Name.....Student ID.....

PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Final Examination : Semester II

Academic year : 2008

Date : Feb 25, 2009

Time : 9.00 – 12.00 am

Subject : 230-630 Advance Transport Phenomena I

Room: R 300

ทุจริตในการสอบ โทษขั้นต่ำปรับตกในรายวิชานั้น และพักการเรียน 1 ภาคการศึกษา โทษสูงสุด ให้ออก

1. The exam are not allow to leave an exam room
2. All books, notes, and all computing devices (i.e., calculator and computer) are allowed
3. Do not discuss or ask any person during taking an exam
4. Do all problems, the mark of each problem is listed below

Problem No.	Total Points	Point obtained
1	15	
2	20	
3	20	
4	20	
5	25	
รวม	**100**	

Please note that the exam must consist of 13 pages (including this page)

Good luck and do your best on the exam

Assoc. Prof. Dr. Charun Bunyakan

Feb 20, 2009

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1. (15 points)

Define and/or give the short but clear answer to the following questions

1.1 Diffusion and Diffusivity (2 points)

1.2 Mass average and Molar average velocity (2 points)

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1.3 Molecular mass and Molar fluxes (2 points)

1.4 Diffusion velocities (2 points)

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1.5 Convective mass and molar fluxes (2 points)

1.6 Combine mass flux and combine molar flux (2 points)

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1.7 Write down the steps to determine the concentration profile, average concentration and the mass transport flux (i.e. molar flux) that can be applied to any steady state diffusion problem. (3 points)

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2 (20 points)

2.1 (10 points)

Predict the D_{AB} for methane (A)-ethane (B) mixtures at 300 K and 1 atm by using the suitable method and give the reason why you chose such method.

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2.2 (10 points)

The measured value of cD_{AB} for a mixture of 60 mol% CH_4 and 40 mole% C_2H_6 at 313K and 136 atm is 6.0×10^{-6} g-mole/ cm s. Predict cD_{AB} for the same mixture at 136 atm and 351K.

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3 (20 points)

Liquid A is evaporating into gas B in the evaporation tube which can be described as a diffusion through a stagnant gas film as shown in Figure 3.1. The distance between the liquid interface and the top of the tube is 11.14 cm. The total pressure on the system is 770 mmHg, and the temperature is 25 °C. The vapor pressure of liquid A at that temperature is 23.81 mmHg. The cross-sectional area of the diffusion tube is 2.29 cm^2. The density and the molecular weight of liquid A are 1.50 g/cm^3 and 85 g/mol, respectively. The diffusivity (D_{AB}) is 0.05 cm^2/s. What is the evaporation rate of A in g/hr.

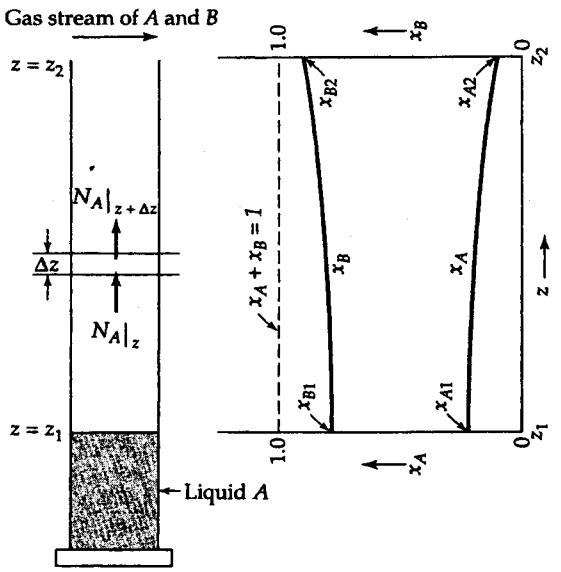

Fig. 3.1

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4 (20 points)

Gas A is being absorbed from a gas mixture in an absorption tower. The absorbing fluid is liquid B, which is moving downward relative to each rising gas bubble enriched in species A near the interface in the manner of the falling film. The diameter of a single gas bubble is 2 cm. The average terminal velocity of a gas bubble is 17.7 cm/s. The diffusivity of A into B is 1.3×10^{-5} cm^2/s. The saturation concentration of A in liquid B is 0.80 g of A per 100 g of B. If the reaction between A and B can be neglected and the density of liquid B is 1.2 g/cm^3, determine the absorption rate of A into liquid B for each gas bubble in g/hr.

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5 (25 points)

The substance A is leaching from a solid particle by solvent B. We may postulate that the rate controlling step is the diffusion of A from the particle surface through a stagnant liquid film thickness δ out into the main liquid stream as shown in Fig. 5.1. The molar solubility of A in B is C_{A0}, and the concentration of A in the main stream is $C_{A\delta}$. Determine the expressions for

(a) The concentration profiles in the region between z = 0 and z = δ

(b) The average concentration over the region between z = 0 and z = δ

(c) The molar flux at the plane z = 0

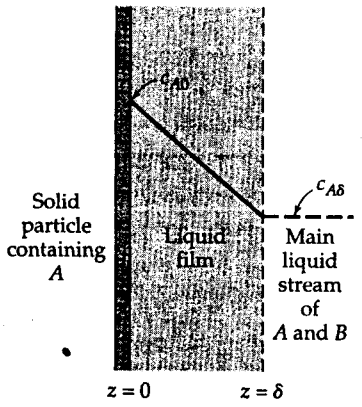

Fig. 5.1