

元智大學 107 學年度 碩士班 招生試題卷

系(所)別：化學工程與材料科學學系碩士班 組別：不分組

科目：化工動力學

用紙第 / 頁共 / 頁

●可使用現行『國家考試電子計算器規格標準』規定第二類之計算機

1. (50 %) Definitions and questions:
 - (a) Please describe what the considerations of **Kinetics** and **Thermodynamics** are in designing a chemical reactor? (10%)
 - (b) Describe the continuous stirred tank reactor (**CSTR**) in figure and words. What are the general characteristics of CSTR? What kinds of reactions can be carried out in a CSTR? (10%)
 - (c) Describe the fluid-bed reactor (**FBR**) in figure and words. What are the general characteristics of FBR? What kinds of reactions can be carried out in a FBR? (10%)
 - (d) Explain how the catalyst particle size may affect the overall reaction rate with the consideration of the external and internal mass transfer of a gas-solid catalytic reaction. (10%)
 - (e) What is the physical meaning of **Damköhler number (Da)**? What is the application of it in reactor design? (10%)
2. (30%) For a first order reaction of A with $-r_A = kC_A$, where $k = 0.002 \text{ s}^{-1}$, what are the answers for (a), (b), and (c)?
 - (a) How long must we operate the reactor for the concentration to drop from $C_{A0} = 2 \text{ mol/dm}^3$ to $C_A = 0.4 \text{ mol/dm}^3$ in a batch reactor (**BR**)? (10%)
 - (b) What size of a continuous stirred tank reactor (**CSTR**) would be needed for 80% conversion of a feed of 1000 mol A/hr at $C_{A0} = 1.2 \text{ mol/dm}^3$? (10%)
 - (c) What size of a plug flow reactor (**PFR**) would be needed for 80% conversion of a feed of 1000 mol A/hr at $C_{A0} = 1.2 \text{ mol/dm}^3$? (10%)
3. (20%) The decomposition rate of a component A in water is recorded at 60 °C and the following are the data:

| | | | | | | |
|-------------------------------|-----|------|------|------|------|------|
| Time (min) | 10 | 20 | 30 | 40 | 50 | 60 |
| C_A (mmol/dm ³) | 9.8 | 6.96 | 4.92 | 3.52 | 2.48 | 1.76 |

- (a) **Describe** how you are going to obtain the **rate law** $r_A = -kC_A^\alpha$ of the reaction for such a set of data if the reaction order α is not known beforehand (No need to solve). (10%)
- (b) By the integral analysis method, test to see if this is a **zero**, **first** or **second** order reaction for A and calculate the rate constant k in proper unit. (10%)