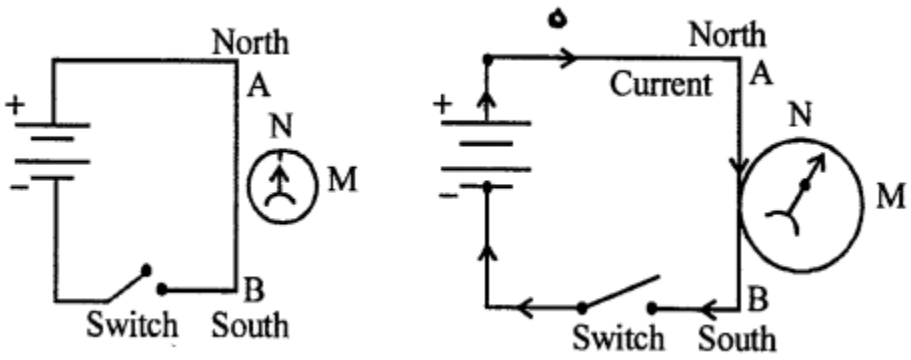
Electromagnetism

Exercise – 1

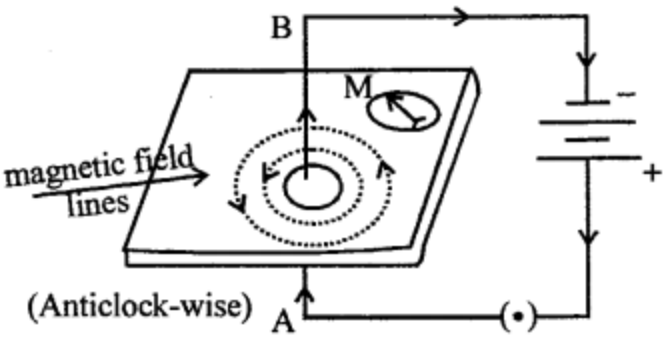
Question 1.
When can an electric charge give rise to a magnetic field?
Answer:
When electric charge is in motion e. charge flows, it gives rise to magnetic field.

Question 2.
Describe Oersted's experiment to show that a conductor carrying current produces a magnetic field around it
Answer:
Oersted's Experiment :
Set up the apparatus as shown in fig. when switch is in open circuit



magnetic needle points in north direction. Showing there is no magnetic field around it. Now when switch is closed and current flows through the wire, the magnetic needle gets deflected from north. This shows that conductor carrying current produces magnetic field around it and deflects the magnetic needle.

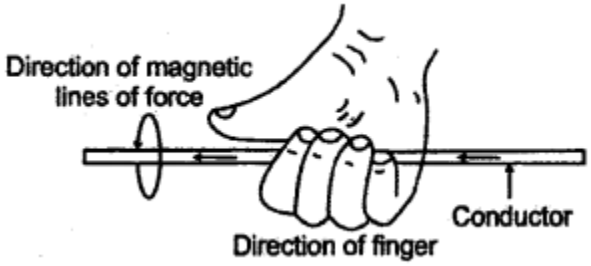
Question 3.
(a) How will you plot the magnetic field lines around a straight conductor carrying current ?
(b) State two rules by which you can determine the direction of the magnetic field around a straight conductor.
Answer:
(a) To plot the magnetic field lines around a straight conductor carrying current: Pass straight conductor through a cardboard or glass-plate. And pass current.



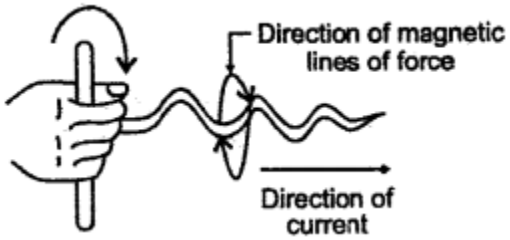
From A to B direction in the upward direction. Sprinkle iron filings on glass plate. Tap the glass plate, the iron filing will arrange themselves in circles around the conductor along the magnetic lines of force. The magnetic fields are circular in nature. The direction of magnetic field can be detected with the help of magnetic compass and direction is found anti clock wise.

(b) Two rules are :

1. **Right hand thumb rule:** "Imagine you are holding the current carrying wire in your right-hand so that your thumb points in the direction of current, then the direction in which your fingers encircle the wire will give the direction of magnetic field lines around the wire."

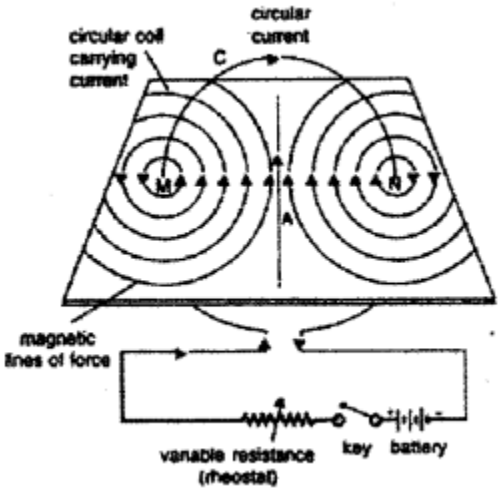


2. **Max Well's Screw Rule :** "Imagine driving a cork screw in the direction of current, then the direction in which we turn its handle is the direction of magnetic field (or magnetic field lines).



Question 4.
(a) Draw a set up for plotting magnetic field around a circular coil carrying current.
(b) State the properties of the magnetic field in 4(a).
Answer:

(a)



(b) Properties of the magnetic field :

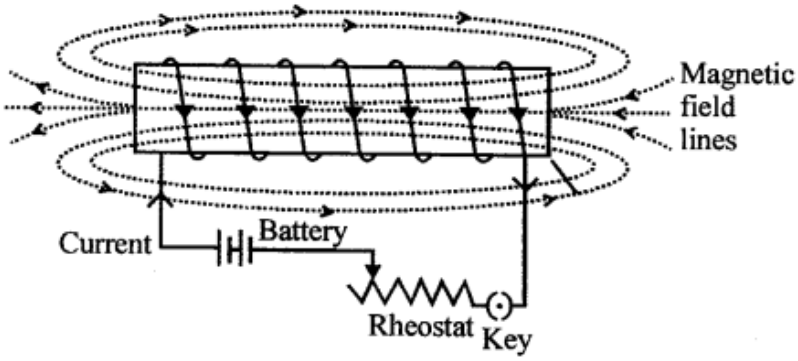
1. The magnetic field lines are circular near current carrying loop.
2. At the center of the circular loop the magnetic field lines are in the same direction and strength of magnetic field increases.

Question 5.

What is a solenoid ? Draw a magnetic field around a solenoid, when direct current flows through it. How will you find the magnetic polarity of a solenoid without using a magnetic needle ?

Answer:

Solenoid : "Is a long coil containing a large number of close turns of insulated copper wire."



Magnetic polarity of solenoid can be determined like a bar magnet i.e. when it is suspended freely, it will come to rest pointing in North and South direction or polarity can be checked by bringing north pole of a bar magnet. The pole repelled by north pole must be North pole of solenoid.

Question 6.

How does the magnetic field set up in a solenoid changes when:

(a) number of turns are increased ?

(b) diameter of the solenoid is increased ?

(c) strength of the current is increased ?

(d) a soft iron core is placed in it ?

Answer:

(a) When number of turns are increased magnetic field will be stronger.

(b) When diameter of the solenoid is increased but diameter should be less than the length of solenoid, so that parallel lines should add up to give a stronger field.

(c) When strength of current is increased stronger will be the magnetic field produced.

(d) When soft iron core is placed in the solenoid very strong magnetic field is produces.

Question 7.

Give four differences between an electromagnet and a permanent magnet.

Answer:

Differences between electromagnet and permanent magnet:

Electromagnet:

1. It is temporary magnet
2. It strength can be changed, by changing the current.
3. Polarity can be changed by changing the direction of current.
4. Produces very strong magnetic force.

Permanent Magnet

1. It is permanent magnet.
2. It strength cannot be changed.
3. Polarity cannot be changed.
4. Produces weak magnetic force.

Question 8.

State four practical applications of electromagnets.

Answer:

Four applications of electromagnet :

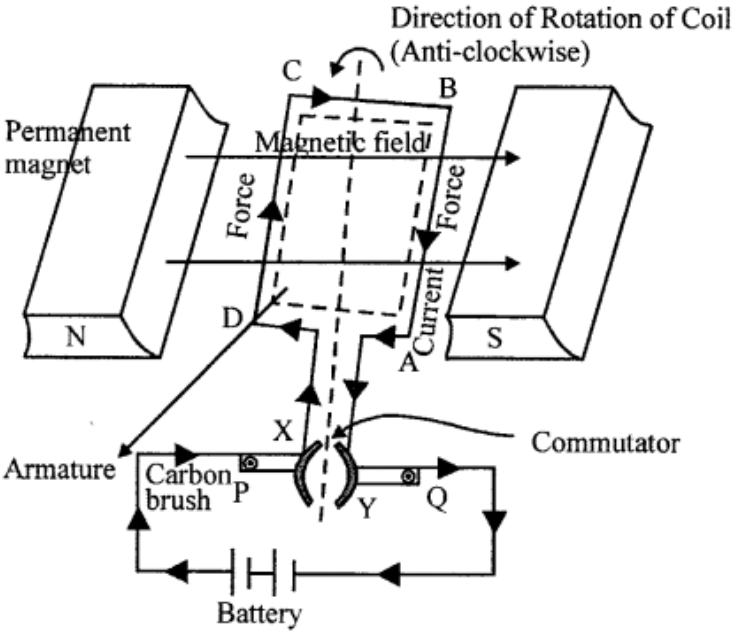
1. In electric bell.
2. In magnetising steel bars.
3. For scanning machines (MRI)
4. In electric motor, generator.

Question 9.
(a) On what factors does the force experienced by a straight conductor placed in a magnetic field depend
(b) State the law which determines the force experienced by a conductor.
Answer:
(a) Factors on which force experienced by a straight conductor depend :

1. **Current passing :** direct proportional to current passing.
2. Inversely proportional to the distance of that point from the wire.

(b) When a conductor carrying current is placed in a magnetic field in a direction other them the direction of magnetic field, experiences a force called Lorentz force. This force is perpendicular to both, the direction of current I and the direction of magnetic fields B. This law is called :
Fleming's left hand rule : "Stretch the fore finger, control finger and the thumb of your left hand mutually perpendicular to each other. If the fore-finger points in the direction of magnetic field, central finger indicates the direction of current, then the thumb will indicate the direction of motion of conductor (i.e., force on conductor)

Question 10.
(a) Draw a neat and labelled diagram of a d.c. motor and explain its construction and working.
(b) How can you make a d.c. motor more powerful ?
(c) How can you convert its jerky motion into uniform circular motion ?
Answer:
(a) D.C. Motor



Construction : A d.c. motor consists of :

1. Rectangular coil ABCD of insulated copper wire moved between two Horse shoe
2. Permanent magnet M such that AB and CD are perpendicular to the magnetic field.
3. Two half rings (commutators) of copper X, Y are soldered to ends A and D of coil to change the direction of current flowing after every half rotation of the coil.
4. Two carbon brushes P and Q fixed to the base of motor keep pressing highly against commutators. Battery to supply the current to coil is connected to the coil. The function of brushes is to make contact with the rotating rings of the commutator and through them to supply current to the coil.

Multiple Choose Questions

Tick (✓) the most appropriate option.

1. **A wire carrying a current is held over a freely suspended magnetic needle, such that the current in the wire flows from south to north. The direction in which the north end of freely suspended magnetic needle will point towards.**
(a) West
(b) East
(c)South
(d) North

2. In an electric motor :
(a) mechanical energy changes to heat energy
(b) mechanical energy changes to electric energy
(c) electric energy changes to mechanical energy.
(d) electric energy changes to magnetic energy

3. By reversing the direction of current in an electromagnet, the magnetic field produced by it
(a) increases in strength
(b) remains unchanged in strength and direction
(c) gets reversed in direction
(d) decreases in strength

4. The power of a d.c. motor can be increased :
(a) by increasing number of turns in its coil
(b) by laminating its soft iron core
(c) by increasing the strength of current flowing through it
(d) all of these

5. Commutator is a device in a d.c. motor which :
(a) increases the power
(b) reverses direction of current coil after full rotation of coil
(c) reverses direction of current after half rotation of coil
(d) increases the strength of electromagnet

6. Which is not the use of an electromagnet ?
(a) Used in electric appliances such as electric bell and electric fans.
(b) Used for magnetising steel bars.
(c) Used for making sensitive magnetic compass.
(d) Used in separating iron particles from a scrap of iron and other metals.

7. Which is not the property of a solenoid ? The magnetic field of solenoid can be increased
(a) by increasing the number of turns in the solenoid.
(b) by increasing the strength of current flowing through the solenoid.
(c) by placing a stainless steel core within the solenoid.
(d) by placing a laminated soft iron core within the solenoid.

Exercise – 2

Question 1.
State Faraday's laws of electromagnetic induction.
Answer:
Faraday's Laws of Electromagnetic Induction :

1. When ever there is a change in the magnetic flux linked with a coil an e.m.f. is induced. The induced e.m.f. lasts as long as the change lasts (i-e-, there is a change in the magnetic flux linked with the coil.
2. The magnitude of the e.m.f. induced is directly proportional to the rate of change of the magnetic flux linked with the coil. If the magnetic flux changed at a fixed rate, a stready e.m.f. is produced.

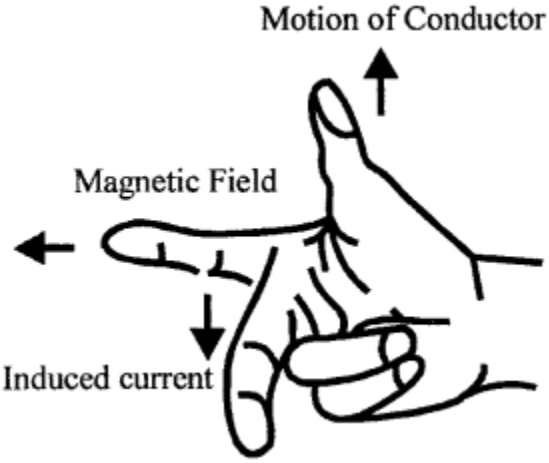
Question 2.
State
(a) Fleming's right hand rule,
(b) Lenz's law for finding the direction of induced current. Which of the above laws is most suitable for finding the direction of current in

1. straight conductor
2. coiled conductor ?

Answer:
(a) Fleming's right hand rule:

Or

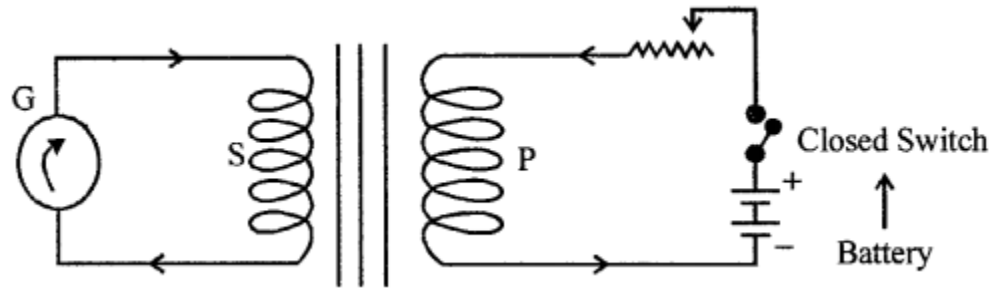
(1) Generator rule : "Stretch the thumb, fore finger and central finger of right hand mutually perpendicular to each other. If the fore finger indicates the direction of magnetic field and thumb indicates the direction of motion of the conductor then central finger will indicate the direction of induced current."



(2) Lenz's Law : "The direction of induced e.m.f. (or induced current) always tends to oppose the cause which produces it."

(a) In straight conductor — Fleming's Right Hand Rule
(b) in coiled conductor — Lenz's Law.

Question 3.
What do you understand by the term mutual induction ? Describe an experiment in support of your answer.
Answer:
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."
Experiment :



P(primary coil) behaves as electro magnet when current passed by opening and closing

the switch and pointer of the secondary coil (s) shows deflection proving that induced e.m.f. is produce in secondary coil. As soon as the switch is off (open circuit) deflection stops in secondary coil.

Or

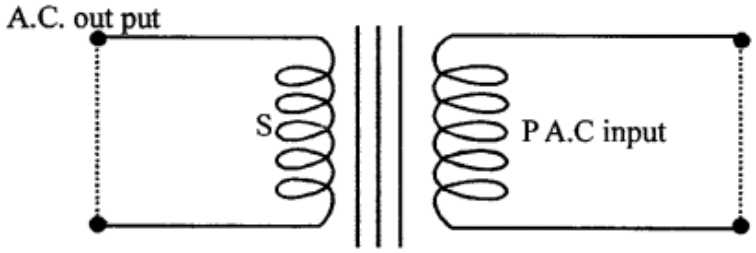
The induced e.m.f. can be generated in the secondary coil, by placing the primary coil permanently in the secondary coil, and rapidly closing and opening the switch closing switch amounts to increases in magnetic flux in the primary coil, and hence in the secondary coil. Opening the switch amounts to decrease in magnetic flux in the primary and the secondary coil. Thus induced e.m.f. is generated in secondary coil.

Question 4.
What do you understand by the terms (a) self induction (b) eddy current ?
Answer:
(a) Self induction: "The phenomenon due to which a current flowing through a part of coil, induces an e.m.f. in the rest of coil due to change in magnetic flux is called self induction."

(b) Eddy currents : "The current produced in any metallic conductor when a magnetic flux is changed around it is called Eddy Current.

Question 5.
(a) Describe with the help of a clear diagram the structure of a.c. transformer, suitable for lighting 12 V lamp from 240 V mains.
(b) Explain how a transformer reduces emf ?
(c) Why are transformers so important for the transmission of energy ?
Answer:
(a) We are to transformer for lighting 12V lamp from 240 V mains.
Therefore step down transformer is needed.
The magnitude of induced e.m.f. is produced by the formula.

$$\frac{e.m.f.\text{across P.coil (240V)}}{e.m.f.\text{Facross S.coil (12V)}} = \frac{\text{Number of turns in primary coil}}{\text{Number of turns in secondry coil}}$$



Step down Transformer

Primary coil:

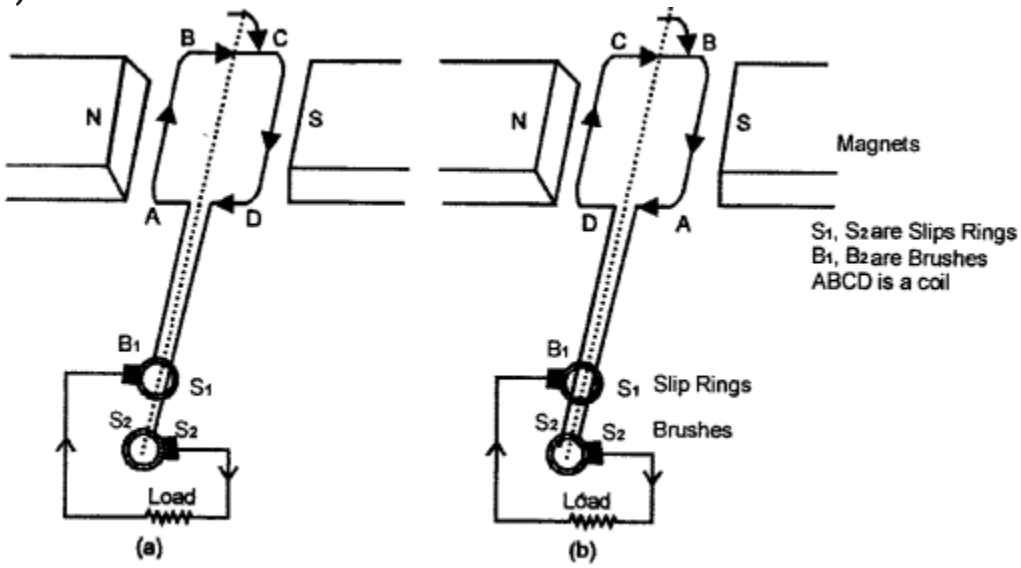
- It should have 20 times more number of turns as compared to secondary coil.
- It is made of thinner copper wire.
- It should be more heavily insulated secondary coil.

Secondary coil :

- It should be made of thicker copper wire.
- It should be less heavily in solated.

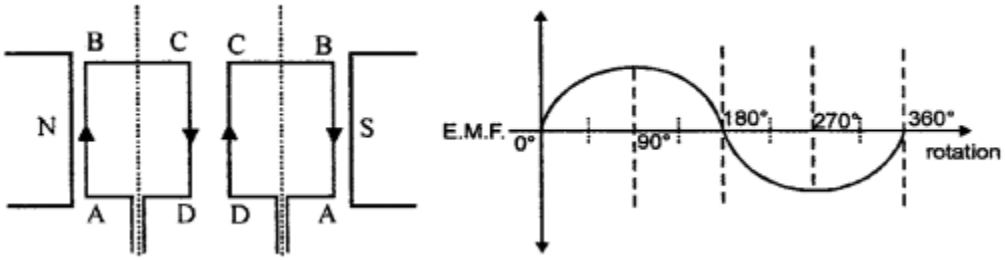
(b) The number of turns in secondary 1/20 of the number of turns in primary coil reduces the e.m.f. to 1/20 th e.m.f. of primary coil.
(c) Transformers are important for transmission of energy. The power from the generating station is transmitted over long distances at a voltage higher than 11 kv to minimise the loss of energy in form of heat in the line wires used for transmission for this step up transformer is used which step up 11 kv to 132 kv at the generating station. To transmit if to industries it is stepped down to 33 kv using step down transformer. Further stepped down to 11 kv to transmit to light industry. It is further stepped down to 220 V by step down transformer to supply it to domestic consumers.

Question 6.
(a) Draw a labelled diagram of an a.c. generator.
(b) Why is the emf produced by an a.c. generator zero at a certain instant and reaches the maximum value at the other instant?
(c) The efficiency of a generator is never 100%. Explain.
Answer:
(a)



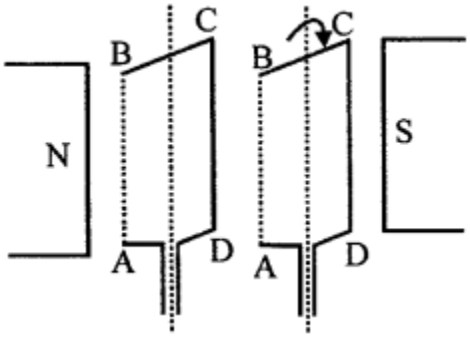
(b) The e.m.f. produced by a.c. generator is zero when magnetic flux linked with coil is

maximum. This happens when the plane of coil is normal to the magnetic field.



(c) The efficiency of a generator is never 100% because

1. a part of energy is wasted due to magnetic hysteresis.
2. A part of energy is wasted an account of the resistance of primary and secondary coils wound around the core
3. A part of current is wasted on account of the Eddy currents formed with in the soft iron core.



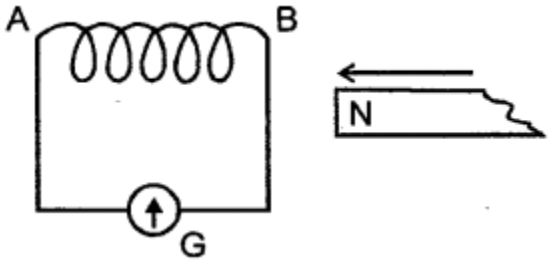
Question 7(a) .

The adjacent diagram 10.44 shows a movable permanent magnet and fixed copper coil of many turns, connected to a center zero galvanometer.

Describe your observations when:

Answer:

1. The magnet is rapidly moved in the direction of the arrow.
2. The magnet is stopped within the coil
3. The magnet is then pulled out rapidly.



Question 7(b).
What will be your observations, if a more powerful magnet is used ?
Answer:
(1)

(1) A momentary deflection of pointer of galvanometer towards right side is seen.
(2) More the speed, more is the deflection.
(3) When magnet is stopped with in the coil, the pointer of galvanometer comes to zero position.
(4) Deflection of pointer of galvanometer is in opposite direction to towards the left.

(2) Then more powerful magnet is used deflection of pointer will be more.

Multiple Choose Questions

Tick (✓) the most appropriate option.

1. The direction of current in a conductor can be obtained by ?
(a) Fleming's right hand rule
(b) Fleming's left hand rule
(c) Right hand thumb rule
(d) Maxwell's cork-screw rule

2. In a step down transformer :
(a) number of turns in primary coil are less than the secondary coil.
(b) number of turns in primary coil are more than the secondary coil.
(c) number of turns in primary coil are equal to the secondary coil
(d) the primary and secondary coils are wound on separate steel cores.

3. Step up transformers are used:
(a) for long distance transmission of power
(b) for distribution power in localities.
(c) for saving sensitive appliances, such as T.V andA.C.
(d) any of these

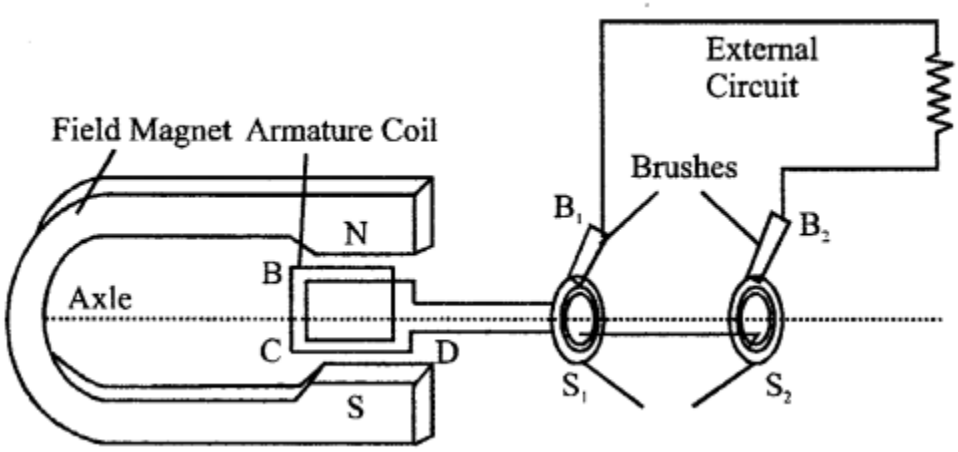
4. Which is the incorrect statement ? In a step down transformer
(a) number of turns in primary are more than the secondary coil
(b) the primary coil is thinner as compared to the secondary coil.
(c) the primary coil is thicker as compared to secondary coil.
(d) the primary coil is more heavily insulated as compared to secondary coil

5. In an cue. generator the magnitude of induced current can be increased by :
(a) increasing number of turns in the coil
(b) increasing the area of cross-section of the coil
(c) increasing the strength of field magnets
(d) all of these

Questions from ICSE Examination Papers

2001

Question 1.
Draw a diagram of a D.C. motor, labelling clearly the following parts:
(a) The field magnet
(b) The armature
(c) Commutator
(d) Wire brushes
What energy changes are involved in the D.C. motor ?
Answer:

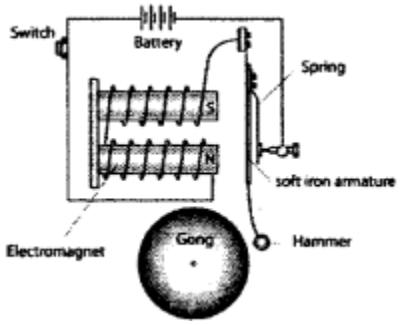


Energy changes involved in D.C. Motor is Mechanical energy is converted into electrical energy.

2002

Question 2(a).
Draw a sketch of an electric bell with the electrical connections and label its main parts.
Why is the armature made of soft iron and not steel ?

Answer:



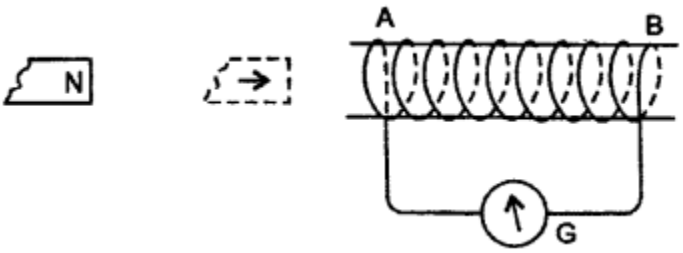
Question 2(b).
State two dissimilarities between a d c motor and an a.c. generator.
Answer:
Different between D.C. motor and A.C. generator
D.C. Motor

1. It converts electrical energy to mechanical
2. It is based on Fleming's left hand rule energy.
3. It has split rings.
4. DC motor works on the principle of force acting on current carrying conductor placed in a magnetic field.

A.C. Generator

1. It converts mechanical energy to electrical energy.
2. It is based on Fleming's right hand rule.
3. It has slip rings.
4. AC generation works on the principle of electromagnetic induction

2003
Question 3.
Fig. shows a coil connected to a center zero galvanometer G The galvanometer shows a deflection to the right when the North — pole of a powerful magnet is moved to the right as shown:



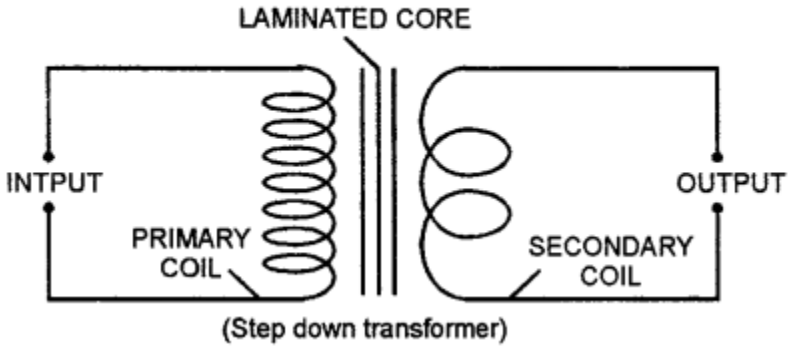
(a) Explain why the deflection occurs in the galvanometer.
(b) Does the direction of the current (clockwise or anticlockwise) when viewed from the

end A ?
(c) State observation in G when the coil AB is moved away from N.
(d) State the observation in G when, both the coil and the magnet, are moved towards the right at the same speed.
Answer:

(a) Due to motion of magnet, magnet flux linked with coil changes. As a result, e.m.f. is induced across its ends, due to which induced current fluxes in coil so galvanometer shows deflection.
(b) clockwise (c) It deflects to left (d) No deflection is observed as there is no change in magnetic flux linked with coil.
(c) Deflection in G is towards left of zero.
(d) Relative motion is zero and there is no deflection e. pointer is at 0 (rest position).

2004

Question 4(a).
Draw a neat and labelled diagram of a step-down transformer.
Answer:



Question 4(b).
What is the main difference between a step-up and step- down transformer.
Answer:
Difference between step Up and Step down Transformer :
Step up Transformer

1. It incrases the a.c. voltage and decreases the current i e. Es >Ep and Is <Ip
2. The wire of primary coil is thicker than that of the secondary coil.
3. NS/NP> I
4. Used at power generating station, in X-ray, T.V. etc.

Step Down Transformer

1. It decreases the a.c. voltage and increases the current. i.e. Es >Ep and Is <Ip
2. The wire of the secondary coil is thicker than that the primary coil.
3. Ns /Np <1
4. Used at power stations electric bell, night electric bulb.

2004

Question 5(a).

How can you demagnetise a bar magnet by employing alternating current ?

Answer:

When current starts flowing in the coil and magnet is with drawn from the coil in East-West direction and is kept far away, the magnetic field produced changes its direction continously, magnetisation becomes weak and weak .untill demagnetised.

Question 5(b).

State two ways by which the emf in an A.C. generator can be increased.

Answer:

The e.m.f. in an a.c. generator can be increased by

1. increasing the number of turns in the armature (or coil).
2. increasing the speed of rotation of the armature about its axis (or coil).

2005

Question 6.

State the energy change which takes place when a magnet is moved inside a coil having a galvanometer at its ends. Name this phenomenon.

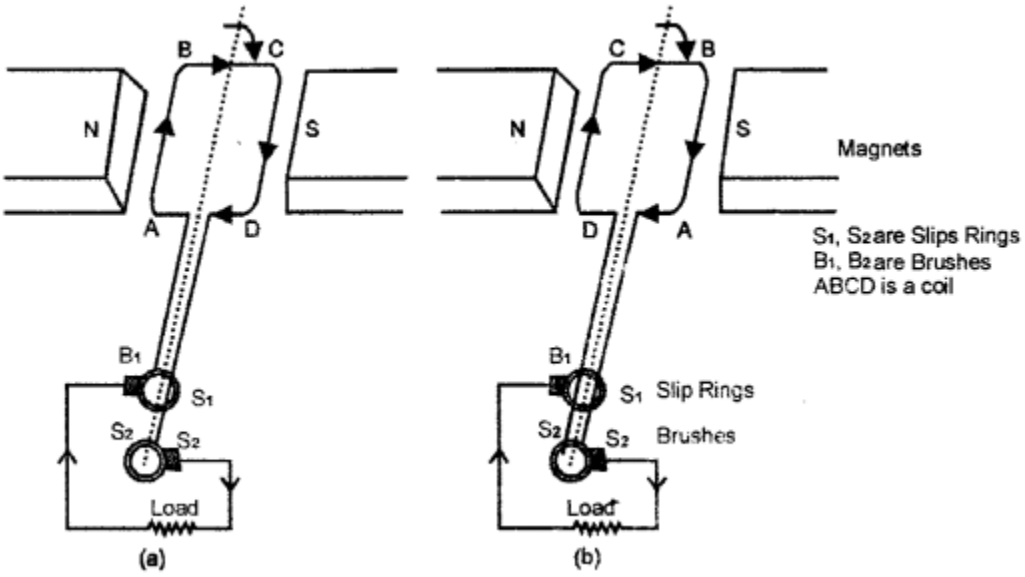
Answer:

When a magnet is moved in side a coil MECHANICAL ENERGY changes into ELECTRICAL ENERGY i.e. magnetic flux (Magnetic lines of force) is converted into e.m.f. or electric current.
The phenomenon is called INDUCED CURRENT.

Question 7.

Draw a labelled diagram of an A.C. generator.

Answer:



Question 8.
(1) State the function of a split ring in a D.C. motor.
(2) Mention two reasons why a soft iron core is used within the coil of a moving coil galvanometer.
Answer:

1. Function of split ring in a D.C. Motor to change the direction of current flowing after eveiy half rotation the coil.
2. Soft iron core provides STRONG MAGNETIC FIELD .when a current flows through the coil wound around it.

2006

Question 9.
State two advantages of an electromagnet over a permanent magnet.
Answer:
Two ADVANTAGES OF ELECTROMAGNETIC OVER PERMANENT MAGNET are :

1. Its strength can be increased or decreased by increasing or decreasing current.
2. It loses magnetism as soon as current is stopped and acquires magnetism as soon as current is passed.
3. The polarity can be changed by changing the direction of current.
4. It produces stronger magnetic field.

Question 10.
(a) What will happen to a compass needle when the compass is placed below a wire

and a current is made to flow through the wire ? Give a reason to justify your answer.
(b) What energy conversion takes place during the working of a d.c. motor ?
Answer:
(a) The needle of compass will deflect as the wire carrying current is associated with magnetic field.
(b) ELECTRICAL energy is transformed to MECHANICAL energy.

2007

Question 11.
(1) State two factors on which the strength of an induced current depends.
(2) When a solenoid that is carrying current is freely suspended, it comes to rest along a particular direction. Why does this happen ?
Answer:
(1) Two factors on which strength of induced current depends are:

(a) The magnitude of current is directly proportional to "The rate of change of magnetic flux with in the closed coil.
(b) It depends upon the number of turns and the area of cross-section of the coil.

(2) This means the solenoid carrying current behaves like a bar magnet and it has come to rest along a particular direction NS N-end of this solenoid points towards north pole of earth and S-end points towards south-pole of earth.

2008

Question 12.
State one point of similarity and one point of difference between an a.c. generator and a d.c. motor.
Answer:
Difference between a.c. generator and d.c. motor
In a.c. generator mechanical energy gets converted into electrical energy and induced e.m.f. is alternating in nature. In d.c. motor electrical energy gets converted into mechanical energy and electricity used in direct current.
Similarity between a.c. generator and d.c. motor is that both use the principle of electromagnetic induction and use a solenoid on which copper wire is would.

Question 13.
(a) What is the name given to a cylindrical coil whose diameter is less in comparison to its length ?
(b) If a piece of soft iron is placed inside a current carrying coil, what is the name given to the device ?

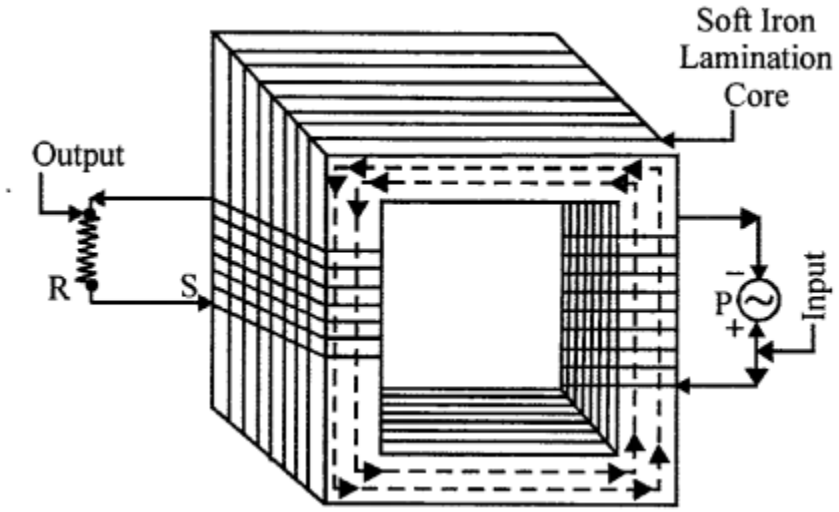
(c) Give one use of the device named by you in 13 (b) above.
Answer:

(a) It is called Solenoid.
(b) Aarmature
(c) Aarmature using soft iron core becomes Magnetised and Increases the strength of magnetic field.Armature makes the motor more powerful.

Question 14(a).
(1) Why does a magnetic needle show a deflection when brought close to a current carrying conductor ?
(2) A wire bent into a circle carries current in an anticlockwise direction. What polarity does this face of the coil exhibit ?
Answer:

1. When an electric current is passed through a conducting wire, a magnetic field is produced around it. A compass needle, if freely suspended, rests in North South direction but due to magnetic field produced around wire, the compass needle gets attracted or repelled and changes its direction.
2. North polarity is formed.

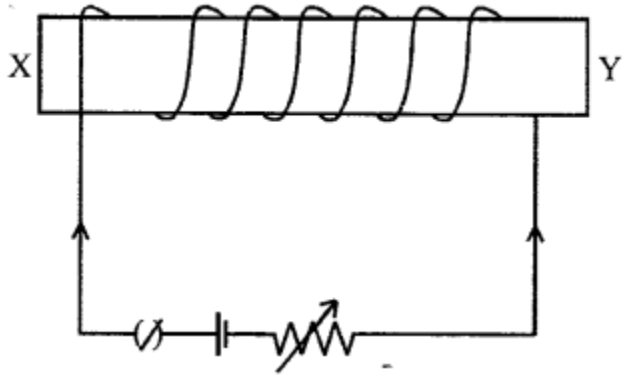
Question 14(b).
Draw a simple sketch of a step-down transformer. Label the different parts in the diagram.
Answer:



2009

Question 15.

The figure below shows an electromagnet.



(a) What will be the polarity at the end X ?
(b) Suggest a way by which the strength of the elctromagnet referred to in the question, may be increased.

Answer:

(a) At end X – North polarity will be formed.
(b) The strength of the electromagnet formed can be increased by

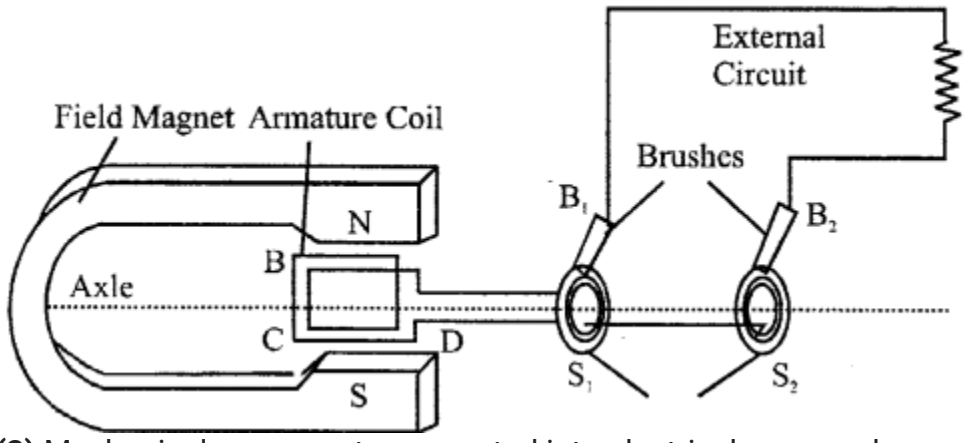
1. Increasing the number of turns of the winding
2. Increasing the current through it and decreasing the gap between them.

Question 16.

(1) Draw a neat and labelled diagram to show the structure of an a.c. generator.
(2) State the energy conversion taking place in the generator when it is working.

Answer:

(1)



(2) Mechanical energy gets connected into electrical energy when generator is working.

2010

Question 17.

A device is used to transform 12V a.c. to 200V a.c.

(1) What is the name of this device ?

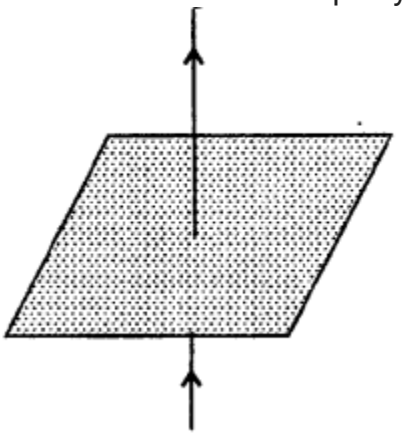
(2) Name the principle on which it works.

Answer:

1. Since the device is being used to step up 12 V a.c. to 200 V a.c., it is called a step up transformer.
2. A transformer works on the principle of mutual induction.
3. "When an alternating current is passed in the primary coil wound on the soft iron core, an induced emf- is produced in the secondary coil, wound on a soft iron

Question 18(a).

1. A straight wire conductor passes vertically through a piece of cardboard sprinkled with iron filings. Copy the diagram and show the setting of iron filings when a current is passed through the wire in the upward direction and the cardboard is tapped gently. Draw arrows to represent the direction of the magnetic field lines.
2. Name the law which helped you to find the direction of the magnetic field lines



Answer:

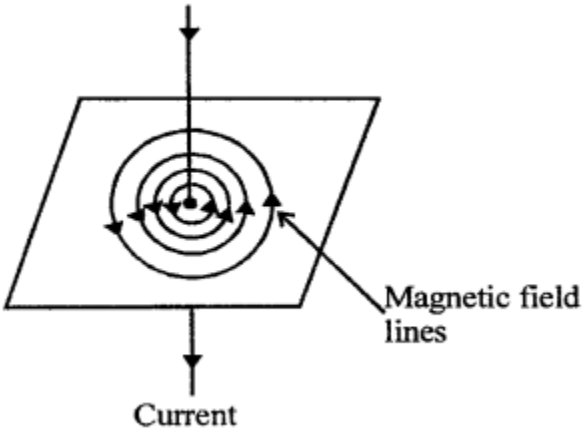
1. The direction of the magnetic lines of force will be anticlockwise. The iron filings will align themselves in circular lines of force (By Right hand thumb rule.)
2. Right hand thumb rule or Maxwell's cork screw rule.

Question 18(b).

1. State two ways by which the magnetic field of a solenoid can be made stronger.
2. What material is used for making the armature of a electric bell ? Give a reason for using this material.

Answer:

1. The magnetic field along the axis of a solenoid is given by $B = \mu_0 ni$
   Clearly, the magnetic field can be increased by .
   - Increasing the current.



   - Increasing the number of tums/length.
2. The armature of the electric bell is made of soft iron. This is because soft iron when magnetised is quickly demagnetised when the circuit is broken. Steel armature might lock up the circuit and the bell may not work.

2012

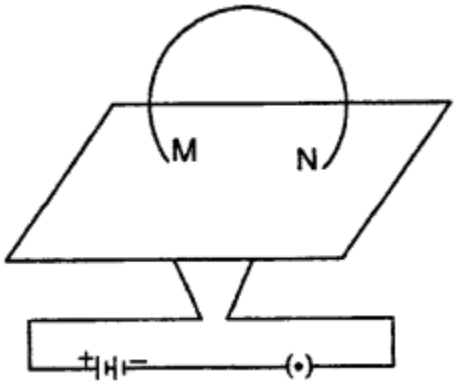
Question 19(a).
(1) What is an a.c. generator or dynamo used for?
(2) Name the principle on which it works.
Answer:
(a)

1. An a.c. generator or dynamo is used to produce electric city by mutual induction i.e. rotating a coil in magnetic field.
2. It works on the principle of electromagnetic Induction that is a coil is rotated in a magnetic field and magnetic flux linked with the coil changes therefore an e.m.f. is induced between the ends of the coil.

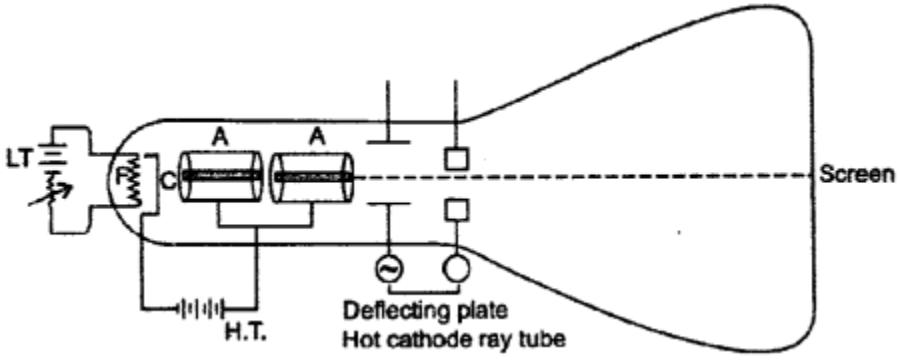
Question 19(b).
The diagram alongside below a current carrying loop or a circular coil passing through a sheet of cardboard at the points M and N. The sheet of cardboard is sprinkled uniformly with iron filings.

1. Copy the diagram and draw an arrow on the circular coil to show the direction of current flowing through it.

2. Draw the pattern of arrangement of the iron filings when current is passed through the loop.



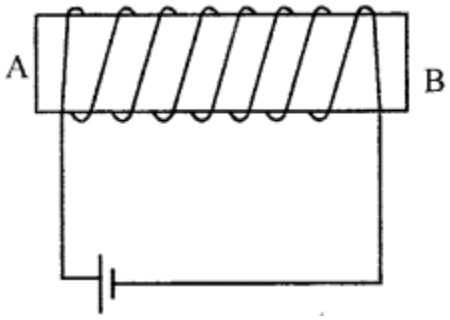
Answer:
(1) and (2)
Direction of current flowing is shown by arrows



2013

Question 20(a).
You have been provided with a solenoid AB.

1. What is the polarity at end A ?
2. Give one advantage of an electromagnet over a permanent magnet.



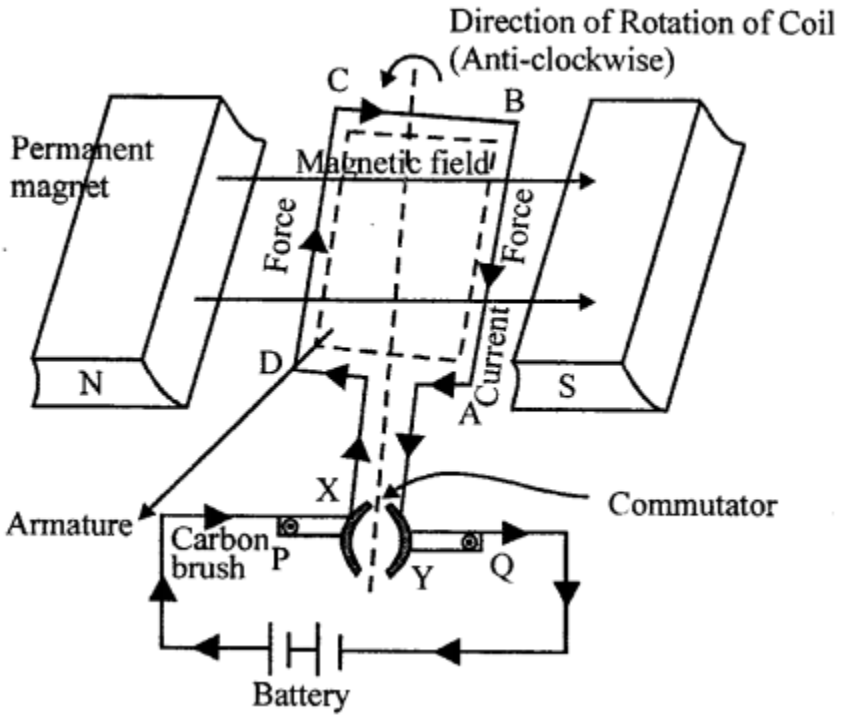
Answer:
(a)

1. Polarity at the end A is NORTH pole .
2. An electromagnet's strength can be increased by increasing the flow of current in the coil, which is not possible in case of a permanent magnet.

Question 20(b).

1. Draw a simple labelled diagram of d.c. electric motor,
2. What is the function of the split rings in a d.c. motor ?
3. State one advantage of a.c. over d.c.

Answer:
(1)



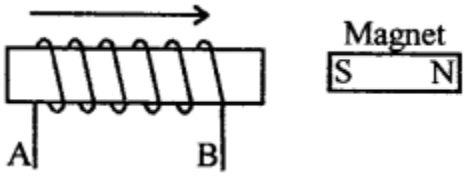
(2) The split rings alter the direction of current in the coil after every half rotation. This in turn helps the coil to move in the same direction, i.e., clockwise or anticlockwise direction.
(3) The alternating current can be easily stepped up or down and can be transmitted over long distance cable wires. This is not possible in case of direct current.

2014

Question 21.

(a) Name two factors on which the magnitude of an induced e.m.f. in the secondary coil depends.

(b)



In the following diagram an arrow shows the motion of the bar magnet.

(1) State in which direction the current flows A to B or B to A?

(2) Name the law used to come to the conclusion

Ans:

(a) The magnittude of induction e.m.f in the secondary coil depends on the following two factors

1. Strengh of current in primary
2. Speed of motion of coil
3. Area of coil and number of turns

(b)

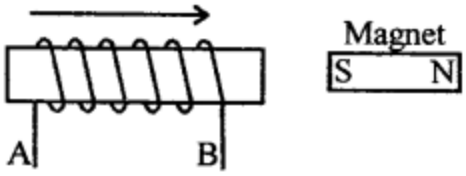
1. Current flows from A and B as N-pole is formed at end B and S-pole is is formed at end A
2. Name of the law is Lenz's law i.e such polarity is formed at coil which opposes the cause which produces

2015

Question 22 .

(a)Why does a current carrying freely suspended solenoid rest along a particular direction

(b)State the dircection in which it rest



(c) Give two similartyies between an Ac generation and DC motor

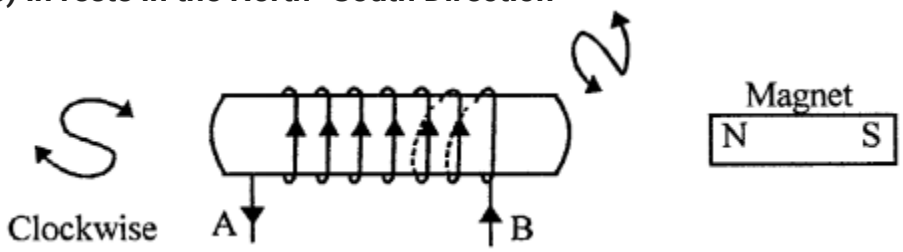
(d) fill in the blanks

on reversing the direction of the current in a wire the magnetic field produced by its gets……..

Answer:

(a) A current-carrying freely suspended solenoid acts as a bar magnet, and thus, due to the Earth's magnetic field, it rests along a particular direction.

(b) In rests in the North -South Direction



(c) Two similarities between an AC generator and a DC motor are

- A coil rotates in a magnetic field between the pole pieces of a powerful electromagnet.
- The external circuit is connected to two carbon brushes B and B.,.

(d) On reversing the direction of the current in a wire, the magnetic field produced by it gets reversed.

2016

Question 23(a).
Which coil of a step up transformer is made thicker and why?
Answer
(1) The primary coil of step up transformer is made thicker. it is because a current of higher magnitude flows in this coil, which in turn made melt it on account of resistance. Thus, in order to lower resistance it is made thicker.

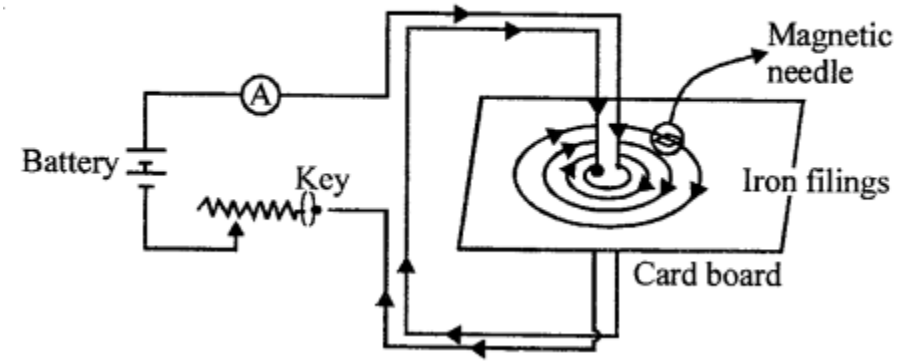
Question 23(b).
(1) Name the transformer used in the power transmitting station of a power plant.
(2) What type of current is transmitted from the power station?
(3) At what voltage is this current available to our household?
Answer

1. A step-up transformer is used in the power transmitting station of a power plant.
2. An alternating current is transmitted from the power station.
3. The current is available to our household at a voltage of 220 V.

Additional Questions.

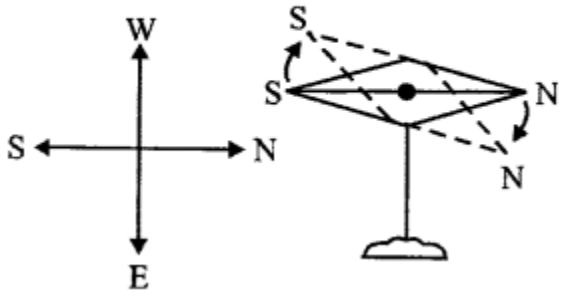
Question 1.
Draw a diagram showing the magnetic field lines due to a straight wire carrying current.

Answer:



Question 2.
A straight wire lying in a horizontal plane carries a current from North to South. What will be the direction of magnetic field at a point just beneath it ? Name the rule used to arrive at answer and state it.
Answer:s.
Towards EAST.

Rule used ⟶ OERSTED RULE

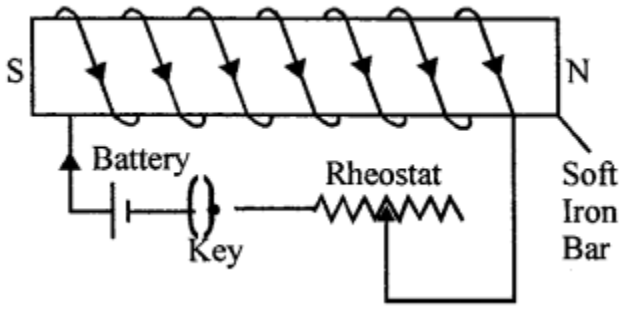


OERSTED RULE. "If a wire is held ABOVE magnetic needle, such that current is flowing NORTH to SOUTH then north pole of magnetic needle will deflect towards. EAST."

Question 3.
State a law, which determines the direction of magnetic field around a current carrying wire.
Answer:
It is RIGHT HAND THUMB RULE which states "If we hold a current carrying conductor in the right hand such that thumb points in the direction of the current, the tips of fingers pointing the direction of magnetic field lines."

Question 4.
What is Solenoid ?
Answer:
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 current flows through it is called SOLENOID."

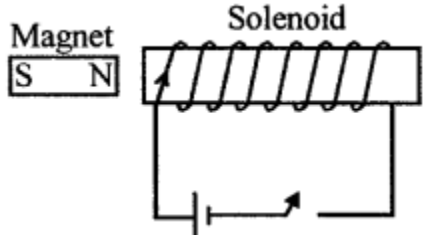
Question 5.
Draw a labelled diagram to make an electromagnet from a soft iron bar. Mark the polarity at its ends. What precautions would you observe ?
Answer:
The labelled diagram is shown in Fig.



Precautions :

1. The source of current must be the d.c. source.
2. The bar must be placed in north-south direction.

Question 6.
The adjacent diagram shows a small magnet placed near a solenoid. When current is switched on in the solenoid, will the magnet be attracted or repelled ? Give a reason for your answer.



Answer:
The magnet will be REPELLED as current flowing is ANTI CLOCK-WISE and N-pole is formed near magnet.

Question 7.
A straight conductor passes vertically through a cardboard sprinkled with iron filings.

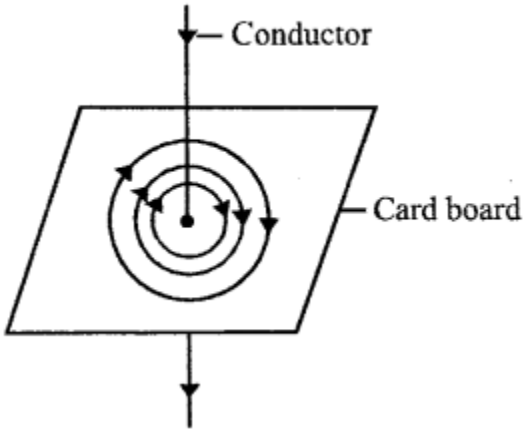
Show the setting of iron filings when a weak current is passed in the downward direction and then the card board is gently tapped.What changes occur if,

1. The strength of current is increased ?
2. The single conductor is replaced by several parallel conductor with current flowing in the same direction ?

Answer:

Fig. shows the setting of iron filings :

1. The arrangement of iron filings remains unchanged but they get arranged upto a larger distance.
2. The magnetic field strength increases.

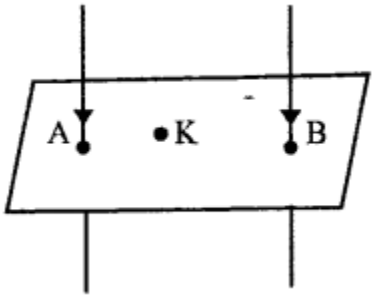


Question 8.

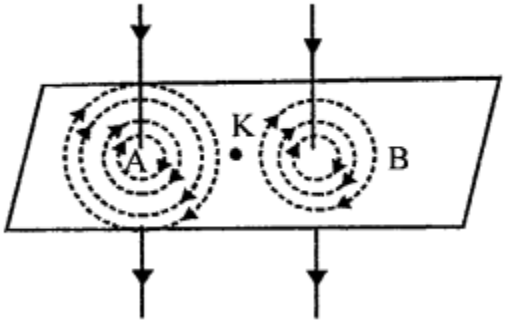
The following diagram shows two straight wires A and B carrying equal currents. Draw the pattern of magnetic field lines around them and mark their directions. What will be the resultant magnetic field at a point K equidistant from the wires A and B ? **(V.V.Imp)**

Answer:

Pattern of magnetic field lines is shown.

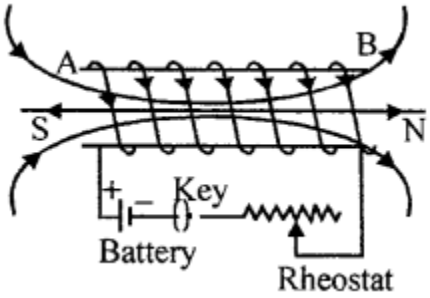


Resultant magnetic field at K is zero



Question 9.
Draw a diagram representing the magnetic field inside and outside a solenoid through which a current is flowing and mark with arrows, the direction of current in the solenoid and the direction of magnetic field lines. Also mark the polarity at the faces of solenoid. A bar of soft-iron is then placed parallel to its length inside the solenoid. Describe what happens. **(V.Imp)**

Answer:
Fig. shows the magnetic field lines due to a current carrying solenoid.
The direction in the solenoid at the face A is clockwise, so it will have the south (S) polarity and the face B of solenoid will have the north (N) polarity.

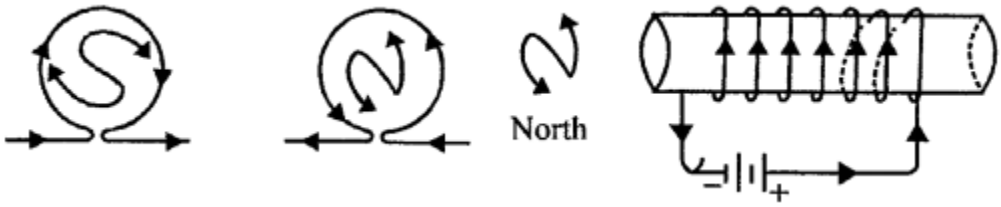


If a bar of soft iron is placed parallel to its length inside the solenoid, the magnetic field inside the solenoid becomes closer i.e. the magnetic field inside the solenoid is increased.

Question 10.
Name and state the rule by which tlv direction of magnetic field in a current carrying solenoid is determined

Answer:
Name of the rule is CLOCK RULE.
Statement : "Looking at the face of loop, if the current around that face is ANTI-CLOCK wise, the face has the NORTH POLARITY and if the current at that face is in CLOCK wise

direction, the face has the SOUTH polarity.

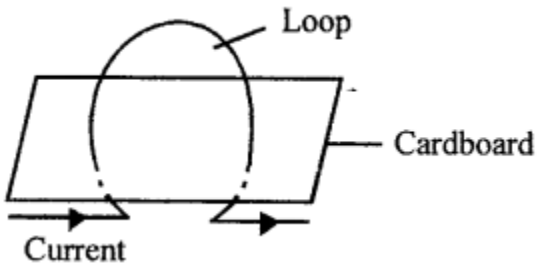


Question 11.
Complete the following sentences :

- When current flows in a wire, it creates **magnetic field around it**
- A current carrying solenoid behaves like **a bar magnet**
- When a current is passed through a conductor, is set up around the conductor **a magnetic field..**

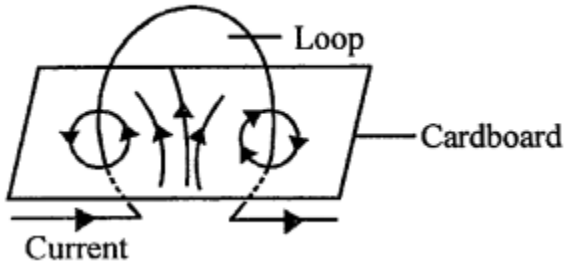
Question 12.
A soft iron bar is introduced inside a current carrying solenoid. The magnetic field inside the solenoid :
(a) will become zero
(b) will decrease
(c) will increase
(d) will remain unaffected.

Question 13.
The diagram below show a current carrying loop passing through a sheet of stiff cardboard. Draw three magnetic field lines on the card board. State two factors on which the magnitude of magnetic field at the center of the loop, depends.



Answer:
Fig. represents the magnetic field lines due to the current carrying loop using right hand

thumb rule.



The magnitude of magnetic field at the center depends on
(1) the strength of current in loop and
(2) the CURRENT radius of loop.

Question 14.
The magnetic field lines inside a current carrying solenoid, are
(a) along the axis and are parallel to each other
(b) perpendicular to the axis and equidistant from each other
(c) circular and do not intersect each other
(d) circular at the ends but they are parallel to the axis inside the solenoid.

Question 15.
What is LORENTZ force ?
Answer:
"A moving charge in magnetic field not parallel to the field experiences a force called LORENTZ FORCE." and since moving charge is called current then conductor carrying a current in magnetic field experiences force F = BI/ in other words this force F α B (magnetic field)

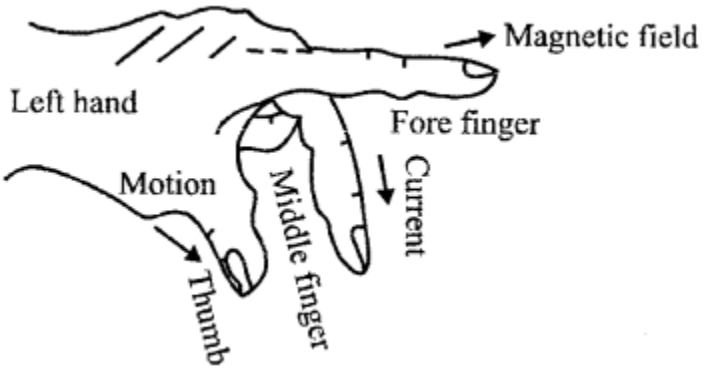
$F \propto 1$ (Current)

$F \propto l$ (length of Conductor inside the field)

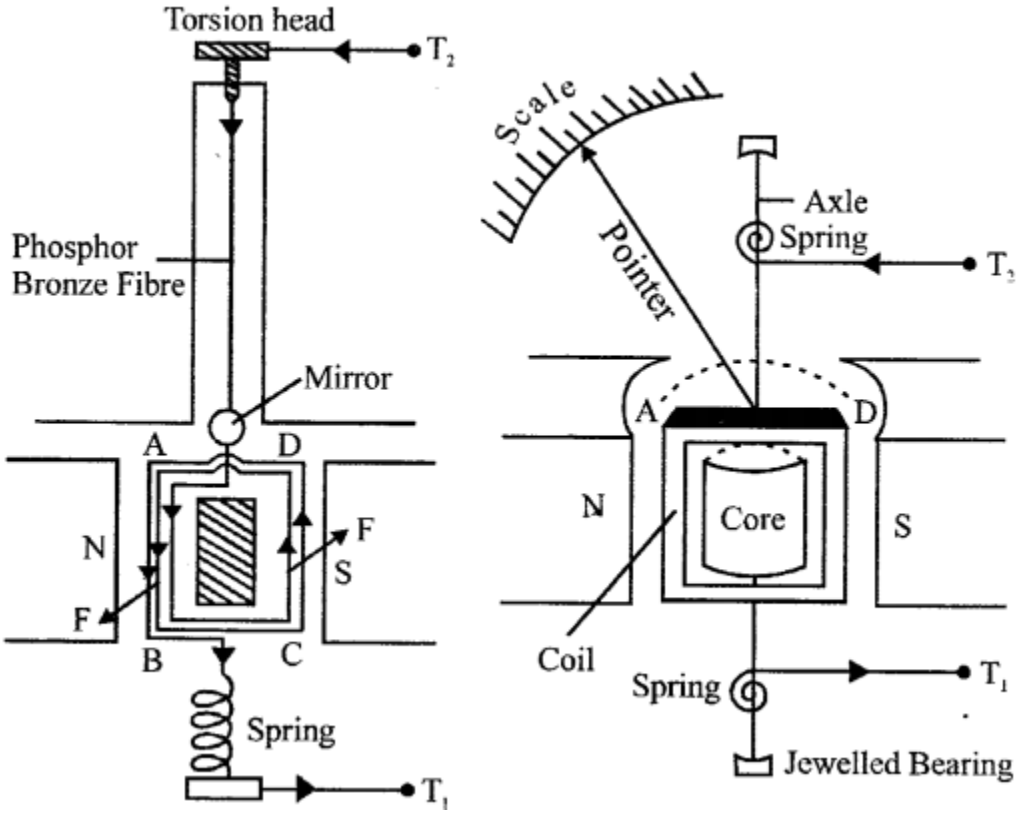
S.I. Unit of MAGNETIC FIELD $B = \frac{F}{Il} = \frac{N}{Am} = NA^{-1}\ m^{-1}$

Question 16.
State Fleming's left hand rule**. (V.Imp.)**
Answer:
Fleming's left hand Rule :
"Stretch the thumb, the force-finger and the middle finger of your left hand mutually at right-angles to each other, such that force-finger points in the direction of magnetic field and middle finger in the direction of flow of current. Then, thumb gives direction of

motion of conductor."



Question 17.
Draw a clear labelled diagram of a moving coil galvanometer. Explain why pole piece are made cylindrical?
Answer:



In order to keep the plane of coil always in the direction of magnetic field lines, the poles of the horse-shoe magnet are made cylindrical.

Question 18.
State the unit of magnetic field in terms of force experienced by a current carrying

conductor placed in a magnetic field.

Answer:

Unit of magnetic field is TESLA. See Page 472 for Tesla.

Question 19.

Why is a soft iron piece placed at the center of the coil of a moving coil galvanometer ?

Answer:

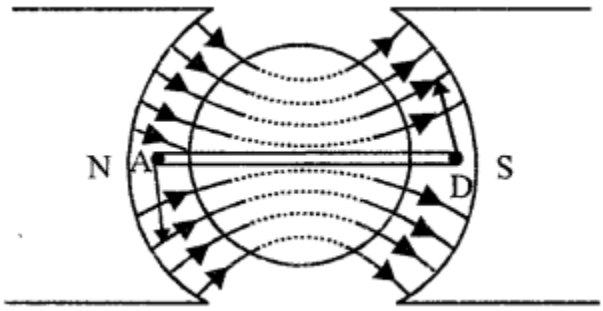
A soft iron core is placed at the center of the coil which intensifies the magnetic field and makes it radial by concentrating the magnetic field lines due to its high permeability as shown in next fig.

Question 20.

What is the use of radial magnetic field ?

Answer:

The coil rotates but its plane always remains parallel to the magnetic field making θ = 0°.



Question 21.

How is the deflection in a moving coil galvanometer related to the current in its coil ?

Answer:

The rotation of coil depends on the magnitude of the deflecting couple which is directly proportional to the strength of current. Hence DEFLECTION OF COIL IS THE MEASURE of CURRENT PASSED in the coif

Question 22.

Give uses of moving coil galvanometer. **(V.Imp.)**

Answer:

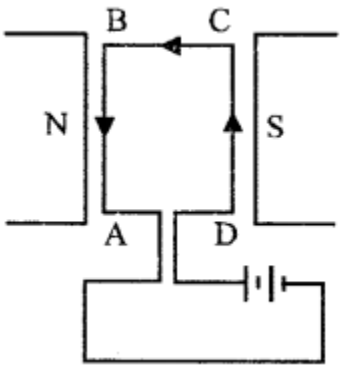
USES OF GALVANOMETER :

1. To detect the presence of current in a circuit. .
2. To convert it into AMMETER to measure current.
3. To convert it in VOLTMETER to measure p.d.
4. To detect the direction of flow of current.

Question 23.
What is an electric motor ? State its principle.
Answer:
ELECTRIC MOTOR : "is a device which converts electrical energy into mechanical energy."
PRINCIPLE : "When a current carrying conductor is placed in a magnetic field normally, it begins to move." The direction of motion is obtained by FLEMING'S LEFT HAND RULE.

Question 24.
A rectangular coil ABCD is placed between the pole pieces of a horse-shoe magnet as shown in fig. **(V.V.Imp.)**

1. What is the direction of force on each arm ?
2. What is the effect of the forces on coil ?
3. How is the effect of force on coil changed if the terminals of battery are interchanged ?



Answer:

1. In Fig. the current in coil is in direction DCBA. By Fleming's left hand rule, on the arm AB, the force is outward at right angles to the plane of coil. On the arm BC no force acts. On the arm CD, the force is inwards perpendicular to the plane of coil. On the arm DA, no force acts.
2. The force on the arms AB and CD are equal in magnitude, but opposite in direction. They form a clockwise couple. So the coil will rotate clockwise with the arm AB coming out and the arm CD going in.
   On interchanging the terminals of battery, the direction of current in coil is reversed so the coil will rotate anticlockwise.

(V.Imp. Note)

If a conductor (coil) is moved in a magnetic field or a magnet is moved in a coil (conductor) e.m.f. is produced.

Question 25.
What is electromagnetic induction ?
Answer:
ELECTROMAGNETIC INDUCTION : "Whenever there is a change in the number of magnetic field lines associated with a conductor, an electromotive force (e.m.f.) is developed between the ends of the conductor which lasts as long as the change is taking place. This phenomenon is called electromagnetic induction."

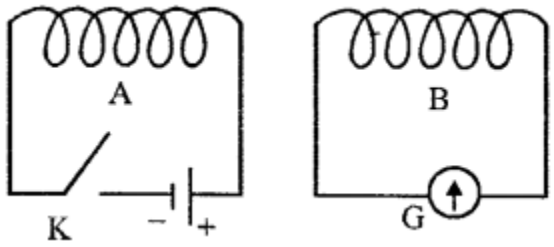
Question 26.
State Faraday's laws of electromagnetic induction. **(V.Imp.)**
Answer:
FARADAY'S LAWS OF e.m.f:

1. The magnitude of the e.m.f. induced is directly proportional to the rate of magnetic flux linked with the coil.
2. Whenever there is a change in magnetic flux linked with a coil, an e.m.f. is induced. The induced e.m.f. lasts so long as there is a change in magnetic flux linked with the coil.

Question 27.
State the two factors on which the magnitude and direction of induced e.m.f depend.
Answer:
Two Factors are :

1. The change in magnetic flux and
2. The time in which the magnetic flux changes.
   DIRECTION of induced e.m.f depends on whether the magnetic flux increases or decreases.

Question 28.
Two coils A and B are placed as shown in Fig. The coil A is connected to a battery and a key K while the coil B is connected to a center zero galvanometer G **(V.Imp.)**



What will you observe in the galvanometer G when

1. the key K is closed.
2. the key K is opened.

3. with the key K closed, the coil A is move rapidly towards the coil B.
4. with the key K closed, the coil B is moved rapidly towards the coil A.
5. with the key K closed, the coils A and B are moved away from each other ?

Answer:

1. As the key K is closed, a deflection is observed in the galvanometer for a short while (i.e. a momentary deflection). In other words, the galvanometer needle deflects for a moment and returns to zero.
2. As the key K is opened, again a momentary deflection (but more) is observed in the opposite direction.
3. With the key K closed, if the coil A is moved rapidly towards the coil B, a deflection is obtained in the galvanometer in the direction as in
    - due to increase in magnetic flux through the coil B. But the deflection lasts so long as the coil A moves.
4. With the key K closed, if the coil B is moved rapidly towards the coil A, again a deflection is observed in the galvanometer in direction as in
    - due to increase in magnetic flux through the coil B. The deflection lasts so long as the coil B moves.
5. With the key K closed, if the coil A and B are moved away from each other, a deflection is observed in the galvanometer in direction as in
    - due to decrease in magnetic flux through the coil B. The deflection lasts so long as there is relative motion between the coils.

Question 29.

The direction of induced current is obtained by :

(a) Fleming's left hand rule
(b) Maxwell's cork-screw rule
(c) Right hand palm rule
(d) Fleming's right hand rule.

Question 30.

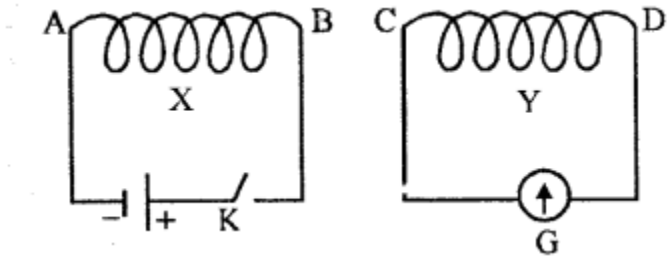
(1) State Fleming's right hand rule.
(2)What is Lenz's law ?

Answer:

1. **FLEMING RIGHT HAND RULE :** "Stretch the thumb, the fore finger and the middle finger of your right hand, mutually at right angles to each other, such that fore finger points in the direction of magnetic field and the thumb in the direction of motion of conductor. Then the direction in which the middle finger points, gives direction of flow of induced current."
2. **LENZ'S LAW :** "The direction of induced current is such, that it always opposes the cause (the motion of conductor) which produced it."

Question 31.

The diagram below shows two coils X and Y. The coil X is connected to a battery S and a key K. The coil Y is connected to a galvanometer G



When the key K is closed, State the polarity.

1. at the end B of the coil X.
2. at the end C of the coil Y.
3. at the end C of the coil Y if the coil Y is
   (a) moved towards the coil X,
   (b) moved away from the coil X

Answer:

1. Current at the end B of coil X is anti-clockwise therefore at this end there is a NORTH pole.
2. While closing the key, polarity at the end C of the coil Y will be north. There will be no polarity at the end C of the coil Y when the current becomes steady in the coil X.
3. **(a)** While the coil Y is moved towards the coil X, the polarity at the end C of the coil Y is NORTH.**(b)** While the coil Y is moved away from the coil X, the polarity at the end C of the coil B is SOUTH.

Question 32.

What is Generator ? Draw a labelled diagram of a simple a.c. generator.**(V.Imp)**

Answer:

A.C. GENERATOR OR DYNAMO

"A dynamo is a device which converts mechanical energy into electrical energy using the principle of electromagnetic induction."

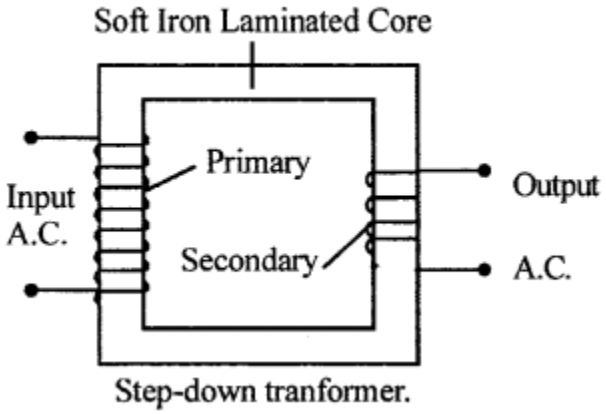
Diagram :

Question 33.

(1) Name the principle on which a transformer works.
(2) What is the function of a step-up transformer ?
(3) Can a transformer work when it is connected to a d.c. source ?
(4) Draw a simple labelled diagram of a step-down transformer ?

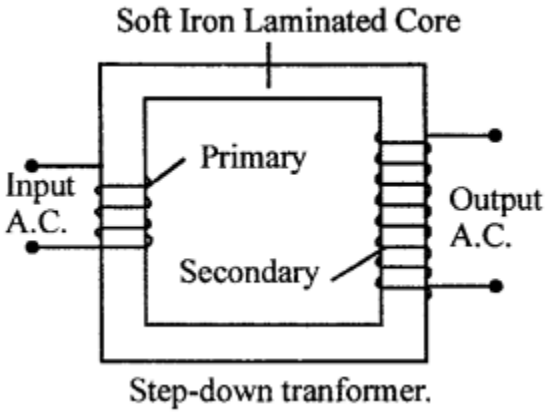
(5) Draw a simple labelled diagram of a step-up transformer. **(V.V.Imp.)**
Answer:

1. A transformer works on the principle of electromagnetic induction.
2. The function of a step-up transformer is to convert a low a.c. voltage to a high a.c. voltage.
3. No. A transformer cannot work when it is connected to a d.c. source.
4. Fig. shows a simple labelled diagram of step -down transformation.



Step-down tranformer.

5. Fig. shows a simple labelled diagram of step -up transformation.

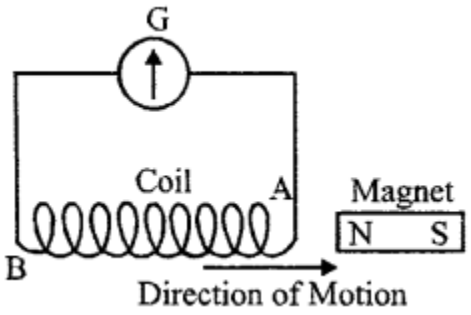


Step-down tranformer.

Question 34.
For what purpose are transformers used ? Can they be used with a direct source ?
Answer:
Transformers are used to increase or decrease the amplitude of alternating e.m.f. They cannot be used with direct source (D.C.) since its working is based on change of magnetic flux with the varying current.

Question 35.
The following diagram shows a coil of several turns of copper wire connected to a

sensitive center-zero galvanometer G near a magnet NS. The coil is free to move.



1. Describe the observation if the coil is rapidly moved in the direction of arrow.
2. How would the observation be altered if
   (a) the coil has twice as many turns,
   (b) the coil is made to move three times as fast ?

Answer:

1. Galavanometer will show deflection and N-polarity will be formed at end A of the coil repel its motion.
2. **(a)** The deflection will be more but in the same direction,
   (b) The deflection will be three times in the same direction.

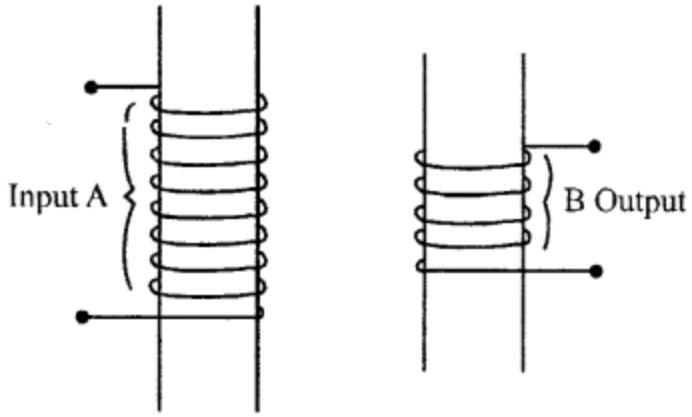
Question 36.
How are the e.m.f. in the primary and secondary coils of a transformer related with the number of turns in these coils ?
Answer:

$$\frac{\text{E.m.f. across the secondary coil } [E_S]}{\text{E.m.f. across the primary coil } [E_P]} = \frac{\text{Number of turns in Secondary } [N_S]}{\text{Number of turns in primary } [N_P]}$$

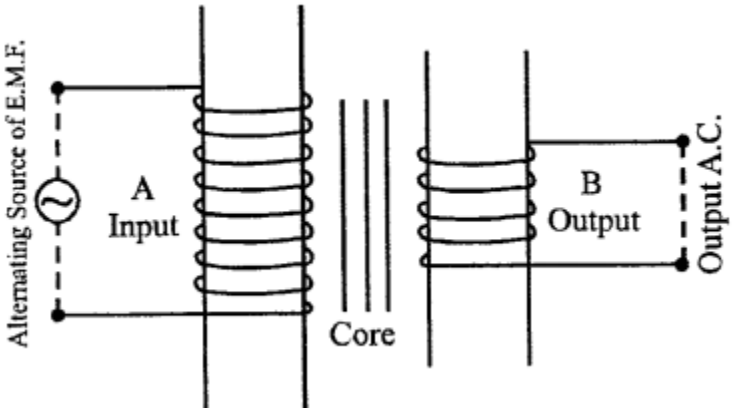
$$\frac{E_S}{E_P} = \frac{N_S}{N_P} = \textit{turns ratio } n$$

for an Ideal Transformer $E_S I_S = E_P I_P$

Question 37.
Complete the following diagram of a transformer and name the parts labelled A and B. Name the part you have drawn to complete the diagram. What is the material of this part ? Is this transformer step-up or step-down ? Why ?



Answer:
Diagram is completed
Part A → Primary Coil
Part B → Secondary Coil
Part drawn is → Input A.C. Alternating source of e.m.f. and output A.C. and core.

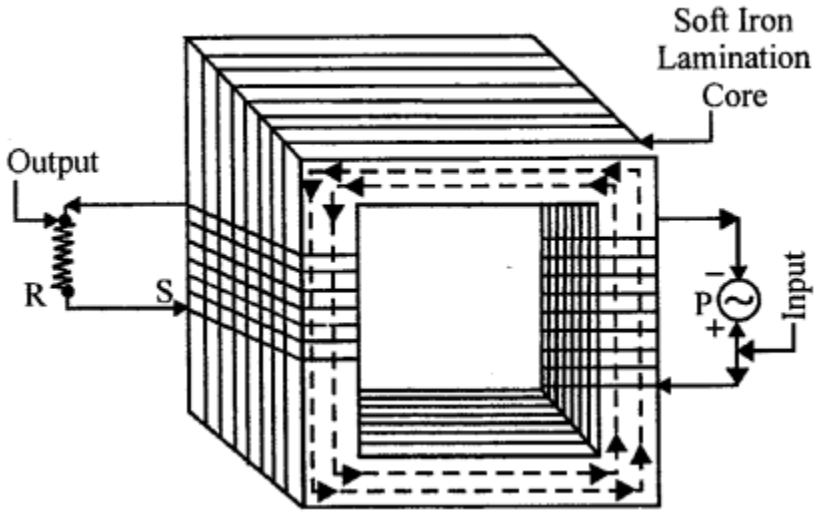


Material of Core is SOFT IRON
It is STEP DOWN TRANSFORM. Since number of turns in Secondary coil is less than that of primary.

Question 38.
Draw labelled diagram to show various components of a
(1) Step up transformer
(2) Step down transformer.
Answer:

1. **STEP-UP TRANSFORMER :** A transformer which increases the applied e.m.f. of an alternating current is called SET-UP TRANSFORMER.
   Number of turns in SECONDARY Coil Should be MORE.

2. **STEP-DOWN TRANSFORMER :** "A transformer which DECREASES the applied e.m.f. of alternating current is called STEP-DOWN TRANSFORMER."



Question 39.

A flat rectangular coil is rotated between the pole pieces of a horse-shoe magnet In which position of coil with respect to the magnetic field, will the e.m.f

(1) be maximum,
(2) be zero and
(3) change direction ? **(V.Imp.)**

Answer:

1. The e.m.f. is maximum when the plane of coil is parallel to the magnetic field.
2. The e.m.f. is zero when the plane of coil is normal perpendicular to the magnetic field.
3. The e.m.f. will change direction when the plane of coil passes from the position normal to the magnetic field.

Question 40.

A dc. motor is rotating in a clockwise direction. How can the direction of rotation be reversed ?

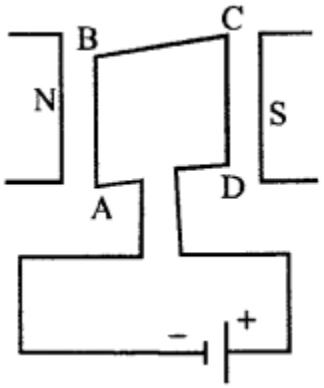
Answer:

The direction of rotation of motor can be reversed by interchanging the terminals of the battery connected to the brushes of motor.

Question 41.

Fig. shows a rectangular coil ABCD placed in between the pole pieces of a horse-shoe

magnet with its plane perpendicular to the magnetic field.



1. What is the direction of force on each arm of coil ?
2. Will the coil rotate due to the forces on its arms ?

Answer:

1. In Fig. the current in coil is in direction DCBA. On the arm AB, the force is upward in the plane of coil i.e. away from the arm CD. On the arm BC, the force is outward in the plane of coil i.e., away from the arm AD. On the arm CD,the force is downward in the plane of coil i.e., away from the arm AB. On arm DA, the force is outward in the plane of coil away from the arm BC.
2. The coil will not rotate (because all the arms experience an outward pull.)