注意事項：

1. 本試題共五題，每題 20 分，共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. A fluid flows past a flat plate such that the boundary layer is laminar and the thickness at a distance 2.0 ft from the leading edge is 0.3 in. If the upstream velocity is 4ft/s, determine (a) the boundary layer thickness at distances of 0.5, 1.0, and 5ft from the leading edge. (10 分) (b)the kinematic viscosity of the fluid.(10分)

2. Two immiscible, incompressible, viscous fluids having the same desity but different viscosities are contained between two infinite, horizontal, parallel plates (see Fig.1). The bottom plate is fixed and the upper plate moves with a constant velocity U, Determine the velocity at the interface. Express your answer in terms of U, μ_1, and μ_2. The motion of the fluid is caused entirely by the movement of the upper plate; that is, there is no pressure gradient in the x direction. The fluid velocity and shearing stress are continuous across the interface between two fluids. Assume laminar flow. (20分)
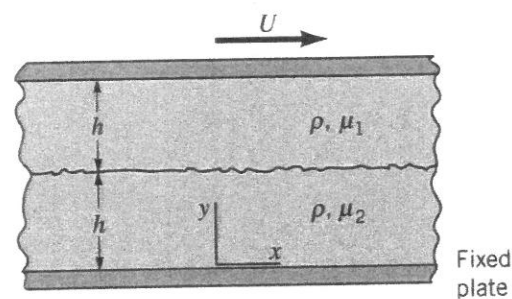

Fig. 1

3. This 1 : 12 pump model, see Figure 2, (using water at 15℃，its viscosity μ =1.139×10^{-3} Pa·s, density ρ=999.1kg/m^3) simulates a prototype for pumping oil of specific gravity 0.90 (ρ=898.4kg/m^3). The input to the model is 0.522 kW. Calculate (a) the viscosity of the oil (10分) and (b) the prototype power for complete dynamic similarity (i.e. at the same Reynolds number $N_R = \rho VL/\mu$ and Froude number $N_F = V/\sqrt{gL}$) between the model and prototype (10分).
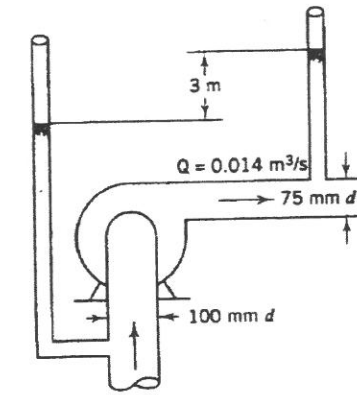

Fig. 2

4. Oil of SG = 0.87 and a kinematic viscosity $v = 2.2 \times 10^{-4}\,\mathrm{m^2/s}$ flows up through the vertical pipe shown in Fig. 3 at a rate of $4 \times 10^{-4}\,\mathrm{m^3/s}$. Determine the manometer reading, h. (20分)
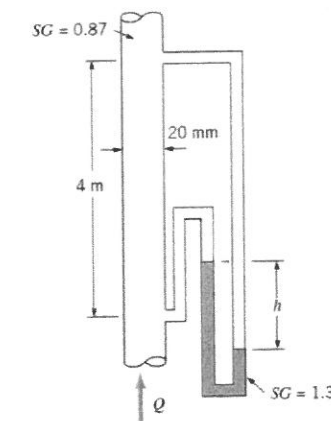

Fig. 3

注意：背面尚有試題

5. (A) A plate is oriented parallel lo the free stream as is indicated in Fig. 4(a). If the boundary layer flow is laminar, determine the ratio of the drag for case *a* to that for case *b*. Explain your answer physically. (10分)

(B) Water flows over two flat plates with the same laminar free-stream velocity. Both plates have the same width,　But Plate #2 is twice as long as Plate1 #2 as shown in Fig. 4(b). What is the relationship between the drag forces for these two plates? (10分)
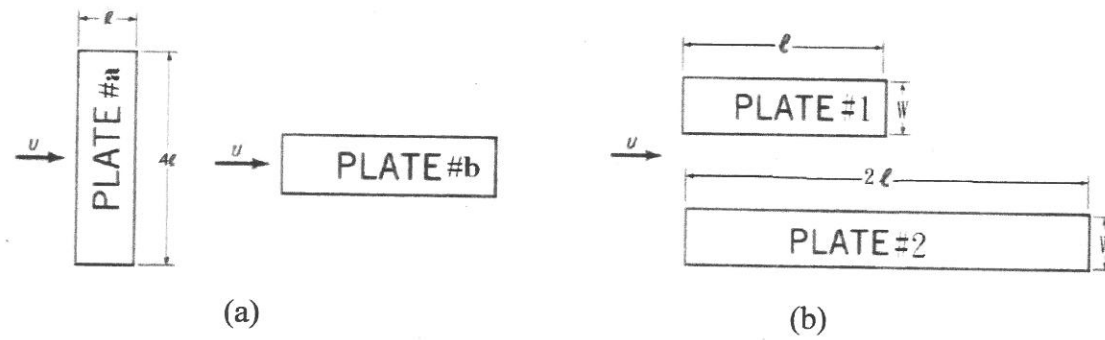

(a)　　　　　　　　(b)

Fig. 4