

元智大學 103 學年度研究所 碩士班 招生試題卷

系(所)別： 化學工程與材料 科學學系碩士班 組別： 不分組-選考 A 科目： 化工熱力學與化工動力學 用紙第 / 頁共 / 頁

● 可使用現行『國家考試電子計算器規格標準』規定第二類之計算機

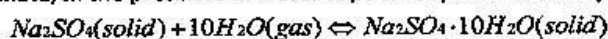
1. Conceptual Questions (answer and explain) (10 %)

5% (a) Is it possible for two objects to be in thermal equilibrium if they are not in thermal contact with each other?

5% (b) Suppose two equal-sized rooms are connected via an open doorway, but one room is warmer than the other. How is this possible? Which room would have more air molecules?

10% 2. (a) Please estimate the constant-pressure heat capacity of ethanol gas at 150 bar and 350K. (b) Please compute the change of enthalpy if ethanol gas change from 150 bar (350K) to 250 bar (500K)? Data: $\alpha = 2.25 \cdot 10^{-4} \text{ K}^{-1}$; $\hat{V} = 2.5 \text{ cm}^3 \text{ g}^{-1}$; $\left(\frac{\partial \alpha}{\partial T}\right)_P = 8.5 \cdot 10^{-6} \text{ K}^{-2}$. (20%)

3. Crystalline sodium sulfate, in the presence of water vapour may form a decahydrate, (20%)



10% (a) Estimate the minimum partial pressure of water at which the decahydrate will form at 25°C.

10% (b) Predict the minimum water partial pressure for decahydrate formation at 15°C.

	$\Delta_f H^\circ$	$\Delta_f G^\circ$
$\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$	-4322.5	-3642.3 kJ/mol
Na_2SO_4	-1382.8	-1265.2
H_2O	-241.8	-228.6

4. Consider a first order reaction $A \rightarrow B$ is carried out in a plug flow reactor (PFR) in which the volumetric flow rate, v , is constant. Determine the reactor volume necessary to reduce the exiting concentration to 10% of the entering concentration when the volumetric flow rate is $10 \text{ dm}^3/\text{min}$ and the specific reaction rate, k , is 0.23 min^{-1} . (10%)

5. The simple gas phase isothermal first order reaction is $A \rightarrow R$. $-r_A = k C_A$, where $k = 10 \text{ h}^{-1}$. The inlet volumetric flow rate is $10 \text{ m}^3 \text{ h}^{-1}$. We design the process with a CSTR (continuous stirred tank reactor) followed by a PFR. Both CSTR and PFR are of volume 1 m^3 . What is the final conversion for the process? (20%)

6. A specific enzyme acts as catalyst in the fermentation of reactant A. The enzyme concentration in the aqueous feed stream C_{A0} is 2 mol dm^{-3} , and the inlet volumetric flow rate is $25 \text{ dm}^3 \text{ min}^{-1}$. Find the volume of the plug flow reactor needed for 95% conversion of reactant A. The rate expression is $-r_A = \frac{0.1 C_A}{1 + 0.5 C_A} \text{ mol dm}^{-3} \text{ min}^{-1}$. (10%)

7. The liquid phase reaction $A \rightarrow B$ is carried out in a CSTR. Inlet molar flow rate is 50 kmol h^{-1} . The data were obtained as follows:

X (conversion)	0	0.2	0.4	0.6	0.65
$-r_A$ ($\text{kmol m}^{-3} \text{ h}^{-1}$)	39	53	59	38	25

Please determine the reactor volume that required for a 40% conversion. (10%)

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