DIRECTORATE OF EDUCATION, GNCT OF DELHI

ANNUAL PRACTICE PAPER

(SESSION: 2025-26)

CLASS: XII SUBJECT: PHYSICS (042)

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 two questions in Section B, one question in Section C 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 where ever necessary

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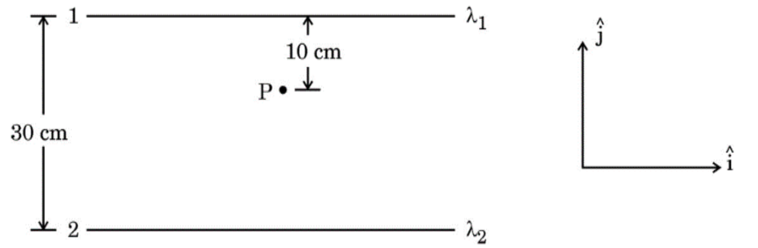
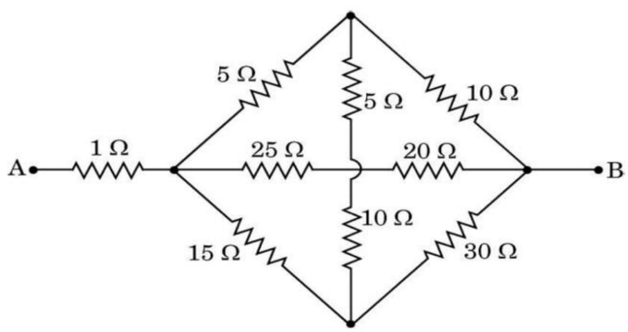
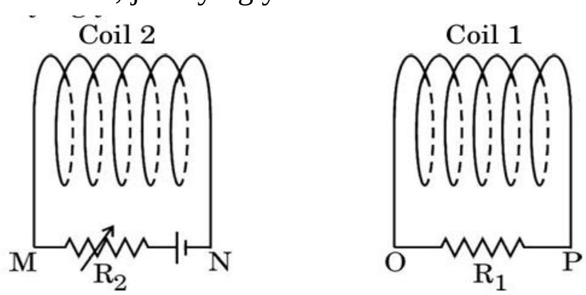
i. $c = 3 \times 10^{8}$ m/s
ii. $m_e = 9.1 \times 10^{-31}$ kg
iii. $m_p = 1.7 \times 10^{-27}$ kg
iv. $e = 1.6 \times 10^{-19}$ C
v. $\mu_0 = 4\pi \times 10^{-7}$ T m $\boldsymbol{A^{-1}}$
vi. $h = 6.63 \times 10^{-34}$ J s
vii. $\varepsilon_0 = 8.854 \times 10^{-12}$ $\boldsymbol{C^{2}N^{-1}m^{-2}}$
viii. Avogadro's number = 6.023 X $\mathbf{10^{23}}$ per gram mole

SECTION (A)		[16X1=16]
Q.N.	**QUESTIONS**	**MARKS**
1	An infinitely long uniformly charged wire produces an electric field of 1.8×10^4 N/C at a distance of 1·0 cm. The linear charge density on the wire is: (A) $1\cdot12 \times 10^{-14}$ C/m (B) $3\cdot08 \times 10^{-15}$ C/m (C) $1\cdot0 \times 10^{-9}$ C/m (D) $1\cdot0 \times 10^{-7}$ C/m	**1**
2.	A wire of resistance R, connected to an ideal battery consumes a power P. If the wire is gradually stretched to double its initial length, and connected across the same battery, the power consumed will be: (A) P/4 (B) P/2 (C) P (D) 2P	**1**
3.	A long straight wire of radius 'a' carries a steady current 'I'. The current is uniformly distributed across its area of cross-section. The ratio of magnitude of magnetic field B_1 at a/2 and B_2 at distance 2a is: (A) ½ (B) 1 (C) 2 (D) 4	**1**
4.	Which of the following has its permeability less than that of free space? (A) Copper (B) Aluminium (C) Copper chloride (D) Nickel	**1**
5.	A transformer is a device used for converting: (A) high ac voltage and large ac current to low ac voltage and small ac current (B) high ac voltage and small ac current to low ac voltage and small ac current (C) low ac voltage and large ac current to high ac voltage and small ac current (D) low ac voltage and small ac current to high ac voltage and large ac current.	**1**
6.	The amplitude of electric field in an electromagnetic wave in free space is 1000 V/m. The amplitude of the magnetic field in this electromagnetic wave is: (A) $3\cdot0 \times 10^{-3}$ T (B) $3\cdot33 \times 10^{-8}$ T (C) $3\cdot0 \times 10^{11}$ T (D) $3\cdot33 \times 10^{-6}$ T	**1**
7.	A tank is filled with liquid of (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**

8.	Two coherent sources, each of intensity I_0, produce interference pattern on a screen. The average intensity of light on the screen is: (A) zero (B) I_0 (C) $2I_0$ (D) $4I_0$	**1**
9.	A beam of red light and a beam of blue light have equal intensities. Which of the following statements is true? (A)The blue beam has a greater number of photons than the red beam. (B) The red beam has a greater number of photons than the blue beam. (C) Wavelength of red light is lesser than wavelength of blue light. (D) The blue light beam has lesser energy per photon than that in the red-light beam.	**1**
10.	In a Geiger-Marsden experiment, what is the distance of closest approach to the nucleus of a 7.7 MeV α-particle before it comes momentarily to rest and reverses its direction? (A) 3.84×10^{-16} Z m (B) 3.84×10^{-14}Z m (C) 3.84×10^{-12} Z m (D) 3.84×10^{-18} Z m	**1**
11.	At a certain temperature in an intrinsic semiconductor, the electrons and holes concentration are $1{\cdot}5\text{x } 10^{16}$ /m^3. When it is doped with a trivalent dopant, hole concentration increases to $4{\cdot}5 \text{ x}10^{22}$ /m^3. In the doped semiconductor, the concentration of electrons (n_e) will be: (A) 3 x10^6 /m^3 (B) 5 X10^7 /m^3 (C) 5x 10^9 /m^3 (D) $6{\cdot}75$x 10^{38} /m^3	**1**
12.	A semiconductor device is connected in series with a battery, an ammeter, and a resistor. A current flow in the circuit. If the polarity of the battery is reversed, the current in the circuit almost becomes zero. The device is a/an (A) intrinsic semiconductor (B) p-type semiconductor (C) n-type semiconductor (D) p-n junction diode	**1**

Questions number 16 to 18 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):** Hydrogen atom consists of only one electron but its emission spectrum has many lines. **Reason (R):** Only Lyman series is found in the absorption spectrum of hydrogen atom whereas in the emission spectrum, all the series are found.	**1**
14.	**Assertion (A):** A ray of light is incident normally on the face of a prism. The emergent ray will graze along the opposite face of the prism when the critical angle at glass-air interface is equal to the angle of the prism. **Reason (R):** The refractive index of a prism depends on angle of the prism.	**1**
15.	**Assertion (A):** The average power consumed in the circuit having resistance over a cycle is zero. **Reason (R):** The current is leading the voltage by $\pi/2$.	**1**
16.	**Assertion (A):** At resonance the impedance of a series LCR circuit is Z=R. **Reason (R):** $\boldsymbol{Z} = \sqrt{R^2 + (X_C - X_L)^2}$ and at resonance the inductive reactance X_L is equal to capacitive reactance X_C.	**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.	Two long straight wires 1 and 2 are kept as shown in the figure. The linear charge density of the two wires is λ_1 = 1.0 C/m and λ_2 = 2.0 C/m. Find the net force experienced by an electron held at point P. 	**2**
19.	(a) Find the current flowing in 1Ω resistance, when a battery of emf 10 V is applied between points A and B for the network shown in the figure.  **OR** (b) A cell of emf E and internal resistance r is connected to an external variable resistance R. Plot a graph showing the variation of terminal voltage V of the cell as a function of current I, supplied by the cell. Explain how the emf of the cell and its internal resistance can be found from it.	**2** **2**
20.	(a) How is an electromagnetic wave produced? (b) An electromagnetic wave is travelling in vertically upward direction. At an instant, its electric field vector points in west direction. In which direction does the magnetic field vector point at that instant?	**2**
21.	(a) Explain the property of a p-n junction which makes it suitable for rectifying alternating voltages. Differentiate between a half-wave and a full-wave rectifier. **OR**	**2**

	(b) Explain the roles of diffusion current and drift current in the formation of the depletion layer in a p-n junction diode.	**2**
	SECTION (C)	**[7X3=21]**
22.	(i) When a potential difference is applied across the ends of a conductor, the free electrons must accelerate along the length of the conductor. But they acquire a steady drift speed. Explain why. (ii)A conductor of length L is connected to a battery of emf E. This conductor is replaced by another conductor of the same material and the same cross-sectional area, but of length 4L. How will the drift speed change?	**3**
23.	(a) Briefly describe how the current sensitivity of a moving coil galvanometer can be increased. (b) A galvanometer of resistance G is converted into a voltmeter of range (0 V) by using a resistance R. Find the resistance, in terms of R and G, required to convert it into a voltmeter of range (0 to V/2).	**3**
24.	(a)Two coils '1' and '2' are placed close to each other as shown in the figure. Find the direction of induced current in coil '1' in each of the following situations, justifying your answers:  (a) Coil '2' is moving towards coil '1'. (b) Coil '2' is moving away from coil '1'. (c) The resistance connected with coil '2' is increased keeping both the coils stationary**.** **For VI students** (a) Define mutual inductance and write its SI units.	**3** **3**

	(b) Derive an expression for the mutual inductance of two long co-axial solenoids of same length wound one over the other. (c) In an experiment, two coils C_1 and C_2 are placed close to each other. Find out the expression for the emf induced in the coil C_1 due to a change in the current through the coil C_2.	
25.	A convex lens of focal length 20 cm and a concave lens of focal length 15 cm are kept 30 cm apart with their principal axes coincident. When an object is placed 30 cm in front of the convex lens, calculate the position of the final image formed by the combination. Would this result change if the object were placed 30 cm in front of the concave lens? Give reason.	**3**
26.	(a) The work function of cesium metal is 2.14 eV. When light of frequency 6×10^{14} Hz is incident on the metal surface, photoemission of electrons occurs. Find the- (i) maximum kinetic energy of the emitted electrons? (ii) stopping potential and (iii) maximum speed of emitted electrons? **OR** (b)An electron and a photon, each has a wavelength of 1.00 nm. Find (i) their momenta (ii) the energy of the photon and (iii) the kinetic energy of electron.	**3** **3**
27.	Show the variation of binding energy per nucleon with mass number. Write the significance of the binding energy curve. **For VI students** Two nuclei with lower binding energy per nucleon form a nuclei with more binding energy per nucleon. (i) What type of nuclear reaction is it? (ii) Whether the total mass of nuclei increases, decreases or remains unchanged? (iii) Does the process require energy or produce energy?	**3** **3**

28.	(i) Write any two distinguishing features between conductors, semiconductors and insulators on the basis of (a) valance band and conduction band at room temperature (b) energy gaps between two bands. (ii) How does the change in temperature affect the behaviors of these materials? Explain briefly.	**3**
	SECTION (D) [4X2=8]	
29.	Diffraction of light is bending of light around the corners of an object whose size is comparable with the wavelength of light. Diffraction actually defines the limits of ray optics. This limit for optical instruments is set by the wavelength of light. An experimental arrangement is set up to observe the diffraction pattern due to a single slit. Answer the following questions based on the above: (i) How will the width of central maximum be affected if the wavelength of light is increased? (ii) Under what condition is the first minimum obtained? (iii) Two students are separated by a 7 m partition wall in a room 10 m high. If both light and sound waves can bend around obstacles, how is it that the students are unable to see each other even though they can converse easily?	 **1** **1** **2**
30.	A hydrogen atom consists of an electron revolving in a circular orbit of radius r with certain velocity v around a proton located at the nucleus of the atom. The electrostatic force of attraction between the revolving electron and the proton provides the requisite centripetal force to keep it in the orbit. According to Bohr's model, an electron can revolve only in certain stable orbits. The angular momentum of the electron in these orbits is some integral multiple of $\frac{h}{2\pi}$, where h is the Planck's constant. Further, when an electron makes a transition from one orbit of higher energy to that of lower energy, a photon is emitted having energy equal to the difference between energies of the initial and final states. Assuming the mass and charge of an electron as m and e respectively, answer the following questions.	

	(i) The expression for the speed of electron v in terms of radius of the orbit (r) and physical constant (K= $\frac{1}{4\pi\epsilon_0}$) (A) $\frac{Ke^2}{mr}$ (B) $\frac{Ke^2}{mr^2}$ (C) $\sqrt{\frac{Ke^2}{mr}}$ (D) $\sqrt{\frac{Ke^2}{mr^2}}$ (ii) The total energy of the atom in terms of r and physical constant K is: (A) Ke^2/r (B) $-Ke^2/2r$ (C) $Ke^2/2r$ (D) $3\ Ke^2/2r$ (iii) A photon of wavelength 500 nm is emitted when an electron makes a transition from one state to the other state in an atom. The change in the total energy of the electron and change in its kinetic energy in eV as per Bohr's model, respectively will be: (A) 2.48, - 2.48 (B) - 1.24, 1.24 (C) - 2.48, 2.48 (D) 1.24, - 1.24 (iv) In Bohr's model of hydrogen atom, the frequency of revolution of electron in its *nth* orbit is proportional to: (A) n (A) 1/n (C) $1/n^2$ (D) $1/n^3$	**1** **1** **1** **1**
	SECTION (E)	**[5X3=15]**
31.	(a) (i) A conducting slab of thickness 't=d/2' and dielectric slab of dielectric constant 'K' and thickness 't=d/4' is inserted between plates of parallel plate capacitor of plate separation d and plate area A. Obtain an expression for its capacitance. (ii) Two capacitors of different capacitances are connected first in (1) series and (2) then in parallel across a dc source of 100 V. If the total energy stored in the combination in two cases are 40mJ and 250 mJ respectively, find the capacitance of the capacitors. **OR**	**5**

	(b) (i)Two-point charges + q and -q are held at (r, 0) and (- r, 0) in x-y plane. Obtain an expression for the net electric field due to the charges at a point (0, y). Hence, find electric field at a far-off point (y >> r). (ii) Four-point charges of 2 mC, 1 mC, 3 mC and 4mC are kept at the vertices A, B, C and D of a square of side 20 cm. Find the total amount of work done in shifting the charges from A to A_1, B to B_1 , C to C_1 and D to D_1. Here A_1, $B_{1,}$ C_1 and D_1 are the midpoints of sides AB, BC, CA and DA respectively.	**5**
32.	(a) (i) Derive an expression for the force acting on a current carrying straight conductor kept in a magnetic field. State the rule which is used to find the direction of this force. Give the condition under which this force is (1) maximum, and (2) minimum. (ii) Two long parallel straight wires A and B are 2.5 cm apart in air. They carry 5 .0 A and 2.5 A currents respectively in opposite directions. Calculate the magnitude of the force exerted by wire A on a 10 cm length of wire B. **OR** (b) (i) A particle of mass m and charge q, at the origin moves with a velocity angle v in xy-plane making an angle θ with x-axis. It is subjected to a uniform magnetic field B along x-axis. Justify that the particle will move in a helical path. Hence, obtain expression for the radius of the helix. (ii) A closely wound circular coil of radius 6·28 cm, having 50 turns carries a steady current of 4 A. Find the magnetic field at the centre of the coil. How will the magnitude of the magnetic field be affected if the radius of the coil is halved keeping other factors same?	**5** **5**

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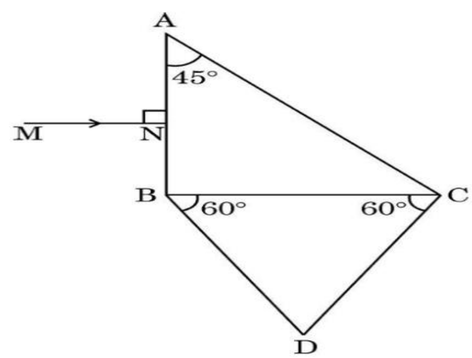
(a) (i) A ray of light is incident on one face of a triangular glass prism of refractive index n and is refracted out from the opposite face. Deduce the expression for Snell’s law in terms of the angle of minimum deviation and angle of the prism.
(ii) A right-angled isosceles glass prism ABC is kept in contact with an equilateral triangular prism DBC as shown in the figure. Both prisms are made of the same glass of refractive index 1·6. Trace the path of the ray MN incident normally on face AB as it passes through the combination.


For VI students
(ii) A ray of light is incident at an angle i on a parallel sided glass slab of diagram to show its path as it emerges out of the slab of thickness ‘d’ and gets refracted into the slab at an angle r. Hence, obtain an expression for the lateral shift of the ray. Under what condition will the shift be minimum?
OR
(b) (i) Draw a ray diagram showing the image formation when a concave mirror produces a real, inverted and magnified image of an object and hence obtain the mirror formula.
For VI students
(i)Use mirror formula to deduce that a convex mirror always produces a virtual image of an object kept in front of it.
(ii) A concave mirror has radius of curvature 20 cm. Calculate the distance of an object from the mirror so as to form an image of magnification. Also find the location of the image.
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