



‘সমানো মন্ত্র: সমিতি: সমানী’

## UNIVERSITY OF NORTH BENGAL

B.Sc. Honours 5th Semester Examination, 2021

### CC12-CHEMISTRY

#### PHYSICAL CHEMISTRY

Time Allotted: 2 Hours

Full Marks: 40

*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) Discuss the importance of Hamiltonian operator in quantum mechanics. 3
  - (b) Show that  $(x, Px) = 0$ . What conclusion can you draw from this result? 3
  - (c) Find out the Schrodinger wave equation for hydrogen atom. 2
  - (d)  $\psi^2$  is more significant than  $\psi$ . — Explain. 2
  
  2. (a) Calculate the first excitation energy of a proton confined to a region equal to diameter of a nucleus ( $10^{-15}$  m). Mass of proton is  $1.6 \times 10^{-24}$  g. 3
  - (b) The wavefunction for a particle in a 1D-box is given as 4
- $$\psi(x) = A \sin\left(\frac{n\pi x}{l}\right)$$
- What will be the value of  $A$ ?
- (c) Write short notes on Eigenvalue and Eigenvalue equation. 3
  
  3. (a) Define R-branch and P-branch frequencies. 4
  - (b) Vibrational transitions of a diatomic molecule are normally accompanied by rotational transitions. — Explain. 3
  - (c) Calculate the smallest increment of energy that can be emitted or absorbed at a frequency  $5 \times 10^{14} \text{ sec}^{-1}$  ( $h = 6.62 \times 10^{-34} \text{ Jsec}$ ). Similarly calculate the energy required for electronic transition if excitation occurs by photons with wavelength 400 nm. 3
  
  4. (a) How do you evaluate the structures, properties qualitatively by vibrational, rotational and electronic spectroscopies? 4
  - (b) Distinguish between fluorescence and phosphorescence. 3
  - (c) What is the explanation of Raman effect from quantum view point? 3

5. (a) Lyophobic colloids are unstable both in presence of excess electrolytes and also in absence of electrolytes. — Explain. 3
- (b) What is Gold number? 2
- (c) Define Lambert-Beers' law. What is the unit of absorbance ( $A$ )? Absorbance ( $A$ ) value at a particular wavelength is founded to be unity. Calculate the fraction of incident photon took part in electronic transitions at that particular wavelength. 2+1+2
6. (a) Calculate the value of the classical-rotational partition function for carbon monoxide molecule at 20°C ( $r = 1.1282 \text{ \AA}$ , atomic mass of C = 12.00390 and O = 16.0000). 3
- (b) Using partition function, show that for a monoatomic gas, 3

$$E = \frac{3}{2} NkT, P = \frac{NkT}{V}$$

- (c) Define the Boltzmann distribution law. 4

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