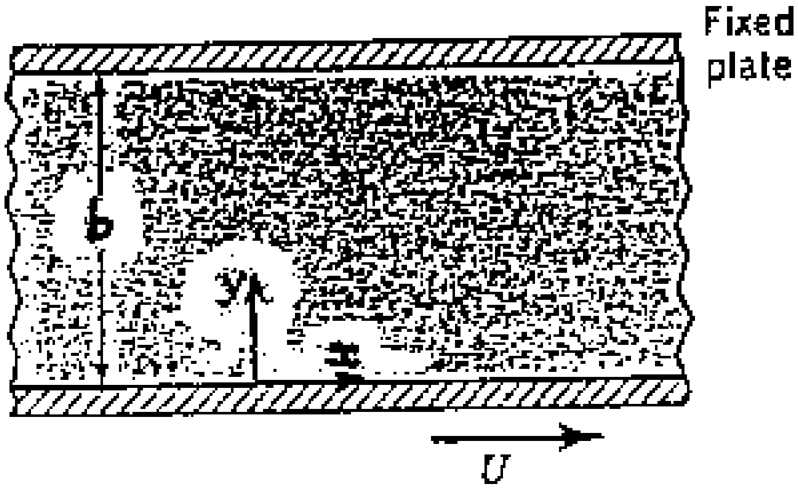
1. Define the following terms ：
   (1) velocity boundary layer and Reynolds numbers (10%)
   (2) Explain the phenomenon of separation when viscous fluids flow over a blunt body. (10%)
   (3) Calculate the dimensionless displacement thickness when the dimensionless velocity distribution U(Y) in the velocity boundary layer is $U(Y)=4Y-10Y^2$. (10%)

2. The viscous, incompressible Newtonian fluid flow between the parallel plates shown in the accompanying figure is caused by both the motion of the bottom plate with velocity U and a pressure gradient, $\partial p/\partial x$. Using a control-volume approach, determine the relationship between U and $\partial p/\partial x$ so that the shearing stress acting on the fixed plate is zero. Assume the flow is laminar and fully developed. (20%)



2 copy

3. (a) Explain the reasons that the dynamic viscosities of liquids decrease w
   and that the dynamic viscosities of gases increase with rising tempe
   (b) Demonstrate a viscometer (粘度計) to measure the dynamic visc
   describe its operation principles. (9%)

4. Consider a gas flow at a free stream velocity V_∞, temperature T_∞ and density ρ_∞ over a stationary evaporating liquid sphere at a higher temperature T_w as shown in the following figure. We are interested in determining the evaporating mass flux. Use the dimensionless analysis to find the relevant dimensionless groups associated with the process. (15%)

5. Fully-developed forced convection heat transfer in a steady laminar fully-developed flow through a circular pipe with a finite wall is considered, as schematically shown in the figure below. Find the Nusselt number analytically. (20%)