

淡江大學九十三年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
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1. (20%) A 2-D incompressible flow is represented by the following stream function:

$$\psi = x^3 - 3x^2 - 3xy^2 + 3y^2$$

Determine (a) the equation of the streamline which passes through the point (5, 12), and (b) the velocity vector V at the point (5, 12).

2. (20%) Air at $T = 70^\circ\text{F}$ and $P = 14.7 \text{ lbf/in}^2$ flows between two parallel flat smooth plates spaced 1 in. apart with a velocity of 0.5 ft/sec. At what distance from the entrance will the boundary layers on the two plates meet? Which thickness formula should you use for the calculation, the laminar one or the turbulent one? Why?

[Hint: For laminar boundary layer, $\delta = 5.48xRe^{-1/2}$

For turbulent boundary layer, $\delta = 0.37xRe^{-1/5}$

in which Re is the local Reynolds number, and dynamic viscosity $\nu = 1.64 \times 10^{-4} \text{ ft}^2/\text{sec}$

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3. (20%) A 2-D, irrotational flow is to be formed by the following function: $\phi = k(x^2 - y^2)/2$
If the pressure is zero at position (2, 3), calculate the maximum pressure in this flow field using Bernoulli's equation.

4. (20%) Please show that $(V \cdot \nabla)V = \nabla(V^2/2) - V \times (\nabla \times V)$

5. (20%) The velocity potential of a steady flow field is given by the equation:

$$\phi = x^2 + y^2 - 2z^2$$

The temperature of the field is described by the following expression:

$$T = x + 3xy + z^2 + 5xyz$$

Determine the time rate of change of temperature of a fluid element (i.e., DT/Dt) as it passes through the point (1, -2, 3).