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CLASS 11 & 12th



Learning Inquiry
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CLASS 12th

Electrodynamics

misostudy



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 \vec{v} 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.

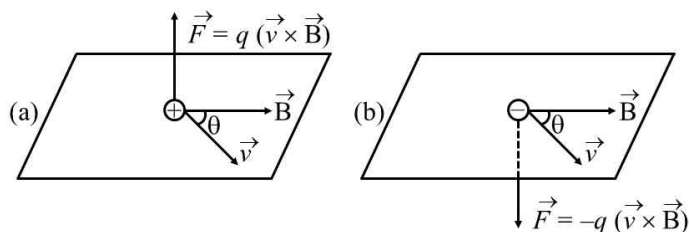
$$F \propto q v \sin \theta B \quad \text{or} \quad F = k q v B \sin \theta$$

Where k is a constant

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

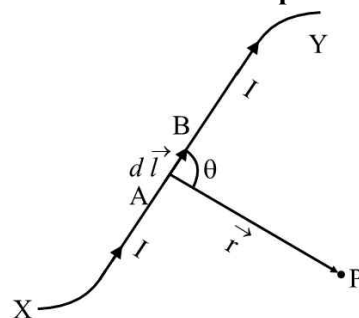
Direction of \vec{F}

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,

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

Direction of \vec{dB}

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

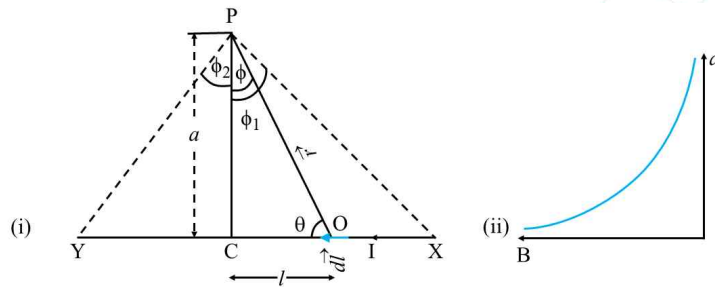
Biot Savart's law in terms of charge (q) and its velocity (v) is.

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

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



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

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

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

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

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

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.

