Chemical Reaction Engg - I 3/12/16

TE/V/CBSGS/CHEM/CRE-I (27)

Q. P. Code : 573800

(3 Hours) (Marks : 80)

N.B: (1) Question No. 1 is compulsory.
(2) Attempt any three out of remaining questions.
(3) Assume suitable data wherever necessary and state the same.

Q1 a) Define Molecularity and order of reaction. (05)

b) Write a note on differential method of analysis of rate data. (05)

c) State difference between space time and residence time. (05)

d) What is optimum Temperature progression. (05)

Q2 a) A zero order homogenous gas phase reaction A $\longrightarrow$ rR takes place in a constant volume bomb P= 1 atm when t = 0 and P= 1.5 atm when t = 1 min. If the same reaction with the same feed composition and initial pressure takes place in a constant pressure reactor, Find V at t = 1 min if V=1 at t=0. (10)

b) The primary reaction occurring in the homogeneous decomposition of nitrous oxide is found to be (10)

$$N_2O \longrightarrow N_2 + 1/2\ O_2$$

with a rate

$$-r_A = \frac{k_1[N_2O]^2}{1+k_2[N_2O]}$$

Suggest mechanism.

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Q3 a) Determine the equilibrium conversion for the following elementary reversible reaction between 273 K and 373 K. (15)

$$A \rightleftharpoons R$$

At 298K ΔG= -14130 J/mol , ΔH^0_R = -75300 J/mol,

$C_{pA} = C_{pR}$= constant

i) Construct a plot of temperature v/s conversion

ii) What restriction should be placed on the reactor operating isothermally if 75% or higher conversion is desired?

b) Write short note on Homogeneous catalyzed reactions. (05)

Q4 a) Use the half life method to determine the order and rate constant of the reaction using following information. (12)

Half life (sec)	0	100	200	300	400
C_{Ao}	4.4	3.6	2.9	2.6	2.3

b) Write a note on recycle reactors (08)

Q5 a) For irreversible first order series reaction $A \longrightarrow R \longrightarrow S$, the values of rate constants k_1 and k_2 are 0.17 min^{-1} and 0.11 min^{-1} respectively. Calculate (10)

i) the time at which the concentration of R is maximum

ii) maximum concentration of R.

b) The pyrolysis of ethane proceeds at an activation energy of 75000 cal/mol. (10)

How much faster is the decomposition at 650 °C than at 500 °C.

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Q6 A gas mixture containing 50 mol % A and 50 mol % inerts at 10 atm enters a reactor system with a flow rate of 360 lit/min at 144 °C. The laboratory measurements of the rate as a function of conversion at 144 °C and 10 atm are : (20)

X_A	0	0.2	0.4	0.6	0.8	0.9
$-r_A$	0.0053	0.005	0.004	0.0025	0.00125	0.0006

If the reaction is carried out in two reactors in series with 40 % conversion in the first reactor and 85% overall conversion. Estimate the total volume of two reactors when:

i) The reactors are both mixed flow

ii) The reactors are both plug flow

iii) Reactors are mixed flow reactor followed by plug flow reactor

iv)Reactors are plug flow followed by mixed flow reactor

Justify the best scheme
