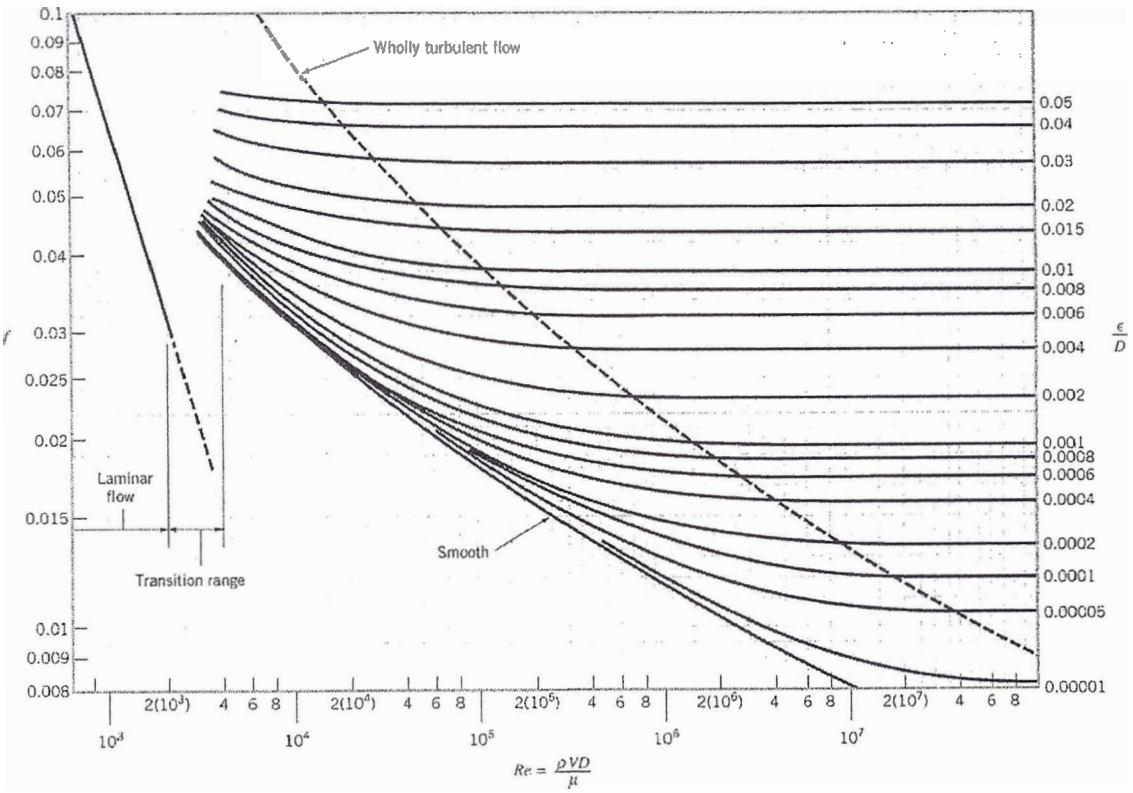
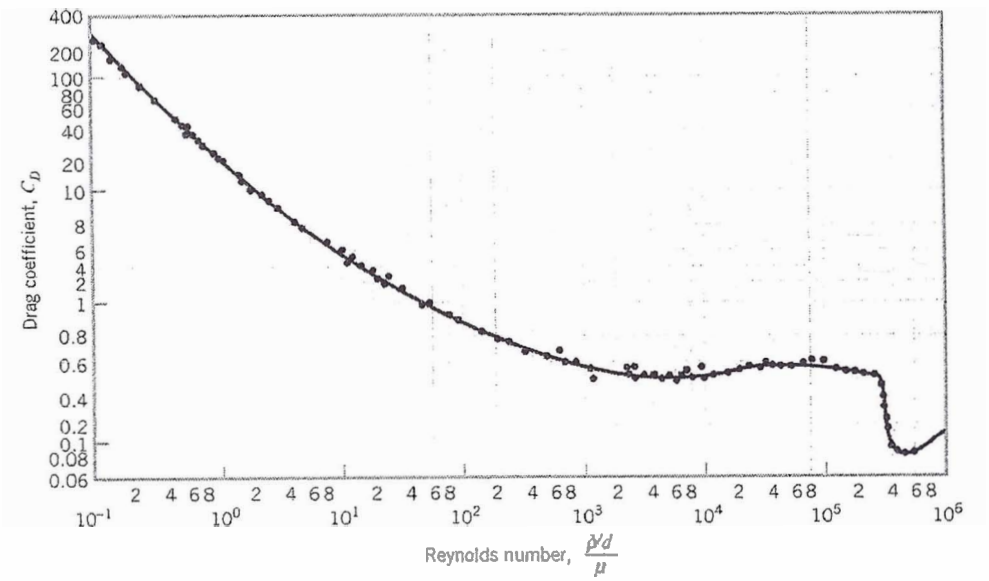
國　立　清　華　大　學　命　題　紙

95 學年度 工程與系統科學 系（所） 乙 組碩士班入學考試

科目 流體力學 科目代碼 3403 共 3 頁第 1 頁 *請在試卷【答案卷】內作答

1. What are these two figures and their purposes? You are asked to describe their important characteristics from the figures as complete as possible. (20%)





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科目 流體力學 科目代碼 3403 共 3 頁第 2 頁 *請在試卷【答案卷】內作答

2. Please describe the characteristics of a two-dimensional incompressible, steady state hydrodynamic boundary layer (x, flow direction; y, vertical to plate) about a horizontal flat plate. For example, list those important features that result in the following Prandtl's boundary layer equations from the more complete Navier-Stokes equations. Explain how such approximations are made. (20%)（解釋由 Navier-Stokes 方程式簡化至邊界層方程式的過程）

Continuity equation, $\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}=0$

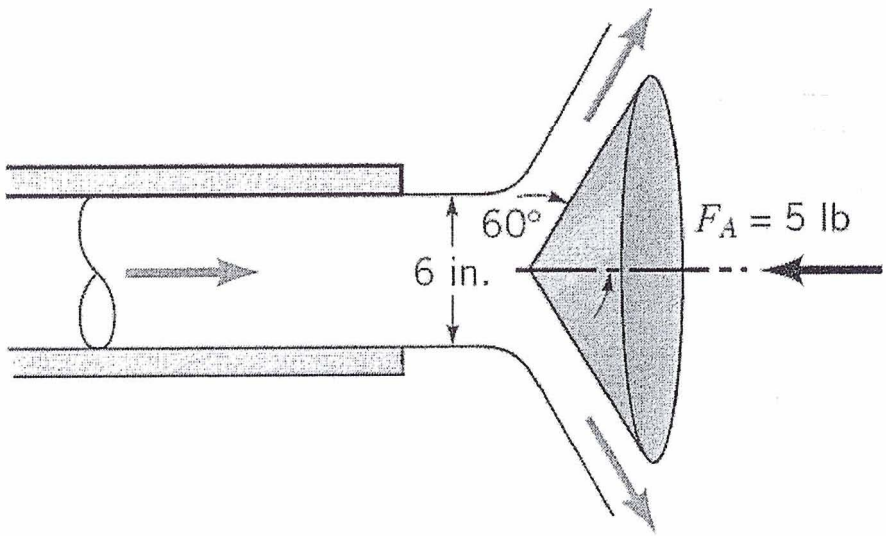
Boundary layer equations, $u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}=\frac{\mu}{\rho}\frac{\partial^2 u}{\partial y^2}$

Navier-Stokes equations,

$$u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}=-\frac{1}{\rho}\frac{\partial p}{\partial x}+\frac{\mu}{\rho}\left[\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}\right]$$

$$u\frac{\partial v}{\partial x}+v\frac{\partial v}{\partial y}=-\frac{1}{\rho}\frac{\partial p}{\partial y}+\frac{\mu}{\rho}\left[\frac{\partial^2 v}{\partial x^2}+\frac{\partial^2 v}{\partial y^2}\right]$$

3. A horizontal, circular cross-sectional jet of air having a diameter of 6 in. strikes a conical (圓錐狀) deflector as shown. A horizontal anchoring force of 5 lb is required to hold the cone in place. Estimate the nozzle flowrate in ft^3/s. The magnitude of the velocity of the air remains constant. (20%)



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科目 流體力學 科目代碼 3403 共 3 頁第 3 頁 *請在試卷【答案卷】內作答

4. 簡答或定義：(20%，各 5%)

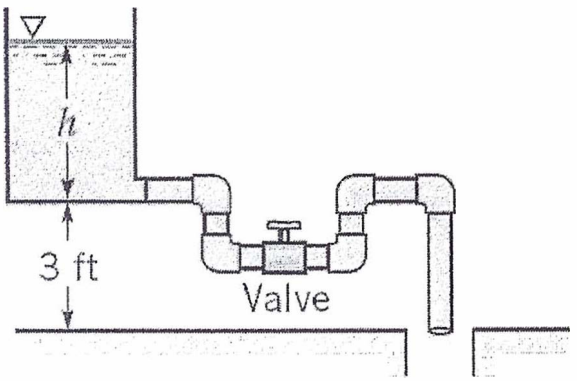
(a), 伯努利方程式的重要假設。

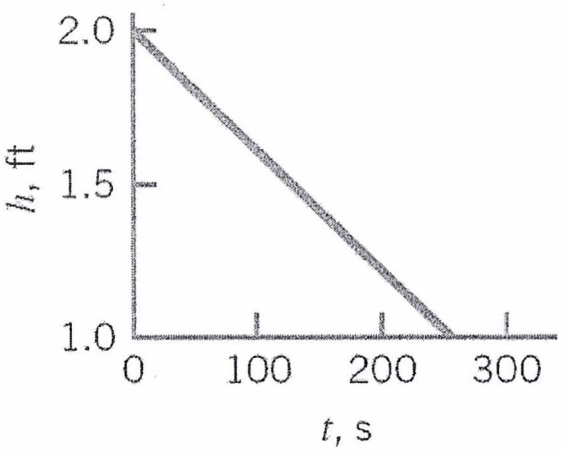
(b), 何謂勢流 (potential flow)？ 劃一簡圖表示勢流條件下，流動通過一個圓球外部的流場壓力分布。

(c), 何謂流線函數 (stream function)？ 請舉例說明之。

(d), 氣體與液體粘滯度 (viscosity) 是隨流體溫度上升而上升或是隨流體溫度上升而下降？ 爲什麼?

5. Water flows from the tank as shown, the water depth in the tank as a function of time is also indicated. Determine the cross-sectional area of the tank. The total length of the 0.60-in-diameter pipe is 20 ft, and the friction factor is 0.03. The loss coefficients are: 0.50 for the entrance, 1.5 for each elbow, and 10 for the valve. (20%)





可能有用資料

水密度；1.94 slugs/ft^3
水粘滯度；2.34×10^{-5} lb·s/ft^2
空氣密度；2.683×10^{-3} slugs/ft^3
空氣粘滯度；3.38×10^{-7} lb·s/ft^2
重力加速度；32.2 ft/s^2