

國立高雄應用科技大學
105 學年度研究所碩士班招生考試
化學工程與材料工程系碩士班
化工熱力學及動力學

注意：本試題共 8 題，共 100 分，作答時不需抄題。

*** 化工熱力學 ***

1. 請寫出四個熱力學的麥克斯威爾關係式(Maxwell's relations) (10%)
2. 已知水及冰的莫耳體積分別為 $18.0 \text{ cm}^3/\text{mole}$ 及 $19.6 \text{ cm}^3/\text{mole}$ ，在 1 atm 下，水的冰點 0°C ，其凝固熱 $\Delta H = -6.0 \text{ kJ/mole}$ ，試問水在 150 atm 時的冰點為何？ (10%)
3. Calculate ΔU for 1 kg of water when it is vaporized at the constant temperature of 373 K and the constant pressure of 101.33 kPa. The specific volumes of liquid and vapor water at these conditions are 0.00104 and $1.673 \text{ m}^3\text{kg}^{-1}$. For this change, heat in the amount of 2400 kJ is added to the water. (15%)
4. A central power plant, rated at 700000 kW, generates steam at 550 K and discards heat to a river at 250 K. If the thermal efficiency of the plant is 65% of the maximum possible value, how much heat is discarded to the river at rated power? (15%)

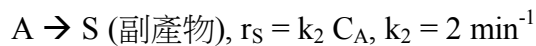
*** 化工動力學 ***

5. In a 20 dm^3 well mixed, constant-volume batch reactor, the gas-phase reaction $A \rightarrow B + C$ is carried out isothermally. Pure A (20 moles) is initially placed in the reactor.
 - (1) If the reaction is: $-r_A = kC_A$ with $k = 0.865 \text{ min}^{-1}$, (a) what is the reaction order? and (b) calculate the time necessary to reduce the number of moles of A in the reactor to 0.2 mol . (5%)
 - (2) If the reaction is: $-r_A = kC_A^2$ with $k = 2 \text{ dm}^3/\text{mol}\cdot\text{min}$, (a) what is the reaction order? and (b) calculate the time necessary to consume 19 mol of A. (5%)
 - (3) if the temperature is 127°C . What is the final total pressure assuming the reaction goes to completion? (5%)

6. 試計算下列反應之平衡轉化率及各物種的濃度。

- (1) 液相反應 $A + B = C$ ，已知 $C_{A0} = C_{B0} = 2 \text{ mol/dm}^3$ ， $K_C = 10 \text{ dm}^3/\text{mol}$ 。 (5%)
- (2) 氣相反應 $A = 3C$ ，純 A 在 400K 及 10 atm 下進入反應器，在沒有壓力降之流動反應器中進行， $K_C (@400K) = 0.25 \text{ dm}^3/\text{mol}^2$ 。 (5%)
- (3) 同上述(2)之氣相反應之條件，但是在定容批式反應器中進行。 (5%)

7. 液相反應物 A 之分解反應如下：



一水溶液進料 ($C_{A0} = 40 \text{ mol/m}^3$) 進入一塞流反應器 (PFR) 分解後，混合物 A, R, S 離開反應器，如果 $X_A = 0.9$ ，(a) 請問此反應屬於串聯或平行反應，(b) 請算出 C_S, C_R, C_A 。 (10%)

$$[\text{Note: } \int dC_A/(1+0.2 C_A) = 5 \ln(1 + 0.2 C_A)]; \quad \ln 5 = 1.6]$$

8. The formation of diphenyl is to be carried out by $2C_6H_6 = C_{12}H_{10} + H_2$. The feed is to be pure benzene in the gas phase at the total pressure of 5 atm and 760°C . The specific reaction rate is $1800 \text{ ft}^3/\text{lb}\cdot\text{mol}\cdot\text{s}$ and the concentration equilibrium constant (K_C) is 0.3.

- (1) What is the equilibrium conversion? (5%)
- (2) If the activation energy is $30,202 \text{ Btu/lb}\cdot\text{mol}$, what is the ratio of the initial rate (i.e. $X = 0$) of reaction at 1400°F and 800°F . (5%)

$$[\text{Note: Gas Constant } R = 1.987 \text{ Btu/lb}\cdot\text{mole}\cdot^\circ\text{R}; \quad ^\circ\text{R} = ^\circ\text{F} + 459.7]$$