

國立臺北科技大學 108 學年度碩士班招生考試

系所組別：3510 化學工程與生物科技系化學工程碩士班甲組

第二節 化工熱力學與反應工程 試題

第一頁 共一頁

注意事項：

1. 本試題共 3 題，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，並詳列計算過程及最後答案及單位，否則不予計分。

(1)(30 分) The isothermal reaction $A \rightarrow B$ is carried out in a liquid phase. The feed rate of A is 10 L/min (v_0) with the concentration of 2 mole/L (C_{A0}). The rate law is $-r_A = kC_A$, and $k=0.5 \text{ min}^{-1}$. If the process is kept at steady state, and the volume flow rate is constant ($v=v_0$), what is the volume (V_1) of CSTR necessary to achieve 50% conversion of A; then followed by a PFR (plug flow reactor) of volume (V_2) in series to reach conversion of 80%?
[$V_1 = ? \text{ (L)}$; $V_2 = ? \text{ (L)}$]

(2)(20 分) The isothermal reaction $A \rightarrow B$ was carried out in a batch reactor. The measured initial reaction rates of A: $-r_{A0}=0.05 \text{ mol/(L}\cdot\text{min)}$ at the initial concentration of A: $C_{A0}=0.01 \text{ mole/L}$; and $-r_{A0}=0.1 \text{ mol/(L}\cdot\text{min)}$ at $C_{A0}=0.04 \text{ mole/L}$, respectively. If rate law is $-r_A=kC_A^n$, what are the rate constant: k , and the reaction order: n ? **[$k=? \text{ (unit=?)}$; $n=?$]**

(3)(3-1)(30 分) An idea gas undergoes the following sequence of mechanically **reversible** processes in a closed system: (a) From an initial state of 60°C and 1 bar, it is compressed adiabatically to 120°C . (b) It is then cooled from 120 to 60°C at constant pressure. (c) Finally, it is expanded isothermally to its original state. **Calculate W, Q, and ΔH for the entire cycle.** Take $C_v=(3/2)R$ and $C_p=(5/2)R$, and $R=8.314 \text{ J mol}^{-1}\text{K}^{-1}$. **[$W=? \text{ (J)}$, $Q=? \text{ (J)}$, and $\Delta H=? \text{ (J)}$]**

(3-2)(20 分) If these processes are carried out **irreversibly** but so as to accomplish exactly the same changes of state (i.e., the same changes in P, T, U, and H). If each step is carried out with an efficiency of 75%, **calculate W and Q for the entire cycle.** Note that the process (a) can no longer be adiabatic. **[$W=? \text{ (J)}$, $Q=? \text{ (J)}$]**

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