

國立成功大學

111學年度碩士班招生考試試題

編 號： 119

系 所： 工程科學系

科 目： 流體力學

日 期： 0220

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。

(15%) 1. 物體在水中有三種情況: (a)沉到水底下 (b)平衡在水中某位置 (c)半沉半浮. 請分析各個情況物體受力如何?

(20%) 2. 用 Control Volume 分析潛水艇在水中以定常速度 U 前進時，潛水艇受到的總阻力有多少?

(20%) 3. For low Reynolds number, the drag force (D) is found to be a function of the fluid viscosity (μ), the velocity (V), and a characteristic length of the body (λ). Determine the functional relationship of the drag force in terms of these variables, using the Pi theorem.

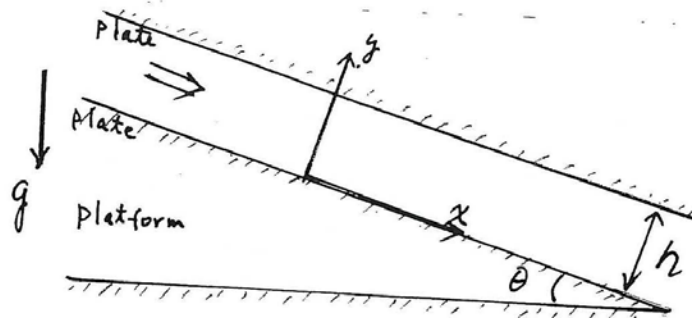
(30%) 4. The incompressible Navier-Stokes equation can be written as following:

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

$$\text{Momentum equation: } \frac{\partial \vec{V}}{\partial t} + \vec{V} \cdot \nabla \vec{V} = \vec{g} - \frac{1}{\rho} \nabla P + \nu \nabla^2 \vec{V}, \text{ where } g \text{ is gravity, } \rho \text{ is fluid density and}$$

$$\nu = \mu / \rho \text{ is kinematic viscosity.}$$

- (a) Write down the conservation of mass and conservation of momentum equations for a **steady 2-D incompressible** flow in Cartesian coordinate system. (5%).
- (b) Analyze the viscous flow using the PDE from (a) for the flow between two infinite parallel **stationary** plates inclined with an angle θ to a platform shown in the following figure. Assume the flow is **laminar** and the driving force is purely from gravity effect. Obtain the fully-developed x-component velocity profile $u=?$ (15%). The so-called fully-developed velocity u implies that the u -profile will no longer change along x -direction, i.e. u is function of y only. What's the volume flow rate across the channel? (5%). What's the shear stress at surface? (5%)



(15%) 5. A man weighing 70 kg tries to jump from the top of Taipei 101 building with the help of a large umbrella. The shape of the umbrella is hemispherical with a diameter of 4 m. Estimate the terminal velocity of the man. Neglect the weight of the umbrella, and any buoyancy effects.