Date
Page

Home Assignment

(1) Ampere's circuital law states that line integral of magnetic field around any closed loop is equal to μ_0 times the electric current flowing through the cross section area enclosed by that loop.

Mathematically $\oint B \cdot dl = \mu I$

Let the current flowing in the solenoid having number of turns per unit length n be I.
Magnitude of magnetic field inside the solenoid B while outside is zero.

Now $\oint_{loop} B \cdot dl = \int B_{ab} \cdot L + \int B_{bc} \cdot L' + \int B_{cd} \cdot L + \int B_{da}$

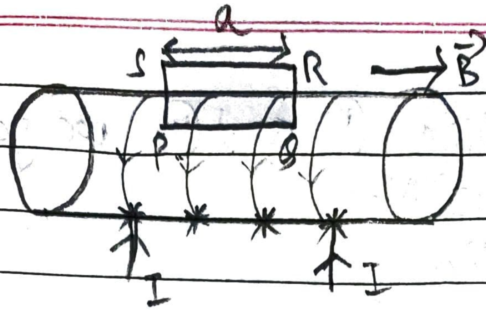
The value of first term $\int B_{ab} \cdot L = BL$

The second and fourth term are zero because angle between magnetic field and the length of the loop is 90°
The third term is also zero as the value of magnetic field outside the solenoid is zero
Total current flow through the loop

$I_{total} = (nL) I$
From Amperes circutal law, we get $BL = \mu_0 (nLI)$

$\Rightarrow B' = \mu_0 n I$

2 (a)



Current flowing through each current = I
Magnetic field is zero outside the Solinoid and is present only in the horizontal axis as, while taking each term the vertical components cancels out each other.

length of the Solenoid = l
PQ = RS = a
current through length a = I_0

According to Ampere's circutal law.

$\oint B\,dl = \mu_0 I$

LHS :- $\oint \vec{B}\cdot d\vec{l} = \int_P^Q \vec{B}\cdot d\vec{l} + \int_Q^R \vec{B}\cdot d\vec{l} + \int_R^S \vec{B}\cdot d\vec{l} + \int_Q^P \vec{B}\cdot d\vec{l}$

$= \oint B\cdot dl\cos 0^\circ + \oint B\,dl\cos 90^\circ + \oint 0\,dl + \oint B\,dl\cos 90^\circ$

$= \oint B\,dl \Rightarrow B\oint dl$
$= Ba$ — (I)

Now, $\oint \vec{B}\cdot d\vec{l} = Ba$
No. of ~~turns~~ turns per unit length = $\frac{nl}{e}$

Total current $= nlI$
$= NI$

$.a = (naI)\mu_0$ — (II)

Date ______
Page ______

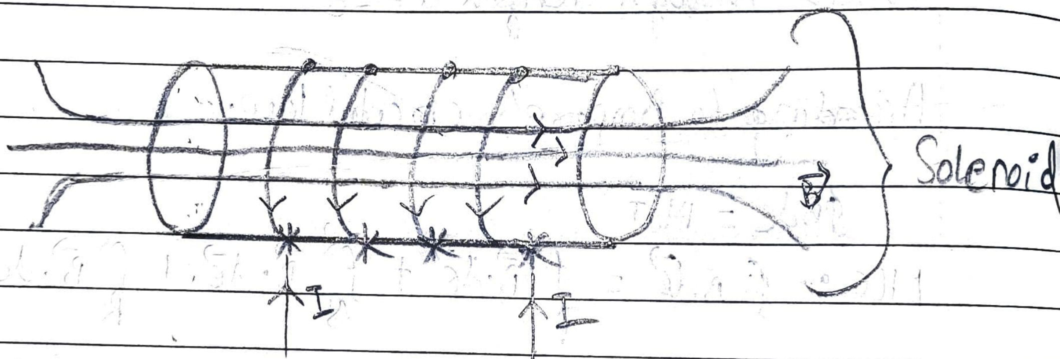
By ~~equalis~~ equating (I) and (II) we got

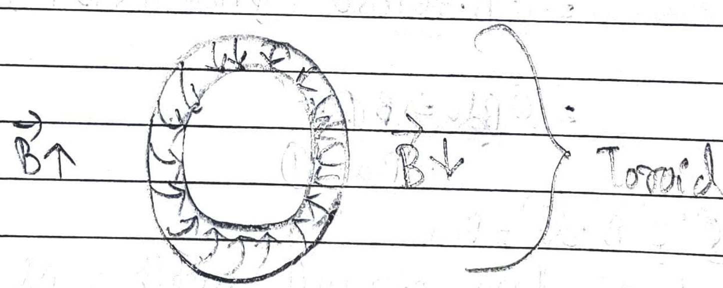
$Ba = (naI)\mu_0$

$B = nI\mu_0$

(b) In Solenoid, the magnetic field is present inside it, where it is uniformly present at the ~~axis~~ axis but decreases towards the end and doesnot exist outside the solenoid.

In ~~ta~~toroid, the magnetic field is present in ~~the~~ the tubular area bounded by the ~~co~~ coil and is ~~not~~ not present inside ~~the~~ and outside the toroid.





(c) The magnetic field can be increased by :

-> Increasing the no. of turns per unit length
-> Increasing the current through it.

Date ______
Page ______

(3) $n = 300$ $l = 0.5\,m$

$I = 5A$ $r = 1\,cm = 0.01\,m$

$l >> r$, So. it is a ideal Solenoid

$B = \mu_0 n I$

$= 4\pi \times 10^{-7} \times 300 \times 5$

$= 4 \times 3.14 \times 1500 \times 10^{-7}$

$= 1.88 \times 10^{-3}\,T$

(4) $l = 0.5\,m$

$N = 500$ $n = \frac{N}{l} = \frac{500}{0.5} = 1000$

Flux density (B) $= 2.52 \times 10^{-3}$

As we know.,

$B = \mu_0 n I$

$\Rightarrow 2.52 \times 10^{-3} = 4\pi \times 10^{-7} \times 1000 \times I$

$\Rightarrow I = \frac{2.52 \times 10^{-3}}{4\pi \times 10^{-7} \times 1000}$

$= \frac{0.63 \times 10}{3.14}$

$= 2A$