

CLASS: XII
MODEL QUESTION PAPER (HPBOSE) 2024-25
SUBJECT PHYSICS (THEORY)

MAXIMUM MARKS : 60

TIME ALLOWED : 3HOURS

General Instructions:

- (1) There are 27 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 twelve MCQ's and Assertion Reasoning based questions of 1 mark each, Section B contains four questions of two marks each, Section C contains seven questions of three marks each, Section D contains one case study based questions of four marks 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. $c = 3 \times 10^8 \text{ m/s}$
- ii. $m_e = 9.1 \times 10^{-31} \text{ kg}$
- iii. $e = 1.6 \times 10^{-19} \text{ C}$
- iv. $\mu_0 = 4\pi \times 10^{-7} \text{ TmA}^{-1}$
- v. $h = 6.63 \times 10^{-34} \text{ Js}$
- vi. $\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2 \text{N}^{-1} \text{m}^{-2}$
- vii. Avogadro's number = 6.023×10^{23} per gram mole

SECTION-A (MULTIPLE CHOICE QUESTIONS)

1. **The unit of electric field intensity is:**
 - a) Volt
 - b) Ohm
 - c) Newton per Coulomb
 - d) Joule per Coulomb
2. **In a parallel circuit, the voltage across each component is:**
 - a) Different
 - b) Zero
 - c) Same
 - d) Averaged
3. **The force on a moving charge in a magnetic field is maximum when the angle between the velocity and the magnetic field is:**
 - a) 0°
 - b) 90°
 - c) 45°
 - d) 180°
4. **The root mean square (RMS) value of an AC current is:**
 - a) Equal to the peak value
 - b) Half of the peak value
 - c) The effective value for power calculation
 - d) Twice the peak value

5. **The self-inductance of a coil is:**
 - a) Inversely proportional to the number of turns
 - b) Directly proportional to the number of turns
 - c) Independent of the number of turns
 - d) Inversely proportional to the coil's area
6. **The phenomenon of light bending around obstacles is called:**
 - a) Refraction
 - b) Diffraction
 - c) Reflection
 - d) Dispersion
7. **A concave lens is used to correct:**
 - a) Hyperopia
 - b) Myopia
 - c) Astigmatism
 - d) Presbyopia
8. **The wavelength of an electron is inversely proportional to its:**
 - a) Speed
 - b) Energy
 - c) Momentum
 - d) Charge
9. **In a nuclear fission reaction, the total mass of the products compared to the reactants is:**
 - a) Greater
 - b) Less
 - c) Equal
 - d) Cannot be determined
10. **In a P-N junction diode, the region where no current flows is known as:**
 - a) Conducting region
 - b) Depletion region
 - c) Accumulation region
 - d) Neutral region

For questions 11 and 12, two statements are given- one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options given below.

- a) Both Assertion and Reason are true, and Reason is the correct explanation.
 - b) Both Assertion and Reason are true, but Reason is not the correct explanation.
 - c) Assertion is true, but Reason is false.
 - d) Assertion is false, but Reason is true.
11. **The Assertion (A):** A charged particle moving in a magnetic field experiences a force that is always perpendicular to its velocity.
Reason (R): The magnetic force on a moving charge is given by $F=q(v \times B)$, where v is the velocity of the charge and B is the magnetic field.
 12. **Assertion (A):** The current through a PN diode increases exponentially with the applied forward voltage.
Reason (R): In a PN diode, the majority carriers move across the junction, and their movement is governed by the exponential relationship in the diode equation.

SECTION-B (VERY SHORT ANSWER)

13. Define drift velocity? Show that $I = neAv_d$, where symbols have their usual meanings.
14. Discuss domain theory of ferromagnetism.
15. Explain the photoelectric effect and derive the equation for the kinetic energy of the emitted photoelectrons.
16. A circular coil of wire consisting of 100 turns, each of radius 8.0 cm carries a current of 0.40 A. What is the magnitude of the magnetic field B at the centre of the coil?

OR

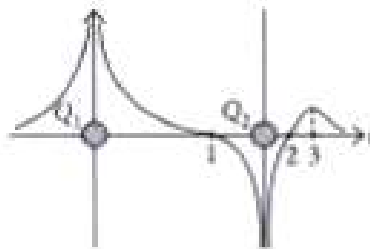
Write the formula for the power factor in an AC circuit and its significance.

SECTION-C (SHORT ANSWER)

17. Discuss the concept of mutual induction, including its physical basis, and derive the expression for the induced electromotive force (emf) in a coil due to a changing current in a nearby coil.
18. Explain the phenomenon of diffraction of light and describe how it differs from interference.
19. Define Binding energy and derive an expression for mass defect.
20. Two charges, q_1 and q_2 , are placed 12 meters apart. The force between them is 5×10^{-2} Newtons. If q_1 is $+4 \mu\text{C}$ and q_2 is unknown, find the magnitude of q_2 .
21. What is displacement current? Find its expression.
22. Explain Ohm's Law and derive the expression for the power dissipated in a resistor.
23. State Bohr's postulates of the hydrogen atom and explain how they help in determining the energy levels of the atom.

SECTION-D: CASE STUDY-BASED QUESTION

24. **Read the following source and answer any four out of the following questions:**
The potential at any observation point P of a static electric field is defined as the work done by the external agent (or negative of work done by electrostatic field) in slowly bringing a unit positive point charge from infinity to the observation point. Figure shows the potential variation along the line of charges. Two point charges Q_1 and Q_2 lie along a line at a distance from each other.



- (i) At which of the points 1, 2 and 3 is the electric field is zero?
(a) 1 (b) 2 (c) 3 (d) Both (a) and (b)
- (ii) The signs of charges Q_1 and Q_2 respectively are
a) positive and negative
b) negative and positive
c) positive and positive
d) negative and negative
- (iii) Which of the two charges Q_1 and Q_2 is greater in magnitude?

- (a) Q2 (b) Q1 (c) Same (d) Can't determined
- (iv) Which of the following statement is not true?
- (a) Electrostatic force is a conservative force
 - (b) Potential energy of charge q at a point is the work done per unit charge in bringing a charge from any point to infinity
 - (c) When two like charges lie infinite distance apart, their potential energy is zero.

SECTION-E

25. A convex lens of focal length 20 cm is used to form an image of an object placed 30 cm away from the lens. (a) Determine the position of the image formed. (b) Calculate the magnification of the lens. (c) If the image is to be projected onto a screen, how far should the screen be placed from the lens to get a sharp image?

OR

Discuss the formation of images by a convex lens. Include in your discussion:

- (a) The lens formula and magnification formula.
 - (b) The nature and position of the image formed for different object distances (i.e., when the object is at infinity, at $2F$, Between F and $2F$).
26. Explain the electrical conduction mechanism in semiconductors. Discuss the concept of energy bands and the band gap in semiconductors. Also give difference between intrinsic and extrinsic semiconductors.
27. Discuss the behavior of an LCR series circuit when connected to an AC source. Define resonance and describe the condition for resonance in an LCR series circuit. Explain the effect of resonance on impedance and current.

OR

An AC circuit has a sinusoidal voltage source with an amplitude of $V_0=100$ V and a frequency of 50 Hz. The current through the circuit is also sinusoidal and has an amplitude of $I_0=5$ A.

- (a) Calculate the average current over one complete cycle of the AC waveform.
- (b) Determine the RMS value of the current.

BLUE PRINT OF PHYSICS MODEL PAPER SESSION 2024-25

| CHAPTER NAME | NO. OF QUESTIONS OF | | | | | Total | Marks Clubbing for flexibility |
|---|---------------------|----------|-----------|----------|-----------|-----------|--------------------------------|
| | 1 marks | 2 Mark | 3 Mark | 4 Mark | 5 Mark | | |
| Electric Charge and Fields | 1 | --- | 1 | --- | --- | 4 | 14 |
| Electrostatic Potential and Capacitance | --- | --- | --- | 1 | --- | 4 | |
| Current Electricity | 1 | 1 | 1 | --- | --- | 6 | |
| Moving Charges and Magnetism | 2 | 1 | --- | --- | --- | 4 | 6 |
| Magnetism and Matter | --- | 1 | --- | --- | --- | 2 | |
| Electromagnetic Induction | 1 | --- | 1 | --- | --- | 4 | 13 |
| Alternating Current | 1 | --- | --- | --- | 1 | 6 | |
| Electromagnetic waves | --- | --- | 1 | --- | --- | 3 | |
| Ray optics and Optical Instruments | 1 | --- | --- | --- | 1 | 6 | 10 |
| Wave optics | 1 | --- | 1 | --- | --- | 4 | |
| Dual Nature of Radiation and matter | 1 | 1 | --- | --- | --- | 3 | 10 |
| Atoms | --- | --- | 1 | --- | --- | 3 | |
| Nuclei | 1 | --- | 1 | --- | --- | 4 | |
| Semiconductor Electronics | 2 | --- | --- | --- | 1 | 7 | 7 |
| TOTAL | 12 | 8 | 21 | 4 | 15 | 60 | 60 |