國立中正大學八十八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

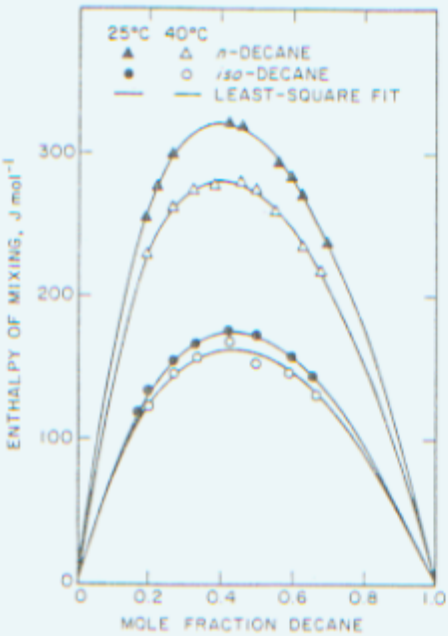
(化工熱力學部份共一頁)

1. Please show that for binary systems, the Lewis/Randall rule will be valid for species 2 whenever Henry's law is valid for species 1. (15 分)

2. On the basis of the information from the attached figure, please answer the following questions:

   (a) Why is the enthalpy of mixing for the n-decane/cyclohexane system larger than that of iso-decane/cyclohexane? (10 分)

   (b) Why is the decrease in enthalpy of mixing for the n-decane/cyclohexane system larger than that of iso-decane/cyclohexane when temperature is changed from 25 to 40°C? (10 分)



Dependence of enthalpy of mixing on the mole fraction for cyclohexane/*n*-decane and cyclohexane/*iso*-decane (2,6 dimethyl octane)

3. Consider a mixture of m gases and assume that the Lewis fugacity rule is valid for this mixture. For this case, please show that the fugacity of the mixture f_M is given by:

$$f_M = \prod_{i=1}^{m} f_i^{y_i}$$

where y_i is the mole fraction of component i and f_i is the fugacity of **pure** component i at the temperature and total pressure of the mixture. (15 分)

化工動力學部份 (共兩頁)

4. 請選出正確答案並簡單說明其理由(每題 2 分，共 12 分)

a. $a\,NO_2^- + b\,MnO_4^- + c\,H^+ \rightarrow d\,NO_3^- + e\,Mn^{+2} + f\,H_2O$
上式中 a + b + c + d + e + f = ? (1)21 (2)18 (3)15 (4)以上皆非。

b. 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。

c. 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。

d. 一自催化反應其反應速率與產物關係爲 (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。

e. 抽煙屬於氧化反應的行爲，此反應爲 (1) 內在質傳控制 (2) 外在質傳控制 (3) 化學反應控制 (4) 伴隨著內在質傳與化學反應控制 。

f. 反應之階數 (Reaction Order) 愈高則反應速率 (1) 愈快 (2)愈慢 (3) 在相同濃度下則愈快 (4) 無法判斷。

5. 解釋名詞: (18 分)
   a. Semibatch Reactor
   b. Enhancement Factor
   c. Elementary Reaction
   d. Effectiveness Factor
   e. Collision Theory
   f. Plug Flow Reactor

6. When products, **P**, of a catalytic reaction compete with reactants, **R**, to be adsorbed on the active sites, **S**, the reaction will be slowed down by the product adsorption. Consider the following sequence of steps illustrating this phenomenon:

R + S → RS
RS → R + S
RS → P + S
P + S → PS
PS → P + S

(a) Derive the kinetics for this sequence, assuming, first the third step (**RS → P + S**) is rate determing (slow) and, second, that the steady-state approximation is valid for C_{RS} (concentration of **RS**) and C_{PS} (concentration of **PS**). (b) Explain the product inhibition phenomenon by the equations you derive? (10 分)

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7. For a first order irreversible reaction, if the internal mass transfer limitation is negligible, please use the data attached to identify the regime of rate control for the reaction temperature of 27, 327, and 627 °C. Please note: (1) the external mass transfer coefficient is insensitive to temperature, and (2) the overall resistance of the reaction is $1/k_o$ ($1/k_o = 1/k_s + 1/k_g a$), where k_s is intrinsic rate constant, k_g is external mass transfer coefficient, and a is the surface area of a catalyst pellet.
(10 分)

Intrinsic rate constant at 25°C	:	1 1/sec
Activation energy	:	10 Kcal/mole
Surface area of catalyst pellet	:	10 cm^2
External mass transfer coefficient	:	40 1/sec cm^2