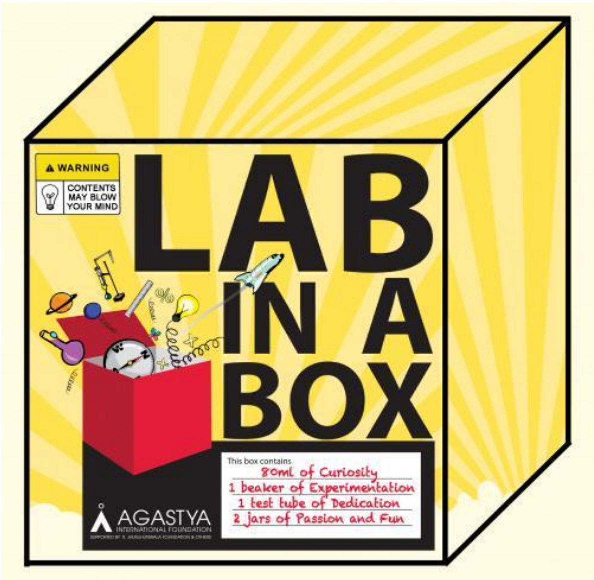
Lab in a Box 10

ELECTRICITY AND ELECTROMAGNETISM



Inventory

Sl.No.	Material	Quantity
	Models	
1	Electric kit and its accessories(17 items)	1
2	Oersted model	1
3	Faradays laws of electromagnetic induction	1
4	Fleming's left hand and right hand rules	1
5	Solenoid model	1
6	Electromagnetic induction(coil and magnets)	1
7	Ac Dynamo	1
8	DC dynamo	1
	Equipment's	
9	Needle magnet	1
10	Iron powder	1
11	Iron Bar	1
12	Rheostat	1
13	Battery box	1
14	Milli ammeters(0-500 mA)	1
15	Voltmeter (0-3)V	1
16	Galvanometer	1
17	Torch bulb	1
18	Iron Nails/Steel nails	2
19	Ammeter	1
20	Resistors	5
21	Magnetic compass	4
22	Bar magnet	2
23	Screwdriver	1
24	Crocodile clips (red and blue)	5each
	Consumables	
25	Cells	4
26	Straw pipes	1pack
27	Pencils	1
28	A4 Size sheets bundle	1
29	Chart papers	5
30	1.5 v bulbs	1 pack
31	Connecting wires (red and blue)	1 meter each
32	Cutter and insulation tape	Each 1

CONTENTS

1. SIMPLE ELECTRIC CIRCUIT

Aim:

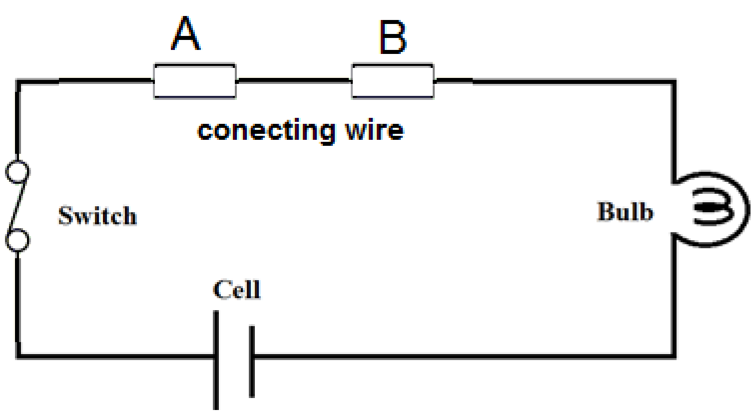
To demonstrate the components of simple circuit.

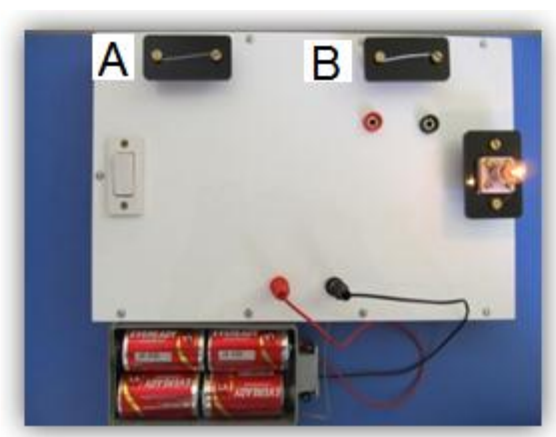
Materials required:

Socket board, connecting wires, bulb, cell box with cells.

Procedure:

Step 1
Connect bulb, cell and connectors A,B as shown in the circuit diagram.
Step 2
Switch on the circuit to pass the current in the circuit and observe the bulb.
Step 3
Switch off and observe.





Observation and explanation

When current flows in the circuit bulb glows. Otherwise it does not glow. When current flows in the bulb a part of electrical energy is converted in to light energy in the electric bulb.

Conclusion:

The electric circuit should be completed, if the bulb has to glow. A switch can make or break the circuit.

Note: when the switch is off the air gap inside the switch being a poor conductor does not allow a flow of current

2. Electric Current and Intensity of the Bulb

Aim:

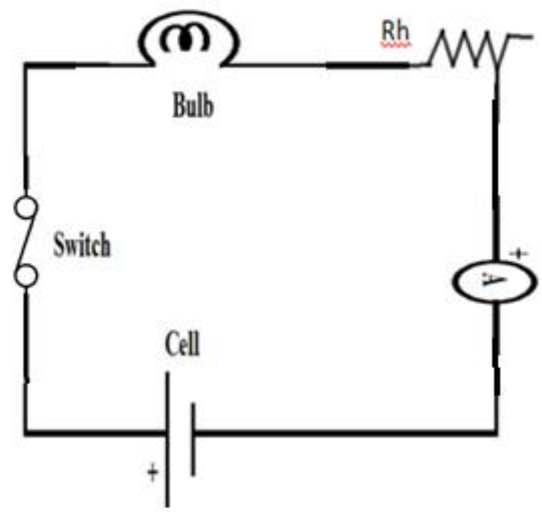
To Study the dependence of intensity of light on current in the circuit.

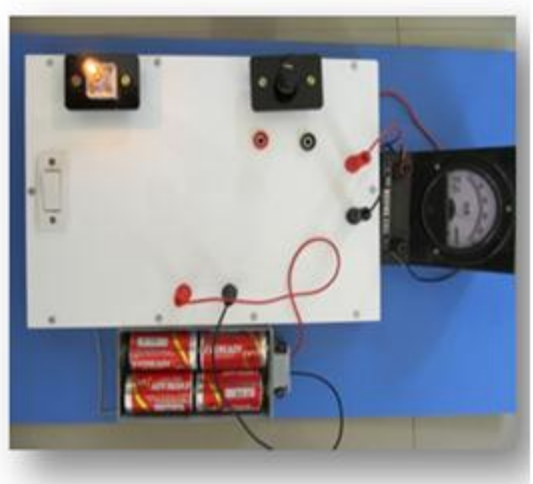
Materials required:

Socket board, ammeter, bulb, cell box with cells switch and rheostat.

Procedure:

Step 1
Connect cell, bulb, rheostat and ammeter in series as shown in the circuit diagram.
Step 2
Switch on the circuit and observe the intensity of the bulb and reading in the ammeter.
Step3
Using the rheostat, increase the current step by step in the circuit and observe the intensity of the bulb and also the current in Ammeter.





Observation and explanation

As current in the circuit increases, more of electrical energy is converted into light and the intensity of the bulb also increases.

Conclusion:

Intensity of the bulb is directly proportional to the current flowing in the circuit.

3. Ohm’s Law

Aim:

To Study the relation between current, voltage and resistance.

Materials required:

Socket board, voltmeter, ammeter, resistor, rheostat, bulb and cell box with cells.

Procedure:

Step 1
Connect cell, rheostat, resistor and mill- ammeter in series as shown in the circuit diagram.

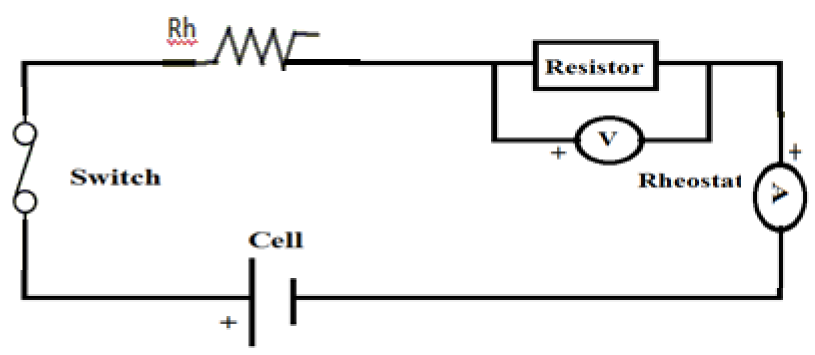
Step 2
Connect voltmeter across resistor.

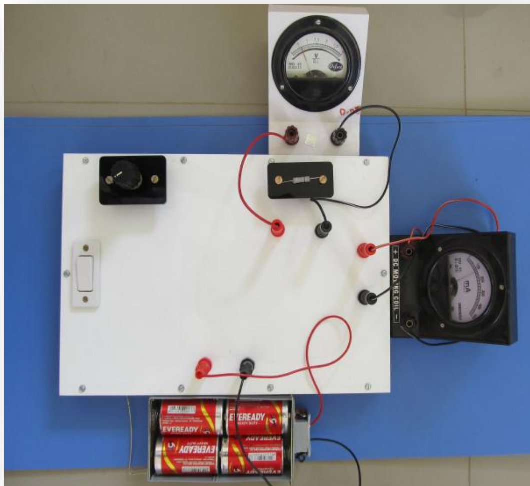
Step 3
Using the rheostat vary the resistance in the circuit.

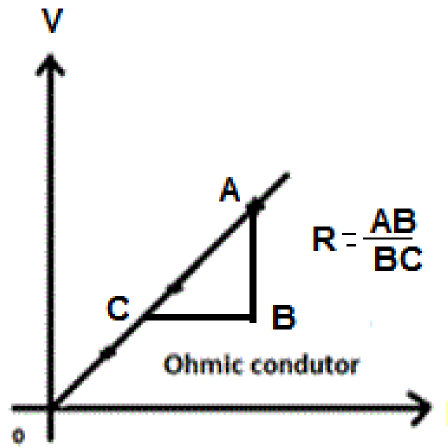
Step 4
Note down the current flowing in the resistor and voltage V across the resistor.

Step 5
Repeat the trial for three different currents and note the readings V and I each time. Calculate the ratio V/I. In each case and find the average.

Step 6
Plot a graph of these values and find the slope.







Sl.No	V_{Volt}	I_{amp}	V/I_{ohm}	Remark
				V/I is constant

Observation and explanation

Ratio V/I remains constant. The graph of V versus I is straight line.

The slope AB /BC is same as V/I and gives the resistance of the conductor.

Conclusion:

Since V/I is a constant the current flowing in the conductor is directly proportional to the potential difference between the two ends of the conductor. This is called Ohm's law.

The conductor which gives straight line graph is called "Ohmic conductor". At normal temperature, copper and other metals obey Ohm's law.

4. RESISTORS IN THE CIRCUIT

Aim:

To show that as the resistance in the circuit increases, current is reduced

Materials required:

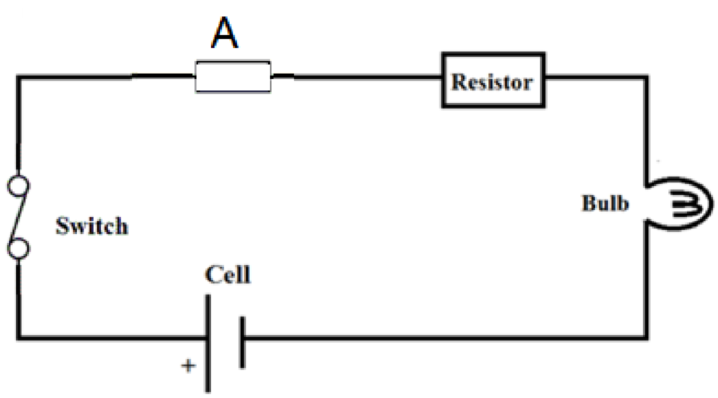
Socket board, resistor, rheostat, bulb, switch and cell box with cells.

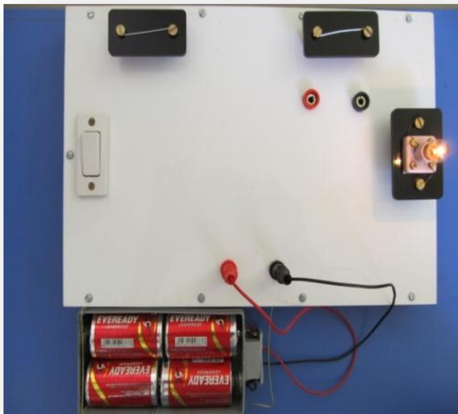
Procedure:

Step 1
Connect the bulb, two connectors (A,B) switch and the cell directly. Pass a current and observe the intensity of the bulb.

Step 2
Insert a resistor in place of connector B in the circuit.

Step 3
Pass a current and observe intensity of the bulb again.





Observation and explanation

Intensity of the bulb is more when there is no resistor in the circuit, and intensity is reduced when resistor is connected in the circuit. By ohms law I=V/R. When resistor is included the resistance of the circuit increases and current decreases, the intensity of the bulb also decreases.

Conclusion:

As the resistance in the circuit increases, current is reduced

5. RESISTORS IN SERIES

Aim:

To prove that when two resistors are connected in series their combined resistance is always equal to the sum of individual resistances.

Materials required:

Socket board, resistors, voltmeter, ammeter, rheostat, bulb, switch and cell box with cells.

Procedure:

Step1

Connect cell, ammeter in the bulb gap and a resistorR_1 in place of connectorA,across R_1 connect a voltmeter

Step 2

Pass the current and note down the readings of voltmeter and ammeter (V,I)

Step 3

Calculate $R_1 = V/I$

Step 4

Now remove R_1 and connect R_2 in its place

Step 5

Measure V and I and calculate $R_2 = V/I$

Step 6

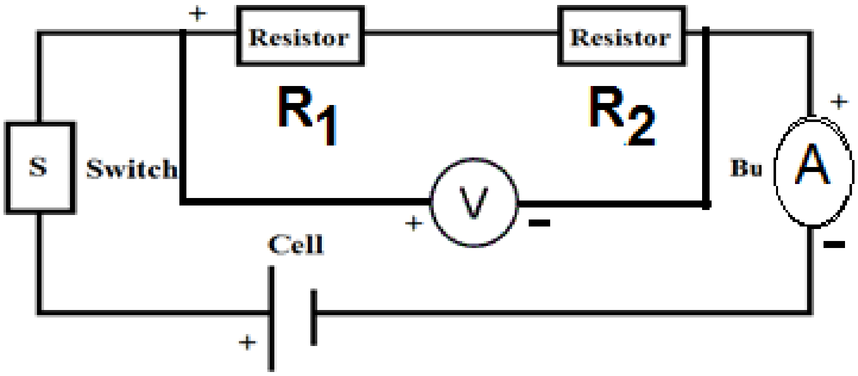
Now remove connector B also and Introduce R_1 in the gap (Both R_1 and$R_2$are in series)

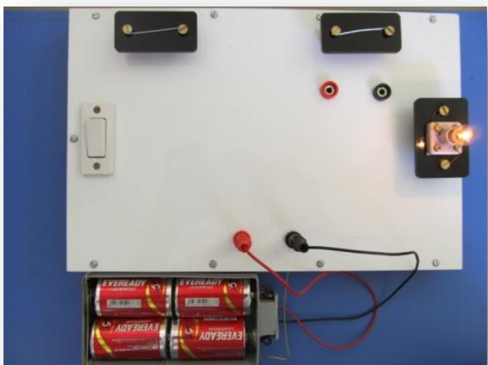
Step 7

Pass the current and note down the voltage V and current I. Calculate combined resistance $R_S = V/I$

Step 8

Compare (R_1+R_2 and R_S)





Observation and explanation

The sum of two resistances $R_1 + R_2$ is found to be equal to R_S.

Conclusion:

$R_1 + R_2 = R_S$ means when two resistors are connected in series their combined resistance is always equal to the sum of individual resistances.

Resistance	V	I	V/I	Remark
R_1				
R_2				
R_S				

6. RESISTORS IN PARALLEL

Aim:

To prove that when two resistors are connected in parallel the reciprocal of the combined resistance is always equal to sum of reciprocals of individual resistances

Materials required:

Socket board, resistors, voltmeter, ammeter, rheostat, bulb, switch and cell box with cells.

Procedure:

Step 1
Connect cell, ammeter in place of bulb holder, connector A and the first resistor $\mathbf{R_1}$in the gap of B. Connect also a voltmeter across $\mathbf{R_1}$

Step 2
Pass a current and note down V and I.
Step 3
Calculate the resistance $\mathbf{R_1} = V/I$

Step 4
Replace R_1 by the secondresistor$\mathbf{R_2}$**.** Pass the current and note down the readings of the ammeter and voltmeter (I,V)

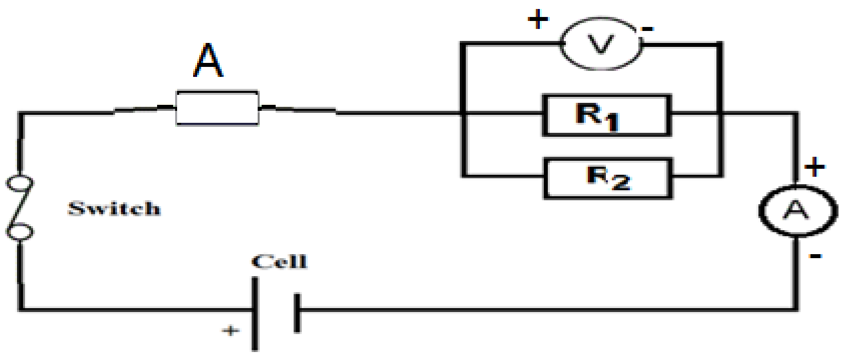
Step 5
Calculate the resistance $\mathbf{R_2} = V/I$

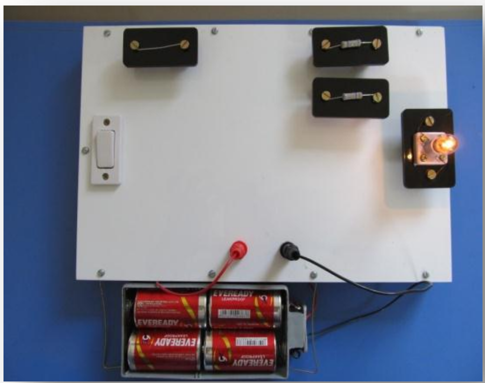
Step 6
Now connect $\mathbf{R_1}$ parallel to$\mathbf{R_{2.C}}$onnect also a voltmeter across them.

Step 7
Pass the current and note down the readings of the voltmeter and ammeter(V,I)

Step 8
Calculate the combined resistance of the two resistors, $R_p = V/I$.

Step 9
Calculate $1/ R_1 + 1/ R_2$ and also $1/ R_p$ and then compare .





Observation:

It is observed that 1/ $\mathbf{R_1}$ **+ 1/**$\mathbf{R_2}$ = 1/ R_p

Conclusion:

When two resistors are connected in parallel the reciprocal of the combined resistance is always equal to sum of reciprocals of individual resistances.

7.DEPENDENCE OF RESISTANCE ON THE LENGTH OF THE CONDUCTOR

Aim:

TO study the dependence of resistance on the length of the conductors

Materials required:

Socket board, connecting wires, short and long wire coils, voltmeter, ammeter, switch and cell box with cells.

Procedure:

Step 1
Connect cell, an ammeter in place of bulb holder, a connector A and wire of short length(R_1) in place of connector B as shown in the diagram. Also connect a voltmeter across the short wire.

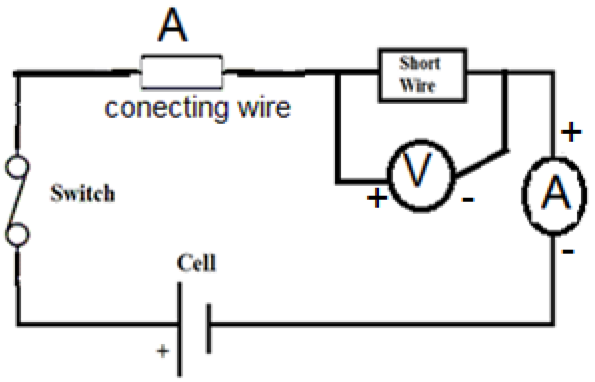
Step 2
Pass the current and note down the ammeter and voltmeter readings (I,V)

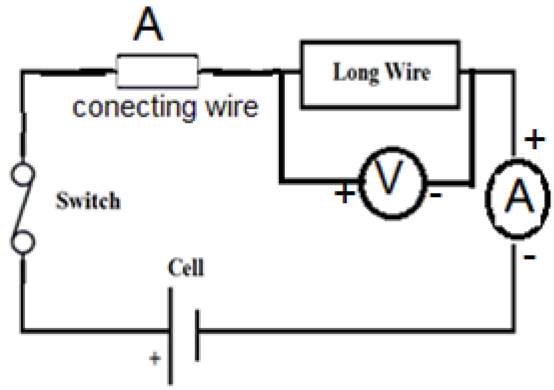
Step 3
Calculate the resistance of the short wire $\mathbf{R_1}$= V/I

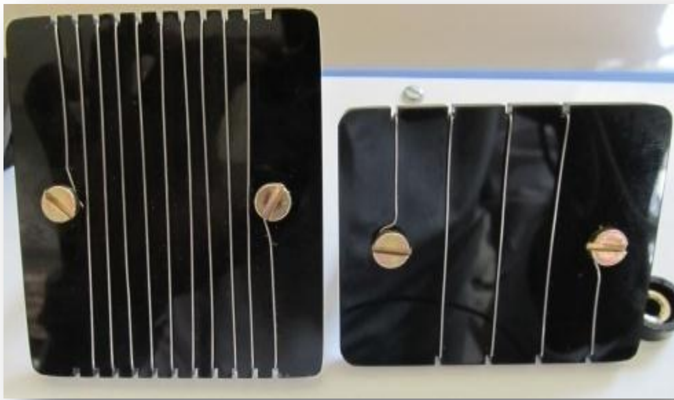
Step 4
Note down the length of the short wire l_1 and calculate $\mathbf{R_1/\ell_1}$

Step 5
Replace the shorter wire by a longer wire and repeat the experiment as explained above. Calculate $\mathbf{R_2/\ell_2}$

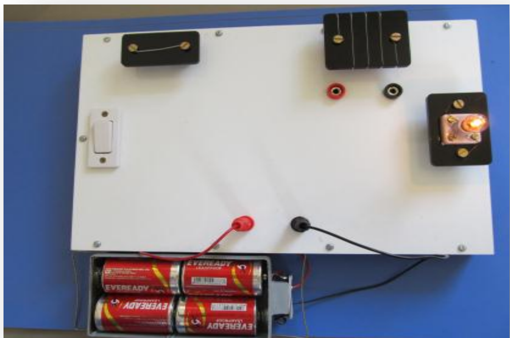
Step 6
Compare$\mathbf{R_1/\ell_1}$ **and** $\mathbf{R_2/\ell_2}$

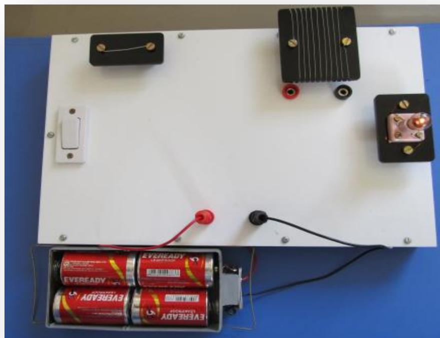






Picture showing different lengths of conductors of same diameter





Observation:

R_1/ℓ_1 is found to be nearly same as R_2/ℓ_2.

Conclusion:

Since $\mathbf{R_1/\ell_1 = R_2/\ell_2}$ **it** means R/l is a constant or $\mathbf{R \alpha \ell}$

The resistance of a conductor is directly proportional to its length.

8. DEPENDENCE OF RESISTANCE ON AREA OF CROSS-SECTION OF THE CONDUCTOR

Aim:

To study the dependence of resistance on area of cross section of the conductor.

Materials required:

Socket board, thick wire board, thin wire board, connecting wire, voltmeter, and ammeter, switch and cell box with cells.

Procedure:

Step 1
Connect cell, an ammeter in place of bulb holder, a connector and A thin wire of short area (R_1) in place of connector B as shown in the diagram. Also connect a voltmeter across the short wire.

Step 2
Pass the current and note down the ammeter and voltmeter readings (I,V)

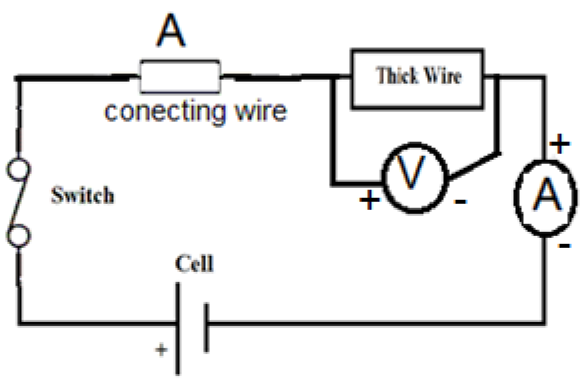
Step 3
Calculate the resistance of the thin wire $\mathbf{R_1}$= V/I

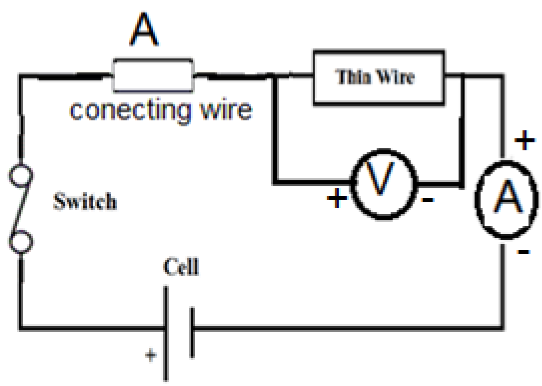
Step 4
Calculate(R_1 $a_{1)}$

Step 5
Remove the thin wire, introduce the thick wire in its place and repeat the experiment as explained above

Step 6
Calculate R_2a_2

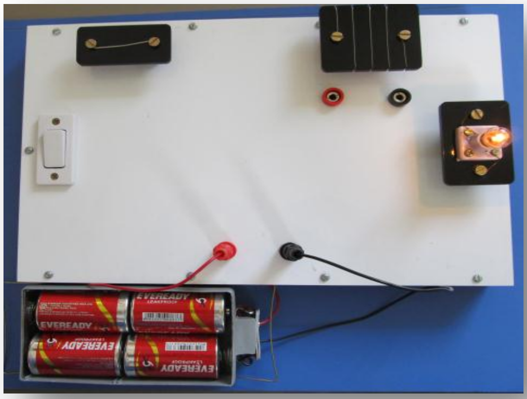
Step 7
Compare(R_1 a_1)and(R_2 a_2)

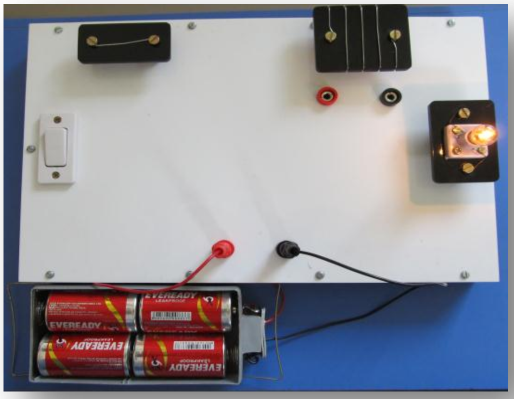




Thick wire a_2 = ... Thin wire a_1 = ...

Picture showing same length of conductors with different area of cross section.





Observation:

It is observed that (R_1a_1) is nearly same as (R_2 a_2)

Conclusion:

Since $R_1 a_1 = R_2 a_2$

$R \times a$ is constant or $\mathbf{R\ \alpha 1/a}$

The resistance of the conductor is inversely proportional to its area of cross session

Note:

For a given length, when the cross sectional area is increased there are very large number of free electrons available to carry current. Hence the current flow increases and resistance decreases.

9. DEPENDENCE OF RESISTANCE ON THE MATERIAL OF THE CONDUCTOR

Aim:

To show the dependence of the resistance on the material of the conductor.

Materials required:

Socket board, connecting wire, copper wire, nichrome wire, brass wire, ammeter, rheostat, switch and cell box with cells.

Procedure:

Step 1
Connect cell, ammeter in place of bulb holder, a connector A and copper wire as shown in the circuit diagram.

Step 2
Pass the current and measure the current in the ammeter

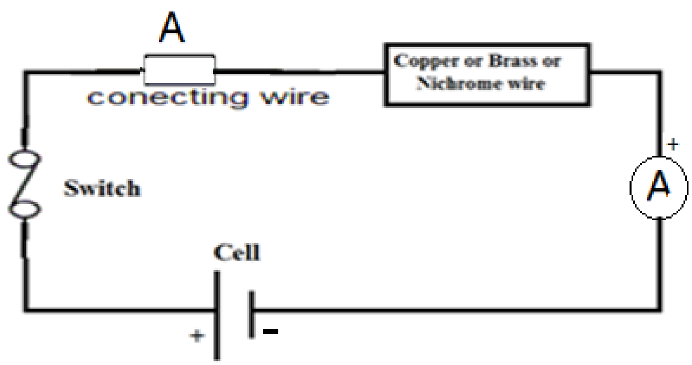
Step 3
Remove copper wire and replace it with brass wire of same length in its place.

Step 4
Pass the current and observe the ammeter reading.

Step 5
Again replace brass wire with nichrome wire of same length in its place.

Step 6
Pass the current and read the ammeter.

1. .



Observation and explanation

The current is maximum when resistor of copper metal is connected. It is less when brass and nichrome resistors are connected. It is because copper has least resistivity of the materials used.

Conclusion:
Resistance of a conductor depends upon nature of its material.

From the activity 7,8 and 9 we learn that resistance of a conductor depends on

- Its length
- Area of cross section
- Nature of material

10. MAGNETIC EFFECT OF ELECTRIC CURRENT

Aim:

To demonstrate experimentally the magnetic effect of electric current.

Materials required:

Socket board, connecting wires, magnetic compass, aluminium conductor, switch and cell box with cells.

Procedure:

Step 1

Connect cell, two connectors and an alluminum strip as shown in the circuit diagram.

Step 2

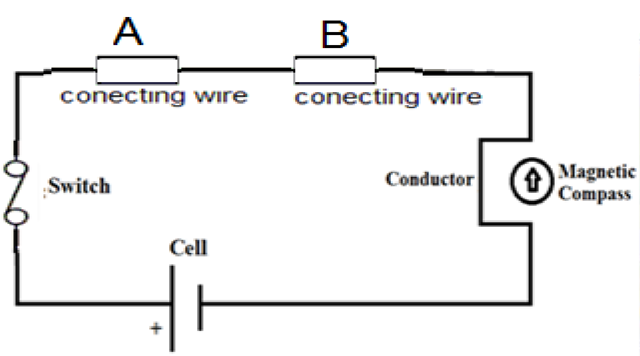
Place the magnetic compass above the aluminum strip, adjust the board such that compass needle remains parallel to the alluminum strip.

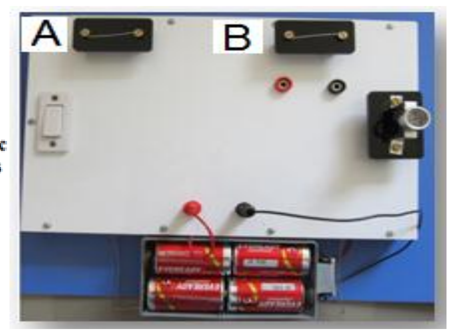
Step 3

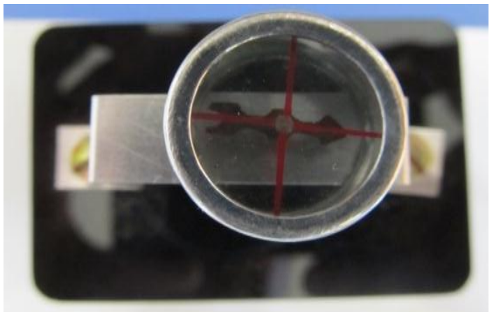
Pass the current and observe position of the needle in compass.

Step 4

Change the direction of the current. What happens?







Observation and expla

ionWhen current is passed through aluminium strip, compass needle is deflected from its original position. When the direction of the current is changed, needle deflects in opposite direction. A current passing through the conductor produces a magnetic field around it .The needle is deflected in this magnetic field.

Conclusion:

Currrent carrying conductor produces a magnetic field around it.The presence of a magnetic field is tested by a compass needle.

11. ELECTROMAGNET

Aim:

To study the magnetization of a substance by a current coil.

Materials required:

Socket board, connecting wires, copper wire winded nail, switch and cell box with cells.

Procedure:

Step 1

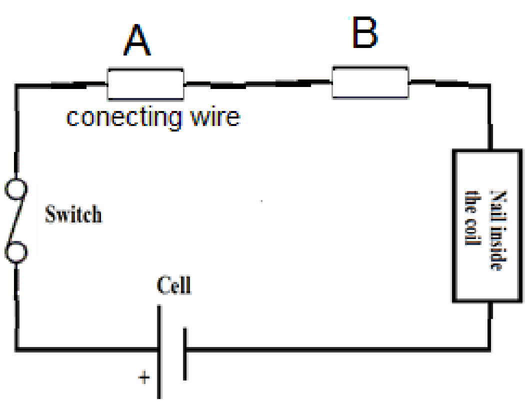
Connect cell, two connectors and a nail wound with copper wire as shown in the circuit diagram.

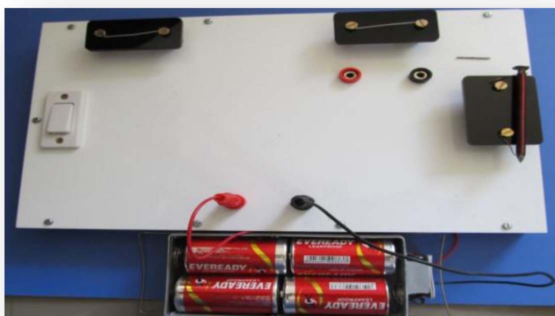
Step 2

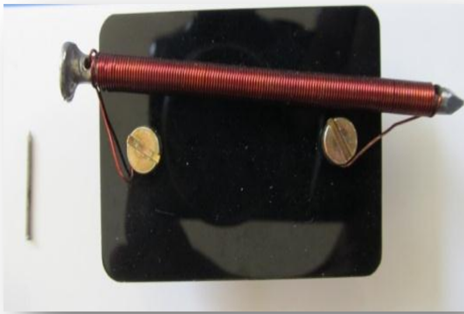
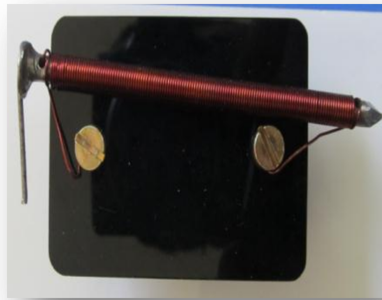
Now place an iron pin near the nail. Does it get attracted?

Step 3

Pass the current through the circuit and observe.





Observation:

When there is no current through the wire, the nail does not attract iron pins. When the current flows, it attracts iron pins (Magnetic material) because it is magnetized in the magnetic field produced inside the copper turns.

Conclusion:

A soft iron nail which is a ferromagnetic material becomes a magnet in the magnetic field produced inside a current coil.

12. MAGNETIC FIELD DUE TO STRAIGHT CONDUCTOR

Aim:

To study

i) the magnetic field produced around a straight conductor

ii)field lines around, when a current is passed through it.

Materials required:

Socket board, connecting wires, straight conductor, compass switch and cell box with cells.

Procedure: A – Field

Step 1

Connect a cell, two connectors and copper coil as shown in the circuit diagram.

Step 2

Place a white cardboard sheet below the coil.

Step 3

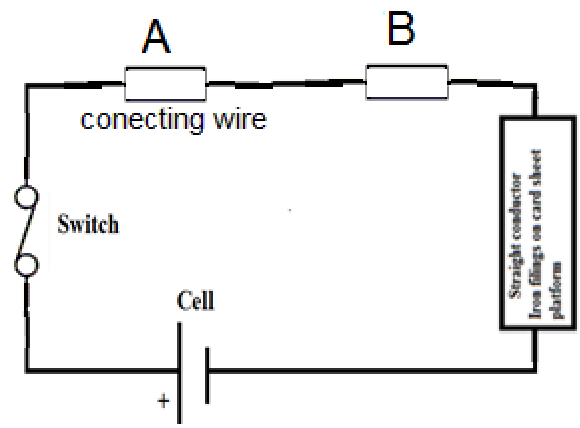
Sprinkle iron fillings on the cardboard sheet around the coil.

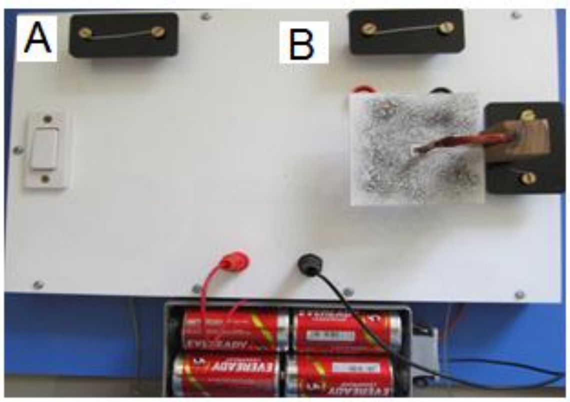
Step 4

Pass the current, gently tap the card board and observe

Step 5

Place a compass needle near the conductor and note the direction which the north end of the needle points. Shift the needle to different positions around the conductor and note the direction of orientation of its north pole.





Observation and explanation:

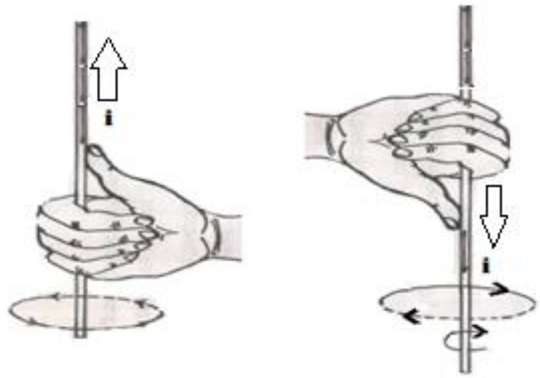
Before passing the current in a straight conductor, iron fillings are randomly oriented. After passing the current, filings are arranged in a concentric closed path in a plane around the conductor. When the compass needle is taken around it comes to rest along the closed path and the north pole points to the direction in which the path is traced

When current is passed through the conductor a magnetic field is produced around it. Iron fillings get magnetized and lie along closed path around the conductor. This path represents the line of force of the magnetic field. The north pole of the compass needle shows direction of the field at every point, therefore each closed line is associated with an arrow mark that decides if the field lines are clockwise or anti clock wise

Conclusion:

Magnetic field is produced around a straight conductor when current is passed through it and field lines are nearly circular in nature. They are either clock wise or anti-clockwise depending upon the direction of the current in the conductor.

B. AMPERE'S RIGHT HAND THUMB RULE



Recall the observations of the previous activity. Identify the direction of the current in the conductor and also the direction of the field lines around it .Now imagine you hold the conductor in your right hand and stretch the thumb in the direction of the current(refer to the figure). The direction in which the fingers encircle the conductor shows the direction of the field lines around it .This is verified by the deflections of the compass needle. This is illustrated by the Ampere's rule – "**hold the conductor in the right hand and stretch the thumb showing the direction of the current along the conductor. The direction in which the fingers encircle the conductor gives the direction of magnetic field"**

13.MAGNETIC FIELD AROUND SOLENOD

Aim:

To study that magnetic field produced by current solenoid.

Materials required:

Socket board, connecting wires, solenoid with iron core, compass, switch and cell box with cells.

Procedure:

Step 1

Connect cell, two connectors and a solenoid as shown in the figure.

Step 2

Place a white card sheet around the solenoid.

Step 3

Sprinkle iron filings on white card sheet around the solenoid.

Step 4

Observe pattern of iron filings.

Step 4

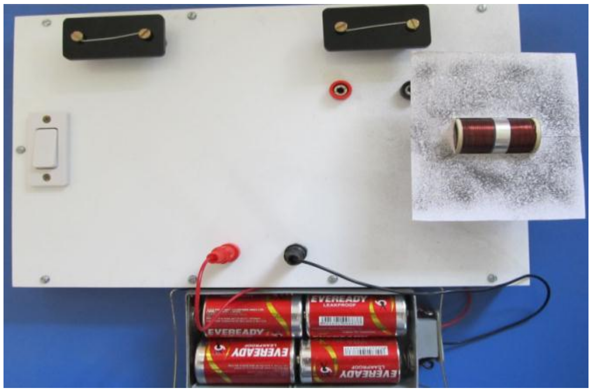
Pass the current and observe the pattern of iron filings.

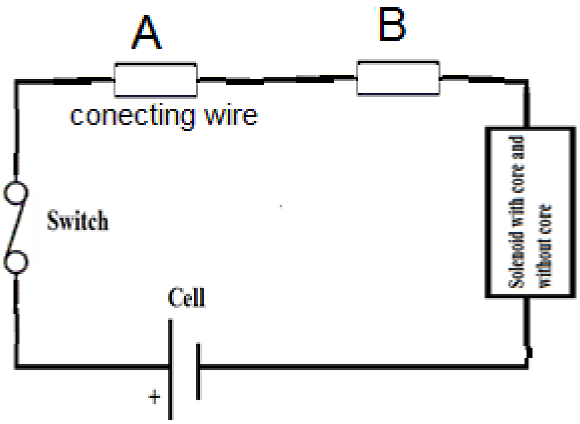
Step 5

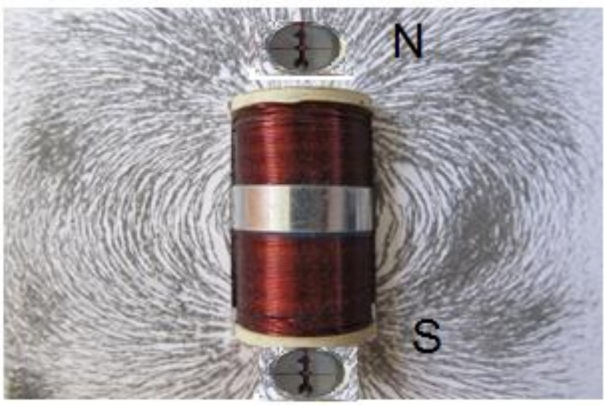
Repeat the same experiment by inserting soft iron core in the solenoid.

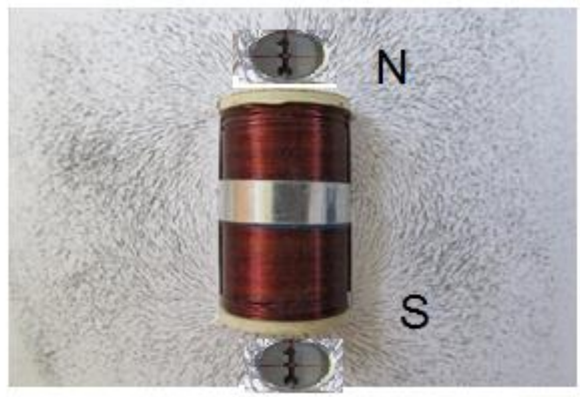
Step 6.

Place a compass needle close to one of the open ends of the solenoid, mark the direction which the north pole points and find out if it is towards the solenoid or away from the solenoid.









Observation and explanation:

Before passing the current, iron filings are randomly distributed on the card sheet. When the current is passed, they align in a specific pattern which resembles the lines of force due to bar magnet. When the core is introduced lines of force are more concentrated.

The magnetic field lines have a direction when the compass needle is placed near one of the open ends of the solenoid and if its north pole points towards the solenoid then field lines in the region converge near that end of the solenoid. Then this end of the solenoid appears to behave as a south pole.

when the compass needle is placed near one of the open ends of the solenoid and if its north pole points away from the solenoid then field lines in the region diverge near that end of the solenoid. Then this end of the solenoid appears to behave as a north pole.

On the whole the field lines that diverge from the North Pole follow a closed path and converge at the South Pole as found in the case of a bar magnet.

Conclusion:

When current is passed in a solenoid a magnetic field is produced around it. Field strength is more when core is inserted into the solenoid. A current solenoid behaves as bar magnet.

14. ELECTROMAGNETIC INDUCTION

Aim:

To demonstrate electromagnetic induction.

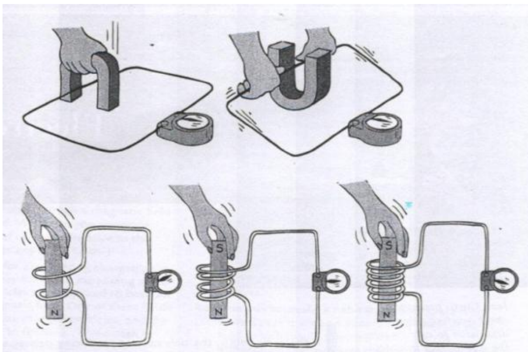
Materials required:

Horse shoe magnet, ammeter, copper wire, bar magnet.

Introduction:

After Oersted discovered that the electricity could produce magnetic effect, many people began to work for the reverse effect. Eventually in 1831 Michael Faraday succeeded in producing electricity using magnetism.

- Model consists of a conducting coil, galvanometer and a bar magnet.



Procedure

Step 1

Connect two ends of the conducting coil to the galvanometer

Step 2

Push bar magnet into the coil and observe the pointer in the galvanometer

Step 3

Hold the bar magnet for some time inside the coil, what happens?

Step 4

Remove the bar magnet from the coil and once again observe the pointer in the galvanometer

Step 5

Now keep the magnet fixed and move the coil towards and away from the magnet. What happens?

Observation and explanation

When bar magnet is pushed inside the coil, the field flux linked with the coil increases and a current is induced in it. The pointer of the galvanometer deflects to one side instantly.

When the bar magnet is stationary there is no change in the field or flux .No current is induced there is no deflection of the galvanometer.

When the magnet is taken out of the coil the magnetic flux linked with coil suddenly decreases and a current is induced in the coil in the opposite direction as indicated by the galvanometer deflection.

The same is true when the magnet is stationary and coil is in motion.

Whether the coil is in motion or the magnet is in motion it is always the change in the magnetic field (flux)that is cause for induction of current

Conclusion

The change in the magnetic field linked with the coil induces a current in it. If the field changes at a larger rate more current is induced. This phenomenon in which a current is induced in a coil due to the magnetic flux changing with respect to it is called electromagnetic induction.

15. FARADAY'S LAWS OF ELECTROMAGNETIC INDUCTION

Concept:

First Law;

Whenever magnetic field(magnetic flux) around a conductor is changed an emf is always induced in it. The emf lasts as long as the field is changing.

Second Law;

The magnitude of the induced emf is directly proportional to the rate of change of magnetic field (magnetic flux).

The model consists of three sets of coils having different number of turns, galvanometer and a bar magnet.

Aim:

To demonstrate faraday's laws of Electromagnetic induction.

Materials required:

Electromagnetic induction model

Procedure

Step 1

Connect the galvanometer to the coil having maximum number of turns

Step 2

Push the bar magnet first slowly then with high speed in the coil. Observe the deflection of the pointer each time.

Step 3

First push a weak magnet then strong magnet with the same speed into the coil and observe the deflection of the pointer in the galvanometer.

Step 4

Repeat the experiment with the coils having different number of turns

Observation and explanation:

Deflection in the galvanometer increases with increase in the speed of magnet inside the coil, with the strength of the magnet and the number of turns in the coil.

When the strength of the magnet is increased or the number of turns of the coil is increased there is a larger magnetic flux. When the speed of the motion of the magnet is increased the magnetic flux changes at a faster rate. Hence a larger current is induced in all these cases as indicated by the larger deflections of the galvanometer .

Conclusion

Our observations are in confirmation with the Faradays laws which state

- A change in magnetic field or flux is necessary to induce an emf in a conductor
- The emf induced is directly professional to the rate of change of this field or flux

16. FLEMING'S LEFT HAND RULE

A conductor carrying a current kept in the magnetic field experiences a force. The direction of the force acting on the conductor is perpendicular to both the direction of the magnetic field and the direction of the current flowing through it.

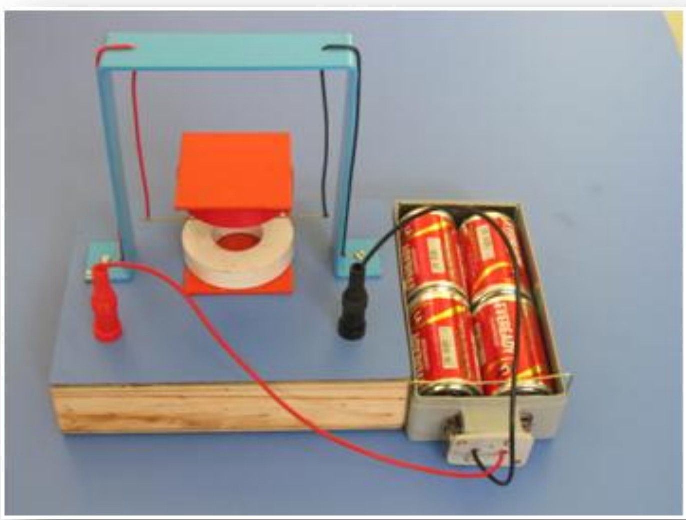
In this model, two strong magnets are fixed on a frame such that their opposite poles face each other. Conductor is suspended between these magnets with a help of connecting wires. Cell, conductor and a switch are connected in series.

Aim:

To demonstrate Motor rule.

Materials required:

principal of motor model



Procedure

Step 1

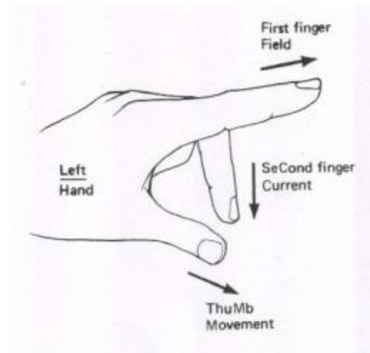
Observe the position of the conductor before passing the current.

Step 2

Pass the current through the conductor with help of switch. What happens?

Step 3

Change the direction of the current in the conductor. What happens?



Observation and explanation:

- Initially conductor is at rest. When current is passed through the conductor, it moves in one direction. If the current is reversed, conductor moves in the opposite direction
- In this experimental demonstration identify the direction of the magnetic field between the poles (N – S), the direction of current in the conductor and the direction of motion of the conductor. Try to relate these directions as is explained in Flemings left hand rule stated below-

Hold your left hand and spread out the thumb, first finger and second finger so that they are perpendicular to each other.

Point your first finger in the direction of the magnetic field (from N to S)

Rotate your hand about that finger until your second finger points in the direction of current (+ve to -ve)Then, your thumb points the direction of movement of the conductor.

Conclusion:

The observations validate Fleming's left hand rule

17. FLEMING'S RIGHT HAND RULE

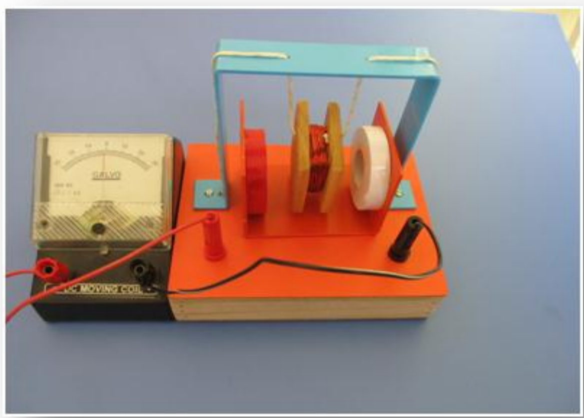
Model consists of two strong magnets in which their opposite poles face each other and a conducting coil is suspended between them.

Aim:

To demonstrate Dynamo rule.

Materials required:

principle of dynamo model



Procedure

Step 1

Connect two ends of the coil to galvanometer.

Step 2

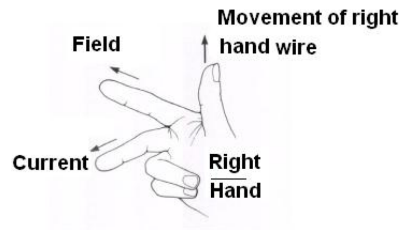
Push the coil towards one side and observe pointer of the galvanometer.

Step 3

Push the coil towards opposite side and observe the pointer of galvanometer

Observation and explanation:

- When coil is pushed towards one side, galvanometer shows a deflection in one side. When it is pushed towards the opposite side the deflection in the galvanometer is also in the opposite side. The galvanometer deflections are due to the induced current in the coil when it moves to and fro. This is an illustration of electromagnetic induction.
- Identify the direction of the magnetic field, the direction of the motion and the direction of the induced current in the experiment. Try to fit these directions in to the Flemings right hand rule described as in the following-
  Spread out the thumb, first and second fingers of the right hand in mutually perpendicular directions



Point your first finger in the direction of magnetic field (N to S).

Rotate your hand about that finger until your thumb points in the direction of movement of the wire.

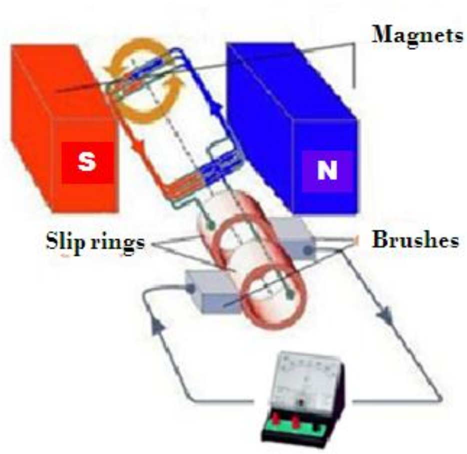
Then your second finger points in the direction of induced current.

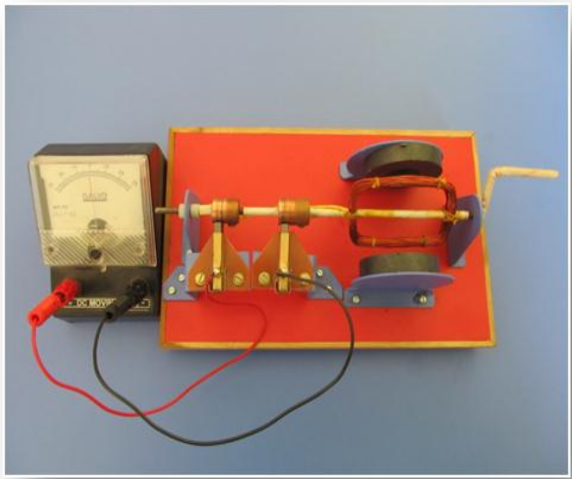
Conclusion:

The observations validate Fleming’s right hand rule

18. AC AND DC DYNAMO

A model consists of following parts





1) **Armature:**

Armature consists of a rectangular coil ABCD made up of insulated copper wire and having sufficient number of turns.

2) **Permanent Magnets:**

Two powerful magnets are fixed on the wooden board, such that their opposite poles face each other. The assembly of magnets provide a stationary magnetic field.

3) **Slip rings:**

The two ends of armature coil are connected to two different slip rings S_1 and S_2. Rings are insulated from each other.

4) **Carbon brushes:**

B_1 and B_2 are carbon brushes, which are always in contact with the slip rings S_1 and S_2 respectively.

5) **Galvanometer:**

Galvanometer is connected between the carbon brushes with connecting wires. Galvanometer detects the induced current in the coil.

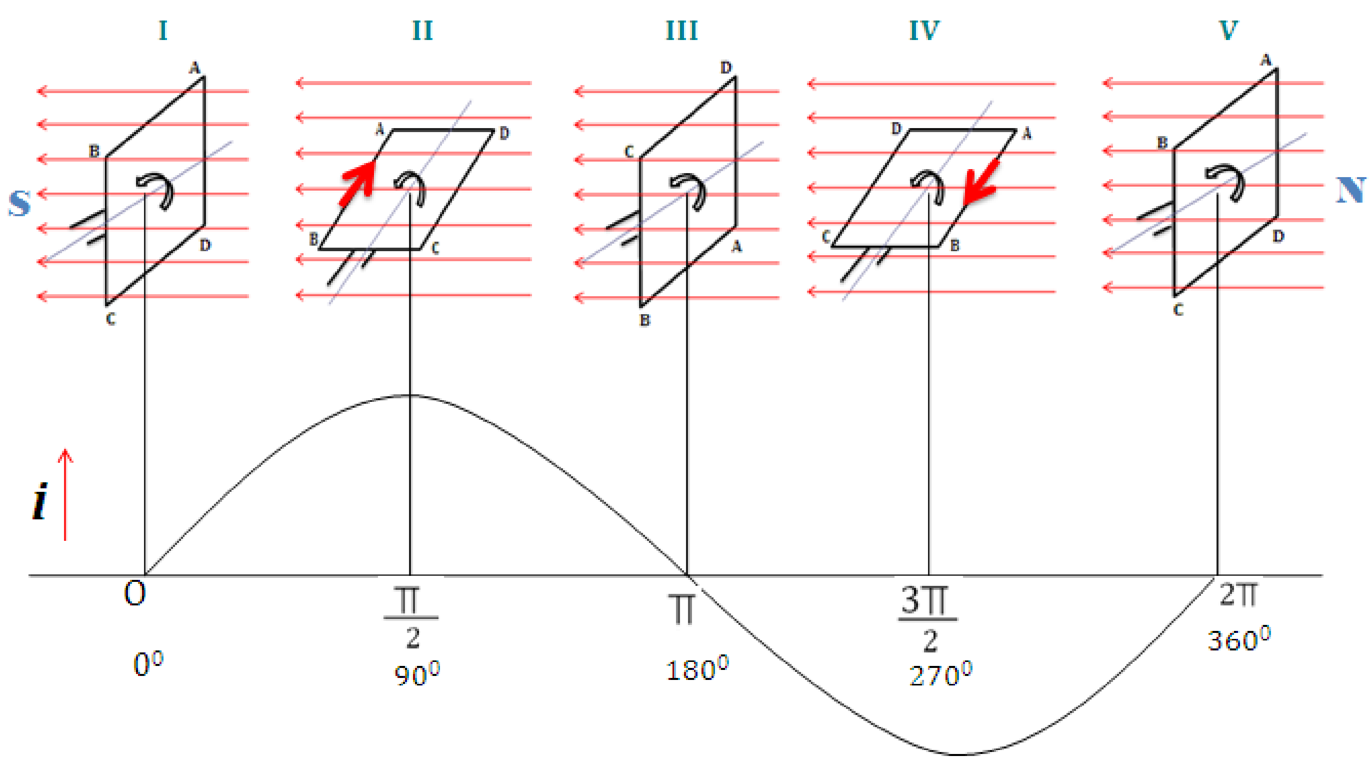
Working Principle

Armature coil ABCD is kept in the magnetic field produced by the magnets. As the coil rotates, it cuts magnetic lines of force and a current is induced in the coil.

Using Fleming's right hand rule, the direction of induced current can be found.

The diagram shows the changes in magnitude of induced current, for different positions of armature coil during one rotation.

Different Positions of the coil in the Magnetic field



In the initial position plane of the coil ABCD is perpendicular to the magnetic field. Angle for this position is taken as 0^0. Note that the maximum number of lines pass through the coil in this position.

To find out change in the magnetic field, position – I is taken as reference.

Rotate the coil in anticlockwise direction. When it is rotated through 90^0 and 270^0 angles its plane is parallel and 180^0 and 360^0 angles its plane is perpendicular to magnetic lines.

When you rotate the coil through 180^0 change in magnetic field first increases, reaches maximum at 90^0 and then decreases, becomes zero at 180^0

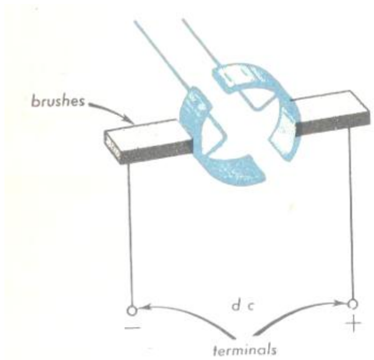
Applying Fleming's right hand rule, as the motion of AB arm is downwards, the direction of the induced current will be from B to A. The value of current reaches maximum in one direction when coil is in position – II and reduced to zero when coil reaches position – III

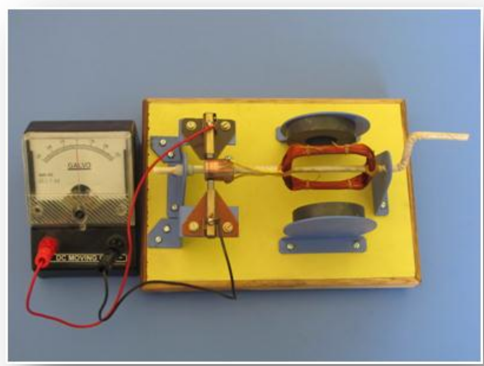
When coil is rotated from 180^0 to 360^0, the same process is repeated with arm moving upwards But according to Fleming's right hand rule the direction of current is reversed and it flows from A to B in the arm AB.

Thus rotation of armature generates current or emf in the external circuit whose direction alternates in every half cycle.

The reversal of current in the AC dynamo occurs because the two ends of armature coil are in permanent contact with same two slip rings S_1 and S_2.

If the direct current is desired, the commutator of the generator must be of the split ring type as shown in the figure.





It can be seen with this arrangement that one brush is at all times in contact with wires moving up across the field, while the other is in contact with wires moving down across the field. This produces a unidirectional electric current and the whole machine is called a direct-current (D.C.) dynamo.