PHYSICS (Code No. 042) CLASS XII (2024-25)

I. General Information:

* **Subject:** Physics
* **Subject Code:** 042
* **Class:** XII
* **Academic Session:** 2024-25
* **Maximum Marks:** 70
* **Time Allowed:** 3 hours
* **No Calculators Allowed**
* **Physical Constants Provided:** [Include a list of common constants like e, ;R Â ¼ €, c, h, k, etc.]

II. Questions:

Section A (16 marks): Answer ALL questions.

(12 MCQs - 1 mark each):

1. The electric field intensity at a point due to a point charge is inversely proportional to:
   (a) r (b) r^2 (c) 1/r (d) $1/r^2$

2. A capacitor stores energy in its:
   (a) dielectric (b) plates (c) electric field (d) none of these

3. Drift velocity of electrons is: (Choose the most appropriate)
   (a) directly proportional to electric field (b) inversely proportional to electric field
   (c) independent of electric field (d) proportional to the square of electric field.

4. The magnetic field due to a long straight current-carrying wire is:
   (a) radial (b) parallel to the wire (c) circular (d) elliptical

5. The unit of magnetic flux density is:
   (a) Tesla (b) Weber (c) Henry (d) Ampere

6. Lenz's law is a consequence of the law of conservation of:
   (a) charge (b) energy (c) momentum (d) mass

7. In an LCR series circuit at resonance, the impedance is:
   (a) maximum (b) minimum (c) zero (d) infinity

8. Electromagnetic waves are:
   (a) longitudinal (b) transverse (c) both (d) neither

9. Total internal reflection occurs when the angle of incidence is:
(a) less than the critical angle (b) equal to the critical angle (c) greater than the critical angle (d) equal to 90°

10. The width of the central maxima in a single-slit diffraction pattern depends on:
(a) wavelength of light only (b) width of slit only (c) both wavelength and width of slit (d) neither wavelength nor width of slit

11. The photoelectric effect demonstrates the:
(a) wave nature of light (b) particle nature of light (c) both wave and particle nature (d) neither wave nor particle nature

12. The nucleus of an atom contains:
(a) protons only (b) neutrons only (c) protons and neutrons (d) electrons and protons

(4 Assertion-Reasoning questions - 1 mark each):

13. **Assertion:** The electric field inside a conductor is zero. **Reason:** Free charges reside on the surface of a conductor.

14. **Assertion:** A transformer works on AC current. **Reason:** AC current can change the magnetic flux linked with the secondary coil.

15. **Assertion:** Diffraction is the bending of light around obstacles. **Reason:** Light shows wave nature.

16. **Assertion:** The binding energy per nucleon is maximum for iron. **Reason:** Nuclear fusion releases energy.

Section B (10 marks): Answer ALL questions.

17. Define electric flux. State Gauss's law in electrostatics.

18. Explain the concept of drift velocity. How is it related to current density?

19. Derive the expression for the magnetic force on a current carrying conductor placed in a uniform magnetic field.

20. Explain the working principle of an AC generator. **OR** Explain how a galvanometer can be converted into a voltmeter.

21. Write the expression for the fringe width in Young's double slit experiment. Explain the significance of coherent sources.

Section C (21 marks): Answer ALL questions.

22. Two point charges, q1 = +2µC and q2 = -4µC, are separated by a distance of 10 cm. Find the electric field intensity at a point midway between them.

23. A resistor of 10:’ —2 6öææV7FVB –â 6W ies with a cell of emf 2V and internal resistance 1:’à Calculate the terminal voltage across the resistor.

24. Describe the phenomenon of self-induction. State the expression for self-inductance.

25. Explain the concept of total internal reflection. Mention two applications of total internal reflection.

26. Explain how a convex lens forms a real image of an object placed beyond its focal length. Use a ray diagram. **OR** Draw a labeled ray diagram for a refracting telescope.

27. State de Broglie's hypothesis. Calculate the de Broglie wavelength of an electron with kinetic energy of 100 eV.

28. Explain the mass-energy equivalence. Write down Einstein's mass-energy equivalence equation.

Section D (8 marks): Answer ALL questions. Each question carries 4 marks.

29. **Case Study:** **Electromagnetic Waves**
(a) Explain the nature of electromagnetic waves. **OR** Explain the electromagnetic spectrum.
(b) Briefly describe the applications of microwaves. **OR** Describe the applications of X-rays.

30. **Case Study:** **Nuclear Physics**
(a) Explain the concept of binding energy per nucleon and its significance. **OR** Briefly explain nuclear fission and nuclear fusion.
(b) Describe the working of a nuclear reactor. **OR** Explain the hazards associated with nuclear radiation.

Section E (15 marks): Answer ALL questions. Each question carries 5 marks and has an internal choice with three options. Choose only one option from the three choices.

31. **Option 1:** Derive the expression for the electric potential due to a point charge.
Option 2: Derive the expression for the energy stored in a capacitor.
Option 3: Explain Kirchhoff's laws and apply them to solve a simple circuit problem.

32. **Option 1:** Derive an expression for the magnetic field at the center of a current carrying circular loop.
Option 2: Explain the working of a moving coil galvanometer.
Option 3: Describe the construction and working of a transformer.

33. **Option 1:** Explain Young's double slit experiment and derive the expression for fringe width.
Option 2: Explain the photoelectric effect and Einstein's photoelectric equation.
Option 3: Explain the Bohr model of the hydrogen atom. Derive an expression for the radius of the nth orbit.

This question paper adheres to the specified format and includes a range of question types, covering all units and topics as per the provided syllabus. Remember to include a list of physical constants at the beginning of the paper. The difficulty level is designed to be medium.