

D 70334

(Pages : 2)

Name.....

Reg. No.....

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2019

(CUCBCSS-UG)

Physics/Applied Physics

PHY 5B 07/APY 5B 08—QUANTUM MECHANICS

Time : Three Hours

Maximum : 80 Marks

Section A

Answer all questions in a word or phrase.

Each question carries 1 mark.

1. The wave velocity of a wave packet is called _____.
2. The eigen value of the momentum of the particle in a box is _____.
3. Compton effect is associated with _____.
4. The quantum mechanical operator for energy is _____.
5. The de Broglie wave length of an electron having a kinetic energy of 10 eV is _____.

Write True or False :

6. The value of $[x, p_x]$ is $i\hbar$.
7. The eigen value of the momentum of the particle in a box is discrete.
8. The wavelength of a particle in a finite potential well is smaller than that of the particle in a box.
9. Davissons and Germer experiment establishes the wave nature of matter.
10. The duration of radar pulse is 10^{-6} s, the uncertainty in energy would be zero.

(10 × 1 = 10 marks)

Section B (Short Answer Type)

Answer all questions in two or three sentences.

Each question carries 2 marks.

11. State uncertainty principle.
12. What is the physical significance of a wave function?
13. What is zero point energy?
14. Briefly explain Pauli's exclusion principle.
15. What is group velocity? Give example.
16. What are operators?
17. Give the expression for de Broglie wavelength.

(7 × 2 = 14 marks)

Section C (Paragraph Type)

Answer any five questions in a paragraph of about half a page to one page.

Each question carries 4 marks.

18. Deduce Einstein's photoelectric equations.
19. Obtain time-dependent form of Schrödinger's equation.

Turn over

20. Explain Bohr radius of a hydrogen atom. Give the expression for radius of orbits in terms of the Bohr radius.
21. Normalize the wave function $\psi(x) = e^{-x/a}$.
22. Find the expectation value $\langle x \rangle$ of the position of a particle trapped in a box.
23. Give a brief account on gravitational red shift. Obtain the expression for the relative frequency change.
24. Explain Frank-Hertz experiment with examples.

(5 × 4 = 20 marks)

Section D (Problems)

Answer any **four** questions.

Each question carries 4 marks.

25. When radiation of wavelength 1500 Å is incident on a photocell, electrons are emitted? If the stopping potential is 4.4 volts. Calculate the threshold frequency, work function and threshold wavelength.
26. If the position of a 5 keV electron is located with 2 Å. What is the percentage uncertainty in its momentum?
27. If a photon has wavelength equal to Compton wavelength of the particle, show that the photon's energy is equal to the rest energy of the particle.
28. Calculate the de Broglie wavelength of an electron having kinetic energy of 1000 eV.
29. Find the energy of an X-ray photon which can impart a maximum energy of 50 keV to an electron.
30. Find the phase and group velocities of the de Broglie waves of an electron whose speed is 0.9 C.
31. Calculate the maximum wavelength that hydrogen in its ground state can absorb. What would be the next maximum wavelength?

(4 × 4 = 16 marks)

Section E (Essays)

Answer any **two** questions in about **two** pages.

Each question carries 10 marks.

32. What is meant by Compton effect? Derive an expression for the Compton shift.
33. What is photoelectric effect? Describe the laws of photoelectric effect. Give the quantum mechanical explanation of photoelectric effect and hence obtain the Einstein's equation for it.
34. Give an brief account on the quantum numbers associated with hydrogen atom. Give their values. Explain the significance of the quantum numbers.
35. Discuss the uncertainty principle and its relevance in quantum mechanics.

(2 × 10 = 20 marks)