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**CBSE Class-12 Physics Quick Revision Notes**  
**Chapter-05: Magnetism and Matter**

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- Magnetic materials tend to point in the north – south direction.
- Like magnetic poles repel and unlike ones attract.
- Magnetic poles cannot be isolated.
- When a bar magnet of dipole moment  $\vec{m}$  is placed in a uniform magnetic field  $\vec{B}$ , then,
  - a) The force on it is zero
  - b) The torque on it is  $\vec{m} \times \vec{B}$
  - c) Its potential energy is  $-\vec{m} \cdot \vec{B}$

where we choose the zero of energy at the orientation when  $\vec{m}$  is perpendicular to  $\vec{B}$ .

- Consider a bar magnet of size  $l$  and magnetic moment  $\vec{m}$ , at a distance  $r$  from its mid – point, where  $r \gg l$ , the magnetic field  $\vec{B}$  due to this bar is,

$$\vec{B} = \frac{\mu_0 \vec{m}}{2\pi r^3} \quad (\text{along axis})$$

$$= \frac{\mu_0 \vec{m}}{4\pi r^3} \quad (\text{along equator})$$

- **Gauss's Law for Magnetism:**

It states that the net magnet flux through any closed surface is zero

$$\phi_B = \sum_{\substack{\text{all area} \\ \text{elements } \Delta \vec{S}}} \vec{B} \cdot \Delta \vec{S} = 0$$

- **Poles:**

- a) The pole near the geographic north pole of the earth is called the north magnetic pole.
- b) The pole near the geographic south – pole is called the south magnetic pole.
- c) The magnitude of the magnetic field on the earth's surface =  $4 \times 10^{-5}$  T.

- **Elements of the Earth's Magnetic Field:**

Three quantities are needed to specify the magnetic field of the earth on its surface,

- a) The horizontal component
- b) The magnetic declination
- c) The magnetic dip.

These are known as the elements of the earth's magnetic field.

- **Magnetic Intensity:**

Consider a material placed in an external magnetic field  $\vec{B}_0$ . The magnetic intensity is,

$$\vec{H} = \frac{\vec{B}_0}{\mu_0}$$

If the magnetization  $\vec{M}$  of the material is its dipole moment per unit volume, then the magnetic field  $\vec{B}$  in the material will be,

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$$\vec{B} = \mu_0(\vec{H} + \vec{M})$$

For a linear material,

$$\vec{M} = \chi\vec{H}$$

So that,

$$\vec{B} = \mu\vec{H}$$

Where  $\chi$  is the magnetic susceptibility of the material and  $\mu_r$  is the relative magnetic permeability.

- **Relationship between  $\mu, \mu_0$  and  $\mu_r$  :**

The magnetic permeability area,  $\mu$  is related as,

$$\mu = \mu_0\mu_r$$

$$\mu_r = 1 + \chi$$

- **Classification of Magnetic Materials:**

Magnetic materials are broadly classified as,

- a) Diamagnetic
- b) Paramagnetic
- c) Ferromagnetic

- **Magnetic Susceptibility of the Material for Magnetic Materials:**

- a) For diamagnetic materials  $\chi$  is negative and small.
- b) For paramagnetic materials  $\chi$  is positive and small.
- c) For ferromagnetic materials  $\chi$  lies between  $\vec{B}$  and  $\vec{H}$

- **Permanent Magnets:**

Substances which retain their ferromagnetic property for a long period of time at room temperature are called permanent magnets.

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