國立中央大學八十六學年度碩士班研究生入學試題卷

A 化工熱力學 (50%)

A1 Explain the first law of thermodynamics in words. (4%)

A2 Explain the important concepts of the second law of thermodynamics. (6%)

A3 The Redlich-Kwong equation of state is

$$P=\frac{RT}{V-b}-\frac{a}{T^{\frac{1}{2}}V(V+b)}$$

a) How do you obtain parameters a and b of a pure component? (3%)

b) Explain why you can use above mathematical relations. (3%)

A4 Given the thermodynamic relationship $dG=-SdT+Vdp$, please

a) define fugacity from this equation and explain why. (6%)

b) what is the role of fugacity in phase equilibria? (3%)

A5 敘述一化學系統之 "equilibrium" 与 "reversible process" 及其成立之通則. (5%)

A6 Ideal gas temp. 与 thermodynamic temp. 如何定義? 两者為何相等? (5%)

A7 敘述導致一系統 "entropy" 增加之各种因素. (5%)

A8 对於一密閉系統, 則 $\oint \frac{dQ}{T} \leq 0$, 試証之. (6%)

A9 儘量舉出求得 fugacity coefficient 与 activity coefficient 之方法. (4%)

B. Chemical Reaction Engineering (50%):

(B1) The irreversible isomerization A ⟶ B was carried out in a batch reactor and the following concentration-time data were obtained:

t (min)	0	5	8	10	12	15	17.5	20
C_A (mol/dm^3)	4.0	2.25	1.45	1.0	0.65	0.25	0.06	0.08

Determine the reaction order and the specific reaction rate. (12%)

(B2) An irreversible reaction A ⟶ R was carried out in a plug flow reactor. The rate equation is

$$-r_A = C_A/(1 + C_A)^2$$

The flow rate of feed is 0.2 m^3/sec. The concentration of A in the feed is 10 kmol/m^3. What is the reactor volume to get the 99 % conversion of A?

(Hint) $$\int \frac{X\,dX}{(a+bX)^2} = \frac{1}{b^2}\left[\ln(a+bX) + \frac{a}{a+bX}\right]$$ (13%)

(B3) Given the reactions

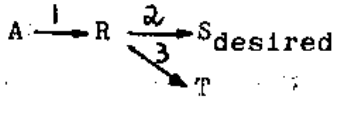
$2A \longrightarrow R_{desired}$, $r_R = C_A^2$

$A \longrightarrow S$, $r_S = 2C_A$

(a) What is the fractional yield expression $\mathcal{P}(R/A)$ for this system?

(b) In what type of single reactor, plug or mixed, would you expect to find the $C_{R,max}$? (12%)

(B4) Determine the conditions such as T, C_A (high, low, intermediate, rising, falling, etc.) and reactor type (plug, mixed) which will favor the formation of the desired product indicated. Also, give the reasons.



n_1, E_1	n_2, E_2	n_3, E_3
1, 25	2, 35	0, 45

where n_i: reaction order of ith step
E_i: activation energy of ith step

(13%)