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

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN EDUCATION

1ST YEAR 2ND SEMESTER 2013/2014 ACADEMIC YEAR

CENTRE: MAIN

COURSE CODE: SPH 102

COURSE TITLE: ELECTRICITY & MAGNETISM I

EXAM VENUE: AH **STREAM: BSc. .Education**

DATE: 9/12/2013 **EXAM SESSION: 9.00 – 11.00 AM**

TIME: 2 HOURS

Instructions:

1. **Answer ALL questions in section A and ANY other 2 questions in section B**
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.**

SECTION A:

1. a) (i) What is a transformer? (2 marks)
(ii) Can a transformer be considered an amplifier? Explain. (3 marks)
(iii) The diagram in figure 1 is a transformer circuit.

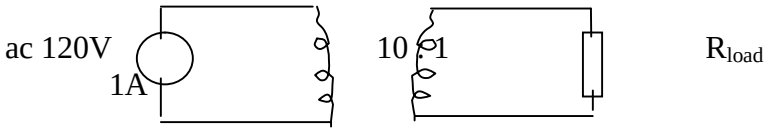


Fig. 1.

Determine the voltage V_c across R_{load}. (2 marks)

b) What must be the distance r between point charge q_1 = 26 μC and point charge q_2 = -47μC for the electrostatic force between them to have a magnitude 5.7N? (Let $1/4\pi\mathcal{E}_0 = 9x10^9$). (3 marks)

c) (i) What is a galvanometer? (1 mark)
(ii) Briefly explain its working principle. (3 marks)

d) The diagram in figure 2 shows a system of charges Q_1 = 10q, Q_2 = -12q and Q_3 = 5q placed as shown.

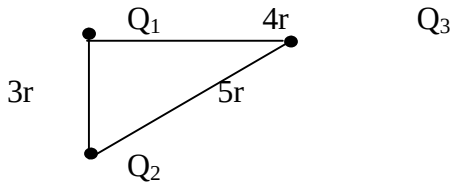
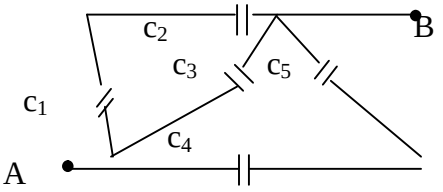


Fig 2.

Compute the electric potential energy E_p produced by the charges**.**
(Let $1/4\pi\mathcal{E}_0 = 9x10^9$). (6 marks)

e) Find the equivalent capacitance C_{eq} between points A and B in figure 3. (6 marks)



$c_1 = c_2 = c_3 = 2\mu F$
$c_4 = c_5 = 4\mu F$

Fig 3.

f) a) Draw the symbols of a *potentiometer* and a *rheostat*. (2 marks)
b) Cite any two difference between them. (2 marks)

SECTION B:

2. a) (i) Define magnetic flux. (2 marks)
(ii) State a fundamental difference between a magnetic flux and magnetic flux density . (2 marks).
(iii) Calculate the total magnetic flux produced by an electromagnet through a circular pole face of radius 50 mm if the flux density if 1.8T. (3 marks**)**

b) (i) As shown in figure 4, current i_1 produces 8N/Am magnetic field **B** at point P. Calculate the magnitude and direction of the total magnetic field produced by i_1 and i_2 at point Q. (10 marks)

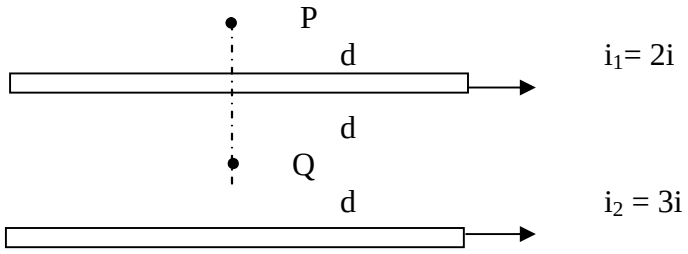


Fig. 4.

(ii) Name and state the rule that helps in finding the direction of the magnetic field created by a current-carrying wire. (3 marks)

3. a) (i) Define *electric field*. (1 mark)
(ii) State the superposition principle for the electric field. (1 mark)
(iii) Two point charges q_1 = +2nC and q_2 = -2nC are located at (-1,0) and (1,0) respectively. Calculate the force that q1 exerts on q2. Distances are in cm. (Let $1/4\pi\varepsilon_0 = 9x10^{9\ Nm2}/C^2$). (4 marks)
(iv) Name and state the law that helped you compute the force in (ii) above. (3 marks)

b) (i) Define an *electric potential*. (1 mark)
(ii) The classical picture of hydrogen atom has a single electron in orbit at a distance 0.0529 nm from the proton. Calculate the electric potential V associated with the proton's electric filed at this distance. (Electron charge = $1.6x10^{-19}$C). **(4 marks).**
(iii) Three point charges q_1 = + 2 μC, q_2 = +2μC and q_3 = +3μC are positioned at (-3,0), (3,0)and (0,4) respectively. Find the total potential energy U associated with the assembly of these charges. **(6 marks).**

4. a) State the Kirchoff's current and voltage laws**.** (4 marks)

b) Calculate the three unknown currents (i_1, i_2 and i_3) and three unknown voltages (v_{ab}, v_{bd} and v_{cb}) in the circuit of figure 5.
Use the loops shown. (16 marks)

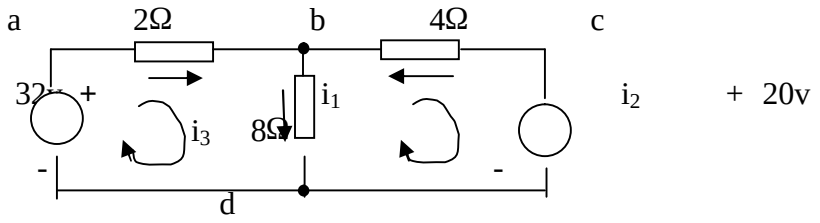


Fig. 5.

5. a) (i) State Faraday's law of electromagnetic induction. (2 marks)

(ii) A wire of loop of radius 10 cm has a resistance of 2Ω. The loop is at right angles to a uniform magnetic field **B**. The field is increasing at 0.1T/s. Calculate the magnitude of the induced current in the loop. (6 marks)

b) A solenoid with length 30 cm, radius 1.2 cm and 1000 turns carries a current of 2.6A. Find **B** on the axis of the solenoid;

(i) at the centre .

(ii) inside the solenoid at a point 10 cm from one end.

(ii) at one end. (Let $\mu_0 = 4\pi \times 10^{-7}$ Tm/A.) (12 marks)