ชื่อ ..... รหัสประจำตัว .....

PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Final Examination : Semester II (#3)	Academic Year	:	2005
Date : 27 February 2006	Time	:	9.00-12.00
Subject : 230-630 Advanced Transport Phenomena I	Room	:	Robot

- ข้อสอบมี 5 ข้อ จำนวน 8 หน้า ต้องทำทุกข้อ คะแนนเต็ม 70 คะแนน
- ควรใช้เวลาทำข้อสอบโดยเฉลี่ย 2 นาที/คะแนน

ข้อที่	คะแนนเต็ม	ได้คะแนน
1	10	
2	10	
3	20	
4	20	
5	10	
รวม	**70**	

- ขอให้นักศึกษาทำข้อสอบในที่ว่างซึ่งได้เตรียมไว้สำหรับข้อสอบแต่ละข้อ โดยอาจใช้เนื้อที่ด้านหลังทำข้อสอบเพิ่มเติมได้
- อนุญาตให้นำหนังสือ เอกสาร เครื่องคำนวณ และอุปกรณ์อื่นๆ เข้าห้องสอบได้

สุธรรม สุขมณี
ผู้ออกข้อสอบ
14 กุมภาพันธ์ 2549

1) Predict $\mathcal{D}_{AB}$ for an equimolar mixture of CH_4 and C_2H_6 at 149 K and 94 atm. Assume this mixture having an ideal gas behavior and the value of universal gas constant (R) is 82.0578 atm-cm^3/mole-K (10 points)

2) Show that the following form of Fick's law for binary system is valid:

$$j_A = -\rho \mathcal{D}_{AB} \frac{d\omega_A}{dy} = -\frac{c^2}{\rho} M_A M_B \mathcal{D}_{AB} \frac{dx_A}{dy}$$

(10 points)

3) Gas A dissolves in liquid B in a container and diffuses isothermally into the liquid phase. As it diffuses, A also undergoes an irreversible second-order homogeneous reaction $A + B \rightarrow AB$. Hence the rate of disappearance of A per unit volume is $k_2''' C_A^2$. Assuming that the diffusion can be treated as pseudobinary and convective mass flux of A may be neglected. Let the liquid phase be sufficiently deep that L can be taken as infinite.
Find the concentration distribution of A in the liquid as a function of z. (20 points)

4) Pure water at 26.1 °C (ρ = 996 kg/m^3 and μ = 0.8 mPa.s) is flowing at a flow rate of 2.27 m^3/h in a tube made from benzoic acid. The tube is 2.0 m long, with an inside diameter of 25 mm. At the temperature of 26.1 °C, the solubility of benzoic acid in water at 26.1 °C is 29.48 mole/m^3 and the diffusivity of benzoic acid in water ($\mathcal{D}_{AB}$) is 1.245×10^{-9} m^2/s. If the pressure drop across the tube is 1471 N/m^2 and the bulk concentration of benzoic acid in water at the tube exit is 0.35 mole/m^3. Assuming that the velocity and the concentration profiles are fully developed, calculate (a) the average mass transfer coefficient of the system and (b) the time-smoothed molar concentration of benzoic acid at r = 12.5 mm and z = 2.0 m. (20 points)

5) Consider, the contacting of a gas mixture of A and B with a liquid mixture of A and B; where the transfer of A and B exists in both phases. Assuming that the interface resistance is negligible and that any fluctuations in y_A (mole fraction of A in gas phase) and x_A (mole fraction of A in liquid phase) are small, so that the time-smoothed gas and liquid compositions lie on the equilibrium curve: $y_{A0} = m \cdot x_{A0}$ (m = slope of the equilibrium line: $y_{Ae} = m \cdot x_{Ab}$). If $N_{Ag0} = -N_{Bg0}$ and the bulk compositions and mass-transfer coefficients are known on both sides of the interface (x_{Ab}, y_{Ab}, k_x and k_y are given). Derive the expressions for the over-all coeeficient in each phase (K_x and K_y) as the function of. x_{Ab}, y_{Ab}, k_x, k_y and m. (10 points)