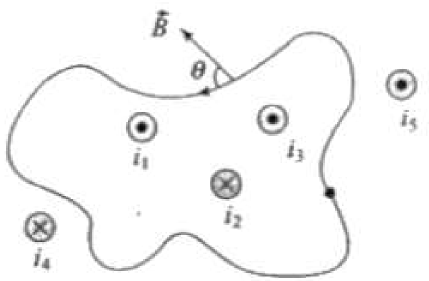
Q 1. Two identical current-carrying coaxial loops, carry current I in an opposite sense. A simple amperian loop passes through both of them once. Calling the loop as C,

a. $\oint_c \vec{\mathbf{B}} \cdot \mathbf{d}\vec{\mathbf{l}} = \pm 2\mu_0 I$
b. the value of $\oint_c \vec{\mathbf{B}} \cdot \mathbf{d}\vec{\mathbf{l}}$ is independent of sense of C.
c. there may be a point on C where B and dl are perpendiculars
d. B vanishes everywhere on C.

Sol. (b, c)

Key concept: Ampere's law gives another method to calculate the magnetic field due to a given current distribution.



The line integral of the magnetic field $\vec{B}$ around any closed curve is equal to μ_0 times the net current i threading through the area enclosed by the curve, i.e.,

$\oint \vec{B} \cdot \overrightarrow{dl} = \mu_0 \, \Sigma i = \mu_0 \, (i_1 + i_3 - i_2)$

Total current crossing the above area is ($i_1 + i_3 + i_2$). Any current outside the area is not included in the net current. (Outward $\odot \rightarrow +ve$, Inward $\otimes \rightarrow -\mathrm{ve}$)

Applying the Ampere's circuital law, we have

$\oint \vec{\mathbf{B}} \cdot \mathbf{d}\vec{\mathbf{l}} = \hat{\mathbf{i}}_0$ (I - I) = 0 (because the current is in the opposite sense.)

Also, there may be a point on C where B and dl are perpendicular and hence,

$\oint_c \vec{\mathbf{B}} \cdot \mathbf{d}\vec{\mathbf{l}} = 0$

The value of B does not vanish on various points of C. Thus option (d) is wrong