CHAPTER

13 MAGNETIC EFFECTS OF ELECTRIC CURRENT

Syllabus

➢ *Maguetic effects of current : Maguetic field, field lines, field due to a current carrying conductor, field due to current carrying coil or solenoid; Force on current carrying conductor, Fleming's Left Hand Rule. Electromagnetic induction. Induced potential difference, Induced current. Fleming's Right Hand Rule, Direct current. Alternating current : frequency of AC. Advantage of AC over DC. Domestic electric circuits.*

Quick Review

- The black ore of iron (Fe_3O_4) called magnetite, capable of attracting similar pieces of iron is called lodestone. They are naturally existing magnets used by man to find the directions.
- There are two basic laws of magnetism. There are two poles of a magnet namely North pole and South pole. Like poles repel each other, while unlike poles attract each other.
- H.C. Oersted, a Danish physicist first noticed the magnetic effect of electric current. According to him, a needle kept near the wire carrying current will deflect due to the magnetic field produced. Any change in the direction of current will show variation in the deflection.
- Magnet is any substance that attracts iron or iron-like substances.

Properties of magnet

(i) Every magnet has two poles i.e., North and South.

(ii) Like poles repel each other.

(iii) Unlike poles attract each other.

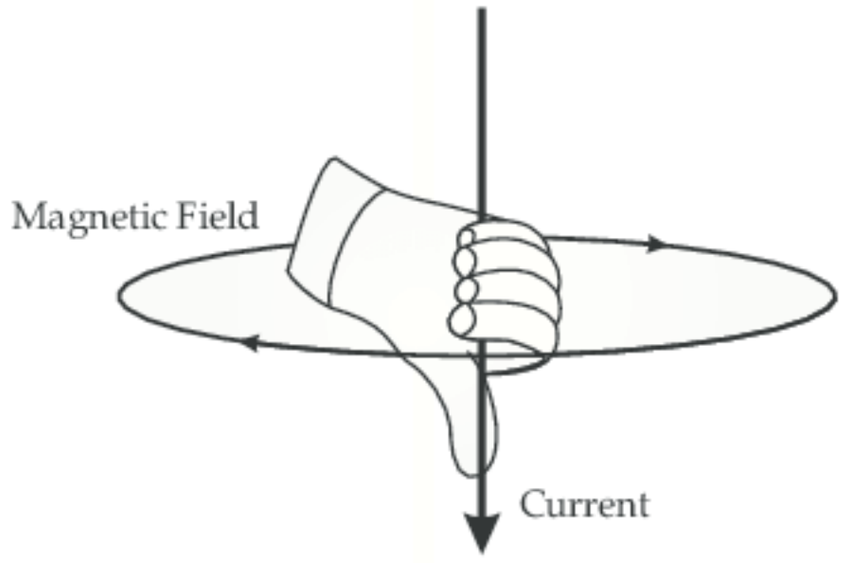
(iv) A freely suspended bar magnet aligns itself in nearly north-south direction, with its north pole towards north direction.

- The substances which are attracted by a magnet are called **magnetic substances. Examples :** Iron, nickel, cobalt, steel. The substances which are not attracted by a magnet are called non-magnetic substances. Examples : wood, glass, copper, aluminium, brass, paper etc.
- **Magnetic Field :** The area around a magnet in which its magnetic force can be experienced.
  - Its SI unit is tesla (T).
  - Magnetic field has both magnitude and direction.
  - Magnetic field can be described with help of a magnetic compass.
  - The needle of a magnetic compass is a freely suspended bar magnet.
- **Characteristics of Field Lines**
  - (i) Field lines arise from North pole and end into South pole of the magnet.
  - (ii) Field lines are closed curves.
  - (iii) Field lines are closer in stronger magnetic field.
  - (iv) Field lines never intersect each other as for two lines to intersect, there must be two north directions at a point, which is not possible.
  - (v) Direction of field lines inside a magnet is from South to North.

(vi) The relative strength of magnetic field is shown by degree of closeness of field lines.

Right Hand Thumb Rule

➢ Imagine you are holding a current carrying straight conductor in your right hand such that the thumb is pointing towards the direction of current. Then the fingers wrapped around the conductor give the direction of magnetic field.



Magnetic Field Due to Current Through a Straight Conductor

- It can be represented by concentric circles at every point on conductor.
- Direction can be given by right hand thumb rule or compass.
- Circles are closer near the conductor.
- Magnetic field ∝ Strength of current
- Magnetic field $\propto \frac{1}{\text{Distance from conductor}}$

Magnetic Field Due to Current Through a Circular Loop

- It can be represented by concentric circle at every point.
- Circles become larger and larger as we move away.
- Every point on wire carrying current would give rise to magnetic field appearing as straight line at centre of the loop.
- The direction of magnetic field inside the loop is same.

Factors affecting magnetic field of a circular current carrying conductor

➢ Magnetic field ∝ Current passing through the conductor

Magnetic field $\propto \frac{1}{\text{Distance from conductor}}$

Magnetic field ∝ No. of turns in the coil

Magnetic field is additive in nature *i.e.,* magnetic field of one loop adds up to magnetic field to another loop. This is because the current in each circular turn has some direction.

➢ A coil of large number of turns closely wound on a hollow cylinder of insulated material or otherwise is called a **solenoid**. The end of the solenoid having clockwise current will act as south pole-field enters into, while on the other hand having anti-clockwise current will act as north pole-field comes out. Thus, a solenoid acts as a normal magnet.

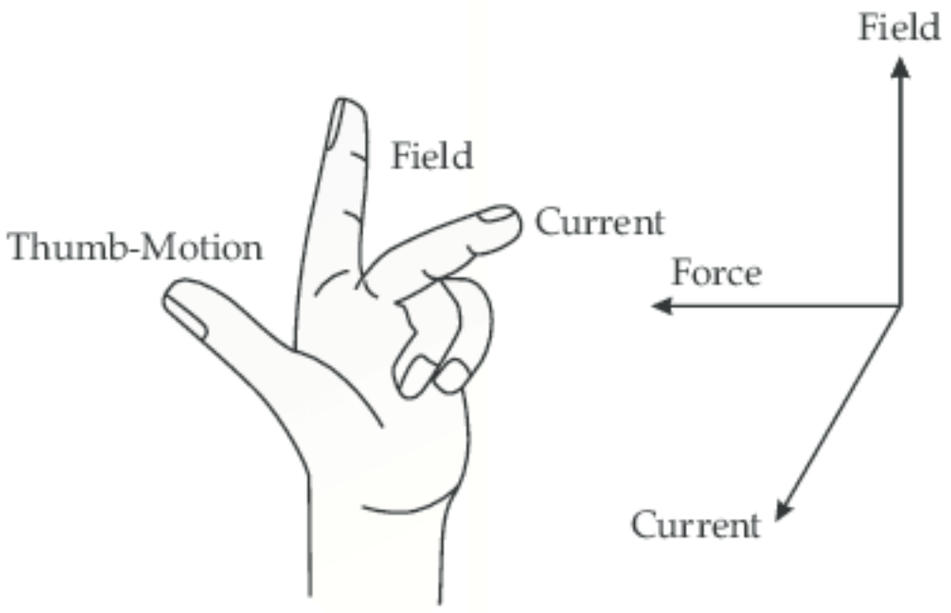
➢ **Permanent magnets** are made of carbon steel, chromium steel, tungsten steel and some alloys like Alnico and Nipermag. Alnico is an alloy of aluminium, nickel and cobalt.

➢ When a material is placed inside a coil carrying current, it will get magnetised. A bunch of nails or an iron rod placed along the axis of the coil can be magnetised by the current allowed to pass through the coil. Such magnets are called electromagnets.

➢ **Ampere** suggested that when a current I passes through a conductor of length l placed in a perpendicular magnetic field B, then the force experienced is given by $F = IBl \sin\theta$, where θ is the angle between the length of the conductor and magnetic field.

Fleming's Left Hand Rule

➢ Stretch the thumb, fore finger and middle finger of your left hand such that they are mutually perpendicular. If fore finger points in the direction of magnetic field, middle finger in the direction of current then thumb will point in the direction of motion or force.

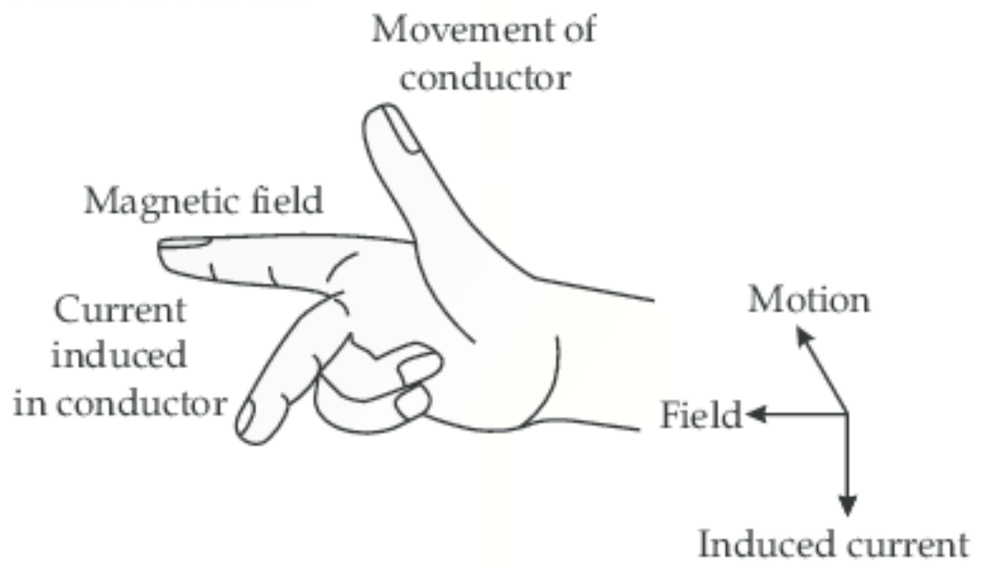


- **Electric motor** is a device used to convert electrical energy to mechanical energy. It works on the principle of force experienced by a current carrying conductor in a magnetic field. The two forces in the opposite sides are equal and opposite.
- **Faraday's Law :** The rate at which the magnetic flux linked with a coil changes, produces the induced emf or current. More the rate, more the current and vice-versa.

$$I = \frac{e}{R \times t} = \frac{\text{Change in flux}}{\text{Resistance} \times \text{Time}}$$

Fleming's Right Hand Rule

- Hold the thumb, the fore finger and the middle finger of right hand at right angles to each other. If the fore finger is in the direction of magnetic field and the thumb points in the direction of motion of conductor, then the direction of induced current is indicated by middle finger.
  - Working principle of electric generator.
  - Used to find direction of induced current.



- Generator works on the principle of Electromagnetic Induction. It converts the mechanical energy available into electrical energy. A.C. Generator produces potential which reverses after every 180° rotation of the coil. D.C. Generator means the generator which produces unidirectional current.

Domestic Electric Circuits

- An electric circuit consist of three main wiring components :
  (i) Live wire (positive) with red insulation cover.
  (ii) Neutral wire (negative) with black insulation cover.
  (iii) Earth wire with green insulation cover.
- The potential difference between live and neutral wire in India is 220 V.
- Pole → Main supply → Fuse → Electricity meter → Distribution box → To separate circuits.

Know the Terms

- When a bar magnet is placed on a cardboard and iron-filings are sprinkled, they will arrange themselves in a pattern of lines known as **magnetic field lines**.
- The area around a magnet in which its effect can be experienced is called **magnetic field.**
- When electric current flows through a conductor, a magnetic field is produced around it. This is called **magnetic effect of current**.

- An **electromagnet** is a solenoid coil that attains magnetism due to the flow of current. It works on the principle of magnetic effect of current.
- The production of electric current due to relative motion between a conductor and a magnetic field is called **electromagnetic induction.** Electric current produced due to this phenomenon is called **induced current.**
- When the current flowing through a coil changes, then the current is induced in the coil itself. This phenomena is called **self induction**.
- **Magnetic flux** is defined as the product of the magnetic field and the area through which magnetic field passes perpendicularly. $\phi = NBA$, when field passes perpendicular to the plane of the coil. It is measured in weber. If B and A are at angle θ, $\phi = NBA \cos\theta$, where N is the number of turns.
- If the current always flows in the same direction, it is called **direct current**. DC can be obtained from a cell or a battery. The positive and negative polarities of DC are fixed.
- If the current changes direction after equal intervals of time it is called **alternating current**. The positive and negative polarities of AC are not fixed.
- Connecting the outer frame of an appliance to earth to avoid any shock caused by fault or current leakage is called **earthing**.
- The coil having many turns used in electric motor or generator is called **armature**.
- **Fuse** is a safety device commonly used in electric circuits. It is connected in the live wire.

TOPIC-1

Magnetic Effects of Electric Current

Very Short Answer Type Questions (1 mark each)

R Q. 1. **What is meant by magnetic field ?**
[Board Term-I, Set-WDCXXOV, 2016]
[DDE 2017]

Ans. The region surrounding a magnet in which the force of the magnet can be detected is said to be its magnetic field. 1
[CBSE Marking Scheme, 2016]

R Q. 2. **Define magnetic field of bar magnet.**
[DDE-2015]

Ans. Magnetic field around the bar magnet is the region in which magnetic force due to bar magnet can be experienced. 1

R Q. 3. **What is the direction of the magnetic field lines inside a bar magnet ?**
[KVS 2017]

Ans. Inside a bar magnet is South to North.

R Q. 4. **What is the direction of the magnetic field lines outside a bar magnet ?** **[KVS 2017]**

Ans. Outside a bar magnet is North to South.

R Q. 5. **Define the term 'induced current'.**
[Board Term I, Set (57) 2012]

Ans. It is the electric current which originates in a conductor by use of fluctuating magnetic field around the conductor. 1

U Q. 6. **Why are magnetic field lines more crowded towards the pole of a magnet ?**
[Board Term I, Set-OQKPLGV, 2016]

Ans. This indicates that the magnetic field in that region is strong. 1
[CBSE Marking Scheme, 2016]

U Q. 7. **Why does a compass needle show deflection when brought near a current carrying conductor ?**
[Board Term I, Set-L7ZSVLH, 2016]

Ans. Due to production of magnetic field around the current carrying conductor. 1
[CBSE Marking Scheme, 2016]

U Q. 8. **Why does two magnetic field lines not intersect ?**
[DDE 2017]

Ans. Magnetic field lines never intersect because for intersection there must be two north directions at a point, which is not possible. 1

U Q. 9. **When a current carrying conductor is kept in a magnetic field, state the position when maximum force acts on it. [NCERT, DDE-2014]**

Ans. The force experienced by a current carrying conductor placed in a magnetic field is the maximum when conductor is kept perpendicular to the direction of the magnetic field. 1

R Q. 10. **List two sources of magnetic fields.**
[NCERT, Board Term I Set (47), 2012]

Ans. Magnet, moving charges, electric current.
(Any two) ½+½
[CBSE Marking Scheme, 2014]

U **Q. 11. State the effect of a magnetic field on the path of a moving charged particle.**
[Board Term I, Set-48, 2012]

Ans. It can deflect the path of the charged particle. 1
[CBSE Marking Scheme, 2012]

A **Q. 12. State the effect on the strength of magnetic field produced at a point near a straight conductor if the electric current flowing through it increases.**
[Board Term I, Set-44, 2012]

Ans. The strength of the magnetic field increases. 1
[CBSE Marking Scheme, 2012]

U **Q. 13. State the conclusions that can be drawn from the observation that a current carrying wire deflects a magnetic needle placed near it.**
[Board Term I, Set-52, 2012]

Ans. A magnetic field exists around it. 1
[CBSE Marking Scheme, 2012]

U **Q. 14. Meena draws magnetic field lines of field close to axis of a current carrying circular loop. As she moves away from the centre of the circular loop she observes that the lines keep on diverging. How will you explain her observation.**
[NCERT Exemplar]

Ans. Strength of the magnetic field falls as distance increases. This is indicated by the decrease in degree of closeness of the lines of field. 1

U **Q. 15. Name the physical quantities which are indicated by the direction of thumb and forefinger in the Fleming's right hand rule.**
[Board Term I, Set-38, 2012]

Ans. Direction of motion of the conductor and direction of field. **[CBSE Marking Scheme, 2012]** 1

A **Q. 16. The magnetic field in a given region is uniform. Draw a diagram to represent it.**
[Board Term I, Set-46, 2012]

Ans.

Uniform magnetic field inside a solenoid. 1
[CBSE Marking Scheme, 2012]

A **Q. 17. State the observation made by Oersted on the basis of his experiment with current carrying conductors.** **[Board Term I, Set-44, 2012]**

Ans. Every current carrying conductor has a magnetic field around it. **[CBSE Marking Scheme, 2012]** 1

U **Q.18. Mention the angle between a current carrying conductor and magnetic field for which the force experienced by this current carrying conductor placed in magnetic field is largest.**
[Board Term I, Set-15, 2012]

Ans. The angle between current carrying conductor and magnetic field is 90°. 1
[CBSE Marking Scheme, 2012]

A **Q. 19. How will the magnetic field intensity at the centre of a circular coil carrying current change, if the current through the coil is doubled and the radius of the coil is halved ?**

Ans. Magnetic field at centre of a coil, $B \propto \frac{I}{R}$, when current I is doubled and radius R is halved, the magnetic field becomes four times the original field. 1

R **Q. 20. Suggest one way of discriminating a wire carrying current from a wire carrying no current.**
[Board Term I, Set-45, 2012]

Ans. Bring a magnetic needle near the wire, a current carrying wire will produce a deflection in the needle whereas a wire without a current will not. 1
[CBSE Marking Scheme, 2012]

U **Q. 21. A straight wire carrying electric current is moving out of plane of paper and is perpendicular to it. What is the direction and type of induced magnetic field ?**

Ans. Induced magnetic field will be in the form of concentric circles in the plane of paper. 1

U **Q. 22. How can it be shown that magnetic field exists around a wire carrying current ?**

Ans. By using magnetic compass, that shows deflection. 1

Short Answer Type Questions-I

(2 marks each)

R **Q. 1. Name and state the rule which determine the direction of magnetic field around a straight current carrying conductor.**
[Board Term I, Set-43, 2012]

Ans. Right Hand Thumb Rule : Imagine holding the current carrying straight conductor in your right hand such that the thumb points towards the direction of current. Then the fingers of right hand wrap around the conductor in the direction of field lines of the magnetic field. 2
[CBSE Marking Scheme, 2012]

R Q. 2. **State Right Hand Thumb Rule and also draw diagram.** **[NCT-2014]**

Ans.

Hold the wire carrying current in your right hand, such that the thumb indicates the direction of current, then the folded fingers will indicate the presence of magnetic field (lines) surrounding the wire. 1 + 1

U Q. 3. **When a current carrying conductor is kept in a magnetic field, it experiences a force. List the factors on which direction of this force depends.**

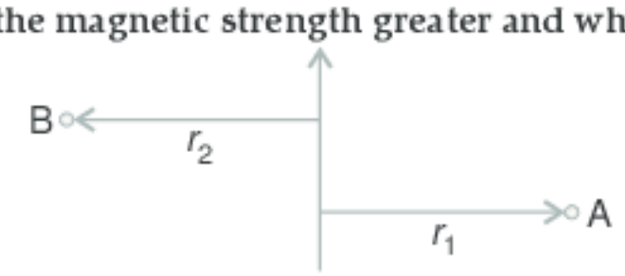
[Board Term I, Set-3R6WRQL, 2013]

Ans. It depends upon :

(i) The direction of current through the conductor. 1

(ii) The direction of magnetic field in which the conductor is placed. **[CBSE Marking Scheme, 2013]** 1

A Q. 4. **PQ is a current carrying conductor producing magnetic field around it. A and B are two points at a distance r_1 and r_2 from it. If $r_1 > r_2$, where is the magnetic strength greater and why ?**



[Board Term I, Set-18, 2012]

Ans. At B, magnetic strength at B is greater as r_2 is lesser than r_1. 2

U Q. 5. **A magnetic compass needle is placed in the plane of paper near point A as shown is Figure. In which plane should a straight current carrying conductor be placed so that it passes through A and there is no change is the deflection of the compass ? Under what condition is the deflection maximum and why ?**

[NCERT Exemplar 2017]

Ans. In the plane of the paper itself. The axis of the compass is vertical and the field due to the conductor is also vertical. It could result in a dip of compass needle which is not possible in this case (dips result only if axis of compass is horizontal). The deflection is maximum when the conductor through A is perpendicular to the plane of paper and the field due to it is maximum in the plane of the paper.

U Q. 6. **A magnetic compass shows a deflection when placed near a current carrying wire. How will the deflection of the compass get affected if the current in the wire is increased ? Support your answer with a reason. [NCERT Exemplar 2017]**

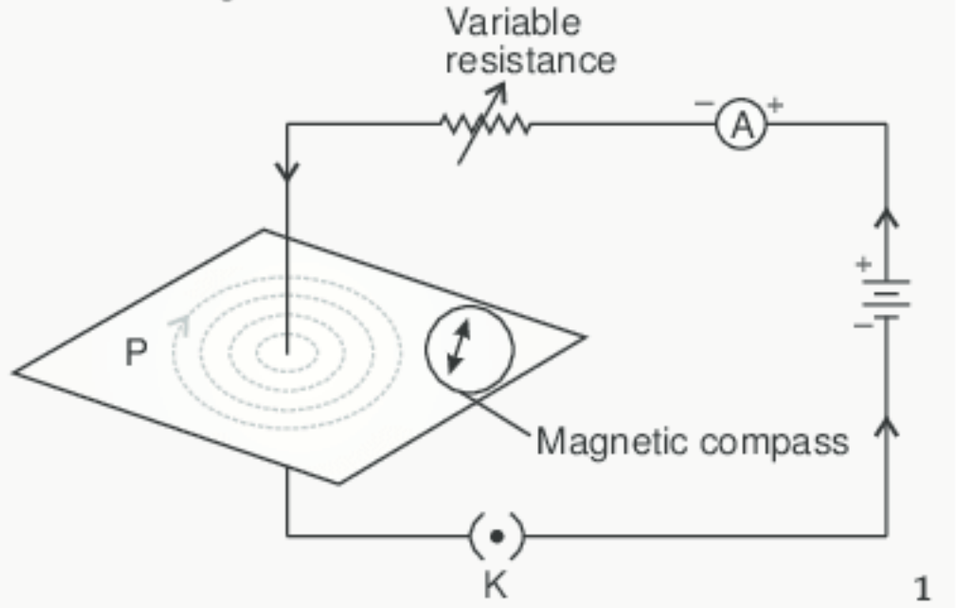
Ans. The deflection increases. The strength of magnetic field is directly proportional to the magnitude of current passing through the straight conductor.

1+1

R Q. 7. **Draw magnetic field lines produced around a current carrying straight conductor passing through cardboard. How will the strength of the magnetic field change, when the point where magnetic field is to be determined, is moved away from the straight wire carrying constant current ? Justify your answer.**

[Board Term I, Set-15, 2012]

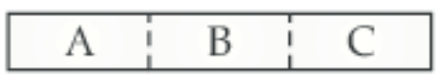
Ans. Using compass needle. When we move away from the straight wire, the deflection of the needle decreases which implies the decreasing strength of the magnetic field. 1



1

[CBSE Marking Scheme, 2012]

U Q. 8. **The given magnet is divided into three parts A, B and C.**



Name the parts where the strength of the magnetic field is :

(i) maximum **(ii) minimum**

How will the density of magnetic field lines differ at these parts ?

[Board Term I, Set-39, 2012]

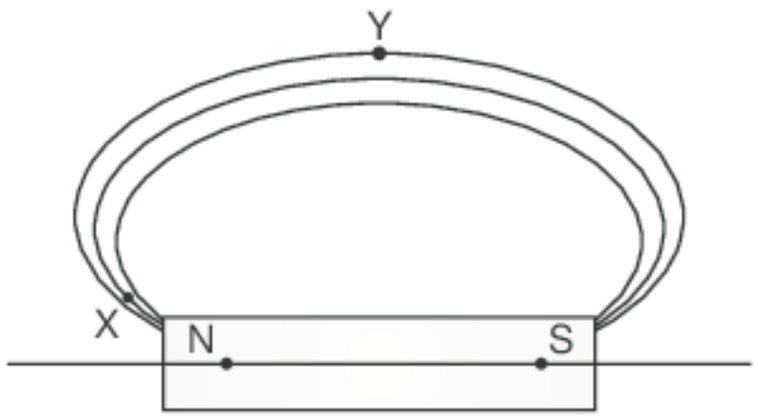
Ans. (i) Maximum magnetic field is in the region A and C. ½

(ii) Minimum magnetic field is in the region B. ½

This is because A and C are magnetic poles and have maximum number of magnetic field line which determine the intensity of magnetic field while B is centre of the magnet that has no magnetic field lines. So intensity of magnetic field near B is almost zero. 1

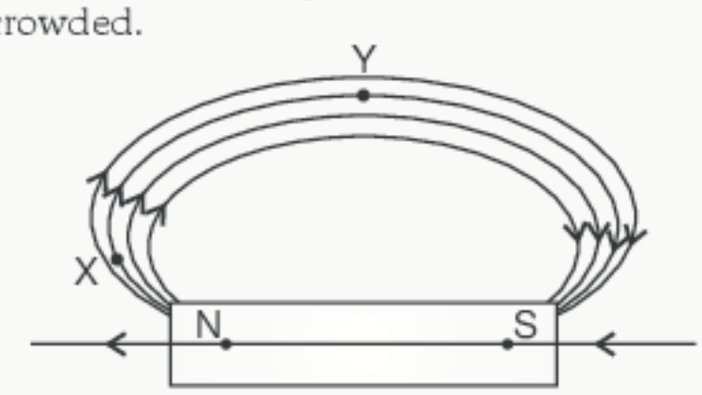
[CBSE Marking Scheme, 2012]

R Q. 9. **Magnetic field lines are shown in the given diagram. A student makes a statement that magnetic field at X is stronger than at Y. Justify this statement. Also redraw the diagram and mark the direction of magnetic field lines.**



[Board Term I, Set-45, 2012]

Ans. The relative strength of the magnetic field is shown by the degree of closeness of the field lines. The degree of closeness is more at 'X' than at 'Y'. **1**
∴ The field is stronger at X where the field lines are crowded.



1

[CBSE Marking Scheme, 2012]

U **Q. 10. A current carrying conductor produces a magnetic field around it. Is there a similar magnetic field produced around a thin beam of moving :**
(i) electrons (ii) neutrons
Justify your answer.[Board Term-I, Set-31, 2012]

Ans. (i) Yes **(ii)** No ½+½
A beam of moving electrons constitutes electric current but neutrons are neutral, so no current and hence no magnetic field. **1**

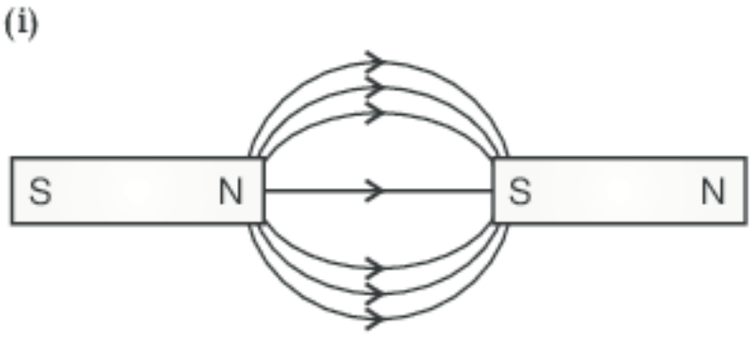
[CBSE Marking Scheme, 2012]

R **Q. 11. (i) Two magnets are lying side by side as shown below. Draw magnetic field line between poles P and Q.**

(ii) What does the degree of closeness of magnetic field lines near the poles signify ?

[Board Term I, Set-50, 2011]

Ans. (i)



1

(ii) Degree of closeness indicates that the relative strength of the magnetic field near the poles where the field lines are crowded is more as compared to other places. **1**

U **Q. 12. In the experiment to show that a current carrying conductor when placed in the uniform magnetic field experiences a force. What happens when :**
(i) You reverse the terminals of the battery ?
(ii) The direction of current is perpendicular to the direction of magnetic field ? State your observation. [Board Term I Set-54, 2012]

Ans. (i) On reversing the terminals of the battery, the deflection of rod will be in opposite direction. **1**
(ii) When the direction of current is perpendicular to the direction of magnetic field, then the rod will experience maximum force. **1**

[CBSE Marking Scheme, 2012]

U **Q. 13. A compass needle is placed near a current-carrying wire. State your observation for the following cases, and give reason for the same in each case :**
(i) Magnitude of electric current in the wire is increased.
(ii) The compass needle is displaced away from the wire. [Board Term I, Set-47, 2012]

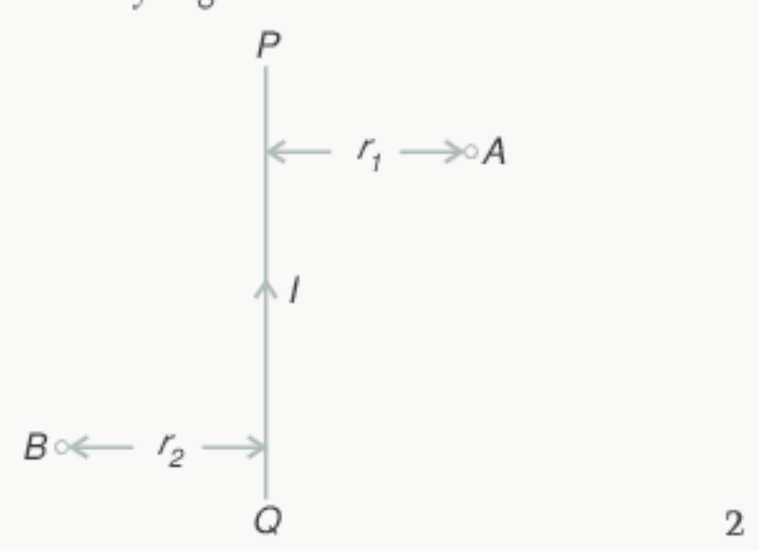
Ans. (i) Deflection of compass needle increases. ½
Magnetic field strength is directly proportional to the amount of current. ½
(ii) Deflection of compass needle decreases. ½
Magnetic field strength is inversely proportional to the distance from wire. ½

[CBSE Marking Scheme, 2012]

U **Q. 14. PQ is a current carrying conductor in the plane of the paper as shown in the fig. Mention the direction of magnetic fields produced by it at points A and B.**
Given : $r_1 < r_2$, where will the strength of the magnetic field be larger ? Justify your answer in each case. [Board Term I, Set-38, 2012]

[NCERT Exemplar]

Ans. Strength of magnetic field will be larger at A as the strength of magnetic field decreases when the distance is increased. Direction of magnetic field lines at A as well as B is anti-clockwise because field lines are concentric circles and direction is determined by Right hand thumb rule.



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[CBSE Marking Scheme, 2012]

U **Q. 15. (a) Write the special name given to the coil AB which has many circular turns of insulated copper wire.**
(b) List two factors on which the strength of the magnetic field produced by AB depends.
(c) What is the effect of placing an iron core in the coil AB ?

[Board Term I, Set-53, 2012]

Ans. (a) Coil AB is a solenoid. ½
(b) (i) Strength of the current. ½
(ii) Number of turns in the coil. ½
(c) The magnetic field associated with the solenoid increases tremendously. It becomes an electromagnet. **[CBSE Marking Scheme, 2012]** ½

Short Answer Type Questions-II

(3 marks each)

R **Q. 1. What is meant by Solenoid ? How does a current carrying Solenoid behave ? Give its main use.**
[Board Term I, Set-L7ZSVLH, 2016]

Ans. A closely bound cylindrical coil of insulated metallic wire. A current carrying solenoid behaves as an electromagnet. The uniform magnetic field inside it may magnetise a steel rod permanently.
[CBSE Marking Scheme, 2016] 3

Detailed Answer :

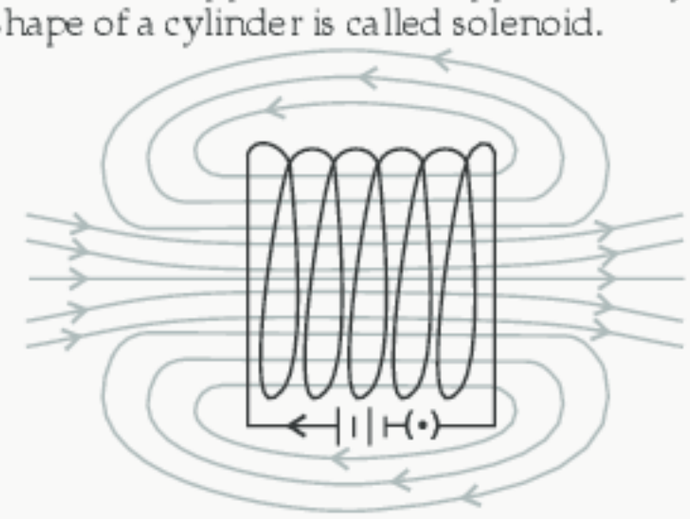
A coil of many circular turns of insulated copper wire wrapped closely in the shape of a cylinder is called a Solenoid.

The field lines around a current-carrying solenoid is similar to that produced by a bar magnet. This means that a current - carrying solenoid behaves as having north pole and south pole.

The strong magnetic field produced inside a solenoid can be used to magnetise a piece of magnetic material like soft iron when placed inside the coil.

A **Q. 2. What is solenoid ? Draw the field lines of the magnetic field produced on passing current through and around a current carrying solenoid.**
[DDE 2017] [Board Term-I Set-A85V2IL, 2015]

Ans. Definition : A coil of many circular turns of insulated copper wire wrapped closely in the shape of a cylinder is called solenoid.



Magnetic field lines through and around a current carrying solenoid. 1½+1½
[CBSE Marking Scheme,2015]

A **Q. 3. What is an electromagnet ? How can we determine north and south pole of an electromagnet with the help of magnetised iron bar.** **[Board Term I, Set-IN14KGB, 2014]**

Ans. An electromagnet is a solenoid coil that attains magnetism due to flow of current. It works on the principle of magnetic effect of current.
(i) By suspending magnetised bar and identify its north and south poles.
(ii) By finding the polarity of electromagnet using the property-like poles repel. 1+1+1
[CBSE Marking Scheme, 2014]

R **Q. 4. (i) What is meant by a magnetic field ? Mention two parameters that are necessary to describe it completely.**
(ii) If field lines of a magnetic field are crossed at a point, what does it indicate ?
[Board Term I, Set-3R6WRQL, 2013]

Ans. (i) The space around the magnet or current carrying conductor within which its influence can be felt by the magnetic substance.
Magnitude and direction. 2
(ii) It would mean that at the point of intersection, compass needle would point to 2 directions which is impossible. **[CBSE Marking Scheme, 2013]** 1

R **Q. 5. Writer the three ways to produce magnetic field.**
[DDE 2017]

Ans. Three ways to produce magnetic field are :
(i) Charge induced magnetic field.
(ii) A current carrying coil may do work.
(iii) The permanent magnet and an electromagnet.
1+1+1

U **Q. 6. What does the magnetic field pattern inside the solenoid indicate ? State how this field be utilised to make an electromagnet. List two ways by which strength of this magnet can be increased.**
[Board Term I, Set-55, 2012]

Ans. It indicates that the magnetic field is same at all points inside the solenoid. 1
This property is utilised to magnetise a piece of magnetic material like soft iron when placed inside the coil. 1
Two ways by which strength of electromagnet can be increased :
Increasing the amount of electric current through it. ½
Increasing the number of turns of the coil. ½
[CBSE Marking Scheme, 2012]

U **Q. 7. Name, state and explain with an example the rule used to determine the direction of force experienced by a current carrying conductor placed in a uniform magnetic field.**
[Board Term I, Set-1ZHNPNO, 2016]

Ans. Fleming's Left Hand Rule : The direction of force which acts on the current carrying conductor placed in a magnetic field is given by Fleming's left hand rule. It states that if the forefinger, thumb and middle finger of left hand are stretched mutually perpendicular and the forefinger point along the direction of external magnetic field, middle finger indicates the direction of current, then thumb points along the direction of force acting on the conductor.

Example : When an electron enters a magnetic field at right angles, the direction of force on electron is perpendicular to the direction of magnetic field and current according to this rule. **3**

U **Q. 8. List the factors on which the magnetic field produced by a current carrying straight conductor depends. State the rule which gives the direction of its magnetic field. Draw the pattern of magnetic field lines due to a straight current carrying conductor.**

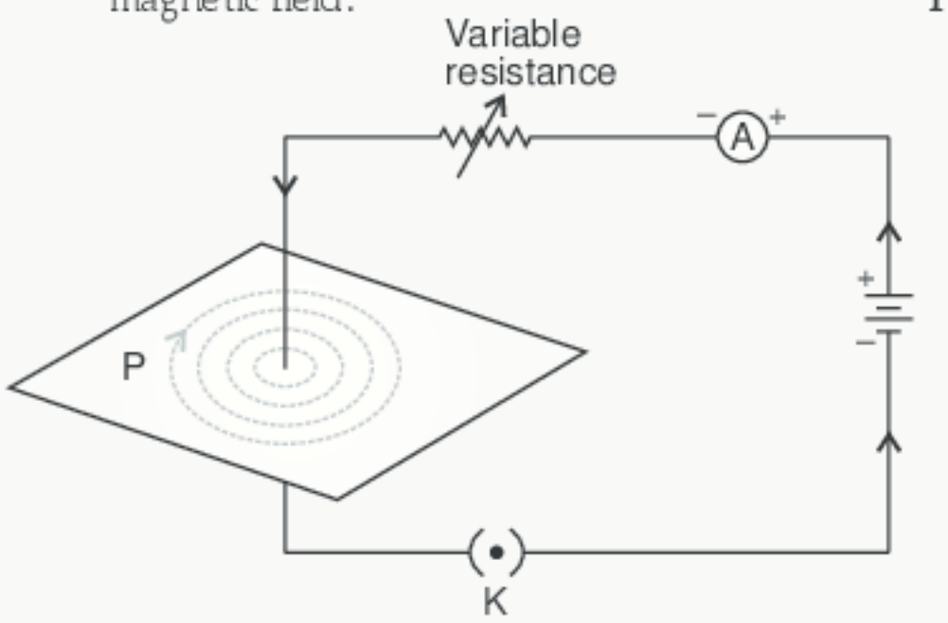
[Board Term I, Set-39, 2012]

Ans. Factors on which the magnetic field produced by a current carrying conductor depends :

(i) current passing through the conductor. ½

(ii) distance of the magnetic compass from the conductor. ½

Right Hand Thumb Rule gives the direction of magnetic field. **1**



[CBSE Marking Scheme, 2012] 1

U **Q. 9. Can a freely suspended current carrying solenoid stay in any direction ? Justify your answer. What will happen when the direction of current in the solenoid is reversed ? Explain.**

[Board Term- I, Set-WDCXXOV, 2016]

Ans. A current carrying solenoid behaves like a magnet. When suspended freely, it will stay in north - south direction.

On reversing current its polarity will be reversed and so it will turn at 180°. **1 + 1 + 1**

[CBSE Marking Scheme, 2016]

U **Q. 10. Explain briefly two different ways to induce current in a coil. State the rule which determines the direction of induced current.**

[Board Term I, Set-43, 2012]

Ans. Two ways to induce current in a coil :

(i) If a coil is moved in a magnetic field.

(ii) By bringing a bar magnet close to the coil or taking away from it.

(iii) By rotating the coil in a uniform magnetic field. **2**

(Any two)

Statement of Fleming's Right Hand Rule. **1**

[CBSE Marking Scheme, 2012]

R **Q. 11. State and explain Fleming's right hand rule for the direction of induced current.**

[Board Term I 2014; DDE-2014]

Ans. The direction of induced current in a straight conductor is given by Fleming's right hand rule. It states that spread the thumb, forefinger and the middle finger of your right hand at right angle to one another in such a way that the forefinger points in the direction of magnetic field, thumb, points in the direction of motion of conductor then the direction in which the middle finger points, gives the direction of induced current. **3**

[CBSE Marking Scheme, 2014]

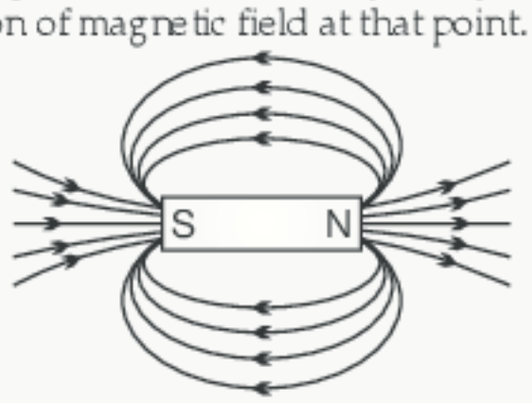
A **Q. 12. Draw a diagram to show the magnetic field lines around a bar magnet. List any two properties of magnetic field lines.**

[Board Term I, Set-42, 2012]

Ans. (i) Two magnetic field lines never interest each other.

(ii) Outside the magnet, the magnetic field lines are directed from North pole of magnet towards South pole.

(iii) The magnetic field lines at any one point gives the direction of magnetic field at that point. **(Any two)**



2+1

[CBSE Marking Scheme, 2012]

A **Q. 13. You are given a strong bar magnet and a magnet compass needle. Describe an activity by which the magnetic field lines due to the bar magnet can be drawn.** **[Board Term I, Set-46, 2012]**

Ans. (i) Place the bar magnet on a sheet of white paper fixed on a drawing board. Mark the boundary of the magnet.

(ii) Place the magnetic compass near the north pole of the given magnet.

(iii) Mark the position of two ends of the needle. Now move the needle to a new position such that its south pole occupies the position previously occupied by its north pole. **2**

(iv) In this way proceed step by step till you reach the south pole of the given magnet.

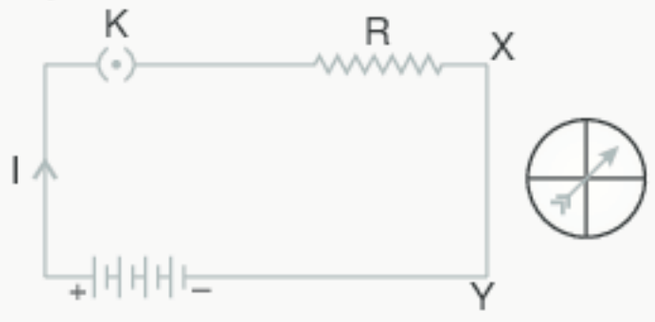
(v) Join the points marked on the paper by a smooth curve. This curve represents a field line. Repeat the above steps for new positions of compass needle. **1**

[CBSE Marking Scheme, 2012]

U **Q. 14. Explain the magnetic effects of current with the help of an activity along with labelled diagram.**

[Board Term I, Set-41, 2012]

Ans. Take a thick straight copper wire and place it between the points X and Y in an electric circuit. Place a small compass near to this wire. See the position of its needle. Pass the current through the circuit by inserting the key into the plug. Observe the change in the position of the compass needle. 2



1

(Compass needle is deflected on passing an electric current through a metallic conductor)

[CBSE Marking Scheme, 2012]

U **Q. 15. Diagram shows lengthwise 2 section of a current carrying solenoid. X indicates current entering into the page, and e indicates current emerging out of the page. Decide which end of the solenoid A or B, will behave as north pole. Give reason for your answer. Also draw field lines inside the solenoid. [Board Term I, Set-2ZGOVVV, 2015]**

Ans. A = south pole, B = north pole.

When north pole of a bar magnet is brought near to end connected to negative terminal of battery then solenoid repels bar magnet. It means the end of solenoid which is connected to negative terminal of the battery behaves as north pole.

For figure — Refer to SATQ-II, Q. 2. Pg. 348 **3**

R **Q. 16. A coil of insulated wire is connected to a galvanometer. Explain what happens if a bar magnet with its north pole towards one face of the coil : [DDE-2015]**

(i) moved quickly towards the coil.

(ii) kept stationary inside the coil.

(iii) moved quickly away from the coil.

Ans. Refer to long answer type Q. 8. **1+1+1**

U **Q. 17. Explain whether an alpha particle will experience any force in a magnetic field if :**

(i) it is placed in the field at rest.

(ii) it moves in the magnetic field parallel to field lines.

(iii) it moves in the magnetic field perpendicular to field lines. [Board Term I, Set-IN14KGB, 2014]

Ans. (i) No, because, a charged particle at rest does not interact with magnetic field.

(ii) No, because, the force is zero if current and field are in the same direction.

(iii) Yes, because, the force is maximum when current and magnetic field are maximum. **1+1+1**

[CBSE Marking Scheme, 2014]

U **Q. 18. Find the direction of magnetic field due to a current carrying circular coil held :**

(i) Vertically in North-South plane and an observer looking it from east sees the current to flow in anti-clockwise direction.

(ii) Vertically in East-West plane and an observe looking it from south sees the current to flow in anti-clockwise direction.

(iii) Horizontally and an observer looking at it from below sees current to flow in clockwise direction.

Ans. (i) Towards south in upward direction.

(ii) Towards west in upward direction.

(iii) Towards upward direction. **1 + 1 + 1**

Long Answer Type Questions

(5 marks each)

R **Q. 1. What are magnetic field lines ? List three characteristics of these lines. Describe in brief an activity to study the magnetic field lines due to a current flowing in a circular coil.**

[Board Term I, Set-NS9SXID, 2016]

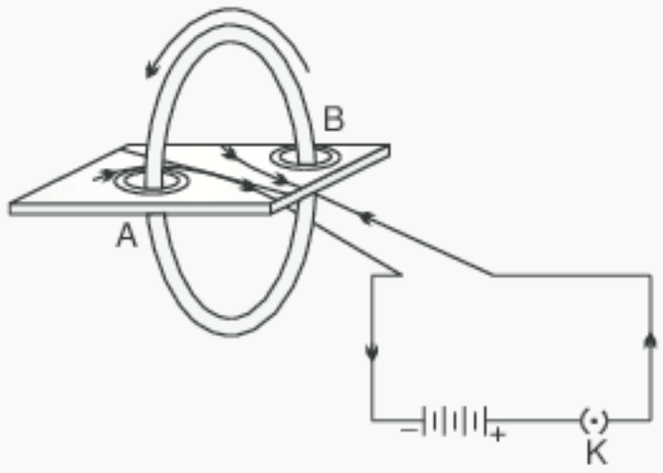
[Board Term I, Set-WH1SGOB, 2014]

Ans. Representation of the magnetic field path along which an imaginary free north pole would tend to move. The tangent at any point on the magnetic field line gives the direction of the magnetic field at that point.

(i) Emerge at north pole and merge at south pole. Inside the magnet, the direction of field lines is from south pole of magnet to its north pole and are closed curves.

(ii) At the points where the magnetic field is stronger, field lines are crowded and vice-versa.

(iii) No two magnetic field lines can intersect each other. **3**



2

[CBSE Marking Scheme, 2014]

R **Q. 2. What are magnetic field lines ? List any two characteristics of field lines. Draw the pattern of magnetic field lines due to a current carrying circular loop.**

[NCT-2014] [Board Term I, Set-13, 2011]

Ans. A magnetic field line is the path along which a free north pole tends to move.

Characteristics :

(i) Outside a magnet, the magnetic field lines are directed from N-pole of magnet towards S-pole. However, inside a magnet field lines are directed from S-pole to N-pole.

(ii) The relative strength of magnetic field lines is given by degree of closeness of the field lines. More crowded field lines means a stronger field.

(iii) No two magnetic field lines can ever intersect each other. **(Any two) 3**

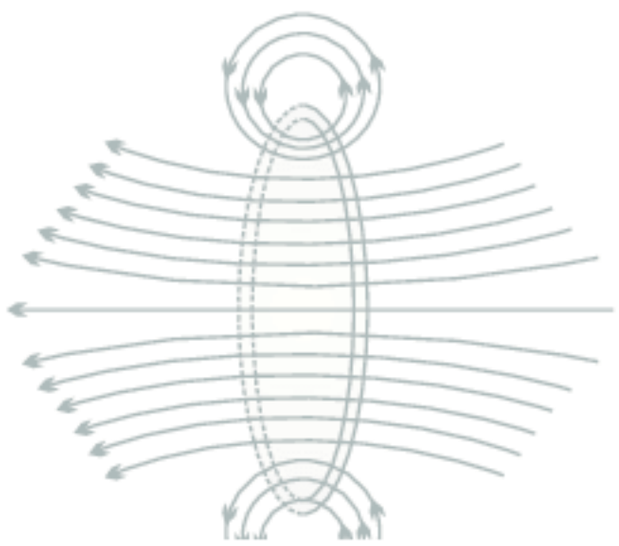


Diagram : Magnetic field pattern of a current carrying circular loop. **1+1**

A **Q. 3. (i) What is a solenoid ?**

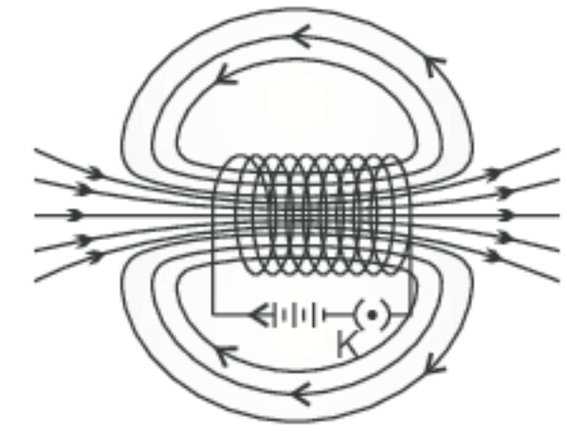
(ii) Draw the pattern of magnetic field formed around a current carrying solenoid. Compare this field to that of a bar magnet.

(iii) Explain an activity to show that a current carrying conductor experiences a force when placed in a magnetic field. [NCT-2014] [DDE-2014]

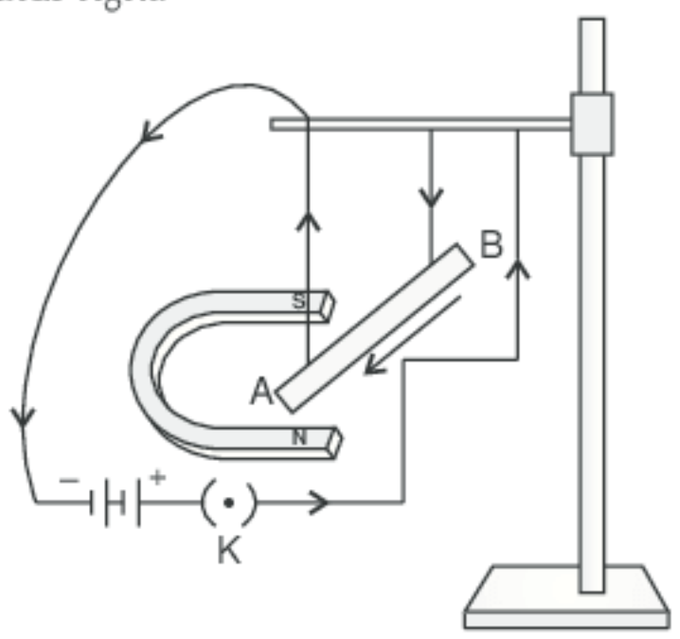
[Board Term I, Set (41, 46, 50, 52, 55), 2011, 12]

Ans. (i) A coil of many circular turns of insulated copper wire wrapped closely in the shape of a cylinder is called solenoid. **1**

(ii) Magnetic fields of a solenoid and a bar magnet are similar. **2**



(iii) A small aluminium rod suspended horizontally from a stand using two connecting wires. Place a strong horse shoe magnet in such a way that the rod lies between the two poles with the magnetic field directed upwards. For this put the north pole of the magnet vertically below and south pole vertically above the aluminium rod. Connect the aluminium rod in series with a battery, a key and a rheostat. Pass a current through the aluminium rod from one end to other. The rod is displaced towards left. When the direction of current flowing through the rod is reversed, the displacement of rod will be towards right.



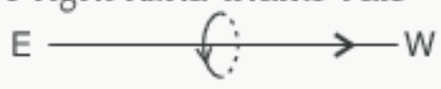
2

U **Q. 4. The magnetic field lines associated with current carrying straight conductor is in anti-clockwise direction. If the conductor was held horizontally along east-west direction, what is the direction of current through it ? Explain it with the help of diagram. Name and state the rule applied to determine the direction of magnetic field. If the conductor is held vertically and current flows from north to south, what will be the direction of magnetic field lines. Draw diagram.**

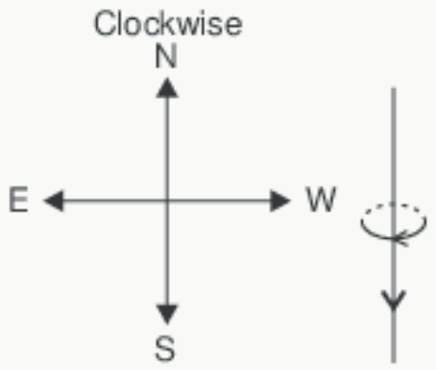
[Board Term I, Set-OQKPLGV, 2016]

Ans. Direction of current will be from East to West direction.

Maxwell's right hand thumb rule



Statement : Imagine that you are holding the current carrying wire in your right hand so that your thumb points in the direction of current, then the direction of your fingers encircle the wire will give the direction of magnetic field.



[CBSE Marking Scheme, 2016] 5

A Q. 5. **(a) Magnetic field lines of two bar magnets A and B are as shown below. Name the poles of the magnets facing each other.**

(b) Two magnetic field lines never intersect each other. Why ?

(c) How does the strength of the magnetic field at the centre of a current carrying circular coil depend on the

(i) radius of the coil,

(ii) number of turns in the coil, and

(iii) Strength of the current flowing in the coil ?

[Board Term I, Set-1ZHNPNO, 2016]

Ans. (a) North poles.

(b) Intersection of magnetic field lines at a point means that the compass needle would point towards two directions at that point, which is not possible.

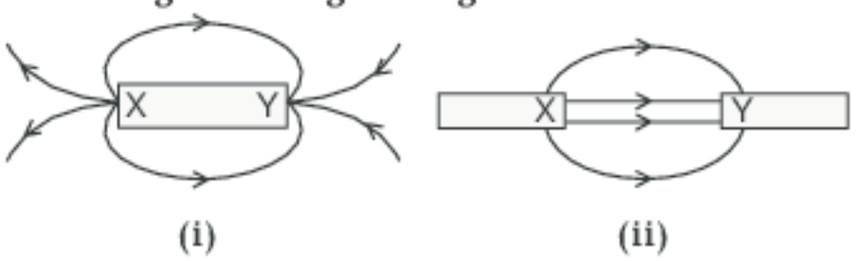
(c) (i) Inversely proportional; more radius less strong magnetic field.

(ii) Directly proportional; more turns more strong magnetic field.

(iii) Directly proportional; more strength of current more strong magnetic field.

[CBSE Marking Scheme, 2016] 5

U Q. 6. **(i) Identify the nature of poles (X and Y) of the magnets in a given figure.**



(i) (ii)

(ii) Draw field lines around a current carrying loop. What happens to the magnetic field lines due to a current carrying straight conductor when the current is reversed ? State the rule which gives relation between of magnetic field lines and direction of current.

[Board Term I, Set-WDCXXOV, 2016]

Ans. (i)

(ii) Refer Question 2 of L.A.T.Q.

Direction of magnetic field lines will change the direction when current is reversed.

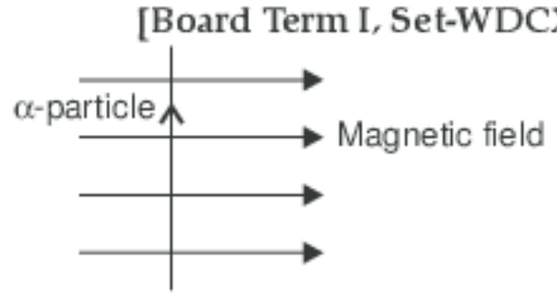
Direction of magnetic field easily found by applying the 'Right hand Thumb Rule'. According to this rule hold the current carrying conductor in your right hand such that thumb is stretched along the direction of current. Then fingers will wrap around the wire in the direction of magnetic field.

[CBSE Marking Scheme, 2016] 5

U Q. 7. **(i) Describe an activity to determine the direction of magnetic field produced by a current carrying straight conductor. Also show that the direction of the magnetic field is reversed on reversing the direction of current.**

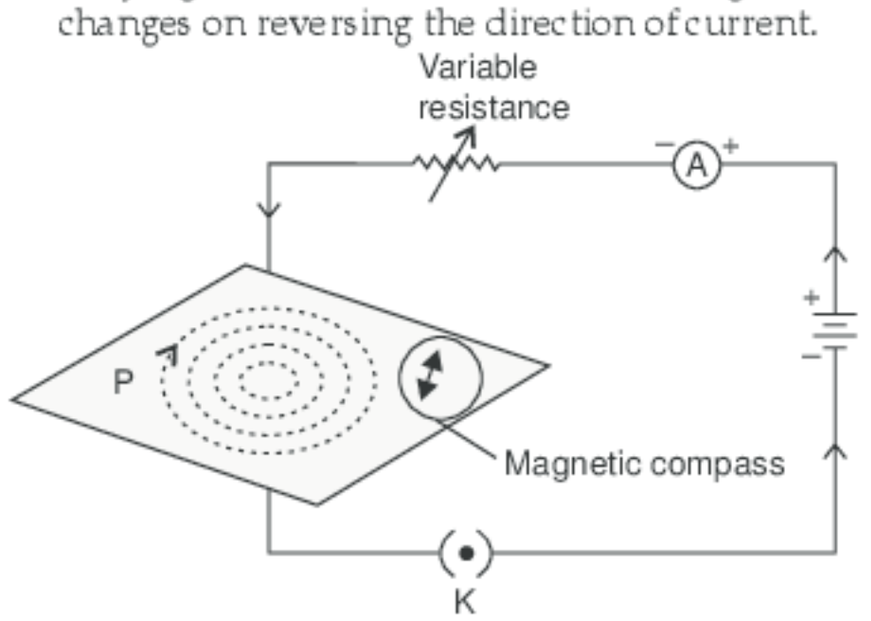
(ii) An α-particle, (which is a positively charged particle) enters, a uniform magnetic field at right angles to it as shown below. Stating the relevant principle explain in which direction will this α-particle move ?

[Board Term I, Set-WDCXXOV, 2016]



Ans. (i) Take a battery (12 V), a variable resistance (or a rheostat), an ammeter (0 - 5A), a plug key and a long straight thick copper wire. Insert the thick wire through the centre, normal to the plane of a rectangular cardboard. Take care that the cardboard is fixed and does not slide up or down.

Connect the copper wire vertically between the points X and Y, in series with the battery, a plug and key. Sprinkle some iron filings uniformly on the cardboard. Keep the variable of the rheostat at a fixed position and note the current through ammeter. Close the key, So that current flows through the wire. Ensure that the copper wire placed between the points X and Y remains vertically straight. Gently tap the cardboard for a few times. Observe the pattern of the iron filings. You would find that the iron filings align themselves showing a pattern of concentric circles around the copper wire. This represents the magnetic field around the current-carrying conductor. The direction of magnetic field changes on reversing the direction of current.



(ii) The alpha particle will move in a circular path. This is because a centripetal force acts on the particle due to the movement of particle in the magnetic field. 3 + 2

U **Q. 8. (i) A coil of insulated copper wire is connected to a galvanometer. What happens if a bar magnet is :**
(a) pushed into the coil ?
(b) withdrawn from inside the coil ?
(c) held stationary inside the coil ?
Give reasons for your observation.
(ii) Mention one more method of inducing current in a coil. [Board Term I, Set 2ZGOVVV; 2015 Board Term I, Set-37, 2012]

Ans. (i) (a) When a bar magnet is pushed into the coil of insulated copper wire connected to a galvanometer, an induced current is set-up in the coil due to charge of magnetic field through it. As a result, galvanometer gives a deflection (say towards left). 1½

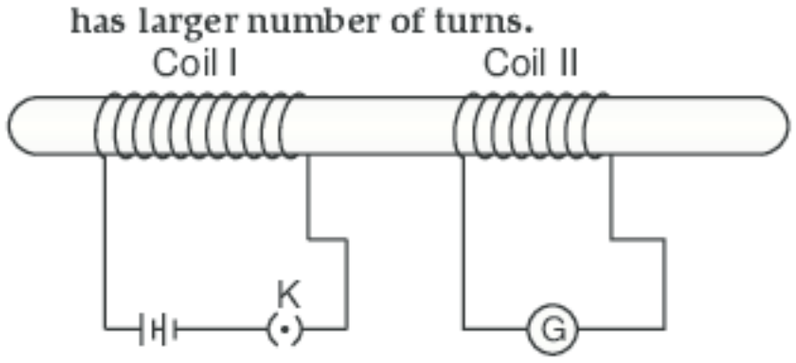
(b) When the bar magnet is withdrawn from inside the coil, again an induced current is set up in the coil due to charge of magnetic field through it. As a result galvanometer gives a deflection in the reverse direction. (say towards right). 1½

(c) If the bar magnet is held stationary inside the coil, then there is no induced current in the coil, because there is no change in magnetic field through it. As a result, galvanometer does not show any deflection. 1

(ii) By changing current in another coil placed near it. 1

[CBSE Marking Scheme, 2012]

U **Q. 9. Two coils of insulated copper wire are wound over a non conducting cylinder as shown. Coil I has larger number of turns.**



(i) Write your observations when,
(a) key K is closed;
(b) key K is opened;
(ii) Give reason for your observations.
(iii) Mention the name of the phenomenon involved and define it.
(iv) Name of two coils used in this experiment.
(v) State the rule which gives the direction of induced current. [Board Term I, Set-31, 2012]

Ans. (i) (a) A momentary deflection is shown by the galvanometer. ½

(b) A momentary deflection is shown by the galvanometer but in the opposite direction. ½

(ii) When key is closed or opened, the current in the coil I changes, therefore the magnetic field linked with coil II changes and hence a current is induced in it. 1

(iii) Electromagnetic induction—The process by which a changing magnetic field in a conductor induces current in another conductor. 1

(iv) Primary coil — coil I
Secondary coil — coil II 1

(v) **Fleming's Right Hand Rule :** Stretch the first three fingers of the right hand mutually perpendicular to each other such that the forefinger gives the direction of magnetic field and the thumb points in the direction of the motion of a conductor then, the middle finger will give the direction of the induced current. 1

U **Q. 10. Describe briefly an activity to :**
(i) demonstrate the pattern of magnetic field lines around a straight current carrying conductor and,
(ii) find the direction of magnetic field produced for a given direction of current in the conductor. Name and state the rule to find the direction of magnetic field around a straight current carrying conductor. Draw a diagram to explain the same activity.
[Board Term I, Set-37, 2012]

Ans. (i) (a) Take a battery (12V), a variable resistance, an ammeter (0 – 5A), a plug key and a long straight thick copper wire.

(b) Insert the thick wire through the centre, normal to the plane of a rectangular cardboard.

(c) Connect the copper wire vertically between X and Y as shown in series with battery, a plug key and a rheostat.

(d) Sprinkle some iron filings uniformly on the cardboard.

(e) Keep the variable of the rheostat at a fixed position and note the current through the ammeter.

(f) Close the key so that a current flows through the wire. Gently tap the cardboard a few times. Observe the pattern of the iron filings. 3

(ii) To find the direction of magnetic field lines, place a compass at a point P over a circle and observe the direction of the needle. The direction of north pole of the compass would give the direction of magnetic field lines.

Maxwell's Right Hand Thumb Rule is used to find the direction of magnetic field lines. It states that "Imagine you are holding a current carrying conductor in your right hand such that the thumb points in the direction of current. Then your fingers will wrap around the conductor in the direction of the magnetic field lines." ½+½

Refer Fig. Q. 1. of L.A.T.Q. 1

[CBSE Marking Scheme, 2012]

U **Q. 11. (i) A stationary charge is placed in a magnetic field. Will it experience a force ? Give reason to justify your answer.**
(ii) On what factors does the direction of force experienced by a conductor when placed in a magnetic field depend ?
(iii) Under what conditions is the force experienced by a current carrying conductor placed in a uniform magnetic field maximum ?

(iv) Name and state the rule which gives the direction of force experienced by a current carrying conductor placed in a magnetic field.

[Board Term I, Set-44, 2012]

Ans. (i) No, a magnetic field exerts a force only on moving charges. **1**

(ii) The direction of force depends on the direction of current and direction of magnetic field. **1**

(iii) The force is maximum when the direction of current is at right angles to the direction of magnetic field. **1**

(iv) Fleming's Left Hand Rule. **1**

According to this rule—"Stretch the thumb, forefinger and middle finger of your left hand such that they are mutually perpendicular to each other.

If the first finger points in the direction of magnetic field and the middle finger in the direction of current, then the thumb will point in the direction of motion or the force acting on the conductor." **1**

[CBSE Marking Scheme, 2012]

U **Q. 12. A student fixes a sheet of white paper on a drawing board. He places a bar magnet in the centre of it. He sprinkles some iron filings uniformly around the bar magnet. Then he taps the board gently and observes that the iron filings arrange themselves in a particular pattern.**

(i) Why do the iron filings arrange in a pattern ?

(ii) What does the lines along which the iron filings align represent ?

(iii) What does the crowding of iron filings at the end of the magnet indicate ?

(iv) How does strength of magnetic field is indicates ?

[Board Term I, Set-WH1SGOB, 2014; Board Term I, Set-40 2012] 5

Ans. (i) Due to the force exerted by the magnet within its magnetic field. **1**

(ii) The lines represent magnetic field lines. **1**

(iii) Crowding of iron filings at the ends of the magnet indicates that the magnetic field is strongest near the poles of the magnet. **1**

(iv) The strength of magnetic field is indicated by the closeness of the field lines. Closer the lines, more will be the strength and farther the lines, lesser will be the field strength. **2**

[CBSE Marking Scheme, 2014]

TOPIC-2

Electric Generator, Electric Motor and Electric Current

Very Short Answer Type Questions (1 mark each)

R **Q. 1. Name any two sources of direct current.**

[Board Term I, Set-IN14KGB, 2014]

Ans. Some sources of direct current are cell, battery and DC generator, etc.

R **Q. 2. Mention the advantage of A.C. over D.C. for long distance transmission.**

[Board Term I, Set-31, 2012]

Ans. A.C. can be easily transmitted over long distances without much loss of energy. **1**

[CBSE Marking Scheme, 2012]

R **Q. 3. What is the frequency of A.C. in India ?**

[DDE 2017]

Ans. The frequency of alternating current in India is 50 Hz. **1**

U **Q. 4. List any one point of difference between A.C. and D.C.** **[Board Term I, Set-36, 2012]**

Ans. As the name suggests, direct current always flows in one direction and alternating current reverses its direction periodically. **1**

[CBSE Marking Scheme, 2012]

R **Q. 5. Name the type of current :**

(i) Used in household supply

(ii) Given by a cell. **[Board Term I, Set-40, 2012]**

Ans. (i) Alternating current

(ii) Direct current. ½+½

[CBSE Marking Scheme, 2012]

A **Q. 6. An alternating current has a frequency of 50 Hz. How many times does it change its direction in one second ?** **[Board Term I, Set-50, 2012]**

Ans. 100 times. **[CBSE Marking Scheme, 2012]** 1

R **Q. 7. Who discovered the electromagnetic induction ?** **[DDE 2017]**

Ans. Electromagnetic induction was first discovered by Michael Faraday. **1**

R **Q. 8. Name the device used to prevent damage to the electrical appliances and the domestic circuit due to overloading.** **[Board Term I, Set-39, 2012]**

Ans. Electric fuse. **[CBSE Marking Scheme, 2012]** 1

A **Q. 9. State the value of potential difference between the live wire and the neutral wire in our country.** **[Board Term I, Set-41, 2012]**

Ans. 220 V. **[CBSE Marking Scheme, 2012] 1**

R **Q. 10. What is Short Circuit ?** **[DDE 2017]**

Ans. Short Circuit is simply a low resistance connection between the two conductors supplying electrical power to any circuit. This results in excessive current flow in the power source through the 'short' and may even cause the power source to be destroyed. **1**

U **Q. 11. State a difference between the wires used in the element of an electric heater and in a fuse.** **[Board Term I, Set-43, 2012]**

Ans. The melting point of the wire used in heater elements is high while a fuse wire has low melting point. **[CBSE Marking Scheme, 2012] 1**

U **Q. 12. How is the type of current that we receive in domestic circuit different from the one that runs a clock ?** **[Board Term I 2014 Set-WH1SGOB]**

Ans. In domestic circuit, it is A.C. while clock cell gives D.C. **1**

R **Q. 13. State the use of earth wire in domestic electric circuit.** **[Board Term I, Set-51, 2012]**

Ans. To ensure that any leakage of current to the metallic body of the appliance does not give shock to the user. **[CBSE Marking Scheme, 2012] 1**

R **Q. 14. Mention the colour convention for live, neutral and earth wires.** **[Board Term-I, Set-A85V2IL, 2015]**

Ans. Live wire — Red, Neutral Wire — Black, Earth wire — Green. **[CBSE Marking Scheme, 2015] 1**

R **Q. 15. In domestic electric circuit, with which wire do we connect a fuse ?** **[Board Term I, Set-37, 2012]**

Ans. Live wire. **[CBSE Marking Scheme, 2012] 1**

A **Q. 16. What is the role of the two conducting stationary brushes in a simple electric motor ?** **[NCERT Exemplar 2017]**

Ans. The brushes are connected to the battery and touch the outer side of two halves of the split ring whose inner sides are insulated and attached to the axle. **1**

Short Answer Type Questions-I

(2 marks each)

R **Q. 1. Explain the terms : Overloading and short-circuiting.** **[Board Term I, Set-36, 2012]**

Ans. Overloading occurs when or two many appliances of high power ratings are connected to a single electric circuit and switched on simultaneously. As a result, the circuit draws large current beyond its capacity.

Short-circuiting takes place in domestic power supply if the live wire and the neutral wire come into direct contact, due to damage of insulation of live wire. **[CBSE Marking Scheme, 2012] 1+1**

U **Q. 2. When does Short Circuit occurs ?**

Ans. A common short circuit occurs when the positive and negative terminals of a battery are connected with a low-resistance conductor, like a wire. With a low resistance in the connection, a high current will flow, causing the delivery of a large amount of energy in a short period of time. **2**

R **Q. 3. What is a solenoid ? Mention two ways to increase the strength of the field of a solenoid.** **[Board Term I, Set (37), 2012]**

Ans. A coil of many circular turns of insulated copper wire wrapped closely in the shape of cylinder is called a solenoid. **1**

Two ways to increase the strength of the field of a solenoid :

(i) By increasing the number of turns. ½

(ii) By increasing current. ½

[CBSE Marking Scheme, 2012]

U **Q. 4. Mention the provision of two different current ratings in our domestic circuits. Explain with reason, the advantage of such a provision.** **[Board Term I, Set-WJ7QPA9, 2013]**

Ans. The two different current ratings provided in domestic circuits are 5A and 15A. This is because different electrical appliances have different power ratings, so they draw different currents when connected in the mains. Some appliances need smaller currents, while some other need heavy currents. **[CBSE Marking Scheme, 2013] 2**

A **Q. 5. Write the use of safety device used in electric circuit.** **[DDE 2017]**

Ans. Electric Fuse.

A fuse is a small conducting wire of low melting point which protects the household electrical system from getting damaged due to unusual high current. The unusual high current may be due to short circuit, power fluctuation etc.

U **Q. 6. List in tabular form two major differences between an electric motor and a generator.** **[Board Term I, Set-41, 2012]**

Ans.

S. No.	Electric Motor	Generator
(i)	Motor converts electrical energy into mechanical energy.	Converts mechanical energy to electrical energy.

(ii)	Works on the principle of Fleming's left hand rule.	Works on the principle of Fleming's right hand rule.

1+1

[CBSE Marking Scheme, 2012]

A Q. 7. **Name four appliances wherein an electric motor, a rotating device that converts electrical energy to mechanical energy, is used as an important component. In what respect motors are different from generators ?**

[NCERT Exemplar 2017]

Ans. Electric fans, mixers, washing machines, computer drives etc. Motors convert electrical energy into mechanical energy whereas generators convert mechanical energy into electrical energy. 2

U Q. 8. **Explain the function of an earth wire. Why is it necessary to earth metallic appliances ?**

[Board Term I, Set-37, 2012]

Ans. Earth wire is used as a safety measure especially for those appliances that have a metallic body, for example – electric press, toaster etc. The metallic body is connected to the earth wire, which provides a low resistance conducting path for the current.

Thus it ensures that any leakage of current to the metallic body of the appliances keeps its potential to that of the earth and the user may not get a severe shock. 2

[CBSE Marking Scheme, 2012]

U Q. 9. **List two precautions to be taken to avoid overloading in the domestic circuit. Also state one difference between overloading and short circuiting.** [Board Term I, Set-44, 2012]

Ans. Precautions :

(i) A fuse of appropriate rating should be used in the circuit. ½

(ii) Too many appliances should never be connected to a single socket. ½

Overloading : Occurs when a large number of higher current drawing appliances are switched on at the same time and the total current drawn through the circuit exceeds its rated value. ½

Short circuiting : Occurs when the live wire comes in direct contact with neutral wire. ½

[CBSE Marking Scheme, 2012]

Short Answer Type Questions-II

(3 marks each)

R Q. 1. **What is overloading and short circuiting ? What is the function of earth wire ?** [NCT-2014]

[DDE 2017]

Ans. If too many electrical appliances of high power rating are switched on at the same time, they draw large current from the circuit. This is called overloading.

If the live wire and neutral wire come in contact either directly or via conducting wire, the situation is called short circuiting.

To avoid risk of electrical shock, the metal body of the appliances is earthed. Earthing means to connect the metal case of the appliance to earth by a means of a metal wire called earth wire. 1 + 1 + 1

U Q. 2. **What is short circuiting ? State one factor/ condition that can lead to it. Name a device in the household that acts as a safety measure for it. State the principle of its working.**

[Board Term I, Set-47, 2012]

Ans. Situation in which live and neutral wire come in direct contact, abruptly increasing the current in the circuit is called short-circuiting. 1

Factor – Insulation of wire is damaged / fault in appliance. ½

Safety device – electric fuse. ½

Electric fuse is an application of Joule's heating. If there is a current larger than the specified value the temperature of fuse wire increases and it melts to break the electric circuit and stop the flow of unduly high electric current. 1

[CBSE Marking Scheme, 2012]

A Q. 3. **What is short-circuiting of an electric circuit ? An electric motor of 1.5 kW power rating is operated in a domestic electric circuit of current rating 5A. What would happen when it is switched ON ? Give reason for your answer.**

[Board Term I, Set-50, 2012]

Ans. Situation when live wire and neutral wire come into direct contact, current in the circuit abruptly increases. 1

$P = 1.5 \times 1000\ W = 1500\ W$

$P = VI \longrightarrow I = \frac{P}{V} = \frac{1500\ W}{220\ V} = 6.8\ A$ 1

Electric current required (6.8 A) is more than the current rating of the circuit, *i.e.*, 5A. Hence the fuse will melt and the electric motor will stop working. [CBSE Marking Scheme, 2012] 1

A Q. 4. **What is earth wire ? How it works in our domestic circuit ?** [DDE 2017]

Ans. The earth wire gives a safe route for the current if the live wire touches the outer casing. Live wire is A wire carrying electric current.

The metallic body is connected to the earth wire, which provides a low resistance-conducting path for the current. It ensures that any leakage of current of the metallic body the appliance will flow to the earth only and the user may not get a severe shock. 1+2

A Q. 5. **(a) Give the significance of the following in a domestic circuit :**

(i) electric meter

(ii) earthing

(b) List two precautions that should be taken to avoid overloading. [Board Term I, Set-52, 2012]

Ans. (a) (i) Electric meter : It is used to record the consumption of electrical energy in kWh in the circuit. 1

(ii) Earthing : It prevents electric shock. The earth-wire is joined to the metal case of the appliance and provides a low resistance conducting path for the current. 1

(b) (i) Too many appliances should not be connected to a single socket. ½

(ii) Fuse of current rating 5A and 15A should be separately used in the domestic circuit. ½

[CBSE Marking Scheme, 2012]

U Q. 6. **What is the role of fuse, used in series with any electrical appliance ? Why should a fuse with defined rating not be replaced by one with a larger rating ?**

[NCERT Exemplar 2017, KVS 2017]

Ans. Fuse is used for protecting appliances due to short-circuiting or overloading. The fuse is rated for a certain maximum current and blows off when a current more than the rated value flows through it. If a fuse is replaced by one with larger ratings, the appliances may get damaged while the protecting fuse does not burn off. This practice of using fuse of improper rating should always be avoided. 3

U Q. 7. **List three factors which can cause overloading of domestic electric circuits.**

[Board Term I, Set-54, 2012]

Ans. Three factors which can cause overloading are :

(i) When the live wire and the neutral wire come into direct contact. 1

(ii) Accidental hike in the supply voltage. 1

(iii) By connecting too many appliances to a single socket. **[CBSE Marking Scheme, 2012]** 1

U Q. 8. **Write one difference between direct current and alternating current. Which one of the two is mostly produced at power stations in our country ? Name one device which provides alternating current. State one important advantage of using alternating current.**

[Board Term I, Set-45, 2012] [NCERT Exemplar]

Ans. Direct current does not change its direction with time whereas alternating current reverses its direction periodically. 1

Most power stations produce AC in India/an AC generator. 1

Electric power can be transmitted over long distances without much loss of energy. 1

[CBSE Marking Scheme, 2012]

U Q. 9. **Name the three types of wires used in household circuits. Out of these three which wire is used as a safety measure especially for those appliances that have metallic body. State the colour of insulation used for this wire. How it ensures the safety of the user ?**

[Board Term-I, Set-49, 2012]

Ans. (i) Live wire ½

(ii) Neutral wire ½

(iii) Earth wire ½

Earth wire, colour of insulation – green ½

The metallic body connected to the earth wire keeps its potential to that of the earth's zero potential and if there is any leakage the user does not get any kind of electric shock. 1

[CBSE Marking Scheme, 2012]

U Q. 10. **Name two electrical appliances of daily use in which electric motor is used. Name and state the principle on which an electric motor works.**

[Board Term-I, Set-44, 2012]

Ans. Electrical appliance – fan, washing machine, mixer. **(Any two) 1**

Fleming's Left Hand Rule – It states that "Stretch the forefinger, the central finger and the thumb of your left hand are mutually perpendicular to each other. If the forefinger shows the direction of the magnetic field and the central finger that of the current then the thumb will point towards the direction of motion of the conductor. 2

[CBSE Marking Scheme, 2012]

A Q. 11. **Explain the function of fuse in a domestic electric circuit ? An electric oven having power rating 2000 W, 220 V is used in an electric circuit, having a fuse of 5A rating. What is likely to happen when the oven is switched on? Explain.**

[Board Term I, Set-18, 2012]

Ans. It prevents the electric circuits and appliances from possible damage by stopping the flow of unduly high electric current. 1

Here, P = 2000 W, V = 220 V

Using P = VI

$$I = \frac{P}{V} = \frac{2000}{220} = 9.09 \text{ A}.$$ 1

Since the current flowing through the oven is larger than the fuse rating (5A), the fuse wire melts and breaks the circuit, thus protecting the circuit. **[CBSE Marking Scheme, 2012]** 1

U Q. 12. **Distinguish between alternating current and direct current. Explain why alternating current is preferred over direct current for transmission over long distances. [DDE-2014]**

Ans. Alternating Current : If the current changes direction after equal intervals of time, it is called alternating current. The positive and negative polarities of AC are not fixed.

Direct Current : If the current always flows in the same direction, it is called direct current. It can be obtained from a cell or a battery. The positive and negative polarities of DC are fixed for long distance transmission. AC is preferred as it caused minimum loss of energy during transmission. **1 + 1 + 1**

U **Q. 13. A coil of insulated copper wire is connected to a galvanometer. What would happen if a bar magnet is :**

(i) Pushed into the coil ?

(ii) Withdrawn from inside the coil ?

(iii) Held stationary inside the coil ?

Ans. (i) Due to change in magnetic flux linked with coil, the galvanometer shows deflection (say towards right).

(ii) Due to change in magnetic flux linked with coil, the galvanometer shows deflection (say towards left opposite to that in case one).

(iii) As it is stationary, no change in magnetic flux linked with coil, so galvanometer shows no deflection.

1 + 1 + 1

A **Q. 14. State the function of a 'fuse' in an electric circuit. A circuit has a fuse of 5A. Find the maximum number of 100 W, 220 V lamps that can be used in this circuit. [Board Term I, Set-51, 2012]**

Ans. It prevents damage to the appliance due to overloading or short circuiting.

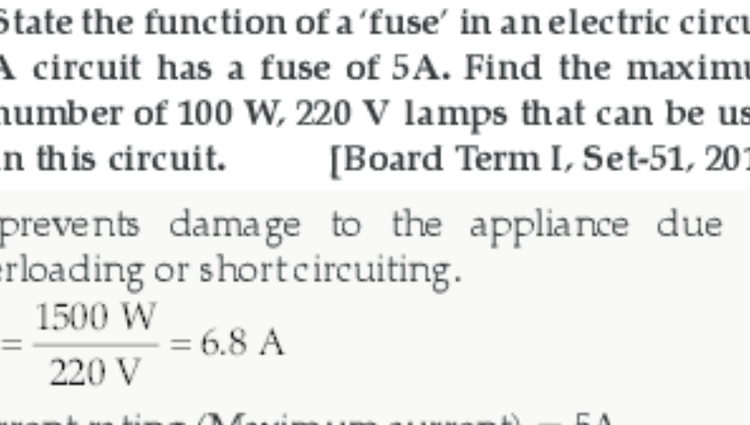
$\frac{P}{V} = \frac{1500\ W}{220\ V} = 6.8\ A$ **1**

Current rating (Maximum current) = 5A **1**

$\therefore$ No of lamps = $\frac{\text{Current rating}}{\text{Current through one lamp}} = \frac{5}{\frac{10}{22}} = 11.$ **1**

[CBSE Marking Scheme, 2012]

A **Q. 15. An electron enters a magnetic field at right angles to it as shown in fig. The direction of the force acting on the electron will be :**
(a) to the right, (b) to the left, (c) out of the page, (d) into the page.



Ans. When a force conductor carrying current is placed perpendicular to the direction of magnetic field, the magnetic field acting on it is given by Fleming's left hand rule. Since the direction of current is the same as that of the motion of a positive charge, the direction ot force acting on it when moving perpendicular to the direction of magnetic field is the same as that acting on a current-carrying conductor placed perpendicular to the direction of magnetic field. Obviously, the force acting on an electron is opposite to that. Therefore in this case it is into the page. **3**

A **Q. 16. It is necessary to connect an earth wire to electric appliances having metallic covers. Why? How will you identify earth wire in household circuit ? [Board Term I, Set-OQKPLGV, 2016]**

Ans. The earth wire provides a low resistance conducting path for the current. In case of any leakage of current to the metallic body of any appliance, the earth wire allows the current to flow into the earth and user saved from electric shock. Earth wire has green insulation.

[CBSE Marking Scheme, 2016]

Detailed Answer :
The earth wire is connected to a metallic plate deep inside the earth. In this way, the metallic body of appliance is connected to the earth, which provides a low resistance conducting path for electric current. Hence, any leakage of current to the metallic body of appliance keeps the potential to that of earth. The user might not get a severe electric shock on touching such an appliance.
Earth wire has green insulation, so it can be identified. **3**

A **Q. 17. A circuit has a line of 5A. how many lamps of rating 40W; 220 V can simultaneously run on this line safely ?**

[Board Term I, Set-57289R, 2014]

Ans. $I = \frac{P}{V} = \frac{40W}{220V} = \frac{2}{11}A = 0.18$ Amp.

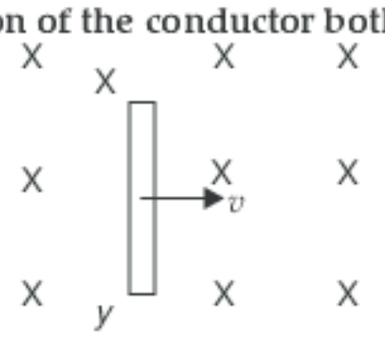
$\frac{2}{11}$ A or 0.18 A current is required by one lamp.

Current rating (Maximum current) = 5A.

$\therefore$ No. of lamps = $\frac{\text{Current rating}}{\text{Current through one lamp}}$

$= \frac{5}{0.18} = 27$ **3**

A **Q. 18. Crosses ⊗ represent a uniform magnetic field directed into the paper. A conductor XY moves in the field toward right side. Find the direction of induced current in the conductor. Name the rule you applied. What will be the direction of current if the direction of field and the direction of motion of the conductor both are reversed ?**



[Board Term I, Set-1ZHNPNO, 2016]

Ans. (i) Y to X
(ii) Fleming's right hand rule.
(iii) The direction of induced current will still be the same *i.e.*, Y to X. **1 + 1 + 1**

[CBSE Marking Scheme, 2016]

Long Answer Type Questions

(5 marks each)

R Q. 1. **(i) What is meant by the terms alternating current and direct current ?**

(ii) Name a source of alternating current and a source of direct current.

(iii) Mention the frequency of AC supply in India.

(iv) State two important advantages of alternating current over direct current.

[Board Term I, Set-A85V2IL, 2015]

Ans. (i) Refer to know the terms.

(ii) Source of AC current — electric generator.
Source of DC current — electric cell.

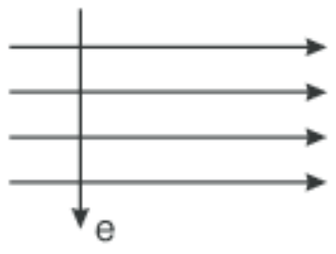
(iii) Frequency of alternating current in India is 50 Hz.

(iv) (a) Alternating current reverses its direction periodically but direct current always flow in one direction.

(b) AC electric power can be transmitted over long distances without much less of energy while DC not. 5

A Q. 2. **(i) Define electromagnetic induction.**

(ii) Two coils P and S are wound over the same iron core. Coil P is connected to battery and key and the coil S is connected to galvanometer. Write your observations when :



(i) Current in the coil P is started by closing the key.

(ii) Current continues to flow in coil P.

(iii) Current in coil P is stopped by removing the key.

Explain the reason for such observation.

[Board Term I, Set-15, 2012]

Ans. (a) **Electromagnetic induction :** The process by which a change in magnetic field in a conductor induces a current in another conductor. 2

(b) (i) There is deflection in galvanometer connected with coils, due to induced current.

(ii) Deflection becomes zero.

(iii) Deflection in galvanometer is in opposite direction. 3 × ½ = 1½

Reason :

(i) E.M. induction takes place because field is changing.

(ii) Since current becomes stationary, no change in field takes place. So no EM induction.

(iii) E.M. induction takes place but induced current is in opposite direction. 3 × ½ = 1½

[CBSE Marking Scheme, 2012]

U Q. 3. **Explain the meanings of the words "electro magnetic" and 'induction' in the term electromagnetic induction. List three factors on which the value of induced correct produced in the circuit depends. Name and state the rule to determine the direction of induced current. State one practical application of this phenomenon in everyday life.**

Ans. 'Electromagnetic' stands for the property by which magnetism developed by a current of electricity. 'Induction' stands for the action or process of bringing about or giving rise to something.

Induced current depends on :

(i) The strength of magnetic field used.

(ii) The rate of change of magnetic flux associated with the coil.

(iii) The conductor in the form of coil of many turns of insulated wire.

Rule : Fleming right Hand Rule

Statement : Refer to Quick Review.

Application : Electric Generator. 2 + 1½ + 1½

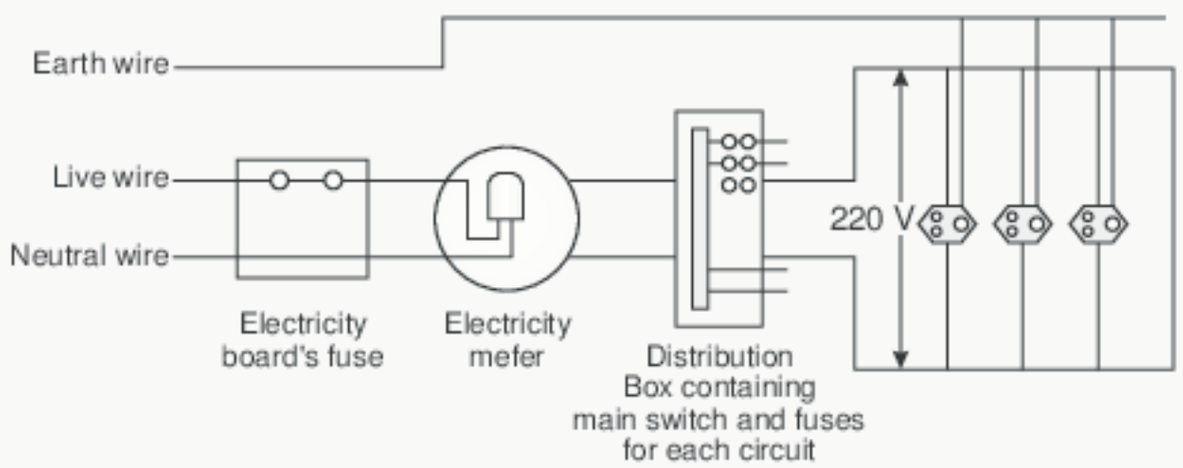
A Q. 4. **(a) Draw a schematic labelled diagram of domestic electric circuit.**

(b) Why is it necessary to provide–

(i) a fuse in an electric circuit

(ii) an earth wire to electric application metallic body? Explain. **[Board Term-I, Set-A85V2IL, 2015]**

Ans.



3

Fig. A schematic diagram of one of the common domestic circuits

(b) (i) It prevents damage to appliance due to overloading or short-circuiting.

(ii) Earth wire is connected to a metallic body buried deep inside earth. It is used as safety measure. It provides a low resistance conducting path for the current any leakage of current to a metallic body does not give shock to user. **[CBSE Marking Scheme, 2015]** 2

U **Q. 5. (i) Explain what is the difference between a direct current and an alternating current. Write one important advantage of using alternating current.**

(ii) An air conditioner of 2kW is used in an electric circuit having a fuse of 10A rating. If the potential difference of the supply is 220 V, will the fuse be able to withstand, when the air conditioner is switched on ? Justify your answer.

[Board Term I, Set-IN14KGB, 2014]

Ans. (i) The current whose direction gets reversed after every half cycle is called an alternating current or AC. There is no change in the direction of DC.

The most important advantage of using AC over DC is that in the AC mode electric power can be transmitted over long distances with less loss of power. **3**

(ii) Here P = 2kW = 2000W, V = 220 Volt

$P = VI$, the current $I = \frac{P}{V} = \frac{2000}{220} = 9.09$ A

As the current is 9.09 A, below the rating of fuse, the fuse will withstand *i.e.*, it will not blow off when AC is on. **2**

[CBSE Marking Scheme, 2014]

U **Q. 6. Describe any five safety measures that should be taken while dealing with electric appliances connected in domestic electric circuit.**

[Board Term I, Set-3R6WRQL, 2013]

Ans. (i) To avoid shocks from electrical appliances use proper-earthing arrangement.

(ii) Replace old worn out and damaged wires with new set.

(iii) Put the main switch off when removing any fault in electric circuits.

(iv) Wear rubber shoes and gloves while dealing with replacement of any appliance.

(v) Work with electric circuits in proper light.

(vi) Do not put your hand inside water being heated with immersion rod, when the rod is inside and on.

(Any five) 1×5

U **Q. 7. (i) Explain two safety measures commonly used in electric circuits and appliances.**

(ii) An electron enters a magnetic field at right angles to it as shown in figure. What will be the direction of force acting on the electron ? State the rule which gives direction of force on electron.

(iii) If instead of electron, a neutron enters a field, what will be its direction of motion ? Give reason for your answer. **[Board Term I, Set-18, 2012]**

Ans. (i) Fuse being a wire of low melting point, it melts when a large current flows due to short-circuiting or overloading. **1**

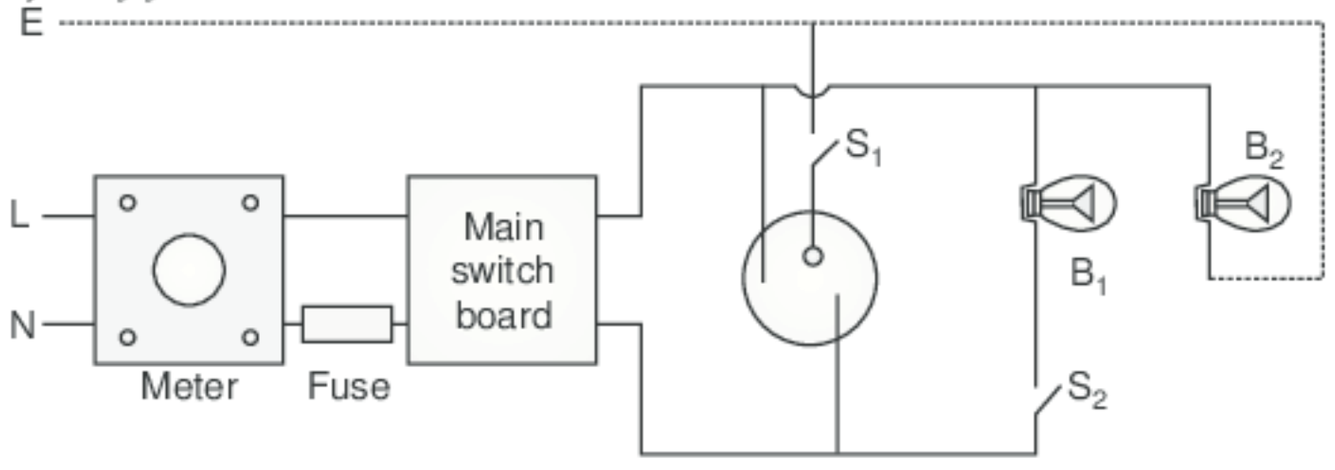
Earthing of appliance—Earth wire is connected to a plate deep in the earth. If there is leakage of current, it goes to earth. **1**

(ii) Electron will move in a direction perpendicular to the plane of paper and into it. ½

Flemings Left Hand Rule : Stretch the first three fingers of the left hand mutually perpendicular to each other such that the forefinger points the direction of magnetic field, the middle finger points the direction of current, then the thumb will indicate the direction of force experienced by the conductor. It is applied to the direction of the current and field perpendicular to each other. **1½**

(iii) Neutron will continue to move in same direction because no force will act on it since it carries no charge. **[CBSE Marking Scheme, 2012] 1**

A **Q. 8. (i) The given figure shows a domestic electric circuit. Study this circuit carefully. List any two errors in the circuit and justify your answer.** **[DDE 2017]**



(ii) Give one difference between the wires used in the element of an electric heater and in a fuse.

(iii) List two advantages of parallel connection over series connection. **[Board Term I, Set-46, 2012]**

Ans. (i) Two errors are :

(a) Fuse is incorrectly connected to the neutral wire (N), it must be connected to the live wire (L).

(b) Bulb B_2 is not connected to the neutral wire.

(c) Two switches S_1 and S_2 in both B_1 circuit and no switch in bulb B_2 circuit. **(Any two) 2**

(ii) Element of electric heater—high melting point ½

Element of fuse wire—low melting point ½

(iii) (a) Each appliance has equal potential difference. **1**

(b) Each appliance has separate switch to ON/OFF the flow of current through it. **1**

[CBSE Marking Scheme, 2012]

High Order Thinking Skills (HOTS) Questions

Q. 1. Can two magnetic lines of force intersect each other ? Give reasons in support of your answer. 3 [DDE 2017]

Ans. No, two magnetic lines of force never intersect each other. If two magnetic lines of force intersect each other then at the point of intersection there will be two different directions of magnetic field which is not possible. 3

Q. 2. The deflection of the compass needle increases as it is moved towards the pole of a bar magnet. Why ?3

Ans. The magnetic field due to a bar magnet is highest near its two poles. Therefore, the force exerted by the bar magnet on the compass needle is larger in such a region. That is why the deflection of the compass needle increases when it is moved towards the pole of a bar magnet. 3

Q. 3. Sita wants to determine the direction of a force, experienced by a straight current carrying conductor placed in a magnetic field which is perpendicular to it. Which rule will she apply to determine it ? 3

Ans. Sita will apply Fleming's left hand rule. According to Fleming's left hand rule, when the forefinger, the central finger and the thumb of the left hand are stretched mutually perpendicular to each other and if the forefinger points in the direction of the magnetic field, the central finger in the direction of current, then the thumb points in the direction of force on the conductor. 3

Q. 4. A coil of insulated copper wire is connected to a galvanometer as shown in the diagram. State your observations when a bar magnet is :

(i) Pushed into the coil with its north pole entering first.

(ii) Held at rest inside the coil.

(iii) Name the phenomenon responsible for the above observation. 3

Ans. (i) Momentary deflection in the needle of galvanometer say to the right. 1

(ii) Deflection of the galvanometer drops to zero. 1

(iii) Electromagnetic Induction. 1

Q. 5. All the household electric appliances are connected in parallel. List two advantages of this type of arrangement. 3

Ans. Two advantages :

(i) To have equal potential difference across each appliance. 1

(ii) Each appliance has separate switch to ON/OFF the flow of current through it, so that each circuit can work independently. 2

Q. 6. How would the strength of magnetic field due to current carrying loop be affected if :

(i) Radius of the loop is reduced to half its original value ?

(ii) Strength of current through the loop is doubled ? 3

Ans. (i) Strength of magnetic field gets doubled and increases. 1½

(ii) Strength of magnetic field gets doubled and increases. 1½

Q. 7. Where do we connect a fuse; with a live wire or with a neutral wire ? What happens if the fuse wire is connected to neutral wire ? 3

Ans. Fuse is always connected to live wire. If fuse wire is connected to neutral wire instead of live wire then even when the fuse burns out, the appliance remains connected to the live wire and the current supply will not be disrupted due to over loading. 3

Q. 8. Is it possible to change the polarity of an electromagnet ? Give any two uses of electromagnets.

Ans. Yes, we can change the polarity of an electromagnet by reversing the direction of current. 3

Uses of electromagnets :

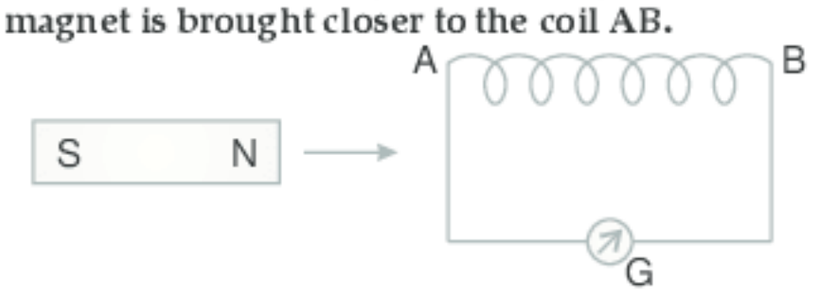
(i) In electric bells

(ii) For separating magnetic substances such as iron and other metallic substances from metallic scrap. 3

Q. 9. In a three pin plug, the earth pin is thicker and longer than the live and the neutral pins. Why ? 3

Ans. The earth pin is thicker so that it does not enter into the live or neutral sockets. It is longer so that the earth connection is made first. This ensures the safety of the users. 3

Q. 10. The given figure shows a closed coil connected to a galvanometer G. The galvanometer shows a deflection to the right when N-pole of the bar magnet is brought closer to the coil AB.



(i) Why does the deflection occur in the galvanometer ? 1

(ii) State the observation when :

(a) the coil is moved away from N-pole

(b) both the coil and magnet are moved to the right with the same speed. 2

Ans. (i) As the magnet is moved closer to coil AB, the flux linked with the coil increases. This set up induced current in the coil as shown by deflection in the galvanometer.

(ii) (a) The direction of induced current in the coil AB is reversed and the galvanometer shows a deflection to the left.

(b) When both the magnet and the coil AB are moved towards right with the same speed, the flux linked with the coil does not change. No induced current is set up. Hence no deflection is shown by the galvanometer. 1

Value Based Questions

Q. 1. (a) Shruti draws magnetic field lines close to the axis of a current carrying circular loop. As she moves away from the centre of circular loop, she observes that the lines keep on diverging. Explain the reason for her observation.

(b) Write two properties of magnetic field lines.

[Board Term-I, Set (38), 2012] 3

Ans. (a) At every point of current carrying circular loop the concentric circles representing the magnetic field around it would become larger and larger as we move away from the wire because magnetic field becomes weaker at larger distance. **1**

(b) (i) The direction of magnetic field lines is from North to South outside the bar magnet and from South to North inside the magnet. **1**

(ii) They never intersect each other. **1**

[CBSE Marking Scheme, 2012]

Q. 2. Temporary magnets and permanent magnets play an important role in our day to day life. A magnet has the ability to attract the magnetic elements. Permanent magnets are made of carbon steel, chromium steel and some alloys like Alnico and Nipermag. Permanent magnets are used in many objects which are necessary for our lives. Magnets are used in junk yard to make new cars and in roller-coasters too.

(i) State the objectives for this observation.

(ii) Estimate the values of electromagnets used by people around you. 3

Ans. (i) Objectives :

To understand the need to have temporary and permanent magnets.

To understand the need to use different materials for making magnets. **1 + 1**

(ii) Uses of Electromagnets :

Used in electric bells, loudspeakers, electric motors, telephone diaphragms, electric fan and for sorting scrap metal and for extraction in hospitals, etc. **1**

Q. 3. Suddenly the news spread in the school that the fire had broken out in examination room. All the important papers and office documents were burnt. The reason for this mishap was short circuiting. What is short circuiting and what precautions can be taken to avoid such tragic incidents ? 3

Ans. Short-circuiting takes place if live wire and neutral wire come into direct contact due to damage of insulation of live wire.

Use fuse, connecting wire should be of good quality, wire should be properly insulated externally. **2**

Associated Value : The learners will become more educated to handle emergency situation like electric fire more carefully. **1**

Q. 4. One day science teacher was teaching in her class, one of her student was very sad. The teacher asked her the reason, the way she responded amazed the students in the class room. She told the teacher of the mishap which took place in her locality where four members of a family died, as they were trying to steal electricity by connecting the conducting wire with the live wire on the street.

Now do you think is this practice of electricity theft good, how does one's conscience allow it ?

What advice would you like to give to improve such mind set ? 3

Ans. No, electricity theft is not good. **1**

Proper connection, billing, safety measure can save both property and life which is more precious. **1**

Associated Value : The learners will be able to appreciate the role of being a responsible citizen and not to involve in any unlawful and risky events like electricity theft etc. **1**

Q. 4. In the birthday party of Bharat, his parents gave slinky to each friend as a return gift. The next day during the school, their teacher explained them about the production of magnetic fields using current carrying coils and also said that they can make permanent magnet using such coils by passing high current through them. Teacher also explained the uses of solenoid.

(a) What values did Bharat's parents exhibit towards his son ? [DDE 2017]

(b) What type of field is produced by solenoid ?

Ans. (a) Knowledge, Sharing and playing with studies.

(b) Magnetic Field. **1+1**

Know the Links

- *mycbseguide.com*
- *jsuniltutorial.weebly.com*
- *www.excellup.com*
- *www.learnnext.com*

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