Summary chapter 29

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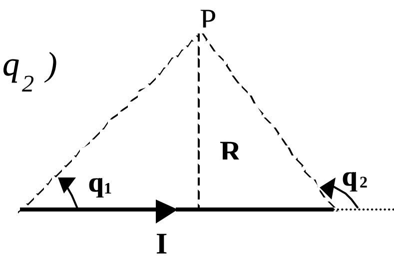
1. ***One main source of magnetic fields is a current carrying wire*.**
2. The magnetic field due to a ***straight wire of finite length and carrying a current I*** is given by;

$$B_p = \frac{\mu_o I}{4\pi R}(\cos\theta_1 - \cos\theta_2)$$



where ***R*** is perpendicular distance between P and the wire and $\mu_o = 4\pi\times10^{-7}$ wb/A.m.

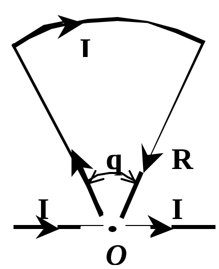
The direction of the magnetic field at point P is ***out of the paper***.

The magnetic field due to an infinite long wire $(\theta_1 = 0, \theta_2 = \pi)$ carrying a current I is:

$$B_p = \frac{\mu_o I}{2\pi R}$$

The magnetic field at the center (point ***O***) of an arc of radius ***R*** that subtends an angle θ is given by:

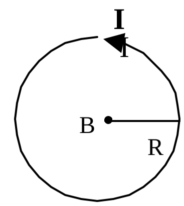
$$B_o = \frac{\mu_o I}{4\pi R}\theta$$



The angle q is in **radian**.

The magnetic field ***at the center*** of a circular loop carrying a current I is given by:

$$B = \frac{m_o I}{2R} \quad \text{(here } \theta = 2\pi\text{)}$$

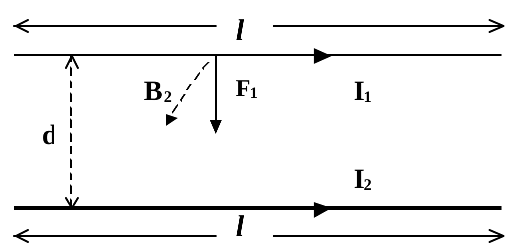


where R is the **radius of the loop**.

The direction of the magnetic in the above figure at the center of the loop is ***out of the paper***.

3. The ***magnetic force per unit length*** between two parallel conducting wires carrying currents I_1 and I_2 is given by:

$$\frac{F_1}{l} = \frac{m_o I_1 I_2}{2p\, d}$$



where d is distance between the two conductors.

* If the currents, I_1 and I_2 have the ***same direction***, the wires will ***attract each other***.

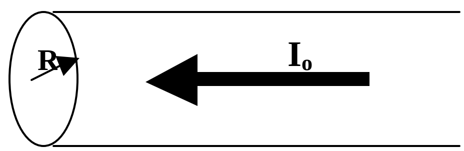
* If the two currents have ***opposite directions***, the wires will ***repel each other***.

4. Amper's law is defined as;

$$\oint \vec{B} \cdot d\vec{S} = m_o I_{encl}$$

This law, just like Gauss' law, is used to evaluate the magnetic field for highly symmetric current distribution.

The magnetic field due to ***a long wire of radius R and carrying a current I*** using Ampere's law is;



$$B = \frac{m_o I_o}{2p\, r} \qquad \text{(outside the wire)}$$

$$B = \left(\frac{m_o I_o}{2p\, R^2} \right) r \qquad \text{(inside the wire)}$$

where ***r*** is the distance from the center of the wire to the point where the magnetic field is to be evaluated.

5. The magnetic field ***inside*** a long solenoid carrying a current I is

$$B = m_o \frac{N}{l} I = m_o n I$$

where ***n*** is the number of turns per unit length.