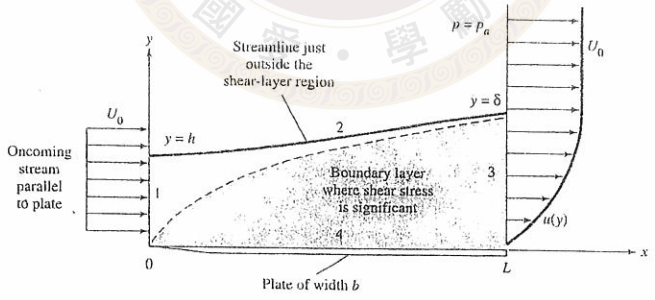
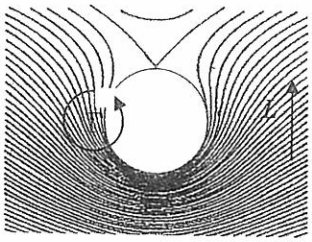
1. (20%, 4% each) Read the following statements carefully and answer them with 'True' or 'False'. If your answer is 'False', please briefly explain your reasons.
   (a) The water has higher value of kinematic viscosity than air at 1 atm and 20℃.
   (b) The higher the flow speed of a laminar circular pipe flow is, the larger are the friction force and the friction factor (or friction coefficient).
   (c) The Weber number is a measure of gravity force in a flow.
   (d) The typhoon is a compressible flow.
   (e) For a compressible flow, we may always mount a converging duct after a converging sonic nozzle in order to increase the maximum flow speed.

2. (30%, 6% each) Briefly answer the following questions.
   (a) What is the definition of a fluid? What is non-Newtonian fluid?
   (b) What is the inviscid flow? Should the viscosity be necessarily zero for the inviscid flow?
   (c) What is the physical meaning of the Mach number and "choking" of a nozzle ?
   (d) What is form drag? How to reduce the form drag?
   (e) What is Kutta-Joukowski theorem? Describe a method to control flow separation on an airfoil and its corresponding flow mechanism.

3. (25 %) Consider an incompressible, steady, laminar boundary layer flow on a flat plate of length L and width b, as shown in the figure. The free stream has a uniform velocity U_0 and the pressure is constant. At the end of the plate, the boundary layer has a thickness δ. Assume no-slip condition on the plate and the boundary layer profile be a simple parabolic curve. Let the density of the fluid be ρ. Determine the drag force D exerted on the plate in terms of ρ, U_0, b, and δ.



4. (25 %) A cylinder of 5 cm in diameter with a circulation Γ is placed in a stream of air having a uniform velocity of 2 m/s. Assume that the flow is potential.
   (a) Calculate the value of Γ (unit: m^2/s) when the two stagnation points coincide. The corresponding stream line pattern is shown in the figure. (15%)
   (b) Estimate the lift force L (unit: N/m) experienced by the cylinder under condition (a), if ρ_{air}=1.2 kg/m^3. (10%)



試題隨卷繳回