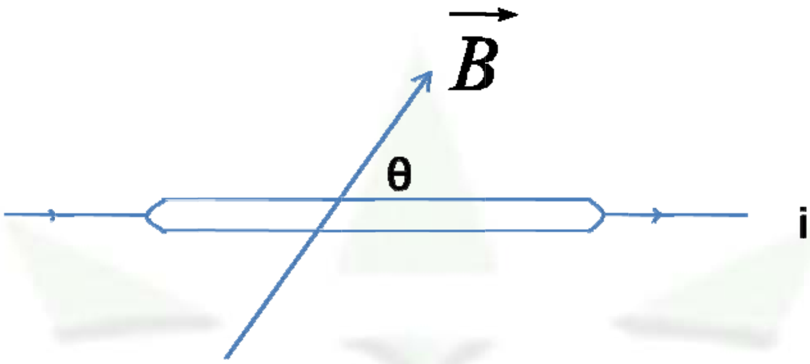
**Mechanical force on a current carrying conductor placed in a magnetic field**:

When a current carrying conductor is placed in an external magnetic field it experiences a force. This force is due to the interaction between the magnetic field produced by the current carrying conductor and the external magnetic field in which the conductor is kept.




Let us consider a current carrying conductor placed in a uniform magnetic field.

Given:

l = length of the conductor

i = current flowing through the conductor

B= the induction vector of the uniform magnetic field.

Let us imagine a charge dQ flowing through the conductor, covers a distance dl in time dt.

Velocity of flow of charge $\vec{v} = \frac{\vec{dl}}{dt}$

The direction of $\vec{dl}$ is along the direction of flow of charge i.e. the direction of flow of current

$i = \frac{dQ}{dt}$ We know that when a charge Q moves in a magnetic field it experiences a force

$$\vec{F} = Q\left(\vec{V} \times \vec{B}\right)$$

Hence the charge dQ flowing through the conductor in the magnetic field B experiences a force

$$\vec{dF} = dQ\left(\vec{v} \times \vec{B}\right) = dQ\left(\frac{\vec{dl}}{dt} \times \vec{B}\right) = \frac{dQ}{dt}\left(\vec{dl} \times \vec{B}\right) = i\left(\vec{dl} \times \vec{B}\right)$$

Hence the total force experienced by the conductor

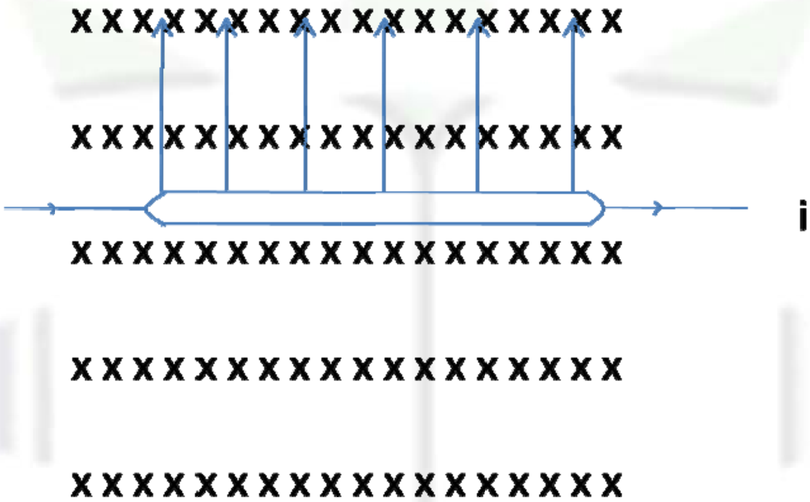
$$\vec{F} = \int \overrightarrow{dF} = \int i\left(\overrightarrow{dl} \times \vec{B}\right)$$

Since the field is uniform we get

$$\vec{F} = i\left(\vec{l} \times \vec{B}\right)$$

The direction of $\vec{l}$ is along the direction of current.

$$\left|\vec{F}\right| = F = ilB\sin 90^0 = ilB$$




Applying the right hand curl for vector product the direction of this force is as shown in figure.