I_3$ in the above circuit. 8mks




b) An electron has a velocity of $V = 10^5\hat{\boldsymbol{k}}\, m/s$ in a magnetic field of $B = 2\times10^{-3}\hat{\boldsymbol{\imath}}T$. Determine the magnitude and direction of the force. 5mks

c) State the two laws of magnetic induction 3mks

d) Using Biot-Savart law, determine the magnetic field density for a circular coil of N turns and carries a current I in each turn. Assume the radius of the coil is r. 4mks