EGERTON UNIVERSITY

UNIVERSITY EXAMINATIONS

NJORO CAMPUS

REGULAR PROGRAM

2016/2017 ACADEMIC YEAR

SECOND YEAR RESIT EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

PHYS 212: ELECTRICITY AND MAGNETISM I

TIME: 2 HRS

STREAMS: B.Sc; B.ED

YEAR: 2017

EXAMINATION SESSION: DECEMBER

INSTRUCTIONS

a) First of all read through the entire question paper carefully

b) Answer questions **ONE** and any other **THREE** questions.

c) Question one carries **40 marks** and the rest carry **10 marks** each.

d) And you may require the following:

i) Planks constant $h = 6.63 \times 10^{-34}$ Js

ii) Electron charge $e = 1.6 \times 10^{-19}$ C

iii) Mass of an electron $M_e = 9.11 \times 10^{-31}$ kg

iv) Gravitational acceleration $g = 9.81$ ms^{-2}

v) Speed of light in air $C = 3.0 \times 10^{8}$ m/s

QUASTION ONE (40 MARKS)

a) A charge of 3.0 μC is separated from a 1.0 μCcharge by 6.0 cm. Determine the location at which a 6.0 μC charge will be in equilibrium. **(3 marks)**

b) Fig. 1. Shows two charges a distance one centimeter apart. The charges and point P together forms an equilateral triangle.

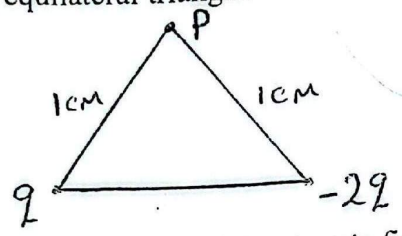


fig. 1

Determine the direction of the electric field at point P **(3 marks)**

c) Charge $q_1 = 3\ \mu C$ is at a point (- 1, 1) in the (x, y) plain. Charge $q_2 = -6\ \mu C$ is at a point (1, 2). Determine the electric potential energy of the charge distribution **(3 marks)**

d) i) State three properties of electric charge **(3 marks)**

ii) Describe the procedure you can use to charge a conducting sphere with negative charge **(4 marks)**

e) i) Define the magnetic field **(4 marks)**

ii) A proton is moving with a velocity $\vec{V} = (4.0\hat{\imath} + 5.0\hat{\jmath})$ x 10^5 m/s in a magnetic field $\vec{B} = (0.003\hat{\imath} - 0.002\hat{\jmath})$ T. Calculate the magnetic force on the proton. **(3 marks)**

f) a proton is moving with a velocity $\vec{V} = (-2\hat{\imath} + 3\hat{k})$ m/s when it enters a region of magnetic field $\vec{B} = 0.03\hat{k}$ T. describe the path followed by the proton henceforth. **(3 marks)**

g) An induced electromotive force is caused by a changing magnetic flux. State three methods you can use to practically induce an emf on an electric path **(3 marks)**

h) Describe the properties of a conductor in electrostatic equilibrium **(3marks)**

i) An electron moving at a speed of 5.0 x 10^5 m/s is accelerated through a potential difference of 3000 V. Calculate its: i) final velocity **(3 marks)**

ii) Gain in energy **(2 marks)**

j) A copper wire bent into a closed circle of radius R= 40cm carries a current of I =3.0 A in the direction shown in fig.2.

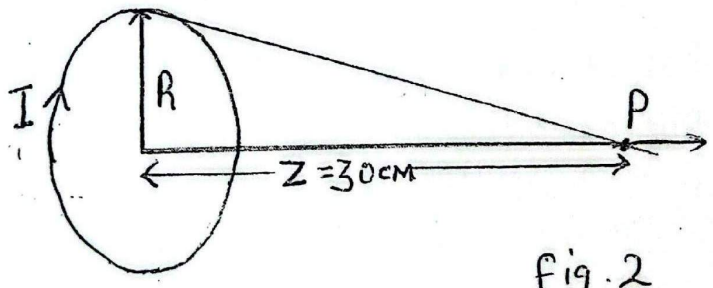


fig. 2

Calculate the magnetic field set up by this current at point P **(3 marks)**

QUESTION TWO (10 MARKS)

a) i) Distinguish between capacitor and capacitance. **(2 marks)**
ii) State any two benefits of a dielectric materials placed between the plates of a capacitor. **(2 marks)**

b) A capacitor is made by sandwiching a 0.2 mm thick polyethyne sheet of dielectric constant k = 2.5 between copper plates of area A = 5.0 cm^2. Determine:
i. The capacitance of the device if it consists of parallel plates. **(3 marks)**
ii. The maximum potential difference the plates if the breakdown strength of polyethlene is 30 KV/mm. **(3 marks)**

QUESTION THREE (10 MARKS)

a) State Gauss' law of electrostatics, and explain the parameters used **(2 marks)**
b) A spherical Gaussian surface of radius r_1 = 3.0 cm. has appoint charge q = 7.6 μC at its centre. Determine:
i. The electric flux through the Gaussian surface **(3 marks)**
ii. The electric flux through a second spherical Gaussian surface that is concentric with the first, but of radius r_2 = 5.0 cm **(1 mark)**
iii. The electric flux through the Gaussian surface in part (i) after a 1.0 μC point charge is brought close to but outside the Gaussian surface. **(1 marks)**
iv. The electric field at surface of first Gaussian surface **(3 marks)**

QUESTION FOUR (10 MARKS)

a) State the Kirchhoff's law of circuit analysis **(2 marks)**
b) Fig. 3. Shows a circuit in which: R_1 = 50Ω; R_2 = 15Ω; R_3 = 37Ω; R_4 = 13Ω; R_5 = 27Ω; r_1 = 0.8Ω; r_2 = 0.5Ω; r_3 = 1.2Ω; $\mathcal{E}_1$ = 16V; $\mathcal{E}_2$ = 12V and $\mathcal{E}_3$ = 17.5V

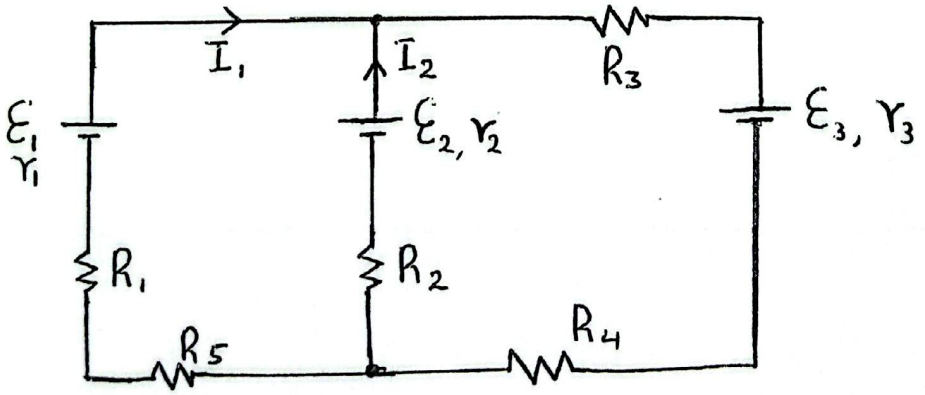


Fig. 3

i. Using the Kirchhoff's law of circuit analysis, write down three equations for I_1; I_2 and I_3 **(3marks)**

ii. Solve the three equations for I_1; I_2 and I_3 **(5 marks)**

QUESTION FIVE (10 MARKS)

a) i) State the Faraday's law of electromagnetic induction **(1 mark)**

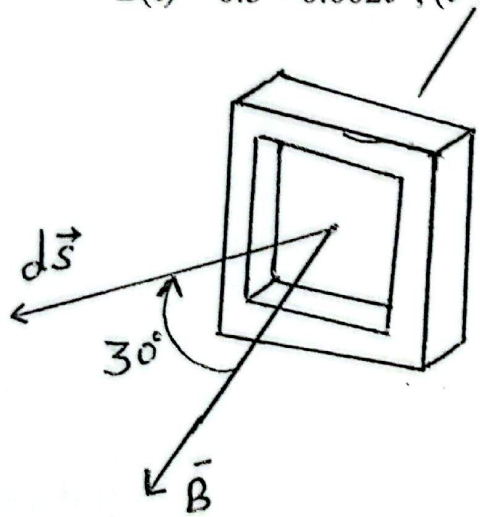
ii) State Lenz's law of electromagnetic induction **(1 mark)**

iii) Explain the difference between the two laws **(2marks)**

b) i) The magnetic flux through a circular loop is given by $\Phi_B = 0.0027t^3$ (SI units). Determine the induced emf in the loop as a function of time, for $t > 0$ **(2marks)**

ii) A square loop of wire 5 cm on a side is placed in a uniform magnetic field $\vec{B}$ such that it's normal makes an angle of 30° with respect to $\vec{B}$, see fig. 4. If the magnetic field strength B as a function of time and in SI units is given by:

$B(t) = 0.5 - 0.002t^2$, $(t>0)$,



Determine the induced emf in the loop as a function of time. **(4 marks)**

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