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# Complete PHYSICS

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CLASS 11&12th

CLASS 12th

# Electrodynamics

## 01. Magnetic Field

### Magnetic Field

*The magnetic field is a space around a conductor carrying current or the space around a magnet in which its magnetic effect can be felt.*

Moving charge is a source of both electric field as well as a magnetic field. Magnetic field denoted by $\vec{B}$ is a vector.

To define the magnetic field $\vec{B}$, we deduce an expression for the force on a moving charge in a magnetic field.

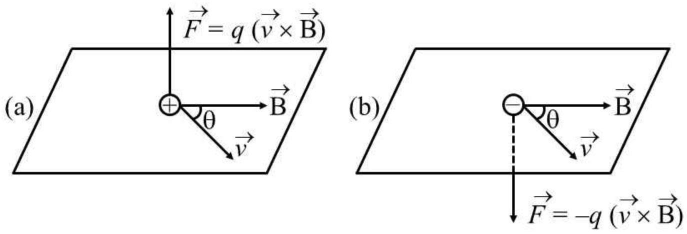
$$F \propto q\ v \sin\theta\ B \quad \text{or} \quad F = k\ q\ v\ B \sin\theta$$

Where k is a constant

$$\left|\vec{F}\right| = q\left|\vec{v}\times\vec{B}\right| \quad \text{or} \quad \vec{F} = q\left(\vec{v}\times\vec{B}\right)$$

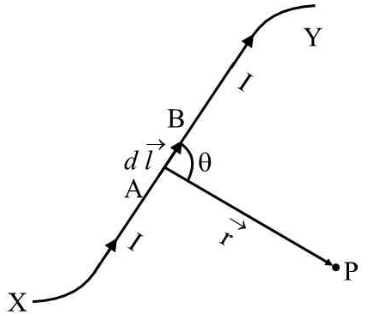
**Direction of $\vec{F}$**

Given by **the Right-Handed-Screw rule** or **Right-Hand Rule.**




## 02. Biot-Savart's Law

**This law deals with the magnetic field induction at a point due to a small current element.**




In SI Units, $$dB = \frac{\mu_0}{4\pi}\times\frac{I\,dl\sin\theta}{r^2}$$

**In vector form,**

$$d\vec{B} = \frac{\mu_0}{4\pi}\frac{I\left(d\vec{l}\times\vec{r}\right)}{r^3}$$

**Direction of d$\vec{B}$**

**Right handed screw rule** or **Right Hand Rule**.

**Biot Savart's law in terms of charge (q) and its velocity ($v$)** is.

$$d\vec{B} = \frac{\mu_0}{4\pi}\frac{q(\vec{v}\times\vec{r})}{r^3}$$

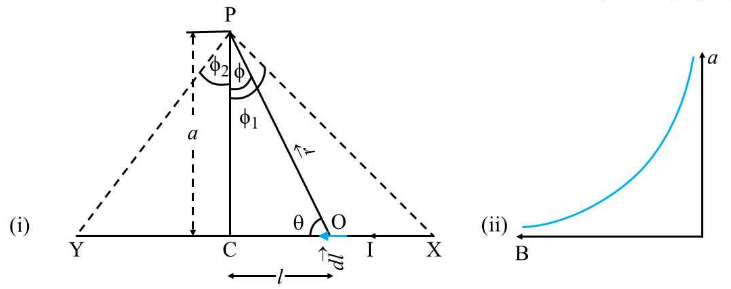
**Important features of Biot Savart's law**

(i) Biot Savart's law is valid for a symmetrical current distribution.

(ii) This law is analogous to Coulomb's law in electrostatics.

(iii) The direction of $d\vec{B}$ is perpendicular to both $I\,d\vec{l}$ and $\vec{r}$.

## 03. Magnetic Field Due to a Straight Wire Carrying Current




$$dB = \frac{\mu_0}{4\pi}\times\frac{I\,dl\sin\theta}{r^2}$$

$$\cos\phi = \frac{a}{r} \quad \text{or} \quad r = \frac{a}{\cos\phi}$$

$$\tan\phi = \frac{1}{a} \quad \text{or} \quad l = a\tan\phi$$

$$dB = \frac{\mu_0}{4\pi}\frac{I(a\sec^2\phi\,d\phi)\cos\phi}{\left(\dfrac{a^2}{\cos^2\phi}\right)} = \frac{\mu_0}{4\pi}\frac{I}{a}\cos\phi\,d\phi$$

$$B = \frac{\mu_0}{4\pi}\frac{I}{a}(\sin\phi_1 + \sin\phi_2)$$

## 04. Magnetic Field at a Point on the Axis of a Circular Coil Carrying Current

Plane of the coil be perpendicular to the plane of the paper and current $I$ be flowing in there coil in the direction shown.