淡江大學九十學年度碩士班招生考試試題

系別：化學工程學系　　科目：化工熱力學 50%

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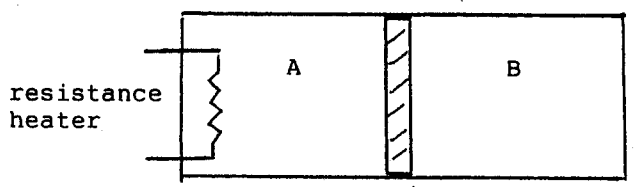
Chemical Engineering Thermodynamics Section

Problem 1: 25 points

A rigid cylinder contains a floating piston, free to move within the cylinder without friction. Initially, it divides the cylinder in half, and on each side of the piston the cylinder holds 1 lb mole of the same ideal gas at 40 °F and 1 atm. An electrical resistance heater is installed on side A of the cylinder as shown in the following figure, and it is energized so as to cause the temperature in side A to rise slowly to 340 °F. If the cylinder and the piston are perfect heat insulators and are of negligible heat capacity, calculate the amount of heat added to the system by the resistance heater. The molar heat capacities of the gas are constant and have the values C_V = 3 Btu/(lb mole) (°F) and C_p = 5 Btu/(lb mole) (°F). The universal gas constant R has a value of 2 Btu/(lb mole) (°R).



HINT: A REVERSIBLE, ADIABATIC COMPRESSION PROCESS.

Problem 2: 25 points

The dimensionless excess Gibbs free energy for liquid mixtures of benzene and cyclohexane is well represented by the following equation

$$\frac{G^E}{x_1 x_2 RT} = B$$

Where the coefficient B is a function of temperature and pressure, but not of mole fractions x_1 and x_2. Calculate G^E/RT, H^E/RT, S^E/R, and the activity coefficients for this system at 40 °C and 1 atm.

Experimental values for B at 1 atm are

Temperature (°C)	35	45	40
B	0.479	0.439	0.458

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系別：化學工程學系　　科目：化學反應工程 50%

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1. Phosphine gas decomposes at 1200 °F from 4.6 atm according to the reaction:

$$4PH_3 \xrightarrow{k} P_{4(g)} + 6H_2 \quad \text{and} \quad -r_{PH_3} = kC_{PH_3}$$

The reaction proceeds with a rate constant k = 10 hr^{-1}. What size is a plug flow reactor (PFR) needed to obtain 80% conversion with a feed containing 4 lb-mol/hr phosphine and 1 lb-mol/hr ineerts? [25 pts]

2. An isothermal reversible reaction $A \Leftrightarrow B$ is carried out in an aqueous solution. The reaction is first-order in both directions. The forward rate constant is 0.4 hr^{-1} and the equilibrium constant is 4.0. The feed to the plant contains 100 kg/m^3 of A and enters at the rate of 12 m^3/hr. Reactor effluents pass to a separator, where B is completely recovered. The reactor is a stirred tank of volume 60 m^3. A fraction (y) of the unreacted effluents is recycled as a solution containing 100 kg/m^3 of A and the remainder is discarded. Product B is worth $2 per kilogram and operating costs are $50 per cubic meter of solution entering the separator. What value of y maximizes the operational profit of the plant? [25 pts]

◀注意背面尚有試題▶