

國立成功大學

115學年度碩士班招生考試試題

編 號：98

系 所：航空太空工程學系

科 目：流體力學

日 期：0203

節 次：第 2 節

注 意：1. 不可使用計算機
2. 請於答案卷(卡)作答，於
試題上作答，不予計分。

1. The stream function for a flow over a 2D cylinder with circulation can be written as:

$$\varphi = V_0 r \sin \theta - \frac{m \sin \theta}{2\pi r} + \frac{\Gamma}{2\pi} \ln r, \text{ (a) write an expression for } m; \text{ (b) calculate lift and drag of the cylinder.}$$

【20 points】

2. Given a stream function $\varphi = x^3 - 3x^2 - 3xy^2 + 3y^2$, (a) calculate the velocity at point (1, 1), (b) find the corresponding potential function.

【20 points】

3. For a boundary layer velocity profile:

$$u(y) = u_0 \left[\frac{4}{3} \left(\frac{y}{\delta} \right) - \frac{1}{3} \left(\frac{y}{\delta} \right)^3 \right], \text{ find } \frac{\delta}{x} = ?$$

Use the formula, $\int_0^x \tau_w dx = u_0 \int_0^\delta \rho u dy - \int_0^\delta \rho u^2 dy$

【20 points】

4. Consider water flowing horizontally through an ideal, inviscid contraction. At the exit, the static pressure decreases by exactly 20% of its upstream value, and the exit area is exactly half of the upstream area. What is the flow speed at the exit of the tube?

(Upstream pressure is $p_1 = 120$ kPa, water density is 1000 kg/m³)

【20 points】

5. A small cart of total mass 15 kg is mounted on frictionless wheels on a horizontal floor. A nozzle rigidly attached to the cart ejects water horizontally backwards with a speed of 30 m/s relative to the cart. The mass flow rate of water through the nozzle is 2 kg/s. What is the speed of the cart after 2 seconds?

(Assume that during the short time considered, the total mass of the cart (including water) remains approximately constant at 15 kg. The cart is initially at rest. Neglect friction and air resistance.)

【20 points】