**SINDHI HIGH SCHOOL, HEBBAL**

**PREBOARD II EXAMINATION-2024-25**

**PHYSICS (042)**

**SET II**

**Grade: XII Max. Marks:70**

**Date:04/01/25 Reading time: 8.15am-8.30am**

**No of sides: 6 Writing time: 8.30am-11.30am**

**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(CBQ) 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.

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| **SECTION A** | | |
| 1. | The temperature coefficient of a wire is 0.00125/0C. At 270C, its resistance is 1Ω. The temperature at which resistance becomes 2Ω is  a) 1154K b) 1100K c) 1400K d)1127K | **1** |
| 2. | Pure silicon at 300K has equal electron (ne) and hole (nh) concentrations of 1.5X1016m-3. Doping by indium increases nh to 4.5X1022m-3. The ne in the doped silicon is  a) 9X10-5m-3 b) 5X109m-3 c) 2.25X1011m-3 d) 3X109 m-3 | **1** |
| 3. | A particle of mass m and charge q is placed at rest in a uniform electric field E and then released, the kinetic energy attained by the particle after moving a distance y will be  a) q2Ey b) qEy c) qE2y d) qEy2 | **1** |
| 4. | A ray of light travelling in air has wavelength λ, frequency ν, velocity v and intensity I. If this ray enters into water, then these parameters are λ’, ν’, v’, I’ respectively. Which of the following relation is correct?  a) λ= λ’ b) ν= ν’ c) v=v’ d) I=I’ | **1** |
| 5. | Two slits in Young’s experiment have widths in the ratio 1:25. The ratio of intensity at the maxima and minima in the interference pattern, is  a) b) c) d) | **1** |
| 6. | The scale of a galvanometer of resistance 100Ω contains 25 divisions. It gives a deflection of one division on passing a current of 4X10-4A. The resistance in ohm to be added to it, so that it may become a voltmeter of range 2.5V is  a) 150 b) 170 c)110 d)220 | **1** |
| 7. | Three charges +4q, Q and q are placed in a straight line of length l at points at distances 0, l/2 and l respectively. What should be Q in order to make the net force on q to be zero?  a) -q b) -2q c) -q/2 d) 4q | **1** |
| 8. | The susceptibility of a paramagnetic material is χ at 270C. At what temperature will its susceptibility be χ/2?  a) 3270C b) 540C c) 2370C d) 16000C | **1** |
| 9. | The magnetic field of a plane electromagnetic wave is given by  = 2 X10-8 sin(0.5X103x + 1.5X1011t) T. The amplitude of electric field would be  a) 6 Vm-1 along X-axis b) 3Vm-1 along z-axis  c) 6 Vm-1 along Z-axis d) 2X108 along Z-axis | **1** |
| 10. | An α particle and a proton are accelerated from rest through the same potential difference. The ratio of linear momenta acquired by above two particles will be  a) :1 b)2 :1 c) 4 :1 d) 8:1 | **1** |
| 11. | The power factor of the circuit shown in the figure is  a) 0.2 b) 0.4  c) 0.6 d) 0.8 | **1** |
| 12. | A nucleus disintegrates into two nuclear parts, which have their velocities in the ratio 2:1. The ratio of their nuclear sizes will be  a) b) 1: c) d) | **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) If both Assertion and Reason are true and Reason is correct explanation of Assertion.**  **b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.**  **c) If Assertion is true but Reason is false.**  **d) If both Assertion and Reason are false**  **e) If Assertion is false but Reason is true** | | |
| 13. | **Assertion(A):** The frequency of the electromagnetic wave naturally equals the frequency of oscillations of the charge.  **Reason (R):** The energy associated with the propagating wave comes at the expense of the energy of the source. | **1** |
| 14. | **Assertion(A):** A ray of light incident along the normal to the plane mirror retraces its path after reflection from the mirror.  **Reason (R):** A ray of light along the normal has an angle of incidence of π/2. | **1** |
| 15. | **Assertion(A):** Two coherent sources transmit waves of equal intensity I0. Resultant intensity at a point where path difference is λ/3 is also I0.  **Reason (R):** In interference,resultant intensity at any point is the average intensity of two individual intensities. | **1** |
| 16. | **Assertion(A):** The applied voltage (in forward bias of p-n junction) mostly drops across the depletion region and the voltage drop across the p-side and n- side of the junction is negligible.  **Reason (R):** Resistance of the depletion region is large compared to the resistance of n-side or p-side. | **1** |
| **SECTION B** | | |
| 17. | A cell of emf E and internal resistance r is connected to two external resistances R1 and R2 and a perfect ammeter. The current in the circuit is measured in four different situations:  i) without any external resistance in the circuit  ii) with resistance R1 only  iii) with R1 and R2 in series combination  iv) with R1 and R2 in parallel combination.  The currents measured in the four cases are 0.42A, 1.05A, 1.4A and 4.2A, but not necessarily in that order. Identify the currents corresponding to the four cases mentioned above. | **2** |
| 18. | Calculate the angle of emergence (e) of the ray of light incident normally on face AC of a glass prism ABC of refractive index . How will the angle of emergence change, if the ray of light emerges into a prism of a liquid of refractive index 1.3 instead of air? | **2** |
| 19. | i) A 44mH inductor is connected to a 220V, 50Hz ac supply. Determine the rms value of current in the circuit.  ii) What is the net power absorbed by the circuit in a complete cycle?  **OR**  A given ac power supply has a voltage rating of 80 V. An LCR series circuit draws a current of 5A when connected to this ac power supply. Determine the range of values of the average power that can be delivered by the ac power source to the circuit. | **2** |
| 20. | Almost a constant electric current of 20 μA flows through a given p-n junction diode in reverse bias. The current becomes 4 times in case the p-n junction diode is forward biased.  Determine the diffusion current that flows through the given diode in case it is:  a. unbiased  b. reverse biased  c. forward biased | **2** |
| 21. | The oscillating magnetic field in a plane electromagnetic wave is given by By=(8X10-6)sin [2 X 1011t +300πx]T  i) Calculate the wavelength of the electromagnetic wave  ii) Write down the expression for the oscillating electric field. | **2** |
| **SECTION C** | | |
| 22. | In the study of a photoelectric effect the graph between the stopping potential V and frequency ν of the incident radiation on two different metals P and Q is shown:  (i)Which one of the two metals has higher threshold frequency?  (ii) Determine the work function of the metal which has greater value of threshold frequency.  (iii) Find the maximum kinetic energy of electron emitted by light of frequency 8×1014 Hz for this metal. | **3** |
| 23. | i) Draw a graph showing the variation of potential energy between a pair of nucleons as a function of their separation. Indicate the regions in which the nuclear force is attractive and repulsive.  Write two important conclusions which you can draw regarding the nature of the nuclear forces.  ii) In the following nuclear reaction    assign the values of *Z* and *A*.  iii) If both the number of protons and the number of neutrons are conserved in each nuclear reaction, in what way is the mass converted into energy? Explain. | **3** |
| 24. | Explain with a proper diagram how an ac signal can be converted into a dc pulsating signal with output frequency as double than input frequency using p-n junction diode. Give its input and output waveforms. | **3** |
| 25. | A wire of uniform cross section and resistance 4 ohm is bent in the shape of a square ABCD. Point A is connected on DC by a wire AP of resistance 1 ohm. When a potential difference is applied between A and C, the points B and P are seen to be at the same potential. What is the resistance of the part D? | **3** |
| 26. | A beam of light consisting of two wavelength 650 nm and 520 nm, is used to obtain interference fringes in a Young’s double slit experiment on a screen 1.2 m away. The separation between the slits is 2 mm.  i) Find the distance of the third bright fringe on the screen from the central maximum for wavelength 650 nm.  ii) What is the least distance from the central maximum when the bright fringes due to both the wavelength coincide? | **3** |
| 27. | Using Biot Savart’s law, derive an expression for the magnetic field at any point on the axial of a current carrying circular loop. Hence, find the magnetic field intensity at the centre of the circular loop.  **OR**  i) The figure shows three infinitely long straight parallel current carrying conductors. Find the (*a*) magnitude and direction of the net magnetic field at point *A* lying on conductor 1,  (*b*) magnetic force on conductor 2.  ii) The magnitude *F* of the force between two straight parallel conductors carrying currents  *I*1 and *I*2 kept at a distance *d* apart in air  Use the expression for the same, and the sign convention to draw graphs showing dependence of *F* on  a) *I*1 *I*2 when *d* is kept constant  b) *d* when the product *I*1 *I*2 is maintained at a constant positive value.  c) *d* when the product *I*1 *I*2 is maintained at a constant negative value. | **3** |
| 28. | i) State Gauss’ law in electrostatics. Show with the help of suitable figure that the outward flux due to a point charge Q in vacuum within Gaussian surface is independent of its size and shape.  ii) 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 the electric field at a point to the left of the sheet of charge density +2 σ and to the right of the sheet of charge density + σ. | **3** |
| **SECTION D** | | |
|  | **Case study** |  |
| 29. | **Magnetic Dipole**  Magnetic dipole, generally a tiny [magnet](https://www.britannica.com/science/magnet) of microscopic to subatomic dimensions, equivalent to a flow of [electric charge](https://www.britannica.com/science/electric-charge) around a loop. [Electrons](https://www.britannica.com/science/electron) circulating around atomic nuclei, electrons spinning on their axes, and rotating positively charged atomic nuclei all are [magnetic](https://www.britannica.com/science/magnetic-pole) dipoles. The sum of these effects may cancel so that a given type of [atom](https://www.britannica.com/science/atom) may not be a magnetic dipole. If they do not fully cancel, the atom is a permanent magnetic dipole, as are [iron](https://www.britannica.com/science/iron-chemical-element) atoms. Many millions of iron atoms spontaneously locked into the same alignment to form a [ferromagnetic](https://www.britannica.com/science/ferromagnetism) domain also [constitute](https://www.merriam-webster.com/dictionary/constitute) a magnetic dipole. Magnetic [compass](https://www.britannica.com/technology/compass-navigational-instrument) needles and bar magnets are examples of macroscopic magnetic dipoles.  i) A magnet of magnetic moment 2J/T is aligned in the direction of magnetic field of 0.1T. What is the net work done to bring the magnet normal to the magnetic field?  a) 0.1J b) 0.2J c) 1J d) 2J  ii) The figure below shows the various positions of small magnetised needles P and Q. The arrows show the direction of their magnetic moments. Which configuration corresponds to the lowest potential energy among all the configurations shown?  a) PQ3 b) PQ4 c) PQ5 d) PQ6  **OR**  A short bar magnet of magnetic moment 0.4JT-1 is placed in a uniform magnetic field of 0.16T. The magnet is in stable equilibrium when the potential energy is  a) -0.082J b) 0.064J c) -0.064J d) zero  iii) The magnetic moment has dimensions of  a) [LA] b) [L2 A] c) [LT-1 A] d) [L2T-1 A]  iv) Given figures show the arrangement of bar magnets in different configurations. Each magnet has magnetic dipole moment . Which configuration has the highest net magnetic dipole moment?  a) A b) B  c) C d) D | **4** |
| 30. | **Hydrogen Spectrum**  A hydrogen atom consists of an electron and a [proton](https://testbook.com/), and the force of attraction between the electron and nuclear proton leads to a set of energy levels or quantum states. Each energy state has its energy and physical attributes. These states were first described by Neil Bohr, and he called them orbits. However, his model was later modified into a quantum mechanics model, and these energy levels were called atomic orbitals.  The hydrogen spectrum appears when the electron of the [hydrogen](https://testbook.com/) atom jumps from a higher energy level to a lower energy level. These two states are differentiated by n (higher energy state) and n’ (lower energy state). The intensity of emitted light particles or [photons](https://testbook.com/) directly depends on the difference in the two energy levels.  i)According to Bohr atom model, in which of the following transitions will the frequency be maximum?  a) n=3 to n=2 b) n=5 to n=4 c) n=4 to n=3 d) n=2 to n=1  ii) The first excitation potential of a given atom is 10.2V. Then ionisation potential must be  a) 20.4V b) 13.6V c) 30.6V d) 40.8V  iii) If the electron in the hydrogen atom jumps from the third orbit to the second orbit, the wavelength of the emitted radiations in terms of Rydberg constant is  a) b) c) d)  iv) The wavelength of radiation emitted is λ0 when an electron in hydrogen atom jumps from 3rd to 2nd orbit. If in the hydrogen atom itself, the electron jumps from 4th to 2nd orbit, then wavelength of the emitted radiation will be  a) λ0  b) λ0 c) λ0 d) λ0  **OR**  The diagram shows the energy levels for an electron in a certain atom. Which transition shown represents the emission of photon with the most energy?  a) III b) IV  c) I d) II | **4** |
|  | **SECTION E** |  |
| 31. | i) Derive an expression for the electric potential at a point due to an electric dipole. Mention the contrasting features of electric potential of a dipole at a point as compared to that due to a single charge.  ii) The two graphs drawn, show the variations of electrostatic potential (*V*) with 1/*r* (*r* being the distance of field point from the point charge) for two  point charges *q*1 and *q*2.  a) What are the signs of the two charges?  b) Which of the two charges has the larger magnitude and why?  **OR**  i) A charge *Q* is distributed over the surfaces of two concentric hollow spheres of radii *r* and *R* (*R* >> *r*), such that their surface charge densities are equal. Derive the expression for the potential at the common centre.  ii) Draw equipotential surfaces corresponding to the electric field that uniformly increases in magnitude along with the z-direction.  iii) Two charges -q and +q are located at point (0,0,-a) and (0,0,a). What is the electrostatic potential (0,0,±z) and (x,y,0). | **5** |
| 32. | i) A long solenoid of radius r consists of n turns per unit length. A current I=I0sinωt flows in the solenoid. A coil of N turns is wound tightly around it near its centre. What is (a) the induced emf in the coil (b) mutual inductance between the solenoid and the coil  ii) When a conducting loop of resistance 10Ω and area 10cm2 is removed from an external magnetic field acting normally, the variation of the induced current I in the loop with time t is as shown in the figure.  Find the a) total charge passed through the loop (b) change in magnetic flux through the loop (c) magnitude of the magnetic field applied.  **OR**  (i) Derive an expression for the mutual induction of two long coaxial solenoids of the same length wound one over the other  (ii) In an experiment two coils C1 and C2 are placed close to each other. Find out the expression for emf induced in the coil C1 due to a change in the current through the coil C2. | **5** |
| 33. | i) Two convex lenses P and Q of an astronomical telescope having focal lengths 4 cm and 16 cm respectively are arranged as shown in the figure.  a) Which one of the two lenses will you select to use as the objective lens and why?  b) What should be the change in the distance between the lenses to have the telescope in its normal adjustment position?  c) Calculate the magnifying power of the telescope in the normal adjustment position.  ii) Draw the ray diagram showing the image formation by a refracting telescope  **OR**  i) The intensity at the central maxima O in a Young’s double slit experiment is I0. If the distance OP equals one third of the fringe width of the pattern, show that the intensity of the pattern would be .  ii) In a diffraction pattern due to single slit, how would the angular width of central maximum change if  a) orange light is used in the place of green light  b) the screen is moved closer to the slit  c) the slit width is decreased? Justify your answer in each case. | **5** |