

所別	科目	准考證號碼 (請考生填入)	考試日期	節次	第一頁/共=頁
化學工程研究所	化工熱力學與化工動力學		94年5月1日	第二節	

可使用非記憶性電子計算機；第 1~5 題為熱力學，第 6~10 題為動力學。

1. The van der Waals equation of state: $P = \frac{RT}{V-b} - \frac{a}{V^2}$

please prove the $Z_c = \frac{3}{8}$ (10%)

2. (a) A closed, nonreactive system contains species 1 and 2 in vapor/liquid equilibrium. Species 2 is a very light gas, essentially insoluble in the liquid phase. The vapor phase contains both species 1 and 2. Some additional moles of species 2 are added to the system, which is then restored to its initial T and P . As a result of the process, does the total number of moles of liquid increase, decrease, or remain unchanged? (5%)

(b) A system comprised of chloroform, 1,4-dioxane, and ethanol exists as a two-phase vapor/liquid system at 50°C and 55kPa . It is found, after the addition of some pure ethanol, that the system can be returned to two-phase equilibrium at the initial T and P . In what respect has the system changed, and in what respect has it not changed? (5%)

3. Show that $(\frac{\partial s}{\partial T})_p = \frac{C_p}{T}$ and $(\frac{\partial s}{\partial T})_v = \frac{C_v}{T}$. (10%)

4. For a steam at condition with temperature T being 100°C and specific volume v being $2731\text{ cm}^3/\text{g}$, please calculate the pressure(Pa) by

(1) ideal gas; (5%)

(2) van der Waals equation. (5%)

The critical conditions of water are given as $T_c = 647.3\text{K}$ and $P_c = 221.2\text{bar}$.

5. 1 g-mole of an ideal gas is reversibly and adiabatically compressed from an initial volume of 30000 cc to a final volume of 5000 cc. The initial temperature is 298 K. How much work is done (J) and what is the final temperature (K)?

The specific heat $C_v = \frac{5}{2}R$. (10%)

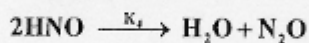
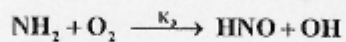
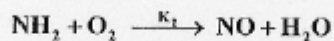
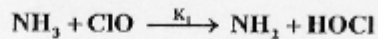
6. For the decomposition $A \rightarrow R$, $C_{A0} = 1\text{ mol/liter}$, in a batch reactor conversion is 75% after 1 hour, and is just complete after 2 hours. Find a rate equation to represent these kinetics. (10%)

7. For the reaction in series $A \xrightarrow{k_1} R \xrightarrow{k_2} S$, $k_1 = k_2$. Find the maximum concentration of R and when it is reached. (10%)

8. Milk is pasteurized if it is heated to 63°C for 30min, but if it is heated to 74°C it only needs 15second. Find the activation energy of this sterilization processes. (10%)

所別	科目	准考證號碼 (請考生填入)	考試日期	節次	第二頁/共三頁
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9. The proposed mechanism for the oxidation of ammonia into N_2O in the presence of ClO is shown below:



- (1) Make your assumptions and derive the rate equation of N_2O . (5%)
 (2) Discuss the reaction rate for the cases of (a) $K_2 \gg K_3$ and (b) $K_3 \gg K_2$. (5%)
10. The desired product B is obtained from the elementary reaction $A \xrightarrow{K} B$ ($K = 10 \text{ hr}^{-1}$). The feed flow rate is 50 liter/hr and the concentration of reactant A is 0.10 mol/l. If two CSTR (5 liter each) and two PFR (5 liter each) are available, what kind of arrangement should be used in order to get the maximum conversion if you can choose any two reactors? (10%)