SHAHEED BHAGAT SINGH STATE TECHNICAL CAMPUS, FEROZEPUR

ROLL No: | | | | | | | | | | | | Total number of pages:[3]
Total number of questions:06

B.Tech. || CHE || 5th Sem
Chemical Reaction Engg-I
Subject Code: BTCH-502A
Paper ID:

Max Marks: 60

Time allowed: 3 Hrs

Important Instructions:

- **All questions are compulsory**
- **Assume any missing data**

PART A (2×10)

All Cos

Q. 1. Short-Answer Questions:

(a) Define the terms Molecularity & Order of an elementary reaction.

(b) On doubling the concentration of a reactant the rate of reaction triples. Find the reaction order.

(c) Calculate the volume change co-efficient (ε_A) for gas phase reaction $A + 2B \rightarrow 2P + 3Q$

(d) What are the variables that affect the rate of reaction

(e) Define space time & space velocity.

(f) What is a zero order reaction?

(g) What is meant of equilibrium constant?

(h) Half-life of a first order reaction $A \rightarrow B$ is 10 min. What percent of A remains after 60 min?

(i) What are the operating conditions for an exothermic reversible reaction-taking place in a plug-flow reactor?

(j) How earliness of lateness of mixing affects the residence time distribution?

PART B (8×5)

CO 1

Q 2 (a) For a gas reaction at 400 K the rate is reported as

$$-\frac{dP_A}{dt} = 3.66\, p_A^2, \quad atm/hour$$

(i) What are the units of the rate constant?

(ii) What is the value of the rate constant for this reaction if the rate equation is expressed as

$$-r_A = -\frac{1}{V}\frac{dN_A}{dt} = kC_A^2, \quad \frac{mol}{m^3 sec}$$

(b) Experiment shows that the homogeneous decomposition of ozone proceeds with a rate

$$-r_{O_3} = k\,[O_3]^2\,[O_2]^{-1}$$

(i) What is the overall order of reaction? (ii) Suggest a two-step mechanism to explain this rate and state how you would further test this mechanism.

OR

(a) Differentiate by giving examples (i) Elementary and non-elementary reactions (ii) homogeneous and heterogeneous reactions (4) CO1

(b) Aqueous A reacts to form R (A → R) and in the first minute in a batch reactor its concentration drops from C_{Ao} = 2.03 mol/liter to C_{Af} = 1.97 mol/liter. Find the rate equation for the reaction if the kinetics are second order with respect to A. (4)

Q 3 (a) Derive the performance equation for first-order irreversible reaction with varying volume. (3) CO2

(b) The first-order reversible liquid reaction

$$A \leftrightarrow R, C_{A_O} = 0.5\frac{mol}{ltr}, C_{A_O} = 0,$$

takes place in a batch reactor. After 8 minutes, conversion of A is 33.3% while equilibrium conversion is 66.7%. Find the rate equation for this reaction. (5)

OR

(a) Differentiate integral and differential method of analysis of batch reactor data. (4) CO2

(b) Find the first-order rate constant for the disappearance of A in the gas reaction $2A \rightarrow R$ if, on holding the pressure constant, the volume of the reaction mixture, starting with 80% A, decreases by 20% in 3 min. (4)

Q 4 An elementary reaction A → R → S, takes place in a mixed flow reactor. Find the condition for maximum concentration of R. What is its value? (Assume no R and S initially). CO3

OR

(a) An aqueous feed containing A (1 mol/liter) enters a 2-liter plug flow reactor and reacts away (2A → R, $-r_A = 0.05\, C_A^2 \frac{mol}{ltr.sec}$). Find the outlet concentration of A for a feed rate of 0.5 liter/min. CO3

(b) Derive the performance equation for the reaction A → R (first order kinetics) takes place in equal-size mixed flow reactors in series. (4)

Q5 (a) Wr ite short notes on Optimum temperature progression. (4)

(b) How will you find the best reactor type for adiabatic operations?

Or

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Between 0°C and 100°C determine the equilibrium conversion for the elementary aqueous reaction A↔R , $\Delta G^0_{298} = -14130\ J/mol,$ $\Delta H^0_{298} = -75300\ J/mol$ CO4

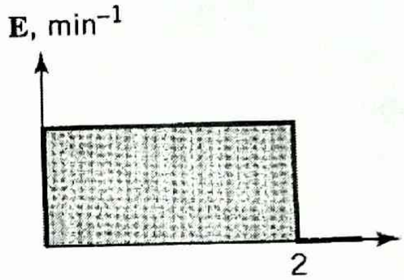
(a) Present the results in the form of a plot of temperature versus conversion.
(b) What restrictions should be placed on the reactor operating isothermally if we are to obtain a conversion of 75% or higher

Q 6 (a) Wh at is residence time distribution? How exit age distribution is calculated experimentally? (4) CO5

(b) A liquid macro fluid reacts according to A → R as it flows through a vessel. Find the conversion of A for the flow pattern and kinetics shown below:

(4)

$$C_{A0} = 1 \text{ mol/liter}$$
$$-r_A = kC_A^{0.5}$$
$$k = 2 \text{ mol}^{0.5}/\text{liter}^{0.5}\cdot\text{min}$$



OR

The concentration data were observed a continuous response to a pulse input into a closed vessel. This vessel is to be used as reactor for decomposition of liquid A (A→R, $-r_A=k*C_A$ & $k = 0.10\ min^{-1}$)

t (min)	C_{pulse} (g/cm^3)	t (min)	C_{pulse} (g/cm^3)
0	0	7	4
1	1	8	3
2	5	9	2.2
3	8	10	1.5
4	10	12	0.6
5	8	13	0.2
6	6	14	0

Calculate the conversion of reactant v/s t and determine E.