UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2009/2010

SUBJECT	:	FIZIK III
CODE	:	DSF 2913
COURSE	:	1 DFA/ 2 DFA
DATE	:	APRIL 2010
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER ANY 5 QUESTIONS

THIS EXAMINATION PAPER CONSISTS OF SEVEN (7) PAGES

Q1 (a) Define Coulomb's law of electrostatic forces.

(2 marks)

(b) A charge Q exerts a 12 N force on another charge q. If the distance between the charges is doubled, what is the magnitude of the force exerted on Q by q?

(3 marks)

(c) A +2.0 nC point charge is at the origin, the other point charge -5.0 nC is on the x-axis at $x = 0.8$ m.

(i) Find the electric field (magnitude and direction) at $x = 0.2$m, 1.2m, -0.2m

(ii) Determine the net electric force that the two charges would exert on an electron placed at each point in part (ii).

(15 marks)

Q2 (a) Two positive point charges are separated by a distance R. If the distance between the charges is reduced to $R/2$, what happens to the total electric potential energy of the system?

(4 marks)

(b) Three point charges $-Q$, $-Q$, and $+3Q$ are arranged along a line as shown in **Figure Q2(b)**. Express the electric potential at the point **P** in terms of Q?

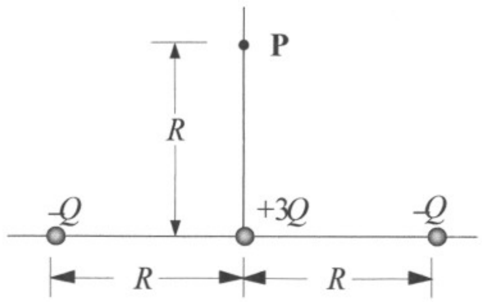

Figure Q2(b)

(9 marks)

(c) **Figure Q2(c)** shows cross sections of equipotential surfaces between two charged conductors that are shown in solid grey. Various points on the equipotential surfaces near the conductors are labeled **A, B, C, ..., I.**

(i) What is the potential difference between points **B** and **E**?
(ii) What is the direction of the electric field at **B**? How do you define your answer?
(iii) A point charge gains 50 μJ of electric potential energy when it is moved from point **D** to point **G**. Determine the magnitude of the charge.

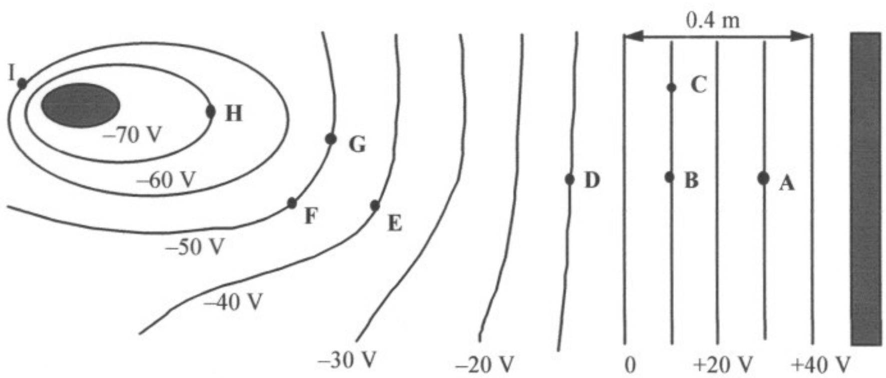

Figure Q2(c)

(7 marks)

Q3 The plates of a parallel plate capacitor each have an area of 0.40 m^2 and are separated by a distance of 0.02 m. They are charged until the potential difference between the plates is 3000 V. The charged capacitor is then isolated.

(a) Determine the magnitude of the electric field between the capacitor plates.

(4 marks)

(b) Determine the value of the capacitance.

(4 marks)

(c) Determine the magnitude of the charge on either capacitor plate.

(3 marks)

(d) How much work is required to move a –4.0 μC charge from the negative plate to the positive plate of this system?

(3 marks)

(e) Suppose that a dielectric sheet is inserted to completely fill the space between the plates and the potential difference between the plates drops to 1000 V. What is the capacitance of the system after the dielectric is inserted? Calculate the dielectric constant.

(6 marks)

Q4 (a) A non-ideal battery has a 6.0 V *emf* and an internal resistance of 0.6 Ω. Determine the terminal voltage when the current drawn from the battery is 1.0 A.

(4 marks)

(b) Five resistors are connected as shown in **Figure Q4(b)**. The potential difference between points ***A*** and ***B*** is 25 V.

(i) What is the equivalent resistance between the points **A** and **B**?
(ii) What is the current through the 3.6 Ω resistor?
(iii) What is the current through the 1.8 Ω resistor?
(iv) What is the potential drop across the 3.5 Ω resistor?

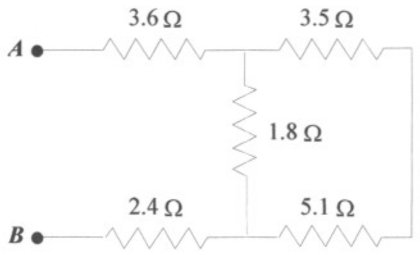

Figure Q4(b)

(16 marks)

Q5 (a) A particle with a speed of 50 ms^{-1} enters a uniform magnetic field whose magnitude is 0.20 T. The magnitude of the charge is 1.6×10^{-19} C. For each of the cases, *(X)*, *(Y)* and *(Z)* as shown in the **Figure Q5(a)**, find the magnitude and the direction of the magnetic force on the particle.
Note: particle for case (*Z*) is negative particle.

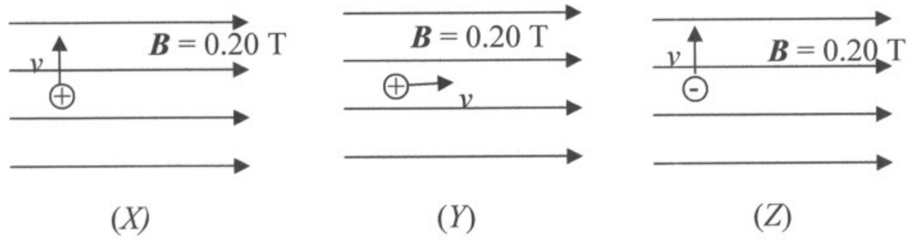

Figure Q5(a)

(8 marks)

(b) Three long, straight parallel wires carry currents $I_1 = 10$ A, $I_2 = 20$ A and $I_3 = 30$ A respectively and fix on horizontal plane as shown in **Figure Q5(b)**. The direction of I_1 is perpendicularly out of the page whereas I_2 and I_3 is perpendicularly into the page. Determine

(i) The magnetic field strength experienced by the wire I_2.
(ii) The net magnetic force per meter experienced by the wire I_2.

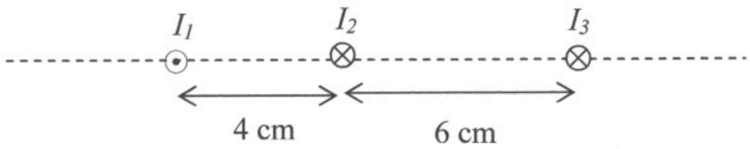

Figure Q5(b)

(12 marks)

Q6 (a) State the Faraday's law of electromagnetic induction.

(3 marks)

(b) A copper square coil with dimension 20 cm on each side slides horizontally through a region of uniform magnetic field $\boldsymbol{B} = 2.0$ T, with constant velocity $v = 0.02$ ms^{-1}. The direction of magnetic field is perpendicularly downward of the page. The coil is moved from position *(P)*, *(Q)*, *(R)* and *(S)* as shown in **Figure Q6(b)**. The region outside the dotted line has zero magnetic fields.

(i) Find the magnitude of the induced emf in the coil at the position *(P)* and position *(Q)*.
(ii) Determine the direction of the induced current in the coil for each position.

(iii) Find the induced current in the coil at the position (*R*) if the coil's resistance is 0.70 ohms.

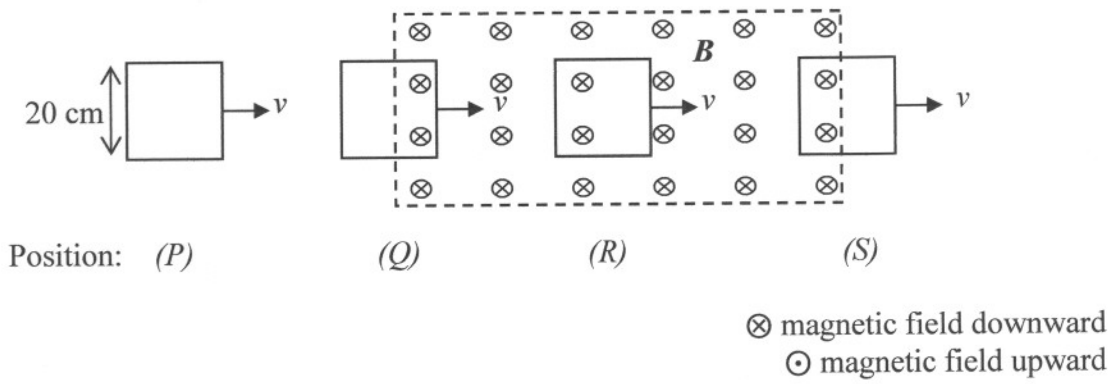

Figure Q6(b)

(17 marks)

Q7 (a) Name one experimental evidence (each) to indicate

(i) Waves can exhibit particle-like characteristics.
(ii) Particles can exhibit wave-like properties.

(4 marks)

(b) State the Einstein's theory regarding quantization of energy of electromagnetic waves radiation.

(3 marks)

(c) An electron moving with kinetic energy of 1000 eV. What is the *de Broglie* wavelength of the particle?

(4 marks)

(d) The work function for ceasium is 2.14 eV. When light illuminates on a ceasium surface, the maximum kinetic energy of an electron ejected from the surface is 0.96 eV. What is the wavelength of the illuminating radiation?

(9 marks)

LIST OF CONSTANTS AND FORMULA

Acceleration due to the gravity, $g = 9.8\ ms^{-2}$
Speed of light, $c = 3 \times 10^{8}\ ms^{-1}$
Elementary charge, $e = 1.6 \times 10^{-19}$ C
Electron mass, $m_e = 9.1 \times 10^{-31}$ kg
Permittivity constant, $\varepsilon_\circ = 8.85 \times 10^{-12}\ C^2N^{-1}m^{-2}$
Coulomb constant, $k = 9.0 \times 10^{9}\ Nm^2C^{-2}$
Permeability constant, $\mu_\circ = 1.26 \times 10^{-6}\ NA^{-2}$
Planck's constant, $h = 6.63 \times 10^{-34}$ Js

$F_{12} = \frac{kq_1q_2}{r^2}$ $E = \frac{F}{q_\circ}$; $E = \frac{kq}{r^2}$ $V = \sum \frac{kq}{r}$ $C = \frac{Q}{V}$ $C = \frac{K\varepsilon_\circ A}{d}$ $K = \frac{C}{C_\circ} = \frac{V_\circ}{V}$ $U = \frac{1}{2}CV^2 = \frac{1}{2}QV$	$V = IR$ $R_{eq} = R_1 + R_2 + ..$ $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + ..$ $V_{ab} = \varepsilon - Ir = IR$ $P = V_{ab}I = I^2R$ $V_{ab} = V_b - V_a$ $\sum I = 0$ $\sum \Delta V = 0$ $\sum \varepsilon = \sum IR$	$F = qvB\sin\theta$ $F = ilb\sin\theta$ $F_{21} = \frac{\mu_\circ I_1 I_2 l_2}{2\pi d}$ $B = \frac{\mu_\circ I}{2\pi r}$ $B = \mu_\circ nI$ $\phi = BA\cos\theta$ $\varepsilon = -\frac{\Delta\phi}{\Delta t}$ $\varepsilon = -Blv$ $E = hf = h\frac{c}{\lambda}$ $E = \Phi + K_{max}$ $p = \frac{h}{\lambda}$; $p = \sqrt{2mK}$ $K_{max} = eV_\circ$