KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER
SUPLEMETARY EXAMINATIONS

FOR THE DEGREE OF B.SC (SCIENCE)

COURSE CODE: SPC 121

COURSE TITLE: ELECTRICITY AND MAGNETISM I

DATE: 27/07/2022 **TIME: 2:00PM-4:00PM**

INSTRUCTIONS TO CANDIDATES

TIME: 2 Hours

Answer question ONE and any TWO of the remaining

QUESTION ONE (30 marks) compulsory

(a) Define the term electric current (1mk)

(b) A particle of mass 5×10^{-6}g is kept over a large horizontal sheet of charge density 4.0×10^{-6} Cm^{-2}. What charge should be given to this particle so that if released, it does not fall down? How many electrons are to be removed to give this charge? How much mass is decreased due to the removal of these electrons? (9mks)

(c) Derive Gauss law from Coulomb's law (6mks)

(d) Given C= 1pF, A= $50cm^{-2}$ and k=2, find d in mm (4mks)

(e) Outline two uses of the following materials:

(i) Ferrimagnetic materials (2mks)

(ii) Antiferromagnetic materials (2mks)

(iii) Diamagnetic materials (2mks)

(f) Define the term electrostatic potential and state its integral equation (2mks)

(g) State any two factors that determines the resistance of a metallic conductor (2mks)

QUESTION TWO (20 marks)

(a) Given A= $50cm^{-2}$, k= 2, d= 0.3mm and Q = 1nC, find the total energy stored by the capacitor (6mks)

(b) Given an infinitely long wire with linear charge density, λ, and length, L, determine the electric field assuming a cylindrical Gaussian surface (7marks)

(c) A large plane charge sheet having surface charge density, $\sigma = 2.0 \times 10^{-6}$ cm^{-2} lies in the x-y plane. Find the flux of the electric field through a circular area of radius 1cm lying completely in the region where x, y, z are all positive and with its normal marking an angle of 60^0 with z-axis. (7mks)

QUESTION THREE (20 marks)

(c) A charge of 4×10^{-8} is distributed uniformly on the surface of a sphere of radius 1cm. it is covered by a concentric hollow conducting sphere of radius 5cm.

(i) Find the electric field at a point 2cm away from the centre (6mks)

(iii) A charge of 6×10^{-8} C is placed on the hollow sphere. Find the surface charge density on the outer surface of the hollow sphere. (4mks)

(d) Consider a thin spherical shell of surface charge density, σ, and radius, R. assuming that the shell is symmetrical, determine the electric field:

(iii) Outside the spherical shell (7mks)

(iv) Inside the spherical shell (3mks)

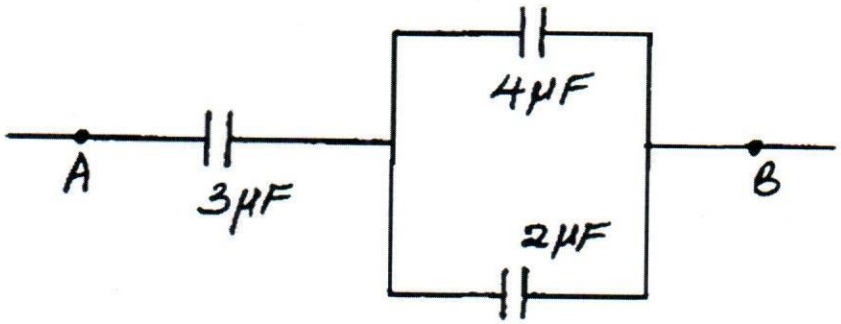
QUESTION FOUR (20 marks)

(a) State any two factors that determine the capacitance of parallel-plate capacitor (2mks)

(b) Show that the capacitance is given by, $C = \frac{Ak\varepsilon}{d}$ where k is the dielectric constant, A is area of overlap and d is the distance of separation of the plates (8mks)

(e) Proof that the effective capacitance for three capacitors in parallel arrangement is given by: $C_T = C_1 + C_2 + C_3$, where C_T is the effective/total capacitance and C_1, C_2 and C_3 are individual capacitances of capacitors in parallel network. (4mks)

(f) The figure below shows part of a circuit containing three capacitors.



(i) Calculate the effective capacitance between **A** and **B**.(3 marks)

(ii) Given that the potential difference (p.d.) across AB is 10V, what is the total charge flowing through the circuit? (3mks)

QUESTION FIVE (20 marks)

(e) State any three conditions for validity of Coulomb's law (3mks)

(f) Consider a uniform line of charge density λ at a distance x from a point P. if the uniform line has a length, L, show that the electric field $E_x = \frac{\lambda}{2\pi\varepsilon_0 x}$ where L>>x

(12mks)

(g) What is the electric force between two charges q_1=50nC and q_2=50nC located 5cm apart (5mks)