

T.E. sem-VI (CBSEGS) chemical - CRE - I 3/12/16
 Chemical Reaction Engineering-I

Q. P. Code : 573800

extra

(3 Hours)

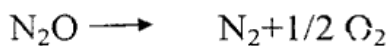
(Marks : 80)

- 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)



with a rate

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

Suggest mechanism.

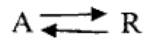
[TURN OVER]

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



At 298K $\Delta G = -14130 \text{ J/mol}$, $\Delta H_R^0 = -75300 \text{ J/mol}$,

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

- 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_{A0}	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 (20) 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 :

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:

- The reactors are both mixed flow
- The reactors are both plug flow
- Reactors are mixed flow reactor followed by plug flow reactor
- Reactors are plug flow followed by mixed flow reactor

Justify the best scheme

21-3