

淡江大學 101 學年度碩士班招生考試試題

系別：化學工程與材料工程學系

科目：化工熱力學 50%

考試日期：2月26日(星期日) 第3節

本試題共 3 大題， 1 頁

Problem 1 (15 points)

Fifty kmol per hour of air is compressed from $P_1 = 1.2$ bar to $P_2 = 6.0$ bar in a steady-flow compressor. Delivered mechanical power is 98.8 kW. Temperatures and velocities are $T_1 = 300$ K, $u_1 = 10$ m/s, $T_2 = 520$ K and $u_2 = 3.5$ m/s. Estimate the rate of heat transfer from the compressor. Assume for air that $C_p = 3.5 R$ and the enthalpy is independent of pressure.

Problem 2 (15 points)

Explain the following terminologies: (a) the efficiency of a heat engine, (b) the coefficient of performance of a refrigerator, (c) fugacity?

Problem 3 (20 points)

The molar volume (cm^3/mol) of a binary liquid mixture at T and P is given by:

$$V = 120x_1 + 70x_2 + (15x_1 + 8x_2)x_1x_2$$

- Find expressions for the partial molar volumes of species 1 and 2 at T and P .
- Show that those expressions obtained in part (a) satisfy the Gibbs/Duhem equation.
- Plot values of V , \bar{V}_1 (the partial molar volume of species 1), and \bar{V}_2 vs. x_1 . Label points V_1 , V_2 , \bar{V}_1^∞ (the infinite-dilution value of \bar{V}_1), and \bar{V}_2^∞ , and show their values.

本試題雙面印刷

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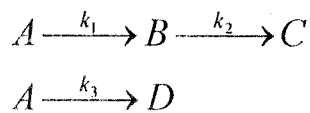
系別：化學工程與材料工程學系

科目：反應工程 50%

考試日期：2 月 26 日(星期日) 第 3 節

本試題共 2 大題， 1 頁

1. The elementary liquid phase series reaction



is carried out in an isothermal batch reactor. The initial concentration of A is C_{A0} . B, C and D are not present in the reactor initially.

- (a) Derive a relationship that will express C_B as a function of reaction time. (15%)
(b) Derive the reaction time for which C_B is a maximum. (10%)

2. The first order irreversible gas phase reaction $A \rightarrow B$ is to be carried out in a packed bed reactor isothermally. Currently 1000 kg of catalyst are packed in a 4 cm diameter pipe. The catalyst particles are 0.5 cm in diameter and the bulk density of the packed catalyst is 1000 kg/m³. Currently 15.0 % conversion of A is realized. The entering pressure is 20 atm and the pressure at the exit of the reactor is 9 atm.

- (a) Calculate the pressure parameter in the given equation, α , in the present system.. (5 %)
(b) What conversion could be achieved in a CSTR with the same catalyst weight and no pressure drop? (20 %)

$$\frac{P}{P_0} = \sqrt{1 - \alpha W} \quad \text{for isothermal system with fixed total number of moles.}$$

Where P is the pressure of the stream entering the packed bed reactor

P_0 is the pressure of the stream leaving the packed bed reactor

α is the pressure parameter

W is the weight of catalyst in the packed bed reactor

$$\text{Given integral } \int_0^W (1 - \alpha W)^{1/2} dW = \frac{2}{3\alpha} [1 - (1 - \alpha W)^{3/2}]$$