

TOPIC 4

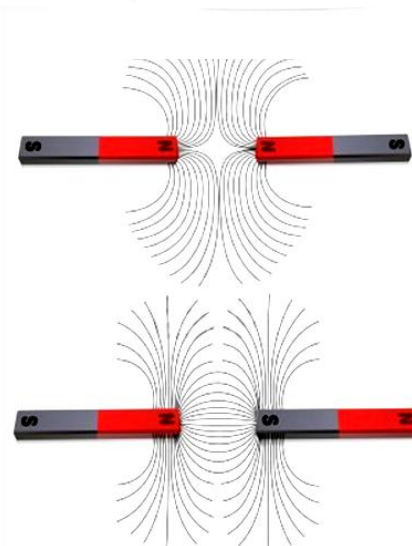
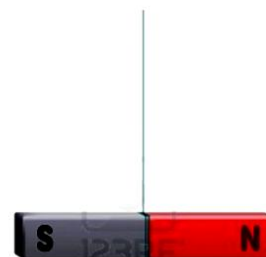
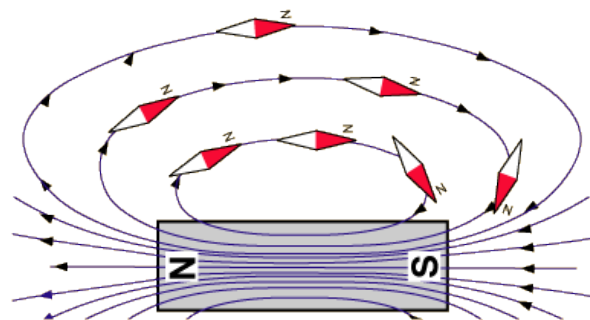
MAGNETISM

MAGNETISM:

1. Magnetism was first discovered by Greeks as early as 600 BC.
2. Certain type of iron ore called magnetite or lodestone has property to attract small pieces of iron.
3. Chemically the magnetic material has formula Fe_3O_4 .
4. The word magnetism is derived from Magnesia, the place where magnetic iron ore was first discovered.

Properties of Magnetic Materials:

1. The materials that can easily be attracted by magnet are called **ferrous materials** or **ferromagnetic** such as iron, steel, nickel, cobalt.
2. The materials that are not attracted by magnet are called non-ferrous materials such as copper, brass, wood and glass.
3. Poles of a magnet are at the ends to which magnetic material are attracted. These ends are of equal strengths. They are **called north and south poles**.
4. When a magnet is hanged freely, its poles are always facing towards the earth's north and south poles.
5. **Law of magnetic poles:** Like poles of magnets repel and unlike poles attract each other.
6. **Magnetic field:** The space surrounding a magnet where it produces a magnetic force on magnetic materials is called magnetic field. It has direction which is at any point should be the direction of the force from north pole to south that is the arrows are always coming out from north pole to south pole.
7. The magnetic lines of force are the lines of magnetic field which are always pointing from North Pole to south pole of a magnet.
8. **Soft Magnetic Material:** That can magnetize and demagnetize easily, like iron
9. **Hard Magnetic Material:** They are harder to magnetize and demagnetize, like steel.
10. **Neutral point:** When two magnet of same magnetic strength are place next to each other facing the like poles, they create a point where one magnetic field cancels the other. This point is called neutral point of null point.



Induced Magnetism:

When a piece of un-magnetized steel (for example nail) is placed either near to or in contact with the pole of a magnet and then removed, it is found to be magnetized. This is called induced magnetism.

Methods of Magnetization:

Single stroke method:

Place the soft iron piece AB flat on a table and stroke it with a bar magnet from A to B with one end of a bar magnet as shown in figure. When the magnet reaches B it is lifted, and brought back to A to repeat the stroke. After a few strokes you will notice that A will become a magnet with the same polarity as the pole being rubbed with it.

Double stroke method:

It was found that using two bar magnets we could magnetize a steel bar quicker and more uniformly.

By passing electrical current through the coil:

The best method of making a powerful magnet is by passing electric current. Wrap a length of insulated copper wire around an iron or steel rod and connect the ends of the coil of wire to a battery. After the current has passed through the coil for some time you will notice that the rod gets magnetized. The polarity of the rod depends upon the direction of the current. The type of magnetism that can be controlled by electricity is called **electromagnet**.

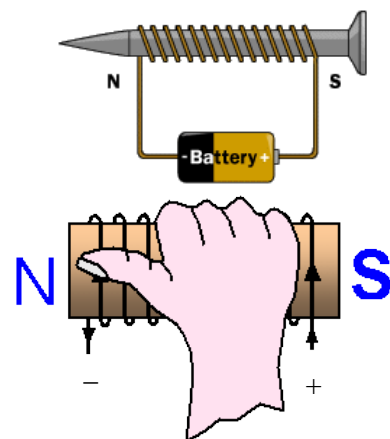
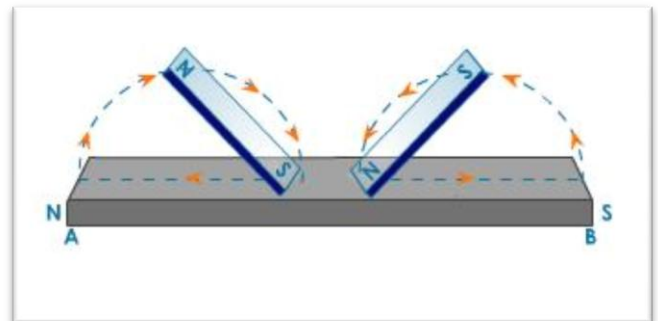
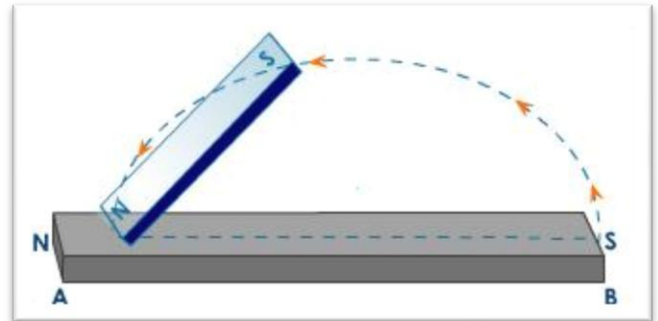
An electromagnet is a coil of wire wrapped around on a soft iron core. The magnetism of electromagnet is temporary and can be switched on and off. The strength of electromagnet increases if,

- the current in the coil increases;
- the number of turns increases or
- the poles are moved closer.

Uses of electromagnets are in heavy crane, electric bell, relay and circuit breaker.

This direction of the poles in an electromagnet can be determined by applying **right hand grip rule**.

Consider your right-hand gripping the coil of the solenoid such that your fingers point the same way as the current. Your thumb then points in the direction of the field. Since the magnetic field line is always coming out from the North Pole, **therefore the thumb points towards the North Pole**.



Experiment to identify the pattern of the magnetic field lines around a bar magnet:

Using the iron fillings:

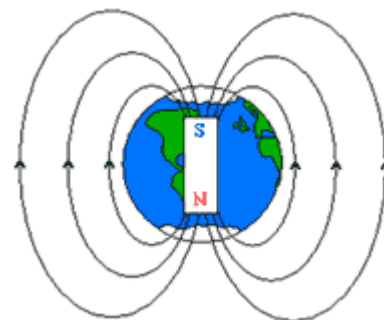
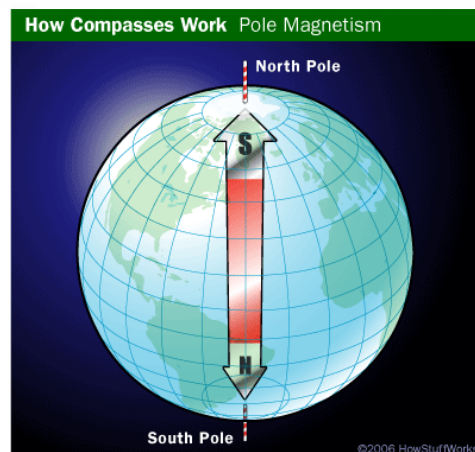
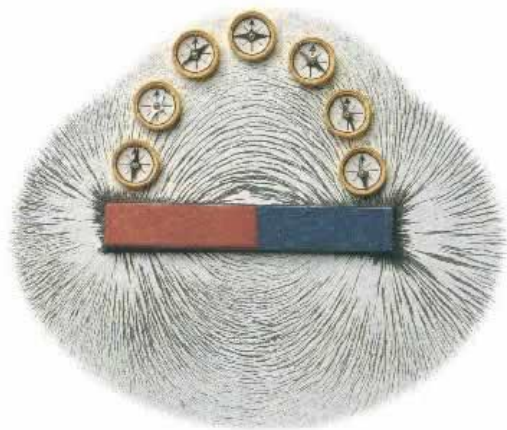
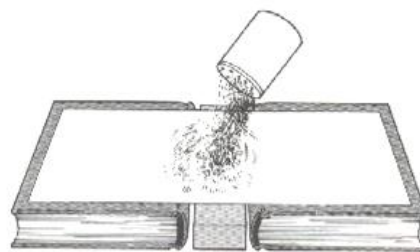
Put a piece of plane paper over the magnet and sprinkle some iron fillings on the paper directly above and slightly to the sides of the magnet. Without moving the paper or the magnet, gently tap the paper. The pattern of iron filling on the paper shows the lines of magnetic field of the magnet.

Plotting the magnetic lines with a compass:

Place a bar magnet on the paper, draw around the magnet and mark the position of the poles. Place a plotting compass next to the north pole of the magnet and around it mark the direction in which the needle is pointing. Now place the plotting compass so that its south pole is in continuation of the arrows you have just drawn. Draw around the compass and mark the direction in which the needle is pointing. Performing this procedure 40-50 time and you will be able to see the shape of magnetic field.

Earth's magnetic field:

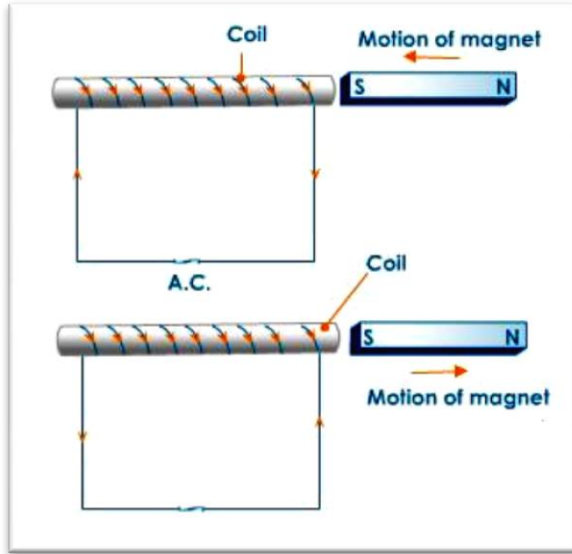
Scientists think that the Earth's magnetic field is generated by electrical currents due to the flow of liquid core deep inside the Earth. Although it's liquid metal, it moves around through a process called convection. These movements of metal in the core set up the currents and magnetic field. When we use compass, the needle always points towards the north pole of the earth and earth behaves as if it has a large bar magnetic inside with north pole of the magnet is at south pole of the earth and south pole of the magnet is at the north pole of the earth.



Methods of Demagnetization:

The magnet can be demagnetized (taking the magnetism away):

1. ..by placing the magnet inside the solenoid (a copper coil) through which the **alternating current** is flowing and by drawing the magnet away from solenoid in W-E direction.
2. ..by heating the magnet to the redness and then allow it to cool while it is lying in and W-E direction.
3. ..by dropping and hammering while the magnet is lying in W-E position.



THEORY OF MAGNETISM:

A completely satisfactory theory of magnetism has still not been formulated. At present it is assumed that magnetism is due to the movement of the electrons. The electrons circulate around the nucleus of the atom. They also spin around an axis through their centres. These two movements set up magnetic field about the electrons. As a result, the atoms act as magnets. Now ferromagnetic metals like iron, cobalt etc. have crystal structure and appear to have minute regions showing strong resultant magnetism. These regions are called 'domains'. In each domain the atomic magnets are in alignment as shown in figure.

It will be noticed that different domains have magnetic axes in random directions. As a result, the metal as a whole does not show any magnetic property. When the iron bar is magnetized, the atomic magnets turn to bring the domain magnetic axes in direction of magnetizing field. When the process of magnetization is complete, the magnetic axes of all the domains is brought into the best possible alignment and the metal is said to be magnetically saturated.

