CHAPTER TWENTY
INTRODUCTION TO MAGNETISM AND ELECTRICITY.

Magnetism:
This refers to the forces which act between magnets.
Magnets can be grouped into two main groups and these are:
(a) Permanent magnets.
(b) Electromagnets.

Permanent magnets:
These are those magnets which have permanent magnetic properties and as such always act as magnets. They are used in situations where magnetism is permanently needed and for this reason, they are used in compasses, generators, electric motors, the radio and the television sets.

Electromagnetism:
An electromagnet is a magnetic material which acts as a magnet only when an electric current flows through it. For this reason, electromagnetism is therefore the magnetism acquired by a magnetic material due to the flow of current through it. For example, a coil of wire acts as a magnet when current passes through it. Electromagnets are normallly used in situations where magnetism is not always needed.For this reasons, they are therefore used in devices such as door bells and apart from that, huge electromagnets are used to lift scrap metals which are later loaded onto railway cars.

Factors which affect the strength of an electromagnet:
As already stated, a coil of wire will act as an electromagnet when current passes through it.Such a coil will stop acting as a magnet when the current stops flowing.
The factors which determine the strength of such an electromagnet or any electromagnet (i.e. the strenght of the magnetism) are:

(1) The nature of the material used in making the wire.

(2) The number of turns of the wire coil (solenoid).

(3) The magnitude of the current which flows through the coil of wire or the solenoid.

(4) The direction of flow of the curent in the solenoid (i.e. the coil of wire)

Magnetic materials (substances):

- These are materials which can be attracted by a magnet and show magnetism.
- If a material shows magnetism, then it can be magnetized or converted into a magnet, and if it shows no magnetism, then it cannot be magnetized.
- Examples of magnetic materials are steel and iron.
- A soft magnetic material is a material which can easily be magnetized into a temporary magnet, but easily looses its magnetism.
- An example is iron and such materials are normally used in making temporary magnets or electromagnets.
- Hard magnetic materials are those materials which are difficult to be magnetized, but once they have been magnetized they do not loose their magnetism easily.
- They are normally used in making permanent magnets and an example is steel.

The poles of a magnet:

- These refer to the ends of a magnet, where the magnetic forces of attraction or the magnetism are strongest.
- If a a bar magnet is placed into a container of nails, more nails will be picked or attracted at its ends than at its mid portion.
- This is due to the fact that since the poles are located at these ends, then the magnetic forces of attraction are strogest at these points.
- Usually, a magnet has two poles and these are the north and the south poles.
- The pole or the end of the magnet which points to the north (geographic north), is called the north pole or the north seeking pole.
- The pole or the end which points to the south (geographic south), is called the south pole or the south seeking pole.
- The poles of a magnet point to the north and the south, ,because they are attracted by the earth`s magnetic poles, which are located near the north and the south poles.

Determination of the north and the south poles of a magnet:

To determine these two poles, the following procedures must be followed:
(i) Hang the bar magnet using a thread from the top of a ceiling, and allow it to swing freely till it comes to rest.
(ii) The end or the pole which points to the north is the north pole, and the one which points to the south is the south pole.

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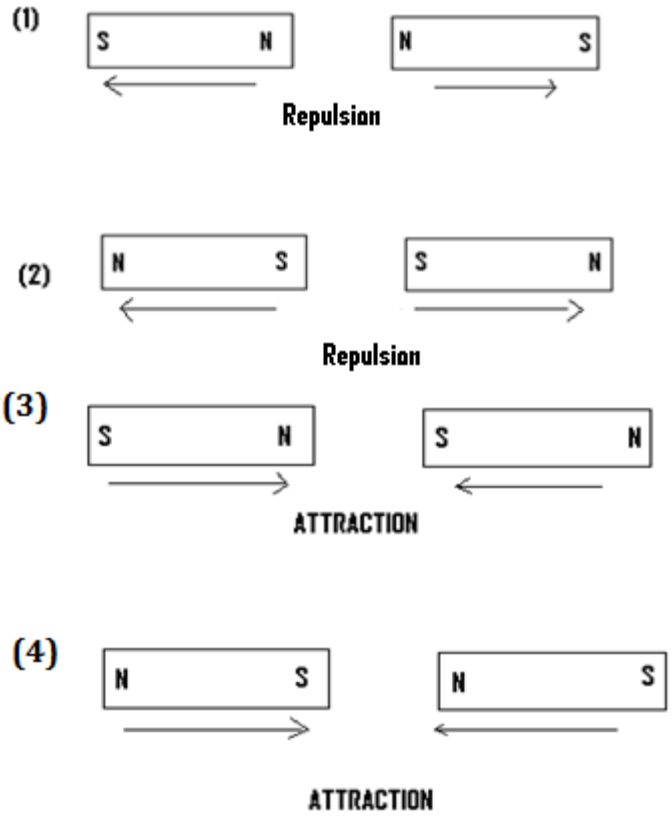
The earth as a magnet:

Our earth acts as a magnet with a south and a north pole, and these poles are located near the geographic poles.

- To explain the magnetic behaviour of the earth, we imagine a bar magnet pointing roughly in the north-south direction.
- Since the north pole of a suspended magnet points towards the north geographic pole, then there must be a south pole located near this geographiic north pole.
- Since the south pole of a suspended magnet points towards the south geographic pole, there must also be a north pole located near the south geographic pole.
- The origin of the earth`s magnetism us believed to be due to current generated within the core of the earth.
- The compass which sailors, surveyors and pilots rely on to find their direction functions as a result if the earth`s magnetism.

Action of one magnet on another:



- If the north pole of one magnet is brought near the north pole of another one which has been suspended, repulsion occurs.
- A similar observation will be made if two south poles (i.e. like or similar poles) are used,
- However, if two unlike or different poles are brought near each other, attraction will occur.

- The law of magnetism therefore states that “like poles repel and unlike poles attract”.

Magnetic Poles in pairs:

- A bar magnet has a north and a south pole.
- If we break a magnet into two pieces, each piece acts as if it has opposite poles at its ends.
- No matter how many times the magnet is divided, new poles wil appear at the break point and each piece will be a complete magnet.
- It has never been possible to separate a magnetic north, from a magnetic south pole.

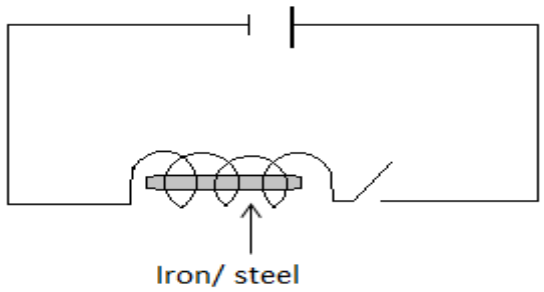
The magnetic properties of steel and iron:

IRON	Steel
(1) It takes a long time for it to be magnetized (2) It loses it manetic property within a short time. (3) It is usually used in making electromagnet or temporary magnets.	(1) Takes a short time for it to be magentized. (2) It takes a long time for it to lose its magnetic property. (3) It is usually used in making permanent magnet.

Magnetization:

This refers to the process of converting a magnetic material into a magnet.
Magnetization can occur using any of the following methods:
(1) By the electrical method.
(2) By the stroking method.
(3) By the hammering method.
(4) By induction.

Magnetization by the electrical method:



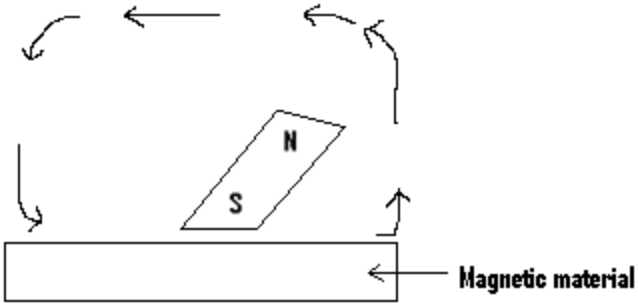
- This is the best method of making a magnet.

- The magnetic material which we want to convert into the magnet is placed inside a device called the solenoid.
- The solenoid consists of a cylindrical coil, wound with 500 or more turns of insulated copper wire which is in series with a 6v or 12v electric battery and a switch.
- After placing the magnetic material inside the solenoid, the current is switched on the off and this material will be changed into a magnet.
- The current must not be left on for a long time since it will damage the coil.

Magnetization by the stroke method:

There are two methods and these are
(i) the single stroke method.
(ii) the double stroke or divided touch method.

The single touch method:



(i) In this method, the magnetic material to be converted into the magnet is placed on a table.
(ii) It is then stroked at the surface using one pole of a permanent magnet in the same direction.
(iii) Between successive strokes, the pole of the magnet used for the stroking is lifted above the bar, otherwise the magentism already induced in it will be weakened.
(iv) In this method, the pole created at the end of the magnet where stroking ends, will be opposite to that used for the stroking.

The double stroking:

(i) In this method, the bar is stroked from the centre outwards with the unlike poles of two magnets simultaneously or at the same time.
(ii) In this case also, the polarity or the poles produced at either end of the bar or the magnetic material, will be opposite to that of the stroking pole.

The hammering method:

- In this method, the magnetic material to be changed into a magnet is heated to red heat.
- It is then hammered several times while lying in the north south direction.
- By so doing, it will be converted into a magnet.

Magnetization by induction:

- In this method, the magnetic material to be magnetized is attached to a permanent magnet for a long period of time.
- After this time period, it will be noticed that the magnetic material has been converted into a magnet.
- The magnet produced is called an induced magnet, and this phenomenon is referred to as induced magnetism.
- It must lastly be noticed that all these methods of magnetization, are used for the making of permanent magnets.