國立高雄大學 101 學年度研究所碩士班招生考試試題

科目：化工熱力學與化學反應工程　系所：化學工程及材料工程學系（甲組）　是否使用計算機：是

考試時間：100 分鐘　本科原始成績：100 分

Table: Values of the universal gas constant

$R = 8.314\ J\ mol^{-1}\ K^{-1} = 8.314\ m^3\ Pa\ mol^{-1}K^{-1}$
$= 83.14\ cm^3\ bar\ mol^{-1}\ K^{-1} = 8314\ cm^3\ kPa\ mol^{-1}\ K^{-1}$
$= 82.06\ cm^3\ (atm)\ mol^{-1}\ K^{-1} = 62356\ cm^3\ (torr)\ mol^{-1}\ K^{-1}$
$= 1.987\ (cal)\ mol^{-1}\ K^{-1} = 1.986\ (Btu)(lb\ mole)^{-1}\ (R)^{-1}$
$= 0.7302\ (ft)^3\ (atm)\ (lb\ mol)^{-1}\ (R)^{-1} = 10.73\ (ft)^3\ (psia)(lb\ mol)^{-1}\ (R)^{-1}$
$=1545\ (ft)(lb_f)(lb\ mol)^{-1}(R)^{-1}$

1. The volume change of mixing ($cm^3\ mol^{-1}$) for the system ethanol(1)/methyl butyl ether(2) at 25 ℃ is given by the equation:

$$\Delta V = x_1 x_2[-1.026 + 0.220(x_1 - x_2)]$$

Given that $V_1 = 58.63\ cm^3\ mol^{-1}$ and $V_2 = 118.46\ cm^3\ mol^{-1}$, what volume of mixture is formed when 750 cm^3 of pure species 1 is mixed with 1500 cm^3 of pure species 2 at 25℃? What would be the volume if an ideal solution were formed? (20%)

2. Fifty mol s^{-1} of enriched air (50 mol % N_2, 50 mol % O_2) are produced by continuously combining air (79 mol % N_2, 21 mol % O_2) with a stream of pure oxygen. All streams are at the constant conditions T = 25℃ and P = 1.2 atm. There are no moving parts.

(a) Determine the rates of air and oxygen (mol s^{-1}). (7%)

(b) What is the rate of heat transfer for the process? (7%)

(c) What is the rate of entropy generation S_G (WK^{-1})? (7%)

3. Two kmol hr^{-1} of liquid n-octane (species 1) are continuously mixed with four kmol hr^{-1} of liquid iso-octane (species 2). The mixing process occurs at constant T and P; mechanical power requirements are negligible. (20%)

(a) Use an energy balance to determine the rate of heat transfer.

(b) Use an entropy balance to determine the rate of entropy generation (WK^{-1}).

State and justify all assumptions.

4.The kinetics of the aqueous phase decomposition of A is investigated in two mixed reactors in series, the second having twice the volume of the first reactor. At steady state with a feed concentration of 1 mol A/liter and mean residence time of 96 sec in the first reactor, the concentration in the first reactor is 0.5 mol A/liter and in the second is 0.25 mol A/liter. Find the kinetic equation for the decomposition. (19%)

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5. A homogeneous liquid phase reaction

$$A \rightarrow R, \qquad -r_A = kC_A^2$$

take place with 50 % conversion in a mixed reactor.

(a) What will be the conversion if this reactor is replaced by one 6 times as large－all else remaining unchanged? (10%)

(b) What will be the conversion if the original reactor is replaced by a plug flow reactor of equal size－all else remaining unchanged? (10%)