UNIVERSITY OF NORTH BENGAL
B.Sc. Honours 1st Semester Examination, 2022

CC2-CHEMISTRY

PHYSICAL CHEMISTRY

NEW AND OLD SYLLABUS

Time Allotted: 2 Hours   Full Marks: 40

The figures in the margin indicate full marks.

GROUP- A

1.   Answer any *five* questions: 1×5 = 5

   (a) Draw the van der Waals isotherms at $T \gg T_c$, $T = T_c$ and $T < T_c$.

   (b) Explain the law of corresponding states.

   (c) Write down the SI unit of surface tension.

   (d) Define intrinsic viscosity.

   (e) Why is it difficult to carry out weak acid-weak base titration?

   (f) Why the pH scale generally between 0 and 14?

   (g) What are Miller indices?

GROUP- B

2.   Answer any *three* questions: 5×3 = 15

   (a) (i)   What is meant by viscosity coefficient? Convert Poise into SI unit.   1+1

       (ii) Discuss the effect of temperature on surface tension with reference to Eötvös equation and Ramsay and Shields modification.   3

   (b) (i)   What is the pH of a 10^{-8} M HCl solution? What is the unit of pH? $2+\frac{1}{2}$

       (ii) Derive an expression for pH of an aqueous CH_3COONH_4 solution. $2\frac{1}{2}$

   (c) (i)   Write down the postulates of kinetic theory of gas.   2

       (ii) Derive the Kinetic gas equation $PV = \frac{1}{3}mN\bar{v}^2$.   3

(d) (i) Describe the working principle of surfactants. Cite examples of cationic and anionic surfactants. — 3

(ii) Explain the factors which led van der Waals to modify the ideal gas equation. — 2

(e) (i) What is contact angle? Define wetting and non-wetting surfaces based on contact angle. Describe the factors that affect the contact angle. — 3

(ii) Prove that the deflected X-rays in Bragg's diffraction is deviated by 2θ, where θ is glancing angle. — 2

GROUP- C

3.   Answer any *two* questions: — $10 \times 2 = 20$

(a) (i) What is capillary action? Derive the formula $\gamma = \frac{1}{2}h\rho g r$ for wetting liquids. What will be the form of this equation for a non-wetting liquid? — 1+2+1

(ii) State the principle of equipartition of energy. — 3

(iii) What is meant by collision number and collision frequency? — 2

(iv) What is Boyle temperature? — 1

(b) (i) Five-fold Symmetry can't the explained by Bragg's law of diffraction. Explain clearly. — 3

(ii) Why NaCl and KCl have different X-ray powder diffractograms? — 2

(iii) How can you apply Bragg's law for crystal structure determination? — 2

(iv) Define reciprocal space and explain its significance in solids. — 2

(v) Is glass a solid? — 1

(c) (i) Describe Ostwald's method for determining the co-efficient of viscosity of a liquid. — 3

(ii) Express van der Waals equation in the form of virial equation of state. — 2

(iii) Show that C_p/C_v for a monoatomic gas is 1.66. — 3

(iv) What is common ion effect? — 2

(d) (i) The solubility product of ferric hydroxide is 1.11×10^{-36} at 25°C. Calculate its solubility in g/L (atomic weight of Fe = 56 and O = 16). — 3

(ii) Derive Henderson's equation for the determination of pH of a buffer solution. What is buffer capacity? — 3+1

(iii) Calculate the pH of a 0.1 M H_2S solution. Given that the first and second dissociation constants of H_2S are 1.0×10^{-7} and 1.3×10^{-14}, respectively. — 3

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