Sub. Code 042

Please check that this paper contains 33 Questions and has 8 printed pages

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D.A.V. INSTITUTIONS, CHHATISGARH

SAMPLE PAPER (9)-2023-24

CLASS – XII, SUBJECT – PHYSICS

Time Allowed: 3 Hours **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 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.

(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 question 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 where ever necessary

(i) $c = 3 \times 10^{8}$ m/s

(ii) $m_e = 9.1 \times 10^{-31}$ Kg

(iii) $h = 6.64 \times 10^{-34}$ Js

(iv) $\mu_0 = 4\pi \times 10^{-7}$ TmA^{-1}

(v) $e = 1.6 \times 10^{-19}$ C

(vi) $\epsilon_0 = 8.854 \times 10^{-12}$ $C^2N^{-1}m^{-2}$ (vii) Avogadro’s no. = 6.023×10^{23} per gram mole

SECTION – A

Q1. At stopping potential, the kinetic energy of emitted photoelectron is

(a) minimum (b) maximum (c) zero (d) cannot be predicted

Q2. A point charge situated at distance r from a short electric dipole on its axis , experiences a force $\vec{F}$. If the distance of the charge is 2r , the force on the charge will be

(a) $\vec{F}$ /16 (b) $\vec{F}$ /8 (c) $\vec{F}$ /4 (d) $\vec{F}$/2

Q3. When an electron in an atom goes from a lower to a higher orbits, its

(a) kinetic energy increases, potential energy decreases

(b) kinetic energy increases, potential energy increases

(c) kinetic energy decreases, potential energy increases

(d) kinetic energy decreases, potential energy decreases

Q4. Two parallel plate capacitors X and Y , have the same area of plates and same separation between plates. X has air and Y with dielectric of constant 2, between its plates. They are connected in series to a battery of 12V.The ratio of electrostatic energy stored in X and Y is

(a) 4:1 (b) 1:4 (c) 2:1 (d) 1:2

Q5. A current of 0.8 A flows in a conductor of 40 Ω for 1 minute. The heat produced in the conductor will be

(a) 1445 J (b) 1536 J (c) 1569 J (d) 1640 J

Q6. Light of frequency 6.4 x 10^{14} Hz is incident on a metal of work function 2.14 eV. the maximum kinetic energy of the emitted electron is about

(a) 0.25 eV (b) 0.51 eV (c) 1.02 eV (d) 0.10 eV

Q7. A region has a uniform magnetic field in it. A proton enters into the region with velocity making an angle 45° with the direction of the magnetic field. In this region the proton will move on a path having the shape of

(a) a straight line (b) a circle (c) spiral (d) helix

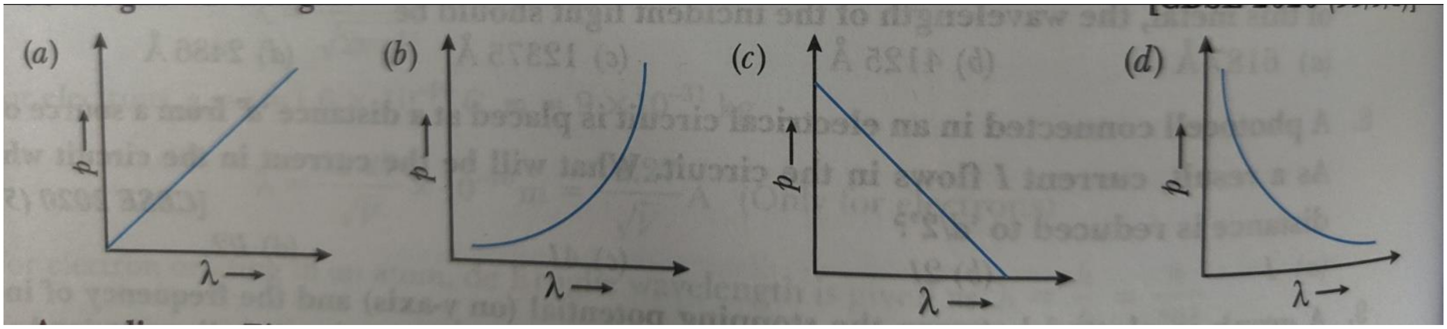
Q8. For a glass prism , the angle of minimum deviation will be smallest for the light of

(a) red colour (b) blue colour (c) yellow colour (d) green colour

Q9. Two waves having intensities in the ratio of 9:1 produce interference ,the ratio of maximum to minimum intensity is

(a) 10 : 8 (b) 9 : 1 (c) 4 : 1 (d) 2 : 1

Q10. Which of the following figure represent the variation of particle momentum and associated de Broglie wavelength ?



Q11. A magnet of magnetic moment m is cut into two equal parts. The two parts are placed perpendicular to other so that their north poles touch each other. Th resultant magnetic moment is

(a) $\sqrt{2}$ m (b) m /$\sqrt{2}$ (c) $\sqrt{3}$ m (d) m / $\sqrt{3}$

Q12. Lenz's law is essential for

(a) conservation of energy (b) conservation of mass

(c) conservation of momentum (d) conservation of charge

For Questions 13 to 16, two statement are given one labeled Assertion (A) and other labeled Reason (R). Select the correct answer to these questions from the options as gives below.

(a) If both Assertion and Reason are true and Reason is the 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.

Q 13. **ASSERTION (A) :** The large angle scattering of α - particle is only due to nucliei.

REASON (R) : Nucleus is very heavy as compared to electron.

Q14. **ASSERTION (A) :** An alternating current does not show any magnetic effect.

REASON (R) : Alternating current does not vary with time.

Q15. **ASSERTION (A) :** The ferromagnetic substances do not obey Curie's law.

REASON (R) : At curie point ferromagnetic substance start behaving as a paramagnetic substance.

Q16. **ASSERTION (A) :** The surface of a conductor is always equipotential surface.

REASON (R) : A conductor contains free electrons which can move freely to equalize the potential.

SECTION – B

Q17. What is the nature of electrostatic force between two points electric charges q_1 and q_2 if

(a) $q_1 + q_2 > 0$? (b) $q_1 + q_2 < 0$?

Q18. Define the term 'mobility' of charge carriers in a current carrying conductor. Obtain the relation for mobility in terms of relaxation.

Q19. Write any two points of difference between a diamagnetic and a paramagnetic substance.

Q20. A small flat search coil of area 5 cm^2 with 140 closely wound turns is placed between the poles of a powerful magnet producing magnetic field 0.09 T and then quickly removed out of the field region . calculate ; (a) change of magnetic flux through the coil, (b) emf induced in the coil.

Q21.In Young's double slit experiment, the two slits are separated by a distance equal to 100 times the wavelength of light that passes through the slits. calculate : (a) the angular separation in radians between the central maxima and adjacent maxima (b) the distance between these two maxima on a screen 50 cm from the slits.

OR

Draw the diagrams to show the behavior of plane wave fronts as they (a) pass through a thin prism, and (b) pass through a thin convex lens.

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SECTION – C

Q22. Explain with the help of a circuit diagram, the working of a p-n junction diode as a half-wave rectifier.

Q23.The ground state energy of hydrogen atom is – 13.6 eV. If an electron makes a transition from an energy level -1.51 eV to -3.4 eV, calculate the wavelength of the spectral line emitted and name the series of hydrogen spectrum to which it belongs.

Q24. Obtain an expression for the capacitance of a parallelplate capacitor, whose plates are separated by a dielectric medium.

Q25. The primary coil of an ideal step up transformer has 100 turns and transformation ratio os also 100.

The voltage and power are 220V and 1100W respectively. calculate (a) the number of turns in primary coil. (b) the current in the primary coil.(c) the voltage across the secondary coil

Q26. Draw a ray diagram for formation of image of a point object by a thin double convex lens having radii of curvature R_1 and R_2, hence derive lens maker's formula for a double convex lens.

Q27. (a) An EM wave is travelling in a medium with a velocity $\vec{v}$ = v$\hat{\imath}$. Draw a sketch showing the propagation of the EM wave , indicating the direction of the oscillating electric and magnetic fields.

(b) How are the magnitudes of the electric and magnetic fields related to the velocity of the EM wave?

Q28. Draw the intensity pattern for single slit diffraction and double slit interference for (i) the fringes produced in interference, and (ii) the hence, state two difference between interference and diffraction.

OR

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 2mm. (a) find the distance of third bright fringe on the screen from the central maximum for wavelength 650 nm. (b) What is the least distance from the central maximum when the bright fringes due to both the wavelength coincide ?

SECTION – D

CASE STUDY BASED QUESTIONS

Read the following paragraph and answer the question that follow :

Q29. **Light emitting diode LED** is a heavily doped P-N junction diode which under forward bias emits spontaneous radiation. When it is forward biased, due to recombination of holes and electrons at the junction, energy is released in the form of photons. In the case of Si and Ge diode, the energy released in recombination lies in the infrared region. LEDs that can emit red, yellow , orange, green and blue light are commercially available. The semiconductor used for fabrication of visible LEDs must at least have a band gap of 1.8 eV. The compound semiconductor Gallium Arsenide Phosphide is used for making LEDs of different colours.

(i) Why are LEDs made of compound semiconductor and not of elemental semiconductors ?

(ii) What should be the order of band gap of an LED, if it is required to emit light in the visible range ?

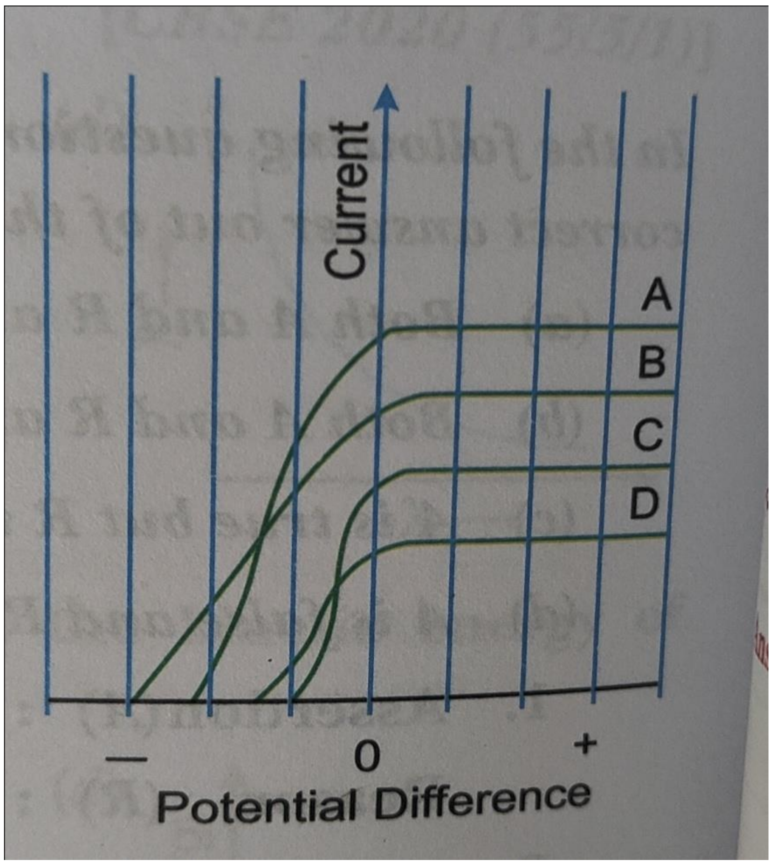
(iii) LEDs operates in forward bias or reveres bias ?

(iv) Write an application of LED.

OR

LEDs have two legs one is long and other is short , which leg acts as cathode?

Q30. Figure shows the variation of photoelectric current measured in a photo cell circuit as a function of the difference between the plates of the photo cell when light beams A, B, C and D of different wavelengths are incident on the photo cell .Examine the given figure and answer the following questions:



(i) Which light beam has the highest frequency ?

(a) A (b) B (c) C (d) D

(ii) Which light beam ejects photoelectrons will maximum momentum ?

(a) D (b) C (c) B (d)

(iii) Consider a beam of electrons (each electrons with energy E_0) incident on a metal surface kept in an evacuated chamber then

(a) electron can be emitted with any energy, with a maximum of E_0

(b) electron can be emitted with any energy

(c) electron can be emitted but all with an energy E_0

(d) no electron will be emitted as only photons can emit electrons

(iv) The stopping potential of a photocell, in which electrons with a maximum kinetic energy of 6 eV are emitted will be

(a) - 6 eV (b) 6 V (c) 3V (d) - 3V

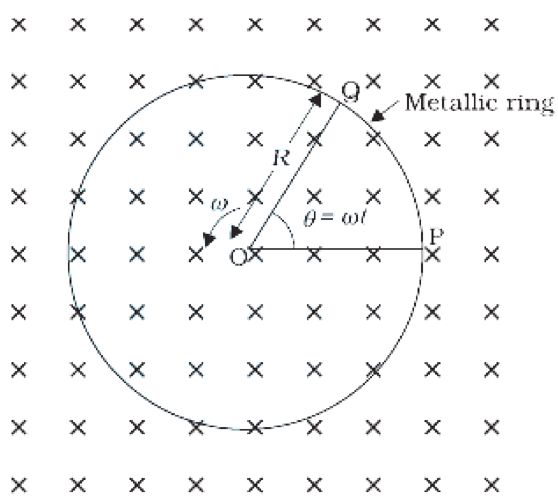
OR

Sodium and copper have work functions 2.3 eV and 4.5 eV respectively. Then the ratio of their threshold wavelengths is nearest to

(a) 1 : 2 (b) 1 : 4 (c) 2 : 1 (d) 4 : 1

SECTION – E

Q31. (a) Metallic rod of 1 m length is rotated with a frequency of 50 rev/s, with its one end hinged at the centre and its other end at the circumference of a circular metallic ring of radius 1 m. The axis of rotation is an axis, passing through the centre and perpendicular to the plane of the ring. A constant and uniform magnetic field of 1 T parallel to the axis is present everywhere. Find the induced emf between the centre and the metallic ring.



(b) Two long parallel straight wires A and B are 2.5 cm apart in air . they carry 5.0 A and 2.5 A currents respectively in opposite directions. Calculate the magnitude of the force exerted by wire A on a 10 cm length of wire B.

OR

(i) Derive an expression for the magnetic field at a point on the axis of a current carrying circular loop.

(ii) Write the expression in a vector form, for the Lorentz magnetic force F due to a charge moving with velocity v in a magnetic field B. Write the expression for force and its direction.

Q32. (a) Define the term conductivity of a metallic wire and write its S.I unit .

(b) Using the concept of free electron in a conductor, derive the expression for the conductivity of a wire in terms of number density and relaxation time. Hence obtain the relation between current density and applied electric field E.

OR

A storage battery is of emf 8V and internal resistance 0.5 ohm is being charged by d.c supply of 120 V using a resistor of 15.5 ohm

(a) Draw the circuit diagram.

(b) Calculate the potential difference across the battery.

(c) What is the purpose of having series resistance in this circuit?

Q33. (a) Derive the formula for refraction at concave refracting surface when the object lies in the rarer medium.

(b) What happens to the focal length of the lens when it is immersed in water.

OR

(a) Derive an expression for refractive index of a prism.

(b) What is total internal reflection of light, write two necessary conditions for total internal reflection.

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