KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

2009/2010 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF COMPUTER SCIENCE

COURSE CODE: PHYS 110

COURSE TITLE: MECHANICS

STREAM: Y1S1

DAY: MONDAY

TIME: 9.00 – 11.00 A.M.

DATE: 07/12/2009

INSTRUCTIONS:
Answer question ONE and any other two.

You may need the following constants:

$\varepsilon_0 = 8.85x10^{12}\ F/m$; $\mu_0 = 4\pi x10^{-7}\ Tm/A$; $h = 6.626x10^{-34}$; $1eV = 1.6x10^{-19}\ J$;
electron charge $e = 1.6x10^{-19}\ C$, *electron mass* $= 9.11x10^{-31}\ kg$

PLEASE TURN OVER

Question ONE (30 marks)

(a) (i) Define electric current. Give its SI units (3 marks)

(ii) State how electrons can be made to move in a conductor. (1 marks)

(b) Explain why if temperature in a conductor is increased, resistance increases. (3 marks)

(c) Show that motion of a charged particle in a magnetic field is a circle, hence find the radius of motion of an electron moving in a magnetic field of 10 T at a velocity of $3x10^5$ m/s. (4 mks)

(d) (i) Define electric potential (2 marks)

(ii) Calculate the electric potential due to a 4 uC charge at a point 2 mm away. (3 marks)

(e) Illustrate the construction of the following types of capacitors

(i) Aluminum foil (3 marks)

(ii) Mica (3 marks)

(f) Calculate the magnetic field of a long straight conductor carrying a current of 10 A at a distance 8 cm from the wire. (3 marks)

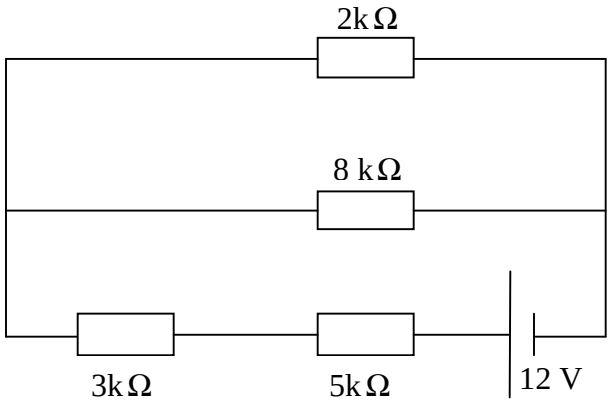
(g) State why a voltmeter is designed to have a very high resistance (1 marks)

(h) Given two components of magnetic field of magnitude 0.5 Tesla each, one pointing north - east and the other pointing eastwards, determine the magnitude and direction of the resultant magnetic field. (4 marks)

Question TWO (20 marks)

(a) (i) State Ohm's law (2 marks)

(ii) For the figure below, identify 3 loops and apply Kirchoff's rules to formulate the voltage equations for the loops, hence determine the current flowing in each resistor. (7 marks)



(b) (i) Define capacitance. Give its SI units. (2 marks)

(ii) You are provided with $2\mu F$, $3\mu F$ and $5\mu F$ capacitors. Show mathematically and diagrammatically how the capacitors can be combined to give

I. $10\mu F$ (3 marks)

II. $2.5\mu F$ (3marks)

III. $1.6\mu F$ (3 marks)

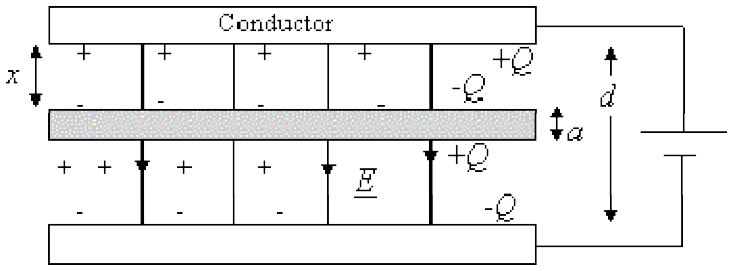
Question THREE (20 marks)

(a) (i) Define a dipole (1 mark)

(ii) Show that the electric field for a dipole can be expressed as $E = \frac{p}{4\pi\varepsilon_0 r^3}$ where p is the dipole moment (7 marks)

(b) The figure below shows a metal plate of thickness a inserted between capacitor plates. The charge, electric field and the plate separation are marked in the figure. Show that the capacitance is given by:

$C = \frac{\varepsilon_0 A}{d-a}$, where A is the area of each plate.



(7 marks)

(c) A conducting hollow sphere of radius 2 mm carries a charge of $2\mu F$. Calculate the Electric field

(i) At the centre of the sphere (2 marks)

(ii) At the surface of the sphere. (3 marks)

Question FOUR (20 marks)

(a) Explain the following types of magnetism

(i) Diamagnetism (2 marks)

(ii) Ferromagnetism (2 marks)

(iii) Paramagnetism (2 marks)

(b) Explain the difference between the magnetic hysteresis loop of steel and soft iron. (4 marks)

(c) Derive the expression for the force between two straight parallel conductors carrying current in the same direction. (4 marks)

(d) The galvanometer is simply a coil and a permanent magnetic. Explain quantitatively its principle operation. (6 marks)