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| **PB1/PHQP/1223/B 05-DEC-2023** | | | | | | | | | | | |
| **PRE BOARD EXAMINATION - I (2023 – 24)** | | | | | | | | | | | |
| **Subject: PHYSICS**  **Grade: XII** | | | | Max. Marks:70Time: 3 hours | | | | | | | |
| **Name:** | | | | | | | | | **Section:** | **Roll No:** | |
| ***General Instructions:***   * There are 33 questions in all. All questions are compulsory. * This question paper has five sections: Section A, Section B, Section C, Section D and Section E. * All the sections are compulsory. * **Section A** contains sixteen questions, twelve MCQ and four Assertion Reasoning based of **ONE**  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. * 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 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 constants wherever necessary   c = 3 x 108 m/s  me = 9.1 x10-31 kg  e = 1.6 x 10-19 C  µ0 = 4π x 10-7 Tm𝑨−𝟏 v.  h = 6.63 x10-34 Js  ε0 = 8.854 x10-12 𝑪𝟐𝑵−𝟏𝒎−𝟐  Avogadro’s number = 6.023 X 𝟏𝟎𝟐𝟑 per gram mole | | | | | | | | | | | |
| 1 | A conducting sphere of radius 10 cm is charged to 10 μC. Another uncharged sphere of radius 20 cm is allowed to touch it for enough time. After the two are separated, the surface density of charge on the two spheres will be in the ratio of | | | | | | | | | | 1 |
|  | a | | 1:3 | | | b | | 3:1 | | |  |
|  | c | | 1:2 | | | d | | 2:1 | | |  |
| 2. | Figure shows some equipotential lines distributed in space. A charged object is moved from point A to point B | | | | | | | | | | 1 |
|  | a | | The work done in Fig. (i) is the greatest. | | | b | | The work done in Fig. (ii) is least | | |  |
|  | c | | The work done is the same in Fig. (i), Fig. (ii) and Fig. (iii). | | | d | | The work done in Fig. (iii) is greater than Fig. (ii)but equal to that in Fig. (i). | | |  |
| 3 | If drift velocity of electron is vd and intensity of electric field is E, then the relation obeys the the Ohm’s law is | | | | | | | | | | 1 |
|  | a | | vd α E | | | b | | vd α √E | | |  |
|  | c | | Vd = constant | | | d | | Vd α E2 | | |  |
| 4 | The correct plot of the magnitude of magnetic field *𝐵*⃗  vs distance r from centre of the wire is, if the radius of wire is R | | | | | | | | | | 1 |
|  | a | |  | | | b | |  | | |  |
|  | c | |  | | | d | |  | | |  |
| 5 | Capacitor plates are charged by a battery with V volts. After charging, battery is disconnected and a dielectric slab with dielectric constant K is inserted between its plates, the potential across the plates of a capacitor will become | | | | | | | | | | 1 |
|  | a | | Zero | | | b | | v/2 | | |  |
|  | c | | V/K | | | d | | KV | | |  |
| 6 | The mass density of a nucleus of mass number A is | | | | | | | | | | 1 |
|  | a | | Proportional to A1/3 | | | b | | Proportional to A2/3 | | |  |
|  | c | | Proportional to A3 | | | d | | Independent of A | | |  |
| 7 | The nature of parallel and anti-parallel currents are | | | | | | | | | | 1 |
|  | a | | parallel currents repel and antiparallel currents attract. | | | b | | parallel currents attract and antiparallel currents repel. | | |  |
|  | c | | both currents attract. ’ | | | d | | both currents repel. | | |  |
| 8 | A plane wave passes through a convex lens. The geometrical shape of the wavefront that emerges is | | | | | | | | | | 1 |
|  | a | | plane | | | b | | Converging spherical | | |  |
|  | c | | Diverging spherical | | | d | | parallel | | |  |
| 9 | A proton and an alpha particle move in circular orbits in a uniform magnetic field. Their speeds are in the ratio of 9:4. The ratio of radii of their circular orbits (rp / ralpha) is | | | | | | | | | | 1 |
|  | a | | 3/4 | | | b | | 4/3 | | |  |
|  | c | | 8/9 | | | d | | 9/8 | | |  |
| 10 | A strong magnetic field is applied on a stationary electron. Then the electron | | | | | | | | | | 1 |
|  | a | | moves in the direction of the field. | | | b | | remained stationary. | | |  |
|  | c | | moves perpendicular to the direction of the field. | | | d | | moves opposite to the direction of the field. | | |  |
| 11 | We shift young’s double slit experiment from air to water. Assuming that water is still and clear, it can be predicted that the fringe pattern will | | | | | | | | | | 1 |
|  | a | | Remain unchanged | | | b | | disappear | | |  |
|  | c | | decrease | | | d | | enlarge | | |  |
| 12 | Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon the | | | | | | | | | | 1 |
|  | a | | Rate at which current changes in the two coils | | | b | | Relative position and orientation of the coils | | |  |
|  | c | | Rate at which voltage induced across two coils. | | | d | | Currents in the two coils | | |  |
|  | **ASSERTION REASONING QUESTIONS**  These questions consist of two statements, each printed as Assertion and Reason. While answering these questions, you are required to choose any one of the following four responses. (a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion. (b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion. (c) If the Assertion is correct but Reason is incorrect. (d) If both the Assertion and Reason are incorrect. | | | | | | | | | |  |
| 13 | **Assertion :**Two equipotential surfaces cannot cut each other. **Reason :**Two equipotential surfaces are parallel to each other. | | | | | | | | | | 1 |
|  | a | | A | | | b | | B | | |  |
|  | c | | C | | | d | | D | | |  |
| 14 | Assertion: the direction of the induced emf is always such as to oppose the changes that causes it.  Reason: the direction of induced emf is given by Lenz’s law | | | | | | | | | | 1 |
|  | a | | A | | | b | | B | | |  |
|  | c | | C | | | d | | D | | |  |
| 15 | **Assertion:** In series LCR resonance circuit, the impedance is equal to the ohmic resistance. **Reason:**At resonance, the inductive reactance exceeds the capacitive reactance. | | | | | | | | | | 1 |
|  | a | | A | | | b | | B | | |  |
|  | c | | C | | | d | | D | | |  |
| 16 | **Assertion :**Thin film such as soap bubble or a thin layer of oil on water show beautiful colors when illuminated by white light. **Reason :**It happens due to the interference of light reflected from upper and lower face of the thin film. | | | | | | | | | | 1 |
|  | a | | A | | | b | | B | | |  |
|  | c | | C | | | d | | D | | |  |
|  | **SHORT ANSWER TYPE QUESTION 1** | | | | | | | | | |  |
| 17 | Two materials Si and Cu are cooled from 300K to 60K. What will be the effect on their resistivity? Show graphically.  **OR**  Express mathematically the relation between current density and drift velocity of electrons. | | | | | | | | | | 2 |
| 18 | Find the position of the image formed by the lens combination given in the figure  Find the position of the image formed by the lens combination given in Fig.  . - Sarthaks eConnect | Largest Online Education Community | | | | | | | | | | 2 |
| 19 | Two waves from two coherent sources S and S’ superimpose at X. If X is a point on the second minima and SX – S’X is 4.5cm. Calculate the wavelength of the waves. | | | | | | | | | | 2 |
| 20 | The ground state energy of hydrogen atom is -13.6eV. What is the potential energy and kinetic energy of an electron in the third excited state. | | | | | | | | | | 2 |
| 21 | Draw a graph showing the variation of binding energy per nucleon as a function of mass number A. The binding energy per nucleon for heave nuclei (A > 170) decreases with the increase in mass number. Explain. | | | | | | | | | | 2 |
| 22 | Two identical parallel plate capacitors A and B are connected to a battery of V volts with the switch S closed. The switch is now opened and the free space between the plates of the capacitors is filled with a dielectric of dielectric constant K. Find the ratio of the total electrostatic energy stored in both capacitors before and after the introduction of the dielectric. | | | | | | | | | | 3 |
| 23 | The following graph shows the variation of terminal potential difference V, across a combination of three cells in series to a resistor, versus the current, I For what current I will the power dissipation of the circuit be maximum? | | | | | | | | | | 3 |
| 24 | Draw the magnetic field lines for a current carrying solenoid when a rod made of (a) copper, (b) aluminum and (c) iron are inserted with the solenoid. | | | | | | | | | | 3 |
| 25 | When an alternating voltage of 220V is applied across device X, a current of 0.5 A flows through the circuit and is in phase with the applied voltage. When the same voltage is applied across another device Y, the same current again flows through the circuit but it lead the applied voltage by π/2 radians. (a) Name the device X and Y. (b) Calculate the current flowing in the circuit when same voltage is applied across the serious combination of X and Y.  OR  A resistor of 200 Ω and a capacitor of 40μF are connected in series to 220 V AC source with angular frequency (ω) = 300 Hz. Calculate the voltages (rms) across the resistor and the capacitor. Why is the algebraic sum of these voltages more than the source voltage? How do you resolve this paradox? | | | | | | | | | | 3 |
| 26 | A capacitor of capacitance” C” is being charged by connecting it across a dc source along with an ammeter. Will the ammeter show a momentary defection during the process of charging? If so, how would you explain this momentary deflection and the resulting continuity of current in the circuit? Wire the expression for the current inside the capacitor | | | | | | | | | | 3 |
| 27 | State Huygens principle. Using geometrical construction of secondary wavelets, explain the refraction of a plane wave front incident at a plane surface. Hence verify Snells law of refraction. | | | | | | | | | | 3 |
| 28 | Draw a graph showing the variation of the number N of scattered alpha particles with scattering angle ϴ in Geiger – Marsden experiment. Infer two conclusions from the graph. | | | | | | | | | | 3 |
| 29 | **CASE STUDY 1**  Self-Induction. When a current I flow through a coil, flux linked with it is φ = LI, where L is a constant known as self-inductance of the coil.    Any charge in current sets up an induced emf in the coil. Thus, self-inductance of a coil is the induced emf set up in it when the current passing through it changes at the unit rate. It is a measure of the opposition to the growth or the decay of current flowing through the coil. Also, value of self-inductance depends on the number of turns in the solenoid, its area of cross-section and the permeability of its core material. | | | | | | | | | | 4 |
| 1 | Determine the inductance of the coil if a 5 V self-induction EMF occurs at a rate of change of current of 10 A / s. | | | | | | | | | | 1 |
|  | A | 5 | | | B | | 0.5 | | | |  |
|  | C | 2 | | | D | | 0.2 | | | |  |
| 2 | In a coil of self-inductance 5 henry, the rate of change of current is 2 ampere per second. The e.m.f. induced in the coil, is | | | | | | | | | | 1 |
|  | a | 10V | | | B | | -10V | | | |  |
|  | C | 5V | | | D | | -5V | | | |  |
| 3 | Self-inductance depends on | | | | | | | | | | 1 |
|  | A | Permeability | | | B | | Permittivity | | | |  |
|  | C | Plank’s constant | | | D | | Rydberg constant | | | |  |
| 4 | The self indcutance L of a solenoid of length *l* and area of cross section A, with a fixed number of turns N increases as | | | | | | | | | | 1 |
|  | A | *l* and A increases | | | B | | *l* decreases and A increases | | | |  |
|  | C | *l* increases and A decreases | | | D | | Both decreases. | | | |  |
|  | OR | | | | | | | | | |  |
|  | The self-inductance of a solenoid of 600 turns is 108 mH. The self-inductance of a coil having 500 turns with the same length the same medium and same radius will be | | | | | | | | | |  |
|  | A | 95mH | | | B | | 90mH | | | |  |
|  | C | 85mH | | | D | | 75mH | | | |  |
| 30 | **CASE STUDY 2**Total internal reflection and optical fibres Optical fibres rely on total internal reflection for their operation.  An optical fibre is a thin rod of high-quality glass. Light/infrared getting in at one end undergoes repeated total internal reflection and emerges at the other end.  Diagram of a cross-section of an optical fibre showing light undergoing repeated total internal reflection as it travels from one end to the other.  Notice that the light refracts towards the normal as it enters the optical fibre.  Notice what happens when the light hits the end of the fibre. The angle of incidence is now less than the critical angle and the light refracts away from the normal into the air. You may be expected to complete a diagram similar to the one above in an exam.  Optical fibres work even when the fibre is bent.  Diagram of a cross-section of a bent optical fibre showing a light ray undergoing repeated total internal reflection as it travels from one end to the other. | | | | | | | | | | 4 |
| 1 | The figure shows a ray of light falling normally on the face AB of an equilateral glass prism having refractive index 3/2 , placed in water of refractive index 4/3 . Will this ray suffer total internal reflection on striking the face AC ? Justify | | | | | | | | | | 2 |
| 2 | Derive a relation between critical angle and refractive index of a medium.  **OR**  State the two conditions necessary for Total internal reflection to happen. | | | | | | | | | | 2 |
| 31 | 1. Derive an expression for the magnitude of electric field intensity at any point along the equatorial line of a short electric dipole. Give the direction of electric field intensity at that point. For short dipole what is the ratio of electric field intensities at two equidistant points from the center of the dipole, One along the axial line and another on the equatorial line? 2. An electric dipole of length 2 cm is placed with its axis making an angle of 60 to a uniform electric field of 10 5 NC -1 . If it experiences a torque of 8√3 Nm, calculate the (i) magnitude of the charge on the dipole and (ii) potential energy of the dipole   **OR**   1. State Gauss’s law in electrostatics. Show with the help of a suitable figure that outward flux due to a point charge Q in vacuum within gaussian surface, is independent of its size and shape. 2. In the figure there are three infinite long thin sheets having surface charge density 2σ , -2σ and σ respectively. Give the magnitude and direction of electric field at a point to the left of sheet of charge density 2σ and to the right of charge density σ. | | | | | | | | | | 5 |
| 32 | 1. A straight thick long wire of uniform circular cross section of radius a is carrying a steady current I. The current is uniformly distributed across the cross section. Use Amperes circuital law to obtain a relation showing the variation of the magnetic field (Br) inside and outside the wire with distance r, (r ≤ a) and (r > a) of the field point from the centre of its cross-section. What is the magnetic field at the surface of this wire? Plot a graph showing the nature of this variation. 2. Calculate the ratio of magnetic field at a point a/2 above the surface of the wire to that at a point a/2 below its surface. What is the maximum value of the field of this wire?   **OR**   1. Explain using a labelled diagram, the principle and working of a moving coil galvanometer. What is the function of (i) uniform radial magnetic field and (ii) soft iron core? 2. An ammeter of resistance 0.8 ohms can measure a current upto 1A. Find the value of shunt resistance required to convert this ammeter to measure a current upto 5A. | | | | | | | | | | 5 |
| 33 | 1. Draw a ray diagram showing the image formation of a distant object by a refracting type telescope. Derive an expression for magnifying power. 2. An astronomical telescope has an angular magnification of 5 for distant objects. The separation between the objective and eye piece is 36cm and the final image is formed at infinity. Calculate the focal length of the objective and the focal length of the eye piece.   OR   1. The spherical surface of radius of curvature R. separates a rarer and a denser medium. Derive the relation connecting object distance u , image distance v, radius of curvature R and the refractive indices n1 and n2 of two media. 2. An object is placed 30 cm in front of a plano-convex lens with its spherical surface of radius of curvature 20 cm. If the refractive index of the material of the lens is 1·5, find the position and nature of the image formed. | | | | | | | | | | 5 |

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