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 1 頁共 1 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?

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

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

$$Na_2SO_4(solid)+10H_2O(gas)\Leftrightarrow Na_2SO_4\cdot 10H_2O(solid)$$

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.

	$\Delta_f H^\circ$	$\Delta_f G^\circ$
$Na_2SO_4\cdot 10H_2O$	−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→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 dm^3/min and the specific reaction rate, k, is 0.23 min^{-1}. (10%)

5. The simple gas phase isothermal first order reaction is A→R. $-r_A=k\ C_A$, where k=10 h^{-1}. The inlet volumetric flow rate is 10 $m^3\ h^{-1}$. 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 $dm^3\ min^{-1}$. Find the volume of the plug flow reactor needed for 95% conversion of reactant A. The rate expression is $-r_A=\frac{0.1C_A}{1+0.5C_A}$ mol $dm^{-3}\ min^{-1}$.(10%)

7. The liquid phase reaction A→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
$-r_A$ (kmol $m^{-3}\ h^{-1}$)	39	53	59	38	25

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