**SINDHI HIGH SCHOOL, HEBBAL**

**PREBOARD II EXAMINATION-2024-25**

**PHYSICS (042)**

**SET I**

**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.

|  |  |  |
| --- | --- | --- |
| **SECTION A** | | |
| 1. | At 10000C, the resistance of a wire is found to be four times its resistance at 00C. The temperature coefficient of resistance of the material of the wire will be  a) 0.004/0C b) 0.002/0C c) 0.003/0C d) 0.001/0C | **1** |
| 2. | A silicon specimen is made into a p-type semiconductor by doping on an average one indium atom per 5X107 silicon atoms. If the number density of atoms in the silicon specimen is 5X1028 atom/m3, then the number of acceptor atoms in silicon per cubic centimetre will be  a) 2.5 X1030 atom/cm3 b) 2.5 X1035 atom/cm3  c) 1.0 X1013 atom/cm3 d) 1.0 X1015 atom/cm3 | **1** |
| 3. | A charged particle of mass m and charge q initially at rest is released in an electric field of magnitude E. Its kinetic energy after time t will be  a) b) c) d) | **1** |
| 4. | An electromagnetic radiation of frequency n, wavelength λ, travelling with velocity v in air enters glass slab of refractive index µ. The frequency, wavelength and velocity of light in the glass slab will be respectively,  a) n, 2λ and b) , and v  c) , and d) n, and | **1** |
| 5. | The interference pattern is obtained with two coherent light sources of intensity ratio n. In the interference pattern, the ratio will be  a) b) c) d) | **1** |
| 6. | In an ammeter, 10% of main current is passing through the galvanometer. If the resistance of the galvanometer is G, then the shunt resistance in ohm is  a) 9G b) G/9 c) 90G d) G/90 | **1** |
| 7. | A and B are two identical spherical charged bodies which repel each other with force F, kept at a finite distance. A third uncharged sphere of the same size is brought in contact with sphere B and removed. It is then kept at midpoint of A and B. Find the magnitude of force on C.  a) F/2 b) F/8 c) F d) zero | **1** |
| 8. | Which of the following is true regarding diamagnetic substances (symbols have their usual meaning)?  a) µr>1 , χm>1 b) µr>1 , χm<1  c) µr<1 , χm<0 d) µr<1 , χm>0 | **1** |
| 9. | Light wave travelling in air along the x-direction is given by  Ey= 540sinπX104(x-ct) V/m. Then the peak value of magnetic field of the wave will be  a) 18X 10-7T b) 54X 10-7T c) 54X 10-8T d) 18X 10-8T | **1** |
| 10. | An α- particle and a proton are accelerated from rest by a potential difference of 200V. After this, the de Broglie wavelengths are λα and λp respectively. The ratio λα / λp is  a) 8 b) 2.8 c)3.8 d) 7.8 | **1** |
| 11. | An alternating voltage V=V0sinωt is applied across a circuit. As a result I=I0sin(ωt-π/2) flows in it. The power consumed per cycle is  a) zero b) 5V0I0  c) 0.707 V0I0 d) 1.414 V0I0 | **1** |
| 12. | In a nuclear fission, 0.1% mass is converted into energy. The energy released by fission of 1kg mass will be  a) 9X109J b) 9X1017J c) 9X1016J d) 9X1013J | **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 current through surface P is zero in cases shown in the figure  **Reason (R):** While applying Ampere’s circuital law to given surfaces with same perimeter, the left hand side of the equation = i(t) has not changed but the right hand side is zero. | **1** |
| 14. | **Assertion(A):** The relation among u,v and f for the spherical mirror is valid only for mirrors whose sizes are very small compared to their radii of curvature  **Reason (R):** The laws of reflection are strictly valid for plane surfaces but not for large spherical surfaces. | **1** |
| 15. | **Assertion(A):** The intensity of the bright band on the screen is maximum and equal to 4I0, where I0 is the intensity of light from each source.  **Reason (R):** The intensity of the dark band is always zero irrespective of the intensity of light waves coming from the two sources. | **1** |
| 16. | **Assertion(A):** If the temperature of the semiconductor is increased, then its resistance decreases.  **Reason (R):** The energy gap between conduction band and valence band is very small. | **1** |
| **SECTION B** | | |
| 17. | The network PQRS, shown in the circuit diagram, has a battery of 4V and 5V and negligible internal resistance. A milliammeter of 20Ω resistance is connected between P and R. calculate the reading in the milliammeter | **2** |
| 18. | A ray of light falls on a transparent sphere with centre C as shown in the figure. The ray emerges from the sphere parallel to the line AB. Find the angle of refraction at A if refractive index of the material of the sphere is . | **2** |
| 19. | The figure shows the graphical variation of the reactance of a capacitor with frequency of ac source.  a) Find the capacitance of the capacitor  b) An ideal inductor has the same reactance at 100Hz frequency as the capacitor has at the same frequency. Find the value of inductance of the inductor  **OR**  A LCR circuit is connected to an ac voltage of fixed Vmax and angular frequency. Current through the circuit is Imax and the resistance R equals the inductive reactance XL in the circuit.  Now if the distance of separation between the capacitor plates is doubled, the  current Imax in the circuit is reduced to half.  Determine the initial relation between resistance R and capacitive reactance Xc. | **2** |
| 20. | A p-n junction diode has a depletion layer of thickness 500 nm and an electric field 16 x 105 V/m.  a. Find the barrier potential created.  b. Determine the minimum kinetic energy (in eV) that the conduction electrons must have so that they can diffuse from n-side onto p-side, in case of:  i. the junction is unbiased  ii. the junction is forward biased at 0.5 V  iii. the junction is reverse biased at 0.5 V | **2** |
| 21. | i)Identify the part of the electromagnetic spectrum which is  a) Suitable for radar system used in aircraft navigation  b) Produced by bombarding a metal target by high speed electrons  ii) Why does a galvanometer show a momentary deflection at the time of charging or discharging a capacitor? Write the necessary expression to explain this observation | **2** |
| **SECTION C** | | |
| 22. | i) An electromagnetic wave of wavelength λ1 is incident on a photosensitive surface of negligible work function. If the photo-electrons emitted from this surface have the de Broglie wavelength prove that λ= λ12  ii)If light of wavelength 412.5nm is incident on each of the metals given below, which ones will show photoelectric emission and why?   |  |  | | --- | --- | | **Metal** | **Work function (eV)** | | Na | 1.92 | | K | 2.15 | | Ca | 3.20 | | Mo | 4.17 | | **3** |
| 23. | Draw a diagram to show the variation of binding energy per nucleon with mass number for different nuclei and mention its two features. Why do lighter nuclei usually undergo nuclear fusion? | **3** |
| 24. | Draw the circuit diagram for studying the V-I characteristics of a p-n junction diode in (i) forward bias and (ii) reverse bias. Draw the typical V-I characteristics of a p-n junction diode.  Describe briefly the following terms.  (i) “majority carrier injection” in forward bias (ii) “breakdown voltage” in reverse bias | **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. | Two light waves of intensity 5X10-2Wm-2 each super impose and produce the interference pattern on a screen. At a point where the path difference between the waves is λ/6, λ being wavelength of the wave , find the  a) phase difference between the waves  b) resultant intensity at the point  c) resultant intensity in terms of the intensity at the maximum | **3** |
| 27. | Two long straight parallel conductors carry steady current I1 and I2 separated by a distance d. If the currents are flowing in the same direction, show how the magnetic field set up in one produces a force on the other. Obtain the expression for this force. Hence define 1A.  **OR**  i) Can a galvanometer as such be used for measuring current? Explain.  ii) An electron moving horizontally with a velocity of 4 X 104 m/s enters a region of uniform magnetic field 10-5T acting vertically upward as shown in the figure. Draw its trajectory and find out the time it takes to come out of the region of magnetic field  iii) A straight wire of mass 200g and length 1.5m carries a current of 2A. It is suspended in mid air by a uniform magnetic field B. What is the magnitude of the magnetic field? | **3** |
| 28. | i) Deduce the expression for torque on a dipole of dipole moment placed in a uniform electric field . Express it in vector form and point out the direction along which it acts  ii) What happens if the field is non-uniform?  iii) What would happen if the external field is increasing (a) parallel to and (b) antiparallel to ? | **3** |
| **SECTION D** | | |
| 29. | **Case study**  **Magnetic Dipole**  Magnetic dipole, generally a tiny [magnet](https://www.britannica.com/science/magnet) of microscopic to subatomic dimensions, equivalent to the 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 around 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) The couple acting on a magnet of length 10cm and pole strength 15Am, kept in a field of B=2X10-5T, at an angle of 300, is  a) 1.5X10-5Nm b) 1.5X10-3Nm c) 1.5X10-2Nm d) 1.5X10-6Nm  ii) The figure 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) Permeability has dimensions of  a) [M-1LT-2A] b) [ML-2 T-2A-1] c) [MLT-2A-2] d) [MLT-1A-1]  iv) A bar magnet AB of magnetic moment 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. The magnetic moment of the combination so formed will be  a) zero b) c) /4 d)3 /4 | **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) An electron in hydrogen atom after absorbing an energy photon jumps from energy state n1 to n2. Then it returns to the ground state after emitting six different wavelengths in emission spectrum. The energy of the emitted photons is either equal to or less that the absorbed photons. Then n1 and n2 are  a) n2=4, n1=5 b) n2=5, n1=3 c) n2=4, n1=2 d) n2=4, n1=1  ii) The ionization energy of hydrogen atom is 13.6eV. Following Bohr’s theory, the energy corresponding to a transition between third and fourth orbits is  a) 3.40eV b) 1.51eV c) 0.85eV d)0.66eV  iii) Minimum energy required to take out the only one electron from ground state of He+ is.  a) 13.6eV b) 54.4eV c) 27.2eV d) 6.8eV  iv) A hydrogen atom in ground state absorbs 10.2eV of energy. The angular momentum of electron of hydrogen atom will increase by a value of  a) 2.10X10-34 Js b)1.05X10-34 Js c) 3.15X10-34 Js d) 4.2X10-34 Js  **OR**  The energy level diagram of an element is given. Which transition corresponds to the spectral emission of wavelength 102.7nm?  a) A b) B  c) C d) D | **4** |
|  | **SECTION E** |  |
| 31. | (i)Derive an expression for the capacitance of a parallel plate capacitor when a dielectric slab of dielectric constant K and thickness t=d/2 but of the same area as of the plates is inserted between the capacitor plates  (ii) The figure shows a network of five capacitors connected to a 10V battery. Calculate the charge acquired by the 5µF capacitor  **OR**  (i) Explain why, for any charge configuration, the equipotential surface through a point is normal to the electric field at that point.  Draw a sketch of equipotential surfaces due to a single charge (– *q*), depicting the electric field lines due to the charge.  (ii) Obtain an expression for the work done to dissociate the system of three charges placed at the vertices of an equilateral triangle of side ‘*a*’ as shown  (iii) A cube of side 20cm is kept in a region as shown in the figure. An electric field exists in the region such that the potential at a point is given by  V=10x +5, where V is in volt and x is in m. Find a) the electric field b) total electric flux through the cube. | **5** |
| 32. | (i) A conducting rod of length ‘l’, with one end pivoted, is rotated with a uniform angular speed ‘ω’ in a vertical plane, normal to a uniform magnetic field ‘B’. Deduce an expression for the emf induced in this rod. If the resistance of the rod is R, what is the current induced in it?  (ii) Two concentric circular loops of radius 1cm and 20cm are placed coaxially. (a) Find the mutual inductance of the arrangement  (b) If the current passed through the outer loop is changed at the rate of 5A/ms, find the emf induced in the inner loop. Assume the magnetic field on the inner loop to be uniform.  **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 place 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. | (a) What is the effect on the interference fringes in a Young's double slit experiment due to each of the following conditions?  (i) Screen is moved away from the plane of the slits.  (ii) The monochromatic source is replaced by another monochromatic source of shorter wavelength.  Give reason to support your answer.  (b) A ray of light is incident normally on one of the faces of a prism of apex angle 30° and refractive index . Find the angle of deviation for the ray of light.  **OR**  (a) In a single slit diffraction pattern, how is the width of the central bright maximum changed when the  (i) slit width is decreased?  (ii) distance between the slit and the screen is increased?  (b) AB and CD are two slabs. The medium between the slabs has refractive index 2. Find the minimum angle of incidence at Q, so that the ray is totally reflected by both the slabs. | **5** |