

國立臺灣科技大學  
八十八學年度碩士班招生考試試題

系所別：機械工程系研究所

組別：丙組

科目：流體力學

(Closed-book)

1.

(15 points) (a) The two - dimensional steady flow in Fig. 1 has constant properties and is fully developed. (i.e., its velocity vector,  $\mathbf{V} = u \mathbf{i} + v \mathbf{j}$ , does not vary with  $x$ ) Which terms in the continuity and momentum equations (Equations A1 - A3) can be dropped (i.e., are equal to zero) for this fully developed flow? Explain.

(15 points) (b) Show that  $p$  (reduced pressure) is a function of  $x$  alone and varies linearly with  $x$  (i.e.,  $p \neq$  function of  $y$  and  $p = a + bx$ ) in Fig. 1.

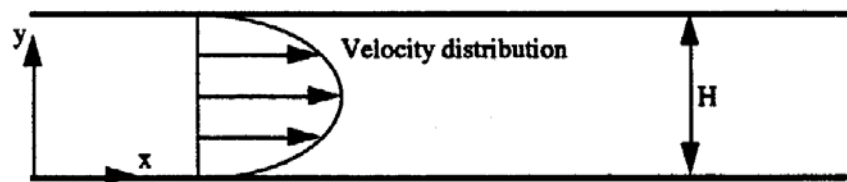
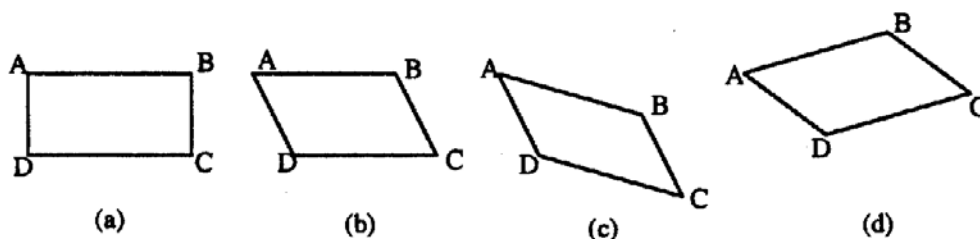
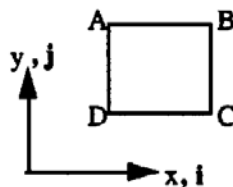


Fig. 1

2. The velocity field of a two - dimensional steady flow is  $\mathbf{V} = -2y \mathbf{i} + 2/x \mathbf{j}$  (m/s).

(10 points) (a) Is the flow compressible or incompressible?

(10 points) (b) A square is marked in the fluid as shown at  $t = 0$ . After  $\tau$  seconds the marked area will look like (a), (b), (c) or (d)? Justify your answer.



(30 points) 3. A small round object is tested in a low-speed wind tunnel. The tunnel diameter is 1 m. Velocity measurements at two sections give the results shown in Fig. 3. Evaluate the drag force on the object. Neglect viscous resistance at the tunnel wall.

國立臺灣科技大學  
八十八學年度碩士班招生考試試題

系所別：機械工程系研究所

組別：丙組

科目：流體力學

Equations for steady, two-dimensional flow of constant properties in Cartesian coordinates :

Continuity :

$$\partial u / \partial x + \partial v / \partial y = 0 \quad (A1)$$

x-momentum :

$$\rho (u \partial u / \partial x + v \partial u / \partial y) = - \partial p / \partial x + \mu (\partial^2 u / \partial x^2 + \partial^2 u / \partial y^2) \quad (A2)$$

y-momentum :

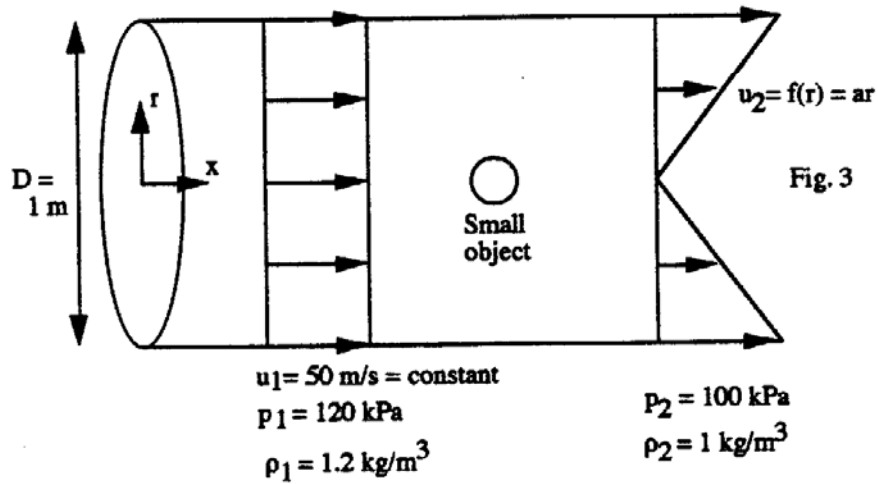
$$\rho (u \partial v / \partial x + v \partial v / \partial y) = - \partial p / \partial y + \mu (\partial^2 v / \partial x^2 + \partial^2 v / \partial y^2) \quad (A3)$$

國立臺灣科技大學  
八十八學年度碩士班招生考試試題

系所別：機械工程系研究所

組別：丙組

科目：流體力學



4. (10 points) (a) Define  
turbulent flow  
Reynolds stress

(10 points) (b) Shown in Fig. 4 is the x component of velocity measured at a fixed location in a pipe. Is the flow laminar or turbulent? Why?

