Answer on Question # 69906, Physics / Electromagnetism

Question. A circular loop of radius R is kept in a uniform magnetic field pointing perpendicular into the plane of paper. When a current I flows in the loop, the tension produced in the loop is

1) BIR; 2) $BIR/2$; 3) $2BIR$; 4) $ZERO$.

Given.

B;

I;

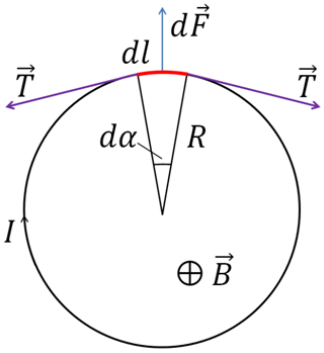
R.

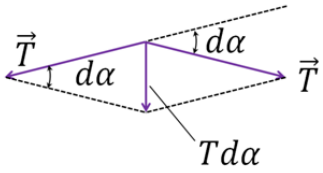
Find.

T.

Solution.

The loop has a curvature. As a result, when we take a small element dl of the loop, the tension force applied to it from both the sides is at an angle (see figure).





From the figure, we have

$$dF = B \cdot I \cdot dl \cdot \sin\gamma = B \cdot I \cdot dl = B \cdot I \cdot R \cdot d\alpha,$$

where $dF = B \cdot I \cdot dl \cdot \sin\gamma$ – Ampere's force and $\gamma = 90° \rightarrow \sin 90° = 1$; $dl = R \cdot d\alpha$.

Finally

$$Td\alpha = dF = B \cdot I \cdot R \cdot d\alpha;$$

and

$$T = BIR.$$

Answer. $T = BIR$.