Strand	Electromagnetism
Sub Strand	Magnetic Substances
Content Learning Outcome	At the end of the lesson students should be able to Show understanding of properties of Magnetic Substances.

Electromagnetism

A magnet is any piece of material that has the property of attracting iron or steel.

Magnets can be permanent or temporary.

A temporary magnet is made from soft iron that is usually easy to magnetize but after a while lose almost all of their magnetism

Permanent magnets are usually difficult to magnetize but will retain their magnetism for a very long time.

Magnetism is present in all materials but at low levels. Iron, steel, nickel and alloys of rare earth metals show high level of magnetism

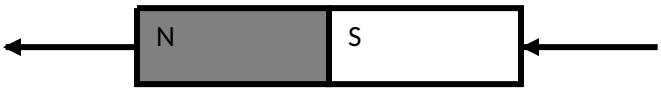
Materials which can be **magnetized** are called **ferromagnetic materials** Iron, nickel, and cobalt are examples of ferromagnetic materials.

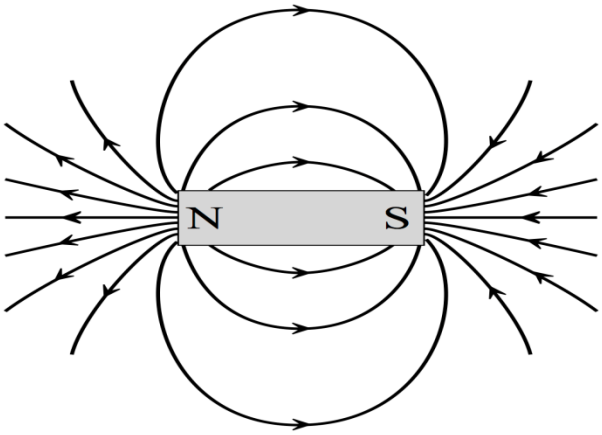
Materials with a small attraction to a magnet is called **paramagnetic material** eg aluminum, platinum and manganese ,magnesium, molybdenum, lithium, and tantalum.

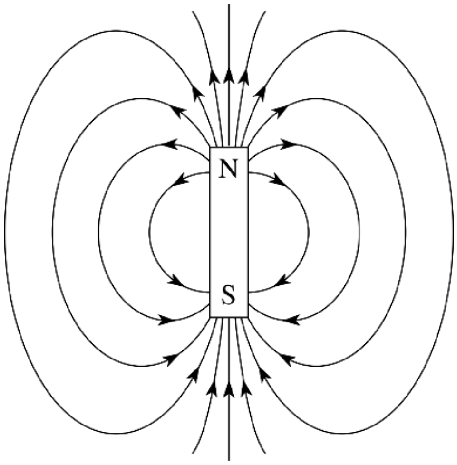
Diamagnetic materials have a weak, negative susceptibility to magnetic fields. Diamagnetic materials are slightly repelled by a magnetic field and the material does not retain the magnetic properties when the external field is removed. Most elements in the periodic table, including copper, silver, and gold, are diamagnetic.

A bar magnet

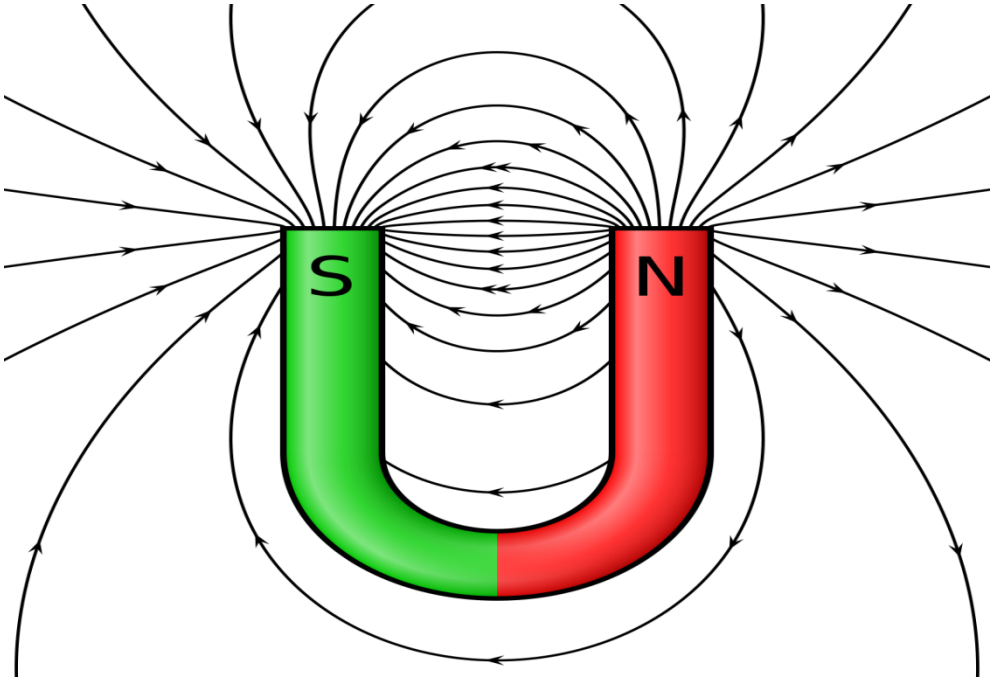
Outwards at N inwards at S







Horse shoe magnet

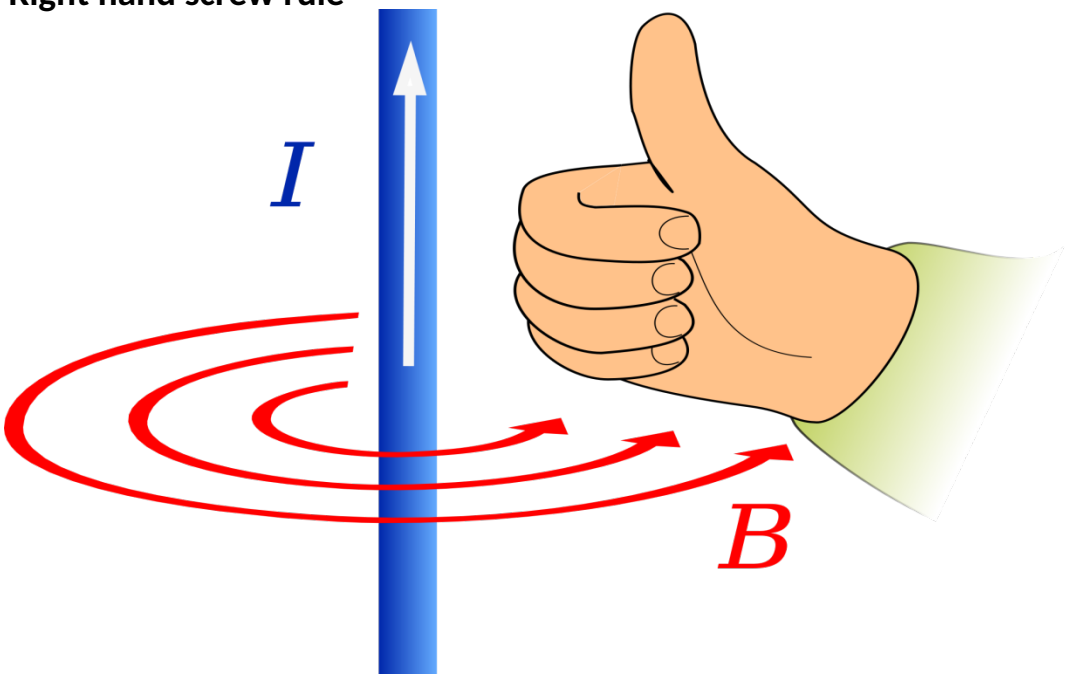


A wire carrying current

A wire carrying current also has magnetic field lines.

The shape of the field lines are in the shape of circles. The direction of the field lines is given by the **right hand screw rule.**

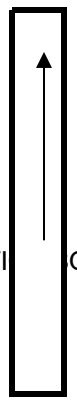
Right hand screw rule



The thumb points in the direction of current and the fingers curl around in the direction of field.

For the following draw the pattern and the direction of magnetic field lines

1.



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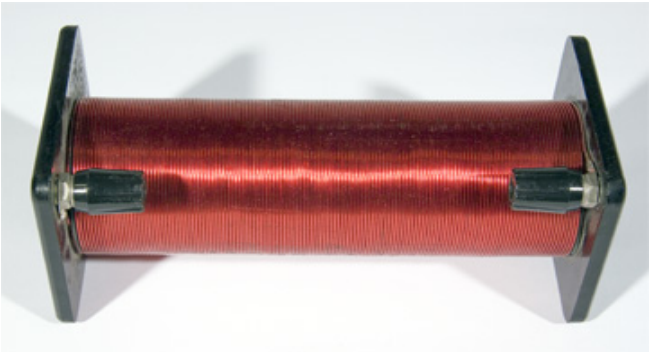
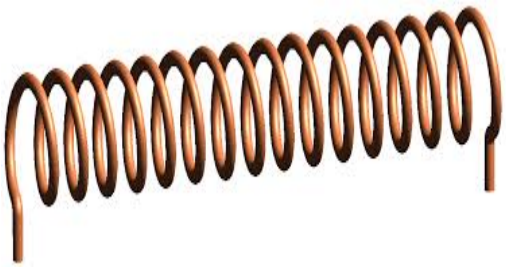
SYMBOLS

Means into page

Means out of page

Solenoid or coil of wire





If a current flows in the coil of wire it also behaves like a magnet. This type of magnet is called the electromagnet.

It will have its north and south pole when the current is flowing through it.

To find the direction of the magnet field and the direction of current we have to use the right hand grip rule.

Right hand grip rule

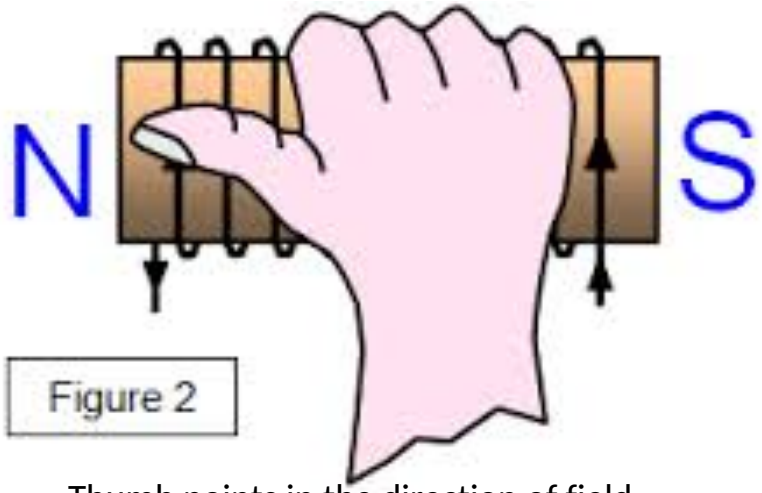


Figure 2

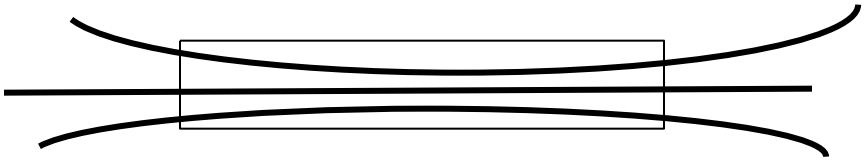
Thumb points in the direction of field

Fingers curl around in the direction of current.

To find the poles of the solenoid,

i. Draw direction of current in the coil if it not given. Current flows form positive to negative form a cell. Extend this to the coil of wire.

ii. Use pattern of field lines in the coil of wire. Draw one line in the middle and arcs on either side of the straight line.

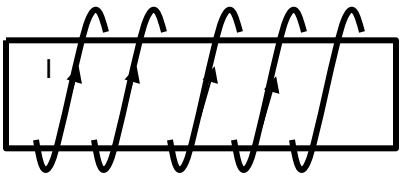


iii. Use the right hand grip rule where the fingers must curl in the direction of current. Use this to find out which direction the thum points.

iv. Label N and S for the coil. Field outward north, field inward- south

Label the poles of the solenoid

1.



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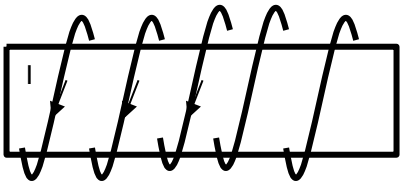

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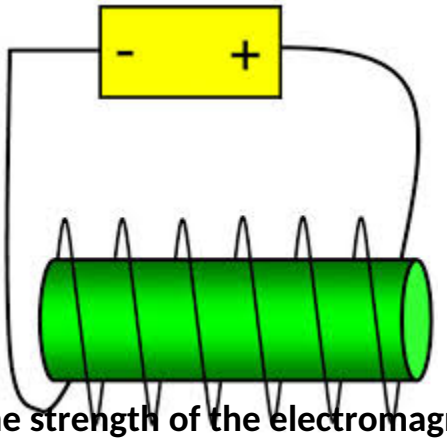

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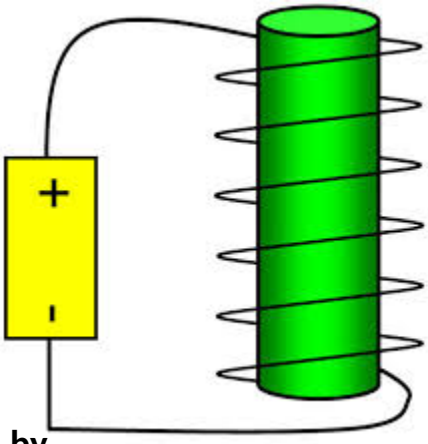


The strength of the electromagnet can be increased by

i. Increasing the Current in the coil

ii. Increasing the Number of turns in the coil
iii. Having a soft iron core

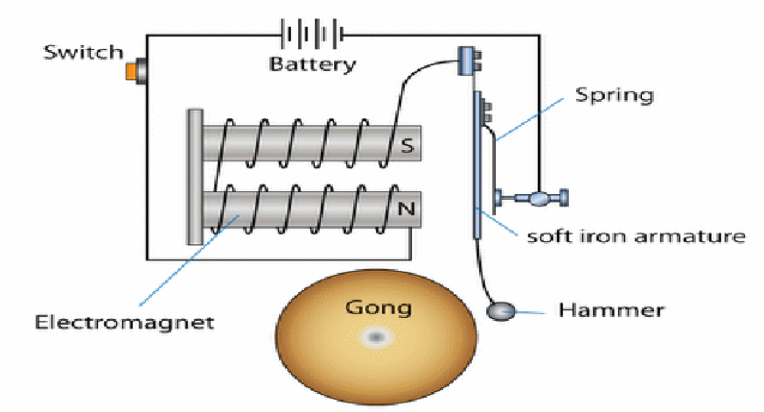
Advantages of a electromagnet over a permanent magnet

i. Can be made much stronger
ii. Magnetic field is controlled by changing current
iii. Lose all their magnetism if there is no current

Uses of electromagnets.

Picking heavy metal in junk yards

in an electric bell

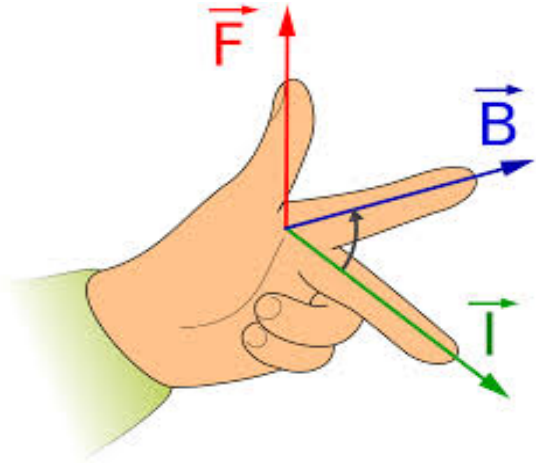


force on a current carrying conductor

if a conductor carrying current is placed inside a magnetic field it experiences a force.

The direction of the force is given by **Flemings left hand motor rule.**

Flemings left hand motor rule.



Thumb- force

First finger – field

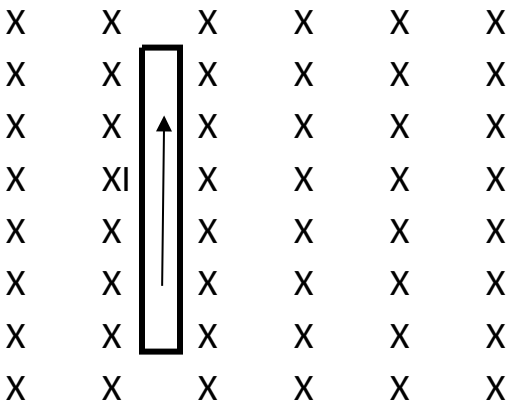
Second finger – current

To find the direction of force on the conductor

i. Use your left hand with the fingers pointing 90^0 to each other as shown.
ii. Point the first finger in the direction of current
iii. Twist the hand so that the second finger points in the direction of current.
iv. Now the thumb points in the direction of force.

For the following diagrams find the direction of force on the conductor.

a. Field into the page



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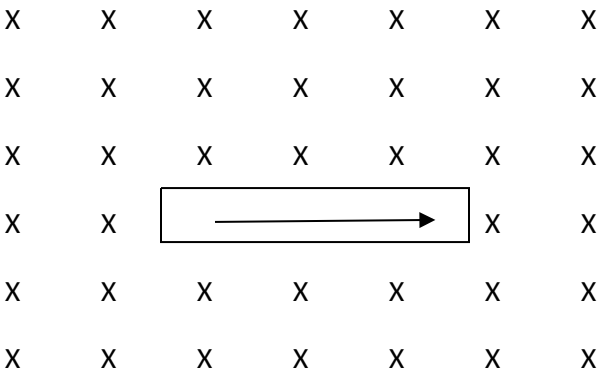

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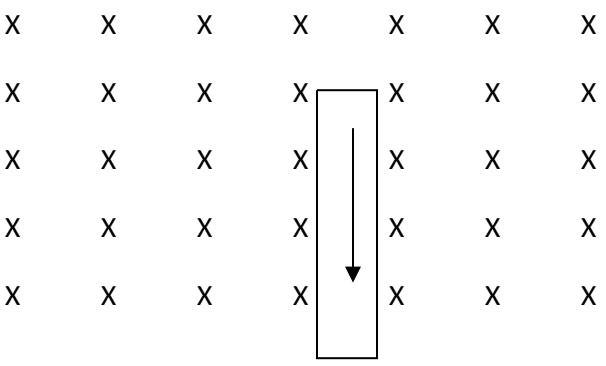
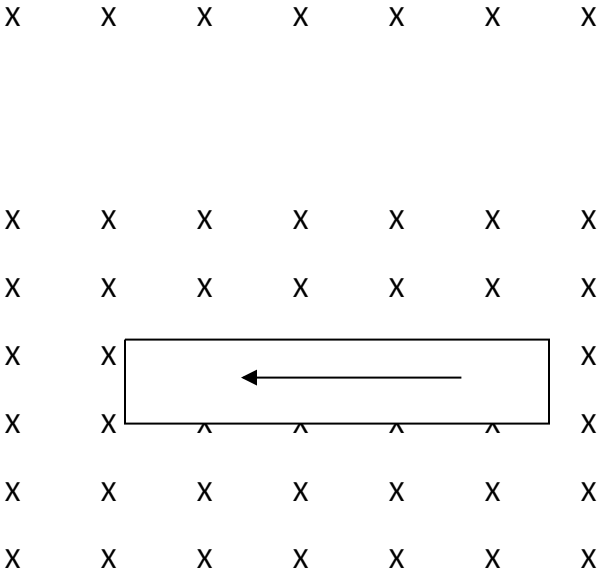
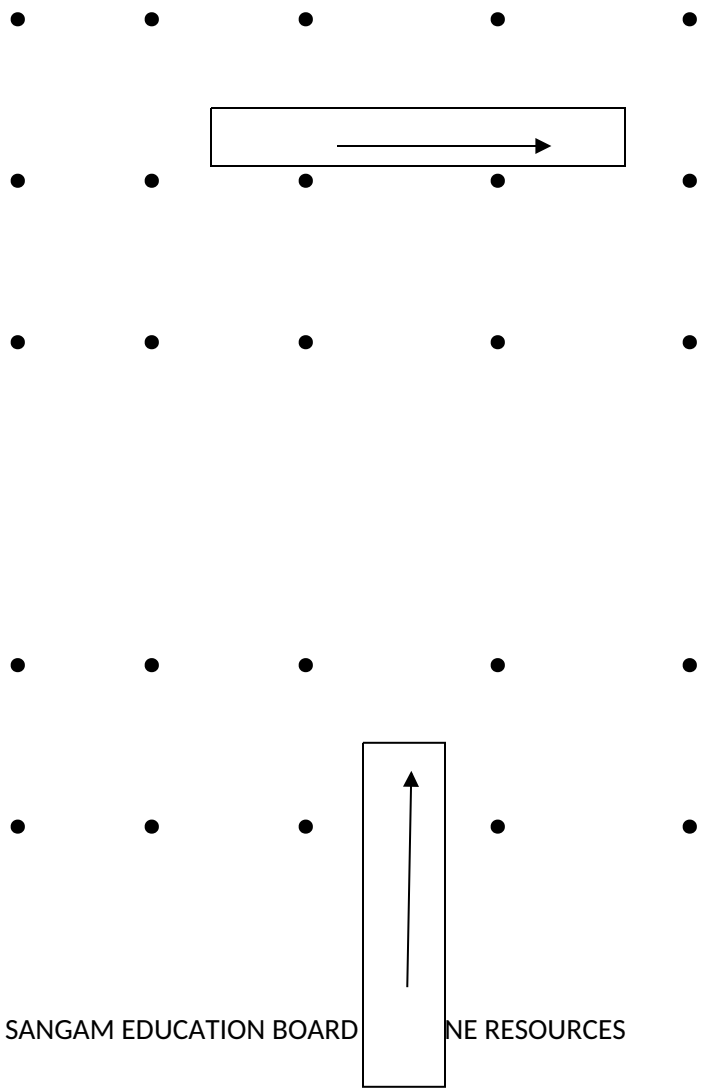




Field out of page



The size of the force is given by the formula

$$F = B\,I\,L\,\sin$$

F is the force in N, B is the magnetic field in Teslas T, I is the current in Amperes A, L is the length of the conductor in the field in m, is the angle in between the field and the conductor

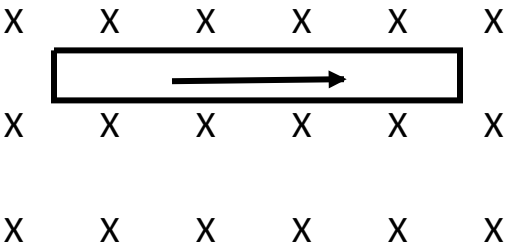
A conductor of length 1.5m is placed in a field strength of 4T. it carries a current of 6A. find the force it experiences if it is

a. Placed 60^0 to the field

b. Placed perpendicular to the field

c. Placed parallel to the field.

1. A conductor is placed in a magnetic field of 0.9T.



a. Find the direction of the force on the charge
b. If the length of the conductor is 0.5m and carries a current of 10A. find the force it experiences.

Motor

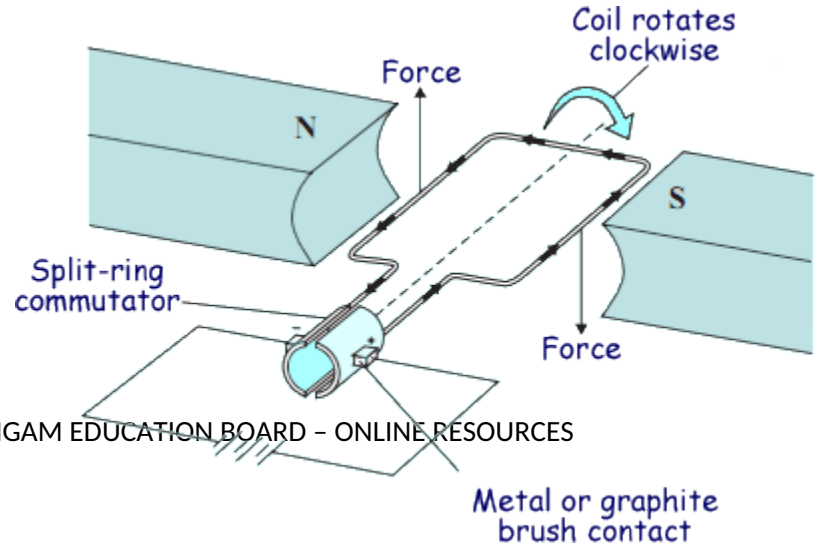
A motor is a very useful device. It is placed in fans, in the washing machine, in a blender and equipments where rotation is required.

From current we get rotation

Energy transformation in a motor

Electrical to mechanical or kinetic energy

DC motor



part	Function
Magnet	Provides magnetic field
Coil or armature	Carries current in the magnetic field
Split ring or commutator	Reverses direction of the current very half cycle so that there is continuous motion
Carbon brushes	For contact and slides over split ring and conducts electricity into the coil

Ways to increase speed of the motor

1. Increase current by increasing voltage
2. Increase number of turns
3. Stronger magnet
4. Use soft iron core because it increases magnetism.

Ways to rotate motor in the opposite direction

1. Reverse direction of current
2. Reverse direction of magnetic field