PHYSICS (Code No. 042) – Class XII

Time Allowed: 3 hours   Maximum Marks: 70

General Instructions:

1. All questions are compulsory.
2. There are 35 questions in total.
3. This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
4. Section A contains twelve multiple choice questions (MCQs) of 1 mark each and four assertion-reasoning type questions of 1 mark each.
5. Section B has five short answer questions of 2 marks each. One question has an internal choice.
6. Section C has seven short answer questions of 3 marks each. One question has an internal choice.
7. Section D has two case study based questions of 4 marks each. Each case study has an internal choice.
8. Section E has three long answer questions of 5 marks each. Each question has an internal choice.
9. Use of calculators is not permitted.
10. Take the value of $g = 10 \text{ m/s}^2$, $c = 3 \times 10 \text{ x m/s}$, and other physical constants as mentioned in the questions.

Section A (16 marks)

(12 MCQs - 1 mark each)

1. The unit of electric flux is:
    (a) N m²/C (b) N m/C (c) N C/m² (d) N C/m

2. Which of the following is a vector quantity?
    (a) Electric potential (b) Electric field intensity (c) Electric charge (d) Electric flux

3. The SI unit of magnetic flux density is:
    (a) Weber (b) Tesla (c) Ampere (d) Coulomb

4. In a purely inductive AC circuit, the phase difference between current and voltage is:
    (a) 0° (b) 45° (c) 90° (d) 180°

5. Which of the following electromagnetic waves has the longest wavelength?
    (a) X-rays (b) Ultraviolet rays (c) Radio waves (d) Infrared rays

6. The phenomenon of bending of light around corners is known as:
    (a) Interference (b) Diffraction (c) Polarization (d) Reflection

7. The de Broglie wavelength of a particle is inversely proportional to its:
   (a) mass (b) velocity (c) momentum (d) energy

8. The nucleus of an atom consists of:
   (a) Protons only (b) Neutrons only (c) Protons and neutrons (d) Electrons and protons

9. A semiconductor with a small amount of pentavalent impurity added is called:
   (a) p-type semiconductor (b) n-type semiconductor (c) intrinsic semiconductor (d) extrinsic semiconductor

10. Which property is responsible for the sharp image formed by a convex lens?
   (a) Refraction (b) Reflection (c) Total internal reflection (d) Dispersion

11. What is the direction of the magnetic field created by a current in a straight wire using the Right-hand thumb rule?
   (a) Parallel to the wire (b) Anti-parallel to the wire (c) Circular around the wire (d) Radial outwards from the wire

12. The process of producing electricity from mechanical motion is called:
   (a) Induction (b) Conduction (c) Convection (d) Radiation

(4 Assertion-Reasoning Questions - 1 mark each)

Instructions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:
(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 but R is true.

13. **A:** The electric field inside a conductor is zero.
    R: Free charges inside a conductor redistribute themselves to cancel out any external electric field.

14. **A:** The energy stored in a capacitor is proportional to the square of the voltage across it.
    R: The energy stored in a capacitor is given by $\frac{1}{2}CV^2$.

15. **A:** The resolving power of a telescope increases with its aperture.
    R: Diffraction of light limits the resolving power of a telescope.

16. **A:** Nuclear fusion releases more energy than nuclear fission.
    R: The binding energy per nucleon is higher for heavier nuclei than for lighter nuclei.

Section B (10 marks)

(5 short answer type questions - 2 marks each)

17. Define electric potential and electric potential energy. What is the relation between them?

18. State Lenz's law. Give one example to illustrate this law.

19. Draw a labelled diagram of a moving coil galvanometer. Briefly explain its working principle.

20. What are matter waves? State de Broglie's hypothesis. OR Explain the concept of mass defect and binding energy.

21. Write the expression for the fringe width in Young's double slit experiment. How does the fringe width change if the wavelength of light is increased?

Section C (21 marks)

(7 short answer type questions - 3 marks each)

22. Derive the expression for the electric field intensity due to an infinitely long uniformly charged straight wire using Gauss's law.

23. Explain the working of a step-up transformer with the help of a labeled diagram. Derive the expression relating the input and output voltages.

24. Draw a ray diagram to show the formation of the image formed by a convex lens when the object is placed between F and 2F. State the nature, size, and position of the image.

25. Explain the photoelectric effect. State Einstein's photoelectric equation and explain the significance of each term. OR Explain the Bohr model of the hydrogen atom and its limitations.

26. Distinguish between intrinsic and extrinsic semiconductors. How are n-type and p-type semiconductors formed?

27. What is meant by the term 'polarization' of light? Explain with suitable examples.

28. Describe the construction and working of a simple astronomical telescope. Derive an expression for its magnifying power.

Section D (8 marks)

(2 case study based questions - 4 marks each)

29. **Case Study:** A parallel plate capacitor is charged by a battery and then disconnected. The separation between the plates is increased.
   (a) What happens to the charge on the capacitor?
   (b) What happens to the potential difference across the capacitor?
   (c) What happens to the capacitance of the capacitor?
   (d) What happens to the energy stored in the capacitor? OR
   Explain the phenomena of total internal reflection and its applications in optical fibers.

30. **Case Study:** A radioactive nucleus decays into a stable nucleus by emitting alpha particles. Explain the process.
   (a) What is an alpha particle?
   (b) How does the atomic number and mass number of the parent nucleus change after alpha decay?
   (c) Give one example of alpha decay.
   (d) What are the characteristics of alpha radiation? OR Explain the process of nuclear fission with an example.

Section E (15 marks)

(3 long answer type questions - 5 marks each)

31. Derive the expression for the balancing condition of a Wheatstone bridge. Explain how the metre bridge works based on this principle.

32. Explain the phenomenon of interference of light. Describe Young's double-slit experiment and obtain the expression for the fringe width. OR Describe the phenomenon of diffraction of light. Explain diffraction through a single slit and obtain an expression for the width of the central maximum.

33. Explain the working of a junction diode as a rectifier. Draw the circuit diagram and explain the input and output waveforms. OR Explain the working of a common emitter amplifier. Draw a circuit diagram and discuss its characteristics.

This question paper adheres to the syllabus provided and the specified format. The difficulty level is kept easy to moderate as requested, focusing on conceptual understanding and application. Remember to adjust the difficulty and specific questions to suit your intended audience.