

1. The irreversible catalytic isomerization $A \rightarrow B$ over pulverized catalysts was carried out in a basket type reactor and the concentration (mole/L)-time(min) data were obtained and shown in the following table.

| | | | | | | | | |
|-------|----|------|------|------|-----|------|------|------|
| time | 0 | 3 | 5 | 8 | 10 | 12 | 15 | 17.5 |
| C_A | 1. | 2.89 | 2.25 | 1.45 | 1.0 | 0.65 | 0.25 | 0.07 |

Determine the reaction order and the reaction constant of a power law model $\text{rate} = kC_A^n$. (15 分)

2. 請選出正確答案並簡單說明其理由(每題 5 分，共 20 分)
- 一般而言溫度對下面那一項之影響最大 (1)表面反應 (2) 內在質傳 (3) 外在質傳 (4) 表面吸附。
 - 下列那一種反應器可能有較大的外在質傳阻力 (1) CSTR (2) Fixed Bed Reactor (3) Batch Reactor (4) Fluidized Bed Reactor .
 - 一自催化反應其反應速率與產物關係為 (1)產物愈多則速率愈快 (2) 產物愈少速率愈快 (3) 無關 (4) 隨著產物增加至最高點後逐漸減少。
 - 抽煙屬於氧化反應的行為，此反應為 (1) 吸附控制 (2) 內在質傳控制 (3) 化學反應控制 (4) 伴隨著質傳與化學反應控制。
3. A homogeneous gas reaction $A \rightarrow 3R$ has a reported rate at 215 °C $-r_A = 10^{-2}C_A^{1/2}$, [mol/liter sec].
Find the space-time needed for 80% conversion of a 50% A-50% inert feed to plug flow reactor operating at 215 °C and 5 atm ($C_{A0} = 0.0625$ mol/liter). (15 分)
Note: expansion factor should be considered in this problem.

4. Define precisely the following terms (total 20 points; 4 points for each item)
 - a. The Second Law of Thermodynamics and the Third Law of Thermodynamics
 - b. Gibbs Free Energy and Super Critical Fluids
 - c. Ideal Gas and Ideal Solution
 - d. Lower critical solution temperature and upper critical solution temperature
 - e. Activity Coefficient and Fugacity Coefficient

5. One mole of an ideal gas at 0°C and 1 bar is allowed to put through the following reversible steps below (in each case starting at 0°C and 1 bar). Calculate w , q , ΔU , and ΔH for each case. (total 20 points; 5 points for each question)
 - a. Cooling at constant volume to -100°C
 - b. Isothermal compression to 100 bar
 - c. Adiabatic expansion to 0.1 bar
 - d. Constant pressure heating to 100°C

6. The vapor-liquid equilibrium of a binary mixture acetone/methanol at 57°C and 760 Torr. It is found that x (acetone) = 0.4 (the mole fraction in the liquid phase) and y acetone = 0.52 (the mole fraction in the vapor phase). Calculate the activity and activity coefficients of both components in the liquid phase on the basis of Raoult's Law. (of note: the vapor pressures of the pure component at this temperature are P^* (acetone) = 786 Torr and P^* (methanol) = 551 Torr, respectively) (10 points)