系所別：化學工程與材料工程學系 科目：化工熱力學及化學反應工程

化工熱力學

A 1、定義 ideal gas temp.(T) scale 與 thermodynamic temp. (θ)，並証明 $T=\theta$。(5%)

A 2、(a) 一合理之 eq. of state 須滿足何條件? (2%)

(b) 儘量寫出 eq. of state 之名稱。(3%)

A 3、(a) 解釋可逆程序。(2%)

(b) 如何判別一程序之可逆性，並舉例証明之。(3%)

A 4、衍導 $dM=(\frac{\partial M}{\partial T})_{P,x}dT+(\frac{\partial M}{\partial P})_{T,x}dP+\sum \overline{M_i}dx_i$。(2%)

A 5、定義 ideal solution 並証明 $\overline{V_i}^{id}=V_i$ 與 $\overline{H_i}^{id}=H_i$。(5%)

A 6、衍導 $d\overline{G_i}=-\overline{S_i}dT+\overline{V_i}dP$ at const. x。(3%)

A 7. Define or explain the following terms with statements or equations (3% each)

a) Azeotropic mixture

b) How to separate an azeotropic mixture

c) Flash process

A 8. A flue gas consists mainly of methane, ethane, propane, butane, and carbon dioxide in a petroleum refinery is burned. What could be the maximum temperature for this combustion if this flue gas is burned with oxygen in an insulated container initially at 298 K. You do not have to do numerical calculation, but please write down every computation step, equations, and the thermodynamic properties you need in detail. (16%)

參考用

注意：背面有試題

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化学反應工程

(B1) Pure gas A (reaction $A \rightarrow 2R$; $-r_A = (5\ h^{-1})C_A$) with volumetric flow rate 0.5 m^3/h is fed into a steady mixed flow reactor. Find the reactor volume needed if the final conversion of A is 60 %.

<Hint> for constant ε_A, $C_A/C_{A0} = (1-x_A)/(1+\varepsilon_A x_A)$ (10 %)

(B2) Give a parallel reaction,

$$A \nearrow R_{desired},\quad r_R = (1\ m^3/kmol\cdot min)C_A^2$$
$$A \searrow S,\quad r_S = (3\ min^{-1})C_A$$

(a) What is the fractional yield expression $\varphi(R/A)$ for this system?

(b) In what type of single reactor, plug or mixed, would you expect to find the $C_{R,max}$? Also, give the reasons.

(c) What is this $C_{R,max}$ if $C_{A0} = 1\ kmol/m^3$? (15 %)

(B3) The kinetics of the aqueous-phase decomposition of A is investigated in two-mixed flow reactors in series, the second having three folds the volume of the first reactor. At steady state with a feed concentration of 1 mol A/liter and mean residence time of 36 sec in the first reactor, the concentration in the first reactor is 1/3 mol A/liter and in the second is 1/9 mol A/liter. Find the kinetic equation for the decomposition. (10%)

(B4) Experimental studies of a specific decomposition of A in a batch reactor using pressure units show exactly the same rate at two different temperatures:

at 500 K $-r_A = 3.5\ (p_A)^2$

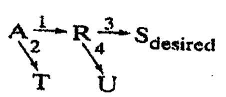
at 600 K $-r_A = 3.5\ (p_A)^2$

where the units of $-r_A$ and p_A are mol/m^3 sec and atm, respectively.

Gas constant = $82.06 \times 10^{-6}\ m^3$ atm/ mol K. Calculate the activation energy. (7%)

(B5)

The first-order reactions



$$k_1 = 10^9 e^{-6000/T}$$
$$k_2 = 10^7 e^{-4000/T}$$
$$k_3 = 10^8 e^{-9000/T}$$
$$k_4 = 10^{12} e^{-12{,}000/T}$$

are to be run in two mixed flow reactors in series anywhere between 10 and 90°C. If the reactors may be kept at different temperatures, what should these temperatures be for maximum fractional yield of S? Find this fractional yield.

(8%)