

淡江大學九十二學年度碩士班招生考試試題

系列：航空太空工程學系

科目：流體力學

准帶項目請打「○」否則打「×」
○ 簡單型計算機

本試題共 / 頁

一、解釋名詞及簡答題：

- (1) 由 Bernoulli equation 知，一流場中流速大則壓力小，反之亦然，試由物理觀點解釋此結果。
(6%)
- (2) What is inviscid flow? 真實流場是否為 inviscid flow? 為何在分析有些流場問題時(如空氣流經機翼空氣動力探討)，可假設為 inviscid flow? (8%)
- (3) Reynolds number(雷諾數)如何在流體力學上扮演重要之角色? (8%)
- (4) 在流體力學之"dimensional analysis and similitude"探討中，什麼是 Dimensional Analysis? 什麼是 Incomplete similarity? (8%)
- (5) 在流體力學之"internal flow"探討中，什麼是 entrance region? 在 entrance region 中其速度分佈有何特徵? 什麼是 fully developed flow? (10%)

二、計算題(一)：(20%)

A tank of 0.05 m^3 volume contains air at 800 kPa (absolute) and 15°C . At $t=0$, air escapes from the tank through a valve with a flow area of 65 mm^2 . The air passing through the valve has a speed of 311 m/s and a density of 6.13 kg/m^3 . Properties in the rest of the tank may be assumed uniform at each instant. Determine the instantaneous rate of change of density in the tank at $t=0$.
(Hint: using the integral equation for conservation of mass)

三、計算題(二)：(20%)

Air at standard conditions flows along a flat plate. The undisturbed freestream speed is $U_0=10 \text{ m/s}$. At $L=145 \text{ mm}$ downstream from the leading edge of the plate, the boundary-layer thickness is $\delta=2.3 \text{ mm}$. The velocity profile at this location is $\frac{u}{U_0} = \frac{3}{2} \frac{y}{\delta} - \frac{1}{2} \left[\frac{y}{\delta} \right]^3$

Calculate the horizontal component of force per unit width required to hold the plate stationary.
(Hint: using the integral equation for x-component momentum equation)

四、計算題(三)：(20%)

Spin plays an important role in the flight trajectory of golf, ping-pong, and tennis balls. Therefore, it is important to know the rate at which spin decreases for a ball in flight. The aerodynamic torque, T , acting on a ball in flight, is thought to depend on flight speed, V , air density, ρ , air viscosity, μ , ball diameter, D , spin rate (angular speed), ω , and diameter of the dimples on the ball, d . Determine the dimensionless parameters that result.