Chapter: 15

Electromagnetism

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Objective

1. The study of magnetic effect current is called:

Ⓐ Electric Capacity **Ⓑ Electromagnetism** Ⓒ Magnetism Ⓓ Electricity

2. If we increase current on wire perpendicular in magnetic field, then the magnetic force on wire will be:

Ⓐ Increase Ⓑ Will be Zero Ⓒ Decrease Ⓓ Will not change

3. The presence of magnetic field can be detected by: or The presence of a magnetic field can be detected by a:

Ⓐ Magnetic compass Ⓑ Stationary positive charge
Ⓒ Stationary negative Ⓓ Small mass

4. What statement is true about the magnetic poles?

Ⓐ A single magnetic pole does not exist Ⓑ Magnetic pole do not effect each other
Ⓒ Like pole attracts Ⓓ Unlike pole repel

5. What is the direction of the magnetic field lines inside a bar magnet?

Ⓐ From north pole to south pole Ⓑ There are no magnetic field lines
Ⓒ From south pole to north pole Ⓓ From side to side

6. Which part of DC motor reverses the direction of current through coil every half cycle?

Ⓐ Split Rings Ⓑ Brushes Ⓒ Commentator Ⓓ Armature

7. In D.C motor coil can rotate in magnetic field by an angle of:

Ⓐ 45^0 Ⓑ 60^0 **Ⓒ 90^0** Ⓓ 30^0

8. Which device is based on the principle of electromagnetism:

Ⓐ Mobile phone Ⓑ C-D Ⓒ T-V **Ⓓ Electric motor**

9. A D.C motor converts:

Ⓐ Electrical Energy into Chemical Energy.
Ⓑ Electrical Energy into Mechanical Energy.
Ⓒ Mechanical Energy into Chemical Energy.
Ⓓ Mechanical Energy into Electrical Energy.

10. Michael Faraday belonged to:

Ⓐ Russia Ⓑ K.S.A **Ⓒ British** Ⓓ U.S.A

11. Which thing works on the principle of electromagnetic induction in hydroelectric power house:

Ⓐ Voltaic Cell Ⓑ Galvanic Cell Ⓒ Motor **Ⓓ Generator**

12. Law of electromagnetic induction and electrolysis were presented by:

Ⓐ Michael Faraday Ⓑ Newton Ⓒ Jorge coulomb Ⓓ Simon ohm

13. The direction of induced e.m.f in a circuit is in accordance with the conservation of:

Ⓐ Energy Ⓑ Momentum Ⓒ Charge Ⓓ Mass

14. On which principle induced e.m.f is produced in the secondary coil?

Ⓐ Induced Current **Ⓑ Mutual Induction** Ⓒ Electric Induction Ⓓ Self-Induction

15. Transformer is used for:

(A) Increase voltage (B) Increase resistance (C) Both A and B (D) None of these

16. Transformer is used to:

(A) Decrease voltage (B) Increase voltage (C) Both A and B (D) None of these

17. A device which is used to increase the alternating voltage is called:

(A) Step-up transformer (B) Motor
(C) Generator (D) Step-down transformer

18. Transformer is used to change the value of:

(A) Power (B) Voltage (C) Energy (D) Charge

19. ..... in a transformer the voltage across secondary coil is denoted by:

(A) V_P (B) N_S (C) N_P (D) V_S

20. Turns ratios in a transformer is 1 : 100, it means that:

(A) $N_S = 100N_P$ (B) $N_S = N_P/10$ (C) $I_S = 101_P$ (D) $V_P/10$

21. The transformer works on. OR The principle of working of transformer is:

(A) Principle of Mutual Induction (B) Principle of Self Induction
(C) Principle of D.C Motor (D) Principle of A.C generator

22. The step up transformer:

(A) Increases the input voltage (B) Has more turns in the primary coil
(C) Has less turns in the secondary soil (D) Increases the input current

23. The turn ratio of transformer is 10. Its means:

(A) $V_S = 10V_P$ (B) $N_S = N_P/10$ (C) $I_S = 10I_P$ (D) $N_S = 10N_P$

24. A device which is used to increase or decrease the alternation voltage is called:

(A) Voltage (B) Transformer (C) Generator (D) Motor

25. When number of turns in primary coil is greater than secondary coil, this transformer is called:

(A) Up and down (B) Step up (C) Step down (D) All of these

26. The application of mutual induction is:

(A) Relay (B) Transformer (C) A.C Generator (D) D.C Motor

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Subjective

Q1: ***Demonstrate by an experiment that a magnetic field is produced around a straight current carrying conductor.***

Ans: *Take a conductor and pass it through the card board. Now connect the wire with battery. The current will start flowing through the wire. Now magnetic field produced around the wire will be in the form of concentric circles.*

The direction of magnetic field depends on the direction of current. If we place the compass needle near the wire its direction will change from north to south. This indicates that magnetic field is present around wire.

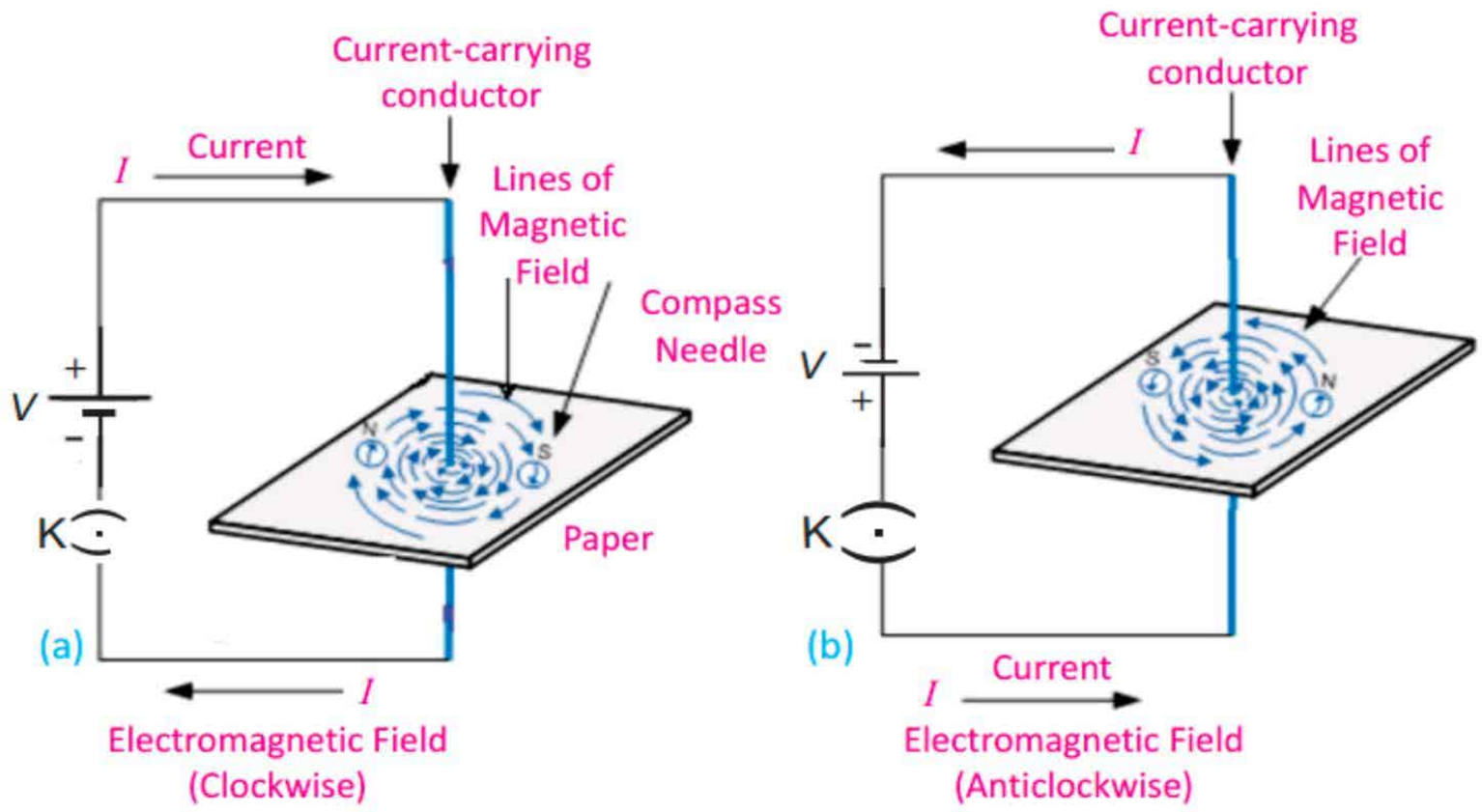

Fig.

Q2: ***State Right Hand Rule.***

Ans: *According to this rule, "Grasp the current carrying conductor in right hand with the thumb being stretched in the direction of conventional current. The curl of fingers of you hand will point in the direction of magnetic lines of force."*

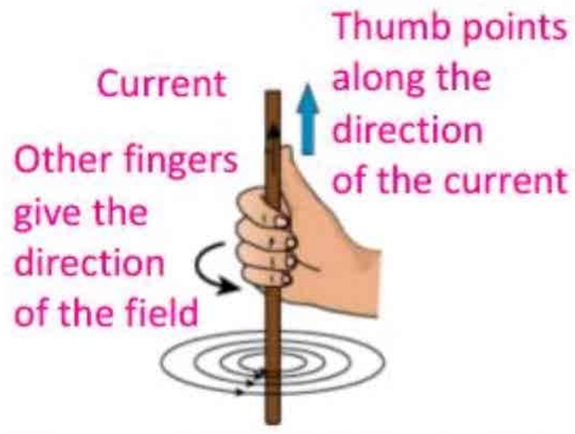

Fig. Right hand grip rule

Q3: ***State Fleming's left hand rule.***

Ans: ***Fleming's left hand rule:***

"Stretched the thumb, forefinger and the middle finger of the left hand mutually, perpendicular to each other. If the forefinger points in the direction of magnetic field, the middle finger in the direction of the current, then thumb would indicate the direction of the force acting on the conductor."

Q4: ***What are the factors which affect the magnitude of the e.m.f induced in a circuit by changing magnetic field?***

Ans: *The magnitude of induced e.m.f in a circuit depends on the following factors:*

- *Strength of magnetic field.*
- *Speed of relative motion of the coil and magnet.*
- *Number of turns of the coil.*

Q5: ***What do you mean by mutual induction?***

Ans: *"The phenomenon of production of induced current in one coil due to change of current in a neighboring coil is called mutual induction."*

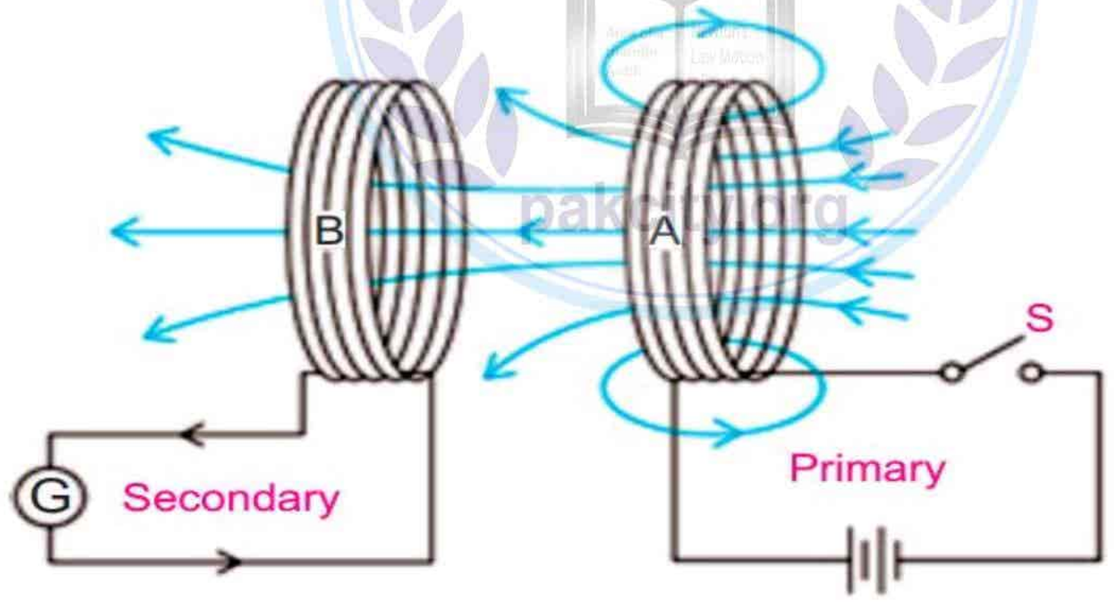

Fig. Mutual induction

Q6: ***The voltage chosen for the transmission of electrical power over large distances in many times greater than the voltage of the domestic supply. Give two reasons why electrical power is transmitted at high voltage?***

Ans: *Since* $P = VI$ or $I = P/V$, *so when the same amount of power is transmitted at high voltages, current in the conductor should be low. This leads to less power loss in the power lines. Since power loss is proportional to the square of current.*

$$P = I^2R$$

So, for the same value of R and power, power losses is less if current is less this can be achieved by transmitting power at high voltages.

Q7: ***Why is the voltage used for the domestic supply much lower than the voltage at which the power is transmitted?***

Ans: *The voltage used for the domestic supply is much lower because voltage is stepped down and is transmitted to the city sub-station. All the house-hold appliances operate at 220v.*

Q8: ***Define Electromagnetism.***

Ans: ***Electromagnetism:***

Electromagnetism is the study of magnetic effect of current. The uses of electromagnetism in different fields of science and technology are very wide. Motors and electric meters are based on the effect of magnetism.

Q9: ***What is meant by solenoid?***

Ans: *A long coil of wire consisting of many loops is called a solenoid. The field from each loop in a solenoid adds to the field of the other loops and creates greater total field's strength.*

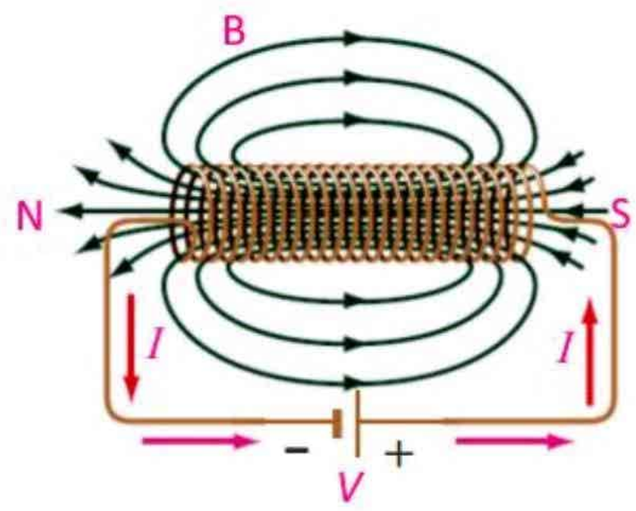

Fig. Magnetic field due to a solenoid

Q10: ***Write down two ways to increase the magnetic field.***

Ans: *Two ways to increase the magnetic field are:*

- *The current in the wire is increased.*
- *Strength of magnetic field is increased.*

Q11: ***Define electric motor.***

Ans: ***Electric motor:***

Electric motor is a device that converts electric energy into rotational kinetic energy.

Principle:

Torque acting on a loop placed in the magnetic field, is proportional to the magnetic of current passing through the loop. If we increase the number of loop, the turning effect greatly increased. This is the principle of electric motor.

Q12: ***What is D.C motor?***

Ans: ***D.C motor:***

D.C motor is a device that converts direct (electrical energy) into mechanical energy.

Q13: ***What is the fundamental difference between generator and motor? OR What is main difference between generator and motor?***

Ans: *Difference between generator and motor is:*

Generator	Motor
❖ *Generator is a device that converts mechanical energy into electric energy.*	❖ *Electric motor is a device that converts electric energy into mechanical energy.*

Q14: ***On what principle D.C motor work?***

Ans: *When a current carrying coil is placed in a magnetic field, it experiences a couple due to which the coil beings to rotate. D.C motor operates on this principle.*

Conceptual Question

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Q1: ***Suppose someone handed you three similar iron bars and told you one was not magnet but the other two were. How would you find the iron bar that was not magnet?***

Ans: *If we bring a compass needle near three iron bars, the compass needle will only show response to the magnets. So when we take compass needle near the iron bar, it will not change its direction so the iron bar will not be a magnet.*

Q2: ***Suppose you have a coil of wire and a bar magnet. Describe how you could use them t generate an electric current?***

Ans: *Whenever there is relative motion between coil and magnet an e.m.f is induced in the coil due to which current began to flow in the coil of wire.*

Q3: ***Which device is used for converting electrical energy into mechanical energy?***

Ans: D.C motor is used to convert electrical energy into mechanical energy.

Q4: ***Suppose we hang a loop of wire so that it can swing easily. If we now put a magnet into the coil, the coil will start swinging. Which way will it swing relative to the magnet and why?***

Ans: According to the Lenz's law "The direction of an induced current in a circuit is always such that it opposes the cause that produced it." Hence coil will move opposite to the direction of motion of magnet. If magnet moves forward, coil moves backward and vice versa.

Q5: ***A conductor wire generates a voltage while moving through a magnetic field. In what direction should the wire be moved, relative to the field to generate the maximum voltage?***

Ans: A conductor wire generates a voltage while moving through a magnetic field. To generate the maximum voltage a conductor wire should be perpendicular to the magnetic field.

Q6: ***What is difference between a generator and a motor?***

Ans: Difference between a generator and a motor is:

Generator	Motor
❖ A generator converts mechanical energy into electrical energy. ❖ Slip rings are used in ac generator. ❖ Mechanical source is needed to rotate coil of generator.	❖ A motor converts electrical energy into mechanical energy. ❖ Split rings are used in D.C motor. ❖ Electrical source is needed to rotate coil of motor.

Q7: ***What reverses the direction of electric current in the armature coil of D.C motor?***

Ans: To reverse direction of current the connection to coil is made through an arrangement of brushes and ring that is split into two halves called split rings. These rings are also called commentators.

Q8: ***Can transformer operate on direct current?***

Ans: ***No,*** *transformer cannot operate on DC because magnetic flux cannot be transferred from primary coil to secondary coil. Transformer works on the phenomenon of production of induced current in one coil due to change of current in a neighboring coil. This is possible only with alternating current.*

Additional Question

Q1: ***What do you understand by magnetic flux?***

Ans: The number of magnetic lines of force passing through any surface held perpendicular to the direction of magnetic field is called magnetic flux.

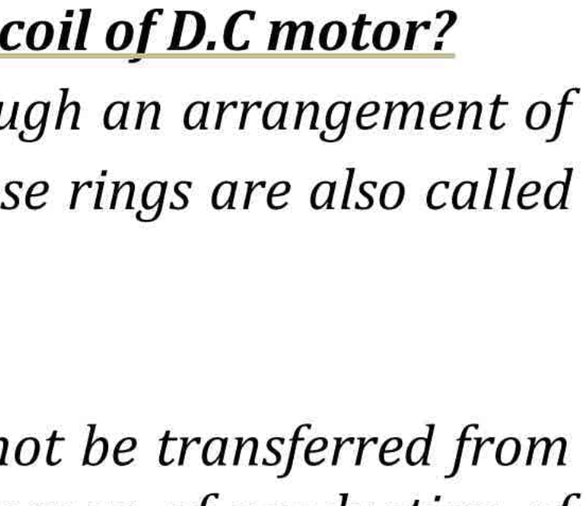

Fig. Maximum strength of magnetic field

Q2: ***On what factors does the magnitude of induced e.m.f depend?***

Ans: The magnitude of induced e.m.f depends on following factors:

- *Number of turns in the coil.*
- *Strength of magnetic field.*
- *Speed of relative motion of magnet and coil.*

Q3: ***What is an AC generator? Write its principle.***

Ans: ***AC generator:***

AC generator converts mechanical energy into electrical energy.

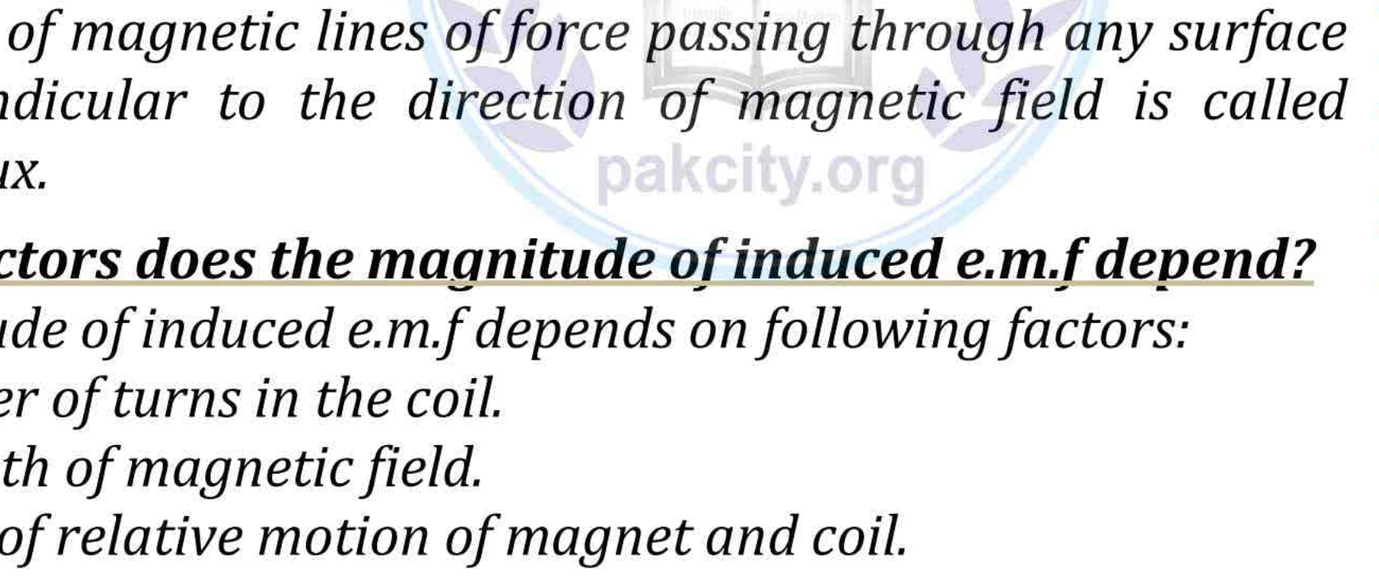

Fig. A.C Generator

Principle:

The principle on which it works is electromagnetic induction i.e. when a coil rotates in a magnetic field the flux passing through it continuously changes. This change of magnetic flux produces and induced e.m.f.

Q4: **What is mutual induction?**

Ans: *If a current is induced in a circuit due to change of current in another circuit. This phenomenon is called mutual induction.*

Q5: **What is a transformer? On which principle does it work?**

Ans: **Transformer:**

A transformer is an electrical device which is used to increase or decrease the value of alternating voltage.

It works on the principle of mutual induction.

Q6: **What are two types of transformer and how they are made? or What do you mean by step up and step down transformer?**

Ans: *The two types of transformer are step-up and step-down transformer.*

Step-up Transformer:

If number of turns in the secondary coil are greater than the number of turns in primary coil than this transformer is called step up transformer. It increases the input voltage.

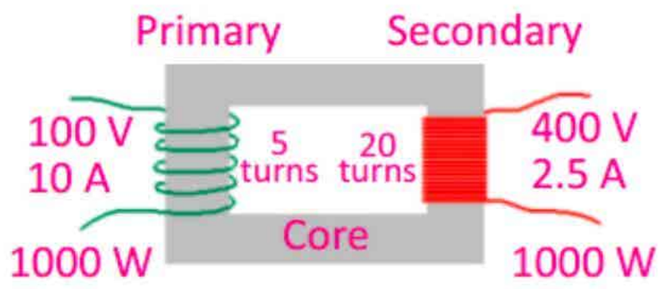

Fig. (a) Step-up transformer

Step-down Transformer:

If number of turns in the secondary coil is less than the number of turns in primary coil than this transformer is called step up transformer. It decreases the input voltage.

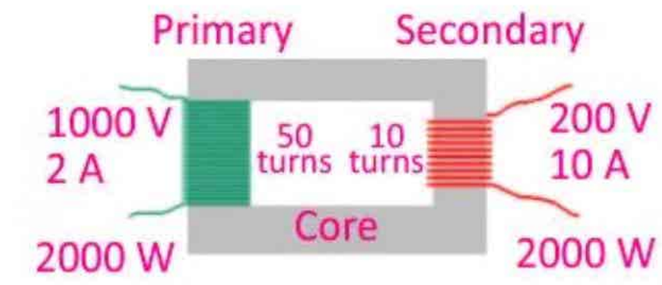

Fig. (b) Step-down transformer

Q7: **What is the function of split rings in D.C motor?**

Ans: *Split rings connect the coil to the battery through carbon brushes. When coil rotates in between the pole of pieces of a magnet, split rings keep the current in the coil and hence coil rotates in the field.*

Q8: **What is D.C motor? On what principle does it work?**

Ans: **D.C motor:**

D.C Motor is a device which converts electrical energy into mechanical energy.

Principle:

It works on the principle that when current passes through a coil placed in magnetic field. It experiences a force due to which coil rotates in the field.

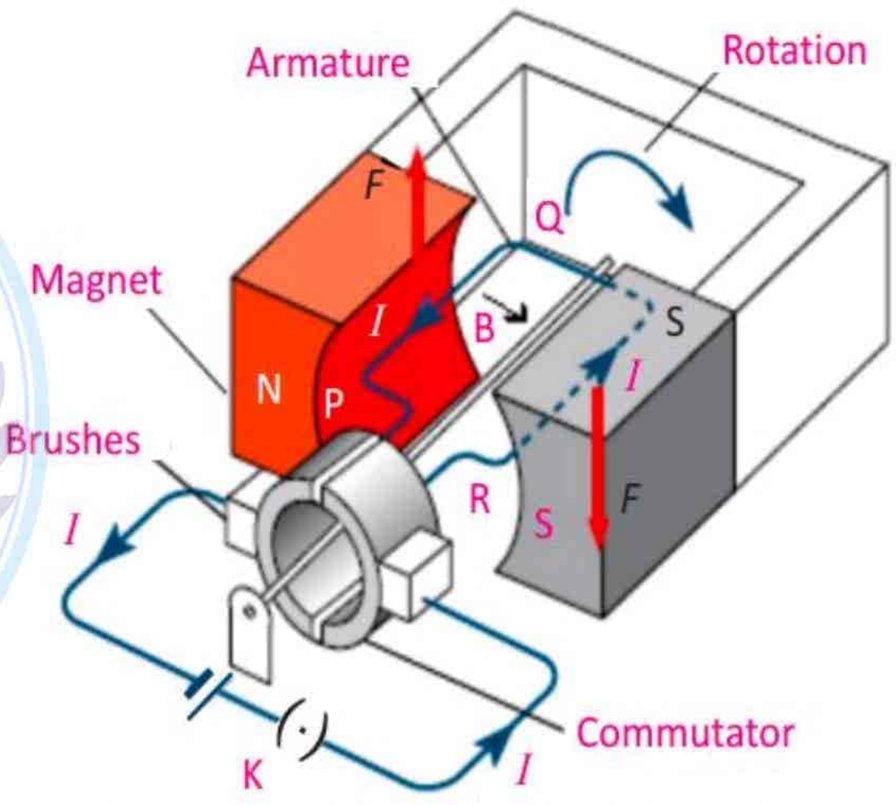

Fig. Working principle of D.C motor

Q9: **State the rule to find north and South Pole of current carrying solenoid.**

Ans: *Hold the solenoid in your right hand by curling the fingers in the direction of current. The stretched thumb will indicates the North Pole.*

Q10: **What is the principle to find the direction of magnetic field? State it.**

Ans: *"Hold the current carrying straight conductor in right hand in such a way that thumb shows the direction of current then curling of right hand fingers will give the direction of magnetic field, which will be in the form of concentric circles."*

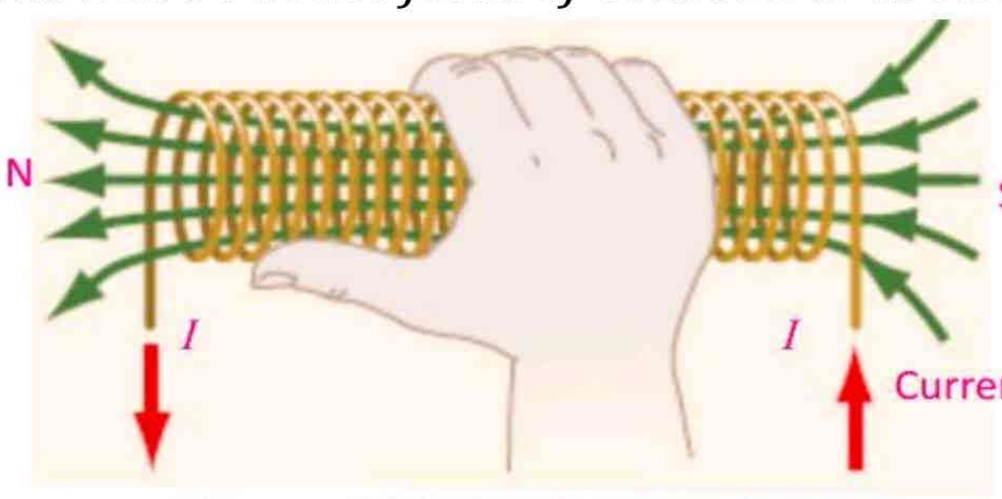

Fig. Right hand grip rule for a coil

Q11: ***What is relay? How does it work?***

Ans: ***Relay:***

The relay is an electrical switch which is used to control a large current with the help of small current it opens and closes under the control of another electrical circuit.

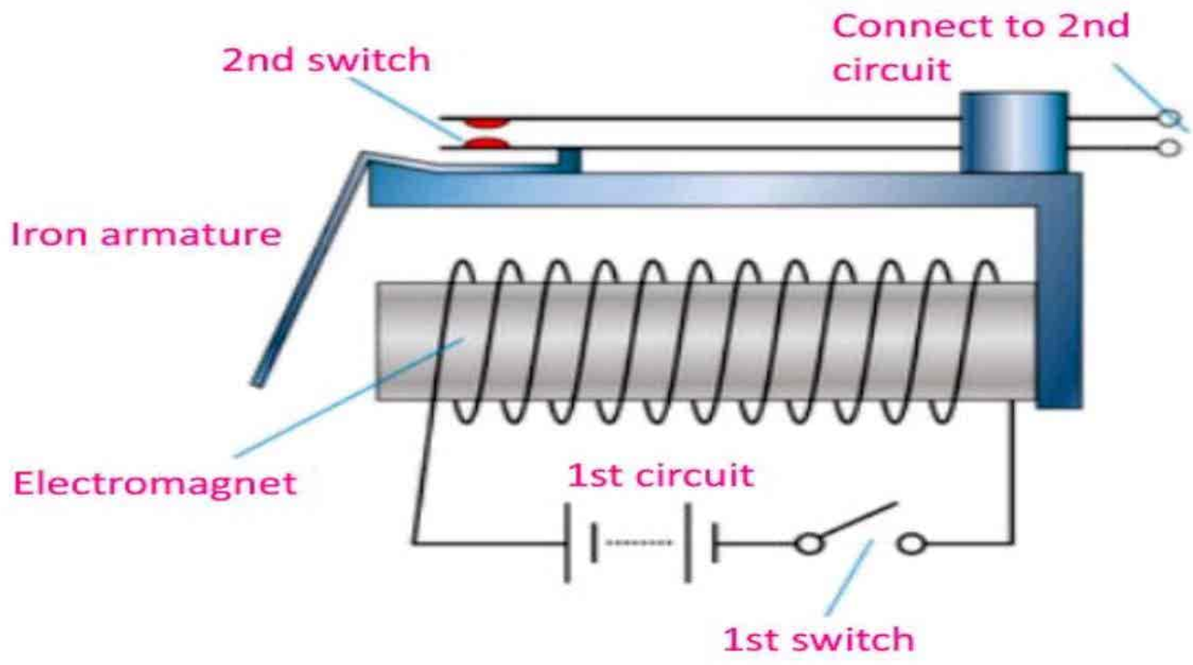

Fig. Relay circuit

Q12: ***Define Lenz's Law***

Ans: ***Lenz's Law:***

"The direction of an induced current in a circuit is always such that it opposes the causes that produce it."

Q13: ***How many coils are used in transformer? Write their names.***

Ans: Two coils are used in transformer:

- *Primary coil*
- *Secondary coil*

Q14: ***What is meant by intensity of magnetic field?***

Ans: The strength of magnetic field is defined as the number of magnetic lines of force passing through any surface.

Q15: ***Define electromagnetic induction.***

Ans: ***Electromagnetic induction:***

The process of generating an induced current in a circuit by changing the number of magnetic lines of force passing through it is called electromagnetic induction.

Q16: ***State Faraday's law of electromagnetic induction.***

Ans: ***Faraday's law:***

"The value of induced e.m.f in a circuit is directly proportional to the rate of change of number of magnetic lines of force through it."

Q17: ***Why reserves the direction of electric current in the armature coil of D.C motor?***

Ans: Brushes, which are usually pieces of graphite, make contact with the commentator and allow current to flow into the loop. As the loop rotates, so does the commentator.
The split ring is arranged so that each half of the commentator charges brushes just as the coil reaches the vertical position changing brushes reverse the current in the loop.

Q18: ***Define strength of magnetic field.***

Ans: The strength of magnetic field is defined as the number of magnetic lines of force passing through any surface.

Condition of maximum and minimum number of lines:

- *The number of lines of force is maximum when the surfaces are held perpendicular to the magnetic lines of force.*
- *Number of lines will be minimum when surface is held parallel to the magnetic lines of force.*

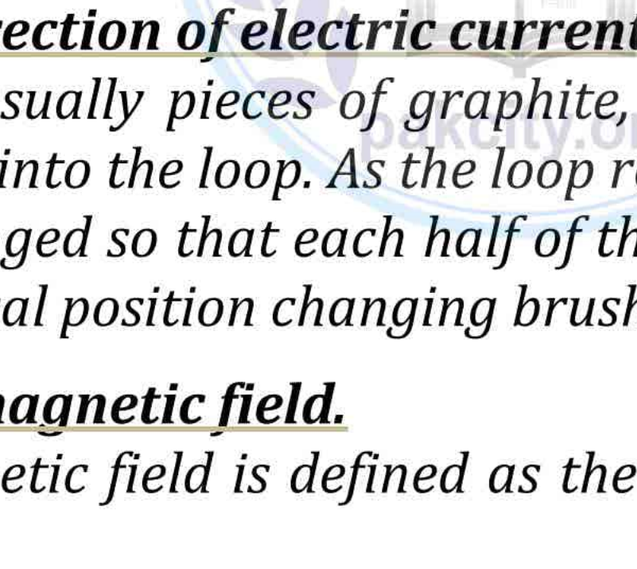

Fig. Maximum strength of magnetic field

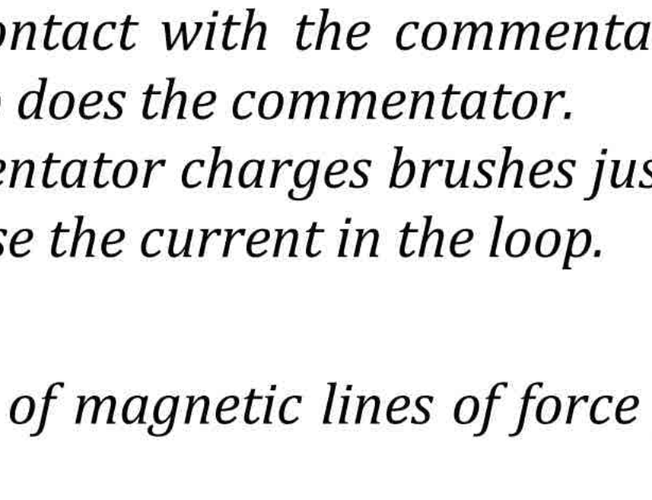

Fig Minimum strength of magnetic field

Q19: ***Can transformer work on direct current?***

Ans: ***No,*** *a standard, transformer cannot work with direct current.*

Reason:

The primary coil has to induce current in the secondary coil. The only way this can happen if there is a varying magnetic field in primary which then will induce a varying magnetic field in secondary which results in a current in the secondary. Only varying (alternating current) current can induce a varying magnetic field.

Q20: ***Prove for an ideal transformer that $V_P/V_S = I_S/I_P$.***

Ans: *For an ideal transformer we known that power of secondary coil = power of primary coil*

$$P_p = P_s$$

Because $P = IV$

Then $I_pV_p = I_sV_s$

$$V_p/V_s = I_s/I_p$$

Chapter : 15	***Electromagnetism***

Imp.Long Questions

Q.1: ***Explain construction, principle and working of D.C. Motor.***

Q.2: ***Explain electromagnetic induction with an example.***

Q.3: ***Define and explain Lenz's law. OR Describe the direction on induced e.m.f in a circuit? How does this phenomenon relate to conservation of energy? Define specific resistance. On what factor does resistance R depend? Derive its relation.***

Q.4: ***What is A.C generator? Explain its construction and working.***

Q.5: ***What is transformer? Explain its construction and working.***

Q.6: ***A step-up transformer has a turn ratios of 1 : 100. An alternating supply of 20 V is connected across the primary coil. What is the secondary voltage?***

Q.7: ***A transformer, designed to convert the voltage from 240 V a.c mains to 12 V, has 4000 turns on the primary coil. How many turns should be on the secondary coil? If the transformer were 100% efficient, what current would flow through the primary coil when the current in the secondary coil was 0.4 A?***

Q.8: ***A power station generates 500 MW of electrical power which is fed to a transmission line. What current would flow in the transmission line, if the input voltage is 250 kV?***