

KENDRIYA VIDYALAYA SANGATHAN
SILCHAR REGION
PRE-BOARD EXAMINATION
SESSION 2025-26

CLASS: XII
SUB: PHYSICS

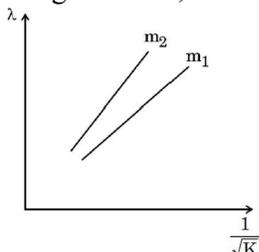
M.M.: 70
TIME: 3 HOURS

General Instructions:

- There are 33 Questions in all. All questions are compulsory.
- This Question paper has 5 sections; Section A, Section B, Section C, Section D and Section E. All sections are compulsory
- Section A** contains **16 questions - 12 MCQs and 04 Assertion-Reasoning** based of 1 mark each, **Section B** contains **5 questions of 2 marks each**, **Section C** contains **7 Questions of 3 Marks each**, **Section D** contains **2 Case study Based Questions of 4 marks each** and **Section E** contains **3 Long Answer Questions of 5 marks each**.
- There is no overall choice. However, an internal choice has been provided in 1 question in Section B, 1 question in Section C, 1 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.
- Use of calculators is not allowed.
- You may use the following values of physical constant wherever necessary.
 - $c = 3 \times 10^8$ m/s
 - $m_e = 9.1 \times 10^{-31}$ Kg
 - $m_p = 1.7 \times 10^{-27}$ Kg
 - $e = 1.6 \times 10^{-19}$ C
 - $\mu_0 = 4\pi \times 10^{-7}$ TmA⁻¹
 - $h = 6/63 \times 10^{-34}$ Js
 - $\epsilon_0 = 8.854 \times 10^{-12}$ C²/Nm²
 - Avogadro's Number = 6.023×10^{23} per gram mole

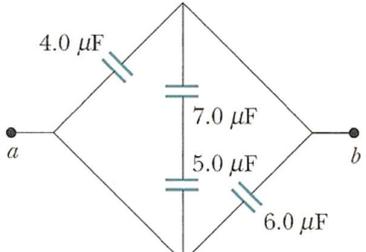
| S.N | SECTION A | M |
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| 1 | An isolated conductor, with a cavity, has a net charge +Q. A point charge +q is inside the cavity. The charges on the cavity wall and the outer surface are respectively : (A) 0 and Q (B) -q and Q-q (C) -q and Q + q (D) 0 and Q-q | 1 |
| 2 | A current carrying circular loop of magnetic moment \vec{M} is suspended in a vertical plane in an external magnetic field \vec{B} such that its plane is normal to \vec{B} . The work done in rotating this loop by 45° about an axis perpendicular to \vec{B} is closest to : (A) - 0.3 MB (B) 0.3 MB (C) - 1.7 MB (D) 1.7 MB | 1 |
| 3 | A 10 cm long wire lies along y-axis. It carries a current of 1.0 A in positive y-direction. A magnetic field $\vec{B} = (5 \text{ mT}) \hat{j} - (8 \text{ mT}) \hat{k}$ exists in the region. The force on the wire is : (A) $(0.8 \text{ mN}) \hat{i}$ (B) $-(0.8 \text{ mN}) \hat{i}$ (C) $(80 \text{ mN}) \hat{i}$ (D) $-(80 \text{ mN}) \hat{i}$ | 1 |
| 4 | \vec{E} and \vec{B} represent the electric and the magnetic field of an electro-magnetic wave respectively. The direction of propagation of the wave is along (A) \vec{B} (B) \vec{E} (C) $\vec{E} \times \vec{B}$ (D) $\vec{B} \times \vec{E}$ | 1 |
| 5 | A current flows through a cylindrical conductor of radius R. The current density at a point in the conductor is $j = \alpha r$ (along its axis), here α is a constant and r is distance from the axis of the conductor. The current flowing through the portion of the conductor from $r = 0$ to $r = R/2$ is proportional to : (A) R (B) R ² (C) R ³ (D) R ⁴ | 1 |

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| 6 | Consider a solenoid of length l and area of cross-section A with fixed number of turns. The self-inductance of the solenoid will increase if : (A) both l and A are increased (B) l is decreased and A is increased (C) l is increased and A is decreased (D) both l and A are decreased | 1 |
| 7 | The reactance of a capacitor of capacitance C connected to an ac source of frequency ω is 'X'. If the capacitance of the capacitor is doubled and the frequency of the source is tripled, the reactance will become : (A) $\frac{X}{6}$ (B) $6X$ (C) $\frac{2}{3}X$ (D) $\frac{3}{2}X$ | 1 |
| 8 | A hydrogen atom makes a transition from $n = 5$ to $n = 1$ orbit. The wavelength of photon emitted is λ . The wavelength of photon emitted when it makes a transition from $n = 5$ to $n = 2$ orbit is (a) $\frac{8}{7}\lambda$ (b) $\frac{16}{7}\lambda$ (c) $\frac{24}{7}\lambda$ (d) $\frac{32}{7}\lambda$ | 1 |
| 9 | The magnification produced by a spherical mirror is $+2.0$. The mirror used and the nature of the image formed will be (A) Convex and virtual (B) Concave and real (C) Concave and virtual (D) Convex and real | 1 |
| 10 | 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 horizontal circles around the wire. (D) coaxial helices around the wire. | 1 |
| 11 | A proton and an alpha particle having equal velocities approach a target nucleus. They come momentarily to rest and then reverse their directions. The ratio of the distance of closest approach of the proton to that of the alpha particle will be : (A) $\frac{1}{2}$ (B) 2 (C) $\frac{1}{4}$ (D) 4 | 1 |
| 12 | Phase difference between any two points on a wavefront is (A) π (B) $\pi/2$ (C) 0 (D) $\pi/4$ | 1 |
| | Question No. 13 to 16 consist of two statements – Assertion (A) and Reason (R). Answer these questions by selecting the appropriate option given below: A. Both A and R are true, and R is the correct explanation of A. B. Both A and R are true, and R is not the correct explanation of A. C. A is true but R is false. D. Both A and R are false | |
| 13 | Assertion: When two charges q_1 and q_2 are kept at some distance apart, force acting between these charges is F . If a third charge q_3 is placed quite close to q_2 , the force will remain F Reason: The force acting between two charges does not depend upon the presence of any other charge | 1 |
| 14 | Assertion: Density of all the nuclei is same. Reason : Radius of nucleus is directly proportional to the square root of mass number. | 1 |
| 15 | Assertion : A convex lens, when immersed in a liquid, disappears. Reason : The refractive indices of material of the lens and the liquid are equal. | 1 |
| 16 | Assertion : In double slit experiment if one slit is closed, diffraction pattern due to the other slit will appear on the screen. Reason : For interference, at least two waves are required. | 1 |
| SECTION B | | |
| 17 | Find the temperature at which the resistance of a wire made of silver will be twice its resistance at 20°C . Take 20°C as the reference temperature and temperature coefficient of resistance of silver at $20^\circ\text{C} = 4.0 \times 10^{-3}\text{K}^{-1}$. | 2 |
| 18 | Light of wavelength 500nm is incident on caesium metal (work function 2.14eV) and photoemission of electrons occurs. Calculate the (i) kinetic energy (in eV) of the fastest electrons | 2 |

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| | <p>and (ii) stopping potential for this situation. (Take $hc = 1240 \text{ eV} \cdot \text{nm}$)</p> <p style="text-align: center;">OR</p> <p>De Broglie wavelength λ as a function of $\frac{1}{\sqrt{K}}$, for two particles of masses m_1 and m_2 are shown in the figure. Here, K is the energy of the moving particles.</p>  <p>(a) What does the slope of a line represent ? (b) Which of the two particles is heavier ? Justify your answer in each case.</p> | |
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| 19 | <p>(a) In a plane electromagnetic wave, the electric field oscillates sinusoidally at a frequency of $2.0 \times 10^{10} \text{ Hz}$ and amplitude 48 V/m.</p> <p>(i) What is the wavelength of the wave? (ii) What is the amplitude of the oscillating magnetic field?</p> <p>(b) Write the expression for the generalized form of Ampere’s circuital law.</p> | 2 |
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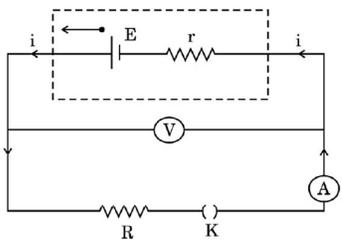
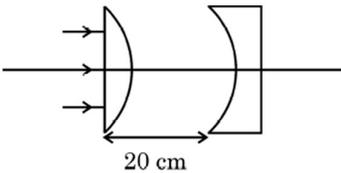
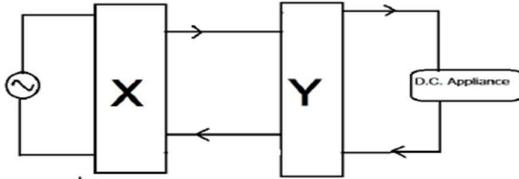
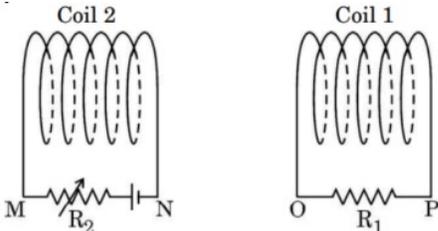
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| 20 | <p>A magnetic dipole with a magnetic moment of 1.5 A m^2 is placed in a uniform magnetic field of 0.3 T. Calculate:</p> <p>(a) The torque when the dipole makes an angle of 45° with the field. (b) The potential energy of the dipole at the same angle.</p> <p style="text-align: center;">OR</p> <p>A proton with kinetic energy $1.3384 \times 10^{-14} \text{ J}$ moving horizontally from north to south, enters a uniform magnetic field B of 2.0 mT directed eastward. Calculate :</p> <p>(a) the speed of the proton (b) the radius of the path traced by the proton [Take (q/m) for proton = $1.0 \times 10^8 \text{ C/kg}$]</p> | 2 |
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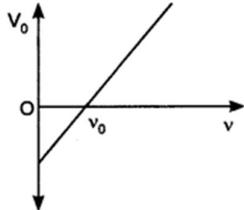
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| 21 | <p>Find the equivalent capacitance of the combination of capacitors between the points a and b.</p>  | 2 |
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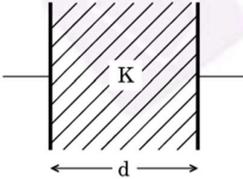
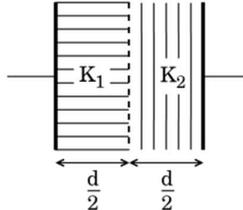
SECTION C

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| 22 | <p>(a) Explain the principle of a velocity selector. Derive the expression for the velocity of a charged particle that passes undeflected through a velocity selector.</p> <p>(b) A velocity selector has a magnetic field of 0.5 T and an electric field of $10,000 \text{ N/C}$, both perpendicular to each other and to the direction of motion of a charged particle. Calculate the velocity of the particle that passes through the selector undeflected.</p> <p style="text-align: center;">OR</p> <p>A uniform conducting wire of length $12a$ and resistance R is wound up as a current carrying coil in the shape of</p> <p>(i) an equilateral triangle of side ‘a’ (ii) a square of sides ‘a’ and, (iii) a regular hexagon of sides ‘a’. The coil is connected to a voltage source V_0. Find the magnetic moment of the coils in each case. (area of hexagon = $\frac{3\sqrt{3}}{2} a^2$)</p> | 3 |
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| 23 | <p>(a) In Young’s double slit experiment, using light of wavelength 400 nm, interference fringes of width ‘X’ are obtained. The wavelength of light is increased to 600 nm and the separation between the slits is halved. If one wants the observed fringe width on the screen to be the same in the two cases, find the ratio of the distance between the screen and the plane of the interfering</p> | 3 |
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| | sources in the two arrangements. (b) A point source is placed at the first principal focus of a convex lens. What is the shape of the wavefront of light emerging from the convex lens? | |
| 24 | <p>A battery of unknown emf E and internal resistance r is connected in a circuit as shown in the figure. When the key (K) is open, the voltmeter reads 10.0 V and ammeter reads 0 A. In the closed circuit, the voltmeter reads 6.0 V and ammeter reads 2.0 A. Calculate :</p> <p>(a) emf of the battery, (b) internal resistance of the battery (r), and (c) external resistance (R).</p>  | 3 |
| 25 | <p>(a) In the given figure the radius of curvature of curved face in the plano-convex and the plano-concave lens is 15 cm each. The refractive index of the material of the lenses is 1.5. Find the final position of the image formed.</p>  <p>(b) A convex lens made up of glass of refractive index 1.5 is dipped in a medium A of refractive index 1.65. Explain, giving reasons, whether it will behave as a converging lens or a diverging lens.</p> | 3 |
| 26 | <p>(a) Calculate the mass defect and binding Energy of an alpha (α) particle in MeV from the following data. Mass of Helium Nucleus = 4.00260 u Mass of neutron = 1.008662 u Mass of proton = 1.007825 u. 1 atomic mass unit (1u) = 931 MeV</p> <p>(b) State any two properties of a nucleus.</p> | 3 |
| 27 | <p>(a) Identify the circuit elements X and Y as shown in the given block diagram and draw the output waveforms of X and Y.</p>  <p>(b) Suppose a pure Si crystal has $5 \times 10^{28}\text{ atoms m}^{-3}$. It is doped by 1 ppm concentration of boron. Calculate the concentration of holes and electrons, given that $n_i = 1.5 \times 10^{16}\text{ m}^{-3}$</p> | 3 |
| 28 | <p>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:</p>  <p>(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.</p> | 3 |
| SECTION D (CASE STUDY BASE QUESTIONS) | | |

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| 29 | <p>When light of sufficiently high frequency is incident on a metallic surface, electrons are emitted from the metallic surface. This phenomenon is called photoelectric emission. Kinetic energy of the emitted photoelectrons depends on the wavelength of incident light and is independent of the intensity of light. Number of emitted photoelectrons depends on intensity. $(h\nu - \Phi)$ is the maximum kinetic energy of emitted photoelectrons (where Φ is the work function of metallic surface). Reverse effect of photo emission produces X-ray. X-ray is not deflected by electric and magnetic fields Wavelength of a continuous X-ray depends on potential difference across the tube. Wavelength of characteristic X-ray depends on the atomic number.</p> <p>(A) The number of photoelectrons emitted for light of frequency (higher than the threshold frequency ν_0) is proportional to: (a) threshold frequency (b) intensity of light (c) frequency of light (d) $\nu - \nu_0$ (B) Two beams, one of red light and the other of blue light, of the same intensity are incident on a metallic surface to emit photoelectrons. Which emits electrons of greater frequency? (a) Both (b) Red light (c) Blue light (d) Neither (C) The stopping potential V_0 for photoelectric emission from a metal surface is plotted along with the y-axis and frequency ν of incident light along the x-axis. A straight line is obtained as shown. Planck's constant is given by</p>  <p>(a) product of the slope of the line and charge on the electron (b) intercept along y-axis divided by the charge on the electron (c) product of the intercept along x-axis and mass of the electron (d) the slope of the line</p> <p>(D) What happens to the kinetic energy of the emitted electrons when the light is incident on a metal surface? (a) It varies with the frequency of light (b) It varies with the light intensity (c) It varies with the speed of light (d) It varies irregularly</p> | 4 |
| 30 | <p>A PN junction diode is an essential component in many electronic circuits. When a p-type and an n-type semiconductor are joined, a depletion region forms at the junction. The behavior of the diode depends on whether it is forward biased or reverse biased. In forward bias, the diode allows current to flow, while in reverse bias, the current flow is minimal, except for a small leakage current. Consider a diode connected in a circuit with a power supply of 5V, a resistor of 100Ω, and a current of 40mA in forward bias.</p> <p>(A) What happens to the width of depletion layer of a p-n junction when it is (i) forward biased, (ii) reverse biased? 2</p> <p>(B) Draw the I-V characteristic curve of a P-N junction in forward and reverse bias. 1</p> <p>(C) Why are trivalent and pentavalent atoms chosen as dopants for making extrinsic semiconductors? 1</p> | |
| SECTION E | | |
| 31 | <p>(i) You are given three circuit elements X, Y and Z. They are connected one by one across a given ac source. It is found that V and I are in phase for element X. V leads I by $\pi/4$ for element Y while I leads V by $\pi/4$ for element Z. Identify elements X, Y and Z.</p> <p>(ii) Establish the expression for impedance of circuit when elements X, Y and Z are connected in series to an ac source. Show the variation of current in the circuit with the frequency of the applied ac source.</p> <p>(iii) In a series LCR circuit, obtain the conditions under which (a) impedance is minimum and (b) wattless current flows in the circuit.</p> <p style="text-align: center;">OR</p> | 5 |

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| | <p>(a) A 100-turn coil of radius 1.6 cm and resistance 5.0 is co-axial with a solenoid of 250 turns/cm and radius 1.8 cm. The solenoid current drops from 1.5 A to zero in 25 ms. Calculate the current induced in the coil in this duration. (Take $\pi^2 = 10$)</p> <p>(b) Obtain an expression for self-inductance of a long solenoid of length l, area of cross-section A having N turns.</p> | |
| <p>32</p> | <p>(a) Derive an expression for the electric field E due to a dipole of length '2a' at a point distant r from the centre of the dipole on the axial line.</p> <p>(b) Draw a graph of E versus r for $r \gg a$.</p> <p>(c) If this dipole were kept in a uniform external electric field E_0, diagrammatically represent the position of the dipole in stable and unstable equilibrium and write the expressions for the torque acting on the dipole in both the cases.</p> <p style="text-align: center;">OR</p> <p>(a) The space between the plates of a parallel plate capacitor is completely filled in two ways. In the first case, it is filled with a slab of dielectric constant K. In the second case, it is filled with two slabs of equal thickness and dielectric constants K_1 and K_2 respectively as shown in the figure. The capacitance of the capacitor is same in the two cases. Obtain the relationship between K, K_1 and K_2.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>(Case 1)</p> </div> <div style="text-align: center;">  <p>(Case 2)</p> </div> </div> <p>(b) Two point charges q and $-q$ are located at points $(0, 0, -a)$ and $(0, 0, a)$ respectively.</p> <p>(i) Find the electrostatic potential at $(0, 0, z)$ and $(x, y, 0)$</p> <p>(ii) How much work is done in moving a small test charge from the point $(5, 0, 0)$ to $(-7, 0, 0)$ along the x-axis?</p> | <p>5</p> |
| <p>33</p> | <p>(a) State Huygens' principle and prove the law of reflection on the basis of wave theory.</p> <p>(b) In the diffraction due to a single slit experiment, the aperture of the slit is 3 mm. If monochromatic light of wavelength 620 nm is incident normally on the slit, calculate the separation between the first order minima and the 3rd order maxima on one side of the screen. The distance between the slit and the screen is 1.5 m.</p> <p style="text-align: center;">OR</p> <p>(a) A point object is placed in front of a double convex lens (of refractive index $n = n_2/n_1$ with respect to air) with its spherical faces of radii of curvature R_1 and R_2. Show the path of rays due to refraction at first and subsequently at the second surface to obtain the formation of the real image of the object. Hence obtain the lens maker's formula for a thin lens.</p> <p>(b) Double convex lenses are to be manufactured from a glass of refractive index 1.55, with both faces of same radius of curvature. What is the radius of curvature required if focal length is to be 20cm ?</p> | <p>5</p> |

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