INTI INTERNATIONAL UNIVERSITY

FOUNDATION IN SCIENCE (CFSI)
PHY1204: GENERAL PHYSICS 2
FINAL EXAMINATION: JUNE 2015 SESSION

Instruction: This paper consists of **FIVE (5)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Question 1

(a) Find the equivalent resistance between the point *P* and *Q* as shown in Figure Q1(a).

(3 marks)

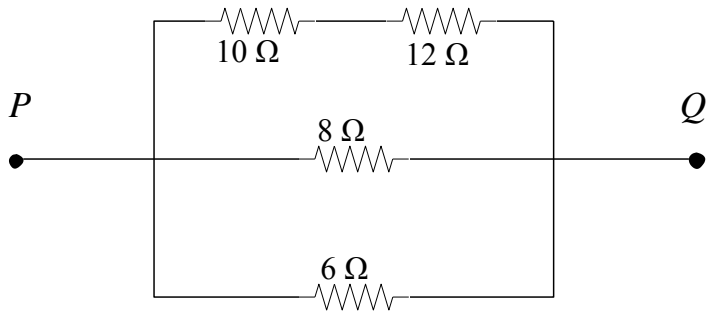

Figure Q1(a)

(b) An electric heater is operated at a potential difference of 110 V. When the device is heating the water, a current of 3.5 A is flowing across the resistor in the device.

(i) Calculate the power produced as thermal energy.

(2 marks)

(ii) Calculate the resistance of the device.

(2 marks)

(c) A monochromatic light of wavelength 445 nm is incident on a narrow slit. On a screen 2 m away, the distance between the fifth diffraction minimum and the central maximum is 3.5 cm.

(i) Calculate the angle of diffraction of the fifth minimum.

(3 marks)

(ii) Find the width of the slit.

(3 marks)

(d) Calculate the current through each resistor in Figure Q1(d).

(12 marks)

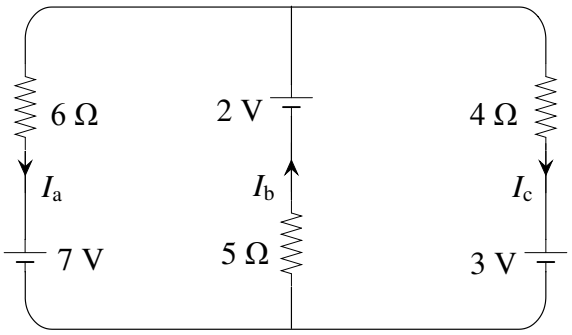

Figure Q1(d)

Question 2

(a) Three charged particles lie on the *xy*-axis are shown in Figure Q2(a).

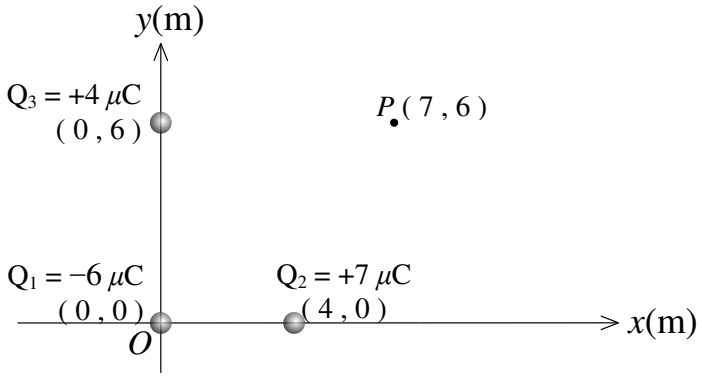

Figure Q2(a)

(i) Draw a free body diagram for the electric field at point *P* due to the charges Q_1, Q_2 and Q_3.

(3 marks)

(ii) By ignoring the effect between the charges, calculate the net electric field at point *P* due to all the charge.

(12 marks)

(iii) To what direction respect to the positive *x*-axis does the net electric field point to due to all the charges?

(4 marks)

(b) The charges and coordinates of two charged particles held fixed along the *x*-axis are listed as follow:

Particle	**Charge (μC)**	**Coordinates (cm)**
A	+3	(4 , 0)
B	−9	(12 , 0)

At what coordinate should a third particle of any charge be placed such that the net electrostatic force on that particle due to the other two particles is zero?

(6 marks)

Question 3

(a) Two long straight wires are parallel and 8 mm apart. The wires carry 1.2 A current each in opposite direction.

(i) Calculate the magnitude of the force per unit length acting on each wire due to the other wire.

(2 marks)

(ii) Is the force attractive or repulsive?

(1 mark)

(b) The total electric flux through a cubical Gaussian surface is 5.65×10^5 Nm^2/C. Given that the flux are pointing inwards.

(i) Calculate the charge enclosed by the surfaces.

(2 marks)

(ii) Another charge of +9 μC is now placed into the cubical Gaussian surface. Calculate the total electric flux through the cubical Gaussian surface.

(3 marks)

(c) A thin rod bent into the shape of an arc of a circle of radius 15 cm carries a charge of −8 μC. The arc subtends an angle as shown in Figure Q3(c).

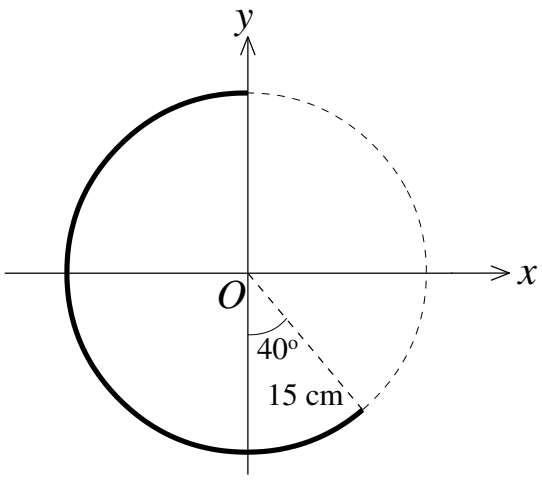

Figure Q3(c)

(i) Calculate the length of the rod.

(3 marks)

(ii) Calculate the linear charge density of the rod.

(2 marks)

(iii) Determine the magnitude of the electric field at the origin *O*.

(4 marks)

(iv) In what direction does the electric field at the origin *O* point to?

(2 marks)

(d) Two spherical charges are given as Q_A = 12 μC and Q_B = −4 μC. These spherical charge are separated by a fixed distance and the force on them is measured to be 120 N. A third neutral non-conducting sphere is touched first to Q_A, then to Q_B, and finally removed. Calculate the new force acting on these two spherical charges.

(6 marks)

Question 4

(a) Figure Q4(a) shows an electron shot at a speed of 2×10^6 m/s perpendicularly into a region of magnetic field is making a circular path rounding a fix point O at a radius of r = 6.3 cm. Calculate the magnetic field in the region.

(3 marks)

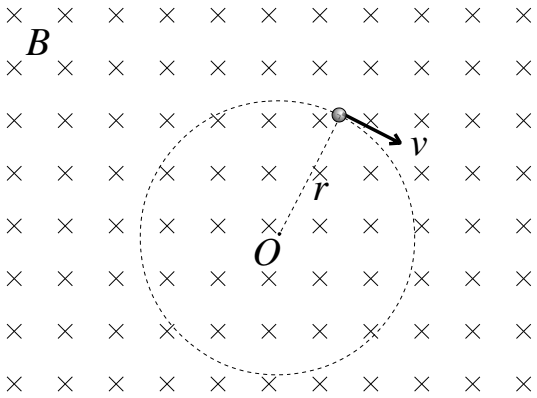

Figure Q4(a)

(b) In Figure Q4(b), current I = 0.35 A is set up between point A and B. Given that the radial length of the larger arc R_1 = 5 cm and the smaller arc R_2 = 3 cm.

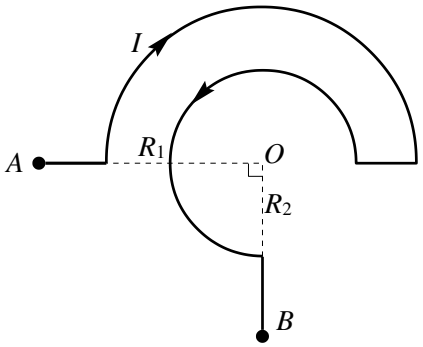

Figure Q4(b)

(i) Calculate the magnitude of the magnetic field at the center of the arcs.

(4 marks)

(ii) Is the direction of the magnetic field pointing inward or outward?

(1 mark)

(c) A 600 turns air-core solenoid of length 40 cm carries a current of 1.5 *A*.

(i) What is the magnetic field strength at the center of the solenoid?

(3 marks)

(ii) On a simple diagram, show the direction of the magnetic field together with the direction of the current on the solenoid.

(2 marks)

(d) The cuboid is 2 m wide, 3 m long, and 2 m high, and is oriented as shown in Figure Q4(d). The cuboid is in a region of uniform electric field, $\vec{E} = (5\hat{i} - 4\hat{k}) \times 10^{3}$ N/C. Find the electric flux through the

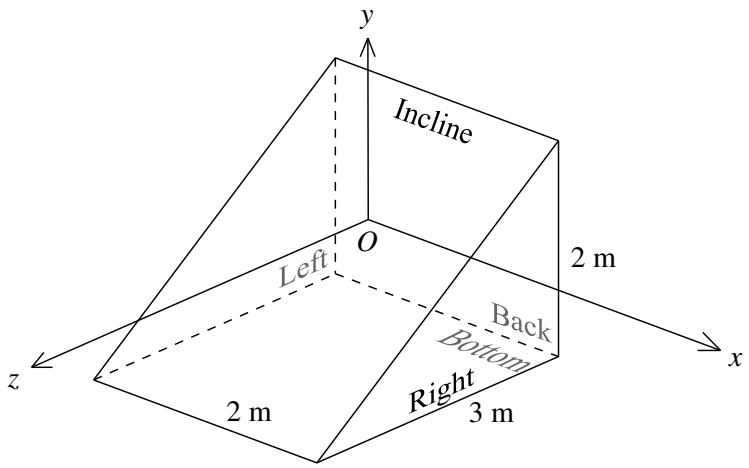

Figure Q4(d)

(i) left face,

(3 marks)

(ii) incline face, and

(3 marks)

(iii) bottom face.

(3 marks)

(e) A direct current is supplied onto an *RL* circuit of which R = 50 Ω and L = 6.3 mH. Calculate the inductive time constant and the half-life of the the circuit.

(3 marks)

Question 5

(a) If the current in a 180 mH coil drops steadily from 2.5 mA to zero in 3.2 ms, what is the induce emf?

(3 marks)

(b) Find the equivalent capacitance of the combination in Figure Q5(b). Given that C_1 = 470 μF, C_2 = 350 μF, C_3 = 240 μF and C_4 = 610 μF.

(4 marks)

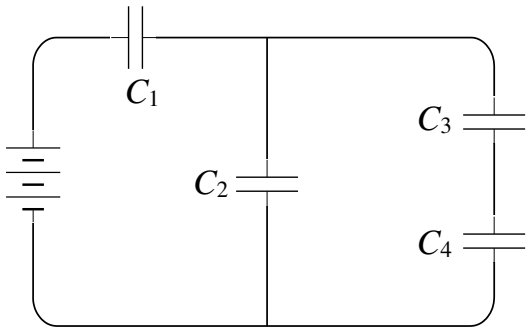

Figure Q5(b)

(c) A parallel-plate air-filled capacitor having plate area of 48 cm by 1.7 cm and plate spacing of 0.2 mm is charged to a potential difference of 2 V. Find

(i) the capacitance of the capacitor,

(3 marks)

(ii) the magnitude of the charge on each plate,

(2 marks)

(iii) the energy stored in the capacitor,

(2 marks)

(iv) the electric field between the plates, and

(2 marks)

(v) the new capacitance of the capacitor if the region between the plates is now filled with material having dielectric of κ = 4.2.

(2 marks)

(d) A 15 kΩ resistor and a capacitor are connected in series. A 9 V potential difference applied across the combination. Given that when the circuit is open, the capacitor discharges through the resistor. It was measured that the potential difference across the capacitor drops to 7 V in 13.3 s.

(i) Calculate the time constant of the circuit.

(4 marks)

(ii) Calculate the capacitance of the capacitor.

(3 marks)

-- **THE END** --