1. (10 分) 黏阻計(viscosity meter)用以量測流體之黏性係數 μ, 如圖 A. 裝置中外桶固定(內半徑為 R_i), 轉距 T (Torque)使內桶以穩定轉速 ω 旋轉(外半徑為 R_o). 請推導出 μ 與 ω,T,l,R_o, R_i 之間的關係式. (推導過程中可忽略下方的邊緣效應, 並假設間隙間之速度為線性分佈)
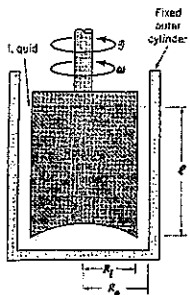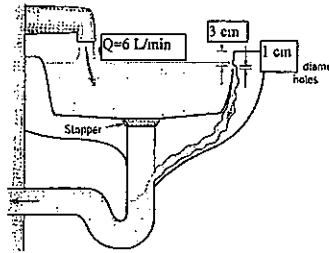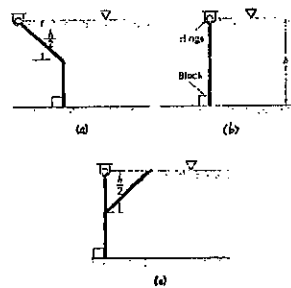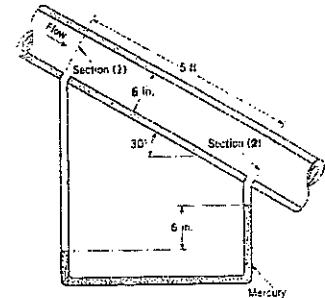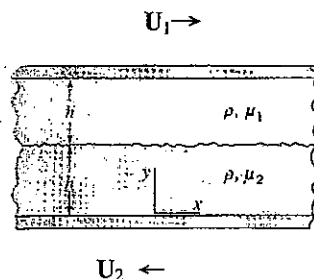

圖 A   圖 B   圖 C   圖 D

2. (10 分) 水以 6L(公升)/min 的流量流入水槽 (如附圖 B). 如果下方排水口關閉, 水仍將可由上方小孔排出以避免由水槽邊緣溢出. 若小孔直徑為 1cm, 試計算出最少需多少個小孔?

3. (15 分) 三種型式之水閘門, 寬度均同為 w (如附圖 C, 其自身重量不計), 用來在渠道中阻擋水流. 若在(b 閘中之作用力為 R. 試計算出其它兩閘的作用力分別為多少 R?

4. (15 分) 水在圓管中穩定的向斜下方流動, 其相對尺寸如附圖 D. 算出位置(1)和(2)間的 *(i)* 壓力差 $p_1 - p_2$ *(ii)* head loss, 及*(iii)* 流體對位置(1)和(2)間之管壁上產生的軸向力. (S.G.$_{Hg}$=13.6)

5. (15 分) Two immiscible, incompressible, viscous fluids having the same densities but different viscosities are contained between two infinite, horizontal, parallel plats. The bottom plate moves with a constant velocity U_1 to the left and the upper plate moves to the right with a constant velocity U_2. Please use the given equations to determine the velocity at the interface between the lower fluid (ρ, μ_1) and the upper fluid (ρ, μ_2). Assume laminar flow. Please express your answer in terms of U_1, U_2, μ_1, μ_2. There is no pressure gradient in the horizontal direction. The fluid velocity and shearing stress are continuous across the interface between the two fluids.

$U_1 \rightarrow$

$$\rho\left(\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y}\right) = -\frac{\partial p}{\partial x} + u\left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}\right)$$

$$\rho\left(\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y}\right) = -\frac{\partial p}{\partial y} - \rho g + u\left(\frac{\partial^2 v}{\partial x^2} + \frac{\partial^2 v}{\partial y^2}\right)$$

$U_2 \leftarrow$

6. (15 分) Dimensionless analysis

The drag, D, on a rigid-sphere located in a pipe through which a fluid is flowing is to be determined experimentally. What dimensionless parameters would you use for this problem? If the sphere is changed to be a spherical living cell, how you would modify your answer?

7. (10 分) Please indicate which drag coefficient of the following objects is larger ? You must explain your answer with the boundary layer development and the viscous effect. Is your answer correct irrespective to the Reynolds number? Why?

Cube   Cube
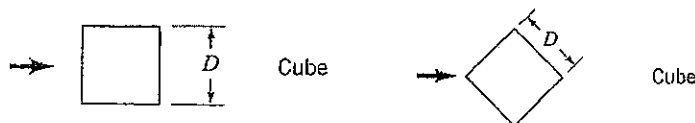
8. (10 分) Does sound travel faster in the winter or summer? Why? (Please derive the equation of the sound speed and interpret your answer with it)

試題隨卷繳回