CHAPTER 13

Magnetice Effect of Electric Current

1. OBJECTIVE QUESTIONS

1. Instrument can be shielded from outside magnetic effects by surrounding them with
(a) Rubber shield (b) Glass shield
(c) Iron shield (d) Brass shield

Ans : (c) Iron shield

2. By removing the inducing magnet, the induced magnetism is
(a) Finished after some time
(b) Finished just after
(c) Not finished for a long time
(d) Not changed

Ans : (b) Finished just after

3. Choose the correct option (s).
The magnetic field inside a long straight solenoid-carrying current
(a) is zero
(b) decreases as we move towards its end.
(c) increases as we move towards its end.
(d) is the same at all points.

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

4. Which of the following is not true
(a) Induction precedes attraction
(b) We cannot isolate a single pole
(c) We can magnetise an iron ring
(d) A permanent magnet retains its magnetism even when heated on a flame.

Ans : (d) A permanent magnet retains its magnetism even when heated on a flame.

5. Which of the following correctly describes the magnetic field near a long straight wire?
(a) The field consists of straight lines perpendicular to the wire.
(b) The field consists of straight lines parallel to the wire.
(c) The field consists of radial lines originating from the wire.
(d) The field consists of concentric circles centred on the wire.

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

6. Magnetic field due to a current through a straight conductor depends on
(a) current
(b) distance from the wire
(c) Both (a) and (b)
(d) cross-sectional area of wire

Ans : (c) Both (a) and (b)

Magnetic field due to a current through a straight conductor depends on the current and distance from the wire (r) i.e.

$$B \propto I$$

$$B \propto \frac{1}{r}$$

$$B \propto \frac{I}{r}$$

7. The magnetic field at a distance r from a long wire carrying current I is 0.4. Tesla. The value of magnetic field at a distance $2r$ is
(a) 0.2 T (b) 0.1 T
(c) 0.15 T (d) 1 T

Ans : (a) 0.2 T

As, $$B \propto \frac{1}{r}$$

$$\frac{B_1}{B_2} = \frac{2r}{r}$$

$$B_2 = \frac{B_1}{2} = \frac{0.4}{2} = 0.2\ \text{T}$$

8. A positively-charged particle (alpha-particle) projected towards west is deflected towards north by a magnetic field. The direction of magnetic field is
(a) towards south (b) towards east
(c) downward (d) upward

Ans : (d) upward

9. The magnetic lines of force, inside a current carrying

solenoid, are
(a) along the axis and are parallel to each other
(b) perpendicular to the axis and equidistance from each other
(c) circular and they do not intersect each other
(d) circular at the ends but they are parallel to the axis inside the solenoid.

Ans : (a) along the axis and are parallel to each other

10. Which of the following statement is not correct about two parallel conductors carrying equal currents in the same direction?
(a) Each of the conductors will repel each other.
(b) The two conductors will repel each other.
(c) The are concentric lines of force around each conductor
(d) Each of the conductors will move if not prevented from doing so

Ans : (b) The two conductors will repel each other.

11. Force on a current carrying conductor in a magnetic field depends on
(a) direction of the current
(b) direction of magnetic field
(c) Both (a) and (b)
(d) length of the wire

Ans : (c) Both (a) and (b)

The direction of force on the conductor depends on
1. direction of current
2. direction of magnetic field

Force on the conductor is maximum when the direction of current is at right angle to the direction of magnetic field.

12. Which of the following processes will not produce new magnetic poles?
(a) cutting a bar magnet in half
(b) turning on a current in a solenoid
(c) running a current through a straight wire
(d) placing an iron rod in contact with a magnet

Ans : (c) running a current through a straight wire

13. A tesla is equivalent to a
(a) newton per coulomb
(b) newton per ampere-meter
(c) ampere per newton
(d) newton per ampere-second

Ans : (b) newton per ampere-meter

14. To avoid risk of electrical shock, which phenomena is used?
(a) Over loading (b) Short circuiting
(c) Earthing (d) None of these

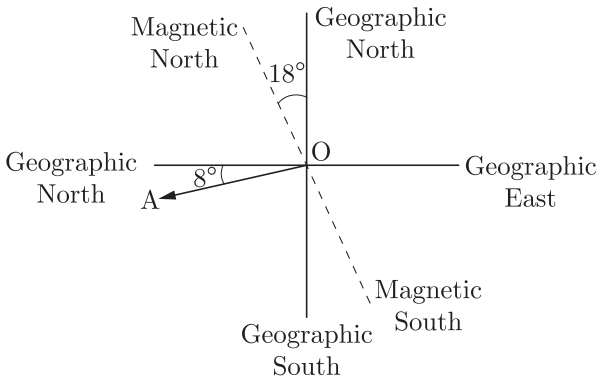
Ans : (c) Earthing

To avoid risk of electrical shock, the metal body of appliance is earthed. Earthing means to connect the metal case of the appliance to earth by means of a metal wire called earth wire. One end of the metal wire is buried in the earth.

15. A ship is to reach a place 8° south of west. In what direction should the ship be steered if declination at the place is 18° west?
(a) West of magnetic south at angle 64°
(b) East of magnetic north at angle 64°
(c) West of magnetic south at angle 50°
(d) East of magnetic north at angle 18°

Ans : (a) West of magnetic south at angle 64°

As the ship is to reach a place 8° South of West, i.e. along OA, as shown in figure, so, the ship should be steered West of magnetic North at an angle of $(90° - 18° - 8°) = 64°$



16. The effective length of the magnet is
(a) the complete length of the magnet
(b) the distance between the two poles of the magnet
(c) the half of the length of the magnet
(d) the square of the length of the magnet

Ans : (b) the distance between the two poles of the magnet

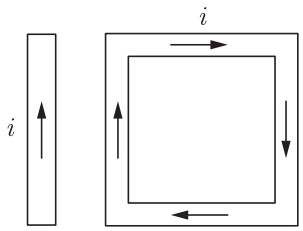
17. A small magnet is placed perpendicular to a uniform magnet field. The forces acting on the magnet will result in
(a) Rotational motion
(b) Translatory motion
(c) No motion at all
(d) Translational and rotational motion both

Ans : (a) Rotational motion

18. The magnetic field at a point due to a current carrying conductor is directly proportional to the
(a) current flowing through to the
(b) Distance from the conductor
(c) Voltage across the conductor
(d) Resistance of the conductor

Ans : (a) current flowing through to the

19. A rectangular loop carrying a current i is situated near a long straight wire such that the wire is parallel to one of the sides of the loop and is in the plane of the loop. If a steady current i is created in wire as shown in figure below, then the loop will



(a) rotate about an axis parallel to the wire
(b) move towards the wire
(c) move away from the wire or towards right
(d) remain stationary

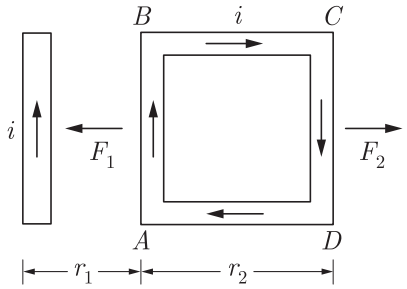
Ans : (b) move towards the wire

As, $r_1 < r_2$

So, $F_1 > F_2$

$F_{net} = F_1 - F_2$

directed towards the wire



20. Which of the following determines the direction of magnetic field due to a current carrying conductor?
(a) Faraday's laws of electromagnetic induction
(b) Fleming's left-hand rule
(c) Lenz's rule
(d) Maxwell's cork screw-rule

Ans : (d) Maxwell's cork screw-rule

21. Magnetic lines do not intersect on one-another because
(a) they are at a distance
(b) they are in the same direction
(c) they are parallel to another
(d) at the point intersection there will be two direction of the magnetic force which is impossible

Ans : (d) at the point intersection there will be two direction of the magnetic force which is impossible

22. A vertical wire carries a current upward. The magnetic field north of the wire will be directed
(a) upward (b) eastward
(c) westward (d) northward

Ans : (c) westward

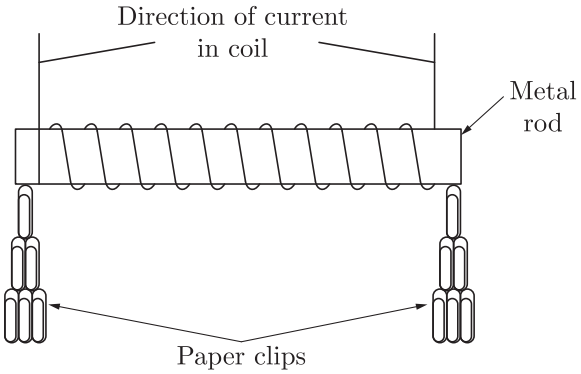
23. When the bars of bismuth are placed between the magnetic poles they set their length
(a) perpendicular to the lines of force
(b) along the lines of force
(c) neither perpendicular nor along the lines of force
(d) In any direction

Ans : (a) perpendicular to the lines of force

24. Which one of the following substances is the magnetic substances?
(a) Mercury (b) Iron
(c) Gold (d) Silver

Ans : (b) Iron

25. Four metal rods are placed, in turn, inside a coil of copper wire.



The table below gives the results of the experiment. Which rod would be the most suitable to use for the case of a coil in a circuit breaker?

Metal rod	Number of paper clips picket up when there is a current in the coil	Number of paper clips still attracted when the current is switched off
(a)	1	0
(b)	20	2
(c)	35	0
(d)	35	30

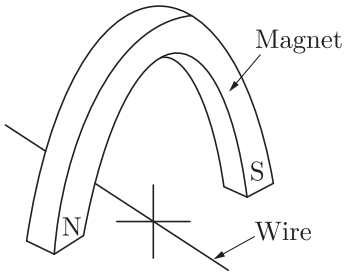
Ans : (c)

The core of the circuit breaker should be made up of soft iron type magnetic material which can be strongly magnetised. But it retains the magnetism till the current is flowing.

Only in the option (c), it is correctly listed. As, it attracts the greatest member of clips when current is

in the coil and as soon as current is removed, it does not attract any clips.

26. A copper wire is held between the poles of a magnet.



The current in the wire can be reversed. The pole of the magnet can also be changed over. In how many of the four directions shown can the force act on the wire?

(a) 1 (b) 2

(c) 3 (d) 4

Ans : (b) 2

From Fleming's left hand rule, we know that the force acting on the wire must be perpendicular to the current in the wire and the magnetic field.

This means, these are only two possibilities for the direction of the force i.e., upward or downward.

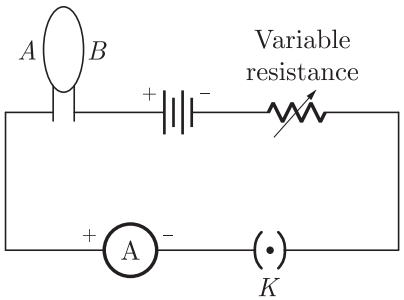
27. A circular loop placed in a plane perpendicular to the plane of paper carries a current when the key is ON. The current as seen from points A and B (in the plane of paper and on the axis of the coil) is anti clockwise and clockwise respectively. The magnetic field lines point from B to A. The N-pole of the resultant magnet is on the face close to

(a) A

(b) B

(c) A if the current is small, and B if the current is large

(d) B if the current is small and A if the current is large



Ans : (a) A

28. Three plotting compasses are placed close to a solenoid carrying a current. How many of the compass needles will change direction, if the current through the solenoid is increased? (Ignore the effect of the earth's magnetic field).

(a) Only 1 compass needle (b) 2 compass needle

(c) 3 compass needle (d) None of the above

Ans : (d) None of the above

The plotting compass gives the direction of the magnetic field. The magnitude of the current affects the strength of field and not the direction of the magnetic field. So, the compass needles will not change the direction.

29. The magnetic lines of force, inside a current carrying solenoid, are

(a) along the axis and are parallel to each other

(b) perpendicular to the axis and equidistance from each other

(c) circular and they do not intersect each other

(d) circular at the ends but they are parallel to the axis inside the solenoid.

Ans : (a) along the axis and are parallel to each other

2. FILL IN THE BLANK

1. A compass needle is a ..... magnet.

Ans : Small

2. Field lines are used to represent a .....

Ans : Magnetic field

3. Field lines are shown closer together where the magnetic field is .....

Ans : Greater

4. A metallic wire carrying an electric current has associated with it a ..... field.

Ans : Magnetic

5. The force that a magnetic field exerts on a current is always perpendicular to the ..... and to the .....

Ans : Field, Current

6. In a magnetic field pointing away from you, an electron traveling to the right will experience a force in the ..... direction.

Ans : Downward

7. Magnetic fields are produced by .....
Ans : Currents

8. Closeness of field lines indicate ..... magnetic field strength.
Ans : high

9. Magnetic field lines emerge from the ..... pole of a solenoid or a permanent magnet.
Ans : North

10. Field lines come out of ..... pole while enters from ..... pole.
Ans : North, South

11. The N-pole of a compass points to the ..... pole of a permanent magnet.
Ans : S

12. In right hand thumb rule the thumb points in the direction of .....
Ans : current

13. You are looking into a solenoid, at its S-pole, along its axis. From your view point, the direction of the current in the solenoid is .....
Ans : Clockwise

14. Crowding the wires of a solenoid more closely together will ..... the strength of the field inside it.
Ans : Increase

15. A Permanent behaves like a solenoid because both contain currents in the form of .....
Ans : Circles

16. The field lines about the wire consist of a series of concentric circles whose direction is given by the ..... rule.
Ans : Right-hand

17. An electric current can be used for making temporary magnets known as .....
Ans : Electromagnets

18. The unit of magnetic field is .....
Ans : Tesla

19. The S.I. unit of magnetic flux .....
Ans : Weber

20. The force between currents is called the ..... force.
Ans : Magnetic

21. The unit of self-inductance in SI system is ..... .
Ans : Henry

22. No force acts on a current carrying conductor when it is ..... to the magnetic field.
Ans : parallel

23. The magnetic lines of force are the lines drawn in a magnetic field along which a ..... pole would move.
Ans : North magnetic

24. An e.m.f. is induced in a coil when ..... linked with it changes.
Ans : The magnetic flux

25. In an AC generator, maximum number of lines of force pass through the coil when the angle between the plane of coil and lines of force is .....
Ans : 90

26. You are looking down the axis of a solenoid, and the current from your position is clockwise. The end of the solenoid facing you is a ..... pole.
Ans : South

27. Red colour insulation is used for ..... wire.
Ans : live

28. A generator converts mechanical energy into ..... energy. It works on the basis of .....
Ans : Electrical, Electromagnetic induction.

29. Larger the number of turns in the solenoid, greater will be the ..... produced.
Ans : magnetic field

30. In our houses we receive AC electric power of ..... with a frequency of .....
Ans : 220V, 50 Hz.

31. An electromagnet is a ..... magnet.
Ans : temporary

32. The frequency for A.C. (alternating current) in USA is .....
Ans : 60 Hz

33. The armature in a motor rotates within a ..... field.
Ans : Magnetic

34. To produce DC, the output of a generator must be fed through a .....
Ans : Commutator

35. In any generator, the current in the armature is of the .....type.
Ans : A.C

36. The phenomenon of production of back e.m.f. in a coil due to flow of varying current through it is called .....
Ans : Self-induction

37. SI unit of magnetic field strength is .....
Ans : tesla

3. TRUE/FALSE

1. The induced e.m.f. depends only the turns of the coil.
Ans : False

2. The magnitude of induced current can be increased by decreasing the speed of rotation of coil.
Ans : False

3. It is standard practice to connect fuse wire in the neutral wire of the household wiring.
Ans : False

4. The magnitude of induced current can be decreased by increasing the area of cross. section of coil.
Ans : False

5. A positive charge projected along the axis of a current carrying solenoid moves undeviated from its original path.
Ans : True

6. Energy associated with an electric field is analogous to potential energy whereas the energy associated with the magnetic field is analogous to kinetic energy.
Ans : True

7. No net force acts on a rectangular coil carrying a steady current when suspended freely in a uniform magnetic field.
Ans : True

8. An electron and a proton move in a uniform magnetic field with same speed perpendicular to the magnetic field. They experience forces in opposite directions differing by a factor of 1840.
Ans : False

9. There is no change in the energy of a charged particle moving in a magnetic field although a magnetic force is acting on it.
Ans : False

10. An electron does not suffer any deflections while passing through a region. This makes sure that there is no magnetic field in that region.
Ans : True

11. We can use either a two pin (plug and socked) or a three pin (plug and socket) while working with an electric iron.
Ans : False

12. The field at the centre of a long circular coil carrying current will be parallel straight lines.
Ans : True

13. A magnetic field exists in the region surrounding a magnet, in which the force of the magnet can be detected.
Ans : True

14. Fleming's left hand rule helps us to find the direction of the induced current.
Ans : False

15. The pattern of the magnetic field around a conductor due to an electric current flowing through it depends on the shape of the conductor.
Ans : True

16. We use the 'right hand thumb rule' for finding the direction of the magnetic field due to both a (current carrying) straight wire as well as a circular coil.
Ans : True

17. A current-carrying conductor when placed in a magnetic field always experiences a force.
Ans : False

18. The electrician must always follow the correct colour code while wiring the household circuits.
Ans : True

19. The direction of force on a current carrying conductor placed in a magnetic field can be reversed by reversing the direction of current flowing in the conductor.
Ans : True

20. While replacing a 'fuse wire'. the electrician must use a fuse wire of correct rating.
Ans : True

21. The direction of force on a current carrying conductor placed in a magnetic field cannot be reversing the direction of magnetic field.
Ans : False

22. Every household circuit must have proper earth wire installed in it.
Ans : True

23. Two magnetic lines of force never intersect each other.
Ans : True

24. It is always good habit not to touch an electric switch with wet hands.
Ans : True

25. The field lines inside the infinite solenoid are in the form of parallel straight lines.
Ans : True

26. An electric generator works on the principle of

electromagnetic induction.

Ans : True

27. In a DC electric motor a pair of split rings is used as commutator.

Ans : True

4. MATCHING QUESTIONS

DIRECTION : Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in column I have to be matched with statements (p, q, r, s) in column II.

1.

Column I		Column II	
(A)	An electric motor works on	(p)	to a battery
(B)	An electric motor is also	(q)	direct current
(C)	A commutator is used to	(r)	reverse the direction of flow of current.
(D)	Commutator rings are connected	(s)	known as DC MOTOR

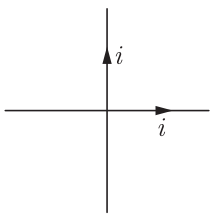
Ans : A-q, B-s, C-r, D-p

2. Column II gives approximate values of magnetic fields due to source given in column I

Column I		Column II	
(A)	At surface of neutron star	(p)	10^{-10} T
(B)	Near big electromagnet	(q)	1.5 T
(C)	At earth surface	(r)	10^{8} T
(D)	In interstellar space	(s)	10^{-4} T

Ans : A-r, B-q, C-s, D-p

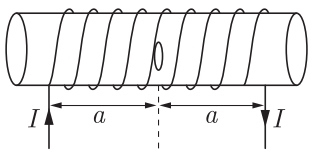
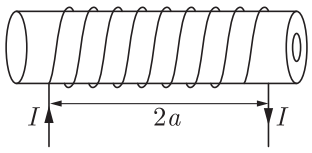
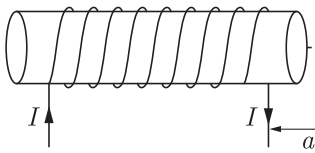
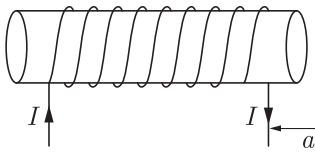
3. Equal currents i flow in two wires along x and y axis as shown. Match the following :



Column I		Column II	
(A)	Magnetic field in first quadrant	(p)	inwards
(B)	Magnetic field in second quadrant	(q)	outwards
(C)	Magnetic field in third quadrant	(r)	may be inwards or outwards
(D)	Magnetic field in fourth quadrant		

Ans : A-r, B-q, C-r, D-p

4. In column I, the position of small current carrying loops have been shown and in column II information related to force experienced by coil is given. Match the entries of column I with the entries of column II.(Assume solenoid radius to be small as compared to its length)

Column I		Column II	
(A)		(p)	Attractive
(B)		(q)	Repulsive
(C)		(r)	Zero
(D)		(s)	Initially zero, then starts increasing

	A	B	C	D
(a)	p	q	r	s
(b)	p, q	t	s	r
(c)	r	p	p	s
(d)	t	q, r	p, s	q

Ans : (c) A-r, B-p, C-p, D-s

The force experienced by a coil in a magnetic field is given by

$$F = P_m \frac{\delta B}{\delta r}$$

Where, $\frac{\delta B}{\delta r}$ is the increment of B along magnetic dipole moment of contour. You can write the expression for magnetic field due to solenoid at a general point and then differentiate it. From this information, you can have the results. Whether the force is attractive or repulsive can also be found by using the concept of nature of poles induced on the solenoid and coil.

The force comes out to be zero at centre and as we approach it from some outside point, its value increase.

For D: The coil first rotates to align itself in such a manner so as to link maximum flux and then the case would be same as that of C.

5. In magnetic field, for a charged particle, match the entries of column I with the entries of column II.

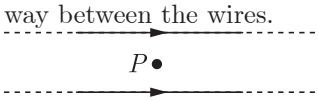
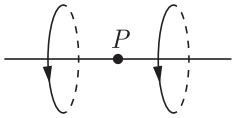
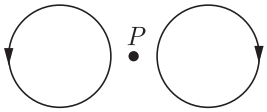
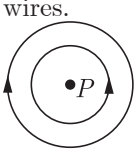
Column I		**Column II**	
(A)	Acceleration	(p)	may be zero
(B)	Velocity	(q)	is zero
(C)	Speed	(r)	may be constant
(D)	Kinetic energy	(s)	is constant

	A	**B**	**C**	**D**
(a)	p	r	s	s
(b)	s	p	q	r
(c)	p, q	s	r, s	q
(d)	q, s	q, r	s	s

Ans : (a) A-p, B-r, C-s, -D-s

Work done by magnetic force is zero. From work-energy theorem, its speed or kinetic energy is constant.

6. Two wires each carrying a steady current I are shown in four configurations in Column I. Some of the resulting effects are described in Column II. Match the statements in Column I with the statements in column II.

Column I		**Column II**	
(A)	Point P is situated mid-way between the wires. 	(p)	The magnetic fields (B) at P due to the currents in the wires are in the same direction.
(B)	Point P is situated at the mid-point of the line joining the centers of the circular wires, which have same radii. 	(q)	The magnetic fields (B) at P due to the currents in the wires are in opposite directions.
(C)	Point P is situated at the mid-point of the line joining the centers of the circular wires, which have same radii. 	(r)	There is no magnetic field at P.
(D)	Point P is situated at the common center of the wires. 	(s)	The wires repel each other.

	A	**B**	**C**	**D**
(a)	p, r	r, s	q, s,	s
(b)	s	p	q	r
(c)	q, r	p	q, r	q, s
(d)	q , s	q, r	s	s

Ans : (c) A-q, r B-p, C-q, r, D-q, s

The magnetic field at P due to current flowing in AB is perpendicular to the plane of paper acting vertically downward. And the magnetic field at P due to current flowing in CD is perpendicular to the plane of paper acting vertically upwards.
Therefore, q is correct.
As P is the mid point, the two magnetic fields, cancel out each other. Therefore, r is correct.
B:p
The magnetic field at P due to current in loop A is along the axial line towards right. Similarly, the magnetic field at P due to current in loop B is also along the axial line towards right.
C:q, r
The magnetic field due to current in loop A at P is equal and opposite to the magnetic field due to current in loop B at P.
D:q, s
The direction of magnetic field at P due to current in lop A is perpendicular to the plane of paper directed vertically upwards.

The direction of magnetic field at P due to current in loop B is perpendicular to the plane of paper directed vertically downward.

Since the current are in opposite direction the wires repel each other.

7. Column I contains some features of AC supply in India and Column II contains their relevant values/ details. Match Columns I and II.

	Column I		**Column II**
(A)	(Average rms) potential differences (in volts) between the live wire and the neutral wire in a household in India.	(p)	100
(B)	Value of the frequency of AC supply in India.	(q)	220
(C)	Number of times the household supply voltage attain its peak value in one second.	(r)	Green (yellow)

(D)	Colour of the earth wire in household wiring.	(s)	00
(E)	(Average rms) potential difference (in volts) between the neutral wire and the ground wire in a domestic electric circuits.	(t)	50

Ans : A-q, B-t, C-p, D-r, E-s

5. ASSERTION AND REASON

DIRECTION : In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

(a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
(c) Assertion (A) is true but reason (R) is false.
(d) Assertion (A) is false but reason (R) is true.
(e) Both Assertion and Reason are false.

1. **Assertion :** Safety fuses are made up of materials having a low melting point.
Reason : Safety fuses should be resistant to electric current.
Ans : (c) Assertion (A) is true but reason (R) is false.

2. **Assertion :** On freely suspending a current - carrying solenoid, it comes to rest in N-S direction just like a bar magnet.
Reason : One end of current carrying straight solenoid behaves as a North pole and the other end as a South pole.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

3. **Assertion :** Copper is used to make electric wires.
Reason : Copper has very low electrical resistance.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
The low electrical resistance of copper makes it a good conductor for electricity.

4. **Assertion :** A compass needle is placed near a current carrying wire. The deflection of the compass needle decreases when the magnitude of an electric current in the wire is increased.
Reason : Strength of a magnetic field at a point near the conductor increases on increasing the current.
Ans : (d) Assertion (A) is false but reason (R) is true.

5. **Assertion :** AC load line is used for long distance transmission.
Reason : It has very less loss of energy in long distance transmission.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
It can be easily transmitted over long distance without much loss in energy.

6. **Assertion :** When two bulbs are operated on same voltage supply, having power 60 W and 100 W then 100 W bulb has less resistance than 60 W.
Reason : The power of the bulb is directly proportional to the square of the voltage.
Ans : (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

Since, $\text{power } (P) = \frac{V^2}{R}$

or $R \propto \frac{1}{P}$

Hence, 100 W bulb has less resistance.

7. **Assertion :** The magnitude of the magnetic field at a point on the axis of a current carrying solenoid is inversely proportional to the current flowing through the solenoid.
Reason : The magnitude of the magnetic field at a point on the axis of a current carrying solenoid is directly proportional to the number of turns per unit length of a solenoid.
Ans : (d) Assertion (A) is false but reason (R) is true.

8. **Assertion :** An induced e.m.f. appears in any coil in which the current is changing.
Reason : Self induction phenomenon obeys Faraday's law of induction.
Ans : (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

9. **Assertion :** The magnetic field produced by a current carrying solenoid is independent of its length and cross-section area.
Reason : The magnetic field inside the solenoid is uniform.
Ans : (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
The magnetic field is independent of length and area. It is uniform inside the solenoid.

10. **Assertion :** The magnetic field is stronger at a point which is nearer to the conductor and goes on decreasing on moving away from the conductor.
Reason : The magnetic field B produced by a straight current carrying wire is inversely proportional to the distance from the wire.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

The magnitude of magnetic field is
1. directly proportional to the current I passing through the wire.
2. Inversely proportional to the distance r from the wire.

The magnetic field is stronger at a point which is nearer to the conductor and goes on decreasing on moving away from the conductor.

11. **Assertion :** A solenoid tends to expand, when a current passes through it.
Reason : Two straight parallel metallic wires carrying current in same direction attract each other.

Ans : (d) Assertion (A) is false but reason (R) is true.

When current flows through a solenoid, the currents in the various turns of the solenoid are parallel and in the same direction. Since the current flowing through parallel wires in the same direction lead to force of attraction between them, the turns of the solenoid will also attract each other and as a result the solenoid tends to contract.

12. **Assertion :** A direction current flows through a metallic rod, produced magnetic field only outside the rod.
Reason : There is no flow of charge carriers inside the rod.

Ans : (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

In the case of metallic rod, the charge carries flow through whole of the cross-section. Therefore, the magnetic field exists both inside as well as outside. However, magnetic field inside the rod will go no decreasing as we go towards the axis.

13. **Assertion :** Force experienced by moving charge will be maximum if direction of velocity of charge is perpendicular to applied magnetic field.
Reason : Force on moving charge is independent of direction of applied magnetic field.

Ans : (c) Assertion (A) is true but reason (R) is false.

From equation $F = qvB\sin\theta$. Force on moving charge will be maximum if direction of velocity of charge is perpendicular to direction of magnetic field (when $\theta = 90^\circ$)

14. **Assertion :** Electric appliances with metallic body have three connections, whereas an electric bulb has two pin connections.
Reason : Three pin connections reduce heating of connecting wires.

Ans : (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

The metallic body of the electrical appliance is connected to the third pin which is connected to the earth. This is a safety precaution and avoids eventual electric shock. By doing this the extra charge flowing through the metallic body is passed to earth and avoid shocks. There is nothing such as reducing the heating of connecting wires by three pin connections.

15. **Assertion :** There is no change in the energy of a charged particle moving in a magnetic field although a magnetic force is acting on it.
Reason : Work done by centripetal force is always zero.

Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

Magnetic force is always perpendicular to the direction of motion of charged particle, i.e., work done on the charge particle moving on a circular path in magnetic field zero.

16. **Assertion :** When two long parallel wires, hanging freely are connected in series to a battery, they come closer to each other.
Reason : Wires carrying current in opposite direction repel each other

Ans : (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

The wires are parallel to each other but the direction of current in it is in same direction so they attract each other. If the current in the wire is in opposite direction then wires repel each other.

17. **Assertion :** In a conductor, free electrons keep on moving but no magnetic force acts on a conductor in a magnetic field.
Reason : Force on free electrons due to magnetic field always acts perpendicular to its direction of motion.

Ans : (c) Assertion (A) is true but reason (R) is false.

In a conductor, the average velocity of electrons is zero. Hence no current flows through the conductor. Hence, no force acts on this conductor.

18. **Assertion :** A small coil carrying current, in equilibrium, is perpendicular to the direction of the uniform magnetic field.
Reason : Torque is maximum when plane of coil and direction of the magnetic field are parallel to each other.

Ans : (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

The torque acting on a coil is given by,

$$\tau = \text{NIA}\, B\sin\theta$$

where θ is the angle between the plane of the coil and the direction of magnetic field. When $\theta = 90^\circ$, then $\tau = 0$. The coil tries to orient itself in this position. Thus in equilibrium, the coil acquires a position, such that its plane makes an angle 90° with the direction of magnetic field.

19. **Assertion :** A current carrying conductor experiences a force in a magnetic field.
Reason : The force acting on a current carrying conductor in a magnetic field is due to interaction between magnetic field produced by the current carrying conductor and external magnetic field in which the conductor is placed.

Ans : (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of

assertion (A).

When a current carrying conductor is placed in a magnetic field, it experiences a force except when it is placed parallel to the magnetic field. The force acting on a current carrying conductor in a magnetic field is due to interaction between magnetic field produced by the current carrying conductor and external magnetic field in which the conductor is placed.

20. **Assertion :** Basic difference between an electric line and magnetic line of force is that former is discontinuous and the later is continuous or endless.
Reason : No electric lines of force exist inside a charged body but magnetic lines do exist inside a magnet.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

In case of the electric field of an electric dipole, the electric lines of force originate from positive charge and, end at negative charge. Since, isolated magnetic lines are closed continuous loops extending throughout the body of magnet, hence they from endless curves.

21. **Assertion :** On changing the direction of flow of current through a straight conductor, the direction of a magnetic field around the conductor is reversed.
Reason : The direction of magnetic field around a conductor can be given in accordance with left hand thumb rule.
Ans : (c) Assertion (A) is true but reason (R) is false.

22. **Assertion :** Two bar magnets attract when they are brought near to each other with the same pole.
Reason : Unlike poles will attract each other.
Ans : (d) Assertion (A) is false but reason (R) is true.

23. **Assertion :** Magnetic field lines never intersect.
Reason : At a particular point magnetic field has only one direction.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

24. **Assertion :** In Fleming's Left Hand Rule, the direction of magnetic field, force and current are mutually perpendicular.
Reason : Fleming's Left hand Rule is applied to measure the induced current.
Ans : (c) Assertion (A) is true but reason (R) is false.

It is used to find the direction of force in a current carrying conductor in the presence of magnetic field.

25. **Assertion :** A compass needle is placed near a current carrying wire. The deflection of the compass needle decreases when the compass needle is displaced away from the wire.
Reason : Strength of a magnetic field decreases as one moves away from a current carrying conductor.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

26. **Assertion :** No net force acts on a rectangular coil carrying a steady current when suspended freely in a uniform magnetic field.
Reason : Force on coil in magnetic field is always non-zero.
Ans : (c) Assertion (A) is true but reason (R) is false.

Force acting on each pair of the opposite sides of the coil are equal.

27. **Assertion :** an induced current has a direction such that the magnetic flux that induces the current.
Reason : Above statement is in accordance with conservation of energy.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

28. **Assertion :** A proton moves horizontally towards a vertical long conductor having an upward electric current. It will deflect vertically downward.
Reason : Seeing the proton and the conductor from the side of the proton, the magnetic field at the site of the proton will be towards right. Hence the force $\vec{F} = q\vec{\nu} \times \vec{B}$ will deflect the proton vertically downward.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

29. **Assertion :** Lenz's law violates the principle of conservation of energy.
Reason : Induced e.m.f. always opposes the change in magnetic flux responsible for its production.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

Lenz's law (that the direction of induced e.m.f. is always such as to oppose the change that cause it) is direct consequence of the law of conservation of energy.

30. **Assertion :** A neutral body may experience a net non-zero magnetic force.
Reason : The net charge on a current carrying wire is zero, but it can experience a force in a magnetic field.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

31. **Assertion :** When number of turns in a coil is doubled coefficient of self-inductance of the coil becomes 4 times.
Reason : This is because $L \propto N^2$.
Ans : (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).

32. **Assertion :** Alternating Current is used in household supply.
Reason : AC electric power can be transmitted over long distance without much loss of energy.
Ans : (a) Both assertion (A) and reason (R) are true

and reason (R) is the correct explanation of assertion (A).

33. **Assertion :** The strength of the magnetic field produced at the centre of a current carrying circular coil increases on increasing the current flowing through the coil.
Reason : Magnetic field strength is inversely proportional to the current flowing in the coil.
Ans : (c) Assertion (A) is true but reason (R) is false.

34. **Assertion :** The strength of the magnetic field produced at the centre of a current carrying circular coil increases on increasing the radius of the circular coil.
Reason : Magnetic field strength is inversely proportional to the radius of the circular coil.
Ans : (d) Assertion (A) is false but reason (R) is true.

35. **Assertion :** The strength of the magnetic field produced at the centre of a current carrying circular coil increases on increasing the number of turns of the circular coil.
Reason : Magnetic field strength is directly proportional to the number of turns of the circular coil.
Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).