Sample Paper-04
Physics (Theory)
Class – XII

Time allowed: 3 hours **Maximum Marks: 70**

General Instructions:

a) All the questions are compulsory.
b) There are **26** questions in total.
c) Questions **1** to **5** are very short answer type questions and carry **one** mark each.
d) Questions **6**to **10** carry **two** marks each.
e) Questions **11** to **22** carry **three** marks each.
f) Questions **23** to **26** carry **five** marks each.
g) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions in five marks each. You have to attempt only one of the choices in such questions.
h) Use of calculators is **not** permitted. However, you may use log tables if necessary.
i) You may use the following values of physical constants wherever necessary:

$c = 3x10^{8} m/s$

$h = 6.63x10^{-34} Js$

$e = 1.6x10^{-19} C$

$\mu_o = 4\pi x10^{-7} TmA^{-1}$

$\frac{1}{4\pi\varepsilon_0} = 9x10^{9} Nm^2C^{-2}$

$m_e = 9.1x10^{-31} kg$

1. What is the basic cause of quantization of charges?
2. What are thermal neutrons?
3. What is the dimensional formula of $\sqrt{LC}$?
4. Give example of β decay.
5. A converging lens of refractive index 1.5 is kept in a liquid having same refractive index. What would be power of lens in this medium?
6. Explain the effect of increase of intensity and potential difference on photoelectrons K.E.?
7. Explain why when current is in circular, the magnetic field is straight.

Or

An electron is describing a circle in a magnetic field of 10^{-4} tesla. Calculate the frequency of revolutions. Given mass of electron = 9 x 10^{-31} kg and charge on electron = 1.6 x 10^{-19} C.

8. Calculate the number of photons emitted per second by transmitter of 10 KW power, radio wave frequency of 6 x 10^{5}Hz.
9. Draw a sketch of a plane electromagnetic wave propagating along x axis. Depict clearly the direction of electric and magnetic field varying sinusoid ally.
10. Calculate current drawn by the primary of a transformer which steps down 200V to 20V to operate a device of resistance 20Ω. Assume the efficiency of transformer to be 80%.
11. What do you mean by a capacitor? Derive an expression for the capacitance of a parallel plate capacitor.

12. What do you mean by superconductors? Give three applications of superconductors.
13. State and explain Biot Savart's law. Give its features also.
14. Explain the Rayleigh's law of scattering. Why the colour of sky appears to be blue?
15. (a) What is the principle of electron microscope?
    (b) A photon and electron have got same de Broglie wavelength (10^{-10} m), which has greater kinetic energy? Explain.
16. Give reasons for the following:
    (a) Lighter elements are better moderators for a nuclear reactor than heavier elements.
    (b) In a natural uranium reactor, heavy water is a preferred moderator to ordinary water.
    (c) Cadmium rods are provided in a reactor.
17. Why is the mass of a nucleus always less than the sum of the masses of its constituents, neutrons and protons?
18. Define coefficient of mutual inductance of two cells. A secondary coil of n_2 turns is wound on a long solenoid of area of cross section A having a primary coil of n_1 turns per unit length. What is the mutual inductance of the two cells?
19. (a) What is transmission medium?
    (b) Explain the term short wave band and medium wave band.
    (c) What is a transducer?
20. Three point charges of +2μc and -3μc are kept at the vertices A,B and C respectively of an equilateral triangle of side 20cm. what should be the sign and magnitude of the charge to be placed at the mid-point M of side BC. So that charges at remains in equilibrium.
21. (a) What do you understand by the term 'magnetic length' and 'geometric length' of the magnet?
    (b) How are the two related to each other?
    (c) Define angle of a dip at a given place.
22. The oscillating magnetic field in a plane electromagnetic wave is given by $B_\gamma = 8\text{x}10^{-6}\sin(20\text{x}10^{11}t + 300\pi x)T$. Calculate the wavelength of electromagnetic wave. Write down the expression for oscillating electric field.
23. In the birthday party of Vishal, he gave big slinkies as a return gifts to all of his friends. In the next day, in the class of Physics, the teacher explained the concept of production of magnetic fields using current carrying coils and also said that they can make permanent magnets, using such coils by passing high currents through them. Ram, the friend of Vishal asked his father about the coils, and their shape. His father asked him to bring the slinky that his friend gave and expalined the uses of toroid and solenoid.
    (i) What values did Ram's father exhibit towards his son?
    (ii) What is the difference in the fields produced by the solenoid and toroid?
24. Coulomb's law for electrostatic force between two point charges and Newton's law for gravitational force between two stationary point masses, both have inverse-square dependence on the distance between the charges/masses.
    (i) Compare the strength of these forces by determining the ratio of their magnitudes (a) for an electron and a proton and (b) for two protons.
    (ii) Estimate the accelerations of electron and proton due to the electrical force of their mutual attraction when they are 1 Å (= 10^{-10} m) apart? (m_p= 1.67 × 10^{-27} kg, m_e= 9.11 × 10^{-31} kg)

Or

A straight thick long wire of uniform cross section of radius 'a' is carrying a steady current I.

(a) Use Ampere's circuital law to obtain a relation showing the variation of the magnetic field (Br) inside and outside the wire with distance r, (r ≤ a) and (r > a) of the field point from the centre of its cross section.
(b) Plot a graph showing the nature of this variation.
(c) Calculate the ratio of magnetic field at a point a/2 above the surface of the wire to that at a point a/2 below its surface.
(d) What is the maximum value of the field of this wire?

25. (a) What are features of Rutherford's atom model?

(b) The wavelength of K_α line for copper is 1.36 $\overset{0}{A}$. Calculate the ionization potential of a K shell electron in copper.

26. (a) Explain the distinction between conductors, semiconductor and insulators on the basis of their energy bands.

(b) The number densities of electrons and holes in pure silicon at 27°C are equal and its value is 2.0×10^{-16} m^{-3}. On doping with indium, the hole density increases to 4.5×10^{22} m^{-3}, find the electron density in dopped silicon.