

## Magnetism

1. Magnetism is the property displayed by magnets and produced by the movement of electric charges, which results in objects being attracted or pushed away.
2. Magnet is a piece of iron or other materials that can attract iron containing objects and that points north and south when suspended.
3. A magnet is characterised by following two properties : (i) Attractive property : A magnet attracts magnetic substances like iron, cobalt, nickel and some of their alloys like magnetite ( $\text{Fe}_3\text{O}_4$ ) (ii) Directive property : When a magnet is freely suspended, it aligns itself in the geographical north south direction.
4. A magnet may be (i) Natural (ii) Artificial
5. Natural magnet is oxide of iron. But due to irregular shape, weak magnetism and high brittleness, natural magnets find no use in the laboratory.
6. The magnets made by artificial methods are called artificial magnets or man made magnets. They may be of different types like bar magnet, horse shoe magnet, Robinson's ball ended magnet, magnetic needle, electromagnet etc.
7. The two points near the two ends of a magnet where the attracting capacity is maximum are called magnetic poles. When a magnet is freely suspended, its one pole always directs towards the north. This pole is called north pole. The other pole is called south pole.
8. The imaginary line joining the two poles of a magnet is called magnetic axis of the magnet.
9. Similar poles repel each other and dissimilar poles attract each other.
10. When a magnetic substance is placed near a magnet, it gets magnetised due to induction.

**Magnetic Field** : Region in space around a magnet where the magnet has its magnetic effect is called magnetic field of the magnet.

Intensity of magnetic field or magnetic flux density : Magnetic flux density of a point in a magnetic field is the force experienced by a north pole of unit strength placed at that point. Its SI unit is newton / ampere-meter or weber/meter<sup>2</sup> or tesla (T).

**Magnetic lines of force :** The magnetic lines of force are imaginary curves which represent a magnetic field graphically. The tangent drawn at any point on the magnetic lines of force gives the direction of magnetic field at that point.

**Properties of magnetic lines of force :**

(i) Magnetic lines of force are closed curves. Outside the magnet they are from north to south pole and inside the magnet they are from south to north pole.

(ii) Two lines of force never intersect each other.

(iii) If the lines of force are crowded, the field is strong.

(iv) If the lines of force are parallel and equidistant, the field is uniform.

**Magnetic Substance :** On the basis of magnetic behaviour, substances can be divided into three categories.

(i) **Diamagnetic substances :** Diamagnetic substances are such substances which when placed in a magnetic field, acquire feeble magnetism opposite to the direction of magnetic field.

**Examples :** Bismuth, Zinc, Copper, Silver, Gold, Diamond, Water, Mercury, Water etc.

(ii) **Paramagnetic Substance :** Paramagnetic substances are such substances which when placed in a magnetic field acquire a feeble magnetism in the direction of the field.

**Examples :** Aluminum, Platinum, Manganese, Sodium, Oxygen etc.

(iii) **Ferromagnetic substance :** Ferromagnetic substances are those substances, which when placed in a magnetic field, are strongly magnetised in the direction of field.

**Examples :** Iron, Cobalt, Nickel etc.

**Domain :** Atoms of ferromagnetic substance have a permanent dipole moment i.e. they behave like a very small magnet. The atoms form a large no. of effective regions called domain in which  $10^{18}$  to  $10^{21}$  atoms have their dipole moment aligned in the same direction. The magnetism in ferromagnetic substance, when placed in a magnetic field, is developed due to these domains by (i) the displacements of boundaries of the domains (ii) the rotation of the domains.

**Curie Temperature** : As temperature increases, the magnetic property of ferromagnetic substance decreases and above a certain temperature the substance changes into paramagnetic substance. This temperature is called Curie temperature.

---> Permanent magnets are made of steel, cobalt steel, ticonal, alcomax and alnico.

---> Electromagnets, cores of transformers, telephone diaphragms, armatures of dynamos and motors are made of soft iron, mu-metal and stalloy.

**Terrestrial Magnetism:** Our earth behaves as a powerful magnet whose south pole is near the geographical north pole and whose north pole is near the geographical south pole. The magnetic field of earth of a place is described in the terms of following three elements.

**(i) Declination** : The acute angle between magnetic meridian and geographical meridian at a place is called the angle of declination at that place.

**(ii) Dip or Inclination** : Dip is the angle which the resultant earth's magnetic field at a place makes with the horizontal. At poles and equator, dip is  $90^\circ$  and  $0^\circ$  respectively.

**(iii) Horizontal component of earth's magnetic field** : At a place it is defined as the component of earth's magnetic field along the horizontal in the magnetic meridian.

Its value is different at different places, (approximately 0.4 gauss or  $0.4 \times 10^{-4}$  tesla).