

INTI INTERNATIONAL UNIVERSITY

FOUNDATION IN SCIENCE (CFSI)
 PHY1204: GENERAL PHYSICS 2
 FINAL EXAMINATION: AUGUST 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) Describe Kirchhoff's rule.

(5 marks)

(b) Figure Q1(b) shows a simple two loops circuit.

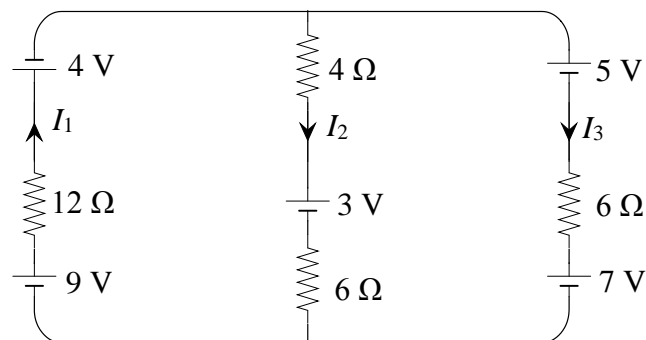


Figure Q1(b)

(i) Simplify the circuit at each section shown in Figure Q1(b).

(3 marks)

(ii) Calculate the current I_1 , I_2 and I_3 .

(8 marks)

(iii) With the help of a simple diagram, show the correct direction of the current at each section.

(3 marks)

(c) Find the equivalent resistance across the terminal A and B in Figure Q1(c). Given that $R_1 = 51 \Omega$, $R_2 = 63 \Omega$, $R_3 = 45 \Omega$, $R_4 = 32 \Omega$, and $R_5 = 72 \Omega$.

(6 marks)

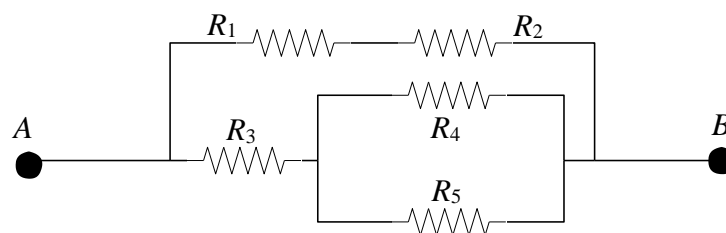


Figure Q1(c)

Question 2

- (a) A thin rod bent into the shape of an arc of a circle of radius 12 cm carries a charge of $-9 \mu\text{C}$. The arc subtends an angle as shown in Figure Q2(a).

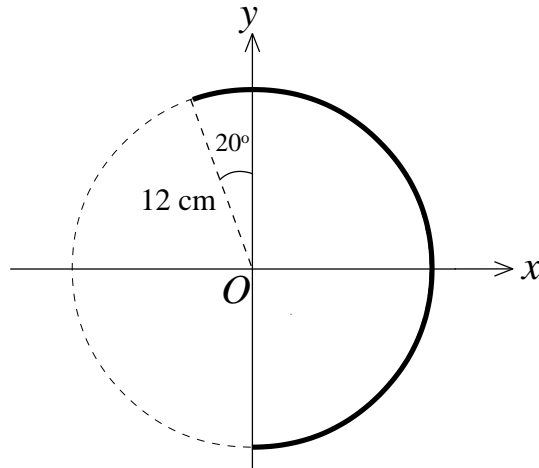


Figure Q2(a)

- (i) Calculate the length of the rod. (2 marks)
- (ii) Calculate the linear charge density of the rod. (3 marks)
- (iii) Determine the magnitude of the electric field at the origin O . (3 marks)
- (iv) In which direction does the electric field at the origin O point to? (2 marks)
- (b) The total electric flux through a cubical Gaussian surface is $5.65 \times 10^5 \text{ Nm}^2/\text{C}$. Given that the flux is pointing inward.
- (i) Calculate the charge enclosed by the surfaces if the edge length of the cube is given to be 40 cm. (2 marks)
- (ii) Another charge of $+7 \mu\text{C}$ is now placed into the cubical Gaussian surface. Calculate the total electric flux through the cubical Gaussian surface. (3 marks)
- (c) An ac current is given by $I(t) = 3\sin 240 t$, where I is in amperes, and t is in seconds.
- (i) Calculate the frequency of the current. (2 marks)
- (ii) What is the peak value of the current? (1 mark)
- (iii) Calculate the rms value of the current. (2 marks)

- (d) A 600 turns air-core solenoid of length 40 cm carries a current of 13 A.
- Determine the magnetic field strength at the center of the solenoid. (3 marks)
 - On a simple diagram, show the direction of the magnetic field together with the direction of the current on the solenoid. (2 marks)

Question 3

- (a) A circular ring of radius $R = 4$ cm is shown in Figure Q3(a). Given that the ring carries a charge of $+6 \mu\text{C}$.

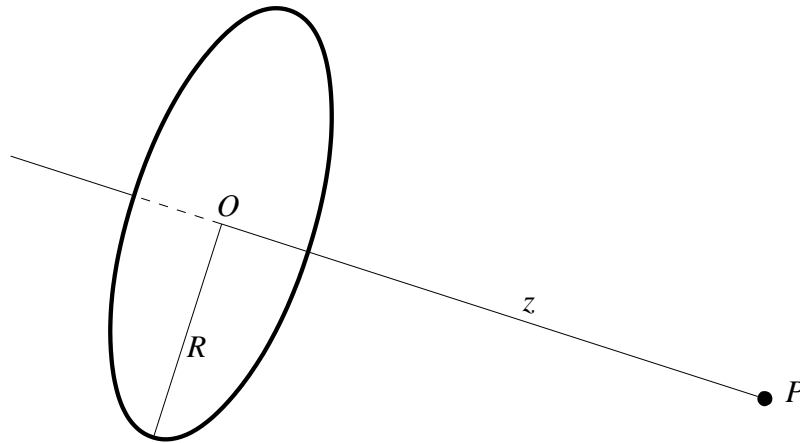


Figure Q3(a)

- Calculate the magnitude of the electric field at a point P as shown in Figure Q3(a) where $z = 12$ cm. (3 marks)
 - Calculate the magnitude of the electric field at a point P_2 if $z = 12$ m which is very much larger than its radius. (2 marks)
- (b) Figure Q3(b) shows the cross section of a spherical capacitor with the inner radius $a = 10$ cm and outer radius $b = 12$ cm. Calculate the capacitance of the capacitor. (3 marks)

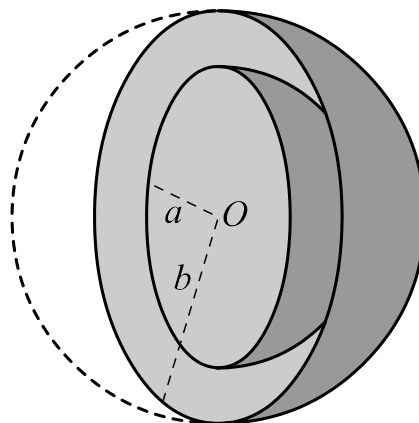


Figure Q3(b)

- (c) Two long straight wires are parallel and 8 cm apart. The wires carry 1.5 A current in opposite direction.
- Calculate the magnitude of the force per unit length acting on each wire due to the other wire. (2 marks)
 - Is the force attractive or repulsive? (1 mark)
- (d) Figure Q3(d) 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 $r = 5.7$ cm.

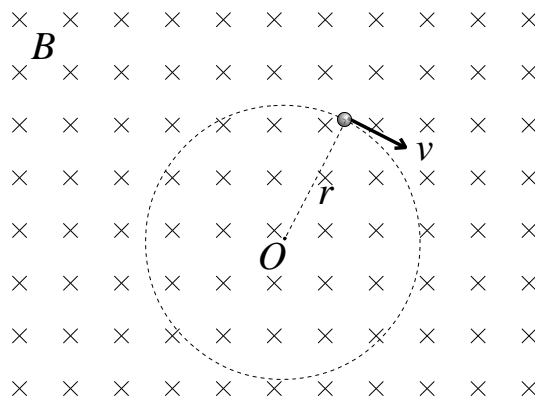


Figure Q3(d)

- Calculate the magnetic field in the region. (3 marks)
 - If the electron is now replaced by a proton with the same speed and same magnetic field, describe the different occur on the path. (2 marks)
- (e) A current of $I = 0.85$ A is set up between point A and B. Given that the radial length of the arcs are 1 cm, 2 cm and 3 cm as shown in Figure Q3(e)

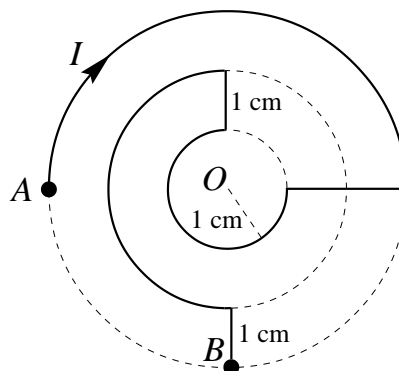


Figure Q3(e)

- Calculate the magnitude of the magnetic field at the center of the arcs. (4 marks)
- Is the direction of the magnetic field pointing inward or outward?

(1 mark)

- (f) Monochromatic light from a helium-neon laser with a wavelength of 632 nm is incident normally on a diffraction grating containing 6000 grooves per centimeter. Find the angle at which the first order minima being observed.

(4 marks)

Question 4

- (a) Three charged particles lie on the x - y plane are as shown in Figure Q4(a).

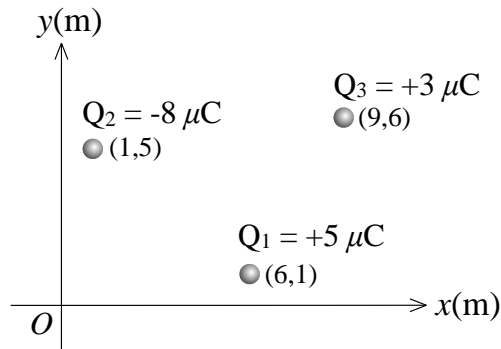


Figure Q4(a)

- (i) Calculate the electric potential at the origin due to the three chargers. (5 marks)
- (ii) Calculate the electric potential at (6 , 6) due to the three chargers. (5 marks)
- (iii) What minimum work must be done by an external force to bring a test charge Q_4 of magnitude $3 \mu\text{C}$ from origin to its final position at (6 , 6)? (5 marks)
- (b) A steel rail has a cross-section diameter of 10 cm. Given that the resistivity of the steel is $3 \times 10^{-7} \Omega\text{m}$. Calculate the resistance of 200 m of such rail. (4 marks)
- (c) The charges and coordinates of two charged particles held fixed along the x -axis are listed as follow:

<u>Particle</u>	<u>Charge (μC)</u>	<u>Coordinates (cm)</u>
A	-5	(2 , 0)
B	+3	(12 , 0)

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

(6 marks)

Question 5

- (a) A converging lens with focal length of 20 cm is placed 35 cm in front of a screen.
- (i) Where an object should be placed in front of the lens so that its image is to appear on the screen?
(2 marks)
 - (ii) Describe the properties of the image in respect to the object.
(3 marks)
- (b) An alternating current of 12 V, 60 Hz is applied across an RL circuit containing a resistor of $R = 5 \Omega$, and an inductor of $L = 8 \text{ mH}$.
- (i) Determine the angular frequency of the circuit.
(2 marks)
 - (ii) Calculate the inductive reactance of the circuit.
(2 marks)
 - (iii) Find the impedance of the circuit.
(2 marks)
 - (iv) Find the phase angle of the impedance.
(2 marks)
- (c) A circular current loop of 8 turns and 5 cm in radius carrying 3 mA of current. The loop is placed on x - y plan and the current is flowing in clockwise direction. Calculate the magnetic field at the center of the loops.
(3 marks)
- (d) A capacitor of $C = 470 \mu\text{F}$ is connected in series to a resistor of $R = 5.1 \text{ k}\Omega$. Starting from $t = 0$, the capacitor is being charged by a battery of $\varepsilon = 24 \text{ V}$.
- (i) Calculate the capacitive time constant of this circuit.
(2 marks)
 - (ii) Calculate the time needed for the voltage across the capacitor to raise to 15 V.
(4 marks)
- (e) An incident light ray is traveling through air on a smooth, flat slab of crown glass at an angle of 35° to the normal. Given that the index of refraction of the medium are $n_{\text{air}} = 1.0$, $n_{\text{glass}} = 1.52$. Calculate the angle of refraction of the ray.
(3 marks)

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