

NUMERICALS

Q1 A wire placed along North-South Direction carries a current of 8 A from South to North. Find the magnetic field due to a 1 cm piece of wire at a point 200 cm N-E from the piece.

(Ans: $1.4 \times 10^{-9} \text{ T}$)

Q2 An element $\vec{\Delta l} = \Delta x \hat{i}$ placed at the origin and carries a large current $I = 10 \text{ A}$. What is the magnetic field on the y axis at a distance of 0.5 m, $\Delta x = 1 \text{ cm}$

(Ans: $4 \times 10^{-8} \text{ T}$ along $\hat{k}$)

Q3 A current of 10 A is flowing east to west in a long wire kept horizontally in E-W direction. Find magnetic field in a horizontal plane at a distance

(a) 10 cm North

(Ans: $2 \times 10^{-5} \text{ T}$ D)

(b) 20 cm South from the wire

(A: $1 \times 10^{-5} \text{ T}$ U)

and in the vertical plane at a distance of

(c) 40 cm downward

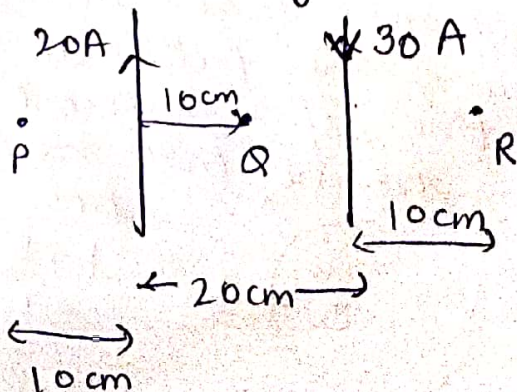
(A: $5 \times 10^{-6} \text{ T}$ S)

(d) 30 cm upward

(A: $4 \times 10^{-6} \text{ T}$ N)

Q4 A long straight-wire carrying a current of 30 A is placed in an external uniform field of $4 \times 10^{-4} \text{ T}$ parallel to the current. Find the magnitude of resultant magnetic field at a point 2 cm away from the wire. (Ans: $5 \times 10^{-4} \text{ T}$)

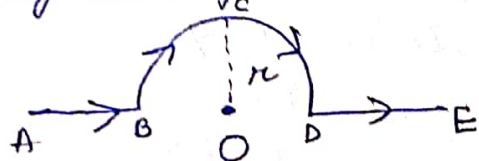
Q5 Find $\vec{B}$ (mag & direction) at P, Q, R.



- Q6 An electric dipole consists of 2 opposite charges of magnitude $q = 2 \times 10^{-6} \text{ C}$ separated by 2 cm . The dipole is placed in an external field of $2 \times 10^5 \text{ N/C}$. Calculate (1) Maximum Torque on dipole. (2) Work done to turn the dipole through 180° , starting from a position $\theta = 0$
- Ans: $8 \times 10^{-3} \text{ N/m}$, $16 \times 10^{-3} \text{ J}$

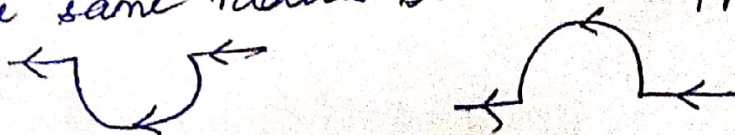
- Q7 Use Biot-Savart Law to obtain an expression for the magnetic field at the centre of a coil bent in the form of a square of side $2a$ carrying current I .
- Ans: $\frac{\sqrt{2} \mu_0 I}{\pi a}$ outwards

- Q8 A long wire having a semi-circular loop of radius r carries a current I . Find the magnetic field due to entire wire at point O.



Ans: $\frac{\mu_0 I}{4r}$

- Q9 A straight wire carrying a current of 12 A is bent into a semi-circular arc of radius 2 cm . What is the direction and magnitude of $\vec{B}$ at the centre of the arc? Would your answer change if the wire were bent into a semi-circular arc of the same radius but in the opposite way?



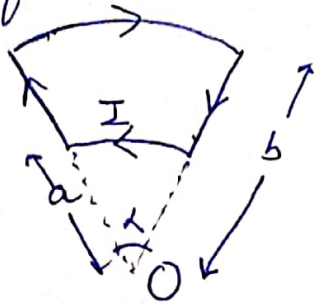
Ans: $1.9 \times 10^{-4} \text{ T}$
($I \rightarrow \odot$ resp)

- Q10 A long wire is bent (as shown). What will be the magnitude and direction of the field at the centre O of the circular portion, if a current I is passed through the wire? Assume that various portions of wire do not touch at P.



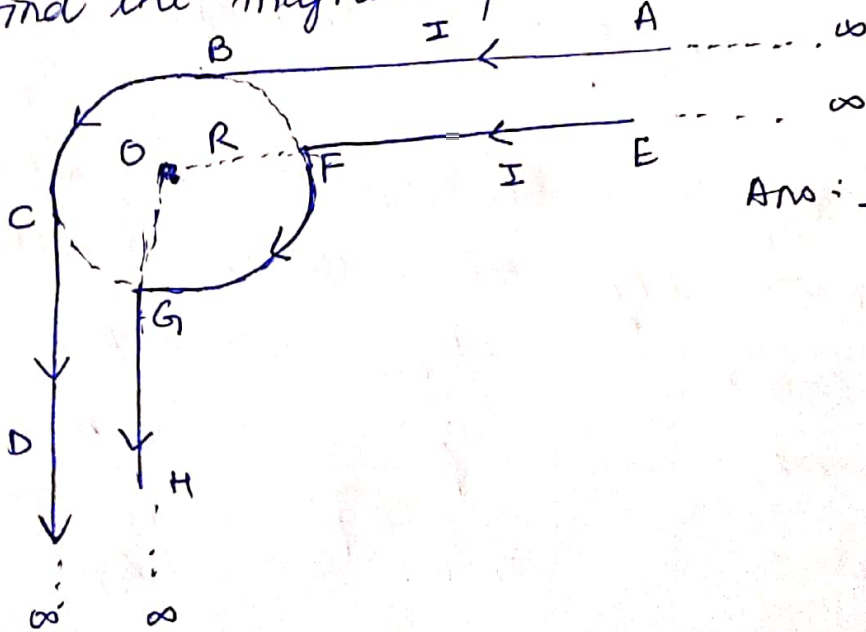
Ans: $\frac{\mu_0 I}{2r} \left(1 + \frac{1}{\pi}\right)$

Q11 Figure shows a current-loop having 2 circular segments and joined by two radial lines. Find magnetic field at O



Ans: $B = \frac{\mu_0 I d (b-a)}{4\pi ab}$

Q12 Two infinitely long wires carry equal current I . Each wire follows a 90° arc along the circumference of the same circle of radius R . Find the magnetic field at centre O .

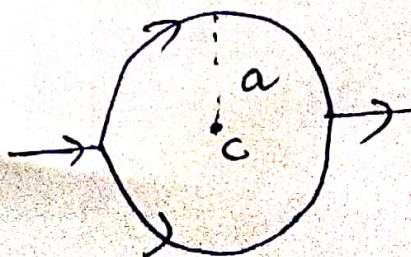


Ans: $\frac{\mu_0 I}{2\pi R}$ normally outward

Q13 A solenoid of length 0.5m has a radius of 1cm is made up of 500 turns. It carries a current of 5A . What is the magnitude of the magnetic field inside the solenoid?

Ans: $6.28 \times 10^{-3} \text{T}$

Q14

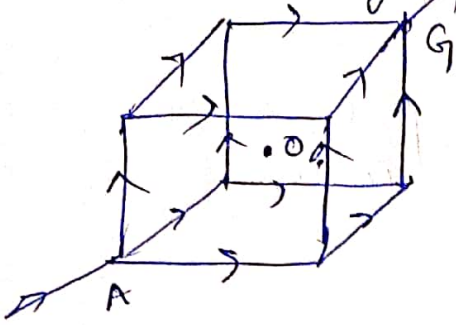


Find magnetic field at the centre C of the circle.

Ans: 0

Q15 Find magnetic field at O if A & G are connected to a battery carrying a current I.

Ans: 0



Q16 Give the concept of the occurrence of Aurora Borealis at the North Pole and South Pole of Earth.
(^{PS} ~~Q16~~; check out Youtube)

Q17 Explain the working of an electromagnet

<u>Q18</u> Give an analogy b/w	Electrostatics & Magnetism	
	Electrostatics	Magnetism
<u>Are</u>		
Free Space Constt	$1/\epsilon_0$	μ_0
Dipole moment	$\vec{p}$	$\vec{m}$
Axial Field	$\frac{1}{4\pi\epsilon_0} \frac{2\vec{p}}{r^3}$	$\frac{\mu_0}{4\pi} \frac{2\vec{m}}{r^3}$
Equatorial Field	$-\frac{1}{4\pi\epsilon_0} \frac{\vec{p}}{r^3}$	$-\frac{\mu_0}{4\pi} \frac{\vec{m}}{r^3}$
Torque in External Field	$\vec{p} \times \vec{E}$	$\vec{m} \times \vec{B}$
Potential energy in Ext Field	$-\vec{p} \cdot \vec{E}$	$-\vec{m} \cdot \vec{B}$