PRINCE ACADEMY
OF HIGHER EDUCATION
[Co-edu. Sr. Sec. School, Affiliated to CBSE, Affiliation No. - 1730387]

Palwas Road, Near Jaipur - Bikaner Bypass Crossing, SIKAR - 332001 (Raj.) INDIA
Mob. : 9610-75-2222, 9610-76-2222
www.princeeduhub.com | E-mail : princeacademy31@gmail.com

BOARD SAMPLE PAPER- I (2025-26)

**Time : 03 : 00 Hours**   **CLASS :– XII-PHYSICS (042)**   **M.M. : 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.

SECTION - A

1. When trivalent impurity is mixed in a pure semiconductor, the conduction is mainly due to

   (a) Holes   (b) Protons   (c) Electrons   (d) Positive ions

2. The direction of induced current as observed by an observer-
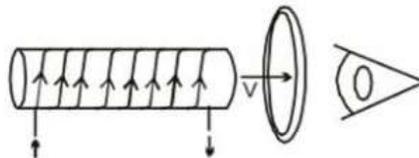

   (a) Clockwise   (b) Anticlockwise   (c) East   (d) West

3. In a circuit the phase difference between the alternating current and the source voltage is $\frac{\pi}{2}$. Which of the following cannot be the element(s) of the circuit ?

   (a) Only C   (b) Only L   (c) L and R   (d) L or C

4. Between the plates of a parallel plate condenser, a plate of thickness t_1 and dielectric constant k_1 is placed, in the rest of the space there is another plate of thickness t_2 and dielectric constant k_2. The potential difference across the condenser will be

   (a) $\dfrac{Q}{A\varepsilon_0}\left(\dfrac{t_1}{k_1}+\dfrac{t_2}{k_2}\right)$ (b) $\dfrac{\varepsilon_0 Q}{A}\left(\dfrac{t_1}{k_1}+\dfrac{t_2}{k_2}\right)$ (c) $\dfrac{\varepsilon_0 Q}{A}\left(k_1 t_1 + k_2 t_2\right)$ (d) $\dfrac{A\varepsilon_0}{Q}\left(\dfrac{t_1}{k_1}+\dfrac{t_2}{k_2}\right)$

5. A magnet make 5 oscillations per minute in earth's magnetic field (B = 0.5 gauss). By what amount should the field be increased so that the magnet may make 20 oscillations per minute?

   (a) 10 gauss   (b) 7.5 gauss   (c) 8 gauss   (d) 1.5 gauss

6. Wavefront is

   (a) Series of points on the wave with same amplitude

   (b) Locus of all adjacent points at which the electric field is the same

   (c) Series of points on the wave with same frequency

   (d) Locus of all adjacent points at which the phase of oscillation is the same

7. If in a p-n junction, a square input signal of 10 V is applied as shown,
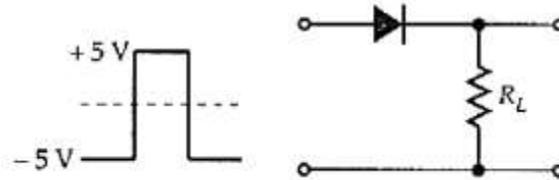
   then the output across R_L will be

   (a)   (b)   (c)   (d)
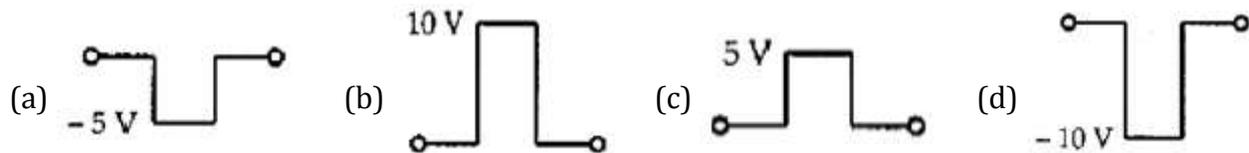
8. A coil contains N turns of insulated copper wire of diameter d and resistivity ρ wound on a cylinder of diameter D. What is the total resistance between the two ends of the coil of copper wire? (given: D>>d)

   (a) $\dfrac{4\rho ND}{d^2}$ (b) $\dfrac{8\rho ND}{d^2}$ (c) $\dfrac{2\rho ND}{d^2}$ (d) $\dfrac{12\rho ND}{d^2}$

9. A glass prism has internal angles of 45°, 45° and 90°. The glass has a critical angle of 45°. Which of the following ray diagrams depicts the possible path the of light through the prism?

   (a)   (b)   (c)   (d)
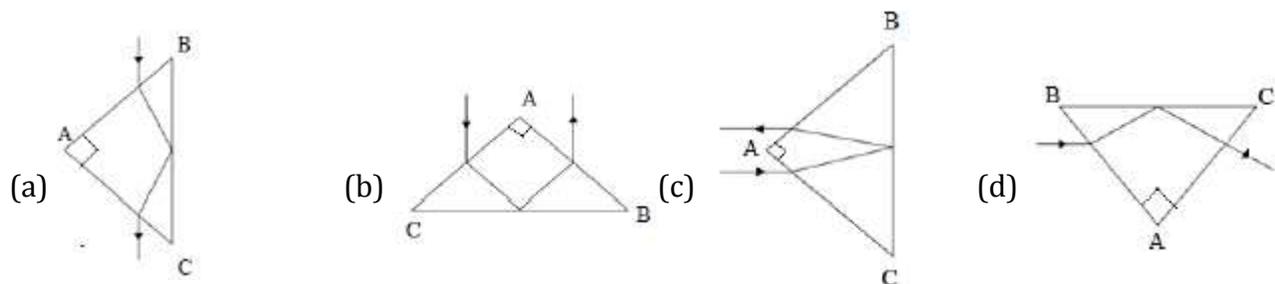
10. Which of the following transitions corresponds to the emission of the radiation of the maximum wavelength?
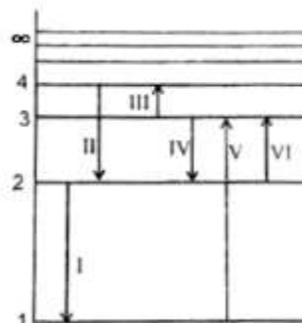
   (a) I   (b) III   (c) IV   (d) VI

11. In a coil of self-induction 5 H, the rate of change of current increase is 2 As^{-1}. Then emf induced in the coil is

    (a) 10 V   (b) -10 V   (c) 5 V   (d) -5 V

12. A capacitor of capacitance $\dfrac{10^{-4}}{\pi} F$, an inductor of inductance $\dfrac{2}{\pi} H$ and a resistor of resistance 100Ω are connected to form a series RLC circuit. When an AC supply of 220 V, 50 Hz is applied to the circuit, determine the impedance of the circuit.

    (a) 14.14Ω (b) 141.4Ω (c) 200Ω (d) 100Ω

Direction (Q: 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 codes (a), (b), (c) and (d) as given below.

(a) Both A and R are true and R is the 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 also false.

13. Assertion (A): Two protons placed at different distances, between the plates of a parallel plate capacitor experience the same force.

    Reason (R): The electric field between the plates of the capacitor is constant.

14. Assertion (A): A transformer does not work on DC.

    Reason (R): DC neither changes direction nor magnitude.

15. Assertion (A): Interference pattern is made by using yellow light instead of red light, the fringes becomes narrower.

    Reason (R): In Young's double slit experiment, fringe width is given by $\beta = \dfrac{\lambda D}{d}$.

16. Assertion (A): When a battery is short circuited, the terminal voltage is zero.

    Reason (R): In short circuit, the current varies with time.

SECTION - B

17. A capacitor of unknown capacitance is connected across a battery of V volt. A charge of $360\mu C$ is stored in it. When the potential across the capacitor is reduced by 120 V, the charge stored in the capacitor becomes $120\mu C$. Calculate V and the unknown capacitance. What would have been the charge on the capacitor if the voltage were increased by 120 V?

18. Calculate the energy in fusion reaction :

    $_{1}^{2}\text{H} + _{1}^{2}\text{H} \rightarrow _{2}^{3}\text{He} + \text{n}$, were BE of $_{1}^{2}\text{H} = 2.23\,\text{Me V}$ and of $_{2}^{3}\text{He} = 7.73\,\text{Me V}$

    OR

    A hydrogen atom in the ground state is excited by an electron beam of 12.5 eV energy. Find out the maximum number of lines emitted by the atom from its excited state.
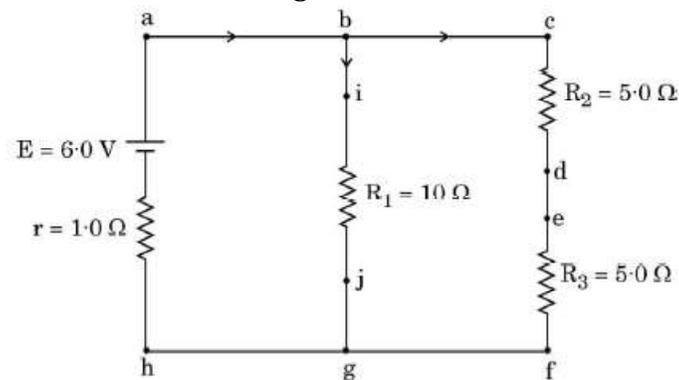
19. An alpha particle is projected with velocity $\vec{v} = \left(3.0 \times 10^5 \, m/s\right)\hat{i}$ into a region in which magnetic field $\vec{B} = \left[(0.4T)\hat{i} + (0.3T)\hat{j}\right]$ exists. Calculate the acceleration of the particle in the region. $\hat{i}, \hat{j}$ and $\hat{k}$ are unit vectors along x, y and z axis respectively and charge to mass ratio for alpha particle is $4.8 \times 10^7 \, C/kg$.

20. Using Huygens' principle, draw a ray diagram showing the propagation of a plane wave refracting at a plane surface separating two media. Also verify Snell's law of refraction.

21. Suppose, we think of fission of a $^{56}_{26}Fe$ nucleus into two equal fragments, $^{28}_{13}Al$. Is the fission energetically possible ? Argue by working out Q of the process. Given $m\left(^{56}_{26}Fe\right) = 55.93494 \, u$ and $m\left(^{28}_{13}Al\right) = 27.98191 \, u$.

OR

Write any two limitations of Bohr's atomic model.

SECTION - C

22. A circular coil of 20 turns and radius 10 cm is placed in a uniform magnetic field of 0.10 T normal to the plane of the coil. If the current in the coil is 5.0 A, what is the

(i) total torque on the coil?

(ii) total force on the coil?

(iii) average force on each electron in the coil due to the magnetic field?

[The coil is made of copper wire of cross-sectional area 10-5 m² and the free electron density in copper is given to be about $10^{29} \, m^{-3}$].

23. Two charges 14µc and −4µc are placed at (-12 cm, 0, 0) and (12 cm, 0, 0) in an external electric field $E = \dfrac{B}{r^2}$, where b $= 1.2 \times 10^6 \, \dfrac{Nm^2}{C}$ and r is in meter. Calculate the electrostatic potential energy of the configuration.

24. The following figure shows a circuit diagram. We can find the currents through and potential differences across different resistors using Kirchhoff rules.

Answer the following questions based on the above :

(a) Which points are at the same potential in the circuit ?

(b) What is the current through arm bg ?

(c) Find the potential difference across resistance R_3.

25. Suppose a pure Si crystal has 5×10^{28} atom m^{-3}. It is doped by 1 ppm concentration of pentavalent As. Calculate the number of electrons and holes. Given that $n_i = 1.5 \times 10^{16} m^{-3}$.

26. (a) For a given a.c., i=$i_m \sin \omega t$, show that the average power dissipated in a resistor R over complete cycle is $\frac{1}{2} i_m^2 R$.

(b) A light bulb is rated at 100 W for a 220 V a.c. supply. Calculate the resistance of the bulb.

OR

A series LCR circuit is connected to an ac source (200 V, 50 Hz). The voltages across the resistor, capacitor and inductor are respectively 200 V , 250 V and 250 V.

(i) The algebraic sum of the voltages across the three elements is greater than the voltage of the source. How is this paradox resolved?

(ii) Plot a graph between current and frequency. What is the meaning of Sharpness of this curve.

27. How does Einstein's photoelectric equation explain the emission of electrons from a metal surface? Explain briefly.

Plot the variation of photocurrent with :

(a) collector plate potential for different intensity of incident radiation, and

(b) intensity of incident radiation.

28. Suppose that the electric field amplitude of an electromagnetic wave is E_0 = 120 N/c and that its frequency is v = 50 MHz.

(i) Determine B_0, ω, K and λ.   (ii) Find expression for E and B.

SECTION - D

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

When the frequency of ac supply is such that the inductive reactance and capacitive become equal, the impedance of the series LCR circuit is equal to the ohmic resistance in the circuit. Such a series LCR circuit is known as resonant series LCR circuit and the frequency of the ac supply is known as resonant frequency.

Resonance phenomenon is exhibited by a circuit only if both L and C are present in the circuit. We cannot have resonance in a RL or RC circuit.

A series LCR circuit with L = 0.12 H, C = 480 nF, R = 23Ω is connected to a 230 V variable frequency supply.

0.12 H   480 nF   23 Ω

230 V

(i) Find the value of source frequency for which current amplitude is maximum.

(A) 222.32 Hz   (B) 550.52 Hz   (C) 663.48 Hz   (D) 770 Hz

(ii) The value of maximum current is

(A) 14.14 A   (B) 22.52 A   (C) 50.25 A   (D) 47.41 A

(iii) The value of maximum power is

(A) 2200 W   (B) 2299.3 W   (C) 5500 W   (D) 4700 W

(iv) What is the Q-factor of the given circuit ?

(A) 25   (B) 42.21   (C) 35.42   (D) 21.74

OR

At resonance which of the following physical quantity is maximum ?

(A) Impedance   (B) Current   (C) Both (A) and (B)   (D) Neither (A) nor (B)

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

Read the following paragraph and answer the questions.

Snell's Window

Total internal reflection is the optical phenomenon in which when the light travels from an optically denser medium to a rarer medium at the interface, it is partly reflected back into the same medium and partly refracted to the second medium.
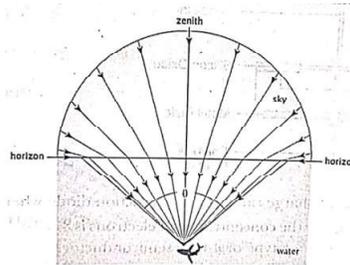
A similar effect can be observed by opening one's eyes while swimming just below the water surface. If the water is calm, the surface outside the critical angle (measured from the critical) appears mirror-like, reflecting objects below. The region above the water cannot be seen except overhead, where the hemispherical field of view is compressed into a conical field known as Snell's window, whose angular diameter is twice the critical angle.

Snel's window is also called Snell's circle or optical man-hole. It is a phenomenon by which an underwater viewer sees everything above the surface through a cone of light.

(i) Angular diameter related to critical angle in Snell's window -

(a) $\theta = i_c$ (b) $\theta = 2i_c$ (c) $\theta = 3i_c$ (d) $\theta = 4i_c$

(ii) Necessary condition for total internal reflection-

(a) $i > i_c$ (b) $i < i_c$ (c) $2i = i_c$ (d) $i = \dfrac{i_c}{2}$

(iii) The speed of light in a medium whose critical angle is 30°-

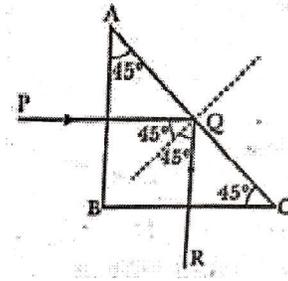(a) $v = c/2$ (b) $v = 2c$ (c) $v = c$ (d) None of these

(iv) As shown in figure, the ray PQ enters through the side AB, normally and is incident on AC at an angle of 45°. If it is totally reflected along QR, then refractive index of prism-

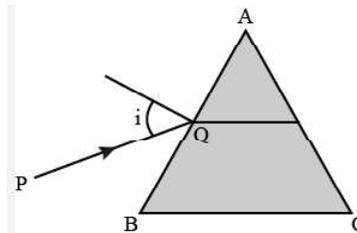(a) $\mu > \sqrt{3}$ (b) $\mu > \sqrt{4}$ (c) $\mu > \sqrt{1}$ (d) $\mu > \sqrt{2}$

SECTION - E

31. (i) A ray PQ of light is incident on the face AB of a glass prism ABC (as shown in the figure) and emerges out of the face AC. Trace the path of the ray. Also show that $< i + <e = <A + <\delta$

Where, δ and e denotes the angle of deviation and angle of emergence.

Also find out the relation between the refractive index (μ) in case of minimum deviation (δ_m).

(ii) If the radii of curvature of the faces of a double convex lens are 9 cm and 15 cm respectively and refractive index of glass is 1.5, then determine the focal length and the power of the lens.

OR

(i) Draw a labelled ray diagram showing the formation of a final image by a compound microscope at least distance of distinct vision and find the magnifying power of compound microscope.

(ii) A tank is filled with water to a height of 12.5 cm. The apparent depth of a needle lying at the bottom of the tank, is measured by a microscope to be 9.4 cm. What is the refractive index of water? If water is replaced by a liquid of refractive index 1.63 upto the same height, then by what distance would the microscope have to be moved to focus on the needle again ?

32. A free pith ball of 8g carries a positive charge of $5 \times 10^{-8} C$. What must be the nature and magnitude of charge that should be given to a second pith ball fixed 5 cm vertically below the former pith-ball, so that upper pith-ball is stationary ? 5

OR

(a) Use Gauss law to derive the expression for the electric field due to straight uniformly charged infinite line of charge density 'λ' c/m. 3

(b) Draw a graph to show the variation of E with perpendicular distance r from the line of charge. 1

(c) Find the workdone in bringing a charge q from perpendicular distance r_1 to r_2 $(r_2 > r_1)$. 1

33. (i) Explain the processes of nuclear fission and nuclear fusion by using the plot of binding energy per nucleon (E_{bn}) verses the mass number (A). 2

(ii) A 60W source emits monochromatic light of wavelength 662.5 nm. Find the value of number of photons emitted per second. 3

OR

(i) In Geiger-Mardsen experiment, calculate the distance of the closest approach to the nucleous of $Z = 80$, when an ∞ − particle of 8 MeV energy impinges on it before comes momentarily to rest and reverse its direction. 3

(ii) Draw a curve between no. of scattered ∞ − particles and deflection angle θ. 2

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