DIRECTORATE OF EDUCATION, GNCT OF DELHI

MID-TERM

CLASS: XII SUBJECT: PHYSICS (042)

PRACTICE PAPER

(SESSION: 2025-26)

DURATION:3 HOURS **MAXIMUM MARKS:70**

General Instructions:

(1) There are 33 questions in all. All questions are compulsory.

(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.

(3) All the sections are compulsory.

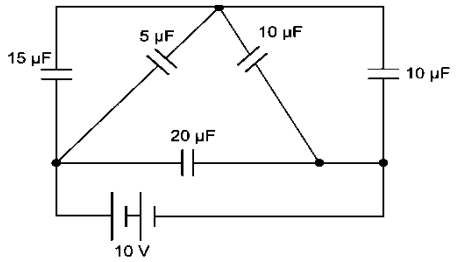
(4) Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study-based questions of four marks each and Section E contains three long answer questions of five marks each.

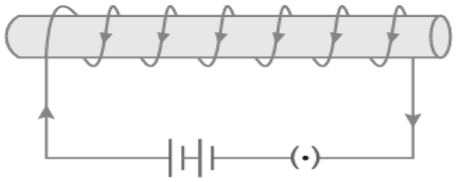
(5) There is no overall choice. However, an internal choice has been provided in two questions in Section B, one question in Section C, one question in each Case study-based questions in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.

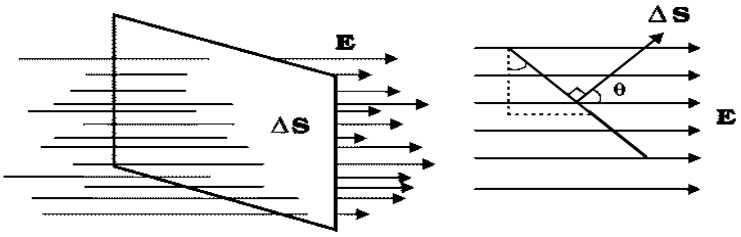
(6) Use of calculators is not allowed.

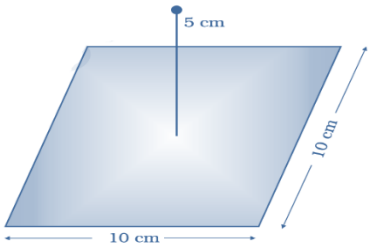
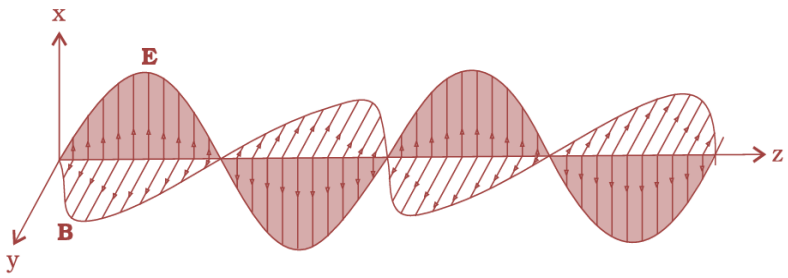
Q.N.	DESCRIPTION OF QUESTION	MARK
	SECTION (A) (16X1=16)	
1.	Electrostatic force between two small spheres at separation 'r' is 'F'. Now both spheres come in contact and again placed at separation 'r' then electrostatic force between them is 16F/15. Then ratio of charges is: - (a) 3 /4 (b) 1 /2 (**c)** 3/ 5 (d) 7/ 2.	1
2.	A capacitor of capacitance C = 900 pF is charged by 100 V battery, when it gets fully charged then it is disconnected from the battery and connected to another uncharged capacitor of capacitance C = 900 pF. The ratio of electrostatic energy stored by the system before and after disconnection of the battery is: (a) 1:1 (b) 1:2 (c) 2:1 (d) 1:3	1
3.	Two wires X and Y are made of same material. The wire Y has twice the diameter and half the length as that of wire X. If the resistance of the wire X is R, then resistance of the wire Y will be: (a) R/3 (b) R/2 (c) 2R/5 (d) R/8	1

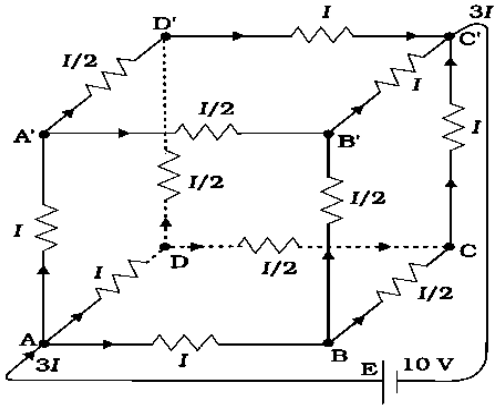
4.	Two electric bulbs of the same power, but with different marked voltages are connected in series across a power line. Their brightness will be: - (a) directly proportional to their marked voltages (b) inversely proportional to their marked voltages (c) directly proportional to the squares of their marked voltages (d) inversely proportional to the squares of their marked voltages	1
5.	A particle with charge q moving with velocity $\vec{v} = v_0\hat{\imath}$ enters a region with magnetic field $\vec{B} = B_1\hat{\jmath} + B_2\hat{k}$ .The magnitude of force experienced by the particle is: (a) $qv_0(B_1 + B_2)$ (b) $q\sqrt{v_0(B_1 + B_2)}$ (c) $qv_0\sqrt{(B_1^2 + B_2^2)}$ (d) $q\sqrt{v_0(B_1^2 + B_2^2)}$	1
6.	A long straight wire is held vertically and carries a steady current in upward direction. The shape of magnetic field lines produced by the current-carrying wire are: (a) horizontal straight lines directed radially out from the wire. (b)straight lines parallel to the current-carrying wire. (c) concentric horizonal circles around the wire. (d) coaxial helixes around the wire.	1
7.	A bar magnet is initially at right angles to a uniform magnetic field. The magnet is rotated till the torque acting on it becomes one-half of its initial value. The angle through which the bar magnet is rotated is: (a) 30^0 (b) 45^0 (c) 60^0 (d) 75^0	1
8.	The self-inductance L of a solenoid of length λ and area of cross-section A, with a fixed number of turns N increases as: (a) λ and A increase. **(b**) λ decreases and A increases. (c) λ increases and A decreases. (d) both λ and A decrease.	1
9.	An AC voltage V_i=140Sin(314t) V is applied to the primary coil having 200 turns of an ideal transformer. If the secondary coil has 20000turns, the peak voltage at output would be: (a)140V (b) 14000V (c) 10000V (d) 1000V	1
10.	The electromagnetic wave used in speed gun is: (a) microwave (b) infrared (c) X-rays (d) UV rays	1
11.	A 100 Ω resistance and a capacitor of reactance 100 Ω are connected in series across a 220 V source. When the capacitor is 50% charged, the peak value of the displacement current is: (a) 1.1A (b)$1.1\sqrt{2}$ A (c)2.2A (d) $2.2\sqrt{2}$ A	1
12.	The radius of curvature of the curved surface of a plano-convex lens is 20 cm. If the refractive index of the material of the lens be 1.5, it will: (a) act as a convex lens only for the objects that lie on its curved side. (b) act as a concave lens for the objects that lie on its curved side. (c) act as a convex lens irrespective of the side on which the object lies. (d) act as a concave lens irrespective of side on which the object lies.	1

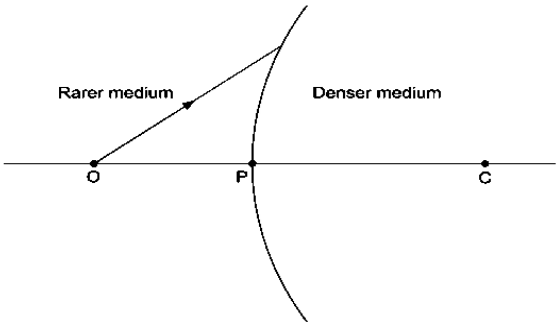
	For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below. (a) If both Assertion and Reason are true and Reason is correct explanation of Assertion. (b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion. (c) If Assertion is true but Reason is false. (d) If both Assertion and Reason are false.	
13.	**Assertion (A):** At every point in electric field, a particle with charge q possesses a certain electrostatic potential energy. **Reason (R):** Work done increases its potential energy by an amount equal to potential energy difference between two points.	1
14.	**Assertion (A):** An electron and a proton moving with same velocity enters a magnetic field. The force experienced by the proton is more than the force experienced by the electron. **Reason (R):** The mass of proton is more than the mass of the electron.	1`
15.	**Assertion (A):** When the number of turns in inductor coil is doubled, self-inductance of the coil becomes four times. **Reason (R):** Self inductance of the coil is directly proportional to square of the number of turns in the coil.	1
16.	**Assertion (A):** A light signal may be transmitted from one place to another with a negligible loss of energy in a glass tube. **Reason (R):** Mostly glass tube behaves as an optical fiber.	1
	SECTION (B) (5X2=10)	
17.	A charge +Q placed at (-d,0,0) and another charge -Q placed at (+d,0,0). Find the electric field at a point (0, R,0). If R>>d, then show that electric field ($E \propto \frac{1}{R^3}$). **OR** Calculate the amount of work done in rotating a dipole, of dipole moment 10^{-5}Cm, from its position of stable equilibrium to the position of unstable equilibrium, in a uniform electric field of intensity 10^4 N/C.	2
18.	The figure shows a network of five capacitors connected to a 10 V battery. Calculate the charge acquired by the 20μF capacitor.  **For VI candidates** Four charges +q, – q, + q and – q is to be arranged respectively at the four corners of a square ABCD of side 'd'. (a) Find the work required to put together this arrangement. (b) A charge q_0 is brought to the centre of the square, the four charges being held fixed. How much extra work is needed to do this?	2

19.	A galvanometer of resistance 'G' can be converted into a voltmeter of range (0 - V) volts by connecting a resistance 'R' in series with it. How much resistance will be required to change its range from 0 to V /2?	2
20.	(i) Define mutual inductance and write its SI unit. (ii) A pair of adjacent coils has a mutual inductance of 1.5 H. If the current in one coil changes from 0 to 20 A in 0.5 s, find the emf induced in the other coil.	2
21.	A ray of light is incident on the face of a prism at the angle of minimum deviation. If the prism were to be placed in water, what effect would this have on the angle of minimum deviation? Give a reason for your answer. **OR** The refractive index of a material of a convex lens is n_1. It is immersed in a medium of refractive index n_2. A parallel beam of light is incident on the lens. Trace the path of emergent rays when (i) $n_2 = n_1$ (ii) $n_2 > n_1$	2
	SECTION (C) (7X3=21)	
22.	Two identical charge particle of charge Q and masses m at rest on smooth surface separated by large distance. If one of them moving to words another charge with constant velocity v, then derive an expression for distance of closest approach.	3
23.	Two conducting wires X and Y of same diameter but different materials are joined in series across a battery. If the number density of electrons in X is twice that in Y, find the ratio of drift velocity of electrons in the two wires.	3
24.	Draw the magnetic field lines for a current carrying solenoid when a rod made of (a) material with small and positive susceptibility, (b) small and negative susceptibility (c) very high and positive susceptibility, are inserted within the solenoid as shown.  **OR** Write three points of differences between para-, dia- and ferro- magnetic materials, giving one example for each.	3
25.	A rectangular loop of sides 10 cm × 5 cm with a small cut is stationary in a uniform magnetic field produced by an electromagnet. If the current feeding the electromagnet is gradually reduced so that the magnetic field decreases from its initial value of 0·5 T at the rate of 0·01 T/s. If the cut is joined and the loop has a resistance of 10 Ω, how much power is dissipated by the loop as heat? What is the source of this power?	3
26.	A resistor of 100 Ω and a capacitor of $100/\pi$ μF are connected in series to a 220 V, 50 Hz ac supply. (a) Calculate the current in the circuit. (b) Calculate the (rms) voltage across the resistor and the capacitor. Do you find the algebraic sum of these voltages more than the source voltage? If yes, how do you resolve the paradox?	3

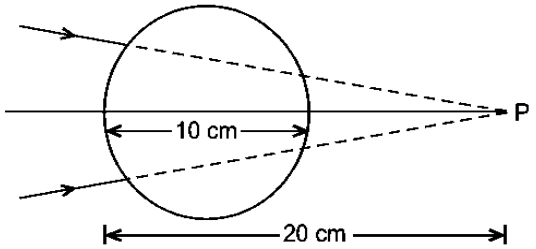
27.	Name the device which generate ac voltage. State the working of this device with the help of a labelled diagram. Deduce the expression for the alternating emf generated by this device. **For VI candidates** The primary coil of an ideal step-up transformer has 100 turns and transformation ratio is also 100. The input voltage and power are 220 V and 1100 W respectively. Calculate (a) the number of turns in the secondary coil. (b) the current in the primary coil. (c) the voltage across the secondary coil.	3
28.	(a) A screen is placed at a distance of 100 cm from an object. The image of the object is formed on the screen by a convex lens for two different locations of the lens separated by 20 cm. Calculate the focal length of the lens used. (b) A converging lens is kept coaxially in contact with a diverging lens - both the lenses being of equal focal length. What is the focal length of the combination?	3
	SECTION (D) (4X2=8)	
29.	The total number of field lines crossing a unit area, placed normal to the field at a point is a measure of the strength of electric field at that point and is called electric flux. If we place a small planar element of area ΔS normal to E, at a point, the number of field lines crossing it is proportional to E ΔS. Now suppose we tilt the area element by angle θ. Clearly, the number of field lines crossing the area element will be smaller. The projection of the area element normal to E is ΔS cosθ. Thus, the number of field lines crossing ΔS is proportional to E ΔS cosθ. When θ = 90°, field lines will be parallel to ΔS and will not cross it at all.  Electric flux Δφ through an area element ΔS is defined by Δφ = E.ΔS = E ΔS cosθ. let us consider the total flux through a sphere of radius r, which encloses a point charge q at its centre. Divide the sphere into small area elements and the total flux through the sphere is obtained by adding up flux through all the different area elements: $\varphi = \sum E.\Delta S = \oint E.\Delta S = q/\varepsilon_0$----------(1) Electric flux through a closed surface S is ($\varphi = q/\varepsilon_0$) where q = total charge enclosed by S. This law is known as Gauss's law. The law implies that the total electric flux through a closed surface is zero if no charge is enclosed by the surface. (i) An electric field is uniform, and in the positive x direction for positive x, and uniform with the same magnitude but in the negative x direction for negative x. It is given that E = 200 $\hat{\imath}$ for x > 0 and E = –200 $\hat{\imath}$ N/C N/C for x < 0. A right circular cylinder of length 20 cm and radius 5 cm has its centre at the origin and its axis along the x-axis so that one face is at x = +10 cm and the other is at x = –10 cm. The net outward flux through the cylinder: (a) 3.14 N m^2 C^{-1} (b) 31.4 N m^2 C^{-1} (c) 0.314 N m^2 C^{-1} (d) 0.0 N m^2 C^{-1} **OR**	1

	A point charge +10 μC is a distance 5 cm directly above the centre of a square of side 10 cm, as shown in Fig. The magnitude of the electric flux through the square? (a) 1.85×10^5N m^2 C^{-1} (b) 1.88×10^5N m^2 C^{-1} (c) 1.83×10^5 N m^2 C^{-1} (d) 1.8×10^5 N m^2 C^{-1} 	1
	(ii) If $\oint E.\Delta S = 0$ over a surface, then (a) the electric field inside the surface and on it is zero. (b) the electric field inside the surface is necessarily uniform. (c) the number of flux lines entering the surface must be equal to the number of flux lines leaving it. (d) all charges must necessarily be outside the surface.	1
	(iii) A uniformly charged conducting sphere of 2.4 m diameter has a surface charge density of 80.0 μC/m^2. Find the charge on the sphere: (a) 145mC (b) 145μC (c)1.45mC (d) 1.45μC	1
	(iv) N dipoles are placed inside the hollow conducting sphere of radius $10/\sqrt{\pi}$, each of dipole moment 10Cm. Find the electric flux through the hollow sphere: (a) 1000 N m^2 C^{-1} (b) 100 N m^2 C^{-1} (c)10 N m^2 C^{-1} (d) Zero	1
30.	Electromagnetic wave and spectrum play very vital role in our daily life. An accelerated charge produces an oscillating electric field in space, which produces an oscillating magnetic field, which in turn, is a source of oscillating electric field, and so on. The oscillating electric and magnetic fields thus regenerate each other as a result the wave propagates through the space. The frequency of the electromagnetic wave naturally equals the frequency of oscillation of the charge. The energy associated with the propagating wave comes at the expense of the energy of the source – the accelerated charge. Figure show a typical example of a plane electromagnetic wave propagating along the z direction (the fields are shown as a function of the z coordinate, at a given time t). The electric field Ex is along the x-axis, and varies sinusoidally with z, at a given time. The magnetic field By is along the y-axis, and again varies sinusoidally with z. The electric and magnetic fields Ex and By are perpendicular to each other, and to the direction z of propagation. 	

	(i) In Electromagnetic wave which one of the following is correct: (a) the magnitude of the electric field is equal to the magnitude of magnetic fields, (b) they carry energy and momentum and it is a longitudinal wave. **(c)** the average energy density of the E field equals the average energy density of the B field. (d) the velocity of electromagnetic wave does not depend on electric and magnetic properties of the medium.	1
	(ii) Suppose that the electric field part of an electromagnetic wave in vacuum is **E** = {(3.1 N/C) cos [(1.8 rad/m) y + (5.4 × 10^6 rad/s) t]}$\hat{\imath}$, the direction of propagation of wave is: **(a)** negative Y axis (b) positive Y axis (c) negative z axis (d) positive X axis	1
	(iii) A plane electromagnetic wave of frequency 25 MHz travels in free space along the x-direction. At a particular point in space and time, E = 6.3$\hat{\jmath}$ V/m. What is B at this point? (a) 2.1 × 10^{-8} $(-\widehat{k})$ T (b) 2.1 × 10^{-8} $(\widehat{j})$T **(c) 2.1 × $10^{-8}\widehat{k}$ T** (d) 2.1 × 10^{-8} $\hat{\imath}$T **OR** The rms value of the electric field of light coming from the sun is 720 N/C. The average total energy density of the electromagnetic wave is: (a) 4.58 × 10^{-6} J/m3 (b) 6.37 × 10^{-9} J/m3 (c) 1.35 × 10^{-12} J/m3 (d) 3.3 × 10^{-3} J/m3	1 1
	(iv) A plane electromagnetic wave propagating along x direction can have the following pairs of E and B: (a) Ex, By (b) Ey, Bz (c) Bx, Ey (d) Ez, By	1
	SECTION (E) (5X3=15)	
31.	(a) State the two Kirchhoff's rules used in the analysis of electric circuits and explain them. (b)A battery of 10 V and negligible internal resistance is connected across the diagonally opposite corners of a cubical network consisting of 12 resistors each of resistance 1 Ω. Find the value of equivalent resistance of the network and the current along each edge of the cube.  **For VI candidates** (b) A storage battery of emf 8.0 V and internal resistance 0.5 W is being charged by a 120 V dc supply using a series resistor of 15.5 W. What is the terminal voltage of the battery during charging? What is the purpose of having a series resistor in the charging circuit? **OR**	5

	(a)A conductor of length L is connected across an ideal cell of emf E. Keeping the cell connected, the length of the conductor is increased to 2L by gradually stretching it. If R and R' are initial and final resistance and v_d and v'_d are initial and final values of drift velocity, find the relation between (i) R and R' and (ii) v_d and v'_d (b)If the electron drift in a conductor from lower to higher potential, does it mean that all the 'free electrons' of the conductor are moving in the same direction.	
32.	(a) Using Biot-Savart law, derive an expression for the magnetic field at a point on the axis of a current carrying circular loop of radius' R, distance 'X' from the Centre. Hence write the magnetic field for (i) X=0 (ii) X>>R. (b) If the circular coils having radius 10 cm and 100 turns. Find the magnetic field at the centre of coil, if current flowing through it is 10 A. **OR** (a) A charged particle q moving with a velocity $\vec{v}$ is subjected to a uniform magnetic field $\vec{B}$ acting perpendicular to $\vec{v}$. If a uniform electric field $\vec{E}$ is also set up in the region along the perpendicular direction of $\vec{B}$, describe the path followed by the particle and draw its shape. (b) If the electric field is switch off. What will be the path and shape followed by the particle? **For VI candidates** An electron of mass m and charge e is revolving anticlockwise around the nucleus of an atom. (a) Obtain the expression for the magnetic dipole moment (μ) of the atom. (b) If $\vec{L}$ is the angular momentum of electron, show that $\mu = -\frac{e}{2m}\vec{L}$ (c) Two identical coils P and Q each of radius R are lying in perpendicular planes such that they have a common Centre. Find the magnitude and direction of magnetic field at the common Centre of the two coils, if they carry currents equal to I and $(3)^{1/2}$ I respectively.	5
33.	(a)A spherical surface of radius of curvature R, separates a rarer and a denser medium as shown in the figure. Complete the path of the incident ray of light, showing the formation of a real image. Hence derive the relation connecting object distance 'u', image distance 'v', radius of curvature R and the refractive indices n_1 and n_2 of two media.  	5

(b) A converging beam of light travelling in air converges at a point P as shown in the figure. When a glass sphere of refractive index 1.5 is introduced in between the path of the beam, calculate the new position of the image. Also draw the ray diagram for the image formed.



OR

(a)Draw the labelled ray diagram for the formation of image by an optical instrument which used for seeing macroscopic objects. Derive an expression for its total magnification (or magnifying power), when the final image is formed at the near point.
(b) A small telescope has an objective lens of focal length 144 cm and an eye piece of focal length 6.0 cm. What is the magnifying power of the telescope? What is the separation between the objective and the eye-piece?

For VI candidates

(a) A small telescope has an objective lens of focal length 140 cm and an eye-piece of focal length 5.0 cm. What is the
(a) magnifying power of telescope for viewing distant objects when the telescope is in normal adjustment (i.e., when the final image is at infinity)?
(b) the final image is formed at the least distance of distinct vision (D = 25 cm)?
(c) What is the separation between the objective and eye lens when final image is formed at infinity?
(d) If this telescope is used to view a 100 m tall tower 3 km away, what is the height of the image of the tower formed by the objective lens?
(e) What is the height of the final image of the tower if it is formed at the least distance of distinct vision D = 25 cm?