



K25U 2358

Reg. No. :

Name :

V Semester B.Sc. Degree (CBCSS – OBE – Regular/Supplementary/
Improvement) Examination, November 2025
(2019 to 2023 Admissions)
CORE COURSE IN PHYSICS
5B06 PHY : Quantum Mechanics

Time : 3 Hours

Max. Marks : 40

PART – A

Short answer questions. Answer **all** questions. **Each** question carries 1 mark.

1. State and explain Pauli's exclusion principle.
2. Write down the time-independent Schrödinger equation in one dimension.
3. State the de Broglie equation and its significance.
4. What is the significance of the Frank-Hertz experiment ?
5. What is meant by spin-orbit coupling ?
6. Write the expression for the energy of an electron of the Hydrogen atom in the ground state. (6×1=6)

PART – B

Short essay questions. Answer **any 6** questions. **Each** question carries 2 marks.

7. Write down the characteristics of a well-behaved wave function.
8. Comment on the features of the photoelectric effect.

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9. State Hund's rule of maximum multiplicity.
10. Discuss the successes and failures of Bohr's atomic model.
11. Distinguish between phase velocity and group velocity of a wave packet.
12. What is the significance of normalizing a wave function ?
13. State and explain the time-independent one dimensional Schrödinger equation. Can it be derived from any previous laws or postulates ?
14. State and explain the correspondence principle. (6×2=12)

PART – C

Problems. Answer **any four** questions. **Each** question carries 3 marks.

15. Calculate the work function of sodium, in electron-volts, given that the threshold wavelength is 6800 Å, and $h = 6.625 \times 10^{-34}$ Js.
16. The beans on the surface of water travel with their phase velocity $V_p = \sqrt{g\lambda}/2\pi$ where g is the acceleration due to gravity and λ is the wavelength of the waves. Show that the group velocity of a wave packet comprised of these waves is $V_g/2$.
17. State the equation for the energy of the n^{th} state of the electron in the hydrogen atom and express it in eV. And then estimate how much energy is required to remove an electron from the $n = 8$ state of a hydrogen atom.
18. X-rays of wavelength 1.4 Å are Compton scattered from a block of carbon. What will be the wavelength of scattered X-rays at
 - i) 180°
 - ii) 90°
 - iii) 0° ?



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19. A subatomic particle produced in a nuclear collision is found to have a mass M such that $Mc^2 = 1228$ MeV where c is the velocity of light with the uncertainty of ± 56 MeV, estimate the lifetime of this state. Assuming that the particle is produced in the collision, it travels at a speed of 10^8 m/s. How far can it travel before it disintegrates ?
20. An electron in a hydrogen atom is in the $n = 3$ state. Calculate its orbital angular momentum. (4×3=12)

PART – D

Long essay questions. Answer **any 2** questions. **Each** question carries 5 marks.

21. Describe the phenomenon of black-body radiation. Explain how Planck's quantum hypothesis successfully explained the black-body radiation.
22. State and explain the Compton effect. Write down the expression for the Compton wavelength shift.
23. Establish Schrödinger's wave equation for a linear harmonic oscillator and solve to obtain its eigenvalues and eigen vectors.
24. Derive the radial part of the Schrödinger equation for the hydrogen atom. (2×5=10)