COMMON PRE-BOARD EXAMINATION

PHYSICS-Code No. 042

Class-XII-(2025-26)

SET: 2

Time allowed: 3 Hrs. **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.

(7) You may use the following values of physical constants wherever necessary.

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

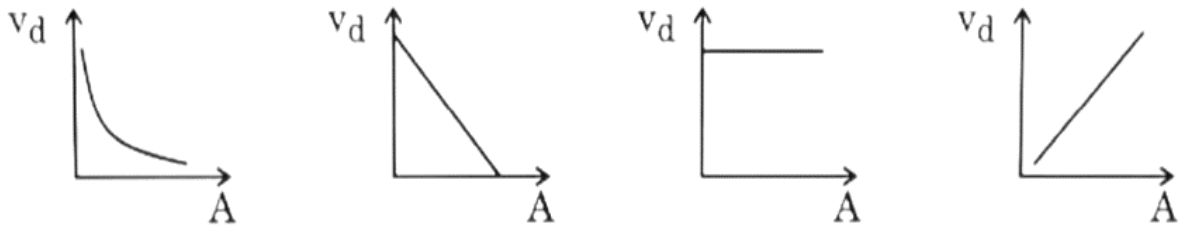
v. $\mu_0 = 4\pi \times 10^{-7}$ T m $\boldsymbol{A^{-1}}$

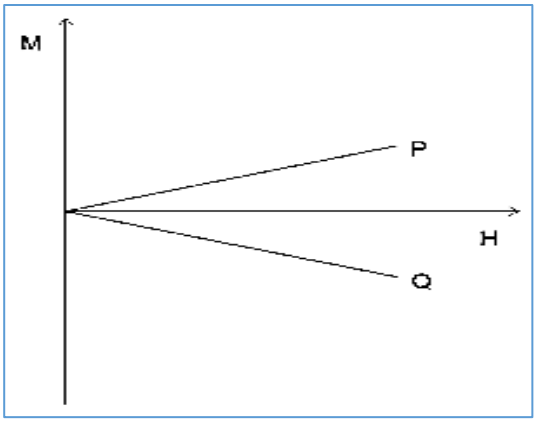
vi. $h = 6.63 \times 10^{-34}$ J s

vii. $\varepsilon_0 = 8.854 \times 10^{-12}$ $\boldsymbol{C^2N^{-1}m^{-2}}$

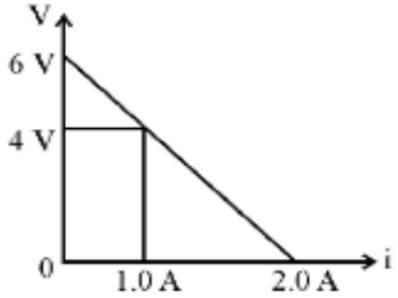
viii. Avogadro's number = 6.023 X $\mathbf{10^{23}}$ per gram mole

SECTION A		
Q. No.	**Question**	**Marks**
1.	The minimum distance between an object and its real image formed by a convex lens of focal length f is: (A) 2f (B) 3f (C) 4f (D) 6f	1
2.	A steady current flows through a metallic wire whose area of cross-section (A) increases continuously from one end of the wire to the other. The magnitude of drift velocity(v_d) of the free electrons as a function of 'A' can be shown by	1

	 **(A)** **(B)** **(C)** **(D)**	
3.	According to Huygen's principle, the amplitude of secondary wavelets is (A) equal in both the forward and backward directions. (B) maximum in the forward direction and zero in the backward direction. (C) large in the forward direction and small in the backward direction. (D) Small in the forward direction and large in the backward direction.	1
4.	In the process of charging a capacitor, the current produced between the plates of the capacitor is (A) $\mu_0 \frac{d\phi_E}{dt}$ (B) $\frac{1}{\mu_0}\frac{d\phi_E}{dt}$ (C) $\varepsilon_0 \frac{d\phi_E}{dt}$ (D) $\frac{1}{\varepsilon_0}\frac{d\phi_E}{dt}$	1
5.	An electric dipole consisting of charges +q and -q separated by a distance 'r', is kept symmetrically at the centre of an imaginary sphere of radius R [$> r$]. Another point charge Q is also kept at the centre of the sphere. The net electric flux coming out of the sphere will be (A) $\frac{-Q}{\varepsilon_0}$ (B) $\frac{Q}{\varepsilon_0}$ (C) Zero (D) $\frac{2q+Q}{\varepsilon_0}$	1
6.	A capacitor and an inductor are connected in series across an ac source of voltage of variable frequency. The frequency is increased continuously. The nature of the circuit before and after the resonance will be (A) Capacitive only. (B) Inductive only. (C) Inductive and capacitive respectively. (D) Capacitive and inductive respectively.	1

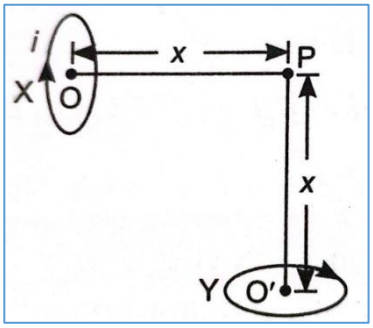
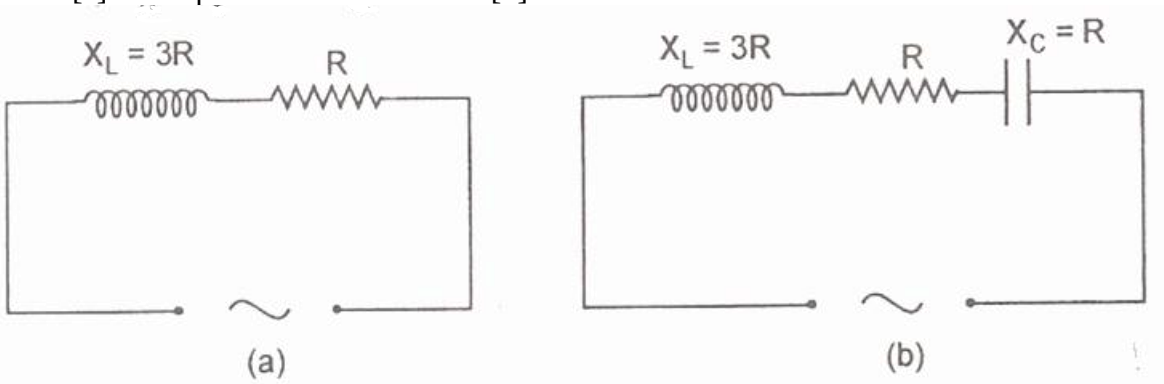
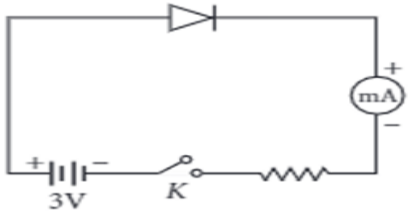
7.	The energy of an electron in the ground state of a hydrogen atom is - 13.6 eV. The kinetic and potential energy of the electron in the ground state will be (A) + 13.6 eV, -27.2eV (B) – 6.8 eV, 13.6 eV (C) 3.4 eV, - 6.8 eV (D) 6.8 eV, - 3.4 eV	1
8.	The graph below represents the variation of intensity of magnetisation (M) with magnetic field strength (H) for substances P and Q.  Which of the two substances is most likely to be attracted when taken near a magnet? (A) Only P (B) Only Q (C) Both P and Q (D) Neither P nor Q	1
9.	A circular disc of radius 0.2 m is placed in a uniform magnetic field of induction $\frac{1}{\pi}\frac{Wb}{m^2}$ in such a way that its axis makes an angle of 60^0 with $\vec{B}$. The magnetic flux linked with the disc is (A) 0.02 Wb (B) 0.06Wb (C) 0.08 Wb (D) 0.04 Wb	1
10.	An alternating current is given by $I = I_0 \cos [100\pi]t$. The least time the current takes to decrease from its maximum value to zero will be (A) $\frac{1}{50}$ s (B) $\frac{1}{100}$ s (C) $\frac{1}{150}$ s (D) $\frac{1}{200}$ s	1
11.	The ratio of the nuclear density of two nuclei having mass numbers 64 and 125 is (A) $\frac{64}{125}$ (B) $\frac{5}{4}$ (C) $\frac{4}{5}$ (D) 1	1

12.	A test charge of 1.6×10^{-19} C is moving with a velocity $v = (4\hat{i} + 3\hat{k})$ ms^{-1} in a magnetic field $B = (3\hat{k} + 4\hat{i})$ T. The force on this test charge is (A) $24\hat{j}$ N (B) $-24\hat{j}$ N (C) $24\hat{k}$ N (D) Zero	1

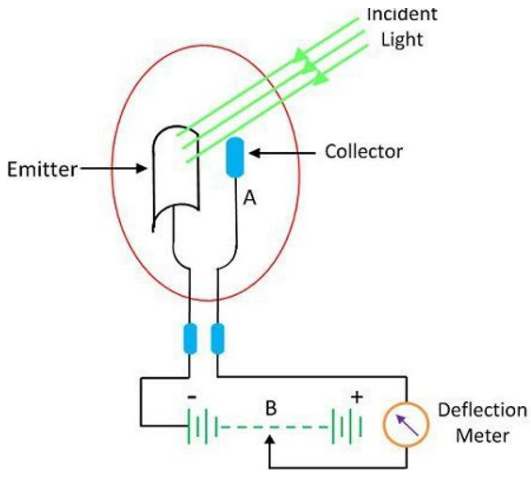
	For Questions 13 to 16, two statements are given one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below. (A) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion. (B) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion. (C) Assertion is true but Reason is false. (D) Both Assertion and Reason are false.	
13.	**Assertion (A):** In the Young's double slit experiment, all fringes are of equal width. **Reason (R):** The fringe width depends upon the wavelength(λ) of light used, the distance of the screen from the plane of slits (D) and slits separation (d).	1
14.	**Assertion (A):** A convex lens, when immersed in a liquid, disappears. **Reason (R):** The refractive indices of the material of the lens and the liquid are equal.	1
15.	**Assertion(A):** An alpha particle is moving towards a gold nucleus. The impact parameter is maximum for the scattering angle of 180^o. **Reason(R):** The impact parameter in an alpha particle scattering experiment does not depend upon the atomic number of the target nucleus.	1
16.	**Assertion (A):** If the electric flux over a closed surface is negative, then the surface encloses net negative charge. **Reason(R):** Electric flux is independent of the charge distribution inside the surface.	1
	SECTION B	
17.	What is an electric dipole? Derive an expression to find the torque acting on an electric dipole placed in a uniform electric field.	2
18.	The figure shows a plot of terminal voltage 'V' versus the current 'i' of a given cell. Calculate from the graph (a) the emf of the cell and (b) the internal resistance of the cell.  	2

19.	Identify the part of the electromagnetic spectrum which is (A) next to the lowest frequency end of the visible part of the electromagnetic spectrum and (B)produced by bombarding a metal target with high-energy electrons. Give one use of each of them.	2
20(I)	The susceptibility of a magnetic material is -2.6×10^{-5}. Identify the type of magnetic material and state its two properties.	2
	OR	
20(II)	(A)Write the expression for the magnetic force acting on a charged particle moving with velocity v in the presence of a magnetic field B. (B) When is the force on a charged particle moving in a magnetic field (i) maximum and (ii) minimum?	2
21(I)	Ultraviolet light of wavelength 2271Å from a source irradiates a photocell made of Molybdenum metal. If the stopping potential is -1.3V, find the work function in eV. How would the photo cell respond to a high intensity red light of wavelength 6328 Å?	2
	OR	
21(II)	If the potential difference used to accelerate electrons is tripled, by what factor does the de-Broglie wavelength of the electron beam change?	2

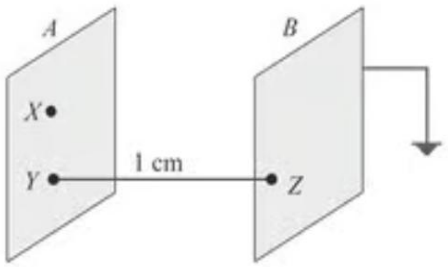
SECTION C		
22.	A given coin has a mass of 3.0 g. Calculate the nuclear energy that would be required to separate all the neutrons and protons from each other. For simplicity, assume that the coin is entirely made of $_{29}Cu^{63}$ atoms (of mass 62.92960 u).	3
23.	(A) Use Kirchhoff 's rules to obtain the balance condition in Wheatstone bridge. (B) Give one practical application that is based on this principle.	3
24.	With the help of a circuit diagram, explain how two p-n junction diodes, along with a centre tapped transformer, can be used as a full wave rectifier.	3
25.	(A) A concave mirror has a radius of curvature of 20 cm. Calculate the distance of an object from the mirror to form a real image of magnification 2. Also, find the location of the image. (B) If the silver coating around the centre of a concave mirror is removed, will the mirror still form the image of an object? Justify your answer.	3
26.	(A) What are the coherent sources of light? Can two independent sodium lamps act like coherent sources? Explain. (B) A beam of light consisting of a known wavelength, 520 nm and an unknown wavelength λ used in Young's double slit experiment produces two interference patterns such that the fourth bright fringe of unknown wavelength coincides with the fifth bright fringe of known wavelength. Find the value of λ.	3

27(I)	(A) State Biot-Savart's law and express this law in the vector form. (B) Two identical circular loops X and Y of radius R and carrying the same current are kept in perpendicular planes such that they have a common centre at P as shown in the figure. Find the magnitude of the net magnetic field at the point P due to the loops.  	3
	OR	
27(II)	(A) State Gauss's law for magnetism. Explain its significance. (B) A bar magnet AB with magnetic moment M is cut into two equal parts perpendicular to its axis. One part is kept over the other so that end B is exactly over A. What will be the magnetic moment of the combination so formed?	3
28.	Given below are two electrical circuits [a] and [b]. Calculate the ratio of the power factor of circuit [a] to the power factor of circuit [b].  	3
	SECTION - D	
29	**POTENTIAL BARRIER** The potential barrier in the p-n junction diode is the barrier in which the charge requires additional force for crossing the region. In other words, the barrier in which the charge carrier gets stopped by the obstructive force is known as a potential barrier. When a p-type semiconductor is brought into close contact with an n-type semiconductor, we get a p-n junction with a barrier potential of 0.4 volts and a width of the depletion region is 4.0×10^{-7} m. This p-n junction is forward biased with a battery of voltage 3 V and a negligible internal resistance in series with a resistor of resistance R, an ideal milliammeter and a key K as shown in the figure. When the key K is pressed, a current of 20 mA passes through the diode.  	1 Mark each

	(I) The intensity of the electric field in the depletion region when p-n junction is unbiased is (A) 0.5 x $10^6 Vm^{-1}$ (B) 1.0 x $10^6 Vm^{-1}$ (C) 2.0 x $10^6 Vm^{-1}$ (D) 1.5 x $10^6 Vm^{-1}$ (II) The resistance of resistor R is (A) 150Ω (B) 300Ω (C) 130Ω (D) 180Ω (III) In a p-n junction, the potential barrier is due to the charges on either side of the junction; these charges are (A) Majority charge carriers. (B) Minority charge carriers. (C) Both (A) and (B). (D) Immobile positive and negative ions. (IV)The voltage of the potential barrier is V_0. A voltage V is applied to the input; at what moment will the barrier disappear? (A) $V < V_0$ (B) $V = V_0$ (C) $V > V_0$ (D) $V << V_0$	

30.	 When a photon of light of frequency 'f' is incident on a photosensitive metal surface of work function $\emptyset_0$, the emission of electrons takes place. But in some metals, there is no emission of electrons. This difference in behaviour was explained by Albert Einstein using the quantum theory of light.	

	(I) Explain why there is no photo emission when the ordinary light ray falls on a Zinc plate. At the same time, there is photo emission when an ordinary light ray falls on the sodium or other alkali metals. Why?	2
	(II) The frequency 'f' of incident radiation is greater than the threshold frequency f_0 in a photo cell. How will the stopping potential vary if the frequency is increased, keeping other factors constant?	1
	(III) Plot a graph showing the variation of kinetic energy of photo electrons with the frequency of incident radiation.	1
	SECTION E	
31(I)	(A) A ray of light is incident normally on a refracting face of a prism of prism angle A and suffers a deviation of angle δ. Prove that the refractive index μ of the material of the prism, $\mu = \frac{\sin(A+\delta)}{\sin A}$. (B) The refractive index of the material of a prism is √2. If the refracting angle of the prism is 60, find the (1) Angle of minimum deviation, and (2) Angle of incidence.	5
	OR	

31 (II)	(A) Draw a labelled ray diagram of a compound microscope showing image formation at the least distance of distinct vision. Derive an expression for its magnifying power. (B) A telescope consists of two lenses of focal lengths 100 cm and 5 cm. Find the magnifying power when the final image is formed at infinity.	5
32(I)	(A) What is an equipotential surface? Give two important properties of an equipotential surface. (B)Two identical plane metallic surfaces A and B are kept parallel to each other in air, separated by a distance of 1.0 cm as shown in fig. Surface A is given a positive potential of 10V, and the outer surface of B is earthed. (i) What is the magnitude and direction of the uniform electric field between points Y and Z? (ii) What is the work done in moving a charge of 20μc from point X to Y, where X is situated on surface A? 	5
	OR	

32(II)	(A)Derive the expression for the capacitance of a parallel plate capacitor having plate area A and plate separation d. In what form is energy stored in a parallel plate capacitor, and give an expression for the energy stored in a capacitor? (B) Two charged spherical conductors of radii R_1 and R_2, when connected by a conducting wire, acquire charges q_1 and q_2, respectively. Find the ratio of their surface charge densities in terms of their radii.	5
33(I)	(A) With the help of a labelled diagram, describe the principle and working of an ac generator. Also, obtain an expression for the instantaneous value of the emf generated if the angular velocity of the armature coil is ω. (B) A rectangular loop of sides 8cm x 2cm with a small cut is stationary in a uniform magnetic field produced by an electromagnet. The current feeding the electromagnet is gradually reduced so that the magnetic field decreases from its initial value of 0.3T at the rate of 0.02T/s. If the cut is joined and the loop has a resistance of 1.6 ohms, how much power is dissipated?	5
	OR	
33(II)	(A) Using a phasor diagram, derive an expression for the impedance of a series LCR circuit connected to an ac supply of variable frequency. (B) Plot a graph showing the variation of current with the frequency of the applied voltage. (C) A series LCR circuit with R = 20Ω, L = 1.5 H and C = 35 μF is connected to a variable frequency 200 V ac supply. When the frequency of the supply equals the natural frequency of the circuit, what is the average power transferred to the circuit in one complete cycle?	5