

7. (a) What are liquid crystals ? Explain their characteristics. 10
 (b) Explain the collision theory of biomolecular reactions. What are the limitations of this theory ? 15
 (c) Derive the Gibbs-Helmholtz equation and explain the terms involved. 15
 (d) Explain the theory of absolute reaction rates. 10
8. (a) Explain the Debye-Huckel theory of strong electrolytes. 15
 (b) Discuss the magnetic property and complex formation of lanthanides 10
 (c) State and explain the third law of thermodynamics. 15
 (d) Explain the concept of chemical potential. 10
9. (a) Explain the application of e.m.f. measurements of fuel cells. 20
 (b) Explain the reactions in liquid SO₂ with respect to :
 (i) acid-base reaction,
 (ii) solvolytic reaction and
 (iii) complex formation reactions. 15
 (c) Calculate the number of moles of HCl(g) produced by the absorption of one joule of radiant energy of wavelength 480 nm in the reaction, H₂(g) + Cl₂(g) → 2HCl(g), if the Quantum yield of the photo-chemical reaction is 1.0×10⁶. 15

Total No. of Printed Pages : 4

Roll No.

1(CCE.M)2

Chemistry—I

(05)

Time : Three Hours]

[Maximum Marks : 300

INSTRUCTIONS

- (i) Answers must be written in English.
 (ii) The number of marks carried by each question is indicated at the end of the question.
 (iii) The answer to each question or part thereof should begin on a fresh page.
 (iv) Your answer should be precise and coherent.
 (v) The part/parts of the same question must be answered together and should not be interposed between answers to other questions.
 (vi) Candidates should attempt question no. **1** which is compulsory and any **four** out of the remaining questions.
 (vii) If you encounter any typographical error, please read it as it appears in the text book.
 (viii) Candidates are in their own interest advised to go through the General Instructions on the back side of the title page of the Answer Script for strict adherence.
 (ix) No continuation sheets shall be provided to any candidate under any circumstances.
 (x) Candidates shall put a cross (×) on blank pages of Answer Script.

- (xi) No blank page be left in between answer to various questions.
- (xii) No programmable Calculator is allowed.
- (xiii) No stencil (with different markings) is allowed.
1. (a) Discuss the molecular orbital theory of Covalent compounds. 10
 - (b) Explain the consequences of lanthanide contraction. 10
 - (c) What is dipole moment ? Explain with example, how the magnitude of dipole moment gives an idea about the structure of a molecule. 10
 - (d) Explain Heisenberg's uncertainty principle and the concept of probability. 10
 - (e) Draw the shapes of p and d-orbitals. 10
 - (f) Explain the limitations of Arrhenius theory of dissociation. 10
 - (g) Calculate the entropy change of 1 mole of helium when it is heated from 300 K to 600 K at constant pressure. 10
 - (h) Explain the laws of photochemistry. 10
 - (i) Explain Fajans rule. 10
 - (j) Explain the concept of resonance and resonance energy with suitable example. 10
 2. (a) Construct Born-Haber cycle for the formation of KCl and explain the terms involved. 15
 - (b) Explain the Quantum numbers and give their significance. 15
 - (c) Discuss the splitting of d-orbitals in octahedral and tetrahedral complexes. 20
 3. (a) Derive the relationship between C_p and C_v for n moles of ideal gas. 15
 - (b) Discuss the significance of ψ and ψ^2 . 10
 - (c) One mole of an ideal monoatomic gas expands reversibly from a volume of 10 dm³ and temperature 298 K to a volume of 20 dm³ and temperature 250 K. Assuming that $C_v=3/2 R$. Calculate the entropy change for the process. 10
 - (d) Explain colour, oxidation states and magnetic properties of d-block elements. 15
 4. (a) Discuss the entropy change in reversible and irreversible process. 15
 - (b) Derive the rate equation for second order reaction when there is only one reactant. Also show that $t_{1/2}$ (half life) is inversely proportional to the initial concentration. 20
 - (c) What is Quantum yield ? How is it determined experimentally ? 15
 5. (a) Describe Schrodinger wave equation. Show how the wave equation supports Bohr's theory of hydrogen atom. 20
 - (b) What are photochemical reactions ? Give at least five examples for photochemical reactions. 15
 - (c) Explain the separation of lanthanides by ion-exchange method. 15
 6. (a) Explain :
 - (i) Precipitation reactions
 - (ii) Acid base reactions
 - (iii) Complex formation reactions in liquid ammonia. 15
 - (b) What are fuel cells ? Explain any three types of fuel cells. 15
 - (c) Derive Bragg's equation. How is it used in the determination of crystal structure ? 20