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MAGNETIC EFFECTS OF ELECTRIC CURRENT

CHAPTER: 13

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science

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MAGNETIC EFFECTS OF ELECTRIC CURRENT

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Q1:- Why does a compass needle get deflected when brought near a bar magnet?

Ans: Compass needle is a tiny magnet, so, due to force of repulsion or attraction between the poles of a magnet, there is deflection in the compass needle.

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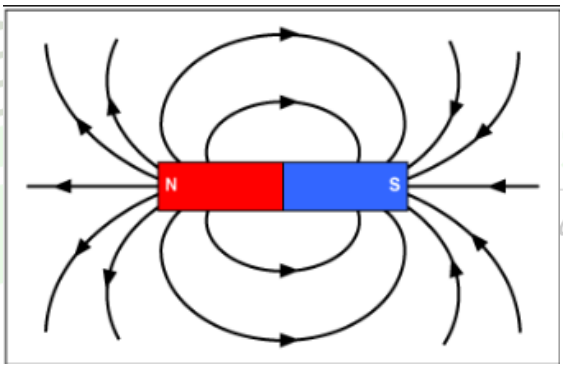
Q1:- Draw magnetic field lines around a bar magnet.

Ans:



Q2:- List the properties of magnetic field lines.

Ans: The magnetic field lines have the following properties:

a) These imaginary lines originate from the north pole and terminate at the south pole.
b) These lines are parallel to each other and do not intersect.
c) The direction of tangent at a point on a magnetic field line indicates the direction of magnetic field at that point.

Q3:- Why don't two magnetic field lines intersect each other?

Ans: Two magnetic lines of force cannot intersect because we cannot have two directions of the magnetic field at the same point.

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Q1:- 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.

Ans: On applying the right-hand rule to the current carrying wire, the direction of magnetic field inside and outside the loop is as shown in the figure below:

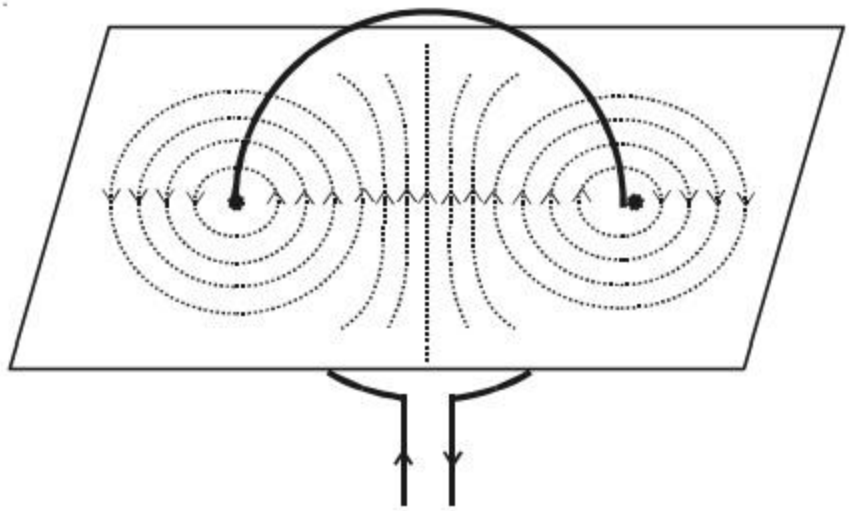

Fig 3.9 Magnetic field due to a circular loop carrying current

Q2:- The magnetic field in a given region is uniform. Draw a diagram to represent it.

Ans: The parallel magnetic field lines represent uniform magnetic field.

Uniform Magnetic Field Lines

Q3:- 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.

Ans: (d) is the same at all points.

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Q1:- 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

Ans: (c) and (d) both are correct.

Q2:- In Activity 13.7, 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?

Ans: We Know that when a current- carrying conductor is kept in a magnetic field the force

(i) Strength of force is increased with increase in current.
(ii) Strength of force is increased with increase in magnetic field.
(iii) Strength of force is increased with increase in the length of rod.

Q3:- 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

Ans: (d) upward

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Q1:- State Fleming's left-hand rule.

Ans: According to this rule, "stretch the forefinger, the middle finger and the thumb perpendicular to each other. If the forefinger gives the direction of the magnetic field and the middle finger the direction of current, then the thumb will give the direction of the force experienced by the current, carrying conductor.

Q2:- What is the principle of an electric motor?

Ans: It is based on the principle that when a current carrying coil is placed in the magnetic field it experiences a torque according to the rule of Fleming right hand rule.

Q3:- What is the role of the split ring in an electric motor?

Ans: Split rings act as a commutator and the main function of commutator is to reverse the direction of current in each half. Due to this function the coil continues to rotate in the same direction.

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Q1:- Explain different ways to induce current in a coil.

Ans: The different ways to induced current in a coil:

(i) By moving a coil rapidly between the two permanent magnetic poles.

(ii) By the to and fro motion of magnet in front of coil.

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Q1:- State the principle of an electric generator.

Ans: It works on the principle of electromagnetic induction. It generates the electric current by rotating a coil between the permanent magnetic poles.

Q2:- Name some sources of direct current.

Ans: Dry cell, solar cell, DC generator.

Q3:- Which sources produce alternating current?

Ans: AC generator, thermal power plant, hydropower plants etc.

Q4:- 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

Ans: (c) half revolution

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Q1:- Name two safety measures commonly used in electric circuits and appliances.

Ans: The two safety measures of electric circuit and appliances are:

(a) Each circuit must be connected through an electric fuse. The main function of this fuse is to protect the electric appliances during electric short circuit.

(b) Earthing must be used during your house wiring because it prevents from the electric shock.

Q2:- An electric oven of 2 kW power rating is operated in a domestic electric circuit (220 V) that has a current rating of 5 A. What result do you expect? Explain.

Ans: Given that

Power(P)= 2 KW = 2000W

Applied voltage= 220V

Now $P = VI$

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

$I = {}^{2000}/_{220}$

$I = {}^{200}/_{22}$

$I = 9.09$ A

Hence the current drawn by the electric oven is 9.09 A and which can exceed the safe current zone and hence the fuse element of the fuse will melt and will break the circuit.

Q3:- What precaution should be taken to avoid the overloading of domestic electric circuits?

Ans: The following precautions should be taken to avoid the overloading: -

(a) Avoid to connect many appliances to one socket.

(b) Avoid the use of faulty appliances.

(c) Should not use too many appliances at a time.

(d) Fuse should be connected in the circuit.

Exercises:

Q1:- 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.

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

Q2:- 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.

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

Q3:- The device used for producing electric current is called a

(a) generator.

(b) galvanometer.

(c) ammeter.

(d) motor.

Ans: (a) generator.

Q4:- 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.

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

Ans: AC generator has slip rings while the DC generator has a commutator.

Q5:- At the time of short circuit, the current in the circuit

(a) reduces substantially.

(b) does not change.

(c) increases heavily.

(d) vary continuously.

Ans: (c) increases heavily.

Q6:- State whether the following statements are true or false.

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

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

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

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

Q7:- List two methods of producing magnetic fields.

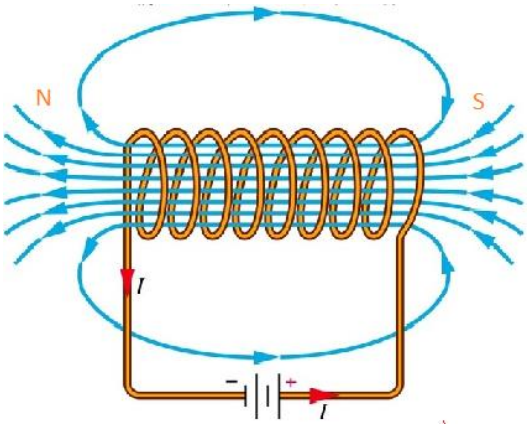
Ans: The given two methods are:

(a) Current carrying conductor can produce magnetic field.

(b) By permanent magnet.

Q8:- 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.

Ans: We know that a current carrying conductor produce magnetic field and the current flows in a circular path. The magnetic field makes two poles according to Fleming's right hand rule. The north pole of the solenoid is on negative side and the south pole is on the other side of the solenoid. Just like as the bar magnet similar poles can repel and opposite poles can attract each other.



Q9:- When is the force experienced by a current–carrying conductor placed in a magnetic field largest?

Ans: When the direction of current is perpendicular to the direction of magnetic field the force experienced by the conductor is maximum.

Q10:- 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?

Ans: According to the Fleming's left hand rule, the direction of magnetic field is perpendicular to the current and the direction of current is opposite to the direction of flow of electron. Here in this case the electrons beam can flow from back wall to front wall and the electron beam get defected towards the right side(force). Hence, the direction of magnetic force is downward.

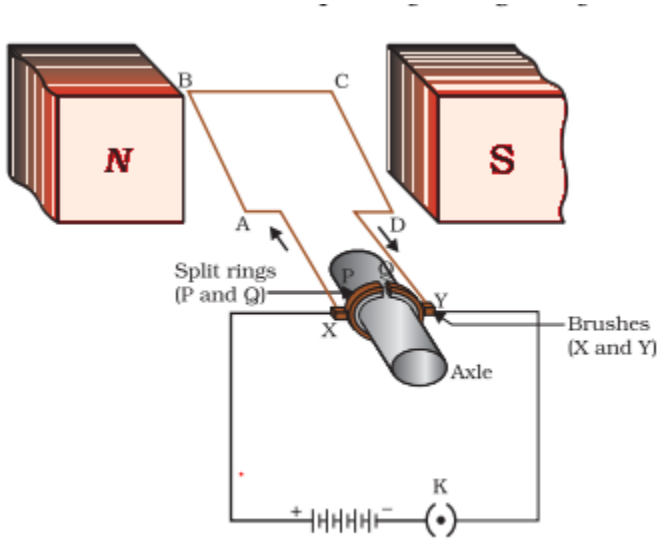
Q11:- Draw a labelled diagram of an electric motor. Explain its principle and working. What is the function of a split ring in an electric motor?

Ans:

(i) Principle: When a current carrying conductor is placed in a magnetic field, it experiences a force in the direction given by Fleming's left hand rule.

(ii) Working: The current in the coil ABCD enters from the source battery through conducting brush X and flows back to the battery through brush Y. The current in the arm of coil AB flows from A to B.

In arm CD, it flows from C to D. So, the current flows in opposite direction in both the arms.
On applying Fleming's left hand rule for direction of force on a current-carrying conductor in a magnetic field, we find that the force acting on arm AB pushes it downwards, while force acting on CD, pushes it upwards. Thus, the coil and axle O, rotate anticlockwise. After half rotation, Q makes contact with brush X and P with brush Y. Therefore, the current in the coil gets reversed and flows along the path DCBA. The reversal of current also reverses the direction of force acting on the two arms AB and CD. Again, apply Fleming's left hand rule for the direction of current and the AB pushes the coil down and the CD pushes the coil up. Therefore, the reversing of the current is repeated at each half rotation, giving rise to continuous rotation of the coil and to the axle.



Electric Motor

(iii) The function of split ring [commutator] is to change the direction of current in the coil after every half a rotation.

Q12:- Name some devices in which electric motors are used.

Ans: The name of devices is:

(a) Cooler
(b) A.C
(c) Fan
(d) Motor cycle, etc.

Q13:- 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?

Ans:

(i) The magnetic flux linked with the coil changes. As a result of this, an induced current flows in the coil and the galvanometer shows the deflection.

(ii) When the bar magnet is moved away from the coil, galvanometer again shows deflection but now in the opposite direction.

(iii) When the bar magnet is stationary near the coil, no deflection in the galvanometer is observed.

Q14:- 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.

Ans: As the current flows in coil A, a magnetic field is generated around it. As the coil B is situated near coil A, it also experiences the magnetic field. As the current in coil A changes, the magnetic field associated with it also changes. Hence, the magnetic field around coil B also changes.
Due to change in magnetic field around the coil B, a current is induced in coil B.

Q15:- 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.

Ans:

(i) We will use Right hand thumb rule to determine the direction in this case. According to this rule "grasp the conductor in the right hand with the thumb pointing in the direction of current, and then the

direction in which the fingers curl gives the direction of the magnetic field,"

(ii) We will use Fleming's left hand rule to determine the direction in this case**.** According to this rule, "stretch the forefinger, the middle finger and the thumb perpendicular to each other. If the forefinger gives the direction of the magnetic field and the middle finger the direction of current, then the thumb will give the direction of the force experienced by the current, carrying conductor.

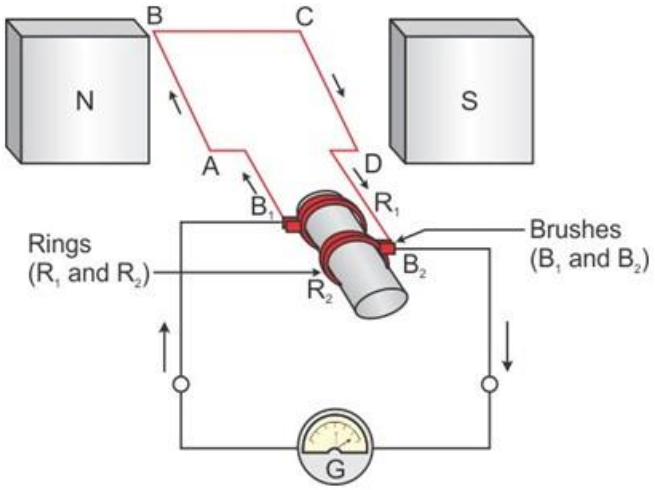
(iii) We will use Fleming's right hand rule to determine the direction in this case. According to this rule, "stretch the forefinger, the middle finger and the thumb perpendicular to each other. If the forefinger gives the direction of the magnetic field and the middle finger the direction of induced current, then the thumb will give the direction of motion of conductor.

Q16:- Explain the underlying principle and working of an electric generator by drawing a labelled diagram. What is the function of brushes?

Ans:

Principle: It works on the principle that when a coil rotates in a uniform magnetic field, a current is induced in the coil.

Working: When the axle is attached to the rings, the rings will get rotated in such a way that arm AB moves up and CD moves down in the magnetic field produced by the permanent magnet. Let us say the coil ABCD is rotated clockwise. By applying Fleming's right hand rule, the induced currents are set up in these arms along the directions AB and CD. Thus, an induced current flow in the direction ABCD. If there is larger number



of turns in the coil, the current in the external circuit flows from B_1 to B_2. Thus, after every half rotation, the polarity of current in the respective arms changes.
Such a current, which changes direction after equal intervals of time, is called an alternating current. This device is called AC generator.

Q17:- When does an electric short circuit occur?
Ans: When the live and neutral wires come in direct contact with each other, a very large current passes through the circuit. Then it is said that "short circuiting" has occurred.

Q18:- What is the function of an earth wire? Why is it necessary to earth metallic appliances?
Ans: The function of earth wire is to pass excess current into the earth. Connecting the metal case appliances to the earth by metal wire is called earthing. It is used as a safety measure specially for those appliances which provide a low resistance conducting path for the current. Thus, if there is any leakage of the current, the user doesn't get any severe shock.