淡江大學 100 學年度碩士班招生考試試題

57-1

系別：化學工程與材料工程學系　　科目：化工熱力學及反應工程

考試日期:2 月 28 日(星期一) 第 3 節　　本試題共 4 大題， 2 頁

本試題雙面印刷

Problem 1 (25pt)

An ideal gas undergoes the following reversible processes in a cycle: (i) from an initial state of 80 °C and 1 bar, it is compressed adiabatically to 160 °C; (ii) the gas is cooled from 160 °C to 80 °C at constant pressure; (iii) the gas is expanded isothermally to its original state. **Calculate** the work (W), heat (Q), ΔU, and ΔH per g-mole of the gas for each of the three processes and for the entire cycle. The heat capacity of the gas at constant volume, C_v, is $3R/2$, and gas constant R = 8.314 J/g-mole K.

Problem 2 (25pt)

A gas enters a reversible isothermal compressor at 520 °R and 10 atm and is continuously compressed to 150 atm. **Calculate** the work per lb-mole of the gas needed to run the compressor and the amount of the heat per lb-mole of the gas that must be removed from the compressor if the gas behaves according the equation of state

$$PV = RT + (b - \frac{a}{T})P$$

where a = 11.13 °R ft^3/lb-mole, b = 0.2445 ft^3/lb-mole.

Hint: The gas constant R = 1.987 Btu/lb-mole °R, and 1 Btu = 0.367 atm ft^3.

$$dH = C_P dT + [V - T(\frac{\partial V}{\partial T})_P]dP \quad \text{and} \quad dS = C_P \frac{dT}{T} - (\frac{\partial V}{\partial T})_P dP$$

背面尚有試題

Problem 3 (25pt)

The elementary liquid-phase reaction

$$A + 2B \rightarrow R$$

with rate equation

$$-r_A = -\frac{1}{2} r_B = 2.5 C_A C_B^2 \quad [\frac{\text{mol}}{\text{dm}^3 \text{ min}}]$$, where C_A and C_B are in unit of [mol/dm^3]

is carried out in a CSTR reactor. Two feed streams are introduced into the reactor. The inlet of reactant A is in one feed of 1.0 dm^3/min flow rate containing 2.0 mol A/dm^3, and the inlet of reactant B is in the other feed of 2.0 dm^3/min flow rate containing 1.5 mol B/dm^3. If 80% conversion of component B is desired, **calculate** the required volume of the CSTR? Assume a constant density system.

Problem 4 (25pt)

The series reaction $A \rightarrow B \rightarrow C$ with the reaction rates

$$A \rightarrow B, \quad r_1 = k_1 C_A = 0.5\, C_A \quad [\text{mole/dm}^3\text{min}]$$

$$B \rightarrow C, \quad r_2 = k_2 C_B = 0.1 C_B \quad [\text{mole/dm}^3\text{min}]$$

is carried out in a plug-flow reactor (PFR). The volumetric flow rate of feed is 4 dm^3/min having C_{Ao} = 2 mole/dm^3 and without component B or C. The volumetric flow rate in the reactor is assumed to be constant. If the conversion of A is 80%, **calculate** the space time, reactor volume, outlet concentrations of B and C, the overall selectivity of B/C, and the overall yield of B.