Sample Paper

6

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. A parallel plate capacitor with air between the plates has a capacitance of 8 pF. Calculate the capacitance if the distance between the plates is reduced by half and the space between them is filled with a substance of dielectric constant. ($\varepsilon_r = 6$)

(a) 72 pF (b) 81 pF (c) 84 pF (d) 96 pF

2. The electric potential at a point on the equatorial line of an electric dipole is

(a) directly proportional to distance (b) inversely proportional to distance

(c) inversely proportional to square of the distance (d) None of these

3. Quantisation of charge implies

(a) charge cannot be destroyed (b) charge exists on particles

(c) there is a minimum permissible charge on a particle (d) charge, which is a fraction of a coulomb is not possible.

4. Two capacitors of capacitances C_1 and C_2 are connected in series, assume that $C_1 < C_2$. The equivalent capacitance of this arrangement is C, where

(a) $C < C_1/2$ (b) $C_1/2 < C < C_2/2$ (c) $C_1 < C < C_2$ (d) $C_2 < C < 2C_2$

5. Force between two identical charges placed at a distance of r in vacuum is F. Now a slab of dielectric of dielectric contrant 4 is inserted between these two charges. If the thickness of the slab is r/2, then the force between the charges will become

(a) F (b) $\frac{3}{5}$F (c) $\frac{4}{9}$F (d) $\frac{F}{2}$

6. 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

7. The potential energy of a system of two charges is negative when

(a) both the charges are positive

(b) both the charges are negative

(c) one charge is positive and other is negative

(d) both the charges are separated by infinite distance

8. The resistance of a metal increases with increasing temperature because
(a) the collisions of the conducting electrons with the electrons increase
(b) the collisions of the conducting electrons with the lattice consisting of the ions of the metal increase
(c) the number of conduction electrons decreases
(d) the number of conduction electrons increases

9. A metal wire is subjected to a constant potential difference. When the temperature of the metal wire increases, the drift velocity of the electron in it
(a) increases, thermal velocity of the electron increases
(b) decreases, thermal velocity of the electron increases
(c) increases, thermal velocity of the electron decreases
(d) decreases, thermal velocity of the electron decreases

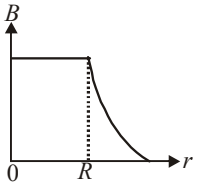
10. The amount of charge Q passed in time t through a cross-section of a wire is $Q = 5t^2 + 3t + 1$. The value of current at time t = 5 s is
(a) 9 A (b) 49 A (c) 53 A (d) None of these

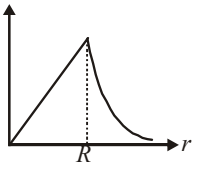
11. A wire of a certain material is stretched slowly by ten per cent. Its new resistance and specific resistance become respectively:
(a) 1.2 times, 1.3 times (b) 1.21 times, same (c) both remain the same (d) 1.1 times, 1.1 times

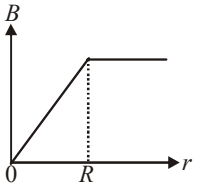
12. The Kirchhoff's second law ($\Sigma iR = \Sigma E$), where the symbols have their usual meanings, is based on
(a) conservation of momentum (b) conservation of charge
(c) conservation of potential (d) conservation of energy

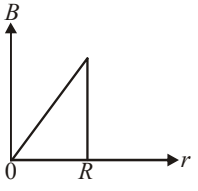
13. In a region, steady and uniform electric and magnetic fields are present. These two fields are parallel to each other. A charged particle is released from rest in this region. The path of the particle will be a
(a) helix (b) straight line (c) ellipse (d) circle

14. The correct plot of the magnitude of magnetic field $\vec{B}$ vs distance r from centre of the wire is, if the radius of wire is R

(a) 

(b) 

(c) 

(d) 

15. The deflection in a moving coil galvanometer is
(a) directly proportional to the torsional constant
(b) directly proportional to the number of turns in the coil
(c) inversely proportional to the area of the coil
(d) inversely proportional to the current flowing

16. In a metre bridge, the balancing length from the left end (standard resistance of one ohm is in the right gap) is found to be 20 cm. The value of the unknown resistance is
(a) 0.8 Ω (b) 0.5 Ω (c) 0.4 Ω (d) 0.25 Ω

17. To draw a maximum current from a combination of cells, how should the cells be grouped?
(a) Parallel
(b) Series
(c) Mixed grouping
(d) Depends upon the relative values of internal and external resistances

18. Magnetic lines of force due to a bar magnet do not intersect because
(a) a point always has a single net magnetic field
(b) the lines have similar charges and so repel each other
(c) the lines always diverge from a single force
(d) None of these

19. At a certain place, the angle of dip is 30° and the horizontal component of earth's magnetic field is 0.50 oerested. The earth's total magnetic field (in oerested) is
(a) $\sqrt{3}$ (b) 1 (c) $\frac{1}{\sqrt{3}}$ (d) $\frac{1}{2}$

20. Lenz's law is a consequence of the law of conservation of
(a) charge (b) mass (c) energy (d) momentum

21. The expression for the induced e.m.f. contains a negative sign $\left[e = -\frac{d\phi}{dt}\right]$. What is the significance of the negative sign?

(a) The induced e.m.f. is produced only when the magnetic flux decreases.
(b) The induced e.m.f. opposes the change in the magnetic flux.
(c) The induced e.m.f. is opposite to the direction of the flux.
(d) None of the above.

22. A coil is wound on a frame of rectangular cross-section. If all the linear dimensions of the frame are increased by a factor 2 and the number of turns per unit length of the coil remains the same, self-inductance of the coil increases by a factor of

(a) 4 (b) 8 (c) 12 (d) 16

23. The alternating current of equivalent value of $\frac{I_0}{\sqrt{2}}$ is

(a) peak current (b) r.m.s. current (c) D.C. current (d) all of these

24. An A.C. source is connected to a resistive circuit. Which of the following is true?

(a) Current leads ahead of voltage in phase
(b) Current lags behind voltage in phase
(c) Current and voltage are in same phase
(d) Any of the above may be true depending upon the value of resistance.

25. At resonant frequency the current amplitude in series *LCR* circuit is

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

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. An electric dipole is placed at an angle of 30° with an electric field of intensity 2×10^5 NC^{-1}, It experiences a torque of 4 Nm. Calculate the charge on the dipole if the dipole length is 2 cm.

(a) 8mC (b) 4mC (c) 8 μC (d) 2mC

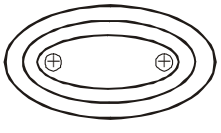
27. An electric dipole, consisting of two opposite charges of 2×10^{-6} C each separated by a distance 3 cm is placed in an electric field of 2×10^5 N/C. Torque acting on the dipole is

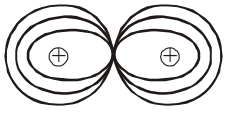
(a) $12 \times 10^{-1} N - m$ (b) $12 \times 10^{-2} N - m$ (c) $12 \times 10^{-3} N - m$ (d) $12 \times 10^{-4} N - m$

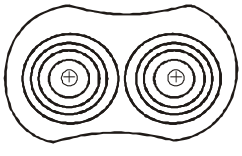
28. A charge Q is enclosed by a Gaussian spherical surface of radius R. If the radius is doubled, then the outward electric flux will

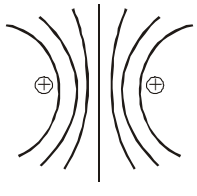
(a) increase four times (b) be reduced to half (c) remain the same (d) be doubled

29. Which of the following figure shows the correct equipotential surfaces of a system of two positive charges?

(a) 

(b) 

(c) 

(d) 

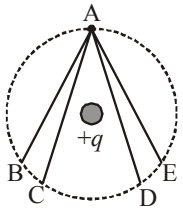
30. In the electric field of a point charge q, a certain charge is carried from point A to B, C, D and E. Then the work done is

(a) least along the path AB

(b) least along the path AD

(c) zero along all the paths AB, AC, AD and AE

(d) least along AE



31. In an LCR series resonant circuit, the capacitance is changed from C to 4C. For the same resonant frequency, the inductance should be changed from L to

(a) 2L (b) $\frac{L}{2}$ (c) 4L (d) $\frac{L}{4}$

32. In series combination of R, L and C with an A.C. source at resonance, if R = 20 ohm, then impedence Z of the combination is

(a) 20 ohm (b) zero (c) 10 ohm (d) 400 ohm

33. Four charges $q_1 = 2 \times 10^{-8}$ C, $q_2 = -2 \times 10^{-8}$ C, $q_3 = -3 \times 10^{-8}$ C, and $q_4 = 6 \times 10^{-8}$ C are placed at four corners of a square of side $\sqrt{2}$ m. What is the potential at the centre of the square?

(a) 270 V (b) 300 V (c) Zero (d) 100 V

34. In the series combination of *n* cells each cell having emf ε and internal resistance *r*. If three cells are wrongly connected, then total emf and internal resistance of this combination will be

(a) $n\varepsilon$, $(nr - 3r)$ (b) $(n\varepsilon - 2\varepsilon)\, nr$ (c) $(n\varepsilon - 4\varepsilon)$, nr (d) $(n\varepsilon - 6\varepsilon)$, nr

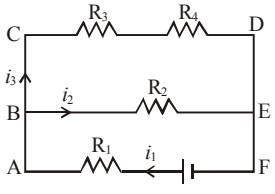
35. Which of the following is the correct equation when kirchhoff's loop rule is applied to the loop BCDEB in clockwise direction?

(a) $-i_3 R_3 - i_3 R_4 - i_2 R_2 = 0$

(b) $-i_3 R_3 - i_3 R_4 + i_2 R_2 = 0$

(c) $-i_3 R_3 + i_3 R_4 + i_2 R_2 = 0$

(d) $-i_3 R_3 + i_3 R_4 + i_2 R_2 = 0$



36. A battery of emf 10V and internal resistance 30hm is conncted to a resister. The current in the circuit is 0.5 amp. The terminal voltage of the battery when the circuit is closed is

(a) 10V (b) zero (c) 1.5V (d) 8.5V

37. It takes 12 minutes to boil 1 litre of water in an electric kettle. Due to some defect it becomes necessary to remove 20% turns of heating coil of the kettle. After repair, how much time will it take to boil 1 litre of water?

(a) 9.6 minute (b) 14.4 minute (c) 16.8 minute (d) 18.2 minute

38. A moving coil galvanometer has a resistance of 900 Ω. In order to send only 10% of the main current through this galvanometer, the resistance of the required shunt is

(a) 0.9 Ω (b) 100 Ω (c) 405 Ω (d) 90 Ω

39. The orbital speed of electron orbiting around a nucleus in a circular orbit of radius 50 pm is 2.2×10^6 ms^{-1}. Then the magnetic dipole moment of an electron is

(a) 1.6×10^{-19} Am^2 (b) 5.3×10^{-21} Am^2 (c) 8.8×10^{-25} Am^2 (d) 8.8×10^{-26} Am^2

40. The earth's magnetic field always has a vertical component except at the

(a) magnetic equator (b) magnetic poles
(c) geographic north pole (d) latitude 45°

41. The mutual inductance of a pair of coils, each of N turns, is M henry. If a current of I ampere in one of the coils is brought to zero in t second, the emf induced per turn in the other coil, in volt, will be

(a) $\frac{MI}{t}$ (b) $\frac{NMI}{t}$ (c) $\frac{MN}{It}$ (d) $\frac{MI}{Nt}$

42. Resonance frequency of LCR series a.c. circuit is f_0. Now the capacitance is made 4 times, then the new resonance frequency will become

(a) $f_0/4$ (b) $2f_0$ (c) f_0 (d) $f_0/2$

43. Two solenoids of same cross-sectional area have their lengths and number of turns in ratio of 1 : 2 both. The ratio of self-inductance of two solenoids is

(a) 1 : 1 (b) 1 : 2 (c) 2 : 1 (d) 1 : 4

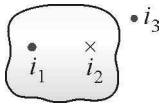
44. Eddy currents are produced when

(a) A metal is kept in varying magnetic field (b) A metal is kept in the steady magnetic field
(c) A circular coil is placed in a magnetic field (d) Through a circular coil, current is passed

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 :** Ampere's law used for the closed loop shown in figure is written as $\oint \vec{B} \cdot d\vec{\ell} = \mu_0 (i_1 - i_2)$. Right side of it does not include i_3, because it produces no magnetic field at the loop.



Reason : The line integral of magnetic field produced by i_3 over the close loop is zero.

46. **Assertion:** The electric potential at any point on the equatorial plane of a dipole is zero.

Reason: The work done in bringing a unit positive charge from infinity to a point in equatorial plane is equal for the two charges of the dipole.

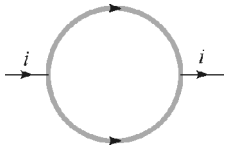
47. **Assertion :** To protect any instrument from external magnetic field, it is put inside an iron body.

Reason : Iron has high permeability.

48. **Assertion :** If the current in a solenoid is reversed in direction while keeping the same magnitude, the magnetic field energy stored in the solenoid decreases.

Reason : Magnetic field energy density is proportional to square of current.

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



Reason : Magnetic field at the centre of loop is given by $B = \frac{\mu_0 ni}{2R}$.

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.*

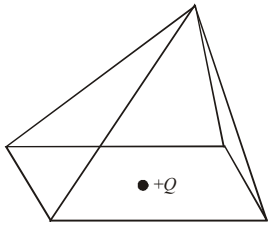
50. A point charge $+Q$ is positioned at the center of the base of a square pyramid as shown. The flux through one of the four identical upper faces of the pyramid is

(a) $\frac{Q}{16\varepsilon_0}$

(b) $\frac{Q}{4\varepsilon_0}$

(c) $\frac{Q}{8\varepsilon_0}$

(d) None of these



51. An electric dipole of moment $\vec{p}$ is placed in a uniform electric field $\vec{E}$. Then which of the following is/are correct?

I. The torque on the dipole is $\vec{p} \times \vec{E}$.
II. The potential energy of the system is $\vec{p} \cdot \vec{E}$.
III. The resultant force on the dipole is zero.

(a) I, II and III (b) I and III (c) I and II (d) II and III

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

A thermal power plant produces electric power of 600 kW at 4000 V, which is to be transported to a place 20 km away from the power plant for consumers' usage. It can be transported either directly with a cable of large current carrying capacity or by using a combination of step-up and step-down transformers at the two ends. The drawback of the direct transmission is the large energy dissipation. In the method using transformers, the dissipation is much smaller. In this method , a step-up transformer is used at the plant side so that the current is reduced to a smaller value. At the consumers' end, a step-down transformer is used to supply power to the consumers at the specified lower voltage. It is reasonable to assume that the power cable is purely resistive and the transformers are ideal with power factor unity. All the currents and voltages mentioned are rms values.

52. In the method using the transformers, assume that the ratio of the number of turns in the primary to that in the secondary in the step-up transformer is 1 : 10. If the power to the consumers has to be supplied at 200 V, the ratio of the number of turns in the primary to that in the secondary in the step-down transformer is

(a) 200 : 1 (b) 150 : 1 (c) 100 : 1 (d) 50 : 1

53. If the direct transmission method with a cable of resistance 0.4 $\Omega\,km^{-1}$ is used, the power dissipation| (in %) during transmission is

(a) 20 (b) 30 (c) 40 (d) 50

54. Transformers are used

(a) in DC circuit only (b) in AC circuits only

(c) in both DC and AC circuits (d) neither in DC nor in AC circuits

55. A transformer is employed to

(a) convert A.C. into D.C. (b) convert D.C. into A.C.

(c) obtain a suitable A.C. voltage (d) obtain a suitable D.C. voltage

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)

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2. Date of Exam

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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	