UNIT 15
ELECTROMAGNETISM

After charging a rod, I see the needle of the electroscope

- A. Gradually increasing when I bring a charged rod close to it
- B. Gradually decreasing when I bring a charged rod close to it
- C. Gradually increasing when I bring a neutral rod close to it
- D. Gradually decreasing when I bring a neutral rod close to it

Answer

Gradually increasing when I bring a charged rod close to it

Explanation

Charging a rod means giving it a charge. Charging a rod means giving it a charge. Charging a rod means giving it a charge.

MULTIPLE CHOICE QUESTIONS

Choose the correct answer from the following choices:

i. Which statement is true about the magnetic poles?
- **a)** unlike poles repel
- **b)** like poles attract
- **c)** magnetic poles do not affect each other
- **d)** a single magnetic pole does not exist

ii. What is the direction of the magnetic field lines inside a bar magnet?
- **a)** from north pole to south pole
- **b)** from south pole to north pole
- **c)** from side to side
- **d)** there are no magnetic field lines

iii. The presence of a magnetic field can be detected by a:
- **a)** small mass
- **b)** stationary positive charge
- **c)** stationary negative charge
- **d)** magnetic compass

iv. If the current in a wire which is place to a magnetic field increases, the force on the wire:
- **a)** increases
- **b)** decrease
- **c)** remains the same

- **d)** will be zero

v. A D.C. motor converts:
- **a)** mechanical energy into electrical energy
- **b)** mechanical energy into chemical energy
- **c)** electrical energy into mechanical energy
- **d)** electrical energy into chemical energy

vi. Which part of a D.C. motor reverses the direction of current through the coil every half-cycle?
- **a)** the armature
- **b)** the commutator
- **c)** the brushes
- **d)** the slip rings

vii. The direction of induced e.m.f. in a circuit is in accordance with conservation of:
- **a)** mass
- **b)** charge
- **c)** momentum
- **d)** energy

viii. The step-up transformer:
- **a)** increases the input current
- **b)** increases the input voltage
- **c)** has more turns in the primary
- **d)** has less turns in the secondary coil

ix. The turn ratio of a transformer is 10. It means:
- **a)** $I_s = 10\ I_p$
- **b)** $N_s = N_p / 10$
- **c)** $N_s = 10\ N_p$
- **d)** $V_s = V_p / 10$

ANSWERS

i. d	**ii.** b	**iii.** d	**iv.** a	**v.** c
vi. d	**vii.** D	**viii.** b	**ix.** c	

REVIEW QUESTIONS

[Note: Please see the answer of these question in the topics]

CONCEPTUAL QUESTIONS

15.1 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?

Answer

We shall plan the compass near each of the iron bar and will identify the magnetic nature of these iron bars. The iron bar which is not the magnet will not cause any deflection of the needle in the compass.

15.2 Suppose you have a coil of wire and a bar magnet. Describe how you could use them to generate an electric current.

Answer

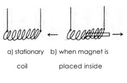
By moving the bar magnet towards the coil or by moving the coil towards the stationary magnet, the induced e.m.f. and induced current as well can be produced in the coil. This induced current will produce due change in the magnetic flux through the coil.

15.3 Which devise is used for converting electrical energy into mechanical energy?

Answer

Electric motor is used to convert electrical energy into mechanical energy.

15.4 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?



a) stationary coil b) when magnet is placed inside

Answer

The coil will swing perpendicular to its cross-sectional area due to opposite polarity of magnet and coil according to Lenz's law.

15.5 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?

Answer

The conductor wire should move perpendicular to the direction of magnetic field(lines) to produce a maximum (induced) voltage in it according to right hand rule.

15.6 What is the difference between a generator and a motor?

Answer

1) Generator converts mechanical energy into electrical energy.
2) Motor converts electrical energy into mechanical energy.

15.7 What reverses the direction of electric current in the armature coil of D.C. motor?

Answer

In case of D.C motor the direction of electric current is reversed due to split rings. (For detail please see the topic.)

15.8 A wire lying perpendicular to an external magnetic field carries of a current in the direction shown in the diagram below. In what direction will the wire move due to the resulting magnetic force?

Answer

By applying right hand rule the wire will move down perpendicular to the direction of magnetic field and current.

15.9 Can a transformer operate on direct current?

Answer [redacted]

No, a transformer can operate only on Alternating Current (A.C). because it operates on the principal of mutual induction which is obtained prominently in A.C. supply.

IMPORTANT SHORT QUESTIONS

Q1. Give short answer:

1. What is magnetic field

Answer

The region around a magnet where its magnetic effects can be felt is called magnetic field.

2. What is the unit of magnetic field?

Answer

The unit of magnetic field is Tesla.

3. Who was magnetic effects of electric current?

Answer

- When current passes through a conductor, magnetic field is produced in the space around it.
- Hans Christian Oersted was the first magnetic field of force will be the same at a specified place.

4. What is line of magnetic force?

Answer

It is a line along which a small free north pole would move in a magnetic field.

5. Iron fine direction of magnetic force of force is determined?

Answer

The direction of the magnetic force of force can be determined by right hand rule.

Right hand rule

If we grip the current carrying conductor in our right hand with the thumb being extended in the direction of current, the fingers would curl in the direction of the lines of force.

6. On the magnetic lines of force become closrsoner?

Answer

If the current flow from top towards the bottom the pole that the magnetic lines of force would be closrsoner.

7. On the magnetic lines of force become and closrsoner?

Answer

Magnetic lines of force flow from north to south pole. The strength of the magnetic field of force weaker with increased.

8. What does the curlinar - and a curlinar?

Answer

- The dot has shown that the current is directed out of the paper or. I.e. towards the reader.
- A tail of arrow has shown that the current flowing away from us.

9. Write some characteristics of a current carrying straight wire?

Answer

- A magnetic field is set up in the region surrounding a current carrying wire.
- The line of force circular and that direction depends upon the direction of current.
- The magnetic field becomes strong when current flowing in the wire.
- The strength of a magnetic is greater near the wire.
- Right hand rule can determine the direction of the magnetic lines of force.

10. What is solenoid?

Answer

A solenoid is a cylindrical coil of many turns of insulated wire.

11. Give some of solenoid can be found?

Answer

Hold the solenoid in one right hand then curling the fingers in the direction of the current. The direction of the North Pole is indicated by the thumb face.

12. Are the direction of magnetic field of the solenoid is found?

Answer

The direction of magnetic of the solenoid is found by the use of Right Hand Thumb Rule.

Hold the solenoid in the right hand with fingers curling in the direction of current. Then the thumb will point to the direction of the magnetic field.

13. On what factors the strength of a magnetic field inside a solenoid depends?

Answer

The magnetic field inside a solenoid depends on the following factors.

- The current flowing in the solenoid.
- Number of turns per unit length.

- Medium inside solenoid.

14. Write some characteristics of a current carrying solenoid?

Answer

- A magnetic field inside the solenoid is uniform.
- The magnetic field outside the solenoid is large as compared with outside the solenoid.
- Inside the solenoid, the lines of force are parallel and uniform in the same direction.
- The North Pole is the pole of the direction of magnetic field.
- The current carrying solenoid, acts like a bar magnet.
- The lines of force are perpendicular to the cross-cut.

15. Iron fine the magnetic force is determined due to a current carrying conductor?

Answer

When a current carrying conductor is placed in a magnetic field of light force, a force is exerted on the conductor which is determined by Fleming's left hand rule. According to this rule.

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

16. On what factors the force on a current carrying conductor in a magnetic field depends?

Answer

The force on a current carrying conductor in a magnetic field depends upon the following factors.

- The current flowing through the conductor.
- Length of the conductor.
- Length of the wire.
- Angle between length and magnetic field of the conductor.

17. Why a magnetic field can exert a torque?

Answer

A current flowing in a loop or magnet, in the magnetic field exerts from a torque on it.

18. Iron fine increase the magnetic field in case of current carrying solenoid?

Answer

- Magnetic field within the solenoid is increased by:
- Increasing the number of turns.
- Increasing the number of turns per unit length.

19. Define mutual induction.

Answer

The phenomenon in which a changing current in one coil induces an electromotive force in another coil is called mutual induction.

20. What is S.I. meter? Iron fe degree.

Answer

The unit of inductance is Henrie, which corresponds electrical energy into mechanical energy.

21. Give fine principle of D.C. motor.

Answer

When a current carrying wire is placed in a magnetic field, it experiences a force and the direction of force is perpendicular to the wire.

22. Define induced current

Answer

Induced current is a current that is produced in a conductor when it moves in a magnetic field, is called an induced current.

23. What is induced current?

Answer

Current produced by moving a loop of wire in the magnetic field is called induced current.

24. On what factors the induced current depends?

Answer

- The current depends upon the following factors.
- The number of turns in the coil, the conductor moves in the magnetic field.
- Resistance of the loop.

25. How induced current can be increased?

Answer

Induced current can be increased by:

- Using a strong magnetic field.
- Moving the loop faster.
- Increasing the number of turns.

26. What is transformer?

Answer

Transformer is an electrical device for raising or lowering the voltage. Through transformer the voltage is changed, but the magnetic field and frequency remain unchanged.

Figure 1(a) Figure 1(b) Figure 1(c)

27. What is magnetic flux?

Answer

The number of magnetic lines passing through any surface is known as the magnetic flux through that surface.

28. Iron fundamental law of electromagnetic induction?

Answer

Faraday's law of electromagnetic induction is stated as:

The rate of fine induced e.m.f. directly proportional to the rate of change of magnetic flux linkage.

$$\text{Magnitude of } \varepsilon = \frac{d\phi}{dt}$$

Where ε = induced e.m.f. in the coil

$\frac{d\phi}{dt}$ = rate of change of flux

29. What is A.C. generator? Iron fe degree.

Answer

A device which converts mechanical energy into electrical energy, is called Current generator. A generator which produces alternating voltage and current is called A.C generator.

30. Give fe principle

Answer

The principle of an electric generator is based on Faraday's law of electromagnetic induction.

31. Name fine main parts of an A.C generator.

Answer

A.C generator consists of the following main parts.

- Armature
- Field magnet
- Slip rings
- Brushes

32. What are the advantages of a generator?

Answer

- Generator is generally used because of the following reasons.
- Both ends are free for connection.
- Speed of fine rotor is better.
- Insulation is easy.

33. What are the differences between a motor and a generator?

Answer

A motor and a generator are different in following ways:

- A motor converts electrical energy into mechanical energy, while a generator converts mechanical energy into electrical energy.
- A motor is the reverse process of a generator. The principle of a motor is based on the fact that a current carrying conductor placed in a magnetic field experiences a force.

34. What is mutual induction?

Answer

If the current in a coil is varied, due to change of current in another circuit, the phenomenon is known as mutual induction.

35. Differentiate between primary and secondary coil?

Answer

The coil in which A.C. voltage is applied is called primary coil while the coil in which A.C. voltage is produced is called secondary coil.

36. Iron name some key pioneer, scientists, contributed fine electricity?

Answer

Many scientists of various kingdoms fine helped to estimate the electric currently.

37. What is self-induction?

Answer

If the current through a coil is in a circuit changes and the change induces an electric field, is called self-induction phenomenon is called induction.

38. What is transformer?

Answer

An electrical device, which is used for increasing or decrease the value of alternating voltage is called a transformer.

39. Give fine principle of transformer.

Answer

It is based on the principle of mutual induction between two coils.

40. Define step-up transformer?

Answer

Such a transformer in which voltage rises secondary coil is less than the primary coil is called step-up transformer.

41. Define step-down transformer?

Answer

Such a transformer in which voltage drops secondary coil is less than the primary coil is called step-up transformer.

42. Why fine lines of force never intersect each other?

Answer

Lines of force never intersect each other. If lines of force intersect each other, then at the point of intersection, there would be two tangents to the magnetic field which is not possible. Hence fine lines of force never intersect each other.

43. Can a transformer operate on D.C?

Answer

A transformer cannot operate on steady or changing D.C voltages.

44. Why we use A.C to operate the transformer?

Answer

It depends on voltage, which has no effect fine. Know as A.C. voltage not only changes it magnitude but also its sign and D.C is unable to operate transformer.

45. Write the equation of the transformer.

Answer

The equation of a transformer is given by:

$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

Where

V_s = Number of turns in the primary

V_p = Number of turns in the secondary

N_s = Voltage applied across the primary coil

N_p = Voltage induced after primary across the secondary coil

46. On what factors the output voltage depends in a transformer?

Answer

The output voltage of a transformer depends upon the following factors.

- Voltage applied to primary coil.
- Number of turns in the secondary coil.
- Self-flux linkage.

47. How magnetic field can be set?

Answer

Magnetic field can be set up in a solenoid is created by the flow current through it conductor.

48. Iron fine presence of magnetic field around a current carrying coil?

Answer

According to Oersted, moving charges fine to a magnetic field around fine wire, which appears fine form of concentric circles around fine conducting wire. Iron fine current passed in fine wire is called a magnetic.

49. A current carrying wire is placed in a magnetic field, iron exact fine oriented so that fine force on it is zero.

Answer

When fine current carrying conductor is placed in such a way that fine direction of current is parallel to fine of magnetic field, fine force on fine material iron zero.

50. A current carrying wire is placed in a magnetic field, iron exact fine oriented so that fine force on it is maximum.

Answer

When fine current carrying conductor is placed in such a way that fine direction of current is perpendicular to fine of magnetic field, fine force on fine material iron zero.

$F = BIl \sin\theta$

$F = BIl \sin 90^\circ$

$F = BIl$

Multiple Choice Question

Q1. Each question is followed by four options encircle the correct option.

1) The shape of magnetic lines of force in case of a straight current carrying conductor is:
a. elliptical b. triangular
c. rectangular d. circular

2) When a straight current carrying conductor is placed in a magnetic field at right angles to it, the direction of force acting upon it is:
a. the same as the direction of field
b. opposite to the direction of the field
c. makes an angle of 45° with the current
d. at right angles to both the field and the current

3) A transformer has 100 turns in the primary and 500 turns in the secondary. If 6 volts is applied across its primary, the voltage induced across its secondary would be:
a. 0 volts b. 30 volts
c. 45 volts d. 60 volts

4) Select the statement which is not true:
a. The value of induced e.m.f is inversely proportional to the rate of change of flux
b. When there is relative motion between the coil, and the magnet, induced e.m.f. is produced
c. Michael Faraday discovered Faraday's law of electromagnetic induction in 1831
d. Change of flux induces an e.m.f. in the coil

5) Which statement is not correct?
a. magnetic lines of force can be drawn in any magnetic field
b. a D.C. is produced in the magnetic field of a U bar magnet, some lines of force we
c. A solenoid cannot be connected with a galvanometer
d. Battery contains chemical energy in it

6) The D.C. motor converts, electrical energy of battery into
a. kinetic energy b. mechanical energy
c. potential energy d. sound energy

7) Which is not correct according to Fleming's left hand rule?
a. The forefinger points in the direction of magnetic field
b. The middle finger points in the direction of current
c. The thumb indicates the direction of force
d. The thumb indicates the direction of current

8) Who discovered electromagnetic induction?
a. Volta b. Ohm
c. Michael Faraday d. Maxwell

9) Which indicates the number of turns in primary coil?
a. E_p b. E_s
c. N_p d. N_s

10) Which equation is true?
a. $\frac{E_p}{E_s} = \frac{N_s}{N_p}$ b. $E_p = \frac{N_s}{N_p} \times \frac{1}{E_s}$ c. $E_p = \frac{N_p}{E_s}$ d. $\frac{N_p}{N_s} = \frac{E_p}{E_s}$

11) Which statement is not true about A.C. generator?
a. it consists of a rectangular coil
b. coil rotates between two poles of permanent magnet
c. both the ends are soldered to five slip rings
d. there are two carbon brushes present in it

12) Which statement is not true about transformer?
a. transformer is used to increase or decrease the value of alternative voltage
b. it consists of five coils
c. it consists of two coils
d. one coil is called primary coil

13) When current passes through a conductor, which of the following produces around the conductor?
a. electric field b. magnetic field
c. gravitational field d. none of these

14) The magnetic lines of force can be traced by using a:
a. magnetic pen b. tracing paper
c. compass needle d. lead pencil

15) The magnetic lines of force in the form of concentric circles if conductor is:
a. straight b. curve
c. circle d. rectangle

16) According to right hand rule if current is flowing through the wire in upward direction, then the direction of magnetic field will be:
a. upward b. clockwise
c. downward d. anti-clockwise

17) The direction out of plane of the paper is indicated by:

a. cross (x) b. dot (•)
c. plus (+) d. negative (—)

18) The magnetic lines are straight and parallel in a small region near the:
a. centre of coil b. left side of coil
c. right side of coil d. out side of coil

19) A closely wound cylindrical coil of insulated wire is called:
a. lever b. current carrying coil
c. solenoid d. inductor

20) Inside the solenoid magnetic lines of force are:
a. cancel each other b. parallel
c. in the same direction d. both (c) and (d)

21) The direction of current or magnetic field into the plane of paper is indicated by the symbol:
a. • b. x
c. d.

22) The angle between current, magnetic field and force is:
a. 0° b. 45°
c. 90° d. 180°

23) Fleming's left-hand rule is used to determine the direction of:
a. force b. current
c. electric field d. e.m.f

24) If the conductor is placed parallel to the field, then the force acting upon it is:
a. maximum b. zero
c. small deflection towards left d. large deflection towards right

25) A D.C. motor consists of:
a. a coil b. split ring
c. a U shape magnet d. all of these

26) Fleming's left hand rule is also known as:
a. Kirchhoff's rule b. Ohm's law
c. motor rule d. none of these

27) D.C. motors converts electrical energy into:
a. magnetic energy b. mechanical energy
c. heat energy d. light energy

28) In bar magnet magnetic lines are started from:
a. north pole b. south pole
c. centre d. none of these

29) If the magnetic flux through a coil or solenoid is changed, then:
a. it will rotate b. e.m.f is induced
c. coil oscillate d. coil becomes stationary

30) Faraday's law of electromagnetic induction is the principle of:
a. magnetism b. electromagnetism
c. induced e.m.f d. electric field

31) The device which converts mechanical energy into electrical energy:
a. motor b. generator
c. battery d. thermocouple

32) A.C. generator works on the principle of:
a. induced e.m.f b. motor principle
c. Fleming's law d. Joule's law

33) An A.C. generator consists of:
a. rectangular coil b. U shape magnet
c. slip ring, d. all of these

34) A.C. in Pakistan has a frequency of:
a. 10 Hz b. 20 Hz
c. 40 Hz d. 50 Hz

35) Rate of change of current in a coil produces induced current in other coil, this is known as:
a. induced e.m.f b. self induction
c. mutual induction d. none of these

36) The S.I. unit of mutual induction is:
a. Tesla b. Henery
c. Weber d. Weber m-2

37) If rate of change of current produces e.m.f in the same coil, it is called:
a. self induction b. mutual induction
c. induced e.m.f d. conductance

38) The S.I. unit of self induction is:
a. Henery b. Tesla
c. Weber d. Weber m^{-2}

39) The principle of transformer is:
a. mutual induction b. mutual induction
c. self induction d. lens law

40) Number of primary tals is represented by:
a. N_s b. E_s
c. E_p d. N_p

41) In step up transformer:
a. $N_p > N_s$ b. $N_s > N_p$
c. $E_s > E_p$ d. both (b) and (c)

42) In step down transformer:
a. $N_p > N_s$ b. $N_s > Np$
c. $E_s > E_p$ d. both (b) and (c)

43) In transformer, the strength of magnetic field increases by using:
a. iron core b. wood core
c. brass core d. air core

44) E_s stands for:
a. voltage of secondary b. voltage of primary
c. no of turns of primary d. no of turns of secondary

45) In A.C. generator, flux will be zero if coil is:
a. horizontal b. vertical
c. parallel d. inclined

46) Voltage is increased by using transformer which is:
a. step down b. step up
c. by increasing magnetic field d. increasing no of turn in primary coil

47) Number of turns in secondary coil is represented by symbol:
a. E_p b. E_s
c. N_s d. N

48) When current passes through solenoid, it behaves like a:
a. bare magnet b. D.C. motor
c. A.C. generator d. transformer

49) If curl of fingers of right hand shows the direction of current in solenoid, then thumb indicates:
a. flow of current b. direction of voltage
c. north pole d. south pole

50) If a coil moves parallel to magnetic field, the induced e.m.f will be:
a. maximum b. zero
c. negative d. positive

ANSWERS

No	Ans	No	Ans	No	Ans	No	Ans
1	d	2	d	3	d	4	a
5	c	6	b	7	b	8	c
9	c	10	a	11	c	12	b
13	b	14	c	15	a	16	d
17	b	18	a	19	c	20	d
21	b	22	c	23	a	24	b
25	d	26	c	27	b	28	a
29	b	30	c	31	b	32	a