SET NO- 01

Roll No | | | | | | | |

Candidates must write the Set No. on the title page of the answer book

DAV PUBLIC SCHOOLS, ODISHA ZONE

PRE-BOARD EXAMINATION (2023-24)

- Check that this question paper contains **8** printed pages.
- Set number given on the right hand side of the question paper should be written on the title page of the answer book by the candidate.
- Check that this question paper contains **33** questions
- Write down the Serial Number of the question in the left side of the margin before attempting it.
- 15 minutes time has been allotted to read this question paper. The question paper will be distributed 15 minutes prior to the commencement of the examination. The students will read the question paper only and will not write any answer on the answer script during this period.

CLASS -XII

SUB: PHYSICS

Time Allowed: 3Hours **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 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 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.

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

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

v. $h = 6.63 \times 10^{-34}$ Js

vi. $\varepsilon_0 = 8.854 \times 10^{-12}$ $C^2N^{-1}m^{-2}$

vii. Avogadro's number = 6.023×10^{23} per gram mole

SECTION-A

1. Each of the statements below are based on the properties of electron orbits in a hydrogen atom. Identify a statement that correctly satisfies the Bohr's model of an atom.

(a) The angular momentum of the orbiting electron is $3h/\pi$.

(b) The potential energy of the electron in any stable orbit is positive.

(c) The radius of the second electron orbit is $2a_0$, where a_0 is Bohr's radius.

(d) An amount of energy = -3.4 eV given to an electron in its second orbit will let it escape the atom.

2. On reducing potential difference across a capacitor, its capacitance:

(a) decreases (b) increases (c) remains constant (d) first increases then decreases

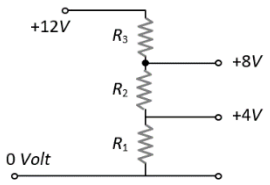
3. A potential divider is used to give outputs of 4 *V* and 8 *V* from a 12 *V* source as shown in the figure. Now the ratio R_1: R_2: R_3 is

(a) 2 : 1 : 2

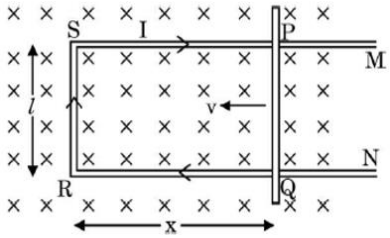
(b) 1 : 1 : 1

(c) 2 : 2 : 1

(d) 1 : 1 : 2

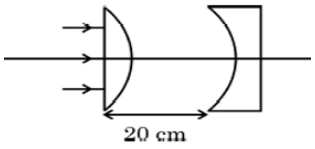


4. Figure shows a rectangular conductor PSRQ in which movable arm PQ has a resistance 'r' and resistance of PSRQ is negligible. The magnitude of emf induced when PQ is moved with a velocity v does not depend on :



(a) Magnetic field (B) (b) velocity (v) (c) Resistance (r) (d) length of PQ

5. In the given figure, the radius of curvature of the curved surface of both the plano-convex and plano-concave lens is 20 cm and refractive index of both is 1.5. The location of the final image after all the refractions through lenses is:



(a) 10cm (b) 20cm (c) 30cm (d) 40cm

6. If the de-Broglie wavelengths for a proton and for an α-particle are equal, then the ratio of their velocities will be

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

7. In a Young's double slit experiment, the source is white light. One of the holes is covered by a red filter and another by a blue filter. In this case

(a) there shall be alternate interference patterns of red and blue.

(b) there shall be an interference pattern for red distinct from that for blue

(c) there shall be no interference fringes.

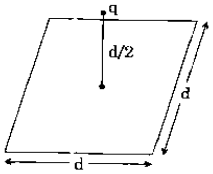
(d) there shall be an interference pattern for red mixing with one for blue.

8. Consider the diffraction pattern for a small pinhole. As the size of the hole will increase

(a) the linear width of fringe increases. (b) the intensity of fringe increases.

(c) the angular width of fringe increases. d) the intensity of fringe decreases.

9. A point charge q is at a distance of d/2 directly above the centre of a square of side d, as shown in figure. The electric flux through the square using gauss law is $\frac{q}{6\varepsilon_0}$. If the point charge is now moved to distance ´d/3´ from the centre of the square, then the electric flux through the square will be

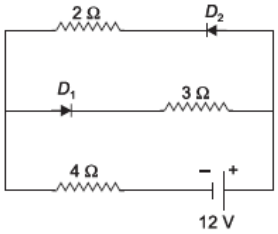


(a) same as $\frac{q}{6\varepsilon_0}$ (b) more than $\frac{q}{6\varepsilon_0}$ (c) less than $\frac{q}{6\varepsilon_0}$ (d) none of these

10. The mass defect in a particular nuclear reaction is 0.3g. The amount of energy liberated in kilowatt hour is

(a) 1.5×10^6 (b) 2.5×10^6 (c) 3×10^6 (d) 7.5×10^6

11. Consider the diodes connected in the circuit are ideal. Now the value of current flowing through D_1 and D_2 respectively are



(a) 4A, 6A (b) 0A, 6A (c) 0A, 2A (d) (12/7)A, 2A

12. If the fundamental frequency in the ripple of the output of a full wave rectifier circuit is 50*Hz*, then the frequency of input ac mains will be

(a) 50 Hz (b) 70.7 Hz (c) 100 Hz (d) 25 Hz

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) Both A and R are true and R is 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) A is false and R is false.

13. Assertion (A): Energy of X-ray photon is greater than that of light (visible) photon
Reason (R): X-ray photon in vacuum travels faster than light (visible) photon.

14. Assertion (A): Acceleration of a vertically falling magnet through a horizontal metallic ring is less than g.
Reason (R): Current induced in the ring opposes the fall of the magnet.

15. Assertion (A): At resonance, LCR series circuit has a minimum current.
Reason (R): At resonance, in LCR series circuit, the current and emf are not in phase with each other.

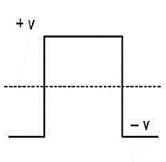
16. Assertion (A): A conductor carrying current is negatively charged.
Reason (R): When current flows in a conductor the excess of free electrons make it negatively charged.

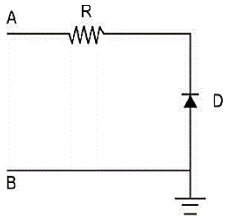
SECTION- B

17. A water molecule is placed in a uniform external electric field $\vec{E}$. Obtain the mathematical expression for the moment of couple experienced by the water molecule in vector form, if the electric dipole moment of water molecule is $\vec{\mu}$ and it is placed making an angle β with $\vec{E}$.

18. A conductor of length '*l*' is connected to a dc source of potential 'V'. If the length of the conductor is tripled by gradually stretching it, keeping 'V' constant, how will the
(i) average speed of the conduction electrons and
(ii) resistance of the conductor be affected?
Give justification in each of the above

19. In the circuit containing an ideal pn diode D and a resistor R given an input square wave as shown.
(a) What is the shape of the output wave form across D?
(b) Give an explanation of your answer in (a).





OR

An ac voltage V = $V_0 \sin\omega t$ is applied to a series combination of a resistor R and an element X. The instantaneous current in the circuit is I = $I_0 \sin(\omega t + \frac{\pi}{4})$. Then

(a) identify the element X

(b) draw the phasor diagram and

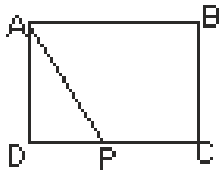
(c) find the value of the corresponding reactance.

20. Draw a plot of the binding energy per nucleon as a function of mass number A of nuclei (2<A<170). Use this graph to explain the release of energy in nuclear fusion.

21. (i) Name the majority and minority carriers in p-type and n-type semiconductors. We know that the dopants provide the majority carriers, but how the crystal gets the minority current carriers? Explain.
(ii) How does the reverse current increase sharply at a particular reverse voltage in reverse bias of a pn junction diode? Explain

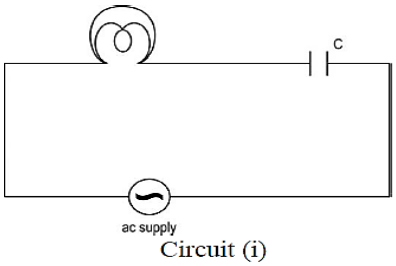
SECTION-C

22. A wire of uniform cross-section and resistance 4 ohm is bent in the shape of square ABCD. Point A is connected to a point P on DC by a wire AP of resistance 1 ohm.

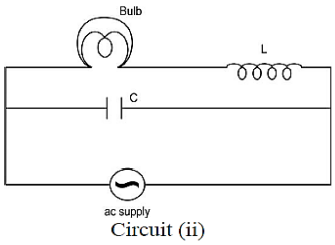


When a potential difference is applied between A and C, the points B and P are seen to be at the same potential. What is the resistance of the part DP?

23. A bulb is connected through a capacitor in an ac circuit as in the circuit (i). The bulb in the circuit glows when the frequency of the input ac voltage is ω.



Circuit (i)



Circuit (ii)

A circuit (ii) is constructed by including an inductor L as shown, keeping all other components the same as in circuit (i). The bulb continues to glow when the frequency of the input ac voltage is ω.

Now the frequency ω of the ac supply is changed in both the circuits while keeping the voltage amplitude constant and same in both the circuits. Explain the effect on the brightness of the bulb in each circuit if
(a) the frequency of input ac voltage is lowered
(b) the frequency of input ac voltage is increased
(c) the frequency of input ac voltage approaches zero

24. (a) A radio wave and an infrasonic wave have the same wavelength when travelling through air. Are their frequencies the same or different? Give a reason for your answer.

(b) An electromagnetic wave traveling east has a magnetic field that oscillates vertically and has a frequency of 60 kHz and rms strength of 8×10^{-9}T.

(i) Determine the frequency and the rms strength of the electric field. (ii) What is the direction of the electric field?

25. (a) In a single slit diffraction experiment, a slit of width 'a' is illuminated by red light of wavelength 650nm. For what value of 'a' will the first secondary maximum fall at an angle of diffraction of 30^0 ?

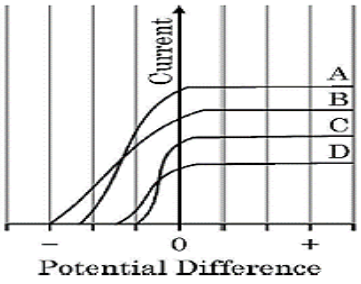
(b) What should the width 'a' of each slit be to obtain eight maxima of two double-slit patterns (slit separation d) within the central maximum of the single slit pattern?

26. Figure shows the variation of photoelectric current measured in a photo cell circuit as a function of the potential 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 and why?

(ii) Which light beam has the longest wavelength and why?

(iii) Which light beam ejects photoelectrons with maximum momentum and why?



OR

(a) Mention one proposition that is predicted as per wave theory of light but discarded on the basis of the actual experimental observation in the phenomenon of photoelectric emission.

(b) A cat is able to see in low light intensity situations by virtue of its large sized pupils of diameter ~ 16 mm and due to the presence of excess number of cone cells on its retina. They can detect light of intensity I as low as ~ 10^{-10} W/m^2.

If intensity I of light is defined as energy of radiation times the number of photons per unit area, then determine the minimum number of incident photons per second of wavelength 600 nm that are required in a radiation to be detected by a cat's eye? Take hc ~ 2 x 10^{-16} J-nm.

27. Derive an expression for the frequency of radiation emitted when a hydrogen atom de-excites from level n to level (n – 1). Also show that for large values of n, this frequency equals to classical frequency of revolution of an electron.

28. (a) Draw V I characteristics of a p-n junction diode. Explain how these characteristics make a diode suitable for rectification.

(b) Carbon and silicon have the same lattice structure. Then why is carbon an insulator but silicon a semiconductor?

SECTION -D

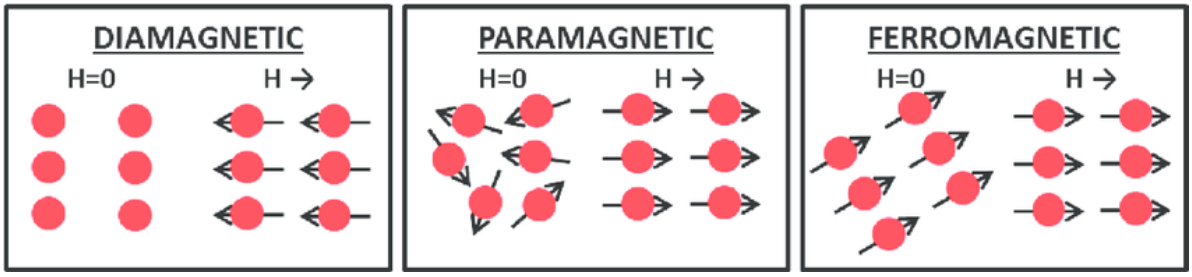
Case Study Based Questions

29. Read the following paragraph and answer the questions that follow.

When the atomic dipoles are aligned partially or fully, there is a net magnetic moment in the direction of the field in any small volume of the material. The actual magnetic field inside material placed in magnetic field is the sum of the applied magnetic field and the magnetic field due to magnetization. The magnetic intensity

$$H = \frac{B}{\mu_0} - M$$

Where M is the magnetization of the material. The measure that tells us how a magnetic material responds to an external field is given by a dimensionless quantity is called the magnetic susceptibility.



Different substances show different behaviors to the external magnetic field. Based upon their behaviors, they are classified as Diamagnetic, Paramagnetic and Ferromagnetic substances.

(i) Which of the following is weakly repelled by a magnetic field:
(a) Iron (b) Cobalt (c) Steel (d) Copper

(ii) If a diamagnetic material is placed in a magnetic field, the magnetic field inside the material compared to that outside will be
(a) Slightly less (b) Slightly more (c) Very high (d) Same

OR

S.I. unit of magnetic pole strength is
(a) ampere/meter (b) ampere-meter (c) volt/meter (d) ampere/meter^2

(iii) The domain formation is a necessary feature of
(a) Diamagnetism (b) Paramagnetism (c) Ferromagnetism (d) all of these

(iv) The susceptibility of a paramagnetic material is χ at 27^0C. At what temperature will its susceptibility be 0.5 χ.
(a) 54^0C (b) 327^0C (c) 600^0C (d) 237^0C

30. Read the following paragraph and answer the questions that follow

The lens maker's formula is useful to design lenses of desired focal lengths using surfaces of suitable radii of curvature. The focal length also depends on the refractive index of the material of the lens and the surrounding medium. The refractive index depends on the wavelength of the light used. The power of a lens is related to its focal length.

Answer the following questions based on the above:

(a) If the wavelength of light increases then the power of a lens will
(i) increase (ii) decrease (iii) remain unaffected (iv) increase first and then decrease

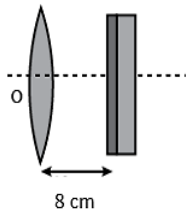
(b) The radius of curvature of two surfaces of a convex lens is R each and for what value of refractive index of the material of the lens, the focal length of the lens is R
(i) 0 (ii) ∞ (iii) 1 (iv) 1.5

(c) The focal length of a concave lens of refractive index 1·5 is 20 cm in air. It is completely immersed in water of refractive index 4/3. Its focal length in water is
(i) 5cm (ii) 40cm (iii) 80cm (iv) none of these

OR

An object is placed in front of a lens which forms its erect image of magnification 3. The power of the lens is 5 D. The distance of the object from the lens is
(i) 13.3cm (ii) 12.3cm (iii) 12cm (iv)none of these

(d) The distance between a convex lens and a plane mirror is 10 cm. The parallel rays incident on the convex lens after reflection from the mirror forms image at the optical center of the lens. Focal length of lens will be

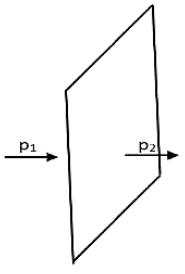


(i) 16 *cm* (ii) 8 *cm* (iii)4 *cm* (iv) ∞

SECTION E

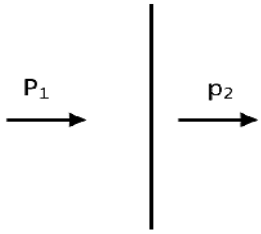
31. (a) Consider two identical point charges located at points (0.0) and (a,0).
(i) Is there a point on the line joining them at which the electric field is zero ?
(ii) Is there a point on the line joining them at which the electric potential is zero ?
Justify your answer in each case.

(b) An electric dipole is kept first to the left and then to the right of a negatively charged infinite plane sheet having a uniform surface charge density. The arrows p_1 and p_2 show the directions of its electric dipole moment in the two cases.



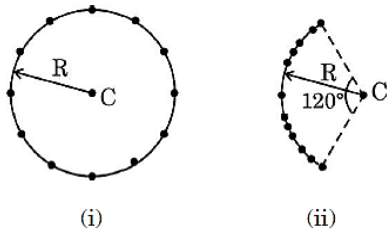
Identify for each case, whether the dipole is in stable or unstable equilibrium. Justify each answer**.**

(c) Next, the dipole is kept in a similar way (as shown), near an infinitely long straight wire having uniform negative linear charge density.
Will the dipole be in equilibrium at these two positions? Justify your answer**.**



OR

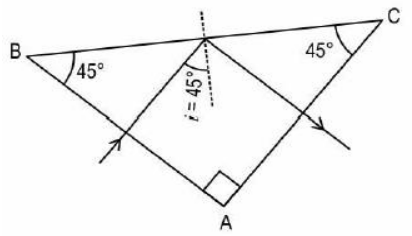
(a) What do you understand by 'principle of superposition of electric potential'.
(b) Twelve negative charges of same magnitude are equally spaced and fixed on the circumference of a circle of radius R as shown in Fig. (i). Relative to potential being zero at infinity, find the electric potential and electric field at the centre C of the circle.
(c) If the charges are unequally spaced and fixed on an arc of 120 of radius R as shown in Fig. (ii), find electric potential at the centre C.



(i) (ii)

(d)What is the amount of work done in displacing a charge 'q' from the centre of the above arc to that of the circle if the distance between their centres is 'x'.

32. (a) A ray of light of wavelength λ falls normally on a right-angled isosceles prism ABC of refractive index n.



Find the minimum value of refractive index n of the prism required for the total internal reflection of the light to occur on the face BC of the prism.
(b) For any given thin prism of small angle A, refractive index n, and an incident blue light, answer the following questions.
i. Write the formula for angle of minimum deviation for a thin prism. If the whole arrangement is immersed in a liquid of refractive index n' < n, how will the angle of minimum deviation change?
ii. For some angle of incidence on the second face of the prism, the incident blue light undergoes total internal reflection. However, a red incident light for the same angle of incidence on the second face of the prism does not undergo total internal reflection. Give reason.

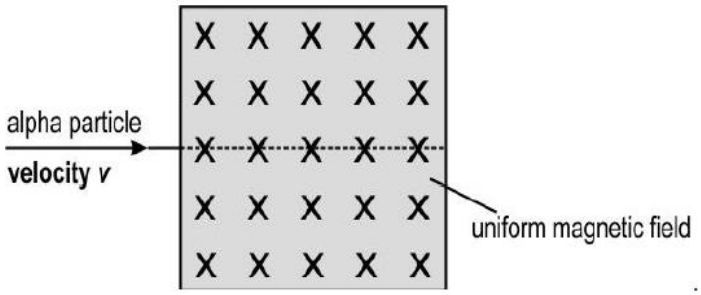
OR

(a) Draw the labelled ray diagram for the formation of image by a reading glass when the final image is formed at the near point.
(b) State its principle of working.
(c) Define magnifying power and derive an expression for it.
(d) A compound microscope used an objective lens of focal length 4 cm and eyepiece lens of focal length 10cm. An object is placed at 6cm from the objective lens. Calculate the magnifying power of the compound microscope, when the final image is formed at near point.

33. (a) A charge particle of charge q, mass m, moving with speed v enters a uniform magnetic field B making an angle θ with B.
(i) Draw the nature of path described by the charge particle.
(ii) Write the expression for the radius of the above path described

(b) An alpha particle is moving with a velocity v. It enters a magnetic field (B) as shown below. The magnetic field is perpendicular and into the plane of paper.

A uniform electric field is applied in the same region as the magnetic field so that the alpha particle passes undeviated through the combined fields.



(i) What should be the direction of the electric field?

(ii) Without any change in the electric and magnetic field, the alpha particle is replaced by the following particles:
(1) proton moving with a velocity v
(2) electron moving with a velocity $v/2$ Will there be any change a deviation in the path of the particles? Give a reason for your answer.

OR

(a) State the law which is used to find the magnetic field at a point due to a current element.
(b) Use it to obtain the magnetic field at an axial point, distant 'r' from the centre of a circular coil of radius 'a' carrying a current 'I'.
(c) A long straight wire carrying current I_1 is passing through the centre of a circular loop and perpendicular to its plane. If R is the radius of the loop carrying current I_2, then find the force on the circular loop by the straight wire.