國立臺北科技大學105學年度碩士班招生考試

系所組別：3510化學工程與生物科技系化學工程碩士班甲組

第三節　化工熱力學與反應工程　試題

注意事項：

1. 本試題共六題，共100分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1.The metal evaporation rate W ($g \cdot cm^{-2}s^{-1}$) in thin film deposition is：

$$W = 5.83\times10^{-2}\frac{P_v M^{1/2}}{T^{1/2}}$$

Since P_v is temperature-dependent, the vapor pressure-temperature relationship is defined as：

$$\log_{10} P_v = A - \frac{B}{T}$$

where P_v is pressure (torr), T is temperature (K) and M is molecular weight.
Calculate the evaporation rate for an aluminum (M=27) at 1219℃. (10%)
Data：A=8.79, B=1.594x10^4.

2.You have just been delivered a tank containing a mixture of n-butane (83.3% by mol) and n-octane at 25℃ and 1 bar. Your boss asks you to measure the viscosity of the mixture, so you have to take a sample for analysis. One technician says you should collect the sample in a test tube because the contents are in the liquid phase. Another technician says you should use a balloon because the contents of the tank are in the vapor phase. A third technician is looking at you waiting for your instructions. What do you do? State all your assumptions and justify your reasoning with calculations. (20%)
Additional data：The saturation pressures of n-butane and n-octane are 2.34 bar and 0.0175 bar, respectively.

3.A gas is found to obey the following equation of state:

$$P(V-b)=RT$$

Obtain the entropy and enthalpy departure from the ideal gas. (20%)

4.When a concentrated urea solution is stored it slowly condensed to biuret by the following elementary reaction：

$$2NH_2-CO-NH_2 \rightarrow NH_2-CO-NH-CO-NH_2+NH_3$$

To study the rate of condensation a sample of urea (C=20 mol/liter) is stored at 100℃ and after 7 hr 40 min we find that 1 mol% has turned into biuret. Find the rate equation for this condensation reaction. (15%)

5.A specific enzyme acts as catalyst in the fermentation of reactant ***A***. At a given enzyme concentration in the aqueous feed stream (25 liter/min) find the volume of plug flow reactor needed for 95% conversion of reactant ***A*** (C_{A0}=2 mol/liter). (15%)

The kinetics of the fermentation at this enzyme concentration is given by

$$A \rightarrow R, \quad -r_A = \frac{0.1C_A}{1+0.5C_A} \quad \frac{mol}{liter \cdot \min}$$

6.Chemical ***A*** reacts to form ***R*** (k_1=6 hr^{-1}) and ***R*** reacts away to form ***S*** (k_2=3 hr^{-1}). In addition ***R*** slowly decomposes to form ***T*** (k_3=1 hr^{-1}). If a solution containing 1.0 mol/liter of ***A*** is introduced into a batch reactor, how long would it take to reach $C_{R,max}$, and what would be $C_{R,max}$? (20%)