DIRECTORATE OF EDUCATION, GNCT OF DELHI

MID-TERM

CLASS: XII SUBJECT: PHYSICS (042)

PRACTICE PAPER

(SESSION: 2026-27)

Time Allowed: 3 hours **Maximum Marks: 70**

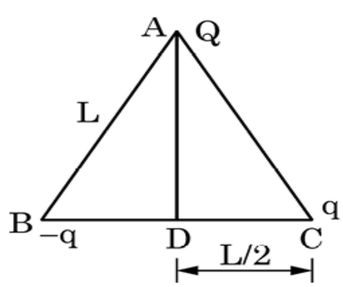
General Instructions

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 one question in Section B, one question in Section C, two question 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. You may use the following values of physical constants and mathematical formulae wherever necessary.

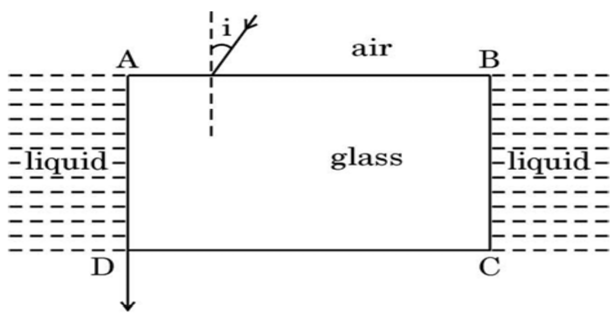
$$c = 3 \times 10^8 \text{ m/s}$$
$$h = 6.63 \times 10^{-34} \text{ J s}$$
$$e = 1.6 \times 10^{-19} \text{ C}$$
$$\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1}$$
$$\varepsilon_0 = 8.854 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$$
$$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$$

Q.N.	SECTION (A) [16X1=16]	MARKS
1.	Three-point charges 2q, –2q and q are kept at the vertices of an equilateral triangle of side l. The potential energy of the system is: (A) zero (B) $\frac{-2q^2}{\pi\varepsilon_0 l}$ (C) $\frac{q^2}{2\pi\varepsilon_0 l}$ (D) $\frac{-q^2}{\pi\varepsilon_0 l}$	1
2.	Which of the following characteristics of electrons determines the current in the conductor? (A) Drift velocity only (B) Thermal velocity only (C) Both drift velocity and thermal velocity (D) Neither drift nor thermal velocity	1
3.	A copper wire is stretched to increase its length by 1%. Then the change in its resistance is close to 1 (A) 1% (B) 4% (C) –4% (D) 2%	1
4.	A particle of mass m and charge q moves along y-axis in a region in which a uniform magnetic field is pointing along x-axis. The Lorentz force acting on the charge will point along: (A) x-axis (B) y-axis (C) z-axis (D) negative z-axis	1
5.	A proton and an α particle enter with the same velocity $\vec{v}$ in a uniform magnetic field $\vec{B}$ such that $\vec{v} \perp \vec{B}$. The ratio of the radii of their paths is: (A) 2 (B) ½ (C) 4 (D) 1/4	1
6.	A coil of an AC generator has 100 turns and an area of 0.1 m. It rotates at half a rotation per second in a magnetic field of 0.02 T. The maximum EMF generated in the coil is: (A) 0.31 V (B) 0.20 V (C) 0.63 V (D) 0.10 V	1
7.	The magnetic flux ϕ (in Wb) linked with a coil is related to time t in (s) as $\phi = 5\,At^2 + Bt - 2C$ The SI units of A and B are respectively: (A) Wbs^2, Wbs (B) $Wb\ s^{-1}$, Wb (C) Wbs^{-2}, Wbs^{-1} (D) Wbs^{-1}, Wbs^{-2}	1

8.	In a series LCR circuit, the voltage across the resistor, capacitor and inductor is 10 V each. If the capacitor is short circuited, the voltage across the inductor will be (A) 10 V (B) $5\sqrt{2}$ V (C) $\frac{5}{\sqrt{2}}$ V (D) $10\sqrt{2}$ V	1
9.	An ac voltage is given as v = 14 sin (314t) V. The average and the effective value of the voltage (in V) over a cycle are respectively: (A) 14 and 7 (B) 10 and 14 (C) 0 and 10 (D) 10 and 0	1
10.	An electromagnetic wave passes from vacuum into a dielectric medium with relative electrical permittivity (3/2) and relative magnetic permeability (8/3). Then, its (A) wavelength is doubled and frequency remains unchanged. (B) wavelength is doubled and frequency is halved. (C) wavelength is halved and frequency remains unchanged. (D) wavelength and frequency both will remain unchanged.	1
11.	In free space, which of the following quantities is always larger for X-rays than for a radio wave? (A) Speed (B) Frequency (C) Amplitude (D) Wavelength	1
12.	A beaker is filled with water (refractive index 4/3) up to a height H. A coin is placed at its bottom. The depth of the coin, when viewed along the near normal direction, will be (A) H/4 (B) 3H/4 (C) H (D) 4H/3	1
	Questions number 13 to 16 are Assertion (A) and Reason (R) type questions. Two statements are given one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the codes (a), (b), (c) and (d) as given below. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (c) Assertion (A) is true, but Reason (R) is false. (d) Assertion (A) is false and Reason (R) is also false.	

13.	**Assertion (A):** The work done, in taking a unit charge around a closed loop of an electric circuit involving cells and resistors in the loop, is zero. **Reason (R):** The potential at a point depends on the location of the point in the loop. After completing one round, the charge comes back to the point of start.	1
14.	**Assertion (A):** The deflection in a galvanometer is directly proportional to the current passing through it. **Reason (R):** The coil of a galvanometer is suspended in a uniform radial magnetic field.	1
15.	**Assertion (A)**: Only a continuous change of magnetic flux will maintain an induced emf in a coil. **Reason (R):** An induced current has a direction such that the magnetic field due to the current opposes the change in the magnetic field that induces the current**.**	1
16.	**Assertion (A):** The image of an object placed between f and 2f from a convex lens can be seen on a screen. If the screen is removed, image is not formed. **Reason (R):** Rays from a given point on the object placed between f and 2f, after passing through a convex lens, do not converge on a point in space.	1
	SECTION (B)	5X2=10
17.	Two-point charges q_1 =16μ C and q_2 = 1 μC are placed at points $\vec{r_1}$= (3 m)$\hat{\imath}$ and $\vec{r_2}$= (4 m)$\hat{\jmath}$. Find the net electric field $\vec{E}$ at point $\vec{r}$= (3 m)$\hat{\imath}$ + (4 m)$\hat{\jmath}$.	2
18.	Three-point charges Q, q and-q placed at the vertices of an equilateral triangle of side 'L' as shown in figure. What is **(i)** the electrostatic potential energy of the arrangement and (ii) the potential at point D.  **For Visually challenged students** Three-point charges 1μC, -1μC and 2μC are kept at the vertices A, B and C respectively of an equilateral triangle of side 1 m. A_1, B_1 and C_1 are the midpoints of the sides AB, BC and CA respectively. Calculate the net amount of work done in displacing the charge from A to A_1, from B to B_1 and from C to C_1.	2

19.	A circular coil of wire having 200 turns, each of radius 4·0 cm is placed in a horizontal plane. It carries a current of 0·40 A in clockwise direction. Find the magnitude and direction of the magnetic field at the center of the coil.	2
20.	A square loop of side 10 cm, free to rotate about a vertical axis coinciding with its one arm, is initially held perpendicular to a uniform horizontal magnetic field of 0·2 T. If it is rotated at the uniform speed of 60 rpm, find the emf induced in the loop.	2
21.	A spherical convex surface of radius of curvature R separates glass (refractive index 1.5) from air. Light from a point source placed in air at distance R/2 from the surface falls on it. Find the position and nature of the image formed.	2
	SECTION (C)	7X3=21
22.	(i) Define electric flux. Is it a scalar or a vector quantity? (ii)A point charge q is kept at a distance of d /2 directly above the centre of a square of side d. Use Gauss' law to obtain the expression for the electric flux through the square. (iii) If the point charge is now moved to a point at a distance 'd' from the centre of the square and the side of the square is doubled, explain how the electric flux through the square will be affected.	3
23.	(a) Establish the relation between drift velocity of electrons (v_d) and electric current (I) in a conductor. (b) How is v_d affected when the length of the conductor is doubled, keeping the voltage applied across the conductor constant	3
24.	(a) State Lenz's law. A rod MN of length L is rotated about an axis passing through its end M perpendicular to its length, with a constant angular velocity ω in a uniform magnetic field parallel to the axis. Obtain an expression for emf induced between its ends. **OR** (b) Define- self-inductance of a coil. Derive an expression for self-inductance of a long solenoid of cross-sectional area A and length l, having n turns per unit length.	3
25.	(a) Discuss the behaviour of an inductor connected to (i) a dc source, and (ii) a high frequency ac source. (b) What is the phase relation between current and voltage in an ideal inductor connected to an ac source? Draw a phasor diagram for the circuit.	3
26.	Name the device which can convert mechanical energy into electrical energy. With the help of a labelled diagram, explain the principle and working of that device.	3

	For Visually challenged students (a) State Faraday's law of electromagnetic induction and explain the role of negative sign in its expression. (b) Explain, with an example, that Lenz's law is consistent with the law of conservation of energy.	
27.	(a) Depict the variation of electric field ($\vec{E}$) and magnetic field ($\vec{B}$) with respect to the direction of propagation of an electromagnetic wave. Write their two important characteristics. (b) Show that gives $\frac{1}{\sqrt{\varepsilon_0 \mu_0}}$ the velocity of an electromagnetic wave in free space.	3
28.	A rectangular glass slab ABCD (refractive index 1·5) is surrounded by a transparent liquid (refractive index 1·25) as shown in the figure. A ray of light is incident on face AB at an angle i such that it is refracted out grazing the face AD. Find the value of angle i.  **For Visually challenged students** (a) State the conditions under which total internal reflection occurs. (b) A glass slab 3.0 cm thick, is placed over a dark ink dot. Find the height through which the image of the dot is raised. The refractive index of the glass is 1.5.	3
	SECTION (D)	
29.	A physics teacher provides three samples (A, B, and C) of magnetic materials to students for an investigatory project. Through various experiments, the students observed the following behaviours: • **Sample A:** When placed near a strong magnet, it is feebly repelled. Field lines tend to avoid passing through this material. • **Sample B:** When placed in a magnetic field, it is feebly attracted and aligns itself parallel to the magnetic field. • **Sample C:** It is strongly attracted to a magnet and can be easily magnetized in the direction of the magnetic field.	4

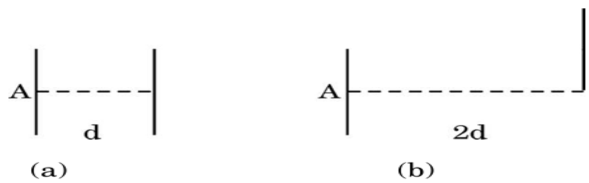
	Based on this case study, analyze the properties of these materials and answer the following multiple-choice questions. (i) Based on the case study, identify which of the following statements correctly represents the magnetic susceptibility (χ) and relative permeability (μ_r) of the three samples. (a) Sample A is ferromagnetic ($\chi \gg 1$), Sample B is diamagnetic (χ < 0), and Sample C is paramagnetic ($\chi > 0$). (b) Sample A is paramagnetic (χ is small and positive), Sample B is diamagnetic (χ) is small and negative), and Sample C is ferromagnetic (χ) is large and positive (c) Sample A, B, and C are all paramagnetic, but differ in the magnitude of their relative permeabilities (d) Sample A is diamagnetic (χ < 0, μ_r < 1), Sample B is paramagnetic (χ > 0, μ_r > 1), and Sample C is ferromagnetic (χ >>1, μ_r >>1) (ii) If small rods of Samples A, B, and C are suspended in a non-uniform magnetic field, how will they orient or move? (a) All three samples will move from the stronger parts of the magnetic field to the weaker parts. (b) Sample A will move from stronger to weaker parts of the field, while Samples B and C will move from weaker to stronger parts. (c) Sample B and C will move from stronger to weaker parts of the field, while Sample A will move from weaker to stronger parts. (d) All three samples will align perpendicular to the magnetic field lines. (iii) How will the magnetic susceptibility of Samples A, B, and C change if the temperature of the samples is increased? (a)The susceptibility of all three samples will increase linearly with an increase in temperature. (b) The susceptibility of Samples B and C will decrease, while the susceptibility of Sample A will remain independent of temperature. (c) The susceptibility of Sample A will decrease, Sample B will increase, and Sample C will remain unaffected. (d) The susceptibility of all three samples remains unaffected by any change in temperature.	1 1 1

	(iv) (I) A hollow pipe made of Sample A is placed in a uniform magnetic field. Which of the following best describes the behavior of magnetic field lines inside the hollow portion of the pipe? (a) The magnetic field lines will concentrate inside the hollow portion, making the field much stronger than the outside (b) The magnetic field lines will mostly be excluded from the material, and the inside of the hollow pipe will have a very weak magnetic field. (c) The magnetic field lines will pass straight through the hollow pipe with the same density as the outside field. (d) The magnetic field lines will spiral inside the hollow pipe due to the negative permeability of the material. OR (II) A student measures the relative permeability (μ_r) of a given Sample X to be 1.00001. Based on this value, how should the student classify Sample X, and how will it behave when placed in a magnetic field? (a) Sample X is diamagnetic and will be strongly repelled by a magnetic field. (b) Sample X is paramagnetic and will be feebly attracted by a magnetic field. (c) Sample X is ferromagnetic and will align parallel to the magnetic field with great force. (d) Sample X is non-magnetic and will show no response to a magnetic field.	1
30.	A capacitor is a system of two conductors separated by an insulator. In practice, the two conductors have charges Q and -Q with potential difference $V = V_1 - V_2$ between them. The ratio Q/C is a constant, denoted by C and is called the capacitance of the capacitor. It is independent of Q or V. It depends only on the geometrical configuration (shape, size, separation) of the two conductors and the medium separating the conductors. When a parallel plate capacitor is charged, the electric field E_0 is localized between the plates and is uniform throughout. When a slab of a dielectric is inserted between the charged plates (charge density σ), the dielectric is polarized by the field. Consequently, opposite charges appear on the faces of the slab, near the plates, with surface charge density of magnitude σ_p. For a linear dielectric σ_p is proportional to E_0. Introduction of a dielectric changes the electric field, and hence, the capacitance of a capacitor, and hence, the energy stored in the capacitor. Like resistors, capacitors can also be arranged in series or in parallel or in a combination of series and parallel. Based on this case study, analyze behavior of capacitor in presence of dielectric and answer the following multiple-choice questions.	4

(i) A slab (area A and thickness d_1) of a linear dielectric of dielectric constant K is inserted between charged plates (charge density σ) of a parallel plate capacitor [plate area A and plate separation d (> d_1)] and opposite charges with charge density of magnitude σ_p appear on the faces of the slab. The dielectric constant K is given by: 1

(a) $\frac{\sigma+\sigma_p}{\sigma}$ (b) $\frac{\sigma}{\sigma-\sigma_p}$ (c) $\frac{\sigma+\sigma_p}{\sigma_p}$ (d) $\frac{\sigma}{\sigma_p}$

(ii) Consider a capacitor of capacitance C, with plate area A and plate separation d, filled with air [Fig. (a)]. The distance between the plates is increased to 2d and one of the plates is shifted as shown in Fig.(b). The capacitance of the new system now is: 1



(a) C/4 (b) C/2 (c) 2C (d) 4C

(iii) An electric field E is established between the plates of an air-filled parallel plate capacitor, with charges Q and -Q. V is the volume of the space enclosed between the plates. The energy stored in the capacitor is: 1

(a) $\frac{1}{2}\epsilon_0 E^2$ (b) $\epsilon_0 Q^2 E$

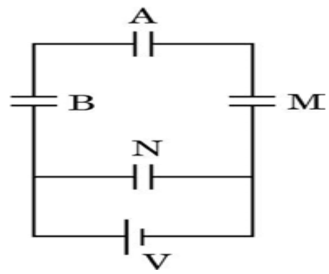
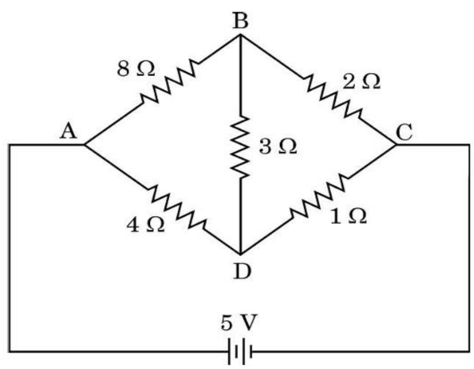
(c) $\frac{1}{2}\epsilon_0 E^2 V$ (d) $\epsilon_0 EQV$

(iv) (I) A slab (area A and thickness d/2) of dielectric constant K is inserted in a parallel plate capacitor of plate area A and plate separation d. If C and C_0 are the capacitances of the capacitors with and without the dielectric, then $\frac{C}{C_0}$ is: 1

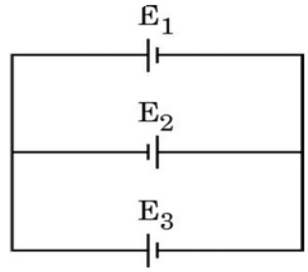
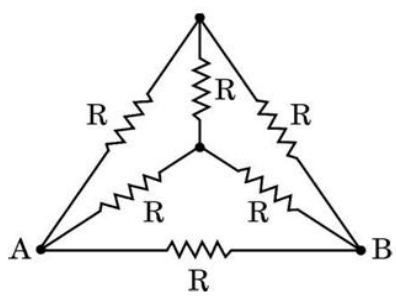
(a) $\frac{K+1}{2K}$ (b) $\frac{2K}{K+1}$

(c) $\frac{K}{K-1}$ (d) $\frac{K-1}{K}$.

OR

<table>
<tr><td></td><td>(II) Three capacitors A, B and M, each of capacitance C are connected to a capacitor N of capacitance 2C and a battery as shown in the figure. If the charges on A and N are Q and Q’ respectively, then Q’/Q is:
(a) 1/6 (b) 1/3 (c) 6 (d)3

</td><td></td></tr>
<tr><td></td><td>SECTION (E)</td><td>5x3=15</td></tr>
<tr><td>31.</td><td>(A) (i) Derive the condition for which a Wheatstone Bridge is balanced.
(ii) The figure shows a network of resistors connected across a battery. Find the current supplied by the battery of emf 5 V and internal resistance 2/3 Ω.


For Visually challenged students
(ii) A wire of resistance X ohm is gradually stretched till its length becomes twice its original length. If its new resistance becomes 40 values of X.
OR
(B) (i) Three batteries E_1, E_2 and E_3 of emfs and internal resistances (4 V, 2Ω), (2 V, 4 Ω) and (6 V, 2 Ω) respectively are connected as shown in the figure. Find the values of the currents passing through batteries E_1, E_2 and E_3.</td><td>5</td></tr>
</table>

	 **For Visually challenged students** A heating element using nichrome is connected to a 220 V supply. Initially it draws a current of 2.9 A. After some time, the current attains a steady value of 2.5 A. Find the steady temperature of the heating element if the room temperature is 27^0C. The temperature coefficient of resistance of nichrome is $1.7x10^{-4}0C^{-1}$. (ii) The ends of six wires, each of resistance R (= 10 Ω) are joined as shown in the figure. The points A and B of the arrangement are connected in a circuit. Find the value of the effective resistance offered by it to the circuit. 	
32.	(A) (I) (i) write Ampere's circuital law in mathematical form and explain the terms used. (ii) As the current carrying solenoid is made longer, the magnetic field produced outside it approaches zero. Why? (iii) A flexible loop of irregular shape carrying current when located in an external magnetic field, changes to a circular shape. Give reason. (II) A galvanometer of resistance G is converted into a voltmeter to measure up to V volts, by connecting a resistance R_1 series with the coil. If R_1 is replaced by R_2, then it can only measure up to V/2 volt. Find the value of the resistance R_3 (in terms of R_1 and R_2) needed to convert it into a voltmeter that can read up to 2 V. **OR**	5

	(B) (i) "What is the source of force acting on a current-carrying conductor placed in a magnetic field? Obtain the expression for force acting between two long straight parallel conductors carrying steady currents and hence define 'ampere'." **(ii)** A point charge q is moving with velocity v in a uniform magnetic field B. Find the work done by the magnetic force on the charge. **(iii)** Explain the necessary conditions in which the trajectory of a charged particle is helical in a uniform magnetic field.	
33.	(A) (i) A ray of light is incident at an angle of incidence, A/2 on face AB of a prism ABC of angle of prism A. The ray emerges normally from the opposite face AC. If the refractive index of the material of the prism be n, find the relation between A and n. (ii) The focal length of a convex lens of refractive index 1.5 is 20 cm. Find the focal length of this lens when immersed in a liquid of refractive index 1.25. **OR** (B) (i) Draw a ray diagram of a reflecting telescope (Cassegrain) and explain the formation of image. State two important advantages that a reflecting telescope has over a refracting telescope. (ii) In a refracting telescope, the focal length of the objective is 50 times the focal length of the eyepiece. When the final image is formed at infinity, the length of the tube is 102 cm. Find the focal lengths of the two lenses.	5