

B. Tech.
ODD SEMESTER
MAJOR EXAMINATION 2017 - 2018
Applied Engineering Chemistry

Time: 3 Hrs.

Note: Attempt all questions. Each question carry equal marks.

Max. Marks: 50

1. Attempt any four parts of the following:

(4 × 2.5 = 10)

- (a) Define the terms internal energy and enthalpy and give the relationship between them.
- (b) State the second law of thermodynamics in terms of entropy and express it mathematically. What is the change in entropy in a thermodynamically reversible process?
- (c) Compute the enthalpy of formation of nitric oxide using the following data:
 $\text{NO} + \text{CO} \rightarrow \frac{1}{2} \text{N}_2(\text{g}) + \text{CO}_2(\text{g}); \Delta H = -372.2 \text{ kJ/mol}$
Where $\Delta H_f^\circ(\text{CO}) = -110.5 \text{ kJ/mol}$ and $\Delta H_f^\circ(\text{CO}_2) = -393.5 \text{ kJ/mol}$
- (d) A first order reaction is 50% completed in 30 minutes. Calculate the time required for 75% completion of the reaction.
- (e) Explain the hydrolysis of salts in water. What is hydrolysis constant?
- (f) The rate of a reaction becomes three times when the temperature is changed from 298K to 358K. Calculate the energy of activation for the reaction. Given $R = 8.314 \text{ J/K/mol}$.

2. Attempt any two parts of the following:

(2 × 5 = 10)

- (a) Suggest a suitable mechanism for the reaction:
 $\text{CH}_3\text{CHDBr} + \text{OH}^- \rightarrow \text{CH}_3\text{CHDOH} + \text{Br}^-$
Explain the stereochemistry and order of the reaction.
- (b) Give the mechanism of bromination of benzene explaining the requirement of catalyst for the reaction. Also explain the directing effect of bromine in the product formed.
- (c) What are rearrangement reactions? Explain the mechanism of Beckmann rearrangement with the help of a suitable example.

3.

Attempt any two parts of the following:

(2 × 5 = 10)

- (a) Identify the type (of reaction) and explain the mechanism for the reaction:
 $(\text{CH}_3)_3\text{C-Br} + \text{KOH} \rightarrow (\text{CH}_3)_3\text{C=CH}_2 + \text{KBr} + \text{H}_2\text{O}$
- (b) Write an explanatory note on Friedel-Crafts alkylation of aromatic ring giving the reaction conditions, role of the catalyst and mechanism of the reaction.
- (c) What are addition reactions? Give examples of three different types of addition reactions. Give the mechanism of hydration of alkenes.

4.

Attempt any two parts of the following:

 $(2 \times 5 = 10)$

- (a) Discuss the concept of primary and secondary valencies (with suitable examples) in coordination complexes as postulated in Werner's theory
- (b) Explain the term "crystal field splitting" and show splitting of d-orbital in **tetrahedral** complexes.
- (c) Write the IUPAC names of the following complexes:
- (i) $[\text{Co}(\text{en})_3]\text{Cl}_3$ ii) $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$ iii) $[\text{CoSO}_4(\text{NH}_3)_4]\text{NO}_3$
(iv) $[\text{Cd}(\text{SCN})_4]\text{SO}_4$ v) $[\text{Pt}(\text{NH}_3)_4][\text{PtCl}_4]$

5.

Attempt any two parts of the following:

 $(2 \times 5 = 10)$

- (a) What are low spin and high spin complexes? The complex $[\text{Co}(\text{NH}_3)_6]^{3+}$ is diamagnetic but $[\text{CoF}_6]^{3-}$ is paramagnetic. Explain using crystal field theory.
- (b) Write an explanatory note on the **structural** isomerism in inorganic complexes. Give the structures of all the isomers of $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$.
- (c) How does the formation of a coordination complex take place according to valence bond theory? What are the limitations of the theory?