

# 國立中正大學九十學年度碩士班招生考試試題

系所別：化學工程學系

科目：化工熱力學與化工動力學

1. Calculate the equilibrium conversion and concentrations for each of the following reactions.

(a) The liquid-phase reaction



with  $C_{A0} = C_{B0} = 2 \text{ mol/dm}^3$  and  $K_C = 10 \text{ dm}^3/\text{mol}$ . (5%)

(b) The gas-phase reaction

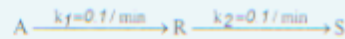


carried out in a flow reactor with no pressure drop. Pure A enters at a temperature of 400°K and 10 atm. At this temperature,  $K_C = 0.25 \text{ dm}^3/\text{mol}^2$ . (5%)

(c) The gas-phase reaction in part (b) carried out in a constant-volume batch reaction. (5%)

(d) The gas-phase reaction in part (b) carried out in a constant-pressure batch reaction. (5%)

2. Under appropriate conditions A decomposes as follows:



R is produced from 1000 liter/hr of feed in which  $C_{A0} = 1 \text{ mol/liter}$ ,  $C_{R0} = C_{S0} = 0$ .

(a) What size of plug flow reactor will maximize the concentration of R, and what is that concentration in the effluent stream from this reactor? (10%)

(b) What size of mixed flow reactor will maximize the concentration of R, and what is  $C_{R,max}$  in the effluent stream from this reactor? (10%)

3. Consider the following power-law rate for the reaction



The reaction is carried out isothermally. For what values of  $n$  will a CSTR give a greater conversion than a PFR of equal volume? (10%)

4. A stream of ethane gas at 220°C and 30 bar expands isentropically in a turbine to 2.6 bar. Assuming the ethane gas is an ideal gas and the heat capacity is  $3.5R$  (where  $R$  is the gas constant), determine the temperature of the expanded gas and the work produced. (25%)

5. A 30 m<sup>3</sup> tank contains 14 m<sup>3</sup> of liquid *n*-butane in equilibrium with its vapor at 25°C. The vapor pressure of *n*-butane at the given temperature is 2.43 bar. The critical temperature of *n*-butane is 152°C and the critical pressure is 37.96 bar. Estimate the mass of *n*-butane vapor in the tank using the following compressibility factor: (25%)

$$Z = 1 - 0.7861 \frac{P_r}{T_r}$$

where  $P_r$  and  $T_r$  are reduced  $P$  and  $T$ .

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