13 Magnetic Effects of Electric Current

IMPORTANT NOTES

1. **Magnetic field:** The space surrounding a magnet in which its influence in the form of magnetic force can be detected, is called magnetic field.
2. When an electric current is passed through a conductor, then a magnetic field is produced around the conductor, i.e., the conductor behaves like a magnet, as long as the current flows through it.
3. **Ampere's swimming rule:** Imagine a swimmer, swimming in the direction of flow of current and always looking towards the needle, such that current enters from his feet and leaves from his head. The direction in which the left hand of the swimmer points, gives the direction of motion of the north pole of the magnetic needle.
4. **SNOW Rule:** The direction of motion of the north pole of the magnetic needle can be found out by the remembering the word SNOW, where S stands for south, N for north, O for over and W for west.
5. **Right hand thumb rule:** Imagine you are holding the conductor with the palm of your right hand, such that fingers encircle the conductor and the thumb points in the direction of the current. Then the direction of the fingers encircling the conductor, gives the direction of the magnetic lines of force around it.
6. **Solenoid:** An insulated copper wire wound on some cylindrical cardboard or plastic tube, such that its length is greater than its diameter and it behaves like a magnet when a current is made to flow through it, is called a solenoid.
7. **Electromagnet:** A solenoid which has an iron core within it is called electromagnet. The iron core intensifies the magnetic field of the solenoid, as iron gets magnetised due to magnetic induction.
8. **Fleming's left hand rule:** Stretch the thumb, the fore finger and the middle finger of your left hand mutually at right angles to each other, such that the forefinger points in the direction of the magnetic field and the middle finger in the direction of flow of current. Then thumb gives the direction of motion of conductor.
9. **Electric Motor:** An electric motor is a device which converts electric energy into mechanical energy.
10. **Commutator:** A rotating device which changes the direction of current after every half rotation is called the commutator.
11. **Fleming's right hand rule:** Stretch the palm of your right hand in such a way that the thumb, the fore finger and the middle finger are mutually at right angles to each other. Now point the thumb in the direction of motion of the conductor and fore finger in the direction of the magnetic field. Then the direction of the middle finger gives the direction of the induced current.
12. **Electromagnetic Induction:** The phenomenon due to which a changing magnetic field within a conductor or closed coil induces electric current in the conductor or a coil is called electromagnetic induction.
13. **Induced current:** The alternating current produced in a conductor or a closed coil, when the magnetic lines of force rapidly change in it, is called the induced current. Induced current is always alternating in nature.
14. **Lenz's law:** It states "In all cases of electromagnetic induction, the direction of induced current is such that it always opposes the cause (the motion of the conductor) which produces it."
15. **Mutual Induction:** The phenomenon of production of induced e.m.f. in a closed coil, by varying the magnetic flux in another coil is called mutual induction.
16. **Alternating current:** An electric current in which the direction of current changes after equal intervals of time is called alternating current (AC). The electric current supplied for domestic or industrial use is alternating current.
17. **Electric generator:** It is based on the phenomenon of electromagnetic induction. It converts mechanical energy to electric energy.

18. Household wiring is done in parallel. It is provided with safety devices such as fuse and earthing.

19. Electricity for domestic purposes is supplied at 220 V and 50 Hz. Commercial electricity is supplied at 440 V and 50 Hz.

ASSIGNMENTS FOR SUMMATIVE ASSESSMENT

I. VERY SHORT ANSWER QUESTIONS (1 Mark)

A. IMPORTANT QUESTIONS

1. In which direction a freely suspended magnetic needle points?

2. Why does a freely suspended magnetic needle point in north-south direction?

3. What is the south pole of a bar magnet?

4. State two properties of the poles of a bar magnet.

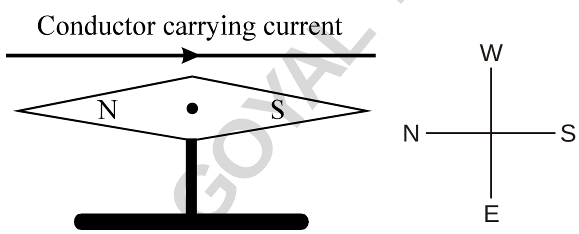
5. What do you understand by the term magnetic field of a bar magnet?

6. What is magnetic field line?

7. Name the physicist who discovered the magnetic effect of the electric current.

8. A straight copper conductor is held parallel to the axis of a freely suspended magnetic needle such that the conductor is under the needle and the current is flowing from south to north. In which direction the north of magnetic needle will move?

9.



In the diagram above, in which direction will the north pole of magnetic needle deflect?

10. If a copper conductor carrying a current is held in north-south direction, in which direction will its magnetic field act?

11. Define Ampere's swimming rule to determine the direction of motion of a freely suspended magnetic needle.

12. A circular coil carrying current is held in horizontal plane. In which direction will its magnetic field be?

13. What is solenoid?

14. Imagine you are facing one end of a solenoid, such that the current flowing through it is in the clockwise direction. What kind of magnetic polarity is produced at the end facing you?

15. How is the intensity of magnetic field around a solenoid going to change, if the magnitude of current in it is increased.

16. The number of turns in a solenoid are increased five times, without any increase in current. How is its magnetic intensity affected?

17. What is an electromagnet?

18. Why does the strength of electromagnet increase, when its soft iron core is laminated?

19. State one use of electromagnet in medicine.

20. State one use of electromagnet in industry.

21. Why does a conductor carrying current experiences force when held in a magnetic field at right angles to it?

22. In the statement of Fleming's left hand rule what do the following represent :

(a) direction of forefinger

(b) direction of middle finger

23. What do you understand by the term induced current?

24. Name the physicist who discovered electromagnetic induction.

25. Is the induced current alternating or direct in nature?

26. What do you understand by the term electric generator?

27. What energy changes take place in an electric generator?

28. What do you understand by the term alternating current?

29. What do you understand by the term direct current?

30. Name a device which produce : (i) alternating current, (ii) direct current.

31. What do you understand by the term electric fuse?

32. Name two metals used in making an electric fuse wire.

33. What do you understand by the term short circuiting in an electric circuit?

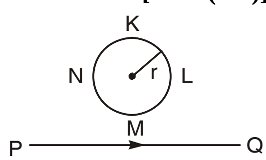
34. What do you understand by the term overloading in an electric circuit?

B. QUESTIONS FROM CBSE EXAMINATION PAPERS

1. What does the direction of thumb indicate in the right-hand thumb rule? **[2010 (T-1)]**

2. What is the frequency of alternating current in India? **[2010 (T-1)]**

3. What is the magnitude of induced current in the circular loop KLMN, of radius '*r*', if the straight wire PQ carries a steady current of magnitude '*i*' ampere? **[2008]**



4. How will you use a solenoid to magnetise a steel bar? **[2006]**

5. An alternating electric current has a frequency of 50 Hz. How many times does it change its direction in one second? **[2004]**

II. SHORT ANSWER QUESTIONS–I (2 Marks)

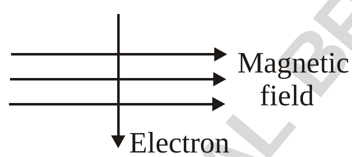
A. IMPORTANT QUESTIONS

1. An electron enters a magnetic field at right angles to it as shown in diagram. The direction of force acting on the electron will be :

(a) to the right (b) to the left

(c) out of page (d) into the page

Give a reason for your choice.



2.

The diagram above shows a conductor carrying current.

(i) By drawing diagram show the direction of magnetic field around the conductor.

(ii) Name the rule which helped you to find the direction of magnetic lines of force.

3. A thick copper wire is passed through a hole in a cardboard held in the horizontal plane, such that the current moves in the copper wire in the upward direction. Plot four magnetic lines of force around the conductor by drawing a neat diagram and show clearly the direction of magnetic lines of force.

4. A straight conductor passes vertically downward through a cardboard on which are sprinkled grains of fine iron powder. What will you observe when:

(i) a weak current is passed through the conductor?

(ii) a strong current is passed through the conductor?

5. How will you find the magnetic polarity at the ends of solenoid, without using a magnetic compass?

6. How will you locate a current carrying wire concealed in a wall?

7. Mention two factors which determine the strength of an electromagnet.

8. If the current in a freely suspended conductor is flowing vertically downward, such that magnetic field is in north-south direction, then in which direction the conductor will move? Name the rule which helped you to answer this question.

9. Fleming stated two laws involving left hand and right hand. Which law is applicable when:

(i) electrical energy changes into mechanical energy?

(ii) mechanical energy changes into electrical energy?

10. (i) What is the nature of electric current produced in the coil of any electric generator?
(ii) Draw a diagram to represent the current named by you.

11. Why does a freely suspended magnet always point in north-south direction?

12. State two desirable properties of a fuse wire.

13. Two fuse wires of same length are rated 15A and 5A. Which of the two fuse wires will be thicker and why?

14. How does the earthing protect user from getting electric shock?

15. Why is the earth terminal in a plug made : (i) thicker (ii) longer as compared to live or neutral terminals?

B. QUESTIONS FROM CBSE EXAMINATION PAPERS

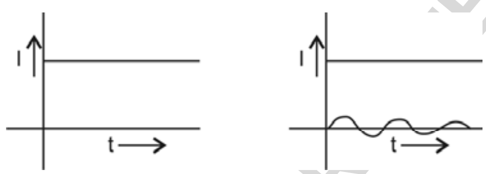
1. In what situation do we use Fleming's right-hand rule? **[2010 (T-I)]**

2. What will be the frequency of an alternating current, if its direction changes after every 0.01 s? **[2010 (T-I)]**

3. What is a solenoid? Draw the pattern of magnetic field lines of a solenoid through which a steady current flows. **[2010 (T-I)]**

4. Draw the pattern of magnetic lines of the field produced by a current carrying circular loop. **[2010 (T-I)]**

5. You are given following current (I)-time (t) graphs from the sources **[2010 (T-I)]**



(a) Name the type of current in each case.
(b) Identify one source for each of these currents.

6. Identify the poles of the magnet in the given figure (1) and (2) **[2010 (T-I)]**

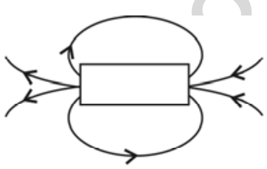


Figure-1


Figure-2

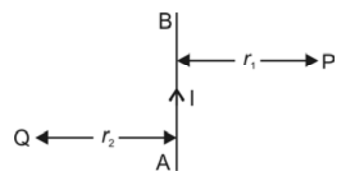
7. What are permanent magnet and electromagnet? Give two uses of each. **[2010 (T-I)]**

8. Describe an activity to draw the magnetic field produced around a current carrying conductor. **[2010 (T-I)]**

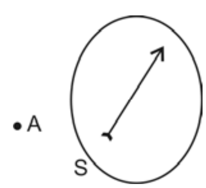
9. Explain briefly different methods of producing induced emf. **[2010 (T-I)]**

10. 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. **[2010 (T-I)]**

11. AB is a current carrying conductor in the plane of the paper as shown in figure. What are the directions of magnetic field produced by it at points P and Q? Given $r_1 > r_2$, where will the strength of the magnetic field be larger? **[2010 (T-I)]**



12. A magnetic compass needle is placed in the plane of paper near point A as shown in the figure. In which plane should a straight current carrying conductor be placed so that it passes through A and there is no change in the deflection of the compass? Under what condition is the deflection maximum and why? **[2010 (T-I)]**



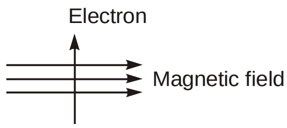
13. No two magnetic field lines can intersect each other. Explain. **[2010 (T-I)]**

14. Two circular coils A and B are placed close to each other. If the current in the coil A is changed, will some current be induced in the coil B? Give reasons. **[2010 (T-I)]**

15. What is meant by the term magnetic field lines? List any two properties of magnetic field lines. **[2010 (T-I)]**

16. Explain different ways to induce current in a coil. **[2010 (T-I)]**

17. An electron enters a uniform magnetic field at right angles to it as shown in the figure below. In which direction will this electron move? State the rule applied by you in finding the direction of motion of the electron. **[2010 (T-I)]**

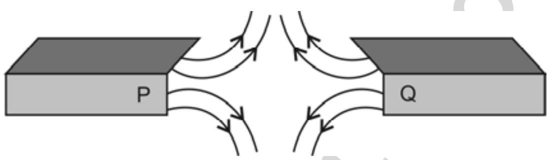


18. Write four properties of magnetic lines of force. **[2010 (T-I)]**

19. A student performs an experiment to study the magnetic effects of current around a current carrying straight conductor with the help of a magnetic compass. He reports that: **[2010 (T-I)]**
    (i) the degree of deflection of the magnetic compass increases when the compass is moved away from the conductor.
    (ii) the degree of deflection of the magnetic compass increases when the current through the conductor is increased.

    Which of the above observations of the student appears to be wrong and why?

20. In the figure below, identify the poles marked P and Q as North Pole or South Pole. Give reason for your answer. **[2010 (T-I)]**



21. A student, while studying the force experienced by a current carrying conductor in a magnetic field records the following observations: **[2010 (T-I)]**
    (i) The force experienced by the conductor increases as the current is increased.
    (ii) The force experienced by the conductor decreases as the strength of the magnetic field is increased.

    Which of the two observations is correct and why?

22. A coil of insulated wire is connected to a galvanometer. What would be seen if a bar magnet with its south pole towards one face of the coil is: **[2010 (T-I)]**
    (a) moved quickly towards it?
    (b) moved quickly away from it?
    (c) placed near its one face?
    (d) Name the phenomena involved.

23. How does the strength of the magnetic field at the centre of a circular coil of a wire depend on **[2010 (T-I)]**
    (a) radius of the coil
    (b) number of turns of wire in the coil

24. State Fleming's left hand rule. A positively charged particle projected towards West is deflected towards North by a magnetic field. Find the direction of magnetic field.

25. How can it be shown that a magnetic field exists around a wire through which a direct electric current is passing? **[2004]**

26. Under what conditions does a moving charge experience : (i) maximum force; (ii) minimum force? **[2001]**

III. SHORT ANSWER QUESTIONS-II (3 Marks)

A. IMPORTANT QUESTIONS

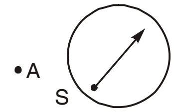
1. How does the magnetic field set up by a solenoid change when:
   (i) the number of turns of the coil are increased?
   (ii) the strength of current is increased?
   (iii) soft iron core is inserted within the coil?
2. State four practical uses of electromagnets.
3. Draw a rough sketch of pattern of field lines due to:
   (i) current flowing into a circular coil.
   (ii) solenoid carrying current.
4. (a) Why is fuse wire always placed in live wire?
   (b) How does a fuse wire protect an electric circuit?
5. (a) How is household circuit earthed?
   (b) Explain how the fuse melts when a short circuited appliance gets earthed?
6. (i) What is the function of an electric switch in an electric circuit?
   (ii) Why is the switch placed in the live wire, which is connected to an appliance?
   (iii) What consequences will follow, if the switch is placed in the neutral wire?
7. A straight copper conductor, whose ends are connected to a sensitive galvanometer, is moved up and down in a strong magnetic field.

(i) State your observations.

(ii) What is the nature of induced current generated in the conductor?

(iii) What kind of energy transformations take place in the above experiment?

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



9. It is established that an electric current through a metallic conductor produces a magnetic field around it. Is there a similar magnetic field produced around a thin beam of moving (i) alpha particles, (ii) neutrons? Justify your answer. **[HOTS]**

B. QUESTIONS FROM CBSE EXAMINATION PAPERS

1. (a) Describe an activity to draw a magnetic field line outside a bar magnet from one pole to another.

(b) List any two properties of magnetic field lines. **[2010 (T-I)]**

2. Explain two ways to induce current in a coil. When is the induced current produced highest? State the rule used to find direction of induced current. **[2010 (T-I)]**

3. (a) What are the factors on which the magnetic field produced by the current carrying circular coil depends?

(b) What happens if the current through the coil is reversed? **[2010 (T-I)]**

4. Describe an activity to draw the magnetic field line around a coil of wire. **[2010 (T-I)]**

5. Describe an activity to show how to magnetise an iron nail. **[2010 (T-I)]**

6. Why does a current carrying conductor kept in a magnetic field experience force? On what factors does the direction of this force depend? Name and state the rule used for determination of direction of this force. **[2010 (T-I)]**

7. (a) Swati draws magnetic field lines of field close to the 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?

(b) Write two properties of magnetic field lines. **[2010 (T-I)]**

8. What does the direction of thumb indicate in the right-hand thumb rule? In what way this rule is different from Fleming's left-hand rule? **[2010 (T-I)]**

9. What is meant by the 'magnetic field lines'? List any two properties of magnetic field lines? **[2010 (T-I)]**

10. What is a solenoid? Draw a diagram to show the magnetic field lines around a solenoid. What is its main use? **[2010 (T-I)]**

11. Give an activity to show magnetic field produced by a current carrying circular coil. **[2010 (T-I)]**

12. Explain the magnetic effects of current for Oersted's experiment with the help of labelled diagram. **[2010 (T-I)]**

13. State the rule to determine the direction of force experienced by a current carrying conductor in a magnetic field. How will this force get affected on: **[2010 (T-I)]**

(i) doubling the magnitude of current?

(ii) reversing the direction of current flow?

14. Under what condition does a current carrying conductor kept in a magnetic field experience maximum force? On what other factors does the magnitude of this force depend? Name and state the rule used for determination of direction of this force. **[2010 (T-I)]**

15. A coil made of insulated copper wire is connected to a galvanometer. What will happen to the deflection of the galvanometer if a bar magnet is pushed into the coil and then pulled out of it? Give reason for your answer and name the phenomenon involved. **[2010 (T-I)]**

16. How will the magnetic field produced in a current carrying a circular coil change if we

(i) increase the value of current,

(ii) increase the distance from the coil,

(iii) increase the number of turns of the coil? **[2010 (T-I)]**

17. What happens to the deflection of the compass needle placed at a point near current carrying straight conductor **[2010 (T-I)]**

(a) if the current is increased,

(b) if the direction of current in the conductor is changed,

(c) if compass is moved away from the conductor?

18. State Fleming's Right hand rule. Give one application of this rule. What is SI unit of induced current? **[2010 (T-I)]**

19. Draw a figure of current carrying solenoid and show magnetic field lines inside and outside it. Compare the pattern of the field with the magnetic field around a bar magnet. **[2010 (T-I)]**

20. When is an electric circuit said to be over loaded? State two measures to avoid it. What name is given to a situation in which the live and the neutral wires accidently come in contact? State the role of a safety device in this situation. **[2009]**

21. With the help of a neat diagram describe how you can generate induced current in a circuit. **[2009]**

22. 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. **[2009]**

23. What is an electric fuse? What result do you expect if someone operates an electric heater of power rating 2 kW, 220 V in a domestic electric circuit. What has a fuse of current rating of 5A? Justify your answer. **[2009]**

24. Describe an activity to show how you can make an electromagnet in your school laboratory. **[2009]**

25. Draw a diagram to show how a magnetic needle deflects when it is placed above or below a straight conductor carrying current depending on the direction of the current in the conductor.

IV. LONG ANSWER QUESTIONS (5 Marks)

A. IMPORTANT QUESTIONS

1. (i) A straight conductor carries a current as shown in diagram. What is the direction of magnetic field lines around the conductor?

(ii) State the law which helped you to find the direction of magnetic field lines.

(iii) On what factors does the force experienced by a current carrying conductor placed in a uniform magnetic field depends?

2. A powerful bar magnet is moved within the closed coil, which is connected to a sensitive galvanometer. The magnet is initially moved slowly and then rapidly in and out of the coil. It is observed that galvanometer needle moves from one side to the other and the deflection increases with the increase in the movement of magnet. Furthermore, if the motion of magnet is stopped the galvanometer shows no deflection. State five conclusions which you can draw from the above experiment.

3. Why does a magnetic compass needle pointing North and South in the absence of a nearby magnet get deflected when a bar magnet or a current carrying loop is brought near it? Describe some salient features of magnetic lines of field concept. **[HOTS]**

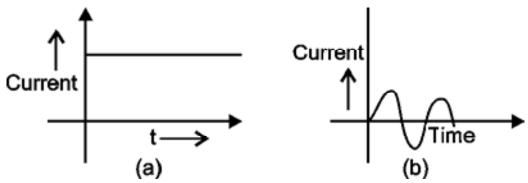
4. Explain with the help of a labelled diagram the distribution of magnetic field due to a current through a circular loop. Why is it that if a current carrying coil has *n* turns the field produced at any point is *n* times as large as that produced by a single turn? **[HOTS]**

5. Draw an appropriate schematic diagram showing common domestic circuits and discuss the importance of fuse. Why is it that a burnt out fuse should be replaced by another fuse of identical rating? **[HOTS]**

B. QUESTIONS FROM CBSE EXAMINATION PAPERS

1. Describe in short, 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 associated with a current carrying conductor. Apply this rule to determine the direction of the magnetic field inside and outside a current carrying circular loop lying horizontally on a table. Assume that the current through the loop in anticlockwise. **[2010 (T-I)]**

2. In our daily life we use two types of electric current whose current-time graphs are given below:



(i) Name the type of current in two cases.
(ii) Identify any one source for each type of current.
(iii) What is the frequency of current in case (b) in our country?
(iv) On the basis of these graphs, list two differences between the two currents.
(v) Out of the two which one is used in transmitting electric power over long distances and why? **[2010 (T-I)]**

3. (a) What is a solenoid?
(b) Draw the field lines of the magnetic field through and around a current carrying solenoid.
(c) Compare the field pattern with magnetic field around a bar magnet. **[2010 (T-I)]**

4. (a) Which rule helps to find the force on a current carrying conductor in a magnetic field?
(b) State the rule.
(c) Name the three factors on which the force on the current carrying conductor depends. **[2010 (T-I)]**

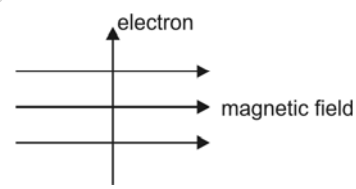
5. (a) Describe an experiment with a diagram to show that force is exerted on a current carrying conductor when placed perpendicular in a magnetic field.
(b) How will this force change if current in the conductor is increased?
(c) Name a device that uses the above principle. **[2010 (T-I)]**

6. (a) What is a solenoid? Draw the pattern of magnetic field lines around a current carrying solenoid.
(b) What is the pattern of field lines inside a solenoid? What do they indicate?
(c) How is the magnetic field produced in a solenoid used? **[2010 (T-I)]**

7. (a) What is electromagnetic induction?
(b) Explain the various methods of producing induced current.
(c) State the rule which gives the direction of induced current.
(d) Name two devices which work on the principle of electromagnetic induction. **[2010 (T-I)]**

8. (a) What are factors on which the magnetic field produced by a current carrying conductor depend?
(b) What happens to the magnetic field lines due to a current carrying conductor, when the current is reversed? State the rule which gives this direction and current. **[2010 (T-I)]**

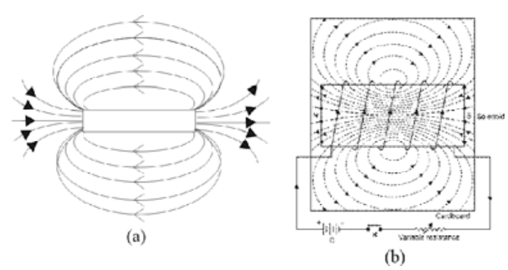
9. (a) Explain an activity to show that a current carrying conductor experiences a force when placed in a magnetic field.
(b) State the rule which gives the direction of force acting on the conductor.
(c) An electron moves perpendicular to a magnetic field as shown in the figure. What would be the direction of force experienced by the electron? **[2010 (T-I)]**

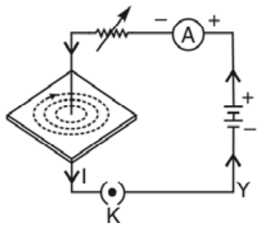


10. (a) What is a solenoid?
(b) Draw the pattern of magnetic field formed around a current carrying solenoid. Compare this field to that of a bar magnet.
(c) Explain what is short circuiting and over loading in electric supply? **[2010 (T-I)]**

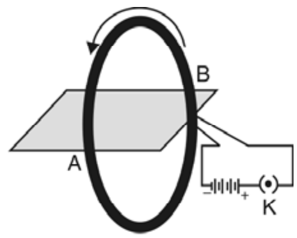
11. Describe the activity that shows that a current-carrying conductor experiences a force perpendicular to its length and the external magnetic field. How does Fleming's left-hand rule help us to find the direction of the force acting on the current carrying conductor? **[2010 (T-I)]**

12. Shown in the diagrams (a), (b), (c) and (d) are the magnetic fields around different systems. Identify them. Compare the patterns of the fields in all the four examples. Are they similar? Why? **[2010 (T-I)]**





(c)



(d)

13. Explain with the help of a labelled diagram the distribution of magnetic field due to a current through a circular loop. Why is it that if a current carrying coil has *n* turns, the field produced at any point is *n* times as large as that produced by a single turn? **[2010 (T-I)]**

14. Describe the activity that shows that a current-carrying conductor experiences a force perpendicular to its length and the external magnetic field. How does Fleming's left-hand rule help us to find the direction of the force acting on the current carrying conductor? **[2010 (T-I)]**

15. (a) A positively charged particle projected towards west is deflected towards north by a magnetic field. What is the direction of the magnetic field?

(b) Draw the magnetic field lines of the field produced due to a current carrying circular loop.

(c) State the law used to find the direction of magnetic field around a straight current carrying conductor. **[2010 (T-I)]**

16. (a) State Fleming's left hand rule with a labelled diagram. **[2010 (T-I)]**

(b) A coil of insulated copper wire is connected to a galvanometer. What happens if a bar magnet is

(i) pushed into the coil,
(ii) withdrawn from inside the coil,
(iii) held stationary inside the coil?

17. (a) Two circular coils A and B are placed closed to each other. If the current in the coil A is changed, will some current be induced in coil B? Give reason. **[2010 (T-I)]**

(b) State the rule to determine the direction of a:

(i) magnetic field produced around a straight conductor-carrying current.
(ii) force experienced by a current carrying straight conductor placed in a magnetic field, which is perpendicular to it.
(iii) current induced in a coil due to its rotation in a magnetic field.

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

19. What are magnetic field lines? How is the direction of a magnetic field at a point determined?

Draw the magnetic field lines (including field directions) of the magnetic field due to a circular coil of current. Name any two factors on which the magnitude of the magnetic field due to this coil depends. **[2010 (T-I)]**

20. Give any two properties of magnetic field lines.

Draw the magnetic field lines (including field directions) of the magnetic field due to a long straight solenoid. Name any two factors on which the magnitude of the magnetic field due to this solenoid depends. **[2010 (T-I)]**

21. (i) Two circular coils P and Q are kept close to each other, of which coil P carries a current. If coil P is moved towards Q, will some current be induced in coil Q? Give reason for your answer and name the phenomenon involved.

(ii) What happens if coil P is moved away from Q?

(iii) Briefly explain any two methods of inducing current in a coil. **[2010 (T-I)]**

22. (i) With the help of an activity, explain the method of inducing electric current in a coil with moving magnets. State the rule to find the direction of electric current thus generated in the coil.

(ii) Two circular coils P and Q are kept close to each other, of which coil P carries a current. What will you observe in Q,

(a) if current in the coil P is changed?
(b) if both the coils are moved in the same direction with the same speed? Give reason.

23. Briefly explain an activity to plot the magnetic field lines around a straight current carrying conductor. Sketch the field pattern for the same, specifying current and field directions.

What happens to this field, **[2010 (T-I)]**

(i) if the strength of the current is decreased?
(ii) if the direction of the current is reversed?

24. Briefly explain an activity to plot the magnetic field lines around a bar magnet. Sketch the field pattern for the same specifying field directions.

A region 'A' has magnetic field lines relatively closer than another region 'B'. Which region has stronger magnetic field? Give reason to support your answer.

25. (a) State the rule to determine the direction of

(i) magnetic field produced around a straight conductor carrying current.

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

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

(b) What is the function of an earth wire? Why is it necessary to earth metallic appliances?

26. Answer the following questions: **[2010 (T-I)]**

(i) What is the direction of magnetic field lines outside a bar-magent?

(ii) What is SI unit of magnetic field?

(iii) What does crowding of magnetic field lines indicate?

(iv) What is the frequency of A.C. in India?

(v) Name two organs in the human body where magnetic field is quite significant.

27. What is electromagnetic induction? Draw a schematic diagram showing electromagnetic induction by using two coils and explain the observations. **[2010 (T-I)]**

28. (a) Describe an activity to demonstrate the pattern of magnetic field lines around a straight conductor carrying current. **[2008]**

(b) State the rule to find the direction of magnetic field associated with a current carrying conductor.

(c) Two room heaters are marked 220 V, 500 W and 200 V, 800 W respectively. If the heaters are connected in parallel to 220 V mains supply, calculate

(i) the current drawn by each heater.

(ii) the resistance of each heater.

(iii) total electric energy consumed in commercial units if they operate simultaneously for 2 hours.

29. (a) State Fleming's Right Hand Rule.

(b) (i) Name the electric device that converts mechanical energy into electrical energy.

(ii) Write the principle involved in this device.

(c) An electric geyser of 2 kW rating is operated in a domestic circuit operating on 220V main supply that has a fuse of current rating of 5A. What will be the outcome? Explain. **[2008]**

30. (i) In which situation Fleming's left hand rule is applied? What does this rule determine?

(ii) How many times will the direction of current change in one second if its frequency is 50 Hz?

(iii) Under what conditions does a moving charge experience : (1) maximum force, (ii) minimum force?

(iv) How would the strength of magnetic field produced at the centre of circular loop be affected, if :

(1) the strength of current passing through the loop is doubled?

(2) the radius of this loop is reduced to one half of the original radius? **[2007]**

ASSIGNMENTS FOR FORMATIVE ASSESSMENT

A. Activities

1. Objective

To find how does a freely suspended magnet behave and to find the effect of magnet on a freely suspended magnet.

Materials required

A pair of powerful bar magnets, a stiff paper, thread, a wooden stand.

Procedure

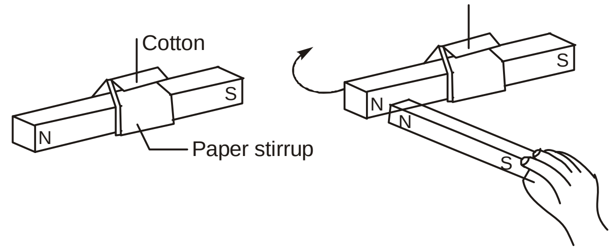


Fig. 1(a) **Fig. 1(b)**

1. Find out the direction of East from the rising sun. Knowing East, mark on the table E-W and N-S with the help of a chalk.
2. Make stirrup out of stiff paper and place one of the magnet in it.
3. Suspended the stirrup by a thread from a wooden stand.
4. Place the wooden stand in the middle of marked directions.
5. Note the direction in which the freely suspended magnet points.
6. Disturb the magnet and again allow it to come to rest. Again find the direction in which it points.
7. Mark the end of the magnet which points towards the north as N. Also mark the other end of magnet which points towards south as S.
8. Now bring the north pole of the second magnet close to the north pole of the suspended magnet. What is your observation?
9. Now bring the south pole of the second magnet close to the north pole of the suspended magent. What is your observation?

Having done the activity answer the following questions.

1. Why does the freely suspended magnet point in north-south direction?
2. What do you observe, when the north of the second magnet is brought near the north pole of suspended magnet?
3. What do you observe, when the south pole of the second magnet is brought near the north pole of suspended magnet?
4. Write three conclusions from the above activity.

2. Objective

Converting a piece of small steel bar into a magnet.

Materials required

Unmagnetised small steel bar, a strong bar magnet, a magnetic compass or freely suspended magnet needle and a bowl containing iron filings.

Procedure

1. Check that small steel bar is not already magnetised. This can be done by rolling it in the iron filings. If the iron filings do not stick to it, then it is not magnetised.

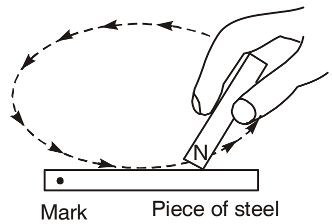


Fig. 2

2. Make a dot on one end of the steel bar with ink.
3. Place the north pole of bar magnet on the dot and rub it along the length of steel bar, lifting it up at the other end. Make at least 30 strokes as shown in figure in the same direction.
4. Place the marked end in the bowl in the iron filings. Find out how much iron filings it can lift.
5. Find the magnetic polarity of the marked end with help of magnetic compass, remembering, the like poles of a magnet always repel one another.
6. Write two conclusions which can be drawn from above activity.

3. Objective

To show that in umagnetised ferromagnetic substances (iron, cobalt, nickel and steel), the molecular magnets (or molecular domains) are arranged randomly. On being magnetised they align in one direction and hence a substance gets magnetised.

Materials required

Fine iron filings, a small glass test tube, a rubber cork, a strong bar magnet, a small magnetic compass, or a freely suspended magnetic needle.

Procedure

1. Fill the glass test tube completely with fine iron filings and insert a cork in it.

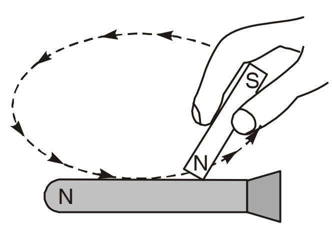


Fig. 3

2. Check that iron filings are not already magnetised by bringing the test tube close to the north pole and then south pole of the magnetic compass. If no repulsion takes place, it implies that iron filings are ummagnetised.
3. Place the glass test tube flat on the table. Stroke the glass test tube with a bar magnet at least 20 times as shown in figure. Make your observations regarding what happens inside the test tube. You will notice with every stroke the iron filings are

pulled along the bar magnet forming a sort of straight lines.

4. Find out which end of the test tube is north pole with the help of a magnetic compass.
5. Shake the test tube vigorously. Check the test tube for its magnetic properties. Is it demagnetised? If so, why?
6. State at least two conclusions from the above activity.

4. Objective

To plot the magnetic field with the help of fine iron filings (a) single bar magnet (b) two bar magnets, such that their opposite poles face each other (c) two bar magnets, such that their similar poles face each other.

Materials required

1. Fine iron filings filled in a sprinkler (same kind of sprinkler used for salt or pepper).
2. A fullscape white sheet of paper.
3. Two bar magnets.
4. Two thick and wide books of same thickness.

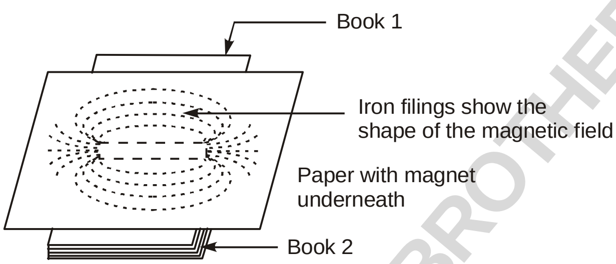


Fig. 4(a)

Procedure

1. Arrange the thick books in such a way that you get a flat smooth surface, wide enough for the fullscape white sheet of paper.

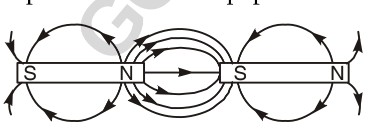


Fig. 4(b)

2. Make a small gap between the books and insert a bar magnet between the gap.

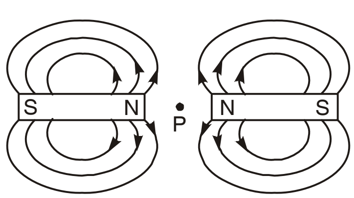
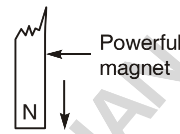


Fig. 4(c)

3. Spread the white sheet of paper on the books and secure it with cello tape.
4. Sprinkle iron filings all over the paper evenly.
5. Tap the paper gently. You will observe that iron filings act like thousands of tiny magnetic compasses and align themselves along the magnetic lines of force as shown in figure (4a).

   These lines come out of the magnet from the north pole and end up at south pole.



6. Now place two bar magnets in the gap between the books, such that north pole of one magnet is facing towards the south pole of other magnet as shown in figure 4(b). Repeat the activity again and observe the magnetic field.
7. Now place two bar magnets in the gap between the books, such that north poles of both magnets face each other as shown in figure 4(c). Repeat the activity again and observe the magnetic field.

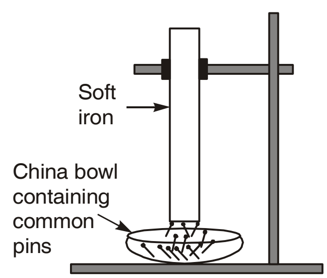


Fig. 5

In this case you will find that at point P, between the two north poles there are no iron filings. It is because there is no magnetic field at P. This is called **neutral point**.

5. Objective

To show soft iron and steel can be magnetised by induction and hence study the relative magnetic properties of iron and steel.

Materials required

(i) A piece of soft iron and a piece of steel of similar dimensions (ii) A powerful bar magnet (iii) A china bowl containing common pins (iv) a wooden stand.

Procedure

1. Fix the soft iron piece in a wooden stand in vertical position and place under it a china bowl containing common pins.

2. Adjust the height of soft iron piece, such that it is 1 cm above the common pins.
3. Now hold the powerful magnet 50 cm above the soft iron piece. Slowly bring the magnet towards soft iron piece, till it is very close to it.

   What do you observe?

   You will find as the magnet moves towards soft iron piece, the number of pins clinging to it goes on increasing.
4. Count the number of pins clinging to the soft iron, when the bar magnet is closest.
5. Now slowly move the bar magnet upward to the original height. What do you observe?

   You will find that pins start falling from the soft iron, till (at a height of 50 cm) no pin is clinging to it. From this observation, it implies that soft iron is completely demagnetised, i.e., it cannot retain magnetism.
6. Repeat the above activity using steel. You will observe that steel attracts less pins towards itself as compared to soft iron. When the magnet is moved away from the steel all pins donot fall. Few pins continue clinging to it. From this it implies that steel gets permanently magnetised, i.e., it can retain magnetism.

Conclusions

1. Both soft iron and steel acquire magnetic properties when held near a powerful magnet. This process of magnetisation is called magnetic induction.
2. The magnetic induction in soft iron or steel increases with the decrease in distance between them and the bar magnet.

Question 1:

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

Answer:

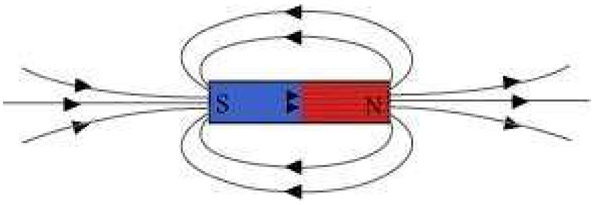
A compass needle is a small bar magnet. When it is brought near a bar magnet, its magnetic field lines interact with that of the bar magnet. Hence, a compass needle shows a deflection when brought near the bar magnet.

Question 1:

Draw magnetic field lines around a bar magnet.

Answer:

Magnetic field lines of a bar magnet emerge from the north pole and terminate at the south pole. Inside the magnet, the field lines emerge from the south pole and terminate at the north pole, as shown in the given figure.



Question 2:

List the properties of magnetic lines of force.

Answer:

The properties of magnetic lines of force are as follows.

(a) Magnetic field lines emerge from the north pole.

(b) They merge at the south pole.

(c) The direction of field lines inside the magnet is from the south pole to the north pole.

(d) Magnetic lines do not intersect with each other.

Question 3:

Why don't two magnetic lines of force intersect each other?

Answer:

If two field lines of a magnet intersect, then at the point of intersection, the compass needle points in two different directions. This is not possible. Hence, two field lines do not intersect each other.

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Question 1:

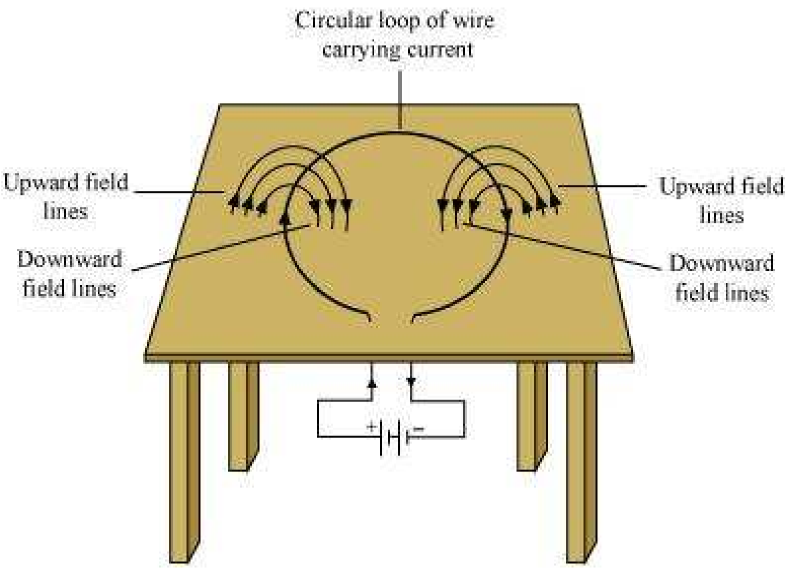
Consider a circular loop of wire lying in the plane of the table. Let the current pass through the loop clockwise. Apply the right-hand rule to find out the direction of the magnetic field inside and outside the loop.

Answer:

Inside the loop = Pierce inside the table

Outside the loop = Appear to emerge out from the table

For downward direction of current flowing in the circular loop, the direction of magnetic field lines will be as if they are emerging from the table outside the loop and merging in the table inside the loop. Similarly, for upward direction of current flowing in the circular loop, the direction of magnetic field lines will be as if they are emerging from the table outside the loop and merging in the table inside the loop, as shown in the given figure.



Question 3:

How much energy is given to each coulomb of charge passing through a 6 V battery?

Answer:

The energy given to each coulomb of charge is equal to the amount of work required to move it. The amount of work is given by the expression,

Potential difference = $\frac{\text{Work done}}{\text{Charge}}$

$\text{Work Done} = \text{Potential Difference} \times \text{Charge}$

Where,

Charge = 1 C

Potential difference = 6 V

$\text{Work Done} = 6 \times 1 = 6\ \text{J}$

Therefore, 6 J of energy is given to each coulomb of charge passing through a battery of 6 V.

Question 3:

Choose the correct option.

The magnetic field inside a long straight solenoid-carrying current

(a) is zero

(b) decreases as we move towards its end

(c) increases as we move towards its end

(d) is the same at all points

Answer:

(d)The magnetic field inside a long, straight, current-carrying solenoid is uniform. It is the same at all points inside the solenoid.

Question 1:

Which of the following property of a proton can change while it moves freely in a magnetic field? (There may be more than one correct answer.)

(a) mass

(b) speed

(c) velocity

(d) momentum

Answer:

(c) and (d)

When a proton enters in a region of magnetic field, it experiences a magnetic force. As a result of the force, the path of the proton becomes circular. Hence, its velocity and momentum change.

Question 2:

In Activity 13.7 (page: 230), how do we think the displacement of rod AB will be affected if (i) current in rod AB is increased: (ii) a stronger horse-shoe magnet is used: and (iii) length of the rod AB is increased?

Answer:

A current-carrying conductor placed in a magnetic field experiences a force. The magnitude of force increases with the amount of current, strength of the magnetic field, and the length of the conductor. Hence, the magnetic force exerted on rod AB and its deflection will increase if

(i) current in rod AB is increased

(ii) a stronger horse-shoe magnet is used

(iii) length of rod AB is increased

Question 3:

A positively-charged particle (alpha-particle) projected towards west is deflected towards north by a magnetic field. The direction of magnetic field is

(a) towards south (b) towards east

(c) downward (d) upward

Answer:

(d) The direction of the magnetic field can be determined by the Fleming’s left hand rule. According this rule, if we arrange the thumb, the centre finger, and the forefinger of the left hand at right angles to each other, then the thumb points towards the direction of the magnetic force, the centre finger gives the direction of current, and the forefinger points in the direction of magnetic field. Since the direction of positively charged alpha particle is towards west, the direction of current will be the same i.e., towards west. Again, the direction of magnetic force is towards north. Hence, according to Fleming's left hand rule, the direction of magnetic field will be upwards.

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Question 1:

State Fleming's left-hand rule.

Answer:

Fleming's left hand rule states that if we arrange the thumb, the centre finger, and the forefinger of the left hand at right angles to each other, then the thumb points towards the direction of the magnetic force, the centre finger gives the direction of current, and the forefinger points in the direction of magnetic field.

Question 2:

What is the principle of an electric motor?

Answer:

The working principle of an electric motor is based on the magnetic effect of current. A current-carrying loop experiences a force and rotates when placed in a magnetic field. The direction of rotation of the loop is given by the Fleming's left-hand rule.

Question 3:

What is the role of the split ring in an electric motor?

Answer:

The split ring in the electric motor acts as a commutator. The commutator reverses the direction of current flowing through the coil after each half rotation of the coil. Due to this reversal of the current, the coil continues to rotate in the same direction.

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Question 1:

Explain different ways to induce current in a coil.

Answer:

The different ways to induce current in a coil are as follows:

(a) If a coil is moved rapidly between the two poles of a horse-shoe magnet, then an electric current is induced in the coil.

(b) If a magnet is moved relative to a coil, then an electric current is induced in the coil.

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Question 1:

State the principle of an electric generator.

Answer:

An electric generator works on the principle of electromagnetic induction. It generates electricity by rotating a coil in a magnetic field.

Question 2:

Name some sources of direct current.

Answer:

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

Question 3:

Which sources produce alternating current?

Answer:

AC generators, power plants, etc., produce alternating current.

Question 4:

Choose the correct option.

A rectangular coil of copper wires is rotated in a magnetic field. The direction of the induced current changes once in each

(a) two revolutions (b) one revolution

(c) half revolution (d) one-fourth revolution

Answer:

(c) When a rectangular coil of copper is rotated in a magnetic field, the direction of the induced current in the coil changes once in each half revolution. As a result, the direction of current in the coil remains the same.

Question 1:

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

Answer:

Two safety measures commonly used in electric circuits and appliances are as follows:

(i) Each circuit must be connected with an electric fuse. This prevents the flow of excessive current through the circuit. When the current passing through the wire exceeds the maximum limit of the fuse element, the fuse melts to stop the flow of current through that circuit, hence protecting the appliances connected to the circuit.

(ii) Earthing is a must to prevent electric shocks. Any leakage of current in an electric appliance is transferred to the ground and people using the appliance do not get the shock.

Question 2:

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

Answer:

Current drawn by the electric oven can be obtained by the expression,

$P = VI$

$$I = \frac{P}{V}$$

Where,

Current = I

Power of the oven, P = 2 kW = 2000 W

Voltage supplied, V = 220 V

$$I = \frac{2000}{220} = 9.09 \text{ A}$$

Hence, the current drawn by the electric oven is 9.09 A, which exceeds the safe limit of the circuit. Fuse element of the electric fuse will melt and break the circuit.

Question 3:

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

Answer:

The precautions that should be taken to avoid the overloading of domestic circuits are as follows:

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

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(b) Too many appliances should not be used at the same time.

(c) Faulty appliances should not be connected in the circuit.

(d) Fuse should be connected in the circuit.

Question 1:

Which of the following correctly describes the magnetic field near a long straight wire?

(a) The field consists of straight lines perpendicular to the wire

(b) The field consists of straight lines parallel to the wire

(c) The field consists of radial lines originating from the wire

(d) The field consists of concentric circles centred on the wire

Answer:

(d) The magnetic field lines, produced around a straight current-carrying conductor, are concentric circles. Their centres lie on the wire.

Question 2:

The phenomenon of electromagnetic induction is

(a) the process of charging a body

(b) the process of generating magnetic field due to a current passing through a coil

(c) producing induced current in a coil due to relative motion between a magnet and the coil

(d) the process of rotating a coil of an electric motor

Answer:

(c) When a straight coil and a magnet are moved relative to each other, a current is induced in the coil. This phenomenon is known as electromagnetic induction.

Question 3:

The device used for producing electric current is called a

(a) generator

(b) galvanometer

(c) ammeter

(d) motor

Answer:

(a) An electric generator produces electric current. It converts mechanical energy into electricity.

Question 4:

The essential difference between an AC generator and a DC generator is that

(a) AC generator has an electromagnet while a DC generator has permanent magnet.

(b) DC generator will generate a higher voltage.

(c) AC generator will generate a higher voltage.

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(d) AC generator has slip rings while the DC generator has a commutator.

Answer:

(d) An AC generator has two rings called slip rings. A DC generator has two half rings called commutator. This is the main difference between both the types of generators.

Question 5:

At the time of short circuit, the current in the circuit

(a) reduces substantially

(b) does not change

(c) increases heavily

(d) vary continuously

Answer:

(c) When two naked wires of an electric circuit touch each other, the amount of current that is flowing in the circuit increases abruptly. This causes short-circuit.

Question 6:

State whether the following statements are true or false.

(a) An electric motor converts mechanical energy into electrical energy.

(b) An electric generator works on the principle of electromagnetic induction.

(c) The field at the centre of a long circular coil carrying current will be parallel straight lines.

(d) A wire with a green insulation is usually the live wire of an electric supply.

Answer:

(a) False

An electric motor converts electrical energy into mechanical energy.

(b) True

A generator is an electric device that generates electricity by rotating a coil in a magnetic field. It works on the principle of electromagnetic induction.

(c) True

A long circular coil is a long solenoid. The magnetic field lines inside the solenoid are parallel lines.

(d) False

Live wire has red insulation cover, whereas earth wire has green insulation colour in the domestic circuits.

Question 7:

List three sources of magnetic fields.

Answer:

Three sources of magnetic fields are as follows:

(a) Current-carrying conductors

(b) Permanent magnets

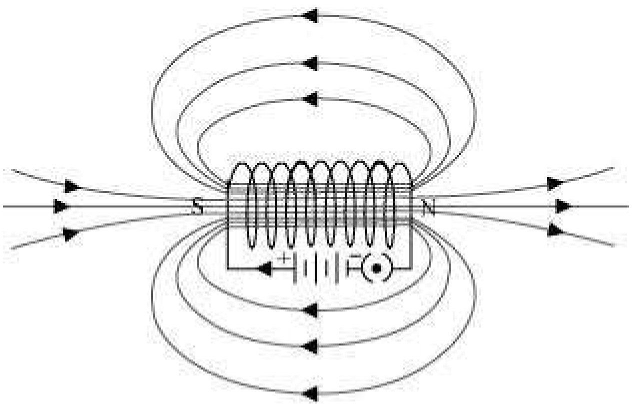
(c) Electromagnets

Question 8:

How does a solenoid behave like a magnet? Can you determine the north and south poles of a current-carrying solenoid with the help of a bar magnet? Explain.

Answer:

A solenoid is a long coil of circular loops of insulated copper wire. Magnetic field lines are produced around the solenoid when a current is allowed to flow through it. The magnetic field produced by it is similar to the magnetic field of a bar magnet. The field lines produced in a current-carrying solenoid is shown in the following figure.



In the above figure, when the north pole of a bar magnet is brought near the end connected to the negative terminal of the battery, the solenoid repels the bar magnet. Since like poles repel each other, the end connected to the negative terminal of the battery behaves as the north pole of the solenoid and the other end behaves as a south pole. Hence, one end of the solenoid behaves as a north pole and the other end behaves as a south pole.

Question 9:

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

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Answer:

The force experienced by a current-currying conductor is the maximum when the direction of current is perpendicular to the direction of the magnetic field.

Question 10:

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?

Answer:

The direction of magnetic field is given by Fleming's left hand rule. Magnetic field inside the chamber will be perpendicular to the direction of current (opposite to the direction of electron) and direction of deflection/force i.e., either upward or downward. The direction of current is from the front wall to the back wall because negatively charged electrons are moving from back wall to the front wall. The direction of magnetic force is rightward. Hence, using Fleming's left hand rule, it can be concluded that the direction of magnetic field inside the chamber is downward.

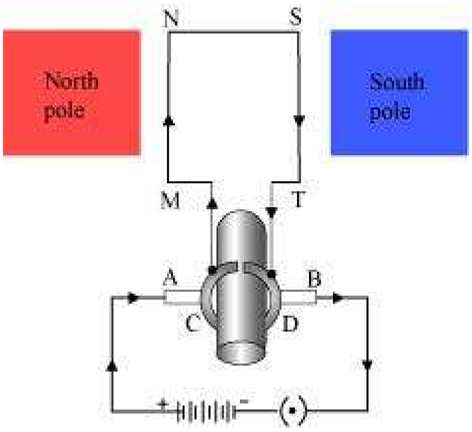
Question 11:

Draw a labelled diagram of an electric motor. Explain its principle and working. What is the function of a split ring in an electric motor?

Answer:

An electric motor converts electrical energy into mechanical energy.

It works on the principle of the magnetic effect of current. A current-carrying coil rotates in a magnetic field. The following figure shows a simple electric motor.



When a current is allowed to flow through the coil MNST by closing the switch, the coil starts rotating anti-clockwise. This happens because a downward force acts on length MN

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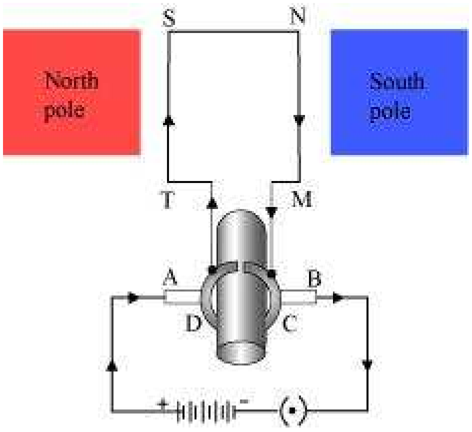
and at the same time, an upward force acts on length ST. As a result, the coil rotates anti-clockwise.

Current in the length MN flows from M to N and the magnetic field acts from left to right, normal to length MN. Therefore, according to Fleming's left hand rule, a downward force acts on the length MN. Similarly, current in the length ST flows from S to T and the magnetic field acts from left to right, normal to the flow of current. Therefore, an upward force acts on the length ST. These two forces cause the coil to rotate anti-clockwise.

After half a rotation, the position of MN and ST interchange. The half-ring **D** comes in contact with brush **A** and half-ring **C** comes in contact with brush **B**. Hence, the direction of current in the coil MNST gets reversed.



The current flows through the coil in the direction TSNM. The reversal of current through the coil MNST repeats after each half rotation. As a result, the coil rotates unidirectional. The split rings help to reverse the direction of current in the circuit. These are called the commutator.

Question 12:

Name some devices in which electric motors are used?

Answer:

Some devices in which electric motors are used are as follows:

(a) Water pumps

(b) Electric fans

(c) Electric mixers

(d) Washing machines

Question 13:

A coil of insulated copper wire is connected to a galvanometer. What will happen if a bar magnet is (i) pushed into the coil, (ii) withdrawn from inside the coil, (iii) held stationary inside the coil?

Answer:

A current induces in a solenoid if a bar magnet is moved relative to it. This is the principle of electromagnetic induction.

(i) When a bar magnet is pushed into a coil of insulated copper wire, a current is induced momentarily in the coil. As a result, the needle of the galvanometer deflects momentarily in a particular direction.

(ii) When the bar magnet is withdrawn from inside the coil of the insulated copper wire, a current is again induced momentarily in the coil in the opposite direction. As a result, the needle of the galvanometer deflects momentarily in the opposite direction.

(iii) When a bar magnet is held stationary inside the coil, no current will be induced in the coil. Hence, galvanometer will show no deflection.

Question 14:

Two circular coils A and B are placed closed to each other. If the current in the coil A is changed, will some current be induced in the coil B? Give reason.

Answer:

Two circular coils **A** and **B** are placed close to each other. When the current in coil **A** is changed, the magnetic field associated with it also changes. As a result, the magnetic field around coil **B** also changes. This change in magnetic field lines around coil **B** induces an electric current in it. This is called electromagnetic induction.

Question 15:

State the rule to determine the direction of a (i) magnetic field produced around a straight conductor-carrying current, (ii) force experienced by a current-carrying straight conductor placed in a magnetic field which is perpendicular to it, and (iii) current induced in a coil due to its rotation in a magnetic field.

Answer:

(i) Maxwell’s right hand thumb rule

(ii) Fleming’s left hand rule

(iii) Fleming’s right hand rule

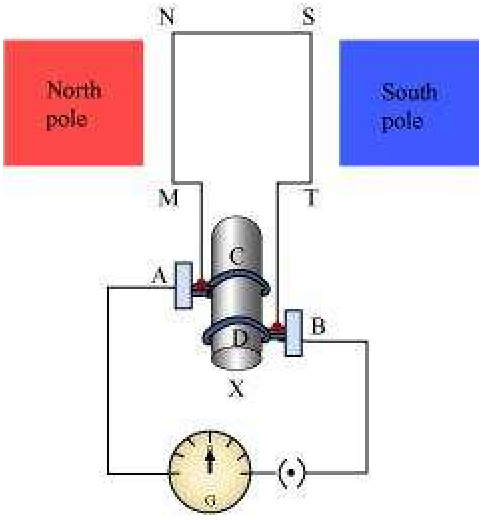
Question 16:

Explain the underlying principle and working of an electric generator by drawing a labelled diagram. What is the function of brushes?

Answer:

An electric generator converts mechanical energy into electrical energy.

The principle of working of an electric generator is that when a loop is moved in a magnetic field, an electric current is induced in the coil. It generates electricity by rotating a coil in a magnetic field. The following figure shows a simple AC generator.



MNST → Rectangular coil

A and **B** → Brushes

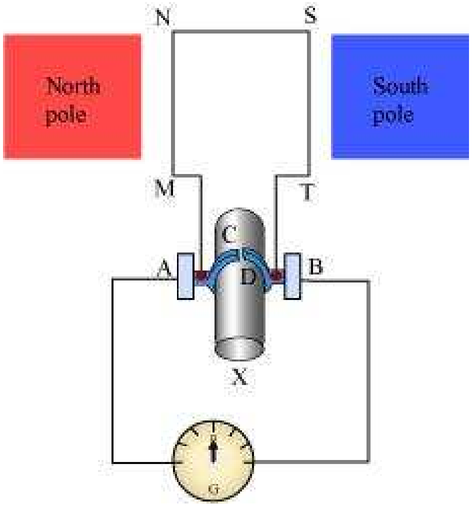
C and **D** → Two slip rings

X → Axle, **G** → Galvanometer

If axle **X**is rotated clockwise, then the length MN moves upwards while length ST moves downwards. Since the lengths MN and ST are moving in a magnetic field, a current will be induced in both of them due to electromagnetic induction. Length MN is moving upwards and the magnetic field acts from left to right. Hence, according to Fleming's right hand rule, the direction of induced current will be from M to N. Similarly, the direction of induced current in the length ST will be from S to T.

The direction of current in the coil is MNST. Hence, the galvanometer shows a deflection in a particular direction. After half a rotation, length MN starts moving down whereas length ST starts moving upward. The direction of the induced current in the coil gets reversed as TSNM. As the direction of current gets reversed after each half rotation, the produced current is called an alternating current (AC).

To get a unidirectional current, instead of two slip rings, two split rings are used, as shown in the following figure.



In this arrangement, brush **A** always remains in contact with the length of the coil that is moving up whereas brush **B** always remains in contact with the length that is moving down. The split rings **C** and **D** act as a commutator.

The direction of current induced in the coil will be MNST for the first rotation and TSNM in the second half of the rotation. Hence, a unidirectional current is produced from the generator called **DC** generator. The current is called AC current.

Question 17:

When does an electric short circuit occur?

Answer:

If the resistance of an electric circuit becomes very low, then the current flowing through the circuit becomes very high. This is caused by connecting too many appliances to a single socket or connecting high power rating appliances to the light circuits. This results in a short circuit.

When the insulation of live and neutral wires undergoes wear and tear and then touches each other, the current flowing in the circuit increases abruptly. Hence, a short circuit occurs.

Question 18:

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

Answer:

The metallic body of electric appliances is connected to the earth by means of earth wire so that any leakage of electric current is transferred to the ground. This prevents any electric shock to the user. That is why earthing of the electrical appliances is necessary.

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