

國立成功大學  
110學年度碩士班招生考試試題

編 號：117

系 所：工程科學系

科 目：流體力學

日 期：0203

節 次：第 2 節

備 註：可使用計算機

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

(10%) 1. Prove that pressure is a scalar and isotropic at a point in a flow field.

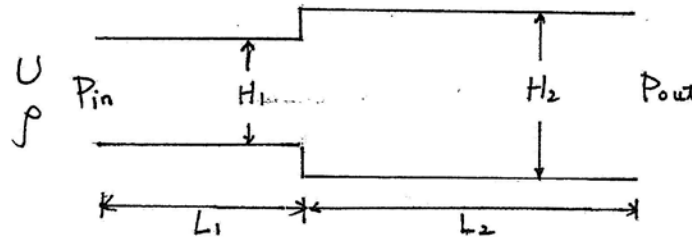
(20%) 2. A flow field is given by  $\vec{V} = Ax\vec{i} - Ay\vec{j}$  in Cartesian coordinate system, A is a constant. Is the flow incompressible? (5%) At time  $t=0$ , the fluid particle is located at  $x=2$  and  $y=2$ . Find the equation for both path line and stream line through this point (10%). What is the vorticity at this point? (5%)

(40%) 3. The incompressible Navier-Stokes equation can be written as following:

Continuity equation:  $\nabla \cdot \vec{V} = 0$

Momentum equation:  $\frac{\partial \vec{V}}{\partial t} + \vec{V} \cdot \nabla \vec{V} = -\frac{1}{\rho} \nabla P + \nu \nabla^2 \vec{V}$ , where  $\rho$  is fluid density and  $\nu = \mu/\rho$  is the kinematic viscosity.

- (a) Write down the governing equations for a steady 2D incompressible flow in Cartesian coordinate system (x and y coordinates). (15%)
- (b) Find the fully developed velocity profile for a steady incompressible viscous flow inside a 2D channel with length  $L_1$  and height  $H_1$ . Show the solution step by step using the Navier-Stokes Eqs given above. (15%).
- (c) If another channel with length  $L_2$  and height  $H_2$  is connected after  $L_1$  shown below. Find the relationship of the overall flow rate with respect to pressure drop. (10%) We assume the flow-field is laminar and fully developed.



(15%) 4. Design a method that can be used to measure surface tension between air and liquid contained in a vessel.

(15%) 5. Draw figures to show flow patterns for a flow passing over a cylinder when the Reynolds number

- (a)  $Re = 0.01$ , (b)  $Re = 10$ , (c)  $Re = 1,000,000$ . Explain your reason.