國立成功大學 104 學年度碩士班招生考試試題

系所組別：生物醫學工程學系甲組

考試科目：流體力學

考試日期：0211，節次：2

※ 考生請注意：本試題不可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (a) Name two unique properties of fluid which are distinct from solid, and (b) describe their definitions and characteristics in detail. (15%)

2. Water flows through the pipe contraction shown in Fig. 1. For the given h height difference in the manometer level, (a) determine the flow rate in terms of the pipe diameters (D_1, D_2) and h based on the Bernoulli equation. (b) What assumptions are required when the Bernoulli equation is applied? (20%)

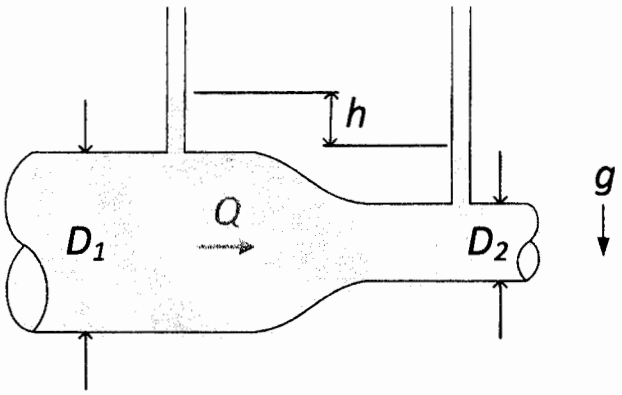

Figure 1

3. The original Bernoulli equation can only be used in "ideal" conditions. However, the equation can be modified to approximately fit in the real world with the addition of head losses. (a) Explain the head losses and their causes. (b) Consider the head losses in problem 2 (see Fig. 2), determine the modified flow rate. Assume the major head losses are negligible and the minor head loss of the nozzle can be expressed as $K_L \frac{V_2^2}{2g}$. (18%)

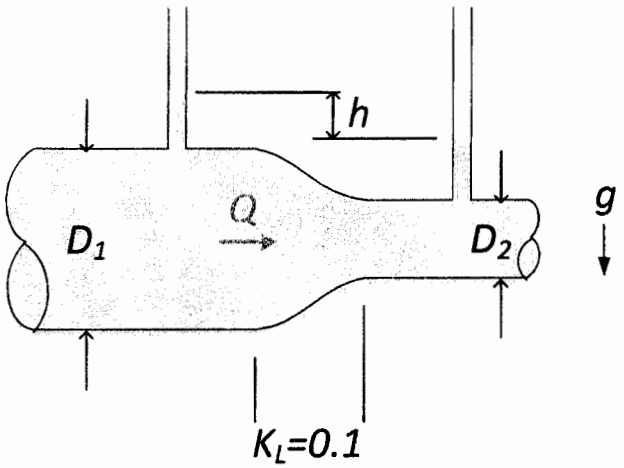

Figure 2

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4. An incompressible, viscous fluid is placed between horizontal, infinite, parallel plates as shown in Fig. 3. The two plates move in opposite directions with constant velocities, U_1 and U_2. The pressure gradient in the x direction is zero and the only body force is due to gravity which acts in the y direction. (a) Determine an expression for the velocity distribution between the plates assuming laminar flow. (b) Determine the volumetric flow rate of the fluid between the plates. Assume the depth in the z direction is 1. The Navier Stokes equation in the axial direction is provided below. (21%)

$$\rho\left(\frac{\partial u}{\partial t}+u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}+w\frac{\partial u}{\partial z}\right)=-\frac{\partial p}{\partial x}+\mu\left[\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}+\frac{\partial^2 u}{\partial z^2}\right]+\rho g_x$$

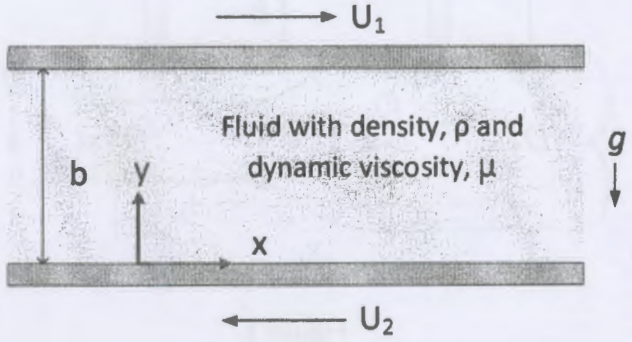

Figure 3

5. A lever system as shown in Fig. 4. has water flowing from a large tank into a dish. (a) If at the instant shown the tank and the water in it weigh W_1, what the weight W_3 should be in order to keep the system in equilibrium? (b) If at the same instant shown the dish and the water in it weigh W_2, what is the weight N shown on the scale? (26%)

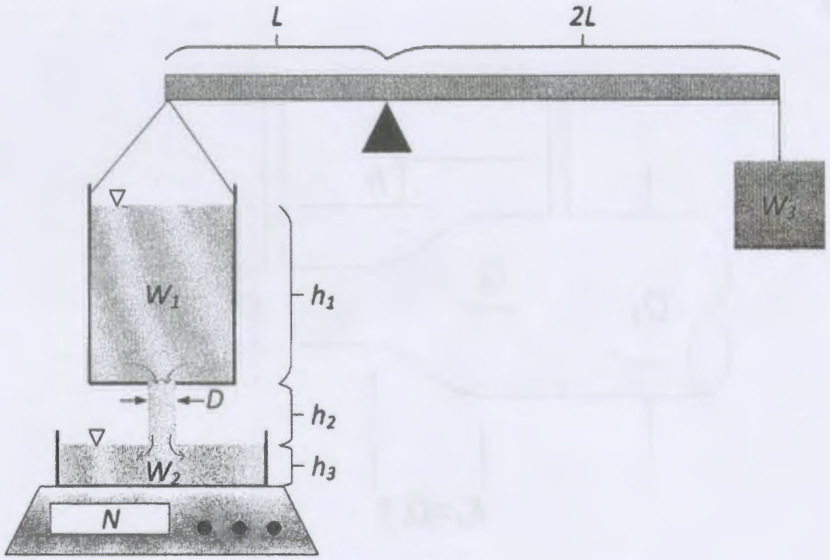

Figure 4