

元智大學 107 學年度 碩士班 招生試題卷

系(所)別：化學工程與材料
科學學系碩士班

組別：不分組

科目：輸送現象與單元
操作

用紙第一頁共二頁

●可使用現行『國家考試電子計算器規格標準』規定第二類之計算機

- Two immiscible Newtonian fluids of different density and viscosity are flowing between two parallel plates. What are the two boundary conditions at the interface between two fluids. (20%)
- For a Newtonian fluid of density ρ and viscosity μ . Please employ the shell momentum balance on a suitable control volume to determine the velocity profile for the fluid flowing between two parallel plates separated by a distance h . The pressure gradient is fixed: $\frac{dp}{dx} = W$, where W is a given constant. There is no effect of gravity (20%)
- Heat is generated in a plate according to the relationship $\dot{q} = \dot{q}_{\max} \left[1 - \frac{x}{L} \right]$ (see Figure 1), where \dot{q} is the volumetric heat generation rate kW/m^3 , L is the half thickness of the plate, and x is measured from the plate center line. The conductivity of the plate is k , the temperature at $x=L$ is T_w . Please (i) give the expression of temperature distribution in the plate; (ii) What is the temperature at the central line? (20%) (10% for each)

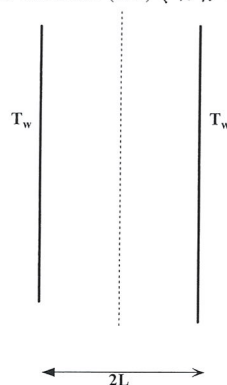


Figure 1

- Please give the dimensions of (i) viscosity, (ii) diffusion coefficient, in SI unit (20%) (10% for each)

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用紙第二頁共二頁

●可使用現行『國家考試電子計算器規格標準』規定第二類之計算機

5. Consider the biosensor device shown in Figure 2. The biosensor is designed to measure the concentration of solute A in the well mixed liquid phase. At the base of the device is an electrode of surface area 1 cm^2 . The electrode is coated with an enzyme that catalyzes the reaction $A \rightarrow 2D$. When solute A reacts to product D, product D is detected by the electrode, enabling for direct measurement of the flux of D. The rate of reaction A at the enzyme surface is rapid relative to the rate of diffusion of A down to the surface. Directly above the enzyme coated electrode is a gel layer of 0.5 cm thickness. The effective diffusion coefficient of solute A in the gel layer is $D_A = 5 \times 10^{-7} \text{ cm}^2/\text{s}$. Above the gel layer is a well mixed liquid containing a constant concentration of solute A, C_{A0} . The solubility of solute A in the liquid phase differs from the solubility of A in the gel layer. The phase equilibrium relationship is satisfied at the gel/liquid interface $C_{A0} = K C_{AG}$, where C_{AG} is concentration of A in the gel layer near the interface. The phase equilibrium constant $K = 2 \text{ cm}^3 \text{ gel} / \text{cm}^3 \text{ liquid}$. The rate of formation of product D is $1 \times 10^{-10} \text{ mol/s}$. Calculate the concentration of A in the well mixed liquid phase C_{A0} ? (20%)

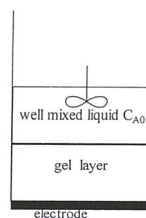


Figure 2