2025

PHYSICS
(Theory)

Full Marks: 70

Pass Marks: 21

Time : Three hours

Attempt all Questions.

The figures in the right margin indicate full marks for the questions.

Question Nos. 1 to 7 are 'Multiple Choice Type' questions carrying 1 mark each. Choose the correct answer out of the four alternatives and rewrite the correct answer.

1. In the middle of the depletion layer of a reverse biased P-N junction, the

   (A) electric field is zero

   (B) electric potential is zero

   (C) electric field is maximum

   (D) electric potential is maximum 1

2. A semi-circular arc of radius 'a' is charged uniformly and the charge per unit length is λ. The electric field at its centre is

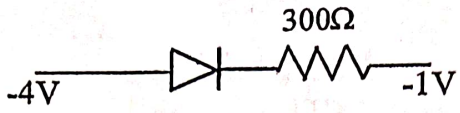
   (A) $\frac{\lambda}{2\pi \in_o a^2}$

   (B) $\frac{\lambda}{4 \in_o a}$

   (C) $\frac{\lambda^2}{2\pi \in_o a}$

   (D) $\frac{\lambda}{2\pi \in_o a}$ 1

3. What is the current in the circuit shown in the following figure?



(A) 10^{-2}A

(B) 10^{-1}A

(C) 1A

(D) Zero 1

4. Two coherent monochromatic light beams of intensities I and 4I are superposed. What will be in maximum possible intensities ?

(A) 4I

(B) I

(C) 9I

(D) 5I 1

5. The resolving power of a telescope when light of wavelength 540nm used when the diameter of objective lens having 6cm is

(A) 6.1×10^4

(B) 9.1×10^4

(C) 3×10^4

(D) 2×10^2 1

6. Two slits in Young's experiment have with in the ratio 1:25. The ratio of intensity at the maxima and minima in the interference pattern I_{max}/I_{max} is

(A) $\frac{4}{9}$

(B) $\frac{2}{4}$

(C) $\frac{121}{49}$

(D) $\frac{49}{121}$ 1

7. The photoelectric effect can be explained on the basis of

(A) corpuscular theory

(B) wave theory

(C) electromagnetic theory

(D) quantum theory 1

Question Nos. 8 to 17 are "Very Short Answer" type questions carrying 1 mark each.

8. State Lenz's law. 1

9. Name the series of hydrogen spectrum, which has least wavelength. 1

10. What is the de-Broglie wavelength associated with an electron accelerated through a potential difference of 100 Volt? 1

11. In Bohr's theory of hydrogen atom, what is the implication of the fact that the potential energy is negative and is greater than in magnitude than the kinetic energy? 1

12. Nuclear forces are short range forces. Comment. 1

13. Why diamond behaves like an insulator? Give reason. 1

14. Out of electron and hole, which one has higher mobility and why. Justify your answer. 1

15. Draw a labelled circuit diagram of forward biasing of P-N junction. 1

16. In deriving the single slit diffraction pattern, it was stated that the intensity is zero at angles $\frac{n\lambda}{a}$. Justify this by suitably dividing slit to bring out the cancellation. 1

17. Calculate the critical angle for total internal reflection of light from water into air. Given ${}^{a}\mu_{w} = 1.33$, $\sin^{-1}(0.7518) = 48^{0}44'$. 1

Question Nos. 18 to 27 are 'Short Answer Type-II' questions carrying 2 marks each.

18. Draw the labelled ray diagram of the image formed by a compound microscope for a small object placed beyond the focus of objective. 2

19. An air bubble in a jar of water shines brightly. Give reason. 2

20. Give any two points of difference between a half wave rectifier and a full wave rectifier. 2

21. The number of α-particles scattered at 60° is 110 per minute in an alpha particle scattering experiment. Calculate the number of alpha particles scattered per minute at 90°. 2

22. What are the conclusions obtained from Rutherford's α - particle scattering experiment? 2

23. A wire in the form of a tightly wound solenoid is connected to DC source and carries a current. If the coil is stretched so that there are gaps between successive elements of the spiral coil will the current increase or decrease. Justify your answer. 2

24. A silver wire has a resistance of 2.1 Ω at 27.5°C and a resistance of 2.7 Ω at 100°C. Determine the temperature co-efficient of resistivity of silver. 2

25. Two bulbs of same wattage, one having a carbon filament and the other having a metallic filament are connected in series to the mains. Which one will glow more? Give reason. 2

26. A galvanometer with a coil of resistance 12Ω shows a full scale deflection for a current of 25mA. How will you convert it into a voltmeter of range 7.5V? 2

27. What will happen to a solenoid when a current passes through it ? 2

Question Nos. 28 to 33 are 'Short Answer Type-I' questions carrying 3 marks each.

28. Define e.m.f of a cell.

State the rules for the series combination of cells. 1+1+1=3

Or

State Kirchhoff's first and 2nd laws of electrical circuits. What is the sign convention of the first law? 1+1+1=3

29. Derive Einstein's photoelectric equation. 3

Or

Derive the de-Broglie wavelength for material particle. 3

30. What happens to focal length of a concave lens when it immersed in water?3

Or

The radii of curvature of both the surfaces of a lens are equal. How will its focal length and power change if one of the surfaces of the lens made plane?3

31. Establish the mirror formula of a concave mirror. 3

Or

A concave mirror of focal length 10cm is placed at a distance of 35cm from a wall. How far from the wall should an object be placed to form a real image on the wall? Also, find the magnification of the image. 3

32. Identify and name the part of e.m. wave with one use of each of the following waves with wavelength

I) λ_1 is used in satellite communication.

II) λ_2 is used to kill germs in water purifier.

III) λ_3 is used to detect leakage of oil in underground pipelines. 1+1+1=3

33. Write any three properties of equipotential surfaces. 3

Or

Give any three properties of electric lines of force. 3

Question Nos. ***34*** to 36 *are 'Long Answer Type' questions carrying 5 marks each.*

34. Define reactance.

With the help of phasor diagram, derive the expression of alternating e.m.f in the LCR series circuit. 1+4=5

Or

What is root mean square value of current? Prove that the root mean square value of current is 0.707 times the maximum current. 1+4=5

35. Define intensity of electric field at a point.

Derive the expression of electric field intensity at a point on the equatorial line of an electric dipole. 1+4=5

Or

Define electrie potential energy.

Derive the expression of electric potential energy of a system of two point charges. 1+4=5

36. State Biot-Savart's law.

Derive the expression of magnetic field at the centre of the circular coil carrying current. 2+3=5

Or

Define magnetic field and torque.

Derive the expression of torque acting on a dipole magnet in a uniform magnetic field. 2+3=5