

(7 pages)

Reg. No. :

Code No. : 10457 E Sub. Code : CMPH 61

B.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2024.

Sixth Semester

Physics — Core

QUANTUM MECHANICS

(For those who joined in July 2021–2022)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. As the wavelength of the radiation decreases, the intensity of the black body radiations _____.

- (a) Increases
- (b) Decreases
- (c) First increases then decrease
- (d) First decreases then increase

2. The photoelectric emission could be explained by the _____.

- (a) Wave nature of light
- (b) Particle nature of light
- (c) Dual nature of light
- (d) Quantum nature

3. Elastic waves in crystals are made up of _____.

- (a) Photons (b) Nano particles
- (c) Atoms (d) Phonons

4. Which of the following is the correct relation between the group velocity and the phase velocity?

- (a) $v_g = v_p + \lambda dv_p / d\lambda$
- (b) $v_p = v_g + \lambda dv_p / d\lambda$
- (c) $v_p = v_g - \lambda dv_p / d\lambda$
- (d) $v_g = v_p - \lambda dv_p / d\lambda$



5. What is the uncertainty principle proposed by Werner Heisenberg?

- (a) The principle that states that the position and velocity of a particle cannot be measured simultaneously with infinite precision
- (b) The principle that states that the energy and time of a particle cannot be measured simultaneously with infinite precision
- (c) The principle that states that the mass and charge of a particle cannot be measured simultaneously with infinite precision
- (d) The principle that states that the temperature and pressure of a particle cannot be measured simultaneously with infinite precision

6. Which other variable pairs (other than momentum and position) are important observables in Heisenberg's uncertainty principle?

- (a) Momentum and velocity
- (b) Time and position
- (c) Energy and momentum
- (d) Energy and time

7. For a quantum wave particle, $E =$ _____.

- (a) $\hbar k$
- (b) $\hbar \omega$
- (c) $\hbar \omega / 2$
- (d) $\hbar k / 2$

8. Which of the following can be a wave function?

- (a) $\tan x$
- (b) $\sin x$
- (c) $\cot x$
- (d) $\sec x$

9. For a particle inside a box, the potential is maximum at $x =$ _____.

- (a) L
- (b) $2L$
- (c) $L/2$
- (d) $3L$

10. What is the ground state energy of the quantum mechanical harmonic oscillator?

- (a) $E_0 = (\hbar \nu) / 2$
- (b) $E_0 = \hbar \nu$
- (c) $E_0 = 0$
- (d) $E_0 = \nu / 2$

PART B — ($5 \times 5 = 25$ marks)

Answer ALL questions by choosing (a) or (b).

Each answer should not exceed 250 words.

11. (a) Summarize the concept of plank's quantum theory.

Or

(b) Discuss about the stability of an atom.



12. (a) Justify the diffraction of particles.

Or

- (b) Estimate the velocity of Debroglie waves.

13. (a) Explain Heisenberg Uncertainty principle.

Or

- (b) What are the Consequence of Uncertainty relation?

14. (a) Annotate the physical interpretation of wave function φ .

Or

- (b) State the postulates of quantum mechanics.

15. (a) Explain the particle in a one dimensional box.

Or

- (b) Describe about the reflection at a step potential.

PART C — ($5 \times 8 = 40$ marks)

Answer ALL questions by choosing (a) or (b).

Each answer should not exceed 600 words.

16. (a) Examine the failure of classical physics to explain the energy distribution in the spectrum of a black body.

Or

- (b) Illustrate the Einstein's explanation for photo electric effect.

17. (a) Explain De Broglie hypothesis for matter waves.

Or

- (b) Distinguish between phase velocity and group velocity.

18. (a) Appraise the elementary proof of Heisenberg's uncertainty relation.

Or

- (b) State and explain the Heisenberg principle by Thought experiments.



19. (a) Derive an expression for the time independent Schrodinger wave equation in one dimension.

Or

- (b) Explain the eigen value and eigen function of an Operator.

20. (a) Explain the particle in a rectangular three dimensional box.

Or

- (b) Extend the theory of transmission across the potential barrier.
-

