熱力學

(A1) 18% (選擇題答錯倒扣 2 分)

(1) A gas is described by the equation of state PV = RT + APT – BP (A, B are positive parameters). Does this gas have a critical point? A) yes, B) no, C) can not tell. (5%)

(2) A researcher proposes an equation of state PV = RT + APT + BP (A, B are positive parameters). Do you think it is a reasonable equation of state? A) no, B) yes, C) can not tell. (5%)

(3) A qualitative solid-liquid phase diagram for a binary mixture is shown as **Figure 1**. How many equilibrium relations at temperatures T_a and T_b? A) 2 and 3, B) 1 and 2, C) 1 and 3, D) 1 and 4. (4%)

(4) A qualitative vapor-liquid phase diagram for a binary mixture is shown as **Figure 2**. Which are the correct equilibrium relations at temperatures T_a and T_b?

A) $\hat{f}_1^V = \hat{f}_2^V$, $\hat{f}_1^{L1} = \hat{f}_1^{L2}$, $\hat{f}_2^{L1} = \hat{f}_2^{L2}$, B) $f_1^V = f_2^V$, $\hat{f}_1^{L1} = \hat{f}_1^{L2}$, $\hat{f}_2^{L1} = \hat{f}_2^{L2}$,

C) $\hat{f}_1^V - \hat{f}_2^V$, $f_1^{L1} - f_1^{L2}$, $f_2^{L1} - f_2^{L2}$, D) $\hat{f}_1^{L1} = \hat{f}_1^{L2}$, $\hat{f}_2^{L1} = \hat{f}_2^{L2}$, . (4%)

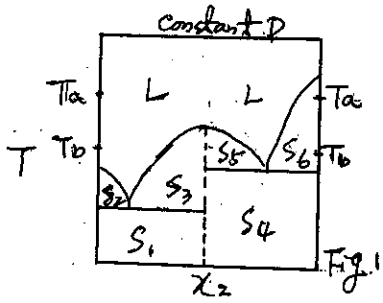


Fig.1

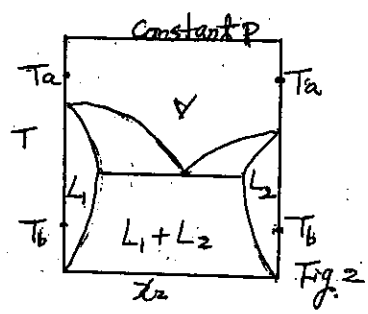


Fig.2

(A2) 4%

The general energy balance equation is given as below equation

$$\left[(H+\frac{u^2}{2g_c}+\frac{gZ}{g_c})\delta M\right]_{in}-\left[(H+\frac{u^2}{2g_c}+\frac{gZ}{g_c})\right]_{out}+\delta Q-\delta W_s=d\left[(U+\frac{u^2}{2g_c}+\frac{gZ}{g_c})M\right]_{sys} \quad (1)$$

where all the thermodynamic properties are in quantity per mole. Please reduce the above equation to its simplest form for the process that water drips slowly out of a hole in the bottom of an enclosed tank. **System: the tank and its contents.**

參考用

注意：背面有試題

(A3) 4%

Using the same equation as for problem (A2) for a gas flows slowly into an insulated tank that was initially evacuated. **System: the tank and its contents.**

(A4)10 %

Can you (a) give two descriptions of the 2nd law of Thermodynamics involved the terminology "entropy" and (b) tell us one application from each description.

(A5) 14 %

The activity coefficient of chloroform in chloroform(1)/1,4-dioxane(2) system can be expressed as: $\ln\gamma_1 = x_1^2(0.372 + 0.348x_1)$

Please determine $\ln\gamma_2$ by the integration of the Gibbs/Duhem equation.

化學反應工程

(B1) 16%

(a) On increasing four folds of reactant concentration, the rate of reaction increases by eight folds. Find the reaction order.

(b) Find the rate constant of a first-order gaseous reaction as 2A→R. On holding the pressure constant, if the volume of the mixture starting with 80% A, decreased by 20% in 5 min.

(B2) 9%

Pure gaseous A was decomposed into R as A→3R. The initial concentration of A was 120 mmol/liter and fed into a 1-liter mixed flow reactor at various flow rates. And the exit concentration was measured and listed as follows:

v_0	liter/min	0.06	0.48	1.5	8.1
C_A	mmol/liter	30	60	80	105

Please find the rate reaction.

注意:背面有試題

參考用

(B3) 15%

For the homogenous catalytic reaction A + B → B + B, $-r = k C_A C_B$ and with a feed of C_{A0} = 90 mol/liter, C_{B0} = 10 mol/liter we want some extent of conversion for reactant A. What flow reactor or combination of flow reactors is the best in that it gives the smallest total volume of reactors needed? There is no need to try to calculate the size of reactors needed; just determine the type of reactor system that is the best and the type of flow that should be used.

The conversion of A is (a) 20%, (b) 80%.

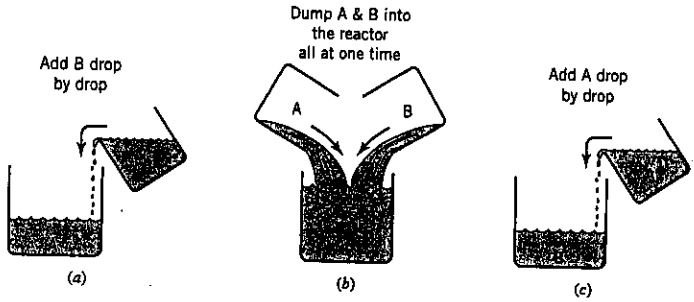
(B4) 10%

For the reactions

$$A + B \rightarrow R \qquad -r = k_1 C_A C_B$$

$$R + B \rightarrow S \qquad -r = k_2 C_R C_B^2$$

Where R is the desired product, which of the following ways of running a batch reactor is favorable, which is not ? Please reason it out.



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