

B.Sc/6th Sem (H)/CEM/25(CBCS)

2025

6th Semester Examination

CHEMISTRY (Honours)

Paper : C 14-T

(Physical Chemistry-V)

[CBCS]

Full Marks : 40

Time : Two Hours

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers  
in their own words as far as practicable.*

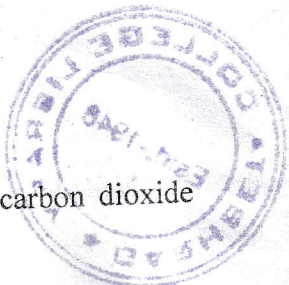
**Group - A**

Answer any *five* questions :  $2 \times 5 = 10$

1. Phosphorescence emission is less intense and less rapid than fluorescence emission. Explain.
2. Explain photochemical equilibrium with respect to the photodimerisation of anthracene.
3. Distinguish between physical adsorption and chemisorption.
4. Distinguish between micelle and reverse micelle.
5. What is Larmor precession?

P.T.O.

( 2 )

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6. Which of the vibrational mode(s) of carbon dioxide molecules is/are Raman active?
  7. A cell of path length 1cm, filled with  $2 \times 10^{-4}$  M solution transmits 10% of the incident light at wavelength 460 nm. Calculate molar extinction coefficient of the solution.
  8. State and explain Born-Oppenheimer approximation for molecular spectra.

### Group - B

Answer any *four* questions :

5×4=20

9. (a) Why Stokes lines are observed to be more intense than the anti-Stokes lines in the vibrational Raman spectrum?
- (b) The fundamental line in the IR spectrum of  $^{12}\text{C}^{16}\text{O}$  occurs at  $2143 \text{ cm}^{-1}$  and first overtone occurs at  $4260 \text{ cm}^{-1}$ . Calculate the value of  $\bar{\nu}_0$  and  $x_e$  for  $^{12}\text{C}^{16}\text{O}$ .  
2+3
10. (a) Prove that rotational spectral lines of a diatomic molecule are equi-spaced under rigid rotor approximation.
- (b) Microwave spectrum of  $^{39}\text{K}^{127}\text{I}$  consists of a series of lines whose spacing is almost constant at 3634 MHz. Calculate the bond length of  $^{39}\text{K}^{127}\text{I}$ .  
2+3

11. Discuss the fluorescence, phosphorescence, deactivation, IC, and ISC with the help of Jablonski diagram.
12. (a) Show the variation of surface tension with surfactant concentration using a qualitative sketch, and explain the nature of the curve.
- (b) Calculate the work done involved in blowing a soap bubble in air of radius 5 cm. Surface tension of the soap solution = 30 dyne/cm. 2+3
13. (a) In a given cell, solution A transmits 42% and solution B transmits 85% radiation of wavelength 520 nm. What is the transmittance at the same wavelength of a solution made by mixing 35ml of A solution and 55 ml of B solution. (Assume no reaction between the solution.)
- (b) What is the physical basis of vertical transition in electronic spectroscopy? 3+2
14. (a) What is Langmuir adsorption isotherm? Draw the isotherm at different temperature for a specific adsorbate-adsorbent pair.
- (b) How high will the water rise in a capillary of radius  $3 \times 10^{-4}$  m at  $25^{\circ}\text{C}$ . Given surface tension of water =  $72.75 \times 10^{-3} \text{ Nm}^{-1}$ ,  $g = 9.8 \text{ ms}^{-2}$ , density of water =  $998 \text{ kgm}^{-3}$ . (1+2)+2

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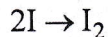
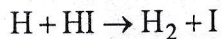
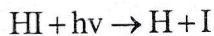
## Group - C

Answer any *one* question :  $10 \times 1 = 10$ 

15. (a) A photochemical reaction was carried out using a radiation (490 nm) of intensity 100 watt. When the sample was irradiated for 30 mins, 0.3 mol of the reactant was decomposed. Estimate the quantum efficiency assuming 50% absorption.
- (b) In the photochemical decomposition of HI, the quantum yield ( $\phi$ ) is 2. But on passing time it becomes less than 2. Explain.
- (c) What is the difference between excimer and excited state dimer?
- (d) Average bond energies of C-H, C-C and C-O bonds are 414, 347 and 732 kJ mol<sup>-1</sup> respectively. Predict the possible products of photodecomposition of acetone with radiation of wavelength 300 nm.
- $3+2+2+3$
16. (a) On irradiation with light of wavelength  $3 \times 10^{-7}$  m, an aldehyde decomposes to form CO at 300K. The quantum yield for the process is 0.54. The light intensity being  $1.5 \times 10^{-3}$  Js<sup>-1</sup>. Calculate the light intensity in Einsteins s<sup>-1</sup>. What is the rate of formation of CO?
- (b) Define zeta potential and stern double layer.

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- (c) The photochemical decomposition of HI consists of the following steps :



Applying steady state approximation for [H] calculate the quantum yield of the reaction. Does it violate the Einstein's law of photochemical equivalence?

4+2+4