107CH03

國立臺北科技大學 107 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

注意事項：

1. 本試題共五題，每題二十分，共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Consider the reaction mechanism:

i + S → i · S (1)

w + S → w · S (2)

i · S + w · S → t · S + S (3)

t · S → t + S (4)

Derive a rate law assuming:

(a) (7%) The surface reaction is rate-limiting.

(b) (6%) The adsorption of i is rate-limiting.

(c) (7%) The surface reaction is rate-limiting and the reaction follows Eley-Rideal kinetics.

i · S + w → t · S (hint: The reaction (2) and (3) should be modified or deleted.)

2. Consider the system with the reactors in series: PFR → CSTR → PFR, the entering molar flow rate (F_{A0}) is 50 kmol/h and the final conversion is 85%.

X	0.0	0.1	0.2	0.4	0.75	0.80	0.85
$-r_A$ (kmol/m^3·h)	1.25	1.667	2.5	2.5	2.5	1.25	0.833

(a) (10%) What are the reactor volumes if the two intermediate conversions (X_1 and X_2) are 40% and 60%, respectively?

(b) (10%) What are the conversions X_1 and X_2 if all the reactors have the same volume?

3. Carnot cycle heat engine receives 300 kJ from reservoir at 300 °C, releases heat at 25 °C.

(a) (8%)Calculate the work and the efficiency of the cycle.

(b) (8%)Calculate the entropy change of the high-temperature and low temperature reservoirs.

(c) (4%)Show the cycle on a T-S diagram. The working fluid is the system.

4. The enthalpy of a binary system of A and B at constant temperature and pressure is shown as follows.

$$H = 100\,x_A + 200\,x_B + x_A \cdot x_B(20\,x_A + 10\,x_B)$$

(a)(6%) Determine expressions for $\overline{H_A}$ and $\overline{H_B}$ as a function of x_A.

(b)(6%)Determine the numerical values of enthalpy for pure A and pure B.

(c)(8%)Determine the numerical values of partial molar enthalpy for A and B at infinite dilution.

5. Components A and B comprising a binary system with vapor and liquid phases in equilibrium at temperature of 343.15 K. Activity coefficients for A and B are as follows.

$$\ln(\gamma_A) = x_B^2 \text{ and } \ln(\gamma_B) = x_A^2$$

Where x_A and x_B are the mole fractions of component A and B in the liquid phase, respectively. The saturated pressures are P_A^{sat} = 60 kPa and P_B^{sat} = 30 kPa. At x_A = 0.4, answer the following questions. Assume that the vapor phase is ideal.

(a)(10%)The bubble pressure.

(b)(10%)The vapor composition, y_A and y_B.