INTI INTERNATIONAL UNIVERSITY

FOUNDATION IN SCIENCE (CFSI)
PHY1204: GENERAL PHYSICS 2
FINAL EXAMINATION: JANUARY 2014 SESSION

Instructions: 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) The resistivity of Nichrome is 1.5×10^{-6} Ωm. Given that the radius of a Nichrome wire is measured to be 0.321 mm, calculate the resistance of 10 m long of this Nichrome wire.

(3 marks)

(b) A coil has an inductance of 30 mH and an internal resistance of 6 Ω. A direct current of 120 mA is applied across the coil.

(i) How much energy is stored as magnetic field after the current has built up to its equilibrium value?

(2 marks)

(ii) What is the inductive time constant of the inductor?

(2 marks)

(c) An alternating current of V_{max} = 150 V, f = 60 Hz is applied across an *RLC* circuit containing a resistor of R = 425 Ω, an inductor of L = 1.25 H, and a capacitor of C = 3.5 μF.

(i) Find the angular frequency of the current.

(2 marks)

(ii) Calculate the inductive reactance of the circuit.

(2 marks)

(iii) Calculate the capacitive reactance of the circuit.

(2 marks)

(iv) Find the impedance of the circuit.

(3 marks)

(v) Find the phase angle of the impedance.

(2 marks)

(vi) Briefly describe the resonant frequency of an *RLC* circuit.

(2 marks)

(vii) Calculate the resonant frequency of the circuit.

(2 marks)

(d) Figure Q1(d) shows the cross section of a spherical capacitor with the inner radius a = 7 cm and outer radius b = 10 cm. Calculate the capacitance of the capacitor.

(3 marks)

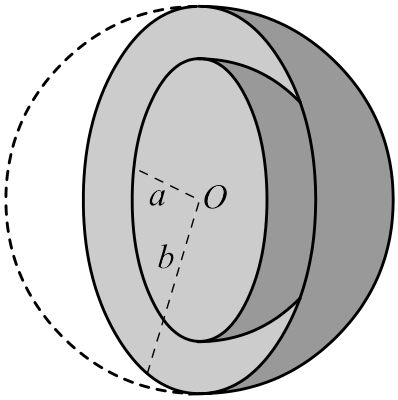

Figure Q1(d)

Question 2

(a) A thin 40 cm long solenoid has a total of 1000 turns of loops. A current of 1.25 A is flowing across the solenoid.

(i) Calculate the number of loops per meter length of the solenoid.

(2 marks)

(ii) Calculate the magnetic field generated at the center of the solenoid.

(3 marks)

(iii) By drawing a simple diagram, label and show the direction of magnetic field at the center of the solenoid.

(3 marks)

(iv) If the solenoid is cut into half of its initial length, what will be the magnetic field near the center of this shorter solenoid if the same value of current is flowing across it?

(3 marks)

(b) (i) Describe Kirchhoff's junction rule.

(2 marks)

(ii) Calculate the currents I_a, I_b and I_c as shown in Figure Q2(b).

(12 marks)

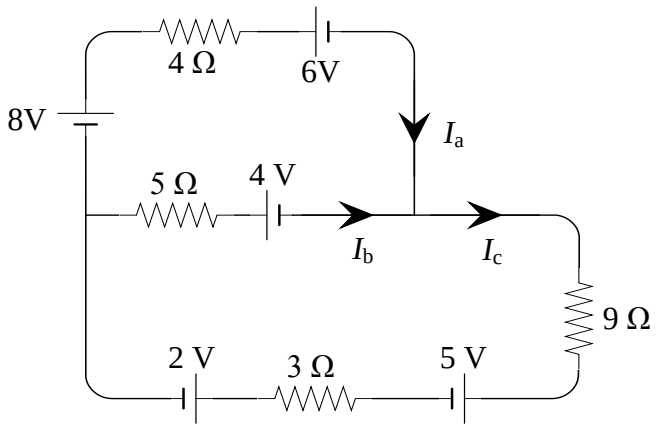

Figure Q2(b)

Question 3

(a) A charge of magnitude of +6 μC is uniformly distributed along a non-conducting thin line of length
20 cm.

(i) Calculate the linear charge density of the line.

(3 marks)

(ii) Calculate the electric field at a point 10 cm away from the center of the line directly perpendicular to the axis of the line.

(3 marks)

(iii) Describe the direction of the electric field respect to the axis of the line.

(2 marks)

(b) The total electric flux through a cubical Gaussian surface is 7.34×10^5 Nm^2/C. Given that the flux are pointing outward,

(i) calculate the charge enclosed by the surfaces.

(2 marks)

(ii) Another charge of -8 μC is now placed inside the cubical Gaussian surface. Calculate the total electric flux through the cubical Gaussian surface.

(4 marks)

(c) When two sources of light emit through the same medium in the same direction, interference patterns are observed when projected on a screen. This is happening only if the two sources are coherent.

(i) Briefly describe the properties of coherent sources.

(2 marks)

(ii) A slide containing two slits with 0.1 mm apart is put 1.2 m from the viewing screen. It was observed that the separation of the first bright interference fringe from the central axis projected on the screen is 7.2×10^{-3} m apart. Calculate the wavelength and frequency of the light.

(4 marks)

(d) A circular ring of radius R = 5 cm is shown in Figure Q3(d). Given that the ring carries a charge of +6 μC.

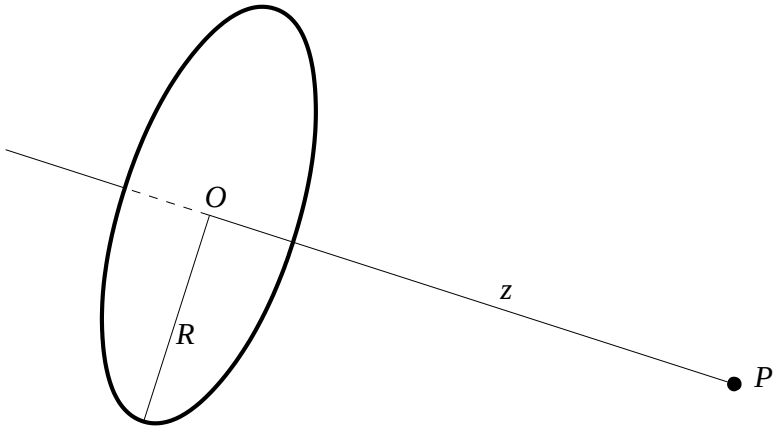

Figure Q3(d)

(i) Calculate the magnitude of the electric field at a point P as shown in Figure Q3(d) where z = 15 cm.

(3 marks)

(ii) Calculate the magnitude of the electric field at a point P_2 if z = 15 m which is very much larger than its radius.

(2 marks)

Question 4

(a) Two charged particles lie on the *xy*-axis are shown in Figure Q4(a). By ignoring the effect between the charges, calculate the electric potential at point *P* due to both of the charges.

(8 marks)

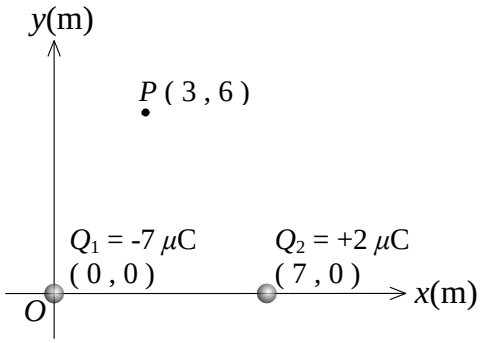

Figure Q4(a)

(b) In Figure Q4(b), current I = 0.65 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,

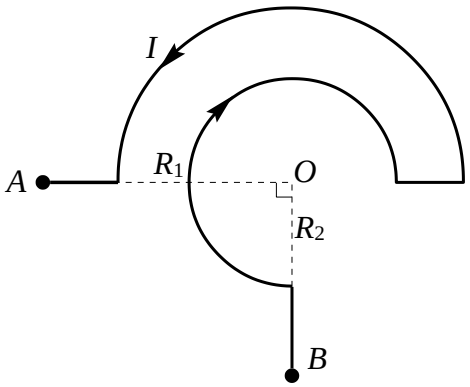

Figure Q4(b)

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

(6 marks)

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

(1 mark)

(c) Light from a monochromatic source strikes a diffraction grating that has 600 lines per centimeter. Diffraction patterns are shown on a screen 1.5 m from the grating. It was measured that the first order of minima at both side from the central axis are separated by 11.2 cm. Determine the wavelength of the laser light.

(3 marks)

(d) A converging lens focuses an upright object 2.85 m away as an image 48.3 cm on the other side of the lens.

(i) Find the focal length of the lens.

(2 marks)

(ii) Draw a simple ray diagram on the focusing process.

(2 marks)

(iii) What are the properties of the image?

(3 marks)

Question 5

(a) Two wire cords of 30 cm long are 2 mm apart and both carrying a direct current of 0.5 A flowing in the same direction.

(i) Calculate the magnitude of the force between these wires.

(2 marks)

(ii) Is the force attractive or repulsive?

(1 mark)

(b) Figure Q5(b) shows a combination of six capacitor. Given that C_1 = 350 μF, C_2 = 470 μF and V = 12 V. Calculate

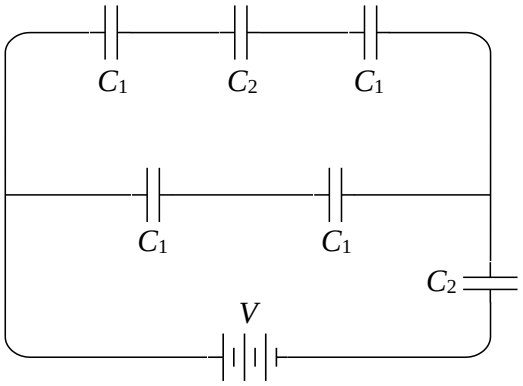

Figure Q5(b)

(i) the equivalence capacitance of the combination,

(6 marks)

(ii) the total charge stored in the combination circuit, and

(2 marks)

(iii) the energy stored in the combined capacitor.

(2 marks)

(c) A storage battery has emf ε = 12 V. When it is connected through a resistor of 5 kΩ resistance, a current of 2.2 mA was measured across the entire circuit. Calculate the internal resistance of the battery.

(3 marks)

(d) Calculate the energy of a photon of blue light of which wavelength λ = 450 nm. Give the answer in the unit of eV.

(3 marks)

(e) Find the equivalent resistance across the terminal *A* and *B* in Figure Q5(e). Given that R_1 = 51 Ω, R_2 = 63 Ω, R_3 = 45 Ω , R_4 = 32 Ω, and R_5 = 72 Ω.

(6 marks)

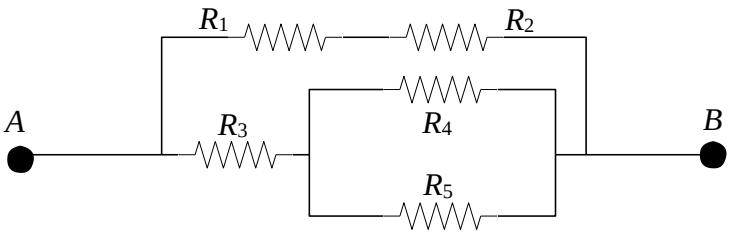

Figure Q5(e)

-- THE END --

PHY1204(F)/JAN2014/LOHSK/200314