Magnetic effect of current

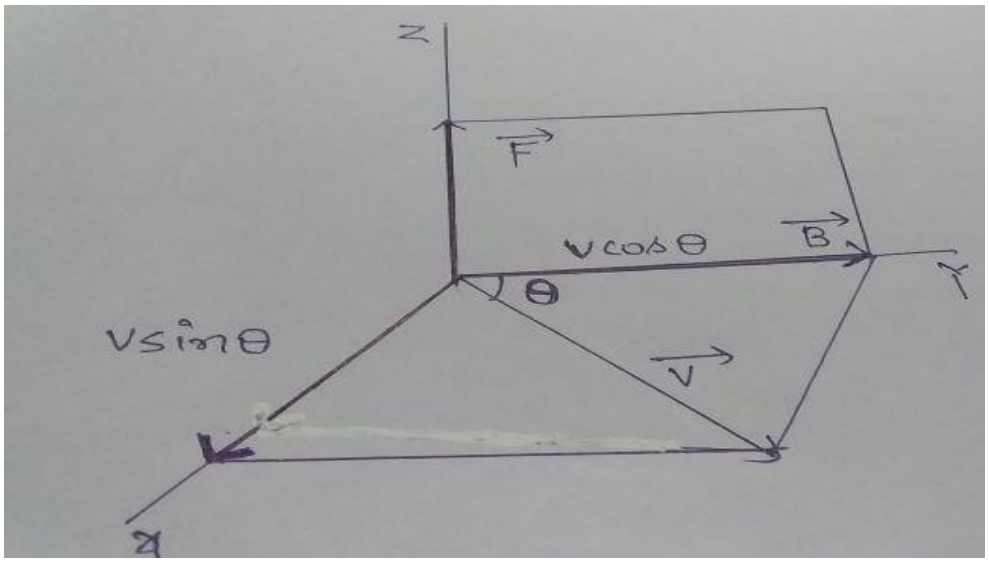
The branch of physics which deal with the magnetism due to the electric current is called electromagnetism.

Orested's observation: A compass needle suffers a deflection when it is placed near a current carrying wire. When the direction of current is reversed, the direction of deflection of the needle also reverses. This conclusively proves that a current carrying conductor produces a magnetic field around it. This is called magnetic effect of current.

Ampere's swimming Rule: According to this rule, if we imagine a man is swimming along the wire in the direction of current with his face always turned towards the needle, so that the current enters through his feet and leaves at his hand, then the N-pole of the magnetic needle will be deflected towards his left hand. This rule can be recollected with the help of the word SNOW

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.

A moving charge is a source of both electric field as well as magnetic field. Magnetic field denoted by B is a vector. It is called **magnetic field induction** or **magnetic flux density.**



Consider a positive charge q moving in a uniform magnetic field B , with a velocity V . let the angle between v and B be Θ then

(1) The magnitude of force F experienced by a moving charge is directly proportional to the magnitude of charge

$F \alpha q$

(ii) F α VsinΘ

(iii) F α B

Combining the above factor we get

F α BqV sinΘ

Or,

$F = q(V \times B)$

S.I unit : tesla or T

C.G.S unit : gauss (G)

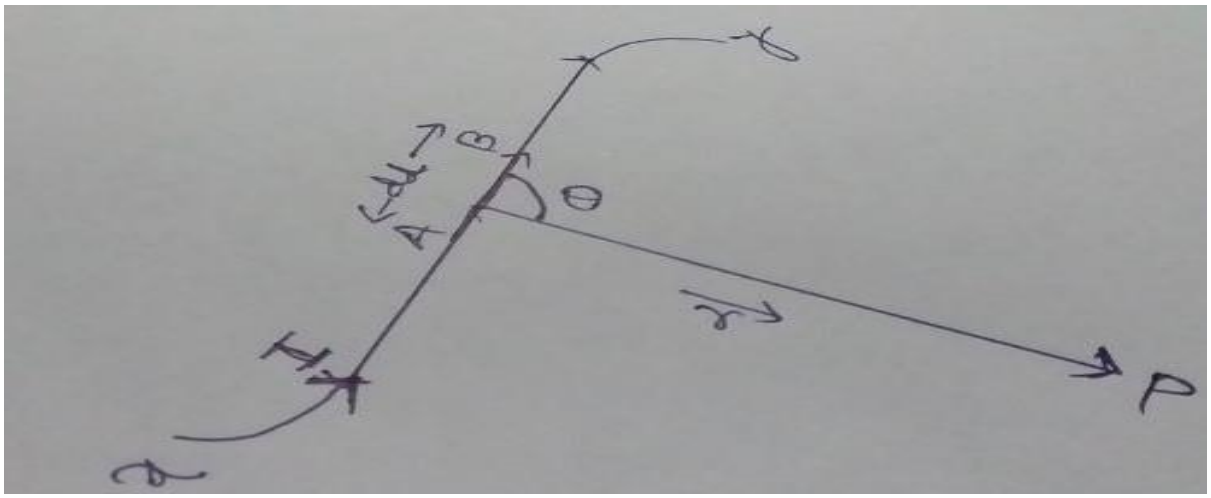
$1G = 10^{-4}$ T

Dimension of B

B= F/qVsinΘ

$B = MLT^{-2}/ AT (LT^{-1}) = [MA^{-1} T^{-2}]$

Biot- Savart's Law: Biot –savart's law is an experimental law predicted by Biot and savart.It is also called Laplace Law. This law deals with the magnetic field induction at a point due to a small current element.



Consider a current element dl of a conductor carrying current I. Let P be the position vector r w.r.t current element dl. Let Θ be the angle between dl and r.

According to Biot Savart law, the magnetic field DB at point p due to current element

(i) DB α I

(ii) DB α dl

(iii) DB α sinΘ

(iv) DB α $1/r^2$

Combining all the four factors, We get

DB α IdlsinΘ / r^2

DB = k IdlsinΘ / r^2

Where K = $\mu_0/4\pi$

$$DB = \mu_0/4\pi \times Idl\sin\Theta / r^2$$

Where $\mu_0/4\pi = 10^{-7}$ tesla