南台科技大學 100 學年度研究所考試入學招生考試

系組：化材系甲丙組　　准考證號碼：□□□□□□

科目：**反應工程學**　　(請考生自行填寫)

注意事項	一、 請先檢查准考證號碼、報考系(組)別、考試科目名稱，確定無誤後再作答。 二、 所有答案應寫於答案紙上，否則不予計分。 三、 作答時應依試題題號，依序由上而下書寫，作答及未作答之題號均應抄寫。

1. (A) Plug flow reactor (PFR); (B) Semi-batch reactor; (C) Batch reactor (BR;
(D) Mixed flow reactor (BFR or CSTR)。請依下列的問題選出正確的反應器。
(a)屬於 continuous reactor 的是 _____? (3%)
(b)反應物加入反應器中，濃度會迅速下降的連續反應器是 ____? (3%)
(c)設備費用低，但需較高操作人力及操作成本的反應器是 ____? (3%)
(d)只能選一個反應器來生產數量少但種類多的產品，應選擇的反應器是 ___? (3%)
(e)當 recycle reactor 的 recycle ratio = ∞ 時，此 recycle reactor 相當於 _____? (3%)

2.一反應 " $NO + \frac{1}{2} O_2 \rightarrow NO_2$ " 的反應機構如下，

$$NO + NO \underset{k_{-1}}{\overset{k_1}{\leftrightarrow}} N_2O_2 \quad \text{--- (I)}$$

$$N_2O_2 + O_2 \xrightarrow{k_2} 2\,NO_2 \text{ --- (II)}$$

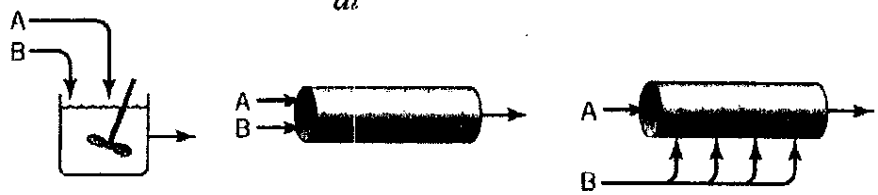
請使用 steady-state approximation 推導證明出速率方程式(rate law)爲

$$\frac{d[NO_2]}{dt} = \frac{2k_1k_2[NO]^2[O_2]}{k_{-1} + k_2[O_2]} \qquad (10\%)$$

3.反應物 A 和 B 經式(I)的反應可得到 T 產物，然而也伴隨著式(II)的反應而產生 S 產物，請從下列三種反應器(含進料方式)中選出何者可得到最高比例的 T 產物?(一定要說明原因) (10%)

$$A + B \xrightarrow{k_1} T \qquad \frac{dC_T}{dt} = k_1 C_A^{1.5} C_B^{0.3} \quad \text{--- (I)}$$

$$A + B \xrightarrow{k_2} S \qquad \frac{dC_S}{dt} = k_2 C_A^{0.5} C_B^{1.8} \quad \text{--- (II)}$$



Reactor (A)　Reactor (B)　Reactor (C)

4. (a) 栓流反應器(Plug Flow Reactor)爲三種理想反應器之一，請說明其特性。(5%)
(b) 下式爲栓流反應器之設計方程式，請說明式中各項的意義。(5%)

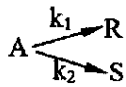
$$\tau = C_{A0} \int_0^{X_{Af}} \frac{dX_A}{-r_A}$$

(c) 一液相反應(A → R)在栓流反應器中進行，進料爲 A (400 liter/min, 100 mmol A/liter)，又

 背面有題

$-r_A = 200C_A \frac{mol}{liter \cdot \min}$。請問若最後 A 轉化率爲 99%時，反應器體積爲若干? (5%)

5. 一階(First-order)的不可逆液相化學反應(A → R)，在一批式反應器中進行，進料之濃度分別爲 C_{A0} = 0.5 mol/L，C_{R0} = 0。在反應 8 分鐘之後，A 之轉化率爲 50%，試求此反應速率式。 (10%)
6. A first-order liquid phase reaction takes place with 60% conversion in a BFR. Now this reactor is replaced by one PFR twice as large as BFR. What will be the conversion if all else conditions remain unchanged? (10%)
7. A second-order liquid phase reaction "A → B + 3C" takes place in two plug flow reactors in series. The volumes of the first and second reactors were 5 and 10 liters, respectively. The rate equation is $-r_A = 0.3 C_A^2$ [mol/liter·min]. The volumetric feed rate is 3 liter/min, and the concentration of the reactant A in feed is 5 mol/L. What is the conversion at the exit of the second PFR? (10%)
8. Consider the parallel unimolecular-type first-order reactions:



The initial concentration of A is $[A]_0$. Neither R nor S is present initially. Derive that the concentration of R = $\frac{k_1[A]_0}{k_1+k_2}(1-e^{-(k_1+k_2)t})$, where t is reaction time. (10%)

9. (a) Briefly describe the following terms and give an example for each term: (5%)
   i. Rate equation
   ii. Order of reaction
   (b) The temperature dependence of the rate constant is often represented by Arrhenius' law. Please write down the expression for the Arrhenius' law and explain its parameters. (5%)