

CLASS XII: PHYSICS (042)
PRE BOARD EXAMINATION
SESSION 2023-24

Yargi
29

Neightage:

70 marks.

Time Duration:

3 hrs

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 a few questions. You have to attempt only one of the choices in such questions.
- (6) Use of calculators is not allowed.

SECTION - A (16X 1= 16M)

1. The work-function for a metal is 3 eV. To emit a photoelectron of energy 2 eV from the surface of this metal, the wavelength of the incident light should be:
a) 6178 Å b) 4125 Å c) 1275 Å d) 2486 Å
2. The ratio of energies of the hydrogen atom in its first to second excited state is:
a) 1:4 b) 4:1 c) -4:-9 d) -¼ : -1/9
3. The radii of two metallic spheres A and B are r_1 and r_2 respectively ($r_1 > r_2$). They are connected by a thin wire and the system is given a certain charge. The charge will be greater
(a) on the surface of the sphere B.
(b) on the surface of the sphere A.
(c) equal on both.
(d) zero on both.
4. If the magnetising field on a ferromagnetic material is increased, its permeability
a) Decreases b) increases c) remains constant d) first decreases and then increases
5. What is the value of inductance L for which the current is maximum in a series LCR - circuit with $\bar{C} = 10 \mu\text{F}$ and $\omega = 1000 \text{ s}^{-1}$?
(a) 100 mH (b) 1 mH
(c) 10 mH (d) cannot be calculated unless R is known

6. The diagram shows the electric field (E) and magnetic field (B) components of an electromagnetic wave at a certain time and location.



- The direction of the propagation of the electromagnetic wave is
- (a) perpendicular to E and B and out of plane of the paper
 - (b) perpendicular to E and B and into the plane of the paper
 - (c) parallel and in the same direction as E
 - (d) parallel and in the same direction as B

7. A negatively charged object X is repelled by another charged object Y. However an object Z is attracted to object Y. Which of the following is the most probable for the object Z?

- a) Positively charged only
- b) negatively charged only
- c) neutral or positively charged
- d) neutral or negatively charged

8. By increasing the temperature, the specific resistance of a conductor and a semiconductor

- a) increases for both
- b) decreases for both
- c) Increases for a conductor and decreases for a semiconductor
- d) decreases for a conductor and increases for a semiconductor

9. Two wires of the same length are shaped into a square of side 'a' and a circle with radius 'r'. If they carry same current, the ratio of their magnetic moment is

- a) $2:\pi$
- b) $\pi:2$
- c) $\pi:4$
- d) $4:\pi$

10. A straight conducting rod of length l and mass m is suspended in a horizontal plane by a pair of flexible strings in a magnetic field of magnitude B. To remove the tension in the supporting strings, the magnitude of the current in the wire is

- a) mgB/l
- b) mg/B
- c) mg/lB
- d) lB/mg

11. To reduce the resonant frequency in a L-C-R series circuit with a generator

- a) The generator frequency should be reduced
- b) Another capacitor should be added in parallel to the first
- c) The iron core of the inductor should be removed
- d) Dielectric in the capacitor should be removed

12. If n_i is density of intrinsic charge carriers ; n_h & n_e are densities of holes and electrons in extrinsic semiconductor, the correct relation between them is

- a) $n_e n_h = n_i^2$
- b) $n_i = n_e + n_h$
- c) $n_i = n_e / n_h$
- d) $n_e n_h = n_i$

For question number 13 - 16 two statements are given-one labeled Assertion (A) and the other labeled 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 but R is not the correct explanation of A.
- (c) A is true but R is false.
- (d) A is false and R is true.

Assertion(A) : An electron & a proton moving with same velocity enter a magnetic field . The force experienced by the proton is more than the force experienced by the electron.
Reason(R) : The mass of a proton is more than the mass of an electron.

14. Assertion(A) : Electric field is always normal to equipotential surfaces & along the direction of decreasing order of potential .

Reason(R) : Negative gradient of electric potential is electric field.

15. Assertion(A) : When the apparatus of Young's double slit experiment is brought in a liquid from air , the fringe width decreases.

Reason(R) : Wavelength of light decreases in the liquid.

16. Assertion(A) : The electrical conductivity of a semiconductor increases on doping .

Reason(R) : Doping always increases the number of electrons in the semiconductor.

SECTION - B (5X 2= 10M)

17. A ray of monochromatic light passes through an equilateral glass prism in such a way that the angle of incidence is equal to the angle of emergence and each of these angles is $\frac{3}{4}$ times the angle of the prism. Determine the angle of deviation and the refractive index of the glass prism.

18. Two electric bulbs P & Q whose resistances are in the ratio 1:2 are connected in parallel to a source of voltage V . What will be the ratio of power dissipation in these bulbs ? Which of the two bulbs are brighter in parallel and why?

19. A point charge is placed at the center of a spherical Gaussian surface. How will the electric flux change , if :

- The sphere is replaced by a cube of the same volume.
- A second charge is placed just outside the original sphere.
- The original charge is replaced by an electric dipole.
- A dielectric of $K = 5$ is filled in the spherical Gaussian surface.

20. Identify the part of the electromagnetic spectrum used to

- detect leakage of oil in underground pipelines.
- improve visibility in runways during fog & mist conditions .
- Draw & write the equations for electric field & magnetic field for an em wave propagating along direction

21. In a pure semiconductor of Si, if antimony is added , then what type of extrinsic semiconductor is obtained ? Draw the energy band diagram of this semiconductor so formed and name the major carriers in this case.

SECTION - C (7X 3= 21M)

22. a) Explain the formation of depletion region for p-n junction diode. How does the width of the depletion region change when the junction is

- i) forward biased
- ii) reverse biased ?

b) Draw the circuit diagram of a full wave rectifier. Briefly explain its working & draw the input & output waveforms.

23. a) Define electrostatic potential. Is it scalar or vector?

b) Two identical point charges, q each, are kept 2 m apart in air. A third point charge Q of unknown magnitude and sign is placed on the line joining the charges such that the system remains in equilibrium. Find the position and nature of Q .

24. a) Draw a labelled diagram to obtain the real image formed by an astronomical telescope in normal adjustment position. Define its magnifying power.

b) You are given three lenses of power 0.5D, 4 D, and 10 D to design a telescope.

- i) Which lenses should be used as objective and eyepiece? Justify your answer.
- ii) Why is the aperture of the objective preferred to be large?

25. a) State Huygens postulates for geometrical construction of secondary wavefront and using it draw a diagram showing the passage of a plane wavefront, from a denser into a rarer medium.

b) The ratio of the widths of two slits in Young's double slit experiment is 4:1. Evaluate the ratio of intensities at maxima and minima in the interference pattern.

26. a) Define drift velocity and show that the current density of a metallic conductor is directly proportional to the drift speed of electrons.

b) Two conducting wires X and Y of same diameter but different materials are joined in series across a battery. If $n_X = 2n_Y$, find the ratio of the drift velocity of electrons in two wires.

27. An alternating voltage $E = E_0 \sin \omega t$ is applied to a circuit containing a resistor R connected in series with a black box. The current in the circuit is found to be $I = I_0 \sin(\omega t + \pi/4)$.

- i) State whether the element in the black box is a capacitor or inductor.
- ii) Draw the corresponding phasor diagram and find the impedance in terms of R .

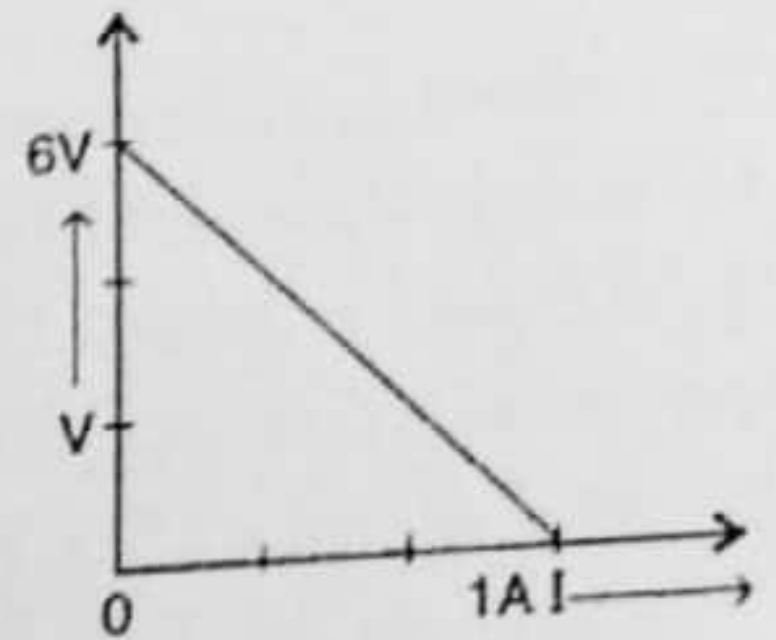
28. State Bohr's postulate for the permitted orbit for the electrons in a hydrogen atom. Use these postulates to prove that the circumference of the n th permitted orbit for the electron can contain exactly n wavelengths of the de Broglie wavelength associated with the electron in that orbit.

SECTION - D (2X4= 8M)

Case Study :
A single cell provides a feeble current. In order to get a higher current in a circuit, we often use a combination of cells. A combination of cells is called a battery, Cells can be joined in series, parallel or in a mixed way.

Two cells are said to be connected in series when the negative terminal of one cell is connected to the positive terminal of the other cell and so on. Two cells are said to be connected in parallel if the positive terminal of each cell is connected to one point and the negative terminal of each cell connected to the other point. In mixed grouping of cells, a certain number of identical cells are joined in series, and all such rows are then connected in parallel with each other.

i) The plot of the variation of potential difference V across a combination of three identical cells in series, versus current I is shown along the question. What is the emf and internal resistance of each cell?



ii) A battery of emf 10 V and internal resistance 3Ω is connected to a resistor. If the current in the circuit is 0.5 A, find the resistance of the resistor & the terminal voltage of the battery.

iii) State the factors on which the internal resistance of a cell depends.

30. Case Study : Diffraction of Light

The phenomenon of bending of light around the sharp corners and the spreading of light within the geometrical shadow of the opaque obstacles is called diffraction of light. The light thus deviates from its linear path. The deviation becomes much more pronounced, when the dimensions of the aperture or the obstacle are comparable to the wavelength of light.

Diffraction of light plays a paramount role in limiting the resolving power of any optical instrument (for example: binoculars, telescopes, microscopes and the eye). The resolving power is the optical instrument's ability to produce separate images of two adjacent points. This is often determined by the quality of the lenses and mirrors in the instrument as well as the properties of the surrounding medium (usually air). The wave-like nature of light forces an ultimate limit to the resolving power of all optical instruments.

i) Draw the graph showing intensity distribution of fringes with phase angle due to diffraction through a single slit & state two important differences between intensity patterns obtained in interference & diffraction.

ii) In a single-slit diffraction experiment, the width of the slit is made double the original width. How does this affect the size and intensity of the central diffraction band?

iii) A parallel beam of light of wavelength 600 nm is incident normally on a slit of width 'a'. If the distance between the slit & the screen is 0.8m & the distance of 2nd order maxima from the center of the screen is 1.5mm, calculate the width of the slit.

SECTION - E (3X5= 15M)

- 31 a) An electric dipole is held in a uniform electric field. What happens to dipole when released in this field. Calculate the work done in rotating it through 180° now.
- b) X and Y are two parallel plate capacitors having same area of the plates and same separation between the plates. X has air and Y has dielectric medium of $K=4$ between the plates. They are connected in series to a 12V supply.
- Calculate each capacitance if equivalent of combination is $4\mu\text{F}$
 - Calculate potential difference between the plates of X and Y.
 - What is the ratio of the electrostatic energy stored in X and Y?

- 32 a) What are the conditions for total internal reflection? Does critical angle depend on the color of light?
- b) An object is placed 15 cm in front of a convex lens L1 of focal length 20 cm and the final image is formed at a distance of 80 cm from the second lens L2. Find the focal length of the lens L2 if the distance of separation between L1 and L2 is 20cm.

OR

- 32 Consider a point object lying on the principal axis in the rarer medium of refractive index n_1 and a real image formed in the denser medium of refractive index n_2 . Derive the mathematical relation between refractive indices n_1 and n_2 of two medium and radius of curvature R for refraction at a convex spherical surface.
- b) Light from a point source in air falls on a convex spherical glass surface of refractive index 1.5 and radius of curvature 20 cm. The distance of the light source from the glass surface is 100 cm. At what position is the image formed?
- 33 a) i) State the principle of working of a transformer. Can a transformer be used to step up or step down a DC voltage?
- Mention the reasons for energy losses in an actual transformer. Specify the two characteristics of the material suitable for making the core of the transformer.
 - Find the ratio of primary & secondary currents in terms of turn ratio in an ideal transformer.
- b) How much current is drawn by the primary of a transformer connected to 220V supply when delivers power to a 110 V - 550 W refrigerator?
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