

QP CODE: 25050792



Reg No :

Name :

MSc DEGREE (CSS) EXAMINATION, DECEMBER 2025

First Semester

M Sc Industrial Chemistry

Core Courses - CH060102 - THEORETICAL CHEMISTRY - I

2020 Admission Onwards

C9C208E6

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

Weight 1 each.

1. Find the maximum velocity of photoelectrons ejected by an 80 nm radiation if the work function of photoelectrode is 4.73 eV .
2. What happens to the wavelength of a moving particle if its velocity is doubled?
3. What do you mean by the term 'collapse of wavefunction'?
4. Specify the condition that a Hermitian operator should satisfy for any well-behaved function.
5. What do you mean by the term 'expectation value' in quantum mechanics?
6. What is the wavelength of light emitted when an electron in one-dimensional box of length 5.0 nm makes a transition between $n = 5$ to $n = 4$?
7. Comment on the symmetric and anti-symmetric nature of the wavefunctions of one-dimensional harmonic oscillator.
8. What do mean by the term 'node' in quantum mechanics.
9. Why does the energy of a rotating molecule depend on orbital quantum number, l but not on magnetic quantum number, m ?
10. Write the Schrodinger wave equation for the relative motion of particles in hydrogenic species in Cartesian coordinates and explain the terms.

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

Weight 2 each.

11. Briefly explain the Stefan-Boltzmann law and Wien's displacement law on black body spectrum.





12. Discuss the uncertainty relations and account for the uncertainty relation between position and linear momentum in terms of the shape of the wavefunction.
13. Explain the significance of the terms in quantum mechanics (a) normalization (b) orthogonality (c) orthonormality
14. Calculate the probability of finding the particle between $L/4$ to $3L/4$ in the ground state, if the particle is confined to move in a one-dimensional box of length L .
15. Discuss the concept of degeneracy in terms of particle in box model. Give the degeneracy of first excited state of a particle in a two-dimensional square box and a particle in a three-dimensional cubic box.
16. Analysing the respective potential energy curves, point out the important differences between the classical and quantum one-dimensional harmonic oscillators.
17. Sketch boundary surfaces of all the d orbitals and assess their important properties.
18. Show that the first order Stark effect on the ground state of hydrogen atom is zero.

(6×2=12 weightage)

Part C (Essay Type Questions)

Answer any **two** questions.

Weight 5 each.

19. Describe Compton's experiment and the Compton shift. Verify how the Compton effect provided the most persuasive evidence for the particle nature of light.
20. Provide a brief summary of the important postulates of quantum mechanics and expound your views on the statistical interpretation of quantum mechanics.
21. Obtain the normalized wavefunction and energy for a particle confined in a one-dimensional box of length ' L '. Depict the energy levels, wavefunctions and probability densities of first four states.
22. Obtain the expression for the complete $R_{(r)}$ equation for hydrogenic species and evaluate the radial wavefunction for (a) $n = 1, l = 0$ (b) $n = 2, l = 0$.

(2×5=10 weightage)

