Summary chapter 30

I. Objective:

1. Calculate **the magnetic field** at a point P due to a current element by using **Biot-Savart law**.

2. Calculate **the magnetic force** between two parallel conductors carrying currents I_1 and I_2 .

3. Use **Amper's law** to calculate the magnetic field due to a cylindrical wire of **radius R**.

4. Calculate the magnetic field due to a **solenoid**.

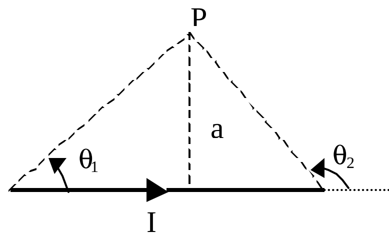
5. Calculate the **magnetic flux** through a surface A placed in a magnetic field.

II. Summary of major points:

1. * The magnetic field due to a straight carrying a current I is given by;

$$B_P = \frac{\mu_0 I}{4\pi a}(\cos\theta_1 - \cos\theta_2)$$

where a is distance between P and the wire and $\mu_0 = 4\pi\times10^{-7}$ wb/A.m.



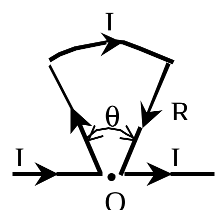
The direction of the magnetic field at point P is **<u>out of the paper</u>**.

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

$$B_p = \frac{\mu_0 I}{2\pi a}$$

* The magnetic feld at the center of an arc of radius **R** which subtends an angle θ is given by:

$$B_o = \frac{\mu_0 I}{4\pi R}\theta$$

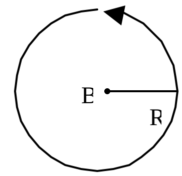


The angle θ is in **<u>radian</u>**.

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

I

$$B = \frac{\mu_0 I}{2R} \quad \text{(here } \theta = 2\pi\text{)}$$



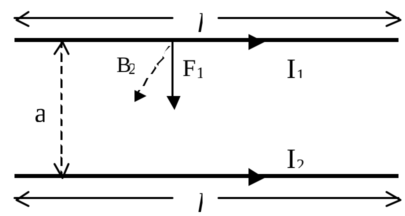
where R is the radius of the loop.

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

2. The **magnetic force** per unit length between parallel conductors is given by:

$$\frac{F_1}{\ell} = \frac{\mu_0 I_1 I_2}{2\pi a}$$

where a is distance between the two conductors.



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

* If the current have **opposite** direction, the wires will **repel** each other.

3. Amper's law is defined as;

$$\oint \vec{B} . d\vec{s} = \mu_o I$$

The magnetic field due to a long wire of radius **R** is;

$$B = \frac{\mu_o I_o}{2\pi r} \quad r \geq R \qquad \text{(inside the wire)}$$

$$B = \left(\frac{\mu_o I_o}{2\pi r} \right) r \quad r < R \qquad \text{(outside the wire)}$$

4. The magnetic flux through a surface **A** is given by:

$$\Phi_m = \int \vec{B} . d\vec{A}$$

If the area is a **plane** then and B is **uniform** then:

$$\Phi_m = BA\cos\theta$$

where *θ* is angle between ***B*** and **A**.