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M 8173

Reg. No. :

Name :

VI Semester B.Sc. Degree (CCSS-Reg./Supple./Improv.)

Examination, May 2015

CORE COURSE IN PHYSICS

6B13 PHY: Quantum Mechanics

(2010 and '11 Admn.)

Time: 3 Hours

Max. Weightage: 30

SECTION - A

(Each bunch carries a weightage of 1).

- 1. i) The waves associated with electrons is
 - a) longitudinal waves
- b) matter waves
- c) transverse waves
- d) compton waves
- ii) According to Schrodinger, a particle is equivalent to
 - a) a single wave

b) a wave-packet

c) light wave

- d) cannot behave as wave
- iii) The uncertainty relation cannot hold for the following pairs
 - a) position and momentum
- b) energy and time
- c) linear momentum and angle
- d) angular momentum and angle
- iv) The energy operator is
 - a) $\frac{\hbar}{i} \frac{\partial}{\partial t}$

b) $\frac{-\hbar^2}{2m}\nabla^2 + V$

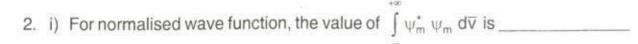
c) $\frac{-\hbar}{i} \frac{\partial}{\partial t}$

d) $i\hbar \frac{\partial}{\partial t}$

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- ii) The zero point energy of harmonic oscillator is given by _____
- iii) The existence of de-Broglie wavelength was confirmed by ______ experiment.
- iv) The eigen values of a particle in one-dimensional box of length 'L' is

 $(2 \times 1 = 2)$

SECTION - B

(Answer any six. Each question carries a weightage of 1).

- 3. What is Planck's quantum hypothesis?
- 4. Elucidate any 2 inadequacies of quantum theory.
- 5. Write Einstein's photoelectric equation in terms of wavelength λ .
- 6. State the principle of superposition of waves.
- 7. State Heisenberg's uncertainty principle.
- 8. What are eigen functions and eigen values?
- 9. What is a Hermitian operator?
- 10. Write the differential equation of a simple harmonic oscillator.

 $(6 \times 1 = 6)$

SECTION - C

(Answer any nine; each question carries a weightage of 2).

- 11. Distinguish between phase velocity and group velocity.
- 12. Give the physical interpretation of wave function.
- 13. Define probability current density.
- 14. Prove that $[x, p_y] = 0$.
- The energy of a linear harmonic oscillator in third excited state is 0% c V. Find the frequency of vibration.



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- 16. Give the significance of zero point energy of a harmonic oscillator.
- 17. Prove the kinetic energy operator from momentum operator.
- 18. Prove that any two eigen functions of a Hermitian operator that belong to different eigen values are orthogonal to each other.
- 19. The radius of a hydrogen atom is 5.3×10^{-11} m. Find the minimum energy an electron can have in this atom using uncertainty principle.
- 20. What do you mean by normalised and orthogonal wave-functions?
- 21. Explain Einstein's photoelectric equation.
- 22. X-rays of wavelength 0.085A° are scattered by carbon. At what angle will compton scattered photons have a wavelength of 0.090? (9×2=18)

SECTION - D

(Answer any one; each question carries a weightage of 4).

- 23. Describe Stern and Gerlach experiment. What are the conclusions drawn from it?
- 24. Derive time-independent Schrodinger equation. Explain the stationary states.

 $(1 \times 4 = 4)$