PHY 210ELECTRICITY AND MAGNETISM II2016.17 SEM I

MAIN EXAM **TIME: 3HRS**

INSTRUCTIONS TO CANDIDATES

Answer all questions in **SECTION A** and any **THREE** questions from **SECTION B.**

Question **ONE** carries **28** marks while all the other questions in section B carry **14** marks each.

You may use the following constants:

$\varepsilon_o = 8.85 \times 10^{-12}$ F/m; $\mu_o = 4\pi \times 10^{-7}$Tm/A; c = 3.0×10^8 m/s;Electron charge, e = 1.6×10^{-19}C; Rest mass of an electron, $M_e = 9.1 \times 10^{-31}$kg, Rest mass of a proton, Mp = 1.672×10^{-27}kg; Resistivity of copper $\rho = 1.7 \times 10^{-8}$, $\mu_0 = 4\pi \times 10^{-7} TmA^{-1}$, k = 9.0×10^9 N.m^2/C^2, G = 6.67×10^{-11}Nm^2/kg^2 ,

SECTION A

QUESTION 1 (28 MARKS)

a) State any three properties of electric field lines **3mks**

b) A helium nucleus has a charge of +2e, and a neon nucleus +10e, where e is the quantum of charge, 1.60×10^{-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**

c) A 1.2 μF capacitor is charged to 3.0kV. Compute the energy stored in the capacitor **2mks**

d) 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. **2mks**

e) As shown in the figure 1, 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. **2mks**

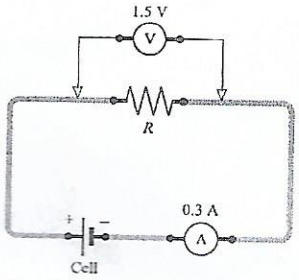

Fig 1

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

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

h) Calculate the electric flux through the rectangle shown in fig 2. The rectangle is 10cm by 20cm, the electric field is uniform at 200N/C and the angle θ is 30^0. **3mks**

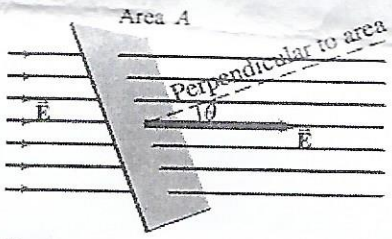

Fig 2

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

j) How many electrons flow through a light bulb each second if the current through the light bulb is 0.75A? **4mks**

SECTION B

QUESTION 2 (14MARKS)

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

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

a) Find the acceleration of the electron while it is in the electric field. **3mks**

b) If the electron enters the field at time $t = 0$, find the time at which it leaves the field. **2mks**

c) 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 (14 MARKS)

a) A tiny nucleus has a charge +50e. Find theabsolute potential V at a radius of 1.0×10^{-12}m from the nucleus. **2mks**

b) In the figure 3, 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. 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**

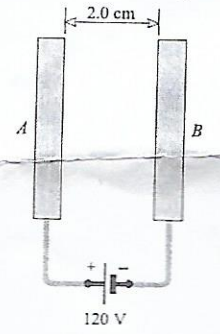

Fig 3

QUESTION 4(14 MARKS)

The series combination of two capacitors shown in figure 4 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 **6mks**

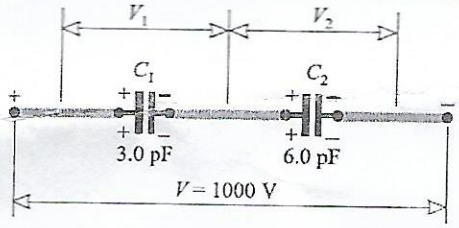

Fig 4

QUESTION 5 (14 MARKS)

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. **14mks**

QUESTION 6 (14 MARKS)

The charges shown in figure 5 are stationary. Find the force on the 4.0μC charge due to the other two. **14mks**

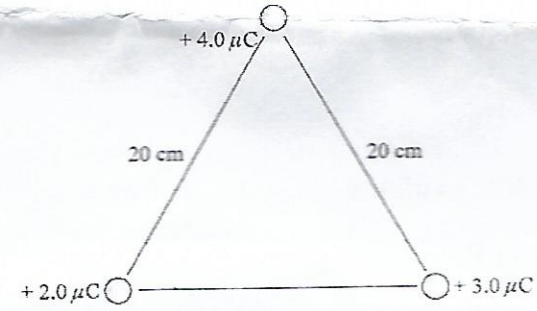

Fig 5