O P JINDAL SCHOOL, SAVITRINAGAR

CLASS NOTES

CLASS XII PHYSICS | TOPIC : MOVING CHARGES AND MAGNETISM

Date : 16/06/20 | SUB TOPIC: BIOT-SAVART LAW

BIOT-SAVART LAW:

- We already know now that current carrying conductor generates magnetic field around themselves. Biot-Savart law just mathematically states the intensity of this magnetic field at a point.

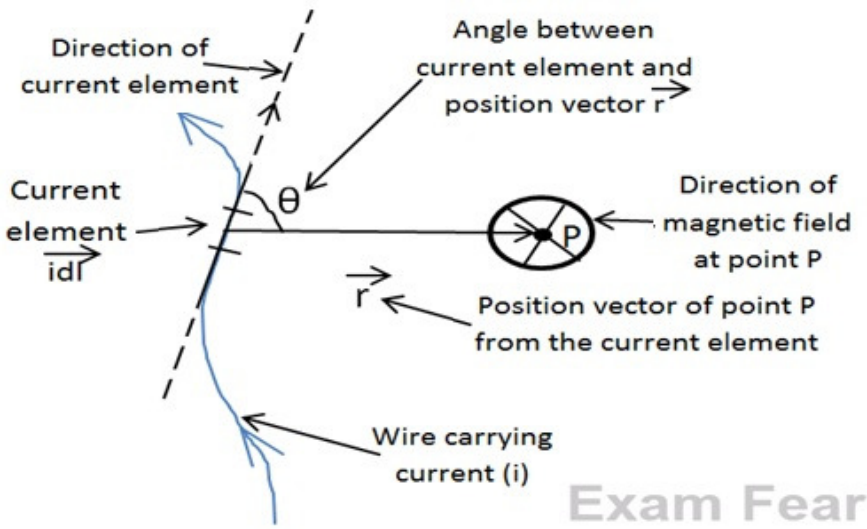
- According to the Biot-Savart law, magnetic field ***dB*** due to current element ***idl***, at a point **P** situated at distance ***r*** from the current element ***idl***, is:

  i) directly proportional to the current element ***idl***,
  ii) ii) directly proportional to the sine of the angle (θ) between current element and ***r***, and
  iii) inversely proportional to the square of the distance ***r*** between current element and the point

$$dB \propto idl\ (sin\theta)/r^2$$

$$dB = (\mu_o/4\pi) \times idl \times (sin\theta)/r^2$$

$$dB = idl \times r / r^3$$

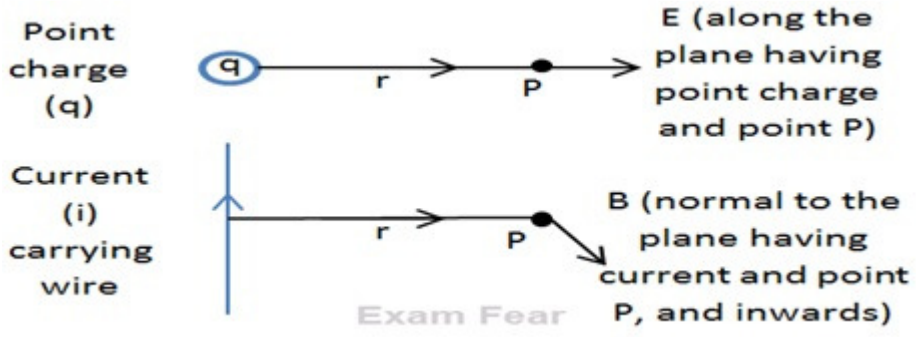


Here proportionality constant is $\mu_o/4\pi = 10^{-7} Tm/A$, and μ_o is the permeability of free space (vacuum)

COMPARISON BETWEEN BIOT-SAVART LAW AND COULOMB'S LAW:

Similarities:

- Both magnetic and electric fields at a point are inversely proportional to the square of the distance between the field source and the point in question
- Electric field due to a point charge (Coulomb's law) is : $E = (1/4\pi\mathcal{E}_o) \times (q/r^2)$
- Magnetic field due to a moving charge (Biot-Savart law) is: $B = (\mu_o/4\pi) \times idl(sin\theta)/r^2$



The first diagram shows the electric field (E) due to a point charge (q)

The second diagram shows the magnetic field (B) due to current carrying wire

- Both laws works on the principle of superposition (resultant field due to more than 1 sources is the vector sum of all the sources independently)
- Both magnetic and electric fields have sources that are linear in nature (both, the current element idl and the electrostatic charge q)
-

Differences:

- The source of electrostatic field is scalar in nature. Whereas, the source of magnetic field, which is current element (idl), is vector in nature.
- Electric field always acts along the plane containing distance (r) between point charge and the point where electric field is to be calculated. But, the magnetic field acts in the plane perpendicular to the plane of distance(r) between the current element and the concerned point.
- Magnetic field depends on the angle (θ) between the current element(idl) and line joining the point and current element. However, electric field doesn't depend on angle(θ).