

**UNIVERSITY COLLEGE TATI (UC TATI)****FINAL EXAMINATION QUESTION BOOKLET**

COURSE CODE	: BCE 3124
COURSE	: CHEMICAL REACTION ENGINEERING
SEMESTER/SESSION	: 2/ 20242025
DURATION	: 3 HOURS

Instructions:

1. This booklet contains **4** questions. Answer **ALL** questions.
2. You are allowed to bring **3** sheets of A4 paper containing formulas, notes, etc.
3. All answers should be written in answer booklet.
4. Write legibly and draw sketches wherever required.
5. If in doubt, raise your hands and ask the invigilator.

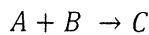
DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 3 PRINTED PAGES INCLUDING COVER PAGE

CHEMICAL REACTION ENGINEERING (BCE 3124)

QUESTION 1

The gas phase irreversible reaction



The entering flow rate of A is 10 mol/min and is equal molar in A and B. The entering concentration of A is 0.4 mol/dm³.

Given

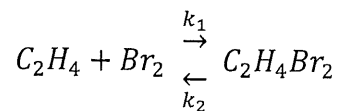
$$k = 2 \text{ dm}^3/\text{mol}$$

$$T = 500\text{K}$$

- Express the rate law in terms of concentration and state your assumption. (3 marks)
- Outline stoichiometric table for the gas phase reaction and the rate law in terms of concentration and conversion. (13 marks)
- Calculate the CSTR & PFR volume necessary to achieve 90% conversion (15 marks)

QUESTION 2

For the gas phase reaction,



Occurred in constant volume batch reactor at 600K at atmospheric pressure (101kPa). The reactor was feed with equimolar amount of C_2H_4 and Br_2 . The reaction follows the reaction kinetic with rate constant with $k_1 = 500 \text{ Lmol}^{-1}\text{hr}^{-1}$, $k_2 = 0.135 \text{ hr}^{-1}$. Given $R = 8.314 \text{ kPaL/Kmol}$.

- Outline the stoichiometric table for the reaction (12 marks)
- Determine the reaction rate, $-r_{C_2H_4}$, $-r_{Br_2}$, $-r_{C_2H_4Br_2}$ (9 marks)
- Determine the inlet concentration of C_2H_4 (4 marks)
- Determine the equilibrium conversion, X_e (6 marks)
- Determine the exit concentrations of each species (6 marks)

CHEMICAL REACTION ENGINEERING (BCE 3124)

QUESTION 3

The thermal decomposition of isopropyl isocyanate was studied in differential packed bed reactor. From the data below,

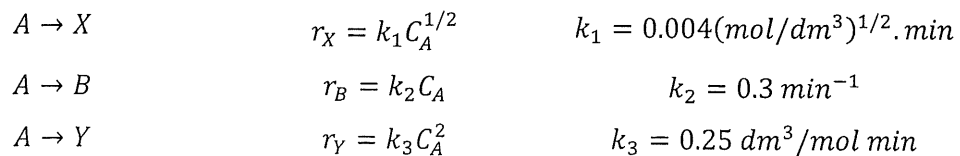
Run	Rate (mol/s.dm ³)	Concentration(mol/dm ³)	Temperature (K)
1	1.1 x 10 ⁻⁴	0.02	750
2	2.4 x 10 ⁻³	0.05	800
3	2.2 x 10 ⁻²	0.08	850
4	1.18 x 10 ⁻¹	0.1	900

Given R=8.314 J/mol.K

- Sketch the Arrhenius plot (8 marks)
- Determine the activation energy, E and A and rate law (5 marks)

QUESTION 4

Consider the following system of gas -phase reaction



- Determine the instantaneous selectivity of B over X, Y and X+Y (6 marks)
- Sketch the instantaneous selectivity of B over X+Y as a function of concentration A, determine the maximum value of $S_{B/XY}$ occurs at concentration of A (13 marks)

-----End of question-----

