Or, $F = kBqv \sin\theta$, where k is proportionality constant and its value is found to be 1 in SI unit.

$$\therefore \boldsymbol{F = Bqv \sin\theta}$$

In vector form; $\boldsymbol{F = q(\vec{v} \times \vec{B})}$

force is perpendicular to both the velocity and magnetic field.

The direction of force is given by vector product of $\vec{v}$ **and** $\vec{B}$ **or Fleming's left hand Rule.**

Special cases:

1. If θ = 0° or 180° (when current carrying conductor is placed parallel or antiparallel to magnetic field)

We have, $F = Bqv \sin\theta$

or, $F = Bqv \sin 0$

$\therefore \boldsymbol{F = 0}$, The above result shows that magnetic field does not exert any force on the charged particle when it is moving in the direction or in opposite direction of magnetic field.

2. If θ = 90° when current carrying conductor is placed perpendicular to magnetic field

We have,

$F = Bqv \sin\theta$

or, $F = Bqv \sin 90$

$\therefore \boldsymbol{F = Bqv(maximum)}$

The above result shows that charged particle experience maximum force when it is moving in a direction perpendicular to magnetic field.

3. When $v = 0, F = 0$

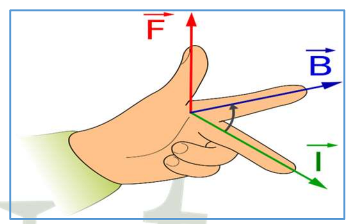
i.e. a charge particle at rest does not experience force due to magnetic field.

4. When $q = 0, F = 0$

i.e. The above result shows that magnetic field does not exert any force on the neutral particle.

Fleming's Left Hand Rule:

- When a current-carrying conductor is placed in an external magnetic field, the conductor experiences a force perpendicular to both the field and to the direction of the current flow.
- This rule is used to find direction of force on a charged particle moving in a magnetic field. According to this rule, the fore finger, middle finger and thumb of left hand are stretched mutually perpendicular to each other in such a way that the fore finger in the direction of magnetic field and middle finger in the direction of motion of positively charged particle then the thump gives direction of force on the charged particle.



- For negatively charged particle, the direction of force will be opposite to that of positively charged particle.

Lorentz Force:

The sum of forces on moving charge q due to electric and magnetic field is called Lorentz force and is given as,

$$\vec{F} = \bar{F}_m + \bar{F}_e$$

$$\boldsymbol{\bar{F} = q[E + (\bar{v} x \bar{B})]} \text{ (In Vector Form)}$$

$$\boldsymbol{F = qE + Bqv \sin\theta} \text{ (in Magnitude)}$$