UNIVERSITY OF NORTH BENGAL

B.Sc. Honours 5th Semester Examination, 2020

CC12-CHEMISTRY

PHYSICAL CHEMISTRY

Full Marks: 40

ASSIGNMENT

The figures in the margin indicate full marks.
All symbols are of usual significance.

Answer any *four* questions from the following 10×4 = 40

1. (a) Define and explain operators in Quantum Mechanics. 2
   (b) Derive Schrodinger Wave Equation (time independent) and also express it by using Laplacian and Hamiltonian operators. 4+2
   (c) What are eigen values and eigen functions? 2

2. (a) Briefly explain normalized and orthogonal wave functions. $1\frac{1}{2}+1\frac{1}{2}$
   (b) What are Orthonormal wave functions? 1
   (c) Solve Schrodinger wave equation for a particle in one dimensional box and also evaluate its energy. 4
   (d) Justify the existence of Zero Point Energy. 2

3. (a) Explain why Heisenberg's Uncertainty Principle is of paramount importance for macroscopic particles but insignificant for macroscopic bodies. 2
   (b) State and explain the Postulates of Quantum Mechanics. 5
   (c) What is it that $\psi\psi^*$ is taken instead of ψ^2? 1
   (d) What will happen if the walls of a one-dimensional box are suddenly removed? 2

4. (a) Pure vibrational transition without affecting rotation is not permitted. Explain. 2
   (b) Which of the two H_2 and HCl will give rotational spectra and why? 2
   (c) Explain the fact that pure rotational Spectra of a linear rotor consists of a series of lines with constant Spacing. 3
   (d) What is Born-Oppenheimer approxmiation? 3

5. (a) Using the energy level expression and appropriate selection rule draw an energy Level diagram and the Spectral transitions for the vibration-rotation spectrum of a diatomic molecule. 5

(b) What are the P- and R-branch in vibration-rotation Spectra of a diatomic molecule? 3

(c) How does an harmonicity affect the vibrational spectra of diatomic molecules? 2

6. (a) What is Raman Effect? 2

(b) What are Rayleigh, Stokes' and Anti-Stokes' lines in Raman Spectra? 4

(c) Although CO_2 has no permanent dipole moment, it can produce both Infra red and Raman Spectra. Explain. 4

7. (a) State and explain Lambert-Beer's Law. Derive the integrated mathematical expression for this law. 2+3

(b) What is the significance of molar extinction coefficient? 1

(c) What is quantum efficiency? 2

(d) Quantum yield of H_2 and Cl_2 reaction is high but that of H_2 and Br_2 is low at ordinary temperature, although both are chain reactions. Explain. 2

8. (a) Explain Photosensitized reactions with suitable examples. 2

(b) Write a note on Chemiluminescence. 3

(c) What are the advantages of Raman Spectroscopy over IR Spectroscopy? 2

(d) If two operators A and B commute, then show that they have the same set of eigen functions. 3

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