JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY SCHOOL OF BIOLOGICAL AND PHYSICAL SCIENCES

UNIVERSITY EXAMINATION FOR THEDEGREE OF BACHELOR OF EDUCATION (SCIENCE)

MAIN

REGULAR-RESIT

COURSE CODE: SPH 102

COURSE TITLE: ELECTRICITY AND MAGNETISM 1

EXAM VENUE: LAB 1 **STREAM: (BED SCI)**

DATE: 4/5/2016 **EXAM SESSION: 9:00-11:00AM**

TIME: 2 HRS

Instructions:

1. **Answer Question 1 (compulsory) and ANY other 2 questions**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

You may use the following constants:
ε_o = 8.85 x 10^{-12} F/m; μ_o = 4πx10^{-7}Tm/A; c = 3.0 x 10^8 m/s;Electron charge, e = 1.6 x 10^{-19}C; Rest mass of an electron, M_e = 9.1 x 10^{-31}kg, Rest mass of a proton, Mp = 1.672 x 10^{-27}kg; Resistivity of copper ρ = 1.7 x 10^{-8}, $\mu_0 = 4\pi \times 10^{-7} TmA^{-1}$, k = 9.0 x 10^9 N.m^2/C^2, G = 6.67 x 10^{-11}Nm^2/kg^2 ,

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QUESTION 1 (30 MARKS)

a) A helium nucleus has a charge of +2e, and a neon nucleus +10e, where e is the quantum of charge, 1.60 x 10^{-19} C. find the repulsive force exerted on one by the other when they are 3nm apart. Assume the system to be in vacuum. 3mks

b) State any three properties of electric field lines 3mks

c) With an aid of a well labeled diagram, explain the working of a cathode ray tube 3mks

d) Calculate the electric flux through the rectangle shown in fig 1 below. The rectangle is 10cm by 20cm, the electric field is uniform at 200N/C and the angle θ is 30^0. 3mks

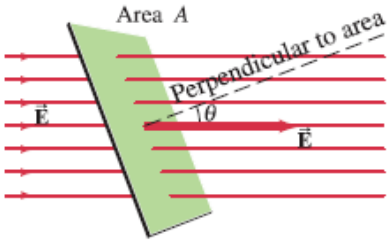

Fig 1

e) Find the voltage required on a set of parallel plates 10.0cm apart to create a field of 1000N/C. 3mks

f) A 1.2 μF capacitor is charged to 3.0kV. Compute the energy stored in the capacitor 3mks

g) How many electrons flow through a light bulb each second if the current through the light bulb is 0.75A? 3mks

h) As shown in the figure 2 below, the ammeter-voltmeter method is used to measure an unknown resistance R. the ammeter reads 0.3A, and the voltmeter reads 1.5V. Compute the value of R if the ammeter and voltmeter are ideal. 3mks

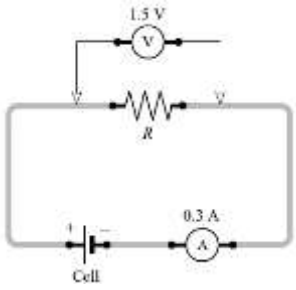

Fig 2

i) A proton enters a magnetic field of flux density 1.5Wb/m^2 with a velocity of 2.0 x 10^7 m/s at an angle of 30^0 with the field. Compute the force on the proton 3mks

j) Compute the value of B in air at a point 5cm from a long straight wire carrying a current of 15A.3mks

QUESTION 2 (20 MARKS)

a) Find the ratio of the Coulomb electric force F_E to the gravitational force F_G between two electrons in vacuum. 5mks

b) Three point charges are placed on the x axis as shown in the figure 3 below. Find the net force on the -5μC charge due to the other charges 6mks

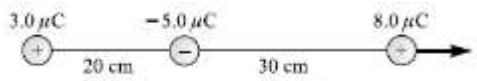

Fig 3

c) An electron enters the region of a uniform electric field with v_i= 3.00 X 10^6 m/s and E = 200 N/C. The horizontal length of the plates is l = 0.100 m.

i. Find the acceleration of the electron while it is in the electric field. 3mks
ii. If the electron enters the field at time t = 0, find the time at which it leaves the field. 3mks
iii. If the vertical position of the electron as it enters the field is y_i= 0, what is its vertical position when it leaves the field? 3mks

QUESTION 3 (20 MARKS)

a) In the figure below, we show two large metal plates connected to a 120 V battery. Assume the plates to be in vacuum and to be much larger than shown in figure 4 below. Find

i. E between the plates 3mks
ii. The force experienced by an electron between the plates, 3mks
iii. The PE_E lost by an electron as it moves from plate B to plate A, and 3mks
iv. The speed of the electron released from plate B before striking plate A. 3mks

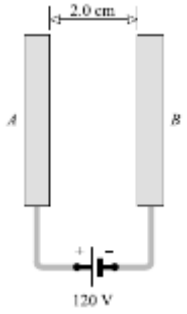

Fig 4

b) A total charge, Q, is uniformly distributed throughout a non-conducting sphere of radius, R. Find the electric field inside and out. Sketch E vs. r. 8mks

QUESTION 4 (20 MARKS)

a) State Ohms' law 1mk

b) The series combination of two capacitors shown in figure 5 below is connected across 1000V. Compute

i. The equivalent capacitance C_{eq} of the combination 2mks
ii. The magnitudes of the charges on the capacitors 2mks
iii. The potential differences across the capacitors and 4mks
iv. The energy stored in the capacitors 5mks

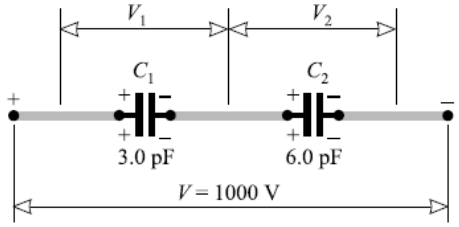

Fig 5

c) A current of 3.0 A flows through the wire shown in fig 6 below. What will a voltmeter read when connected from (a) *A* to *B* (b) *A* to *C* (C) *a* to *D*? 6mks

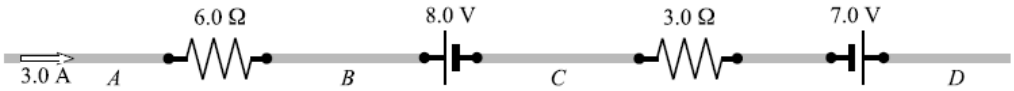

Fig 6

QUESTION 5 (20 MARKS)

a) A 0.100T magnet has a field that points upward. The pole faces have a 2.00cm diameter. Find the force on a 5.00A current flowing eastward. 4mks

b) A mass spectrometer requires charged particles traveling at 2.00×10^5m/s. The magnetic field in the device is 0.500T. Find the potential difference across the plates of the velocity selector given their separation is 0.800cm. 4mks

c) Find the magnetic field inside and outside of a wire of radius a carrying a uniform current I. Sketch the field as a function of r the distance from the center. 12mks