Magnetic Effects of Electric Current

1. What is electro magnetism?

A) The magnetism produced because of flow of electric current is called electromagnetism.

2.What is a magnet?

A) Magnet is an object that has the nature of attracting iron like metal is called a magnet

3. What is magnetism?

A) Magnetism is the study about force that causes magnets to attract or repel each other.

4. What are the properties of a magnet?

A) i. The two ends of the magnet called poles has more force of attraction.

ii. A freely suspended magnet will always come into rest along geographical north-south direction.

iii. Like poles of magnets repel with each other while unlike poles of magnets attract with each other.

iv. The uni pole of a magnet never existed, i.e. Magnetic poles always exist in pairs.

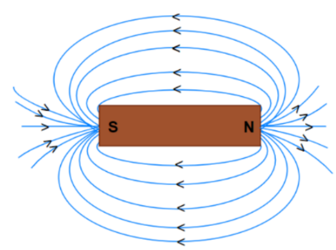
5. What is Magnetic field?

A). The region surrounded the magnet whose influence is acting is called magnetic field.

6. What is non uniform magnetic field?

A) i. If the magnetic field strength and magnetic field direction is not the same at all points in the region, then the magnetic field is said to be non-uniform.

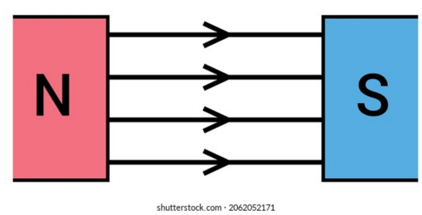
ii. Example: Magnetic field of a bar magnet is non-uniform



7. What is a uniform magnetic field?

A) i. If the magnetic field strength and field direction is the same at all equidistant points in the region, then the magnetic field is said to be uniform.

ii. Examples: Magnetic field inside a long current carrying solenoid is uniform



8. What are magnetic field lines? Write their properties?

A) Magnetic field lines are imaginary lines that represent the strength and direction of a magnetic field

Properties:

i. Magnetic field lines are closed curves

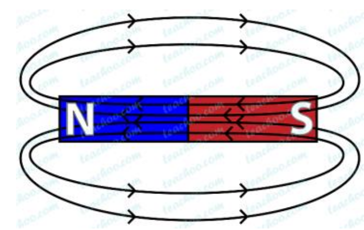
ii. In the magnetic field, field lines emerge at the north pole and merge at the south pole of the magnet.

iii. In the magnetic, field lines emerge at the south pole and merge at the north pole of the magnet.

iv. The tangent of a field line at a point refers magnetic field direction at that point
v. No two field lines are intersecting with each other.
vi. The density of field lines at a point refers magnetic field strength.

9. How can you say magnetic field lines are closed curves.

A) i. Magnetic field lines are closed curves because magnets always have two poles, a north pole and a south pole.
ii. Outside a magnet i.e. in the magnetic field, magnetic field lines begin at the north pole and end at the south pole.
iii. Inside a magnet, magnetic field lines are run south to north.

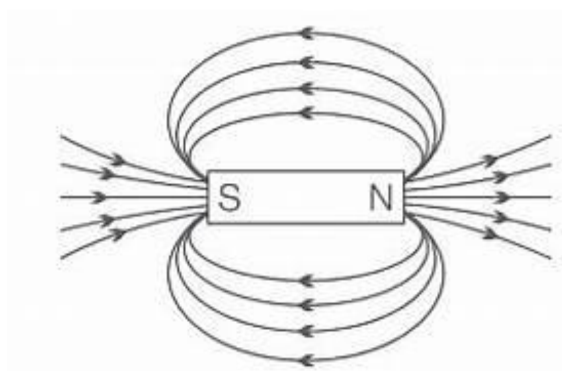


10. Why are no two field lines intersect with each other?

A) At the point of intersection of field lines, the magnetic field has two directions at the same point, which is not possible.

11. Draw a neat labelled diagram of magnetic field lines around a bar magnet.

A)

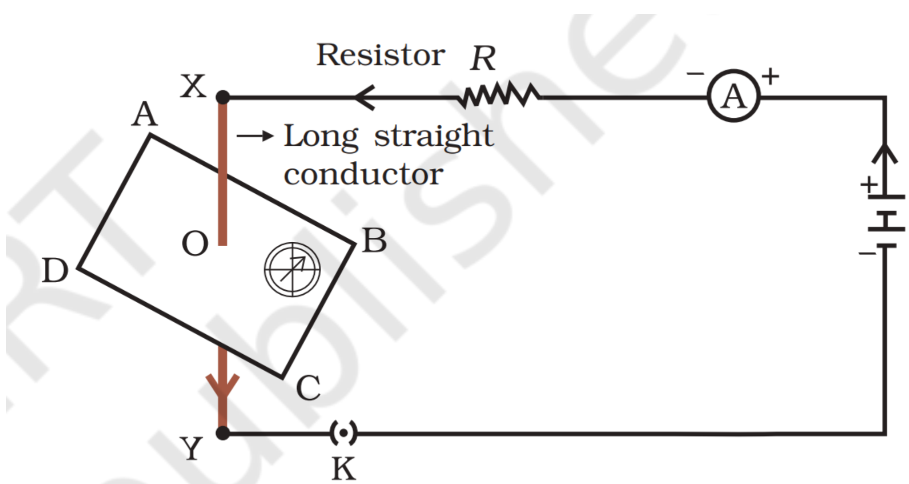


12. Explain magnetic effect of electric current with an activity (OR) Explain Oersted experiment (OR) Explain the relation between electric current and magnetic field

A) **AIM**: To study the relation between electric current and magnetic field

APPARATUS: Straight thick copper wire, card board,9v battery, magnetic compass, switch, ammeter, connecting wires and plug key.

DIAGRAM:



PROCEDURE:

i. Place a straight copper wire perpendicular to a card board at its centre.

ii. Now arrange the copper wire between the points X and Y in an electric circuit as shown in the figure.

iii. Horizontally place a small magnetic compass near the copper wire.

iv. Note the position of the needle in the compass.

v. Pass the current through the circuit by switching on the plug key.

OBSERVATION:

We observe deflection in the magnetic compass while the flow of current in the conductor.

CONCLUSION:

The magnetic field developed around a current carrying conductor.

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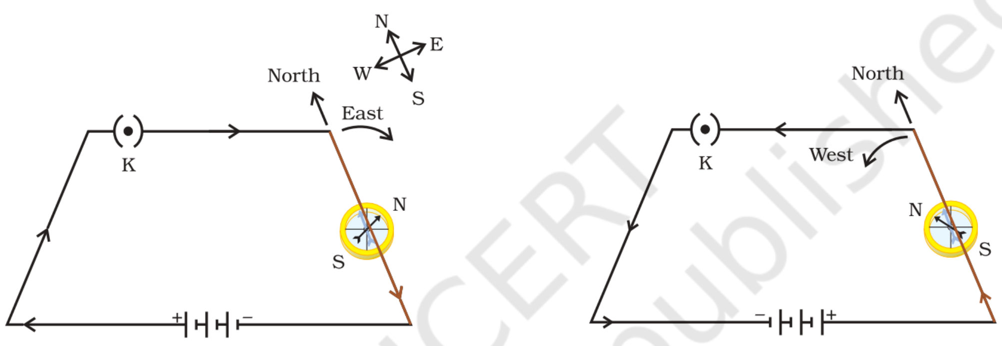
13. How can you say that the magnetic field developed by the current carrying conductor has a direction.

A) **AIM**: The magnetic field developed by the current carrying conductor has a direction.

APPARATUS: Long straight copper wire, three cells 1.5 V of each, plug key, connecting wires and magnetic compass.

DIAGRAM:



PROCEDURE:

i. Take a long straight copper wire and three cells 1.5V of each and a plug key. Connect all of them in series as shown in the figure.

ii. Place the straight wire parallel to and over a compass needle.

iii. Then plug the key in the circuit.

iv. Observe the deflection of the north pole of the compass.

v. If you set the direction of current in the wire from south to north, the magnetic compass deflects towards west i.e. anti clockwise direction.

vi. Now change the direction of current in the wire from north to south, the magnetic compass deflects towards east i.e. clockwise direction.

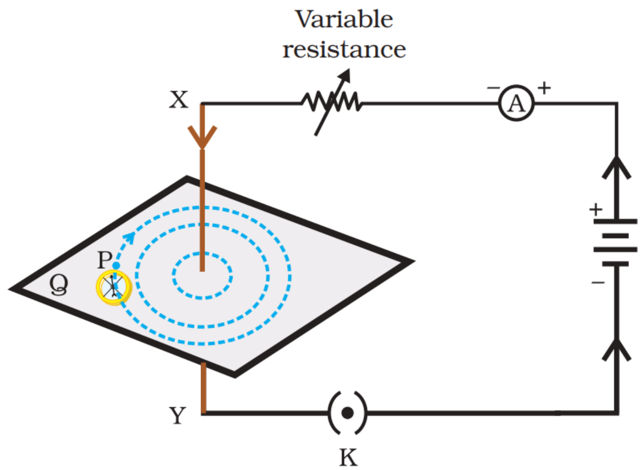
CONCLUSION: It explains that the magnetic field produced by the current carrying conductor has direction and depends on the direction of flow of current in the conductor.

14. Explain the magnetic field produced by a straight current carrying conductor with an activity.

A) **AIM**: Study about the magnetic field produced by a straight current carrying conductor.

APPARATUS: A battery of 12V, rheostat, an ammeter, plug key, a straight copper wire, card board, iron fillings and connecting wires.

DIAGRAM:



PROCEDURE:

i. Insert a thick copper wire through the centre of a rectangular card board which is normal to the plane of the card board.

ii. Now arrange the circuit as shown in the figure, keep the rheostat at a fixed position.

iii. Now sprinkle some iron fillings uniformly on the cardboard.

iv. Then plug the key in the circuit, note the flow of current through the ammeter.

v. Now tap the cardboard gently a few times.

OBSERVATION:

i. We are observed that iron fillings align themselves as concentric circles around the current carrying conductor.

ii. Repeat this experiment by increasing the flow of current in the conductor by using the rheostat.

iii. We are observed that iron filings around the conductor become denser and spread out farther from the conductor.

iv. This is because the magnetic field strength increases with the current, and it's effective over a greater distance.

CONCLUSION:

Magnetic field lines around the current carrying conductor are in the form of concentric circles.

15. What are the factors that influence the magnetic field produced by a straight current carrying conductor?

A) The magnetic field produced by a straight current-carrying conductor is influenced by two factors:

i. **Current in the conductor**:

The magnitude of the magnetic field is directly proportional to the current passing through the wire. i.e. $B \propto I$

ii. **Distance from the wire**:

The magnitude of the magnetic field is inversely proportional to the distance (d)from the wire. i.e. $B \propto 1/d$

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16. How can you find the direction of a magnetic field around a straight current carrying conductor?

A) By using

a) **Magnetic compass**: The direction of deflection of the north pole of the compass refers to the magnetic field direction.

b) **Right hand thumb rule**:(Maxwell 's right hand thumb rule)

i. Point your right thumb in the direction of flow of current in the conductor.

ii. Wrap the rest of your fingers around the current carrying conductor naturally.

iii. The direction of whirling of fingers refers to the direction of the magnetic field.

c). **Maxwell's cork screw rule**:

If we consider ourselves driving a corkscrew in the direction of the current in the conductor, then the direction of the rotation of the handle of the corkscrew is the direction of the magnetic field around the conductor.

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17. Identify the direction of the magnetic field around a straight current carrying conductor in the following situations.

a) Current flow vertically downward i.e. from top to bottom:

A) Clockwise direction.

b) Current flows into the plane of a surface:

A) Clockwise direction.

c) Current flow from north to south

A) Clockwise direction

d) Current flow vertically upward

A) Anti clockwise direction

e) Current flow out of the plane

A) Anti clockwise direction

f) Current flow from south to north

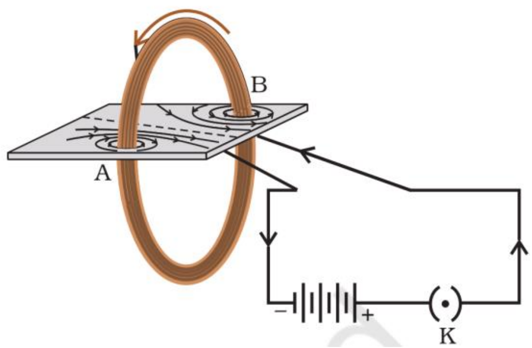
A) Anti clockwise direction.

18.Explain the magnetic field due to a current through a circular loop.

A) **AIM**: Study about the magnetic field due to a current through a circular loop.

APPARATUS: Long copper wire, card board, 12V battery, rheostat, connecting wires, plug key and iron fillings.

DIAGRAM:



PROCEDURE:

i. Take a rectangular cardboard having two holes.

ii. Now take long copper wire, insert a circular coil having number of turns through them, normal to the plane of the cardboard.

iii. Connect the circuit as shown in the figure.

iv. Then plug the key in the circuit.

v. Now sprinkle the iron fillings uniformly on the cardboard and tap it gently a few times.

OBSERVATION:

i. At the two holes where the circular coil enters the card board, magnetic field lines are formed in the form of concentric circles by increasing the radius.

ii. Radius of magnetic field lines increase as we move away from the wire and observe straight lines at the centre of the coil.

CONCLUSION:

Every point on the wire carrying current would give rise to the magnetic field appearing as straight lines at the centre of the coil.

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19. List the factors that are influence the magnetic field strength around a current carrying circular coil?

A) The strength of the magnetic field around a current-carrying circular coil is influenced by three main factors:

i. **Current**: The magnetic field is directly proportional to the amount of current flowing through the coil. i.e. $B \propto I$

ii**. Radius**: The magnetic field is inversely proportional to the radius (R)of the coil. i.e. $B \propto 1/R$

iii. **Number of turns**: Increasing the number of turns(n) in the coil increases the magnetic field. i.e. $B \propto n$

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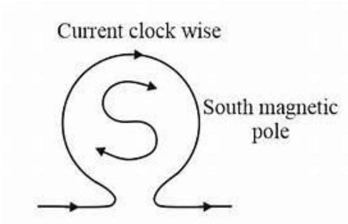
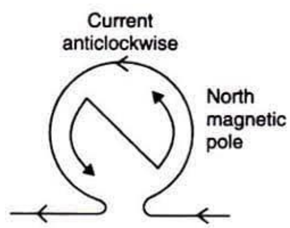
20. How can you identify the magnetic poles of magnetic field around a current carrying circular coil?

A) To find the magnetic poles of a current-carrying circular loop, you can follow the below given rules.

i) **RIGHT-HAND RULE**: If you curl the fingers of your right hand in the direction of the current flowing through the loop, your thumb will point the north pole of the magnetic field produced by the loop.

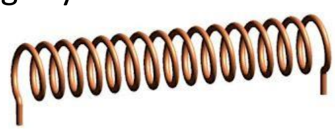
ii) **CLOCK FACE RULE**: The clock face rule states that if the current flows clockwise around the face of a circular coil, then that face is the south pole of the magnetic field. If the current flows counterclockwise i.e. anti clockwise, then that face is the north pole.





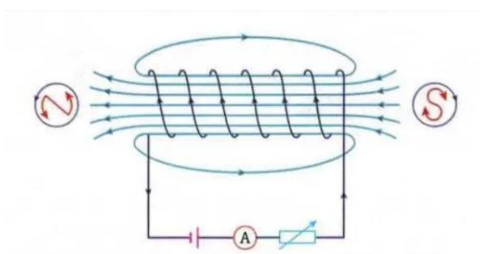
21. What is solenoid?

A). Solenoid is a coil of wire that is tightly wound in the shape of a cylinder



22. Explain the magnetic field produced by the current carrying solenoid.

A)



i. A solenoid behaves like a bar magnet when current is passed through it.

ii. In a bar magnet, magnetic field lines emerge from one end and merge into second end, in a solenoid also magnetic field lines behave in the same manner.

iii. Magnetic field lines are parallel straight lines
inside the solenoid and curved lines out of the solenoid.

iv. It means that the magnetic field inside the solenoid is uniform and around the solenoid are non-uniform.

v. The end of the solenoid where the current enters behaving as the south pole and the end leaving the current is the north pole.

vi. The magnetic field produced in a solenoid is very strong.

vii. Hence it is used as an electro magnet.

23) What are the factors that can influence the magnetic field produced by the current carrying solenoid.

A) The strength of the magnetic field produced by a current-carrying solenoid depends on:

i. **Number of turns in the coil:** The more turns the solenoid has, the greater the magnetic field produced i.e. $B \propto n$

ii. **Strength of current**: The stronger the current passes through the solenoid, the stronger the magnetic field is produced i.e. $B \propto I$

iii. **Core material**: The type of material used to make the solenoid's core affects the strength of the magnetic field. For example, using a soft iron rod as the core produces a stronger magnetic field.

NOTE: Strength of the magnetic field inside a Solenoid does not depend on the radius of the solenoid.

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24. What is an electro magnet? List the factors that can influence the magnetic field strength of an electro magnet.

A) i. An electromagnet is a temporary magnet made by winding a wire around a soft iron core and passing electric current through the wire.

ii. It works only when electric current flows through it.

iii. An electro magnet works on the principal of the magnetic effect of electric current.

iv. Factors affecting the strength of the magnetic field.

a) **Current**: The flow of current in the coil is increased, the strength of electromagnet increases. i.e. $B \propto I$

b) **Area of cross-section of the wire(A):** Area of cross-section of wires increase then the flow of current also increases therefore the magnetic field also increases i,e $B \propto A$

c) **Core material**: The nature of the core material affects the strength of the electromagnet.

d) **Number of turns**: The number of turns of wire on the core increases the strength of the electromagnet also increases i,e $B \propto n$

e) **The length of air gap between the two poles**: The length of air gap between the two poles of an electro magnet is reduce then the strength of electromagnet is increases.

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25. Write the uses of electro magnets.

A) Electromagnets are very widely used in electric and electromechanical devices, including:

i. Electric Motors and generators

ii. Transformers

iii. Electric bells and buzzers

iv. Loudspeakers and headphones

v. MRI machines

vi. Magnetic separation equipment is used for separating magnetic from nonmagnetic material, for example separating iron ore from impurities.

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26. What happens if a current carrying conductor is placed in a magnetic field?

A) i. When a current-carrying conductor is placed in a magnetic field, a mechanical force exerted on the conductor.

ii. The force is perpendicular to both the direction of the current and the direction of the magnetic field.

iii. If the conductor is free to move, it will begin to move in the direction of the force.

iv. The force acting on the conductor is

$$F=BIL$$

B → magnetic field strength

I → strength of the current in the conductor

L → length of the conductor in the magnetic field

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27. Write Fleming 's left hand rule?

A) i. Fleming's left-hand rule is used to find the direction of the force acting on the current carrying conductor placed in a magnetic field.

ii. **FLEMING 'S LEFT HAND RULE**: The left-hand thumb, index finger, and the middle finger are stretched so as be perpendicular to each other. If the index finger is in the direction of the magnetic field, and the middle finger points in the direction of the current, then the direction of the thumb is the direction of the force acting on the conductor.

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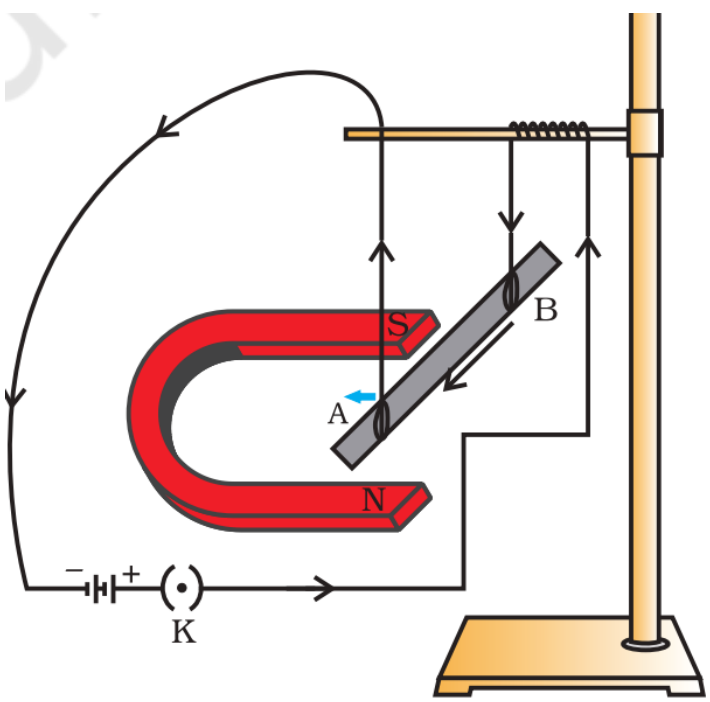
28. Explain with an activity force acting on a current carrying conductor in a magnetic field

A) **AIM**: Study about force acting on a current carrying conductor in a magnetic field

APPARATUS: Stand, aluminium rod of 5 cm length, connecting wires, battery, plug key, rheostat, horse - shoe magnet.

DIAGRAM:



PROCEDURE:
i. Take a small aluminium rod AB, using two connecting wires suspend it horizontally from the stand as shown in the figure.
ii. Take a horse - shoe magnet and place the rod lies between the two poles of the magnet with magnetic field directed upwards.
iii. Connect the aluminium rod in series with a battery, plug key and rheostat.
iv. Now allow the current through the rod from end A to B.
OBSERVATION:
i. We are observed that the rod gets displaced towards the left.
ii. Now reverse the direction of flow of current in the rod, we are noticed that the rod is displaced towards the right.
iii. Now change the direction of magnetic field, we are noticed that the rod displaced in opposite direction.
iv. Increases the strength of current in the rod by using rheostat, we are observed that the displacement of the rod is largest magnitude than the previous case.
EXPLANATION:
i. Around a current carrying conductor some magnetic field is existed.
ii. This magnetic field interact with external magnetic field.
iii. As a result a force acting on the current carrying conductor. Due to this force conductor displaced in a direction.
CONCLUSION:
i. There is a magnetic force that is acting on a current carrying conductor in a magnetic field.
ii. The direction of force acting on the conductor depends on direction of flow of current in the conductor and external magnetic field.
NOTE:
i. Current carrying conductor is perpendicular to the direction of the magnetic field, force acting on the conductor is maximum.
ii. Current carrying conductor is along the direction (parallel) of the magnetic field, the force acting on the conductor is zero.

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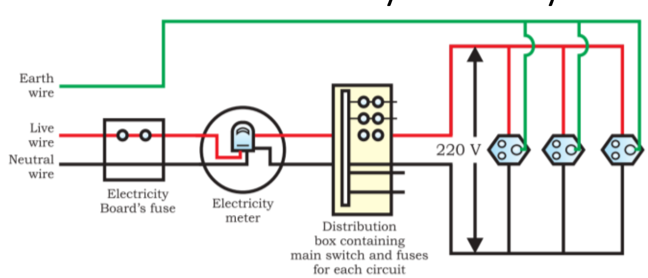
29. Write a short note on domestic electric circuits.

A) i. A domestic electric circuit refers to the electrical wiring system in our homes that allows us to use electrical appliances and devices efficiently and safely.



ii. In our homes, we receive supply of electric power through a main supply also called mains, either supported through overhead electric poles or by underground cables.
iii. We use AC with an electric potential difference of 220 V with a frequency of 50 Hz.
iv. There are three main wires used in domestic circuits:

a. Live Wire: This wire is usually insulated with a red covering and carries the current from the power source to the appliances. This is also called as 'positive wire'

b. Neutral Wire: The neutral wire, which is usually insulated with a black covering, completes the circuit by carrying current back from the appliance to the power source. This is also called as 'negative wire'.

c. Earth Wire: The earth wire, insulated with green covering, is a safety feature. It is connected to the body of metallic appliances to deep inside the Earth to protect users from electric shocks in case of a fault.

v. Through the main switch they are connected to the line wires in the house. Often, two separate circuits are used, one of 15 A current rating for appliances with higher power ratings such as geysers, air coolers, etc. The other circuit is of 5 A current rating for bulbs, fans, etc.
vi. Each appliance in the house has a separate switch to 'ON'/ 'OFF' the appliance which is 'ON'/ 'OFF' the flow of current through it.
vii. Each appliance in the house has equal potential difference it means that they are connected parallel to each other, this is because - If we switch off one appliance then all the appliances should keep working.
viii. Fuse in a circuit to prevents damage to the electrical appliances by overloading and short circuiting.

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30. What is an electric fuse? Explain. (OR) Name the device which protect house hold electric appliances from short circuiting and overloading.

A) i. An electric fuse is a safety device used in household electric circuits to protect appliances and wiring from damage caused by short circuiting or overloading.
ii. A fuse is made of a thin wire, usually of a low melting point material like tin or lead alloy.
iii. The working principle of fuse is heating effect of electric current.
iv. Fuse is connected in series between electric main and house hold circuits
v. The maximum permitted amount of current in house hold circuits are 20A
vi. When too much current flows through the circuit, the fuse wire heats up and melts, breaking the circuit.
vii. This stops the flow of electricity and prevents damage to appliances and fire hazards.

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31. What is short-circuiting? What are the problems arise due to short-circuiting?

A) i. if the plastic insulation of the live wire and neutral wire gets torn, then the two wires touch each other directly is known as short-circuiting.
ii. When the two wires touch each other, the resistance of the circuit become too small.

iii. Due to this the current flowing through the wires becomes very large and heats the wires very dangerously highly temperature and a fire may be started.

32. What is overloading? What are the problems arise due to overloading?

A) i. If too many electric appliances of high-power rating are switched on at the same time, they draw an extremely large current from the circuit. This is known as overloading.

ii. Overloading can also occur if too many appliances are connected to a single socket.

iii. Due to an extremely large current flowing through them, the wires of household circuits get heated to a very high temperature and a fire may be started.

33. Why does a compass needle get deflected when brought near a bar magnet?

A) The bar magnet exerts a magnetic force on compass needle which is itself a tiny pivoted magnet.

34. Consider a circular loop of wire lying in the plane of the table. Let the current pass through the loop clockwise. Apply the right-hand rule to find out the direction of the magnetic field inside and outside the loop.

A) i. A circular loop of wire lies flat on a table (in horizontal plane). Current flows clockwise when viewed from above.

ii. Curl the fingers of your right hand in the direction of current (clockwise). Your thumb points in the direction of the magnetic field at the center of the loop.

iii. This tells you the direction of the magnetic field lines created by the current.

iv. Inside the loop: The magnetic field is directed downward, into the table.

v. Outside the loop: The magnetic field lines spread outward and curve around, pointing upward above the loop, and eventually return into the loop.

35. A small aluminium rod AB is suspended horizontally from a stand by the ends of two connecting wires as shown in the Figure given here. A horseshoe magnet is placed in such a way that north pole of the magnet is vertically below and its south pole vertically above the aluminium rod. The aluminium rod is connected in series with a battery, a key and a rheostat. How do you think the displacement of rod AB will be affected if:

A) **(Explanation: When a current-carrying conductor is perpendicular to the magnetic field, the force acting on it is directly proportional to (a) magnitude of applied, and (c) length of the conductor. And greater the force, greater will be the displacement of the conductor. current flowing in the conductor (b) strength of magnetic field)**

i. Current in rod AB is increased?

A) if the current in rod AB is increased, then more force will act on the rod and hence the displacement of rod will also be more.

ii. A stronger horse shoe magnet is used? A) if a stronger horseshoe magnet is used, then the strength of magnetic field will increase leading to greater force on the rod. And due to greater force, the displacement of rod will also be more.

(iii) Length of the rod AB is increased?

A) If the length of rod AB is increased, then more force will act on the rod and hence the displacement of rod will also be more.

36. Name two safety measures commonly used in electric circuits and appliances.

A) i. Using electric fuse

ii. Earthing of metal bodies of electric appliances.

iii. Using MCBs.

37. An electric oven of 2 kW power rating is operated in a domestic electric circuit (220 V) that has a current rating of 5 A. What result do you expect? Explain.

A) Given: Power (p) = 2 kW = 2000 W

V = 220 V , I =?

We know that Power (p) = v I

=> I = p / v

= 2000 / 220

= 9.1 A

i. The rating of the circuit is 5 A, but the current drawn by the oven is 9.1 A. It causes overloading.

ii. Due to this, the electric fuse gets heat up and melts, as a result the circuit is opened.

38.What precaution should be taken to avoid the overloading of domestic electric circuits?

A) i. Should not be switch on many high-power rating electrical appliances at the same time.

ii. Don't be connect many electrical appliances on a single socket.

39.List two methods of producing magnetic fields.

A) i. By using permanent magnet

ii. By passing electric current through metal wires and plates.

iii. By using electro magnets.

40.When is the force experienced by a current–carrying conductor placed in a magnetic field largest?

A) When the current carrying conductor is perpendicular to the direction of the magnetic field.

41. Imagine that you are sitting in a chamber with your back to one wall. An electron beam, moving horizontally from back wall towards the front wall, is deflected by a strong magnetic field to your right side. What is the direction of magnetic field?

A) i. Given that an electron beam is moving horizontally from back to front, i.e. the direction of current is from front to back.

ii. Force is acting towards right side.

iii. By Fleming's left-hand rule, our fore finger pointed vertically downwards. Hence, the magnetic field is in vertically downward direction.

42. State the rule to determine the direction of a

i. magnetic field produced around a straight conductor-carrying current

A) Right hand thumb rule

(ii) force experienced by a current-carrying straight conductor placed in a magnetic field which is perpendicular to it

A) Fleming's left-hand rule

(iii) current induced in a coil due to its rotation in a magnetic field

A) Fleming's right-hand rule

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43. What is the function of an earth wire? Why is it necessary to earth metallic appliances?

A) i. An earth wire is a safety wire connected from the metal body of an electrical appliance to the ground

ii. The earth wire protects us from electric shocks by carrying leakage current safely to the ground when the metal body of an appliance becomes live.

iii. If the live wire breaks and touches the metal body of an appliance, the whole body becomes live.

iv. Touching it can cause a fatal electric shock.

v. Earthing provides a low-resistance path to the ground, so the current flows to the earth instead of through the user.

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