TRIBHUVAN UNIVERSITY

2080 (Partial)

Bachelor Level 4 Yrs. Prog./Ist Year/Science & Tech. Full Marks: 100

CHE: 101: CHEMISTRY 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* from each Group is compulsory.
Attempt any SIX *Short Answer Questions* from each Group.

GROUP "A" (INORGANIC)

1. *Comprehensive Question*

What is time independent Schrodinger's wave equation? Explain the terms involved. Also explain the physical significance of wave function. [1+5+3]

OR

What is meant by Born Haber's cycle? How is this concept applied to predict the stability of ionic compounds? Explain the terms involved. Can this concept be applied to explain the stability of covalent compounds? [1+2+5+1]

2. *Short Answer Questions* 6×4=24

2.1. What is meant by Heisenberg Uncertainity principle? Explain.

2.2. What is meant by half life of a radioisotope? In what way it is related to decay constant?

2.3. What is radius ratio rule? Draw the structure of CsC*l*.

2.4. State the main postulates of VSEPR theory.

2.5. What is meant by hybridization? Give example of sp^3, dsp^2 hybridization.

2.6. Show the effect of substituent in the relative strength of acid and base.

2.7. Show your familiarity with the concept of united atoms in molecular orbital theory.

2.8. Point out the basic principle involved in volumetric analysis.

2.9. State the merits and demerits of IUPAC system of periodic classification.

□

GROUP "B" (ORGANIC)

3. ***Comprehensive Question***

What are carbocations? State and explain the factors affecting the stability of carbocations. In nucleophilic substitution, *n*-propyl substrate yields the isopropyl product instead of *n*-propyl product. How would you justify this observation with an appropriate example? [2+4+3]

OR

What is configuration? Show the difference between configuration and conformation. The specification of R- or S- configuration is based on a set of sequence rules. Justify this statement with an example. Assign the sequence of priority to the given groups (i) -CHO (ii) -COOH (iii) $-CH_2OH$ (iv) -OH. [1+2+5+1]

4 ***Short Answer Questions*** 6×4=24

4.1. How does a molecule constitute dipole? Define dipole moment. What kind of dipole moment would you expect for nitrogen trifluoride, NF_3? How do you account for this?

4.2. Draw a potential energy diagram for an exothermic two steps reaction of the following type:

$$\underset{\text{Reactants}}{A + B} \xrightarrow{\text{Slow}} \underset{\text{Intermediate}}{X} \xrightarrow{\text{Fast}} \underset{\text{Products}}{C + D}$$

P.T.O.

4.3. Write all the necessary sequence of reactions to prepare 2-methylbutane by coupling of an alkyl halide with lithium dialkylcopper.

4.4. What do you understand by a chiral molecule? Chirality of a molecule is not always necessary condition for a compound to optical activity? Explain it with a suitable example.

4.5. What do you mean by *Z*- and *E*-configuration? Write the *Z*- and *E*- isomers of 3-bromopent-2-ene.

4.6. Account for the fact that the nucleophilic substitution in tert-butyl chloride proceeds by S_N1 mechanism instead of S_N2 mechanism.

4.7. In the preparation of tert-butyl ethyl ether by Williamson's etherification, sodium tert-butoxide is used instead of sodium ethoxide, why?

4.8. Identify the products X, Y, and Z in the given reaction and write the IUPAC names of final products, Y and Z.

$$CH_3CH_2CH{=}CHCH_3 \xrightarrow{O_3} X \xrightarrow{H_2O/Zn} Y + Z$$

4.9. Account for the fact that hydrogen attached to triply bonded carbon in any alkyne shows appreciable acidity. How would you justify that acetylene is a weaker acid than water.

GROUP "C" (PHYSICAL)

5. *Comprehensive Question*

Describe Maxwell's law of distribution of molecular velocities. What are average velocity and most probable velocity? 1

The critical temperature and critical pressure of CO_2 are 30.5°C and 73.2 atmosphere, respectively [R = 0.0821 L atm K^{-1} mol^{-1}]. [4+2+4]

OR

What is hydrolysis of salt? Show that the degree of hydrolysis of salt derived from weak acid and weak base is independent of concentration.

Calculate the pH of 250 mL buffer solution prepared by making 4g of acetic acid with 6.5 of sodium acetate. [Dissociation constant of acid is 1.8×10^{-5}]

[2+4+4]

6. ***Short Answer Questions*** $6\times4=24$

6.1. What are collision frequency and collision diameter? Mention the factors that affect the collision frequency.

6.2. What is Miller indices of a plane? Find the Miller indices for a plane when the intercepts along the axis are 3a, 2b and 3c.

6.3. How are viscosity and surface tension are measured?

6.4. 12.5 mL of HI are produced by reacting 9.1 mL of hydrogen with 8.1 mL of iodine vapour at 400°C. Calculate the equilibrium constant at this temperature.

6.5. Show that relative lowering of vapour pressure is directly proportional to osmotic pressure.

6.6. Define activation energy. Derive Arrhenius equation of a reaction.

6.7. Write the reaction mechanism of iodination of propanone in acidic medium and discuss its kinetic.

6.8. What is calorific value of fuel and food? Calculate the calorific value of C_8H_{18} (l) from the following thermochemical equation.

$2C_8H_{18}(l)+25O_2(g) \longrightarrow 16CO_2(g)+18H_2O(l)$ $\Delta H = -10920KJ$

6.9. What do you mean by molar heat capacity at constant pressure and volume? Derive relation between Cp and Cv.

□