



# 17562

15162

3 Hours / 100 Marks

Seat No.

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- Instructions :** (1) All questions are **compulsory**.  
(2) Answer **each** next main question on a **new** page.  
(3) Illustrate your answers with neat sketches **wherever** necessary.  
(4) Figures to the **right** indicate **full** marks.  
(5) Assume suitable data, if **necessary**.

Marks

1. A) Attempt **any three**:

12

- Define chain and non chain reaction.
- Derive the relationship between conversion and equilibrium constant for second order reversible reaction.
- The rate of reaction at concentrations 0.15 mol/l and 0.05 mol/l are  $2.7 \times 10^{-3}$  and  $0.3 \times 10^{-3}$  mol/l min. What is the order of reaction with respect to the reactant ?
- Give the relation between  $C_A$  and  $X_A$  for :
  - constant density system
  - changing density system.

B) Attempt **any one**:

6

- Derive the integrate form of rate expression for zero order reaction in terms of concentration and conversion. Give the graphical representation.
- List theories of reaction rate constant and compare between them on the basis of
  - Experiment
  - Mathematical equation
  - Activated complex.

2. Attempt **any two**:

16

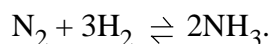
- Explain temperature dependency of rate constant from collision theory.
- In an isothermal batch reactor, the conversion of a liquid reactant A achieved in 13 min is 70%. Find the space time and space velocity necessary to effect this conversion in a plug flow reactor and in a mixed flow reactor consider first order kinetics.
- Draw the neat labeled Sketch of fixed bed and fluidised bed reactor and explain in brief.

P.T.O.

3. Attempt **any four** :

16

- a) In an experiment at 1000 K the equilibrium concentration of ammonia, hydrogen and nitrogen are 0.105, 1.5, and 1.10 mol/l respectively. Calculate  $K_c$  and  $K_p$  for the reaction.



- b) Define half life period and write the relation between half life and rate constant for first order reaction. State its one characteristics.
- c) Define the following terms :
- Fugacity
  - Chemical potential
  - Chemical Equilibrium constant
  - Gibbs free energy.
- d) Explain the types of intermediate involved in non-chain reactions.
- e) State the steps involved in solid catalysed gas phase reactions.

4. A) Attempt **any three** :

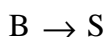
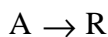
12

- a) Derive an integrated rate expression for irreversible second order reaction.  
 $2A \rightarrow \text{products}$  in terms of conversion.
- b) Name three catalyst deactivation categories. Describe any one in brief.
- c) The half life for the conversion of ammonium cyanate into urea at 303 K at initial concentration of ammonium cyanate of 0.1 mol/l and 0.2 mol/l are 1152 min and 568 min respectively. What is the order of reaction ?
- d) Derive  $K_p = K_c (RT)^{\Delta n}$ .

B) Attempt **any one**:

6

- a) Concentration Vs time data for the reaction is given below



Time (hr)	Concentration of A mol/lit	Concentration of R mol/lit
0	0.100	0.00
2	0.050	0.050



[3]

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Marks

Time (hr)	Concentration of B mol/lit.	Concentration of S mol/lit.
0	0.100	0.00
2	0.075	0.025

Calculate :

- i) Which reaction proceed at greatest rate ?
  - ii) What are the rates of formation of R and S ?
- b) Derive the expression for entropy change of an ideal gas for
- i) constant pressure process.
  - ii) constant temperature process.

**5. Attempt any two :****16**

- a) Derive the integrated form of rate expression for constant volume first order reversible reaction  $A \rightleftharpoons B$  in terms of concentration and conversion. Give the graphical representation also.
- b) Derive the performance equation for constant volume PFR. Give the graphical representation also.
- c) Compare MFR and PFR (4 points).

**6. Attempt any four :****16**

- a) Define space time and space velocity. Give its unit.
  - b) Why temperature increase is not desirable for exothermic reaction ? (On the basis of Van't Hoff equation).
  - c) Give the significance of activation energy.
  - d) Explain the differential method of analysis of data.
  - e) How feeding should be done when PFR's are connected in parallel ?
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