Sample Paper

3

Time : 90 Minutes **Max. Marks : 35**

General Instructions

1. *The Question Paper contains three sections.*
2. *Section A has **25** questions. Attempt any **20** questions.*
3. *Section B has **24** questions. Attempt any **20** questions.*
4. *Section C has **6** questions. Attempt any **5** questions.*
5. *All questions carry equal marks.*
6. *There is no negative marking.*

SECTION-A

*This section consists of 25 multiple choice questions with overall choice to attempt **any 20** questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.*

1. In the equation AB = C, A is the current density, C is the electric field, Then B is
(a) resistivity (b) conductivity (c) potential difference (d) resistance

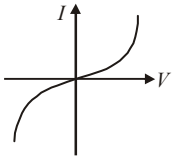
2. Two resistors R_1 and R_2 of 4 Ω and 6 Ω are connected in parallel across a battery. The ratio of power dissipated in them, $P_1 : P_2$ will be
(a) 4 : 9 (b) 3 : 2 (c) 9 : 4 (d) 2 : 3

3. A long solenoid carrying a current produces a magnetic field B along its axis. If the current is double and the number of turns per cm is halved, the new value of the magnetic field is
(a) 4 B (b) B/2 (c) B (d) 2 B

4. A charge moving with velocity v in *X*-direction is subjected to a field of magnetic induction in negative *X*-direction. As a result, the charge will
(a) remain unaffected (b) start moving in a circular path *Y–Z* plane
(c) retard along *X*-axis (d) move along a helical path around *X*-axis

5. Emf of a cell is
(a) the maximum potential difference between the terminals of a cell when no current is drawn from the cell.
(b) the force required to push the electrons in the circuit.
(c) the potential difference between the positive and negative terminal of a cell in a closed circuit.
(d) less than terminal potential difference of the cell.

6. The *I-V* characteristics shown in figure represents
(a) ohmic conductors (b) non-ohmic conductors
(c) insulators (d) superconductors



7. In potentiometer a balance point is obtained, when
(a) the e.m.f. of the battery becomes equal to the e.m.f of the experimental cell
(b) the p.d. of the wire between the +ve end of battery to jockey becomes equal to the e.m.f. of the experimental cell
(c) the p.d. of the wire between +ve point of cell and jockey becomes equal to the e.m.f. of the battery
(d) the p.d. across the potentiometer wire becomes equal to the e.m.f. of the battery

8. Nichrome or Manganin is widely used in wire bound standard resistors because of their
(a) temperature independent resistivity
(b) very weak temperature dependent resistivity.
(c) strong dependence of resistivity with temperature.
(d) mechanical strength.

9. A total charge Q is broken in two parts Q_1 and Q_2 and they are placed at a distance R from each other. The maximum force of repulsion between them will occur. when

(a) $Q_2 = \frac{Q}{R}, Q_1 = Q - \frac{Q}{R}$ (b) $Q_2 = \frac{Q}{4}, Q_1 = Q - \frac{2Q}{3}$

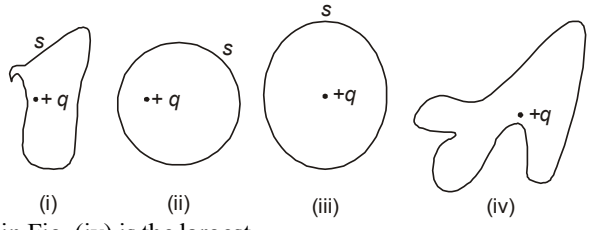
(c) $Q_2 = \frac{Q}{4}, Q_1 = \frac{3Q}{4}$ (d) $Q_1 = \frac{Q}{2}, Q_2 = \frac{Q}{2}$

10. Three charges 2 q, – q and – q are located at the vertices of an equilateral triangle. At the centre of the triangle

(a) the field is zero but potential is non-zero (b) the field is non-zero, but potential is zero

(c) both field and potential are zero (d) both field and potential are non-zero

11. The electric flux through the surface



(i) (ii) (iii) (iv)

(a) in Fig. (iv) is the largest

(b) in Fig. (iii) is the least

(c) in Fig. (ii) is same as Fig. (iii) but is smaller than Fig. (iv)

(d) is the same for all the figures

12. A and B are two points in an electric field. If the work done in carrying 4.0C of electric charge from A to B is 16.0 J, the potential difference between A and B is

(a) zero (b) 2.0 V (c) 4.0 V (d) 16.0 V

13. Two spheres A and B of exactly same mass are given equal positive and negative charges respectively. Their masses after charging

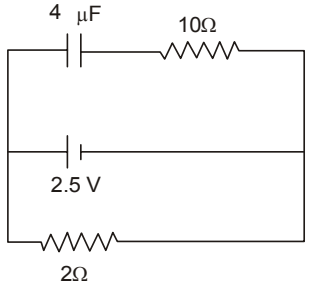
(a) remains unaffected (b) mass of A > mass of B (c) mass of A < mass of B (d) Nothing can be said

14. A parallel plate capacitor is charged by connecting it to a battery. Now the distance between the plates of the capacitor is increased. Which of the following remains constant ?

(a) Capacitance (b) Charge on each plate of the capacitor.

(c) Potential difference between the plates of capacitor (d) Energy stored in the capacitor.

15. A capacitor of 4 μF is connected as shown in the circuit. The internal resistance of the battery is 0.5Ω. The amount of charge on the capacitor plates will be



(a) 0 μC (b) 4 μC (c) 16 μC (d) 8 μC

16. A current passes through a wire of nonuniform cross-section. Which of the following quantities are independent of the cross-section?

(a) The charge crossing (b) Drift velocity (c) Current density (d) Free-electron density

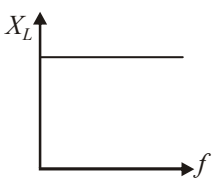
17. In an oscillating LC circuit the maximum charge on the capacitor is Q. The charge on the capacitor when the energy is stored equally between the electric and magnetic field is

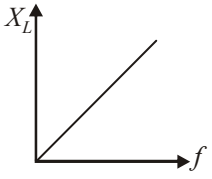
(a) $\frac{Q}{2}$ (b) $\frac{Q}{\sqrt{3}}$ (c) $\frac{Q}{\sqrt{2}}$ (d) Q

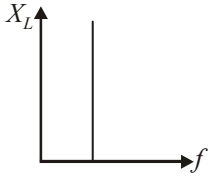
18. A transformer reduces 220 V to 11 V. The primary draws 5 A of current and secondary 90 A. The efficiency of the transformer is

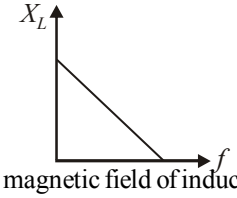
(a) 20% (b) 40% (c) 70% (d) 90%

19. Which of the following graphs represents the correct variation of inductive reactance X_L with frequency f ?

(a) 

(b) 

(c) 

(d) 

20. A straight wire of length 0.5 metre and carrying a current of 1.2 ampere is placed in uniform magnetic field of induction 2 tesla. The magnetic field is perpendicular to the length of the wire. The force on the wire is

(a) 2.4 N (b) 1.2 N (c) 3.0 N (d) 2.0 N

21. A conductor of length 0.4 m is moving with a speed of 7 m/s perpendicular to a magnetic field of intensity 0.9 Wb/m^2. The induced e.m.f. across the conductor is

(a) 1.26 V (b) 2.52 V (c) 5.04 V (d) 25.2 V

22. Lenz's law gives

(a) the magnitude of the induced e.m.f.
(b) the direction of the induced current
(c) both the magnitude and direction of the induced current
(d) the magnitude of the induced current

23. According to Faraday's law of electromagnetic induction

(a) the direction of induced force is such that it opposes the cause producing it
(b) the magnitude of induced e.m.f. produced in a coil is directly proportional to the rate of change of magnetic flux
(c) the direction of induced e.m.f. is such that it opposes the cause producing it
(d) None of these

24. The magnetic lines of force inside a bar magnet

(a) are from north-pole to south-pole of the magnet
(b) do not exist
(c) depend upon the area of cross-section of the bar magnet
(d) are from south-pole to north-pole of the Magnet

25. At the magnetic north pole of the earth, the value of the horizontal component of earth's magnetic field and angle of dip are respectively

(a) zero, maximum (b) maximum, minimum (c) maximum, maximum (d) minimum, minimum

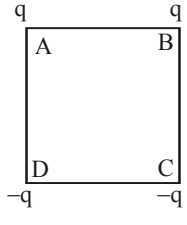
SECTION-B

*This section consists of 24 multiple choice questions with overall choice to attempt **any 20** questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.*

26. Which of the following about potential at a point due to a given point charge is true ?
The potential at a point P due to a given point charge

(a) is a function of distance from the point charge.
(b) varies inversely as the square of distance from the point charge.
(c) is a vector quantity
(d) is directly proportional to the square of distance from the point charge.

27. Charges are placed on the vertices of a square as shown. Let $\vec{E}$ be the electric field and V the potential at the centre. If the charges on A and B are interchanged with those on D and C respectively, then



(a) $\vec{E}$ changes, V remains unchanged
(b) $\vec{E}$ remains unchanged, V changes
(c) both $\vec{E}$ and V change
(d) $\vec{E}$ and V remain unchanged

28. Determine the rms value of the emf given by E(in volt) = 8 sin (ωt) + 6sin (2ωt)

(a) $5\sqrt{2}$V (b) $7\sqrt{2}$V (c) 10 V (d) $10\sqrt{2}$V

29. A resistance of 20 ohm is connected to a source of an alternating potential $V = 200 \cos(100 \pi t)$. The time taken by the current to change from its peak value to rms value, is

(a) 2.5×10^{-3} s (b) 25×10^{-3} s (c) 0.25 s (d) 0.20 s

30. The electric potential at a point (x, y) in the x – y plane is given by $V = -kxy$. The field intensity at a distance r from the origin varies as

(a) r^2 (b) r (c) $\frac{1}{r}$ (d) $\frac{1}{r^2}$

31. A potentiometer can measure emf of a cell because

(a) the sensitivity of potentiometer is large.
(b) no current is drawn from the cell at balance.
(c) no current flows in the wire of potentiometer at balance.
(d) internal resistance of cell is neglected.

32. A wire of radius r and another wire of radius 2r, both of same material and length are connected in series to each other. The combination is connected across a battery. The ratio of the heats produced in the two wires will be

(a) 4.00 (b) 2.00 (c) 0.50 (d) 0.25

33. A cell of internal resistance r is connected across an external resistance nr. Then the ratio of the terminal voltage to the emf of the cell is

(a) $\frac{1}{n}$ (b) $\frac{1}{n+1}$ (c) $\frac{n}{n+1}$ (d) $\frac{n-1}{n}$

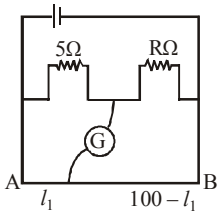
34. The resistances in the two arms of the meter bridge are 5Ω and RΩ, respectively. When the resistance R is shunted with an equal resistance, the new balance point is at 1.6 l_1. The resistance 'R' is :

(a) 10Ω

(b) 15Ω

(c) 20Ω

(d) 25Ω



35. The distance between the wires of electric mains is 12 cm. These wires experience 4 mg wt. per unit length. The value of current flowing in each wire will be

(a) 4.85 A (b) 0 (c) 4.85×10^{-2} A (d) 4.85×10^{-4} A

36. An electron moves in a circular orbit with a uniform speed v. It produces a magnetic field B at the centre of the circle. The radius of the circle is proportional to

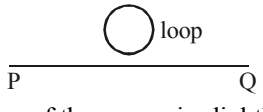
(a) $\sqrt{\frac{B}{v}}$ (b) $\frac{B}{v}$ (c) $\sqrt{\frac{v}{B}}$ (d) $\frac{v}{B}$

37. A bar magnet is cut into two equal halves by a plane parallel to the magnetic axis. Of the following physical quantities the one which remains unchanged is

(a) pole strength (b) magnetic moment (c) intensity of magnetisation (d) None of these

38. An electron moves along the line PQ which lies in the same plane as a circular loop of conducting wire as shown in figure. What will be the direction of the induced current in the loop?

(a) Anticlockwise (b) Clockwise
(c) Alternating (d) No current will be induced



39. An inductor, a resistor and a capacitor are joined in series with an AC source. As the frequency of the source is slightly increased from a very low value, the reactance of the

(a) inductor increases (b) resistor increases (c) capacitor increases (d) circuit increases

40. The magnetic flux through a circuit of resistance R changes by an amount $\Delta\phi$ in a time Δt. Then the total quantity of electric charge Q that passes any point in the circuit during the time Δt is represented by

(a) $R \cdot \frac{\Delta\varphi}{\Delta t}$ (b) $\frac{1}{R} \cdot \frac{\Delta\varphi}{\Delta t}$ (c) $\frac{\Delta\varphi}{R}$ (d) $\frac{\Delta\varphi}{\Delta t}$

41. When the current in a coil changes from 8 amp to 2 amp in 3×10^{-2} seconds, the emf induced in the coil is 2 volt. The self inductance of the coil is

(a) 10 mH (b) 20 mH (c) 5 mH (d) 1 mH

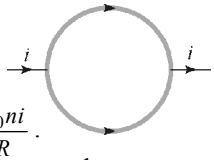
42. A current carrying coil is subjected to a uniform magnetic field. The coil will orient so that its plane becomes
(a) inclined at 45° to the magnetic field (b) inclined at any arbitrary angle to the magnetic field
(c) parallel to the magnetic field (d) perpendicular to the magnetic field

43. It becomes possible to define potential at a point in an electric field because electric field
(a) is a conservative field (b) is a non-conservative field
(c) is a vector field (d) obeys principle of superposition

44. Horizontal component of earth's field at a height of 1 m from the surface of earth is H. Its value at a height of 10 m from surface of earth is
(a) H/10 (b) H/9
(c) H/100 (d) H

Given below are two statements labelled as Assertion (A) and Reason (R). Select the most appropriate answer from the options given below:
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

45. **Assertion :** Figure shows a current carrying circular loop. The magnetic field at the centre of loop is zero.



Reason : Magnitude of magnetic field at the centre of circular loop carrying current *i* is given by $B = \frac{\mu_0 ni}{R}$.

46. **Assertion :** A charged particle moves in a uniform magnetic field. The velocity of the particle at some instant makes an acute angle with the magnetic field. The path of the particle is a helix with constant pitch.
Reason : The force on the particle is given by $\vec{F} = q\left(\vec{v}.\vec{B}\right)$.

47. **Assertion :** 200V AC is more dangerous than 200V D.C.
Reason : For 200V AC, the corresponding peak value is $200\sqrt{2}$. But for 200V DC, peak value is 200V only.

48. **Assertion:** The potential difference between any two points in an electric field depends only on initial and final position.
Reason: Electric field is a conservative field so the work done per unit positive charge does not depend on path followed.

49. **Assertion :** The alternating current lags behind the emf by a phase angle of $\frac{\pi}{2}$, when AC flows through an inductor.
Reason : The inductive reactance increases as the frequency of AC source increases.

SECTION-C

*This section consists of 6 multiple choice questions with an overall choice to attempt **any 5**. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.*

50. The primary winding of a transformer has 100 turns and its secondary winding has 200 turns. The primary is connected to an A.C. supply of 120 V and the current flowing in it is 10 A. The voltage and the current in the secondary are
(a) 240 V, 5 A (b) 240 V, 10 A
(c) 60 V, 20 A (d) 120 V, 20 A

51. Which of the following statements is/are correct?
I. In LCR series ac circuit, as the frequency of the source increases, the impedence of the circuit first decreases and then increases.
II. If the net reactance of an LCR series ac circuit is same as its resistance, then the current lags behind the voltage by 45°.
III. Below resonance, voltage leads the current while above it, current leads the voltage.
(a) I only (b) II only
(c) I and III (d) I and II

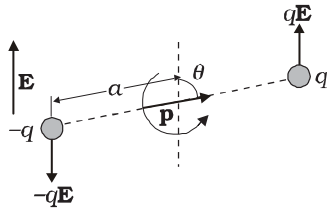
***Case Study:** Read the following paragraph and answers the questions.*

Electric dipole is a pair of equal and opposite point charges separated by a small distance.
Dipole moment is the product of the magnitude of either charge and the distance between them,

Dipole moment = $\left|\vec{p}\right| = q \times 2a$

It is directed from negative to positive charge.

Dipole in a uniform external field : There is a force q**E** on q and a force –q**E** on –q. The net force on the dipole is zero, since **E** is uniform. However, the charges are separated, so the forces act at different points, resulting in a torque on the dipole. When the net force is zero, the torque (couple) is independent of the origin.



52. An electric dipole has a pair of equal and opposite point charges q and $-q$ separated by a distance $2x$. The axis of the dipole is
(a) from positive charge to negative charge
(b) from negative charge to positive charge
(c) perpendicular to the line joining the two charges drawn at the centre and pointing upward direction
(d) perpendicular to the line joining the two charges drawn at the centre and pointing downward direction

53. The electric field at a point on equatorial line of a dipole and direction of the dipole moment
(a) will be parallel
(b) will be in opposite direction
(c) will be perpendicular
(d) are not related

54. An electric dipole is placed at an angle of 30° to a non-uniform electric field. The dipole will experience
(a) a translational force only in the direction of the field
(b) a translational force only in the direction normal to the direction of the field
(c) a torque as well as a translational force
(d) a torque only

55. Intensity of an electric field (E) depends on distance r, due to a dipole, is related as

(a) $E \propto \frac{1}{r}$ (b) $E \propto \frac{1}{r^2}$ (c) $E \propto \frac{1}{r^3}$ (d) $E \propto \frac{1}{r^4}$

OMR ANSWER SHEET

Sample Paper No – ☐

- ✶ Use Blue / Black Ball pen only.
- ✶ Please do not make any atray marks on the answer sheet.
- ✶ Rough work must not be done on the answer sheet.
- ✶ Darken one circle deeply for each question in the OMR Answer sheet, as faintly darkend / half darkened circle might by rejected.

Start time : _____ End time _____ Time taken _____

1. Name (in Block Letters)

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

2. Date of Exam

☐☐ ☐☐ ☐☐

3. Candidate's Signature ☐

Section-A

1.	a	b	c	d	9.	a	b	c	d	17.	a	b	c	d
2.	a	b	c	d	10.	a	b	c	d	18.	a	b	c	d
3.	a	b	c	d	11.	a	b	c	d	19.	a	b	c	d
4.	a	b	c	d	12.	a	b	c	d	20.	a	b	c	d
5.	a	b	c	d	13.	a	b	c	d	21.	a	b	c	d
6.	a	b	c	d	14.	a	b	c	d	22.	a	b	c	d
7.	a	b	c	d	15.	a	b	c	d	23.	a	b	c	d
8.	a	b	c	d	16.	a	b	c	d	24.	a	b	c	d
										25.	a	b	c	d

Section-B

26.	a	b	c	d	34.	a	b	c	d	42.	a	b	c	d
27.	a	b	c	d	35.	a	b	c	d	43.	a	b	c	d
28.	a	b	c	d	36.	a	b	c	d	44.	a	b	c	d
29.	a	b	c	d	37.	a	b	c	d	45.	a	b	c	d
30.	a	b	c	d	38.	a	b	c	d	46.	a	b	c	d
31.	a	b	c	d	39.	a	b	c	d	47.	a	b	c	d
32.	a	b	c	d	40.	a	b	c	d	48.	a	b	c	d
33.	a	b	c	d	41.	a	b	c	d	49	a	b	c	d

Section-C

50.	a	b	c	d	53.	a	b	c	d
51.	a	b	c	d	54.	a	b	c	d
52.	a	b	c	d	55.	a	b	c	d

No. of Qns. Attempted		Correct		Incorrect		Marks	