TRIBHUVAN UNIVERSITY

2082(Regular)

Bachelor Level / 4 Yrs. Prog. / I Year/Science & Tech.

BASIC CHEMISTRY I — Full Marks: 100

CHE-101 — Time: 3 hrs.

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

The figures in the margin indicate full marks.

Use separate answer-book for each group.

The Comprehensive Question of each group is compulsory.

Attempt SIX questions of Short Answer Questions of each Group.

GROUP "A" (INORGANIC)

1. Comprehensive Question

What is the physical significance of wave function? Derive the Schrödinger time independent wave equation. [3+6]

OR

What are the important features of hybridization? Illustrate the type of hybridization and deduce the geometry of following molecules

a) $[Ni(CN)_4]^{2-}$ b) SF_6 c) BF_3 [3+2+2+2]

2. Short Answer Questions 6 x 4 = 24

2.1 What is radial distribution function? Draw this function for the 2s and 2p orbitals in hydrogen atom.

2.2 How does nuclear fission reaction differ from nuclear fusion reaction? Explain with examples.

2.3 What is meant by ionization potential? Point out the factors affecting ionization potential of an atom.

2.4 Define electronegativity. State Pauling's scale of electronegativity.

2.5 Draw and explain the zinc blende structure.

2.6 Predict the geometry of the following molecules based on VSEPR theory:

a) SF_6 b) BF_3 c) IF_7 d) H_2O

2.7 What is HSAB principle? Point out its applications.

2.8 Explain the principle of volumetric analysis.

2.9 Give the Born-Haber Cycle for the formation of M-Cl compound and write the meaning of each term involved in it.

GROUP "B" (ORGANIC)

3. Comprehensive Questions

It has been reported that free radical addition of hydrogen bromide to propene occurs with orientation opposite to that of electrophilic addition of hydrogen bromide. Illustrate these findings by providing appropriate examples with their mechanisms. Why peroxide effect is observed for addition of HBr to unsymmetrical alkenes but not for addition of HCl? [5+4]

OR

How does S_N2 reaction differ from S_N1 reaction in mechanistic and stereochemical aspects? Why nucleophilic substitution reaction in tert-butyl chloride proceeds by S_N1 mechanism instead of S_N2 mechanism? [5+4]

4. Short Answer Questions 6 x 4 = 24

4.1 What kinds of forces hold neutral molecules to each other? Describe each kind of force with an example. How does the difference in strength of intermolecular forces reflect in the physical properties of the compounds?

4.2 Explain with a labelled potential energy diagrams, the endothermic and exothermic reactions. Indicate the value of ΔH in each case.

4.3 Define the term conformations? Write different conformations of n-butane. Why anti conformation of n-butane is more stable than gauche conformation?

4.4 What do you mean by R- and S- configurations? Assign the R- and S-configuration of sec-butyl alcohol.

4.5 What do you mean by racemic mixture and meso compound? Why these are optically inactive? Explain with examples.

4.6 Write the structure of n-propyl carbocation and isopropyl carbocation. These two carbocations are the products of propyl substrate. In general, propyl substrate exclusively forms isopropyl carbocation than n-propyl carbocation. How would you clarify this observation?

4.7 Account for the following facts:

a) The boiling point of an alcohol is higher than that of an ether of same molecular masses.

b) *tert*-Butyl alcohol is more soluble in water as compared to *n*-butyl alcohol.

4.8 Justify the statement "the more stable the alkene, the faster it is formed" with reference to dehydrohalogenation reactions of alkyl halides.

4.9 What happens when propyne is treated with dilute solution of sulphuric acid in presence of mercuric sulphate? Write the reaction with its mechanism.

GROUP "C" (PHYSICAL)

5 Comprehensive Question

Why does real gas deviate from ideal behaviour? Derive Van der Waal's equation and also write the significance of Van der Waal's constant. Calculate the root mean square velocity of CO_2 at 800°C. [2+4+4]

OR

Derive an expression for the variation of heat of reaction with temperature.

10 liters of an ideal gas at 283K and 100 atmospheric pressure are allowed to expand isothermally and reversibly to a pressure of 20 atmosphere. Calculate the work done, internal energy and enthalpy change for the process. [6+4]

6. Short Answer Questions 6 x 4 = 24

6.1 Define mean free path. How is it related to collision diameter?

6.2 How is surface tension of a liquid determined by drop weight method?

6.3 Show your familiarity with covalent and molecular crystals.

6.4 One mole of PCl_5 is heated in a closed vessel. Calculate the equilibrium constant of the reaction which is 35 % dissociated at equilibrium.

6.5 What is buffer solution? How would you prepare acidic buffer solution using acetic acid & sodium acetate? Dissociation constant of acid is 1.75×10^{-5}.

6.6 What do you mean by colligative properties? Derive Raoult's law.

6.7 What is half life period of a reaction? Show that half life of a second order reaction is inversely proportional to initial concentration of the reactant.

6.8 An Arrhenius equation for a certain reaction, the value of A & activation energy (E_a) are 4×10^{12} s^{-1} and 94.2KJ mol^{-1} , respectively. At what temperature will the reaction have rate constant of 1.1×10^{-3} s^{-1}

6.9 The bond enthalpies of C-H, C-C, C=C and H-H bonds are 414, 347, 615 and 435 KJ mol^{-1} respectively. Find the enthalpy change for the following reaction.

$$CH_2 = CH_{2(g)} + H_{2(g)} \rightarrow CH_3 - CH_{3(g)}$$

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