# 17562

**15116**

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

***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.
(6) Use of Non-Programmable Electronic Pocket Calculator is permissible.
(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

**Marks**

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

(a) Define rate of reaction and rate constant. For the elementary reaction $A \rightarrow B$, write the rate equation in terms of reactant A and product B.

(b) Define chemical potential and fugacity. Write the mathematical equation.

(c) Define Half life. Write the expression for half life for $n^{th}$ order reaction and explain the terms.

(d) Write the relation between $C_A$ and $X_A$ for constant volume system and variable volume system.

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

(a) Write the steps for differential method of analysis of kinetic data.

(b) Define Activation energy.

The reaction rate constant of a reaction is $1 \times 10^{-3}$ minute$^{-1}$ at 27 °C and $2 \times 10^{-3}$ minute$^{-1}$ at 37 °C. Calculate activation energy and frequency factor.

**P.T.O.**

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

(a) Derive temperature dependency of rate constant from collision theory.

(b) Derive the performance equation of constant volume PFR in which first order reaction takes place. Give the graphical representation also.

(c) Explain the different methods for the preparation of catalyst.

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

(a) Calculate the entropy change when 1 mole of ice is heated from –10 °C to + 10 °C.

Data : $Cp_{(ice)}$ = 9 cal/g mole k

$Cp_{(H_2O)}$ = 18 cal/g mole k

Molar enthalpy of fusion = 1437 cal/g mole.

(b) Derive the integrated form of rate equation for first order irreversible reaction in terms of fractional conversion. Give the graphical representation also.

(c) Based on Van't Hoff equation, explain why decreasing the temperature is not desirable for endothermic reaction.

(d) Differentiate between order and molecularity of reaction. (4 points)

(e) Draw the diagram of :

(i) Packed bed reactor

(ii) Multitubular packed bed reactor

(iii) Multibed packed bed reactor.

(iv) Fluidized bed reactor with regenerator.

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

(a) Show that for first order reaction, the time required for 75% conversion is double the time required for 50% conversion.

(b) Write any four methods for regenerating the catalyst.

(c) Give the graphical representation in terms of conversion for (i) variable volume zero order reaction, (ii) variable volume first order reaction.

(d) Derive the relation between conversion (extent of reaction) and thermodynamic equilibrium constant for first order reversible reaction of the form $A \rightleftharpoons R$.

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

(a) Explain the types of intermediates formed in a non-chain reaction.

(b) Derive the relation between $\Delta G$ and K.

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

(a) Derive the integrated form of rate equation for constant volume first order reversible reaction in terms of concentration and conversion. Give the graphical representation also.

(b) Compare MFR and PFR (4 points). Give the application of MFR and PFR.

(c) A homogeneous liquid phase reaction, $A \rightarrow R$, '$-\gamma_A = KC_A 2$ takes place with 50% conversion in MFR. What will be the conversion, if this reactor is replaced by one 6 times large – all else remaining unchanged ?

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

(a) Explain the method of feeding when PFR's are connected in parallel.

(b) Derive the relation between $K_P$ and $K_C$.

(c) Write the unit of rate constant for :

(i) Zero order reaction

(ii) First order reaction

(iii) Second order reaction

(iv) Third order reaction

(d) Define autocatalytic reaction. Give one example.

(e) Give the classification of reactors. Write the material balance equation for reactor.

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