

1021 機械系博士班資格考試題目

考試科目	方式	
流體力學	Closed Book, 可使用計算機	Part I

1. $\bar{v} \neq \bar{v} \neq$ momentum integral equation

$$\tau_w = \rho U^2 \frac{d}{dx} \left[\int_0^\delta \left(\frac{u}{U}\right) \left(1 - \frac{u}{U}\right) dy \right]$$

find (1) δ , (2) τ_w , (3) C_f , (4) D , and (5) \bar{C}_f (15%)

2. **GIVEN** Air at a temperature of 38 °C and standard pressure flows from a clothes dryer. According to the appliance manufacturer, the 10-cm-diameter galvanized iron vent on the clothes dryer is not to contain more than 6 m of pipe and four 90° elbows.

$$\gamma = 11.05 \text{ N/m}^3, \nu = 1.66 \cdot 10^{-5} \text{ m}^2/\text{s}$$

FIND Under these conditions determine the air flowrate if the pressure at the start of the vent pipe, directly downstream of the dryer fan, is 0.5 cm of water.

$$\epsilon = 1.5 \cdot 10^{-4} \text{ m}$$

$$\frac{1}{\sqrt{f}} = -2.0 \log \left(\frac{\epsilon/D}{3.7} + \frac{2.51}{\text{Re} \sqrt{f}} \right) \quad (15\%)$$

3. The velocity distribution for laminar flow between parallel plates is given by

$$\frac{u}{u_{\max}} = 1 - \left(\frac{2y}{h}\right)^2$$

where h is the distance separating the plates and the origin is placed midway between the plates. Consider flow of water at 15°C with maximum speed of 0.05 m/s and $h = 5 \text{ mm}$. Calculate the force on a 0.3 m² section of the lower plate and give its direction.

(10%)

$$\mu = 1.2 \cdot 10^{-3} \text{ N}\cdot\text{sec}/\text{m}^2$$

4. Consider the flow field given by $\vec{v} = ax^2y\hat{i} - by\hat{j} + cz^2\hat{k}$, where $a = 1 \text{ m}^{-2} \cdot \text{s}^{-1}$, $b = 3 \text{ s}^{-1}$, and $c = 2 \text{ m}^{-1} \cdot \text{s}^{-1}$. Determine (a) the number of dimensions of the flow, (b) if it is a possible incompressible flow, and (c) the acceleration of a fluid particle at point $(x, y, z) = (3, 1, 2)$.

(10%)

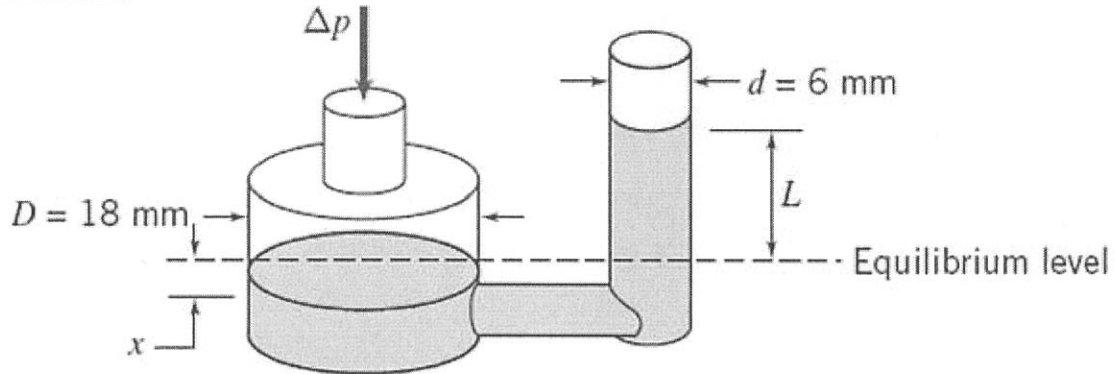
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考試科目	方式	
流體力學	Closed Book, 可使用計算機	Part II

Fluids: Problem I (25 points)

Given: A reservoir manometer has a vertical tubes of diameter $D = 18$ mm and $d = 6$ mm. The manometer liquid is Meriam red oil ($SG_{oil} = 0.827$).

Schematic:



Find:

- a) Develop an algebraic expression for liquid deflection L in the small tube when gage pressure Δp is applied to the reservoir.
- b) Evaluate the liquid deflection when the applied pressure is equivalent to 25 mm of water (gage).

Fluids qualifier questions, Fall 2013

Fluids: Problem II (25 points)

Given: Given speeds and Mach number, assuming air is perfect gas, determine the corresponding local temperature (note: 1 mi/hr = 0.447 m/s) for the following:

Please do the following (5 points each):

- a) A Boeing 747-400 at a cruise speed of 910 km/hr; $M=0.85$.
- b) The Concorde at a cruise speed of 1320 mi/hr; $M=2.0$.
- c) The fastest airplane, the Lockheed SR-71 Blackbird, flying at 2200 mi/hr; $M=3.3$.
- d) The fastest boat, the Spirit of Australia, which averaged a speed of 317.6 mi/hr; $M=0.41$.
- e) The fastest car, the ThrustSSC, which averaged a speed of 760.035 mi/hr; $M=0.97$.