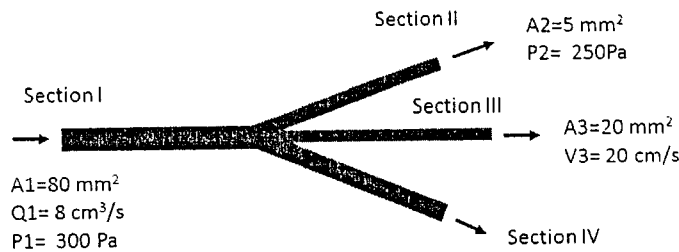


國立中央大學98學年度碩士班考試入學試題卷

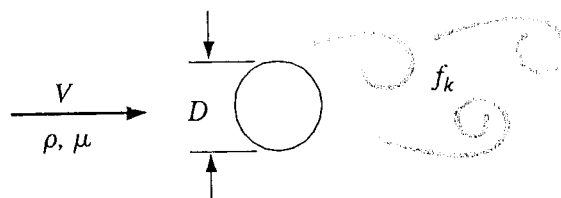
所別：生物醫學工程研究所碩士班 科目：流體力學 共 2 頁 第 1 頁

\*請在試卷答案卷(卡)內作答

1. What is (a) Newtonian fluids and (b) Lagrangian method? (4%)
2. Please derive capillary pressure,  $P_c$ , in a  $w \times h$  rectangular tube (4%)
3. In a test, water was pumped through a horizontal artificial blood vessel (as shown in the figure) with a rate of  $8 \text{ cm}^3/\text{s}$ . Please determine
  - (a) the water speed in section II,
  - (b) the pressure in section III and
  - (c) flowrate in section IV.
 Assume the artificial blood vessel is rigid and viscous effects can be neglect. (9%)



4. In an incompressible flow, the radial and circumferential component of the velocity are:  $v_r = \frac{A}{r} - B \cos \theta$  and  $v_\theta = B \sin \theta$  where  $A$  and  $B$  are positive real constants. Please answer the following questions:
  - (a) Does this flow satisfy continuity? (3%)
  - (b) Find the corresponding streamline function. (5%)
5. As shown in the figure below, a uniform stream with fluid density  $\rho$  and fluid viscosity  $\mu$  having a free-stream velocity  $V$  flows over a circular cylinder of a diameter  $D$  forming a periodic Kármán vortex street. Please use the method of repeating variables to generate a dimensionless relationship for the Kármán vortex shedding frequency  $f_k$  as a function of  $V$ ,  $\rho$ ,  $\mu$ , and  $D$ . (10%)



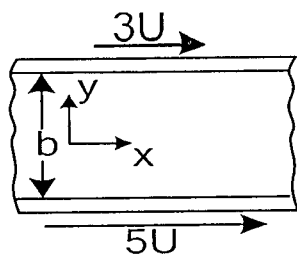
參考用

國立中央大學98學年度碩士班考試入學試題卷

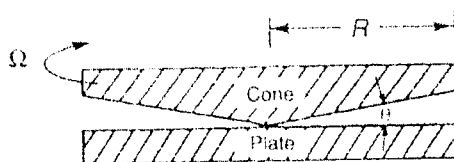
所別：生物醫學工程研究所碩士班 科目：流體力學 共 2 頁 第 2 頁

\*請在試卷答案卷(卡)內作答

6. As shown in the figure below, there is an incompressible, viscous fluid inside the two horizontal plates, where both upper and lower plates are moving toward the x-direction at constant but different velocities,  $3U$  and  $5U$ , respectively. Assuming that the flow is laminar, the pressure gradient in the x direction is zero, and the only body force is due to the fluid weight. Please find the velocity distribution  $u(y)$  between these two plates. (15%)



7. Briefly describe the Poiseuille's law for laminar pipe flow. (10%)
8. A model of an airplane built to a scale of  $1/8$  is to be tested in a wind tunnel operating under a pressure of 12 atm.
- If the prototype is to fly at 300 km/hr under the pressure of 1 atm, what is the corresponding wind speed for testing the model? Assume the model and prototype are operated under the same temperature. (10%)
  - If the model experiences a drag of 500 N, what is the corresponding force on prototype? (10%)
  - Also find the power required by the prototype. (5%)
9. As shown in the figure below, a cone with cone angle  $\theta$  is rotating at an angular velocity  $\Omega$  with respect to a stationary plate. Between the cone and plate a Newtonian fluid of dynamic viscosity  $\mu$  is rotated by the cone. (5%)
- Estimate the viscous shear stress in the fluid. (5%)
  - Estimate the torque required to hold the plate stationary. (10%)



參考用