DPP – 02

SOLUTION

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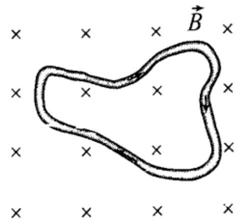
1. For given figure, the $L_{eff} = 0$

$\vec{F} = i(\vec{L} \times \vec{B}) \Rightarrow \vec{F} = 0$



2. $\vec{F} = I\vec{l} \times \vec{B}$

$\Rightarrow \hat{i} = \hat{j} \times \hat{k}$

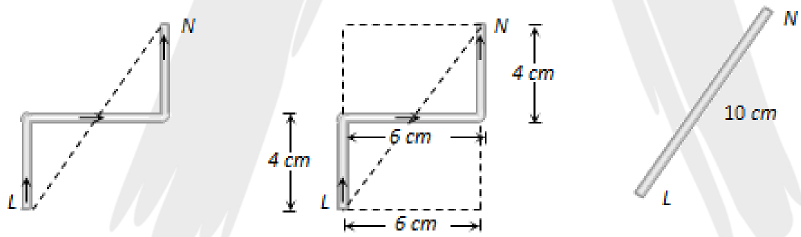
Now for small element of the wire at left hand side,

Direction of F = Direction of B × Direction of Il

$-\hat{i} = \hat{k} \times -\hat{j}$

Hence, the force is stretching in nature.

3. As for effective length, we take straight distance between final point and initial point. So the given wire can be replaced by a straight wire as shown below



Hence force experienced by the wire

$F = Bil = 5 \times 10 \times 0.1 = 5\text{ N}$

4. The given portion of the curved wire may be treated as a straight wire of length 2L (Because for effective length, we take straight distance between final point and initial point) which experiences a magnetic force $F_m = Bi(2L)$.

5. $\vec{F}_{CAD} = \vec{F}_{CD} = \vec{F}_{CED}$

$\therefore$ Net force on frame $= 3\vec{F}_{CD} = (3)(2)(1)(4)$ (Because $F = ilB$) $= 24\text{ N}$

6. Since the wire is kept in the uniform field it can be replaced by the straight wire connecting O and P.

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Also, $\vec{L} = (2\hat{i} + 1.5\hat{j})$, $\vec{B} = (2\hat{i} + 2\hat{j})$

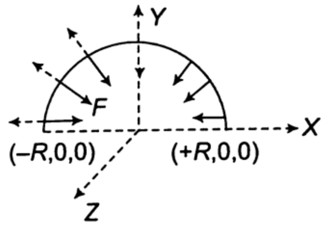
$\vec{F} = I\vec{L} \times \vec{B} = 10(2\hat{i} + 1.5\hat{j}) \times (2\hat{i} + 2\hat{j})$

$= 10[4 - 3]\hat{k} = 10\hat{k}$

$= 10\ N\hat{k}$

7. $\vec{F} = I(\vec{l} \times \vec{B}) = 4(8\hat{i} \times 5\hat{k}) = -160\hat{j}\ N$

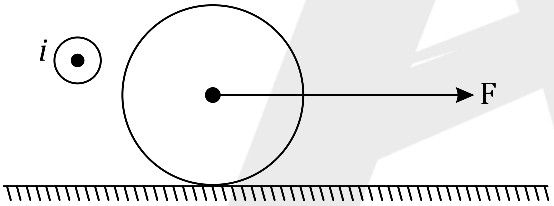
8. Since $\vec{B}$ depends on x-coordinate, the net force acts along-x-axis.



9. $L_{effective} = AB = 4\hat{j}$

$\therefore |\vec{F}| = |\vec{L} \times \vec{B}| = IL_{eff}B = 2 \times 4\hat{j} \times 4(-\hat{k}) = -32\hat{i}\ N$

10.



$F = BiL = W_F = \Delta K$

$$Fx = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 \Rightarrow BiLx = \frac{1}{2}mv^2 + \frac{1}{2}\left(\frac{1}{2}mr^2\right)\omega^2$$

$$\Rightarrow BiLx = \frac{3}{4}mv^2 \Rightarrow v = \sqrt{\frac{4BiLx}{3m}}$$

11. For radial component of magnetic field, the total force will be either in the upward or in the downward direction depending on the direction of current.

$\therefore$ Force $= ILB_{\perp} = I(2\pi a)B\sin\theta$