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. State Kirchhoff's loop rule.
2. A charge 'q' is placed at the centre of the spherical cell of radius 'r'. Another charge 'Q' is placed at a distance 'R' (r < R) from the centre of the spherical shell. The force acting on 'Q' due to 'q' is 'F'. What is the force acting on 'q' due to 'Q'? Explain.
3. If the frequency of surface wave increases how does the height of the antenna and maximum range of coverage changes?
4. The carrier wave is given by $C_{(r)} = 3\sin(8\pi t)$ volt and modulating wave $m_{(r)} = 2\sin(2\pi t)$ volt. What is the amplitude of modulated wave for upper or lower side band frequency?
5. Name the EMW which is used in eye surgery. Why?
6. State Gauss law in electrostatic. Using it obtain an expression for electric field outside the charged spherical shell. Show that charge is connected at the centre of the charged shell.
7. A 100 W sodium lamp radiates energy uniformly in all directions. The lamp is located at the centre of a large sphere that absorbs all the sodium light which is incident on it. The wavelength of the sodium light is 589 nm

a) What is the energy per photon associated with the sodium light?

b) At what rate are the photons deliver to the sphere?

8. State the working principle of the potentiometer. Draw a circuit diagram to compare the emf's of two primary cells using potentiometer. Give an expression for to compare emf's of two primary cells in terms of balancing lengths.

Or

Two polaroid's 'A' and 'B' is placed such that no light is transmitted from 'B' when unpolarised light incident on 'A'. A third polaroid 'C' is placed between 'A' and 'B' such that it makes an angle θ with A. Obtain an expression for intensity of light transmitted from 'B' in terms of I_0. For which value of θ, the maximum intensity of light is transmitted from 'B'?

9. The sum of two points charges is $7\mu c$. They repel each other with a force of 1 N when kept 30 cm apart in free space. Calculate the value of each charge.

10. State the principle of the transformer. How is large scale transmission of electric energy over long distance done with the use of transformers?

11. Obtain the expression for path difference of light waves reaching at a point on the screen in Young's Double slit experiment and hence derive an expression for its bandwidth?

Or

12. A lens made up of material of refractive index 1.5 has focal length 20 cm. how will the focal length of the lens change when

    a) The thickness of the lens increased

    b) The wavelength of incident light is decreased. Justify your answer

    c) Calculate the focal length of the lens when it is dipped in water of n=4/3

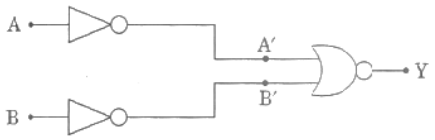
13. What do you mean by resonance of LCR series circuit connected to AC? State any two important characteristics of the series resonance circuit. Draw instantaneous voltage and current vs. time at resonance. Plot a graph to show the variation of current amplitude (I_0) with angular frequency (ω) for LCR series circuit for two resistors R_1 andR_2 ($R_1 > R_2$).

14. A short bar magnet has a magnetic moment of 048J/T.

    a) Give the direction and magnitude of the magnetic field produced by the magnet at a distance of 10 cm from the centre of the magnet on the equatorial line of the magnet.

    b) If this magnet lies aligned with the direction of a uniform magnetic field of 0.22T. What is the amount of work required by an external torque to turn the magnet so as to align its magnetic moment normal to the field direction of field? Calculate the torque experienced by magnetic dipole in the case.

15. State Bohr's postulate in atoms. Using it obtain an expression for radius of the nth orbit, total energy of the electron in the nth orbit of hydrogen atom and wave number of the light emitted.
16. A current carrying rectangular coil is placed in external magnetic field such that normal to the plane makes an angle θ with the magnetic field. Obtain an expression for net force and torque experiment by the coil with neat diagram.
17. Mention three different modes of propagation used in communication system. Explain with the help of a diagram how long distance communication can be achieved by ionospheric reflection of radio waves.
18. The number of nuclei of a given radioactive nucleus at times t = 0 and t = T are N_0, and (N_0/n) respectively. Obtain an expression for the half-life $(T_{1/2})$ of this nucleus in terms of n and T.
19. Describe with the help of the below diagram the role of the two important processes involved in the formation of p-n junction.



20. Give the equation of amplitude modulated wave if the modulating voltage is 20 V, the modulation index is 0.1, the carrier and the modulating frequencies are 17 MHz and 3.5 KHz respectively.
21. A horizontal telephone wire 10^3m long is lying along east in earth's magnetic field. It falls freely to the ground from a height of 20 m. Calculate the emf induced in the wire when the wire strikes the ground assuming that the horizontal component of earth's magnetic field has flux density 0.34×10^{-4}T.
22. When an electron and a proton moving along the same direction with same kinetic energy pass through a uniform magnetic field perpendicular to the direction of their motion, they describe paths of the same radius. Is this statement true or false?
23. Nisha joined a PG course in Nanotechnology lab in IIT Chennai. The first day, when she went to the lab, she met the lab assistant. The lab assistant greeted her and advised her not to touch the wires which were suspended from the roof at every part of the lab as they were from high voltage lines. The lab assistant also told her not to bring any of the two wires closer to each other during any experimental applications and explained her about the precautions that have to be taken in the lab.
    a) Mention any two values of the lab assistant towards Nisha?
    b) Why two high voltage power transmission lines should not be close to each other?
    c) Give an expression for the magnetic force that acts between the wires?

24. Draw a circuit diagram to determine the characteristic of npn transistor in common emitter configuration. Explain how you will determine input and output characteristics of the transistor with suitable graph and also current gain from output characteristics graph. Why is not necessary to repeat the experiment for different value of V_{CE} for input characteristics?

Or

a) Explain the working of zener diode as a voltage stabilizer with circuit diagram.

b) A p-n photodiode is fabricated from a semiconductor with band gap of 2.8 eV. Can it detect a wavelength of 6000 nm? Justify your answer with proper calculation.

25. a) Draw neat diagram to show the formation of final image in astronomical refracting type of telescope. Obtain an expression for its magnifying power.

b) An object of size 3.0 cm is placed 14 cm in front of a concave lens of focal length 21 cm. describe the image produced by the lens. Describe the nature of the image if the object is moved from optical centre to far off distance?

Or

a) A point object is placed in front of convex spherical refracting surface on the principal axis. Obtain an expression relating object distance, image distance, radius of curvature and refractive indices when the ray is travelling from denser to rarer medium.

b) An object is placed at 10 cm in front of a mirror radius of curvature 15 cm which forms real image. Find the position and magnification of the image.

26. a) State Ampere's circuital law. Obtain an expression for magnetic field at a point will inside the current carrying solenoid with neat diagram.

b) A galvanometer coil has a resistance of 12 Ω and the metre shows fill scale deflection for a current of 3mA. How will you convert the metre into a voltmeter of range 0 to 18 V? How much resistance is to be connected in series with 18 V voltmeter to convert into 24V voltmeter? Justify your answer.

Or

a) State the principle of a step up transformer. Explain with the help of labelled diagram its working.

b) Explain in brief any two energy losses with reason for their occurrence in actual transformers.