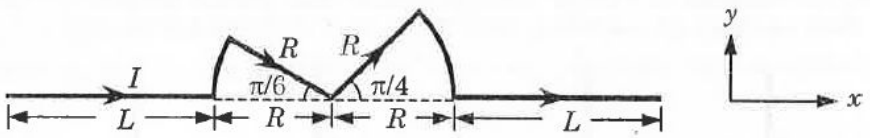
A conductor (shown in the figure) carrying constant current I is kept in the x-y plane in a uniform magnetic field $\vec{B}$. If F is the magnitude of the total magnetic force acting on the conductor, then the correct statement(s) is(are)



(A) If $\vec{B}$ is along $\hat{z}$, $F \propto (L+R)$

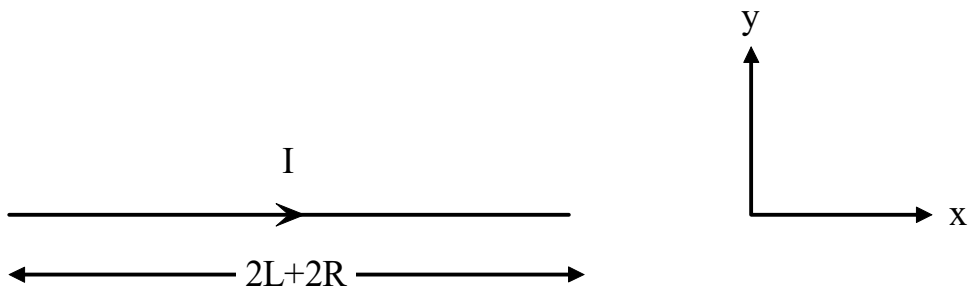
(B) If $\vec{B}$ is along $\hat{x}$, $F=0$

(C) If $\vec{B}$ is along $\hat{y}$, $F \propto (L+R)$

(D) If $\vec{B}$ is along $\hat{z}$, $F=0$

Solution

The equivalent wire is shown below for force calculation in case of current carrying conductor in uniform magnetic field:



$$\vec{F} = I\vec{l} \times \vec{B} = I(2L+2R)\hat{i} \times \vec{B} = 2I(L+R)\hat{i} \times \vec{B}$$

If $\vec{B}$ is along x-direction, $F = 0$

If $\vec{B}$ is along y-direction, $F \propto L+R$

If $\vec{B}$ is along z-direction, $F \propto L+R$

Hence, (A), (B) & (C).