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淡江大學 97 學年度碩士班招生考試試題

系別：化學工程與材料工程學系

科目：化學反應工程

准帶項目請打「V」	
✓	簡單型計算機

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Problem 1

Consider the elementary liquid-phase reaction, $A + B \rightarrow P$, with reaction rate constant $k = 1 \text{ m}^3/(\text{kmole}\cdot\text{s})$. Suppose inlet concentration of feed, $C_{A,\text{in}} = C_{B,\text{in}} = 10 \text{ kmole/m}^3$. It is desired to achieve an output concentration $C_{A,\text{out}} = 1 \text{ kmole/m}^3$.

- (a) Find the mean residence time needed to achieve this value using a PFR. (15pt)
 (b) Repeat (a) assuming that the reaction occurs in a CSTR. (15pt)

Problem 2 (30pt)

A liquid-phase reaction, $A + \text{water} \rightarrow C$, is carried out in a well-mixed batch reactor. In the reactor, 500 ml of a 2 M solution (2 kmole/m^3) of A in water is mixed with 500 ml of water. The temperature was maintained at 50°C . The concentration of product C , C_C , is recorded as a function of time as follows:

Time (min)	C_C (kmole/m^3)
0	0
0.5	0.145
1.0	0.270
1.5	0.376

Using the data shown above, determine the rate constant k at 50°C . The water concentration can be assumed to be constant, and the reaction is first-order in component A .

Hint: Natural logarithms of numbers

n	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9
ln(n)	0.0	0.0953	0.1823	0.2624	0.3365	0.4055	0.4700	0.5306	0.5878	0.6419

Problem 3

The irreversible first-order gas-phase reaction, $A \rightarrow C$, is carried out isothermally in a fluidized-catalytic CSTR containing 50 kg of catalyst. There is no pressure drop in the CSTR, and a 50% conversion is obtained for pure A entering at pressure of 20 atm.

- (a) The same reaction is carried out isothermally in a packed-bed catalytic reactor (PBR) containing 50 kg of catalyst, and pure A enters the PBR at pressure of 20 atm. Assuming there is no pressure drop along the packed-bed, what is the conversion exiting the PBR? (20pt)
 (b) Repeat (a) assuming the pressure drop along the PBR follows $P = P_{\text{in}}(1 - 0.02W)^{1/2}$, where P_{in} is the inlet pressure and W is the catalyst weight in kg. (10pt)

Hint: $\exp(2/3) = 1.948$, $\exp(1) = 2.718$, $\exp(3/2) = 4.482$

Problem 4 (10pt)

請將第三題題目翻譯為中文