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: **Y1S1**

DAY: **TUESDAY**

TIME: **8.30 -10.30 P.M.**

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:*
   $K = 8.99 \times 10^{-12} C^2 N^{-1} m^{-2}$, $\varepsilon_o = 8.85 \times 10^{-12} C^2 N^{-1} m^{-2}$, $e = -1.6 \times 10^{-19} C$, $\mu_o = 4\pi \times 10^{-7} T.mA^{-1}$

PLEASE TURN OVER

QUESTION 1 (30 MARKS)

a.) What do you understand by the term electric field? (1 mark)

b.) A positively charged ball is brought close to a neutral isolated conductor. The conductor is then grounded while the ball is kept close. Is the conductor charged positively or negatively, or is it neutral if

i.) the ball is first taken away and then the ground connection is removed and (1 mark)

ii.) The ground connection is first removed and then the ball is taken away?

c.) What must be the distance between point charge $q_1 = 26.0\mu C$ and point charge $q_2 = -47.0\mu C$ for the electrostatic force between them to have a magnitude of 5.70N? (3 marks)

d.) Draw electric field lines between two similar charges placed close to each other.(1 mark)

e.) Show that the flux Φ_E of the electric field through a closed surface of a cylinder is zero. (4 marks)

f.) What is the electric potential at point Y located at the center of the square of point charges shown in fig 1? The distance d is 1.3m and the charges are; $q_1 = +12nC$, $q_2 = -24nC$, $q_3 = +31nC$ and $q_4 = +17nC$.

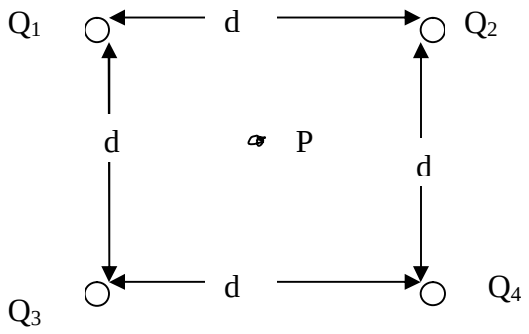

Fig 1

g.) In fig 2, the battery has a potential difference of 20V. Find

i.) The equivalent capacitance of all the capacitors. (2 marks)

ii.) The charge stored on that equivalent capacitance. (2 marks)

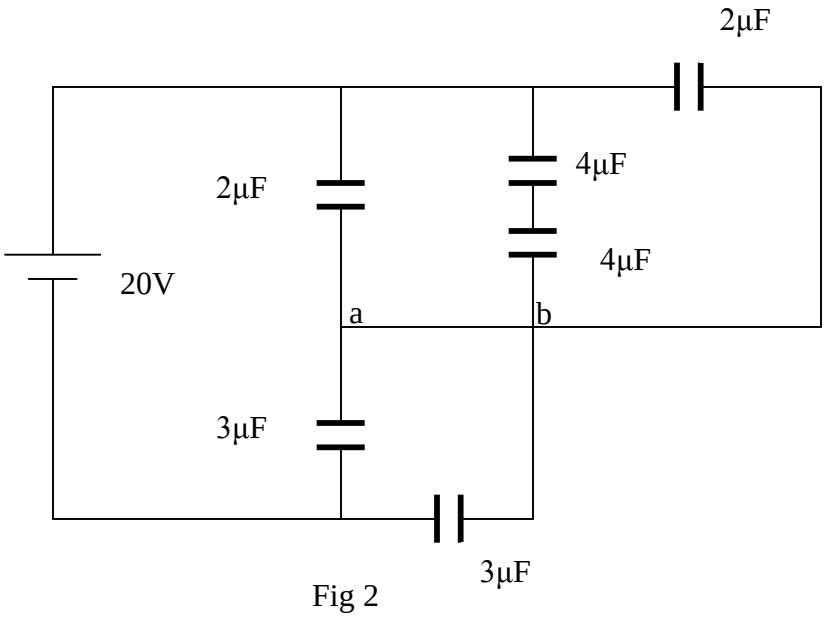

Fig 2

h.) A conducting wire has a 1.0mm diameter, a 2.0m length and a 50mΩ resistance. What is the resistivity of the material?

i.) Define eddy currents. (1 mark)

j.) A loop of wire with sides 20cm by 30cm is oriented at 60^0 to a magnetic field of 5T. The current in the loop is 2.0A in the direction shown in fig 3.

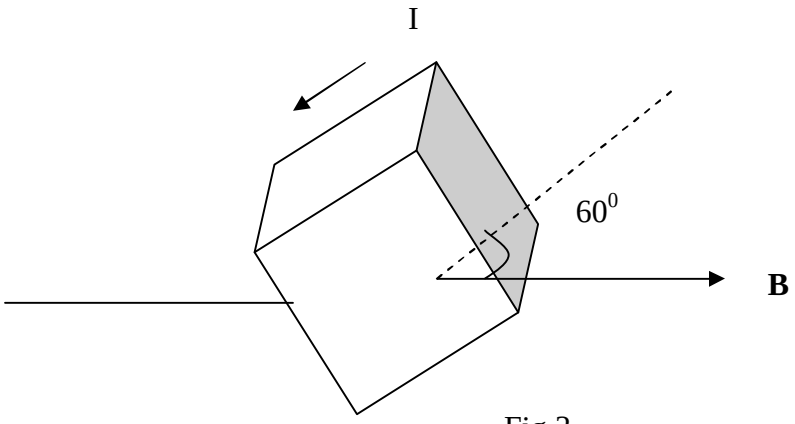

Fig 3

What is the magnitude of the torque at this instance? (3 marks)

k.) i.) Define the term magnetic flux. (1 mark)

ii.) Give two types of magnetism. (2 marks)

l.) State Faraday's law of magnetic induction. (1 mark)

m.) Name one source of energy loses in a transformer. (1 mark)

QUESTION 2 (20 MARKS)

a.) Positive electric charge Q is distributed uniformly throughout the volume of an insulating sphere with radius R. Find the magnitude of the electric field at a point P a distance r from the center of the sphere. (4 marks)

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

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

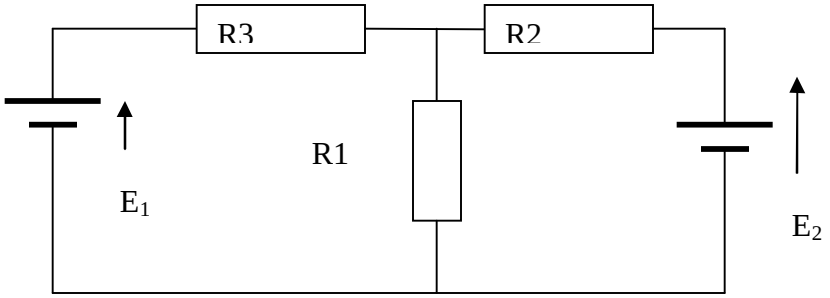

Fig 4

d.) An alpha particle travels at a velocity V of magnitude 550ms^{-1} through a uniform magnetic field of magnitude 0.045T. (An alpha particle has a charge of +3.2 x 10^{-19}C and a mass of 6.6 x 10^{-27}kg). The angle between V and B is 52^0. What are the magnitude of;

i.) The force F_B acting on the particle due to the field and (3 marks)

ii.) The acceleration of the particle due to F_B? (3 marks)

iii.) Does the speed of the particle increase, decrease or remain equal to 550ms^{-1}? Give reason. (2 marks)

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QUESTION 3 (20 MARKS)

a.) Give two conditions that affect capacitance of a capacitor. (2 marks)

b.) Show that in an RC circuit connected in series to each other and a battery $V_{bat,}$ the charge in the capacitor is given as;

$Q = V_{bat}C\ (1 - e^{-t/RC})$

Where the symbols have their usual meaning. Show every step clearly. (5 marks)

c.) Calculate the magnitude of the distance of a point charge 1.2×10^{-11} at which a field of 17.5N/C would be created. (3 marks)

d.) State Ampere's law. (1 mark)

e.) Give two ways in which magnetic flux through a coil can be varied. (2 marks)

f.) In the circuit of fig 5 the following are given; $E_1 = 6V$, $E_2 = 8V$, $R_1 = 2\Omega$, $R_2 = 10\Omega$ and $R_3 = 12\Omega$. The current directions are as shown. Calculate the values of currents through R_1, R_2 and R_3. (6 marks)

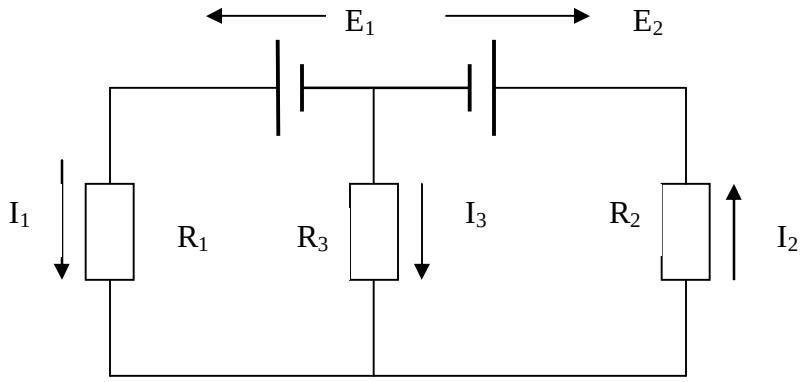

Fig 5

QUESTION 4 (20 MARKS)

a.) State Kirchoff's current law. (1 mark)

b.) Point charges q_1 and q_2 of +12nC and +12nC respectively are placed 0.10m apart (fig 6).

Compute the electric field caused by q_1, the field caused by q_2 and the total field at

i.) point a

ii.) point b

iii.) point c (9 marks)

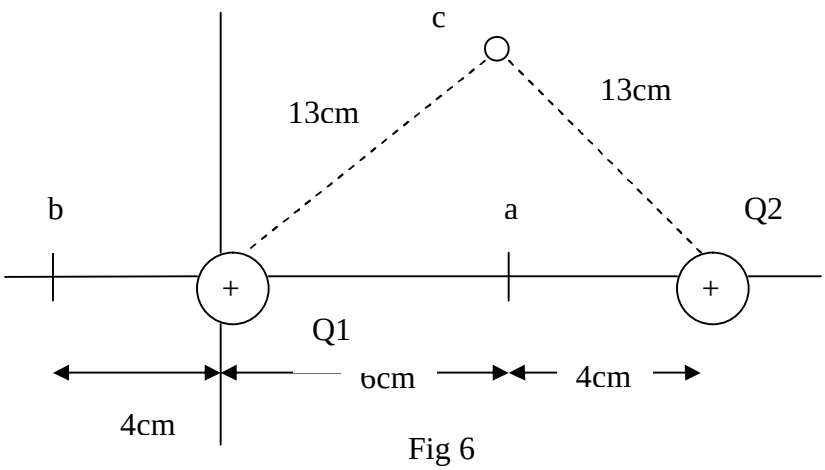

Fig 6

c.) Along straight wire carries current of 15A horizontally. Find the magnetic field at a distance of 0.3cm above the wire. (3 marks)

d.) The primary coil of a transformer has an input of 240V while the current is 0.10A. When the output is 9V, find;

i.) The output current. (2 marks)

ii.) The number of turns in secondary coil if primary coil has 2000 turns. (1 mark)

iii.) The power output (2 marks)

e.) Sketch a characteristic curve of a diode. (2 marks)