Magnetic dipole: Magnetic dipole moment is the product of the strength of either pole (m) and the magnetic length $\overrightarrow{2l}$ of the magnet.

$$\overrightarrow{M} = m\ \overrightarrow{2l}$$

Magnetic field strength at a point due to a bar magnet:

- When the point lies on the axial line of the bar magnet –

  $$B = \frac{\mu_0}{2\pi}\frac{Md}{d^2 - l^2\ ^2}$$

  Where, d is the distance of the point from the centre of the bar magnet
- When the point lies on the equatorial line of the bar magnet –

  $$B = \frac{\mu_0}{4\pi}\frac{M}{d^2 + l^2\ ^{\frac{3}{2}}}$$

Torque on a bar magnet placed in a magnetic field:

$$\tau = MB\sin\theta$$

Potential energy of magnetic dipole in a magnetic field:

$$U = W = -MB\ \cos\theta_2 - \cos\theta_1$$

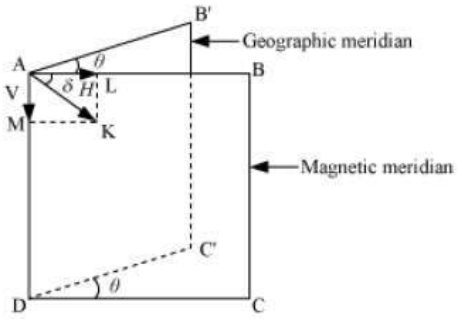
Where, U is the potential energy, which is equal to the work done in rotating the dipole from $\theta = \theta_1$ to $\theta = \theta_2$

Gauss' law for magnetism: According to Gauss' law for magnetism, the net magnetic flux (ϕ_B) through any closed surface is always zero.

$$\phi_B = \oint_s \vec{B}\cdot\overrightarrow{ds} = 0$$

Magnetic elements: The following are the three magnetic elements of earth.

- Magnetic declination (θ)
- Magnetic inclination or dip (δ)
- Horizontal component (H)



Relation between magnetic intensity (*H*) and magnetic field (*B*):

$B = \mu_0(1+\chi)H$

Where, χ is the magnetic susceptibility

Classification of magnetic materials:

- **Diamagnetic substances:** When such substances are placed in an external magnetic field, they get feebly magnetised in the direction opposite to the field.
- **Paramagnetic substances:** When such substances are placed in an external magnetic field, they get feebly magnetised in the direction of the field.
- **Ferromagnetic substances:** When such substances are placed in an external magnetic field, they get strongly magnetised in the direction of the field.

Hysteresis: It is the phenomenon in which the intensity of magnetisation lags behind the magnetic field intensity when a specimen of a magnetic material is subjected to a cycle of magnetisation.