

2023

PHYSICS

(Theory)

Full Marks : 70

Pass Marks : 21

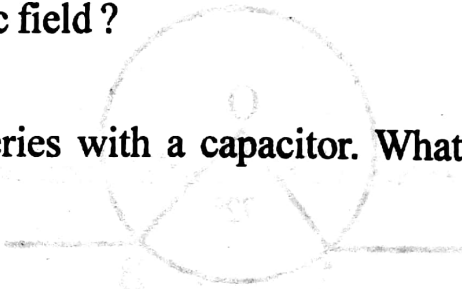
Time : Three hours

All questions are compulsory.

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

Question Nos. 1 to 10 are "Very Short Answer" type questions carrying 1 mark each.

1. Name the S.I. unit of absolute permittivity of free space. 1
2. A charge (q) moves with velocity $\vec{v} = a\vec{k}$ in a magnetic field, $\vec{B} = b\vec{i} + c\vec{j}$. Find the magnetic force on the charge. 1
3. How does the intensity of magnetization of a paramagnetic material vary with increasing applied magnetic field? 1
4. A lamp is connected in series with a capacitor. What will happen if d.c. is connected to the lamp? 1

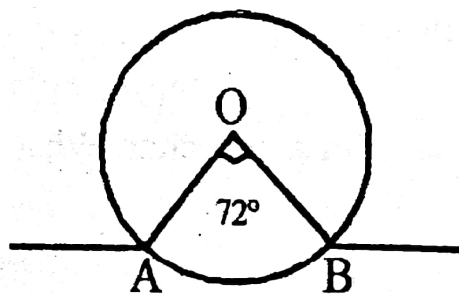


P.T.O.

5. Is the steady electric current the only source of magnetic field ? Justify your answer. 1
6. The work function of caesium is 2.14eV. Find the threshold frequency for caesium. 1
7. The de-Broglie wavelength associated with an electron accelerated through a potential difference V is λ . What will happen to its wavelength when the accelerating potential is increased to $4V$? 1
8. The monochromatic light of frequency 6×10^{14} Hz is produced by a laser. What is the energy of the photon to the light beam ? (Given $h = 6.63 \times 10^{-34}$ Js) 1
9. Why are heavy nuclei usually unstable ? 1
10. Draw a circuit diagram of forward biasing of zener diode. 1

Question Nos. 11 to 20 are 'Short Answer Type-II' questions carrying 2 marks each.

11. Define electromotive force. Give its unit in S.I. 2
12. A resistor of resistance 10Ω is bent in the form of a circle as shown in the figure. What is the effective resistance between A and B ? 2



13. Define 'Bohr magneton'. Write the expression it. 2
14. An alternating current from a source is represented by $I = 10 \sin 314t$. What are the effective value of current and frequency? 2
15. A wire in the form of a tightly wound solenoid is connected to a 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 increases or decreases? Give reason. 2
16. What is electromagnetic wave? Write the formula for the velocity of e.m. waves in space. 2
17. When a wave undergoes reflection and refraction at a denser medium, what happens to its phases? 2
18. Two coherent monochromatic light waves of intensities I and $4I$ are superposed. What will be the intensities when the phase angle is (i) 0° and (ii) 180° ? Justify your answer. 2
19. Draw a graph representing the dependence of binding energy per nucleon on the mass number. 2
20. Distinguish between intrinsic and extrinsic semiconductors (Give any two points). 2

Question Nos. 21 to 27 are 'Short Answer Type-I' questions

carrying 3 marks each.

21. A spherical shell of radius 'b' with charges Q is expanded to radius 'a'. Find the work done by the electrical forces in the process. 3
22. Define (i) drift velocity (ii) mobility. Write the expression of mobility. 1+1+1=3
23. Consider a metallic pipe with inner radius of 1 cm. If a cylindrical bar magnet of radius of 0.8 cm is dropped through the pipe, it takes more time to come down than it takes for a similar unmagnetized cylindrical iron bar dropped through the metallic pipe. Justify your answer. 3
24. Find the expression of resultant amplitude of superposition of two coherent sources of light represented by $y_1 = a \sin \omega t$ and $y_2 = b \sin (\omega t + \phi)$. 3
25. What is resolving power of a telescope? Assume that light of wavelength 6000 \AA is coming from a star. What is the limit of resolution of a telescope whose objective has a diameter of 100 inch? 3
26. Obtain the expression $N = N_0 e^{-\lambda t}$ for the law of radioactive decay. (Symbols have their usual meanings). 3
27. Write down three differences between P-type and N- type semiconductors. 3

Question Nos. 28 to 30 are 'Long Answer Type' questions
carrying 5 marks each.

28. Define electric field intensity. Derive the expression of electric field at a point in the axial line of an electric dipole. 1+4=5

OR

Define capacitance. Find the capacitance of a parallel plate capacitors when a thin dielectric slab is inserted in between the plates. 1+4=5

29. State Biot-Savart's law. Find the magnetic field at the centre of a circular coil carrying current. 1+4=5

OR

State Ampere's circuital law. Find the magnetic field due to an infinite long straight wire carrying current. 1+4=5

30. Define angle of deviation. Establish the formula, $\mu = \frac{\sin \frac{A + Dm}{2}}{\sin \frac{A}{2}}$

(Symbols have their usual meanings)

2+3=5

OR

What is refractive index of a medium ? Obtain the expression of lens maker's

formula, $\frac{1}{f} = (\mu - 1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$.

1+4=5

Question Nos. 31 to 34 are 'Multiple Choice Type' questions carrying 1 mark each. Choose the correct answer out of the four alternatives and rewrite the correct answer.

31. The de-Broglie wavelength (λ) for material particle is given by – 1

(A) $\frac{h\nu}{m}$

(B) $\frac{h}{m\nu}$

(C) $\frac{m\nu}{h}$

(D) $\frac{mh}{\nu}$

32. The resistance of an intrinsic semiconductor when heated – 1

(A) increases

(B) remains constant

(C) decreases

(D) decreases exponentially

33. The slope of frequency of incident light and stopping potential for a given surface will be – 1

(A) h

(B) $\frac{h}{e}$

(C) eh

(D) e

34. Lyman series lies in the ultraviolet region of the hydrogen spectrum. It is represented by –

1

(A) $\frac{1}{\lambda} = R \left(\frac{1}{1^2} - \frac{1}{n^2} \right)$

(B) $\lambda = R^{-1} \left(\frac{1}{1} - \frac{1}{n^2} \right)$

(C) $\frac{1}{\lambda} = R \left(\frac{1}{n^2} - \frac{1}{1^2} \right)$

(D) $\frac{1}{\lambda} = (1^2 - n^2)$

Where $n = 2, 3, 4 \dots\dots$ so on.