國立雲林科技大學 108 學年度 碩士班招生考試試題

系所：化材系

科目：化工動力學

1. The reaction (A→B) is carried out in a CSTR, wherein the reaction data is listed as following. The species A enters the reactor at a molar flow rate of 0.5 mol/s. The entering volumetric flow rate is 0.002 m^3/s.

Conversion of A (%)	Reaction rate (mol/m^3-s)
0	0.45
10	0.37
20	0.30
40	0.195
60	0.113
70	0.079
80	0.040

(a) Please calculate the volume of CSTR to achieve 80% conversion of A. (13%)
(b) Please calculate the space time in hour to achieve 80% conversion of A. (6%)
(c) Please calculate the space velocity to achieve 80% conversion of A. (6%)

2. The reaction (A→C) is carried out in a CSTR, wherein the reaction data is listed as following. The species A enters the reactor at a concentration of 1.0 mol/L.

Reaction time (min)	Concentration of A in the reactor (mol/L)
0	1.000
0.5	0.855
1.0	0.730
1.5	0.624
2.0	0.533
3.0	0.390
4.0	0.285
6.0	0.152
10.0	0.043

(a) If the rate equation obeys first order ($-\gamma_A = kC_A$), please derive reaction time (t) as a function of conversion of A (χ) and evaluate the rate constant. (17%)
(b) If the rate equation obeys second order ($-\gamma_A = kC_A^2$), please derive reaction time (t) as a function of conversion of A (χ). (8%)

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3. (25%) The gaseous reaction A → B is carried out in a tubular reactor system consisting of 10 parallel 10m long tubes with a 20cm inside diameter. Preliminary experiments have determined the reaction rate constant for this first-order reaction as 0.001 s^{-1} at 300K and 0.003 s^{-1} at 350K. A has a molecular weight of 100. Assuming ideal gas behavior is followed and no reverse reaction is happened. At what temperature the reaction rate constant can reached 0.01 s^{-1} and what conversion of A can be reached at this temperature with a feed rate of 3.14 ton/h of pure A and an operating pressure of 8.2 atm?

4. (15%) It is known that

$$A \longrightarrow B \qquad r_B = k_B C_A^2$$

$$A + B \longrightarrow 2C \qquad r_C = k_C C_A C_B$$

If C is the desired product, what is the instantaneous selectivity of C to B? What kind of reactor or reactor combinations and at what temperatures would you use for the reaction system?

$C_{A0} = 4\,\text{mol/dm}^3$ $k_B = 1\,\text{dm}^3/\text{mol}\cdot\text{min}$ at 300K with $E = 4000\,\text{cal/mol}$

$k_C = 1\,\text{dm}^3/\text{mol}\cdot\text{min}$ at 300K with $E = 12000\,\text{cal/mol}$

5. (10%) Please briefly describe the characteristics, usage, advantages, and disadvantages of Plug Flow reactors (PFR) and Batch reactor.