PHYS 212

EGERTON UNIVERSITY

UNIVERSITY EXAMINATIONS

REGULAR PROGRAMME- NJORO CAMPUS

RESIT EXAM

SECOND YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

PHYS 212: ELECTRICITY AND MAGNETISM I

STREAMS: BED (SC), BSC TIME: 2 HOURS

EXAMINATION SESSION: OCTOBER YEAR: 2018

INSTRUCTIONS

Read the questions carefully before answering

Answer question **ONE** (Compulsory) and any other **THREE** questions

Question one comprises **40 marks** and the rest **10 marks** each

Mass of an electron, $m_e = 1.6 \times 10^{-31}$ Kg

Mass of an proton, $m_p = 1.67 \times 10^{-27}$ Kg

Charge of an electron, $e = 1.60 \times 10^{-19}$ C

Permittivity constant, $\varepsilon_0 = 8.85 \times 10^{-12}\ C^2Nm^{-2}$

Electrostatic constant, $k_e = 8.99 \times 10^{9}\ Nm^2C^{-2}$

Universal Gravitational constant, $k_g = 6.67 \times 10^{-11} Nm^2kg^{-2}$

QUESTION ONE (30 Marks)

a) A battery has an emf of 12.0 V and an internal resistance of 0.050 Ω. Its terminals are connected to a load resistance of 3.00 Ω. Find the current in the circuit and the terminal voltage of the battery. **(3 marks)** **(1 mark)**

b) State the first law of electrostatics **(2 marks)**

c) State any two properties of a charge **(2 marks)**

d) Differentiate between conductors and insulators **(1 mark)**

e) State Coulomb's law

f) An electron and a proton of a hydrogen atom are separated by a distance of approximately 5.3×10^{-11} m. Find the magnitude of the electric force and the gravitational force between the two particles. **(4 marks)**

g) Consider three point charges located at the corners of a right triangle as shown in figure 1 where $q_1 = q_3 = 50\ \mu C$, $q_2 = 2.00\ \mu C$ and a=0.100 m. Find the resultant force exerted on q_3. **(4 marks)**

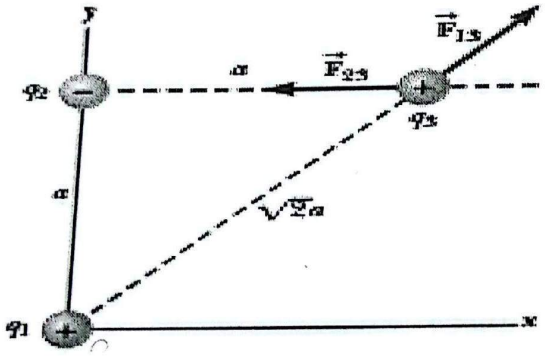

Figure 1

h) In order to measure the magnitude of a uniform magnetic field, electrons are accelerated from rest through a potential difference of 350 V and then enter a uniform magnetic field that is perpendicular to the velocity vector of the electrons. The electrons travel along a curved path because of the magnetic force exerted on them, and the radius of the path is measured to be 7.5 cm. What is the magnitude of the magnetic field? **(4 marks)**

i) Outline any three rules for drawing electric field lines **(3 marks)**

j) A rod of length l, has a uniform positive charge per unit length λ and a total charge Q. Calculate the electric field at a point P that is located along the long axis of the rod and a distance a from one end. **(3 marks)**

k) A battery has a specified potential difference ΔV between its terminals and establishes that potential difference between conductors attached to the terminals. A 12-V battery is connected between two parallel plates. The separation between the plates is d= 0.30 cm, and we assume the electric field between the plates to be uniform. Find the magnitude of the electric field between the plates. **(3 marks)**

QUESTION TWO (10 Marks)

A uniform electric field $\vec{E}$ is directed along the x axis between parallel plates of charge separated by a distance d. A positive point charge q of mass m is released from rest at a point A next to the positive plate and accelerates to a point B next to the negative plate.

a) Find the speed of the particle at B by modeling it as a particle under constant acceleration. **(5 marks)**

b) Find the speed of the particle at **B** by modeling it as a no isolated system in terms of energy **(4 marks)**

c) Hence or otherwise, comment on the two results in a and b above **(1 mark)**

QUESTION THREE (10 Marks)

a) A spherical Gaussian surface surrounds a point charge q. Describe what happens to the total flux through the surface if the

i. Charge is tripled

ii. Radius of the sphere is doubled **(2 marks)**

b) Three resistors are connected in parallel as shown in figure 2. A potential difference of 18.0 V is maintained between points a and b.

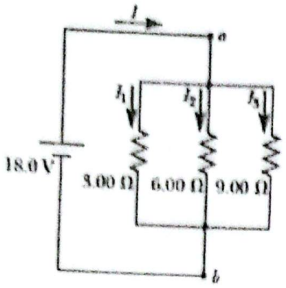

Figure 2

i. Calculate the equivalent resistance of the circuit. **(2 marks)**

ii. Find the current in each resistor. **(3 marks)**

iii. Calculate the power delivered to each resistor **(3 marks)**

c) QUESTION FOUR (10 Marks)

a) Define the term capacitance **(1 mark)**

b) An electron in an old-style television picture tube moves toward the front of the tube with a speed of 8.0×10^6 m/s along the x-axis. Surrounding the neck of the tube are coils of wire that create a magnetic field of magnitude 0.025 T, directed at an angle of 60° to the x axis and lying in the xy plane. Calculate the magnetic force on the electron. **(5 marks)**

c) A solid cylindrical conductor of radius a and charge Q is coaxial with a cylindrical shell of negligible thickness, radius b greater than a, and charge -Q. Find the capacitance of this cylindrical capacitor if its length is l. **(4 marks)**

QUESTION FIVE (10 Marks)

a) The radius of a 22-gauge nichrome wire is 0.32 mm. If the resistivity of nichrome wire is 10^{-6} Ωm, calculate the resistance of per unit length of this wire. **(3 marks)**

b) An electric heater is constructed by applying a potential difference of 120 V across a Nichrome wire that has a total resistance of 8.00 V. Find the current carried by the wire and the power rating of the heater. **(4 marks)**

c) An immersion heater must increase the temperature of 1.50 kg of water from 10.0°C to 50.0°C in 10.0 min while operating at 110 V. What is the required resistance of the heater? **(3 marks)**

CamScanner