國立雲林科技大學
九十三學年度碩士班入學招生考試試題

系所：化工系
科目：輸送現象

1. Using the Navier-Stokes equations for a steady, viscous, incompressible flow, obtain an expression for the velocity profile between two flat, parallel plates (see, Fig. 1). (20%)

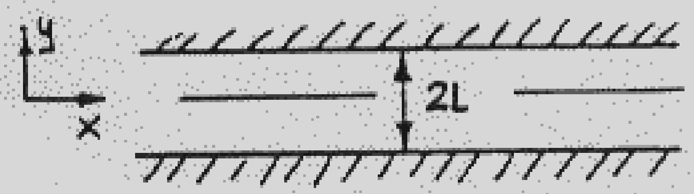

Fig. 1 Flow in two parallel plates

2. Show an analytical solution of the one-dimensional heat conduction equation for the case of the semi-infinite wall (see, Fig. 2). (20%)

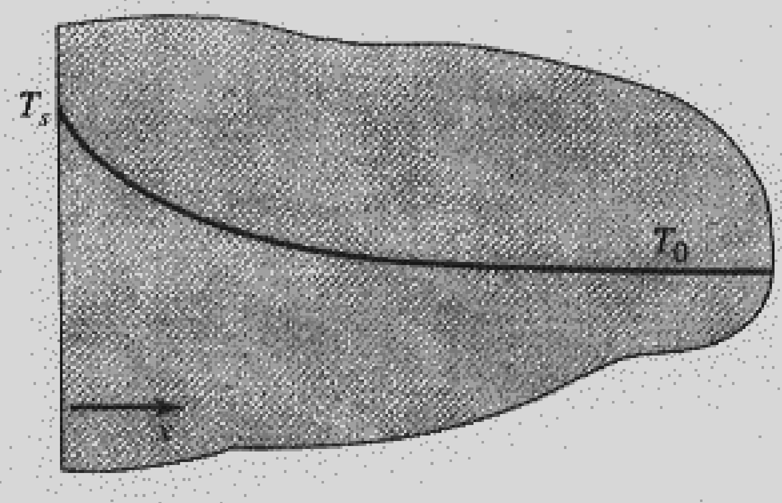

Fig. 2 Temperature distribution in a semi-infinite wall at time t

3. Under the pseudo-steady-state diffusion for the Arnold diffusion cell (see, Fig. 3), show the equation commonly used to evaluate the gas diffusion coefficient D_{AB}. (20%) (Hint: the molar flux $N_{A,z}$ is related to the amount of A leaving the liquid by $N_{A,z} = \dfrac{\rho_{A,L}}{M_A}\dfrac{dz}{dt}$, where $\dfrac{\rho_{A,L}}{M_A}$ is the molar flux of A in the liquid phase)

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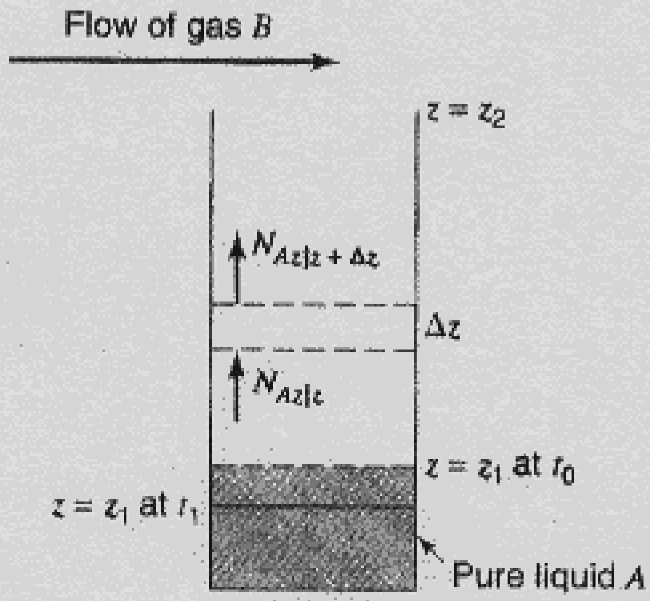

Fig. 3 Arnold diffusion cell with moving liquid surface

4. A heat source is located within a hollow sphere with an internal radius κR and external radius R. Conditions are such that the internal surface temperature is constant at T_i and the external surface temperature is T_o. The thermal conductivity of the shell is k.
   (a) What is the steady state temperature distribution in the spherical shell as a function of r? (10%)
   (b) What is the total heat rate? (10%)

5. Determine $v_\theta(r)$ between two coaxial cylinders of radii R and κR rotating at angular velocities Ω_o and Ω_i, respectively. Assume that the space between cylinders is filled with an incompressible isothermal fluid in laminar flow. (20%)