

B.SC. MSC INTEGRATED PROGRAMME

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Semester II Examination 2022

Paper code : BCH-CC04 TH

Title : Physical Chemistry I: STATES OF MATTER & IONIC EQUILIBRIUM

(Write your Roll No. at the top immediately on receipt of this question paper)

Time: 3 Hours

Maximum Marks: 75

Note: Attempt all the questions marks of each question given in parenthesis. All parts of a question must be attempted in continuation. Start answer of a fresh question on a new page. Cite examples and draw labelled diagrams wherever necessary.

Q1. Attempt all:

(15 x 1 = 15)

i. The rms speed of gaseous molecules at 150K is 56m/s. What will be rms speed at 600K?

- (a). 56 m/s
- (b). 224 m/s
- (c). 448 m/s
- (d). 112 m/s

ii. At 350K and 1atmospheric pressure, a gas has molar volume that is 15% less than that for an ideal gas. The correct option about the gas and its compressibility factor (Z) is:

- (a). repulsive forces are dominant and $Z < 1$
- (b). attractive forces are dominant and $Z > 1$
- (c). attractive forces are dominant and $Z < 1$
- (d). repulsive forces are dominant and $Z > 1$

iii. What is effect of increasing temperature on distribution of speed of molecules in a gas?

- (a). Area under the distribution curve increases
- (b). Fraction of molecules having greater rms increases
- (c). RMS of molecules decreases
- (d). Most probable speed of molecules increases

iv. The shape of a water droplet is spherical. It is due to,

- (a). Vapour pressure of water
- (b). Viscosity of water
- (c). Radial distribution function of water molecules
- (d). Surface tension of liquid water

v. Which of the following will show zero surface tension?

- (a). Liquid water
- (b). Solid water

- (c). Gaseous water
- (d). Water at 4°C

vi. The SI unit of viscosity is,

- (a). Pascal second
- (b). poise
- (c). Newton per square meter
- (d). dyne second per square meter

vii. The radial distribution function (RDF) defines the probability of finding a particle at a distance,

- (a). r from another chosen particle
- (b). equal to particle diameter from another particle
- (c). of 1 cm from another designated particle
- (d). of 1 nm from another selected particle

viii. The fraction of the total volume occupied by the atoms present in a simple cube is

- (a). $\pi/3$
- (b). $\pi/6$
- (c). $\pi/9$
- (d). $\pi/12$

xi. The edge length of fcc cell is 508 pm. If radius of cation is 110 pm, the radius of anion is

- (a). 96 pm
- (b). 124 pm
- (c). 144 pm
- (d). 232 pm

x. Identify the weak electrolyte in aqueous system.

- (a). H_2SO_3
- (b). MgSO_4
- (c). Na_3PO_4
- (d). CaCl_2

xi. The pH of a buffer solution depends on concentration of,

- (a). strong acid
- (b). weak acid
- (c). strong base
- (d). the salt

xii. pH of 0.1M solution of NaOH is

- (a). 12
- (b). 11
- (c). 13
- (d). 10

xiii. What will be the concentration $[\text{OH}^-]$ in the solution, if it is prepared by 20.0 mL of 0.050 M HCl with 30.0 mL of 0.10 M $\text{Ba}(\text{OH})_2$?

- (a). 0.10 M
- (b). 0.12 M
- (c). 0.15M
- (d). 0.054M

xiv. How many elements of symmetry are there in a cubic crystal?

- (a). 14
- (b). 18
- (c). 21
- (d). 23

xv. How many chloride ions are surrounding sodium ion in sodium chloride crystal ?

- (a). 8
- (b). 6
- (c). 12
- (d). 4

Q2. Attempt any three of the following:

(3x5=15)

- (i). Describe laws of crystallography. Differentiate between a solid and liquid crystal.
- (ii). Name all the elements of symmetry in solid state. How many types of defects are there in real crystals?
- (iii). How many types of crystal systems and crystal lattices are there? Name the crystal systems.
- (iv). Derive an expression for Bragg's law. What information can be obtained by XRD for solid systems?
- (v). A beam of X-rays of wavelength 0.071 nm is diffracted by (110) plane of rock salt with lattice constant of 0.28 nm. Find the glancing angle for the first-order diffraction.

Q3. Attempt any three of the following:

(3x5=15)

- (i). Explain the process of ionization. On what factors the degree of ionization depend for a weak electrolyte?
- (ii). What do you understand by p^H ? Derive an expression to find the p^H of an acidic buffer.
- (iii). Derive an expression for ionization constant of a weak electrolyte. Explain ionic product of water.
- (iv). Calculate the concentration of OH^- in a fruit juice which contains $2 \times 10^{-3} M$, H_3O^+ ion. Identify the nature of the solution.
- (v). Find the pH of a buffer solution containing 0.25 M sodium acetate and 0.36M acetic acid. K_a for acetic acid is 1.8×10^{-5} .

Q4. Attempt any three of the following:

(3x5=15)

- (i). Draw a typical radial distribution function curve for liquid state and explain RDF in context of structure of a liquid system.
- (ii). Define surface tension of a liquid. Describe the process of determining surface tension of a liquid using stalagmometer.
- (iii). In the drop-number method, a liquid gives 55 drops while water gave 25 drops for the same volume. The densities of the liquid and water are 0.996 and 0.800 g/cm³ respectively. Find the surface tension of the liquid if that of water is 72.0 dynes/cm
- (iv). Describe laminar flow and viscosity of a liquid. How will you determine viscosity in the laboratory?
- (v). How high will sap rise in a plant if the capillaries are 0.02 mm diameter, the density of the fluid is 1.2 g cm⁻³ and its surface tension 0.065 Nm⁻¹. ($g = 981 \text{ cm s}^{-2}$)

Q5. Attempt any three of the following:

(3x5=15)

- (i). Describe the postulates of kinetic molecular theory of real gases. Explain the terms in van der Waals equation.
- (ii). Define and derive an expression for collision, frequency and collision number.
- (iii). Describe mean free path and coefficient of viscosity of real gases. Derive an expression related to mean free path to viscosity for a gas
- (iv). What do you understand by critical state of a gas? Define critical temperature, critical pressure and critical volume of a real gas.
- (v). Derive an expression for viscosity of gas. Explain the pressure and temperature dependence of viscosity of a real gas.