'समानो मन्त्रः समितिः समानी'

UNIVERSITY OF NORTH BENGAL
B.Sc. Honours 1st Semester Examination, 2023

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 from the following: 1×5 = 5

 (a) Cite an example of each of amorphous and crystalline solid.
 (b) What is the origin of the unit Poise?
 (c) Write down the units of critical pressure and volume.
 (d) 'Molecular collisions are perfectly elastic' — Explain.
 (e) What is buffer capacity?
 (f) Define unit cell.
 (g) What is virial equation of state?

GROUP-B

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

 (a) (i) Calculate the pH of a 10^{-2} M KOH solution.   2

   (ii) What is meant by elements of symmetry in a crystal? Discuss various   1+2
        elements of symmetry in a cubic crystal.

 (b) (i) Larger the values of Miller indices, smaller the intercept of the plane on the   3
         axis. Justify.

   (ii) It is not possible to identify the position of a hydrogen atom in a crystal   2
        using X-ray diffraction study. Explain.

 (c) (i) Show that the surface tension of a liquid is equal to surface energy both   2
         numerically and dimensionally.

   (ii) Discuss the effect of temperature on the viscosity of gases and liquids.   3

 (d) (i) State the principle of equipartition of energy.   1

   (ii) Apply the equipartition of energy principle to calculate C_P for H_2O and CO_2 4
        considering the contribution of all the degrees of freedom.

 (e) (i) Draw and explain P vs. V isotherms of CO_2.   2

(ii) Using the kinetic gas equation $PV = \frac{1}{3}mn\bar{c}^2$ derive Boyle's law and Avogadro's law. 3

GROUP-C

3. Answer any **two** questions from the following: $10\times2 = 20$

(a) (i) Explain why one observes a capillary rise for H_2O and capillary depression for Hg, when a glass capillary is partially dipped into the liquid. 3

(ii) Why a drop of H_2O is spherical? 2

(iii) Describe a method to determine the surface tension of a liquid. 3

(iv) Should an ideal gas have viscosity? Why? 2

(b) (i) Explain the theory of acid-base indicators. 3

(ii) Describe buffer range. 2

(iii) Define wetting and non-wetting surfaces based on contact angle. Describe the factors that affect contact angle. 3

(iv) Show that the buffer capacity is maximum when $pH = pKa$. 2

(c) (i) Show that C_P/C_V of a monoatomic gas is 1.66. 3

(ii) At NTP the viscosity coefficient of oxygen is 0.2 mP. Find the collision diameter of oxygen molecule. 3

(iii) Find the relationship between K_a and K_b for an acid and its conjugate base. 4

(d) (i) Derive the relationship between solubility and solubility product of a sparingly soluble salt $A_m B_n$. 2

(ii) The dissociation constants of formic acid and acetic acid are 1.77×10^{-4} and 1.75×10^{-5}, respectively. Calculate the relative strengths of these acids. 2

(iii) Derive Ostwald's dilution law for weak electrolytes. Can you apply this law for strong electrolytes? 3+1

(iv) Starting from Bragg's equation derive 2

$$\sin^2 \theta_{hkl} = k(h^2 + k^2 + l^2), \quad \text{where} \quad k = \lambda^2/4a^2.$$

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