

系所組別：系統及船舶機電工程學系甲組

考試科目：流體力學

考試日期：0307，節次：2

※ 考生請注意：本試題 可 不可 使用計算機

1. Please write down the appropriate units of the following terms: (16 %; each 2 %)
 - (1) strain rate;
 - (2) shear stress;
 - (3) absolute (dynamic) viscosity;
 - (4) kinematic viscosity;
 - (5) Euler number;
 - (6) dynamic pressure;
 - (7) specific weight;
 - (8) specific gravity.
2. Please answer briefly the following questions. (14 %; each 2 %)
 - (1) What is the Newtonian fluid?
 - (2) What are the absolute pressure and gage pressure?
 - (3) What is the so-called 'non-slip' condition?
 - (4) What is the so-called 'Eulerian description'?
 - (5) What is the so-called 'Lagrangian description'?
 - (6) What are streamlines, streaklines and pathlines?
 - (7) What are the differences between "stable" and "steady"?
3. What is the "vortex"? Please write down the expression of velocity potential and stream function for vortex motion. Also explain the difference between free vortex and forced vortex. (5%)
4. (a) What is the Bernoulli equation? (5%)
(b) Under what assumptions is the Bernoulli equation derived? Briefly discuss the result of the improper use of the equation. (8%)
5. Assume the drag, D , acting on a spherical particle that falls very slowly through a viscous fluid is a function of particle diameter, d , the particle velocity, V , and the fluid viscosity, μ . Determine, with the aid of dimensions analysis, how the drag depends on the particle velocity. (10%)
6. What is the Reynolds transport theorem? Derive the theorem for one-dimensional flow a fixed control volume. (10%)
7. Define Reynolds number, Froude number, and their physical meaning. (6%)

(背面仍有題目,請繼續作答)

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8. (a) How will you describe the main differences between laminar flow and turbulent flow? (5%)

(b) For a pipe of diameter 2-cm used to carry water at average velocity 1 m/s, is the flow laminar or turbulent? Suppose the water temperature to be 20°C. (5%)

9. An incompressible steady-flow field is given by $Cxy\vec{i} - y^2\vec{j}$ (16%)

(a) What is the constant C for the flow to satisfy the continuity equation?

(b) Is the flow irrotational (i.e., potential flow)? Justify your answer.

(c) What is the acceleration of a fluid particle at the instant when it passes the position (1,1)?

(d) If the stream function has a value 0 at point (0,0), what is the stream function value at (2,2)?