6-7-21

1) According to ~~Ap~~ Ampere's circuital law, the line integral of magnetic field induction along a closed curve is equal to the current passing through the surface enclosed in the closed curve times the permeability of medium.

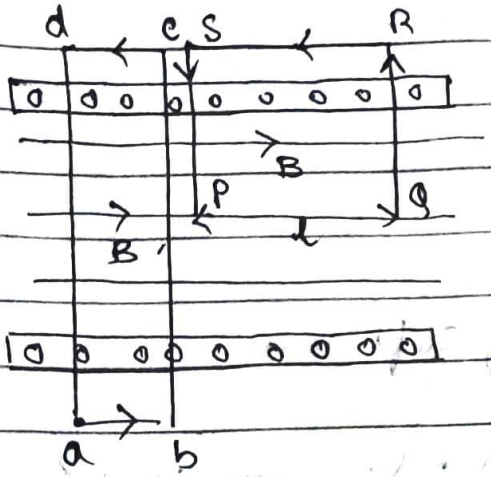
$$\oint \vec{B} \cdot \vec{dl} = \mu_0 I_{enclosed}$$

Applying Ampere's law for given toroid

$$B(2\pi r) = \mu_0 NI$$

But, $N = 2\pi r n$; $B = \mu_0 nI$

2) a)



$$\oint \vec{B} \cdot dl = \mu_0 \times 0$$

$$\therefore B = 0$$

$$\oint_{PQRS} \vec{B} \cdot \vec{dl} = \int_{PQ} \vec{B} \cdot \vec{dl} + \int_{QR} \vec{B} \cdot \vec{dl} + \int_{RS} \vec{B} \cdot \vec{dl} + \int_{SP} \vec{B} \cdot \vec{dl}$$

$$= \int B dl \cos 90^\circ \; 0$$

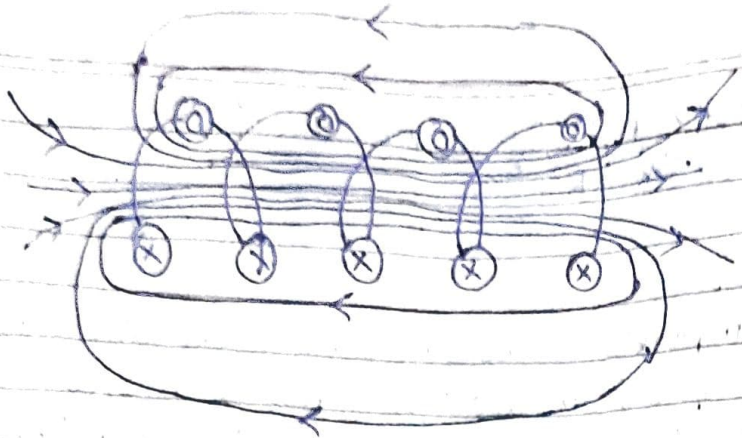
$$= Bl$$

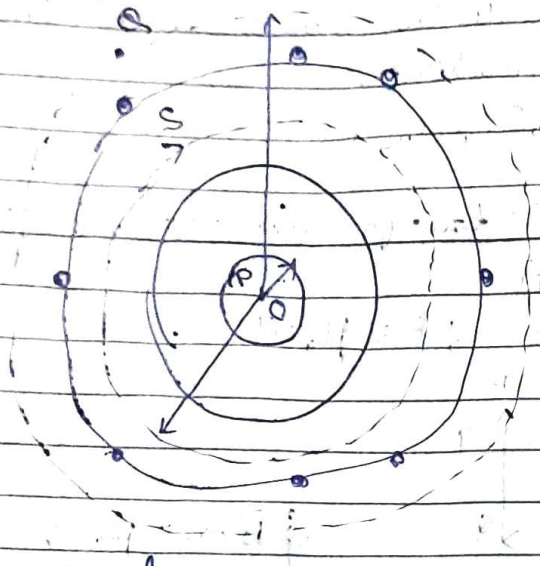
$$\therefore \mu_0 I = Bl$$

$$\Rightarrow \mu_0 (nlI) = Bl$$

$$\Rightarrow \mu_0 nI = B$$

b) Magnetic lines do not exist outside the body of a toroid. Toroid is closed and solenoid is open at both sides. $\vec{B}$ is uniform for a toroid but it is same different ~~from~~ for a solinoid at different parts.





2) i) Passing large current
ii) using laminated soil of soft iron

3) $n = 300$ turns/m ; $I = 5A$; $l = 0.5m$; $r = 10^{-2}$ m
$r = 10^{-2}$ m

$B = \mu_0 n I = (4\pi \times 10^{-7}) \times 300 \times 5$
$= 1.9 \times 10^{-3}$ T

4) $n = \frac{500}{0.5} = 1000$ turns/m

$B = \mu_0 n I$

a) $I = \frac{B}{\mu_0 n} = \frac{2.52 \times 10^{-3}}{4\pi \times 10^{-7} \times 1000} = 2A$