17562

**11718**

**3 Hours / 100 Marks** Seat No. | | | | | | | | |

***Instructions :*** (1) All Questions are *compulsory.*

(2) Illustrate your answers with neat sketches wherever necessary.

(3) Figures to the right indicate full marks.

(4) Assume suitable data, if necessary.

**Marks**

**1. (A) Attempt any THREE :** **12**

(a) Give comparison of transition and collision theories (any four).

(b) Define the terms internal energy, chemical potential, entropy and fugacity.

(c) Define autocatalytic reactions. Give its example.

(d) Define the term space time and space velocity with their units and mathematical expression.

**(B) Attempt any ONE :** **6**

(a) Derive a kinetic expression for second order reaction

$A + B \longrightarrow$ Products

(b) The rate constant of a reaction at 27 °C is $1.3 \times 10^{-3}$ $(S)^{-1}$. Determine the frequency factor. Take E (energy of activation) = 128170 cal/mol.

**2. Attempt any TWO :** **16**

(a) Differentiate between molecularity and order of reaction (any four points).

(b) Derive the performance equation for constant volume batch reactor where first order reaction takes place.

(c) State the various methods of preparation of the catalyst.

**3. Attempt any FOUR :** **16**

(a) Define the following :

(i) Chemical potential

(ii) Chemical equilibrium

(b) Derive the integrated rate expression for zero order reaction in terms of concentration and conversion.

(c) Derive the $\Delta S = n.C_v \, L_n \left(\frac{T_2}{T_1}\right)$ for entropy change for a constant volume process.

(d) State any four factors which affect the rate of chemical reaction.

(e) Explain catalyst regeneration. State three different methods of catalyst regeneration.

**4. (A) Attempt any THREE :** **12**

(a) Draw the graph of concentration term with time for (i) First order reaction (ii) Autocatalytic reaction.

(b) Explain fixed bed and fluidised bed reactor in brief with sketch.

(c) Derive relation $C_A = C_{AO} (1 - X_A)$.

(d) Derive the relation between $K_P = K_C (RT)^{\Delta n}$.

**(B) Attempt any ONE :** **6**

(a) Explain temperature dependency of rate constant on Arrhenius theory.

(b) Helium weighing 4 gm, is expanded from 1 atm to one tenth of original pressure at 30 °C. Calculate the change in its entropy, assuming it be an ideal gas.

**5. Attempt any TWO :** **16**

(a) In case of first order reaction, show that time required for 75% conversion is double the time required for 50% conversion.

(b) With the help of graph, compare the size of mixed flow reactor with plug flow reactor for first order irreversible reaction.

(c) Calculate the first order rate constant for the disappearance of A as per the gas phase reaction A $\longrightarrow$ 1.6 R if the volume of the reaction mixture, starting with pure 'A' increases by 50% in 4 minutes. The total pressure of the system remains constant at 1.2 atm and the temperature is 25 °C.

**6. Attempt any FOUR :** **16**

(a) Derive design equation for mixed flow reactor.

(b) Write Vant-Hoff equation. State its physical significance.

(c) At 500 K, the rate of bimolecular reactions is ten times the rate at 400 K. Find the activation energy of this reaction from Arrhenius law.

(d) After 8 minutes in a batch reactor reactant is 80% converted and after 18 minutes the conversion is 90%. Find a rate expression for this reaction if $C_{AO}$ = 1 mol/l.

(e) Draw graphical representation for batch reactor and plug flow reactor.

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