30.06.25

Delhi Public School, Howrah

PERIODIC TEST – I (2025-2026)

Class-XII

Care must be taken not to write anything on the question paper. All the questions must be attempted in the correct sequence.

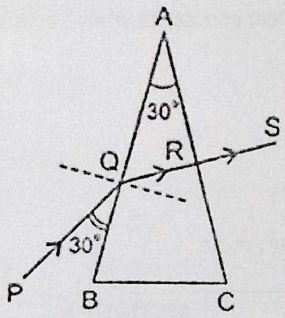
SUBJECT: PHYSICS (CODE- 042)

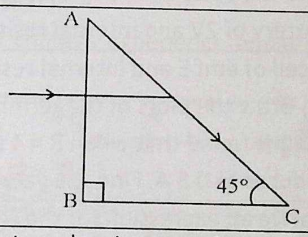
Time:-3 Hours **F.M.-70**

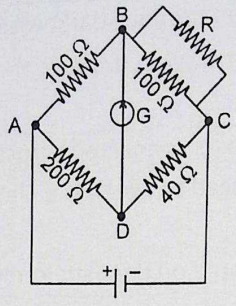
General Instructions:

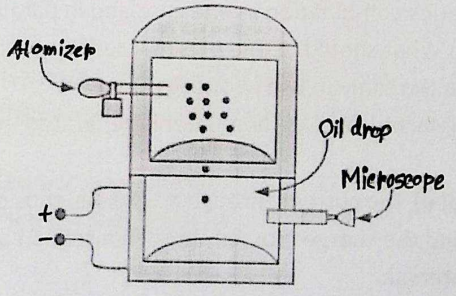
(1) There are 33 questions in all. All questions are compulsory.
(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
(3) All the sections are compulsory.
(4) Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark 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, one question in each CBQ 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.
(7) You may use the following values of physical constants where ever necessary.
i. $c = 3 \times 10^8$ m/s
ii. m_e = 9.1 x10-31 kg
iii. $e = 1.6 \times 10^{-19}$ C
iv. $\mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}
v. $h = 6.63 \times 10^{-34}$ Js
vi. $\varepsilon_0 = 8.854 \times 10^{-12}$ $C^2N^{-1}m^{-2}$
vii. Avogadro's number = 6.023×10^{23} per gram mole

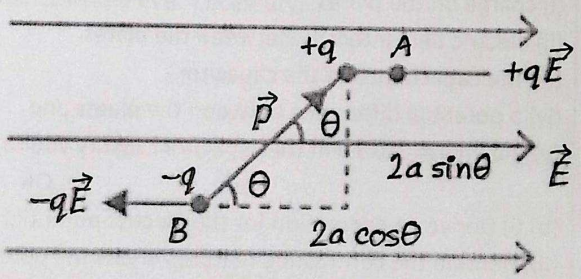
	SECTION - A	
1.	Current density of a conductor is (A) always zero (B) the net charge flowing through an area (C) measure of the flow of electric charge in amperes per unit area of cross-section (D) the net charge flowing through an area per unit time	1
2.	The focal length of a concave mirror is f. An object is placed at a distance x from the focus. The magnification is (A) $\frac{f}{(f+x)}$ (B) $\frac{(f+x)}{f}$ (C) $\frac{f}{x}$ (D) $\frac{x}{f}$	1
3.	The shape of the wavefront of the portion of the wavefront of light from a distant star intercepted by the earth is (A) plane (B) spherical (C) conical (D) hyperboloid	1
4.	According to Joule's law, if potential difference across a conductor of material of resistivity ρ remains constant, then the power consumed by the conductor is directly proportional to (A) ρ (B) $1/\sqrt{\rho}$ (C) ρ^{-1} (D) ρ^2	1

5.	The electrostatic force between the metal plates of an isolated parallel capacitor C having a charge Q and area A (provided the area A is much larger than the distance between the plates d) is: (A) independent of the distance between the plates (B) inversely proportional to the distance between the plates (C) proportional to the square root of the distance between the plates (D) linearly proportional to the distance between the plates	1
6.	Which of the following principle is used in optical fiber? (A) Total internal reflection (B) Scattering (C) Interference (D) Diffraction	1
7.	The dielectric constant K of an insulator will be (A) 0 (B) 4 (C) -4 (D) 0.4	1
8.	The magnitude of the electric field due to a point charge object at a distance of 4.0 m is 9 N/C. From the same charged object the electric field of magnitude, 16 N/C will be at a distance of (A) 6 m (B) 1 m (C) 2 m (D) 3 m	1
9.	An electric bulb marked 40 W - 200 V is used in a circuit of supply voltage 100 V. Now its power is (A) 10 W (B) 40 W (C) 20 W (D) 100 W	1
10.	The dimension of $1/2\ \varepsilon_0 E^2$ where ε_0 is the permittivity of free space and E is the electric field, is (A) $ML^{-1}T^{-2}$ (B) MLT^{-1} (C) ML^2T^{-2} (D) ML^2T^{-1}	1
11.	In the diagram, a prism of angle 30° is used. A ray PQ is incident as shown.  An emergent ray RS emerges perpendicular to the second face. The angle of deviation is (A) 60° (B) 30° (C) 0° (D) 45°	1
12.	Phase difference between any two points of a wavefront is (A) π (B) π/4 (C) π/2 (D) 0°	1
	For question numbers 13 to 16, two statements are given- one labeled as Assertion (A) and the other labeled as Reason (R). Select the correct answer to these questions from the codes (A), (B), (C) and (D) as given below. **(A) Both A and R are true and R is the correct explanation of the 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) Both A and R is false**	
13.	**Assertion(A):** For a charged particle moving from point P to point Q, the net work done by an electrostatic field on the particle is independent of the path connecting point P to point Q. **Reason(R):** The net work done by a conservative force on an object moving along a closed loop is zero.	1

14.	**Assertion (A):** Light added to light can produce darkness. **Reason (R):** When two coherent light waves interfere, there is darkness at position of destructive interference.	1
15.	**Assertion(A):** A parallel plate capacitor is connected across battery through a key. A dielectric slab of dielectric constant K is introduced between the plates. The energy which is stored becomes K times. **Reason(R):** The surface density of charge on the plate remains constant or unchanged.	1
16.	**Assertion(A):** Two equipotential surfaces cannot cut each other. **Reason(R):** Two equipotential surfaces are parallel to each other.	1
	SECTION - B	
17.	(a) Using Gauss's law, derive an expression for the electric field due to an infinitely long straight wire of linear charge density λ. **OR** (b) Use Gauss's law to obtain the expression for the electric field due to a uniformly charged infinite plane sheet of charge.	2 2
18.	Derive an expression for equivalent capacitance of three capacitors when connected in series.	2
19.	(a) Write the relationship between mobility and drift velocity in a current carrying conductor. (b) Two aluminium wires have their lengths in the ratio 2 : 3 and radii in the ratio 1 : 3. These are connected in parallel across a battery of emf E and of negligible internal resistance. Find the ratio of drift velocities of the electrons in the two wires.	1+1
20.	A light ray entering a right-angled prism undergoes total internal reflection at the face AC as shown in the adjacent figure. What is the refractive index of the material of the prism in the figure? 	2
21.	A heating element connected across a battery of 100 V having an internal resistance of 1 Ω draws an initial current of 10 A at room temperature 20.0 °C which settles after a few seconds to a steady value. What is the power consumed by battery itself after the steady temperature of 320.0 °C is attained? Temperature coefficient of resistance averaged over the temperature range involved is 3.70×10^{-4} °C^{-1}.	2
	SECTION - C	
22.	(a) Two cells of EMFs 1 V, 2 V and internal resistances 2 Ω and 1 Ω respectively are connected in series combination in one case and in parallel combination in the other case. (i) What should be the external resistance in the circuit so that the current through the resistance be the same in the two cases? (ii) In which case, more heat is generated in the cells? **OR** (b) (i) The current through a wire depends on time as $i = i_0 + \alpha t$, where $i_0 = 10$ A and $\alpha = 4$ A/s. Find the charge crossed through a section of the wire in 10 seconds, and average current for that interval. (ii) The given Wheatstone bridge in the figure below is showing no deflection in the galvanometer which is joined between the points B and D. Calculate the value of R.	2+1 1+2

		
23.	A beam of light consisting of two wavelengths 650 nm and 520 nm, are used to obtain interference fringes in a Young's double slit experiment. (a) Find the distance of the third bright fringe on the screen from the central maximum for wavelength 650 nm. (b) What is the least distance from the central maximum where the bright fringes due to both the wavelengths coincide? **[Note: The value of d and D are not given in the question.]**	1+1+1
24.	(a) Derive an expression for the energy stored in a parallel plate capacitor of capacitance C when charged up to voltage V. (b) How is this energy stored in the capacitor?	2+1
25.	In a Wheatstone bridge, P = 1 Ω, Q = 2 Ω, R = 2 Ω, S = 3 Ω and galvanometer resistance Rg = 4 Ω. Find the current through the galvanometer in the unbalanced position of the bridge, when a battery of 2V and internal resistance 2 Ω is used.	3
26.	A cell of emf E and internal resistance r is connected across a variable load resistor R. (a) Draw the plots of the terminal voltage V versus (i) resistance R and (ii) current I. (b) It is found that when R = 4 Ω, the current is 1A and when R is increased to 9Ω, the current reduces to 0.5 A. Find the values of the emf E and internal resistance r.	1+1+1
27.	Derive an expression for the capacitance of a parallel plate capacitor filled with a medium of dielectric constant K.	3
28.	(a) A coin is placed inside a denser medium. Why does it appear to be raised? (b) Obtain an expression for the height through which the object appears to be raised in terms of refractive index of the medium and real depth.	1+2
	SECTION – D	
29.	**Read the following passage and answer the questions based on that.** In 1909, Robert Millikan was the first to find the charge of an electron in his now-famous oil-drop experiment. In that experiment, tiny oil drops were sprayed into a uniform electric field between a horizontal pair of oppositely charged plates. The drops were observed with a magnifying eyepiece, and the electric field was adjusted so that the upward force on some negatively charged oil drops was just sufficient to balance the downward force of gravity. That is, when suspended, upward force qE just equaled Mg. Millikan accurately measured the charges on many oil drops and found the values to be whole number multiples of 1.6×10^{-19} C that is the charge of an electron. For this, he won the Nobel prize.	



i.	If a drop of mass 1.08×10^{-14} kg remains stationary in an electric field of 1.68×10^{5} N/C then the charge of this drop is (A) 6.40×10^{-19} C (B) 4.8×10^{-19} C (C) 3.2×10^{-19} C (D) 1.6×10^{-19} C	1
ii.	The no. of extra electrons on this particular oil drop (given the presently known charge of the electron) are (A) 4 (B) 5 (C) 8 (D) 3	1
iii.	A negatively charged oil drop is prevented from falling under gravity by applying a vertical electric field 100 V m^{-1}. If the mass of the drop is 1.6×10^{-3} gm, the number of electrons carried by the drop is ($g = 10\ ms^{-2}$) (A) 10^{9} (B) 10^{18} (C) 10^{12} (D) 10^{15}	1
iv.	The important conclusion given by Millikan's experiment about the charge is (A) charge has no definite value (B) charge is quantized (C) charge is never quantized (D) charge on oil drop always increases	1
	OR	
iv.	If in Millikan's oil drop experiment, charges on drops are found to be 8 μC, 12 μC, 20 μC then quanta of charge is (A) 20 μC (B) 8 μC (C)12 μC (D) 4 μC	1
30.	**Read the following passage and answer the questions based on that.** When electric dipole is placed in uniform electric field, its two charges experience equal and opposite forces, which cancel each other and hence net force on electric dipole in uniform electric field is zero. However these forces are not collinear, so they give rise to some torque on the dipole. Since net force on electric dipole in uniform electric field is zero. So no work is done in moving the electric dipole in uniform electric field. However some work is done in rotating the dipole against the torque acting on it.  	
i.	The dipole moment of a dipole in a uniform external field $\vec{E}$ is $\vec{P}$. Then the torque $\vec{\tau}$ acting on the dipole is (A) $\vec{\tau} = 2(\vec{P}+\vec{E})$ (B) $\vec{\tau} = (\vec{P}+\vec{E})$ (C) $\vec{\tau} = (\vec{P} \times \vec{E})$ (D) $\vec{\tau} = (\vec{P}.\vec{E})$	1
ii.	An electric dipole consists of two opposite charges, each of magnitude 1.0 μC separated by a distance of 2.0 cm. The dipole is placed in an external field of 10^{5} NC^{-1}. The maximum torque on the dipole is (A) 4 x 10^{-3} Nm (B) 2 x 10^{-3} Nm (C) 1 x 10^{-3} Nm (D) 0.2 x 10^{-3} Nm	1
iii.	Torque on a dipole in uniform electric field is minimum when the angle is equal to (A) 0° (B) 90° (C) 180° (D) both 0° & 180°	1
iv.	When an electric dipole is held at an angle (not equal to 0° or 90°) in a uniform electric field, the net force F and torque on the dipole are (A) F = 0, $\tau = 0$ (B) $F \neq 0, \tau \neq 0$ (C) F = 0, $\tau \neq 0$ (D) $F \neq 0, \tau = 0$	1
	OR	

iv.	An electric dipole of moment p is placed in an electric field of intensity E. The dipole acquires a position such that the axis of the dipole makes an angle with the direction of the field. Assuming that the potential energy of the dipole to be zero when $\theta = 90°$, the torque and the potential energy of the dipole will respectively be (A) pE sinθ , - pE cosθ (B) pE cosθ, - pE sinθ (C) pE sinθ , 2pE cosθ (D) pE sinθ , - 2pE cosθ	1
	SECTION - E	
31.	(a) A compound microscope consists of an objective lens of focal length 2.0 cm and an eyepiece of focal length 6.25 cm separated by a distance of 15 cm. How far from the objective lens should an object be placed in order to obtain the final image at (i) the least distance of distinct vision (25 cm) and (ii) at infinity? (iii) What is the magnifying power of the microscope in each case? **OR** (b) (i) Use Huygen's geometrical construction to show how a plane wavefront at t = 0 propagates and produces a wavefront at a later time. (ii) Verify, using Huygen's principle, Snell's law of refraction of a plane wave propagating from a denser to a rarer medium.	5 5
32.	(a) A parallel plate capacitor is charged by a battery. After some time, the battery is disconnected and a dielectric slab with its thickness equal to the plate separation is inserted between the plates. What change, if any, will take place in (i) charge on the plates (ii) electric field intensity between the plates (iii) the capacitance of the capacitor (iv) a potential difference between the plates and (v) the energy stored in the capacitor? Justify your answer in each case. **OR** (b) (i) Derive an expression for the electric potential at any point due to an electric dipole. (ii) Mention the contrasting features of electric potential of a dipole at a point as compared to that due to a single charge.	5 5
33.	(a) (i) Six lead-acid type of secondary cells each of emf 2.0 V and internal resistance 0.015 Ω are joined in series to provide a supply to a resistance of 8.5 Ω. What are the current drawn from the supply and its terminal voltage? (ii) A secondary cell after long use has an emf of 1.9 V and a large internal resistance of 380 Ω. What maximum current can be drawn from the cell? Could the cell drive the starting motor of a car? **OR** (b)Two wires of equal length, one of aluminium and the other of copper have the same resistance. Which of the two wires is lighter? Hence explain why aluminium wires are preferred for overhead power cables. Given, $\rho_{Al} = 2.63 \times 10^{-8}$ Ωm, $\rho_{Cu} = 1.72 \times 10^{-8}$ Ωm, Relative density of Al = 2.7, Relative density of Cu = 8.9.	5 5