B.Sc. 6th Semester (Honours) Examination, 2021

CHEMISTRY

(Physical Chemistry-IV)

Paper: UG/CHEM/602/C-14

Course ID: 61412

Time: 1 Hour 15 Minutes **Full Marks: 25**

The figures in the right hand side margin indicate marks.
Candidates are required to give their answers in their own words as far as practicable.

1. Answer *any five* of the following questions: 1×5 = 5

(a) On what factors does the molar extinction coefficient depend on?

(b) Write down the Freundlich adsorption isotherm stating the terms involved.

(c) State the specific selection rule(s) for rotational Raman spectra of diatomic molecules.

(d) Write down the S.I. unit of surface tension.

(e) Define 'chemical shift' in NMR spectroscopy.

(f) Write down the degeneracy of J = 3 rotational level.

(g) Indicate the value of quantum yield for a photochemical reaction that obeys Einstein's law.

(h) Define zeta potential.

2. Answer *any two* of the following questions: 5×2 = 10

(a) (i) Define surface excess. State whether the surface excess is positive or negative if soap is added to pure water.

(ii) A spherical air bubble is created within a liquid of surface tension 72 dyne cm^{-1}. If the volume of the bubble is $\pi/6$ cm^3, calculate the excess pressure inside the bubble. 3+2 = 5

(b) (i) State the rule of 'mutual exclusion' in Raman spectroscopy.

(ii) Name the material used commonly as reference in NMR spectra and give reasons for its choice. 2+3 = 5

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(c) (i) Draw potential energy diagrams for vibrational motion of a diatomic molecule on the basis of ideal harmonic oscillator model and the actual molecular model.

(ii) Derive the energy expression of a molecule obeying linear harmonic motion and calculate the energy spacing between two consecutive levels. 2+3 = 5

(d) (i) BET model fails for multilayer adsorption-Why?

(ii) A certain substance in a cell of length '*l*' absorbs 10% of incident light. What percentage of light will be absorbed in a call of length '5*l*'. 2+3 = 5

3. Answer *any one* of the following questions: 10 × 1 = 10

(a) (i) Increase of temperature of a metal leads to decrease in heat of adsorption.—Explain

(ii) State Grotthuss Draper law. Write down all the steps involved for Hg sensitized photochemical reaction between H_2 and CO.

(iii) Sketch the normal modes of vibration of CO_2 and explain which of these are I.R. active.

(iv) The spacing between rotational lines of CO is 3.86 cm^{-1}. Calculate the bond distance of CO. 1+(1+2)+(1+2)+3 =10

(b) (i) Write down the expression for the rotational energy of a diatomic molecule behaving as a rigid rotator in the J^{th} energy level and show that the rotational spectral lines are equispaced.

(ii) What is meant by fundamental absorption, first overtone and hot bands in IR spectroscopy?

(iii) "Phosphorescence" is spin forbidden, yet it is observed for some heavier molecules." — Justify.

(iv) Define Critical Micellar Concentration.

(v) Give an example of endothermic adsorption. (1+2)+3+2+1+1 = 10