

Total number of printed pages : 5

NB/XII/PHY/1

2023
PHYSICS

Total marks : 70

Time : 3 hours

General instructions:

i) Approximately 15 minutes is allotted to read the question paper and revise the answers.

ii) The question paper consists of 30 questions. All questions are compulsory.

iii) Marks are indicated against each question.

iv) Internal choice has been provided in some questions.

N.B: Check that all pages of the question paper is complete as indicated on the top left side.

1. Which of the following relation does not hold at resonance in LCR series circuit? 1

(a) $\omega = \frac{1}{LC}$	(b) $\omega = \frac{1}{\sqrt{LC}}$
(c) $\omega L = \frac{1}{C\omega}$	(d) $C\omega = \frac{1}{L\omega}$

2. If the refractive index for a medium is 1.5, then velocity of light in this medium will be (in m/s) 1

(a) 10×10^8	(b) 2×10^8
(c) 3×10^8	(d) 4×10^8

3. Photons of energy of 6eV are incident on a metal surface whose work function is 4eV. The minimum kinetic energy of the emitted photoelectrons will be 1

(a) 0eV	(b) 1eV	(c) 2eV	(d) 10eV.
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4. An atom bomb works on the principle of 1

(a) nuclear fusion	(b) nuclear fission
(c) α -decay	(d) β -decay.

5. When a semiconductor is heated, 1

(a) number of electrons increases while that of holes decreases
(b) number of holes increases while that of electrons decreases
(c) number of electrons and holes remains same
(d) number of electrons and holes increases equally.

6. A wire cuts across a flux of 0.2×10^{-2} weber in 0.12 second. What is the emf induced in the wire? 1

7. a. Arrange the following radiations in ascending order with respect to their frequencies:
X-rays, microwaves, UV rays and radiowaves.
Or 1
- b. How are electromagnetic waves produced?
8. Define impact parameter. 1
9. Why does PN junction not conduct in reverse bias? 1
10. a. What is the function of a repeater used in communication system?
Or 1
- b. How does the effective power radiated from a linear antenna depend on the wavelength of the signal to be transmitted?
11. a. Two charges $3 \times 10^{-8}\text{C}$ and $-2 \times 10^{-8}\text{C}$ are located 15cm apart. At what point on the line joining the two charges is the electric potential zero? Take the potential at infinity to be zero.
Or 2
- b. Three capacitors of capacitance 2pF, 3pF and 4pF are connected parallel.
- i) What is the total capacitance of the combination?
ii) Determine the charge on each capacitor if the combination is connected to a 100V supply.
12. a. A current of 5 ampere's flows steadily through a metal wire of cross-sectional area $4 \times 10^{-6}\text{m}^2$. If the number density of conduction electrons in the wire be $4.8 \times 10^{28}\text{m}^{-3}$, find
i) current density and
ii) drift speed of electrons.
Or 2
- b. A battery of emf 10V and internal resistance 3Ω is connected to a resistor. If the current in the circuit is 0.5A, what is resistance of the resistor? What is the terminal voltage of the battery when the circuit is closed?
13. a. Write the expression for the force on a charge of moving with velocity \vec{v} in a magnetic field \vec{B} . Under what circumstances the force shall be zero?
Or 2
- b. What is the nature of magnetic field produced by a current flowing in a straight conductor? Name the rule to find the direction of magnetic field.
14. a. Find the magnetic potential energy stored in an inductor carrying current I.
Or 2

- b.** Prove mathematically that current in a capacitor leads the voltage by a phase angle of $\frac{\pi}{2}$ when an alternating voltage is applied on it.
15. **a.** Show that the speed of propagation of electromagnetic waves in free space is $C = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$ where the symbols have their usual meanings.
- Or** **2**
- b.** Give four properties of electromagnetic waves.
16. **a.** Calculate the binding energy of an alpha-particle. Given
Mass of proton = 1.0073 amu
Mass of neutron = 1.0087 amu
Mass of α -particle = 4.0015 amu.
- Or** **2**
- b.** Express 1 joule in eV. Taking 1amu = 931 MeV, calculate the mass of C-12 atom.
17. **a.** Find the magnitude of electric field on the equatorial plane of an electric dipole.
- Or** **3**
- b.** Establish the relation between electric field and potential. If electric potential within a certain region is constant, what will be the nature of electric field inside the region?
18. **a.** How does the resistivity of a conductor vary with temperature?
- Or** **3**
- b.** Draw a circuit showing a wheatstone bridge. Using Kirchoff's rules, obtain the balanced condition of wheatstone bridge.
19. **a.** Two long and parallel straight wires A and B carrying currents of 8.0A and 5.0A in the same direction are separated by a distance of 4.0cm. Estimate the force on a 10cm section of wire A.
- Or** **3**
- b.** A circular coil of 30 turns and radius of 8.0cm carrying a current of 6.0A is suspended vertically in a uniform horizontal magnetic of magnitude 1.0T. Find the magnitude of torque:
i) when the coil makes an angle of 30° with the direction of field.
ii) When the coil is parallel with the field.
Would the torque change if the circular coil is replaced by a planar coil that encloses the same area?
20. **a.** Using Biot-Savart's law, find the magnitude of magnetic field on the axis of a circular current carrying coil.
- Or** **3**

- b. Explain the working principle of moving coil galvanometer with a labelled diagram.
21. a. Define electromagnetic induction. Discuss two methods for producing induced emf.
Or **3**
- b. Obtain the expression of mutual inductance for two long co-axial solenoid.
22. a. Obtain the relation between RMS value and peak value of an AC.
Or **3**
- b. Find the average power of AC over one complete cycle in an LCR series circuit.
23. a. A convex lens of focal length 20cm in air is made of material of refractive index 1.6. The lens is now immersed in a liquid whose refractive index is 1.3. Determine the new focal length and nature of the lens inside the liquid.
Or **3**
- b. A compound microscope consists of an objective lens of focal length 2.0cm and an eyepiece of focal length 6.25cm separated by a distance of 15cm. How far from the objective should an object be placed in order to obtain the final image at-
- i) the least distance of distinct vision
ii) at infinity.
24. a. What is total internal reflection? Give the relation between refractive index and critical angle. Write one application of total internal reflection.
Or **3**
- b. Using Huygen's wave theory, prove that for refraction of light, the ratio of sine of angle of incidence to sine of angle of refraction is constant.
25. a. What is photoelectric emission? State the laws of photoelectric effect.
Or **3**
- b. Obtain the de-Broglie relation for material particles. What is the rest mass of a photon?
26. a. Write the conclusion drawn from alpha particle scattering experiment. Define distance of closest approach.
Or **3**
- b. On the basis of Bohr's theory, explain the energy levels of hydrogen atom with a diagram.

27. a. Draw the block diagram of a generalized communication system. Mention two basic modes of communication. **Or** **3**
- b. What is ground wave? Why is short wave communication over long distances not possible via ground waves?
28. a. State and prove Gauss law. Using this law, obtain the magnitude of electric field inside and outside of a charged spherical shell. **Or** **5**
- b. Draw a labelled diagram of Van de Graff generator. Explain its working principle to show how by introducing a small charged sphere into a larger sphere, a large amount of charge can be transferred to the outer sphere.
29. a. Prove the relation $A + \delta = i + e$ for a prism. What does relation become, when prism is placed in minimum deviation? **Or** **5**
- b. Explain Young's double slit experiment. What is the effect on the interference fringe, when monochromatic source is replaced by a source of white light? Write two conditions to obtain sustained interference.
30. a. What is a rectifier? Explain with circuit diagram the working of a full wave rectifier. Also show its input-output wave formation. **Or** **5**
- b. Draw a circuit diagram for n-p-n transistor in common emitter configuration. Draw the input and output characteristics and explain them.
