

**2025
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 34 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. If both the charges and distance between them is doubled, then the new electrostatic force will be 1
(a) F (b) $2F$ (c) $3F$ (d) $4F$
2. The maximum current that can be drawn from a cell is when 1
(a) $R = 0$ (b) $r = 0$ (c) $R > r$ (d) $r > R$
3. A bar magnet of magnetic moment M is cut into two parts of equal lengths. The magnetic moment and pole strength of either part is 1
(a) $\frac{M}{2}, \frac{m}{2}$ (b) $M, \frac{m}{2}$
(c) $\frac{M}{2}, m$ (d) M, m
4. A magnetic field of flux density 1.0 Wbm^{-2} acts normal to a 80 turn coil of 0.01 m^2 area. If this coil is removed from the field in 0.1s. The emf induced is 1
(a) 6V (b) 7V (c) 8V (d) 9V.
5. Which of the following rays is not an electromagnetic wave? 1
(a) Gamma rays (b) X-rays
(c) Microwaves (d) Beta rays.
6. If the critical angle for total internal reflection from a medium to vacuum is 30° , then velocity of light in medium is (velocity of light = $3 \times 10^8 \text{ ms}^{-1}$). 1
(a) $1.5 \times 10^8 \text{ ms}^{-1}$ (b) $0.75 \times 10^8 \text{ ms}^{-1}$
(c) $3 \times 10^8 \text{ ms}^{-1}$ (d) $2 \times 10^8 \text{ ms}^{-1}$.

7. When a photon is accelerated (from rest) through a potential difference of one volt, the kinetic energy gained by it is equal to 1
(a) 1837eV (b) 1 eV
(c) $\frac{1}{1837}$ eV (d) none of the above.
8. Rutherford's model of the atom was unstable, because 1
(a) nuclei will break down
(b) electrons move in circular orbits
(c) orbiting electrons radiate energy
(d) electrons are repelled by nucleus.
9. A transistor has an current gain of 0.95. If the change in emitter current is 100 mA, then the change in the collector current is 1
(a) 95 mA (b) 99.05 mA
(c) 100.95 mA (d) 100 mA.
10. In a communication system, noise is most likely to affect the signal in the 1
(a) transmission medium (b) transmitter
(c) information source (d) destination.
11. The test charge used to measure electric field at a point should be vanishingly small. Why? 1
12. A current of 5.0 A flows through a press of resistance 11Ω. Calculate the energy consumed by the press in 5 minutes. 1
13. Name two useful devices based on the phenomenon of mutual induction. 1
14. Define impact parameter. 1
15. What type of feedback is required in an oscillator. Why? 1
16. Define sky wave propagation. 1
17. A long wire carries a steady current. It is bent into a circle of one turn and the magnetic field at the centre of the coil is B. It is then bent into a circular loop of 'n' turns. Find the new magnetic field at the centre of the coil. 2
18. Deduce an expression to show that an atom behaves as a magnetic dipole. 2
19. a. Show that the displacement current produced is equal to the conduction current, when a capacitor is discharged. 2
- Or**
- b. State the principle of production of electromagnetic waves. What is the value of velocity of these waves?

20. a. The radius of oxygen nuclei (${}_8\text{O}^{16}$) is 2.8×10^{-15} m. Calculate the radius of the lead nucleus (${}_{82}\text{Pb}^{205}$). 2
- Or**
- b. Find out the binding energy per nucleon of an α -particle in MeV. The masses of α -particle, proton and neutron are 4.00150 u, 1.00728 u and 1.00867 u respectively.

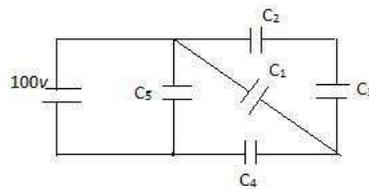
21. How does the potential barrier change, when a p-n junction is reverse biased? Can the potential barrier be measured by putting a sensitive voltmeter across its terminal? 2

22. Which is the basic mode of communication used in satellite communication? Write the expression for the maximum line of sight with distance 'd' between two antennae having heights h_1 and h_2 . 2

23. a. Two point charges $q_1 = 3 \mu\text{C}$ and $q_2 = -3 \mu\text{C}$ are located 20cm apart in vacuum.
- i) What is the electric field at the mid-point of the line joining the two charges?
- ii) If a test charge of magnitude $1.5 \times 10^{-9}\text{C}$ is placed at this point, what is the force experienced by this charge?

Or 3

- b. Find the equivalent capacitance of the capacitors in the network shown below. Also, calculate the total charge in the network when a 100V battery is connected across the combination. Given that $C_1 = C_5 = 1 \mu\text{F}$, $C_2 = C_3 = C_4 = 2 \mu\text{F}$.



24. a. Find the expression of resistivity of a conductor in terms of relaxation time. What is the effect of temperature on the resistivity? 3
- Or**
- b. Using Kirchoff's rules, deduce the balanced condition of a Wheatstone bridge. Name a practical device where Wheatstone bridge principle is applied.

25. a. Using Ampere circuital law, find the magnitude of magnetic field along the axis of a current carrying solenoid. What kind of magnetic field is produced due to a straight solenoid?

Or

3

- b. A rectangular coil of N turns having area A is placed in a uniform magnetic field B. The coil makes an angle θ with respect to the direction of the field. When current I is passed to the coil, a torque acts on it. Find the magnitude of torque acting on the coil.

26. Find the induced emf developed in a conductor of length 'l' moving with velocity V in transverse magnetic field of strength B. What factors governs the direction of emf?

3

27. A double convex lens has 10 cm and 15 cm as its two radii of curvature. The image of an object, placed 30 cm from the lens, is formed at 20 cm from the lens on the other side. Find the refractive index of the material of the lens. What will be the focal length? What will be the focal length of the lens if it is immersed in water of refractive index 1.33?

3

28. State two essential conditions, which must be satisfied for two light sources to be coherent. Two light waves of amplitudes a_1 and a_2 interfere with each other. Show that $\frac{I_{\max}}{I_{\min}} = \left(\frac{a_1 + a_2}{a_1 - a_2}\right)^2$.

3

29. Discuss de-Broglie concept of matter waves with the help of relevant expressions.

3

30. Explain the energy level diagram of a hydrogen atom.

3

31. With a circuit diagram, explain how a junction diode can act as a full-wave rectifier.

3

32. a. Derive an expression for the electric field at a point on a perpendicular bisector of an electric dipole moment. If E_a and E_b are the electric field on the axial line and perpendicular bisector of dipole, then show $E_a = 2E_b$. Also, what is the direction of electric dipole moment vector of an electric dipole?

Or

5

- b. State and prove Gauss theorem. Two infinite parallel planes have uniform charge densities $\pm \sigma$. What is the electric field -
i) in the region between the planes and
ii) outside the plates?

33. a. Define alternating current and root mean square value of alternating current. Prove that $I_{\text{rms}} = \frac{I_o}{\sqrt{2}}$, where I_o is peak value of current.

Or

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b. Establish an expression for the average power in a LCR series circuit. Prove mathematically that the average power over a complete cycle of alternating current through an ideal inductor is zero. What is the value of power factor at resonance?

34. Discuss the phenomenon of refraction through a prism and show that $A + D = i + e$, where the symbols have their usual meaning. Also, find the refractive index of the material of prism at minimum deviation position.

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