113 CH01

國立臺北科技大學 113 學年度碩士班招生考試

系所組別：3510 化學工程與生物科技系化學工程碩士班甲組

第一節　單元操作與輸送現象　試題

注意事項：

1. 本試題共 8 題，每題 10 或 15 分，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. ①What is the viscosity of fluid? (5%)
   ②The viscosity of a mineral oil is 50 cp and the specific gravity is 0.82. What is its kinematic viscosity (Use SI system; $1cp=10^{-3}$ kg/m·s)? (5%)
2. ①When fluid flows through the surface of a flat plate, why does a boundary layer occur and what are its characteristics? (5%)
   ②To explain the three types of flow mechanisms in the turbulent flow area of boundary layer. (5%)
3. For a water pipe with an equilateral triangle cross-section, the volume flow rate of water is 6×10^{-3} m^3/sec, the density is 1000 kg/m^3, and the viscosity is 1.2×10^{-3} kg/m·s. How large is the side length required to produce turbulent flow? (10%)
4. Why is necessary to use an extended surface (fin) in heat exchanger (5%) and what matters should be paid attention to during design? (5%)
5. Double-layer insulated glass window, each layer of glass is 10 mm thick, and there is a 50 mm still air layer in the middle of the glass. The thermal conductivity coefficients of glass and air are 1.0 W/m·k and 0.025 W/m·K respectively. There is flowing air both inside and outside the glass window, and their convection heat transfer coefficient h = 12 W/m^2·K. The inside air temperature is 320K and the outside air temperature is 275K. If the total heat transfer area is 2 m^2, ①What is the heat transfer rate? (5%) ②What is the interface temperature between the outside glass and the interlayer air? (5%) ③What is the total heat transfer coefficient? (5%)
6. ①Please explain the two film theory. (5%)
   ②If a gas phase containing 5% ammonia contacts a liquid containing 1% ammonia, at gas-liquid equilibrium $y_{Ai}=4x_{Ai}$, kx=100 mol/h·cm^2, ky = 120 mol/h·cm^2, and calculate the composition of the gas-liquid interface. (10%)
7. Ammonia gas is diffusing through N_2 under steady state conditions with N_2 nondiffusing since it is insoluble in one boundary. The total pressure is 1.013×10^5 Pa and temperature is 298 K. The partial pressure of NH_3 at one point is 1.333×10^4 Pa, and at the other point 20 mm away it is 6.666×10^3 Pa. The D_{AB} for the mixture at 1.013×10^5 Pa and 298K is 2.30×10^{-5} m^2/s. ①Calculate the flux of NH_3 in kg mol/s·m^2. (10%) ② Do the same as ① but assume the N_2 also diffuse; that is, both boundaries are permeable to both gases and the flux is equimolar counterdiffusion. (5%)
8. A continuous single effect evaporator concentrates 10000 kg/h of a 1.0 wt % salt solution (heat capacity Cp = 4.14 kJ/kg·K) entering at 313.2 K to a final concentration of 2.5 wt %. The vapor space of the evaporator is at 101.325 kPa (latent heat of water is 2257 kJ/kg at 101.325 kPa and 373.2 K), and the steam supplied is saturated at 143.3kPa (saturated temperature=383.2 K, and latent heat of steam is 2230 kJ/kg). The overall coefficient U=1800 W/m^2·K. Calculate the steam used (5%), the steam economy (5%), and the heat transfer area required. (5%)