KABARAK UNIVERSITY

EXAMINATIONS

2008/2009 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: **PHYS 110**

COURSE TITLE: **ELECTRICITY AND MAGNETISM I**

STREAM: **SESSION I**

DAY: **WEDNESDAY**

TIME: **9.00-11.00 AM**

DATE: **25/11/2008**

INSTRUCTIONS:

1. ***Answer question 1 and any other two questions.***
2. ***Question 1 carries 30 marks.***
3. ***All other questions carry 20 marks each.***
4. ***Where necessary use the constants below:***
   $K = 8.99 \times 10^{-12} C^2 N^{-1} m^{-2}$, $\varepsilon_o = 8.85 \times 10^{-12} C^2 N^{-1} m^{-2}$, $e = -1.6 \times 10^{-19} C$, $\mu_o = 4\pi \times 10^{-7} T.mA^{-1}$

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QUESTION 1 (30 MARKS)

a.) State Ampere's law. **(1 mark)**

b.) List two factors that affect the magnitude of induced e.m.f. E in a loop. (**2 marks)**

c.) Explain what you understand by the term magnetostriction. **(1 mark)**

d.) What is the magnitude of a point charge that would create an electric field of 1.00 N/C at points 1.00m away? **(3 marks)**

e.) Figure 1 below shows a full Gaussian surface enclosing two of the four positively charged particles; $q_1 = q_4 = +3.1nC$, $q_2 = -5.9nC$, $q_3 = -3.1nC$.

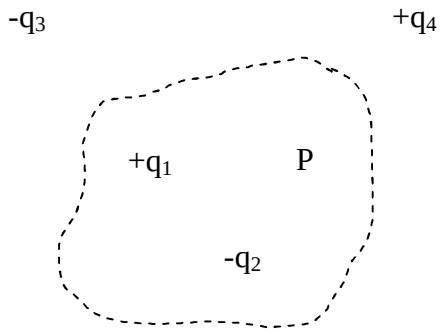

Fig 1

i.) Which of the particles contribute to the electric field at point P. **(1 Mark)**

ii.) What is the net electric flux through the surface? **(3 marks)**

f.) i) Find the equivalent capacitance for the combination of capacitances shown in figure 2 across which potential difference V is applied. Assume $C_1 = 12.0\mu F$, $C_2 = 5.30\mu F$ and $C_3 = 4.50\mu F$ **(2 marks)**

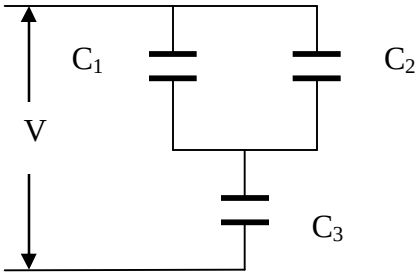

Fig 2

ii.) The potential difference that is applied to the input terminals in fig 2 is V = 12.5V, what is the charge on C_1? **(2 marks)**

iii.) Find potential difference across C_1. **(1 mark)**

g.) In fig 3 below $E_1 = 3V$, $E_2 = 1V$, $R_1 = 5\Omega$, $R_2 = 2\Omega$, $R_3 = 4\Omega$ and both batteries are ideal. What is the current through R_1, R_2, and R_3? **(5 marks)**

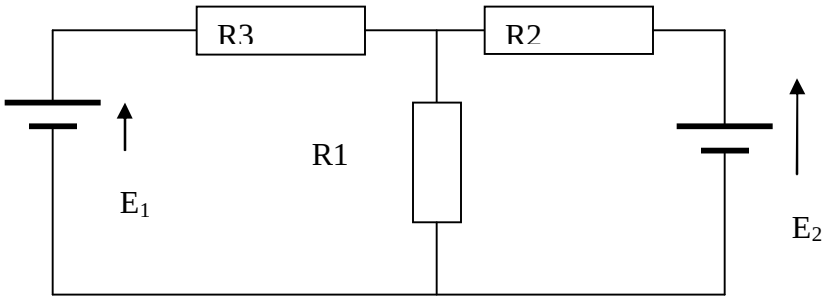

Fig 3

h.) i.) State Ohm's law. **(1 mark)**

ii.) Sketch a characteristic curve for a silicon diode. **(2 marks)**

i.) Show that the potential energy U of three charges is given as;

$$U = \left(\frac{q_1 q_2}{r_{12}} + \frac{q_1 q_3}{r_{13}} + \frac{q_2 q_3}{r_{23}} \right)$$ **(3 marks)**

j.) Show that torque on a current carrying coil is given as;

$\tau = \mu B \sin\theta$

Where μ = NIA – the magnetic moment. **(3 marks)**

QUESTION 2 (20 MARKS)

a.) Define eddy current. **(1 mark)**

b.) Two particles with equal charge magnitudes of 2.0×10^{-7}C but opposite sign are held 15 cm apart. What are the magnitude and direction of electric field **E** at the point midway between the charges? **(3 marks)**

c.) Show that the electric potential required to move a charge from r_1 to r_2 is given as

$$\Delta V = kq\left(\frac{1}{r_2} - \frac{1}{r_1}\right)$$ **(3 marks)**

d.) A disk of radius 5 cm is inclined at 40^0 to a uniform electric field **E** with magnitude 205 NC^{-1};
i.) What is the electric flux through the disk? **(2 marks)**
ii.) What is the flux through the disk if it is turned so that its normal is perpendicular to E? **(1 mark)**

e.) Fig 4 below shows a potentiometer with the readings as E_s = 1.5V, L_s = 197.4cm. If the length for the unknown e.m.f. is 201.2cm,

i.) Determine the e.m.f. of the e.m.f. source. **(2 marks)**

ii.) What factor limits the accuracy of a potentiometer? **(2 marks)**

f.) A uniform magnetic field **B** with magnitude 1.2mT is directed vertically upward throughout the volume of a laboratory chamber. A proton with kinetic energy 5.3MeV enters the chamber moving horizontally from South to North. What magnetic deflecting force acts on the proton as it enters the chamber? The proton mass is 1.67×10^{-27}kg. (Neglect the magnetic field of the earth) **(3 marks)**

g.) Calculate the potential created when work of 80J is used to move a charge of 2.0nC. Give your answer in MeV). **(2 marks)**

QUESTION 3 (20 MARKS)

a.) State Kirchoff's voltage and current laws. **(2 marks)**

b.) Fig 5 below shows a circuit whose elements have the following values; E_1 = 3.0V, E_2 = 6.0V, R_1 = 2.0Ω, R_2 = 4.0Ω. The three batteries are ideal. Find the magnitude and direction of the current in each of the three branches. **(5 marks)**

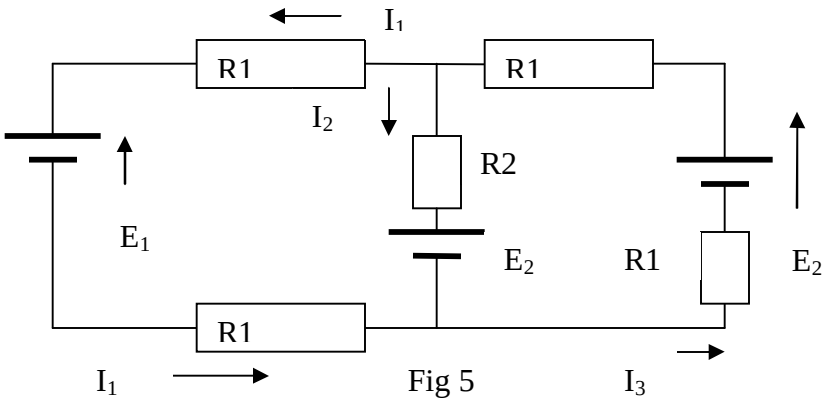

Fig 5

c.) Give the difference between diamagnetism and ferromagnetism. **(2 marks)**

d.) A conductor carries current from North to South creating a magnetic field of 8.0 x 10^{-6}T. Find the direction of this field and the magnitude of the current at a point 6cm from the wire. **(4 marks)**

e.) i.) Why is oil used in a transformer? **(1 mark)**

ii.) Primary coil of a transformer has potential difference of 450V and a current of 2A. If the secondary side has current of 0.5A, find the potential difference of the secondary part. What type of transformer is it? **(4 marks)**

iii.) Calculate the energy dissipated as heat in secondary coil if its resistance is 10MΩ. **(2 marks)**

QUESTION 4 (20 MARKS)

a.) Define magnetic permeability. **(1 mark)**

b.) Two parallel conductors carrying current in the same direction are placed close to each other. With reason show the direction of force existing between the conductors. **(2 marks)**

c.) i.) Define electric flux. **(1 mark)**

ii.) A flat sheet of paper of area 0.5m^2 is oriented so that the normal to the sheet is at an angle of 70^0 to a uniform electric field of magnitude 12 NC^{-1}. Find the magnitude of the electric flux through the sheet. **(3 marks)**

iii.) The electric flux through a closed surface is found to be 4.9Nm^2C^{-1}. What quantity of charge is enclosed by the surface? **(2 marks)**

d.) The network below shows resistors of varying sizes. Given that $R_1 = 100\Omega$, $R_2 = R_3 = 50\Omega$, $R_4 = 75\Omega$ and E = 6V, calculate;

i.) The total effective resistance R_T.
ii.) The current through R_1. **(2 marks)**

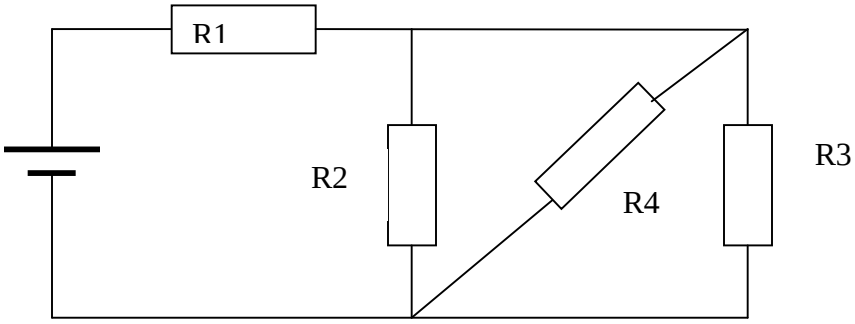

Fig 6

e.) Give an expression for charge q for a charging capacitor. **(1 mark)**

f.) Sketch a graph showing the variation of electric field E verses the distance r of the intensity of a sphere. **(2 marks)**

g.) Give two factors that affect the magnitude of a magnetic flux. **(2 marks)**

h.) Give two properties of charges. **(2 marks)**