

本科目可以使用計算機

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1. Explain the following terms physically and/or mathematically. (30%)

- | | |
|-----------------------------------|------|
| (1) Newtonian fluid | (5%) |
| (2) Eulerian view | (5%) |
| (3) Steady, two-dimensional flows | (5%) |
| (4) Hydraulic grade line | (5%) |
| (5) Kinematic similarity | (5%) |
| (6) Froude number | (5%) |

2. The flow around a two-dimensional bluff body is investigated, as shown in Fig. P2. It is known that vortices are generated behind the body at a shedding frequency (ω), which depends on D , H , velocity (V), fluid density (ρ), and absolute viscosity (μ). Related quantities are listed as follows: (20%)

| Variables | Prototype | Model |
|-----------|--|--|
| D | 20 cm | 2 cm |
| H | 0.5 m | 0.05 m |
| V | 10 Km/hr | V_m |
| ρ | 1.23 Kg/m ³ (air) | 998 Kg/m ³ (water) |
| μ | 4 x 10 ⁻⁷ lbf·sec/ft ² | 2.4 x 10 ⁻⁵ lbf·sec/ft ² |
| ω | ω_p | 2 Hz |

Table P2

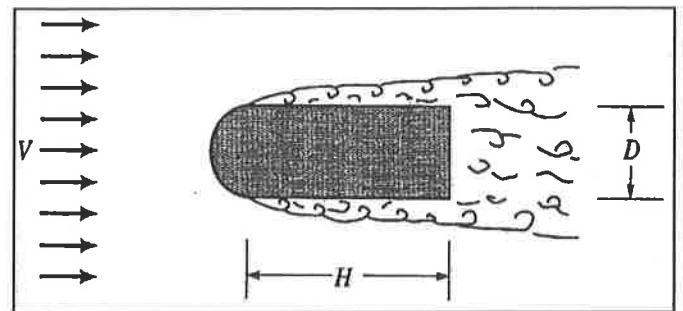


Fig. P2

- (1) For similarity, determine V_m (in Km/hr) for the model. (12%)
- (2) Compute ω_p (in Hz). (8%)

3. Air is drawn into a wind tunnel used for testing automobiles as shown in Fig. P3.

- (1) Determine the manometer reading, h , when the velocity in the testing is 98 km/h. Note that there is a 2.5 cm column of oil (specific gravity, $SG = 0.9$) on the water in the manometer. (10%)
- (2) Determine the difference between the stagnation pressure on the front of the automobile and the pressure in the test section. (10%)

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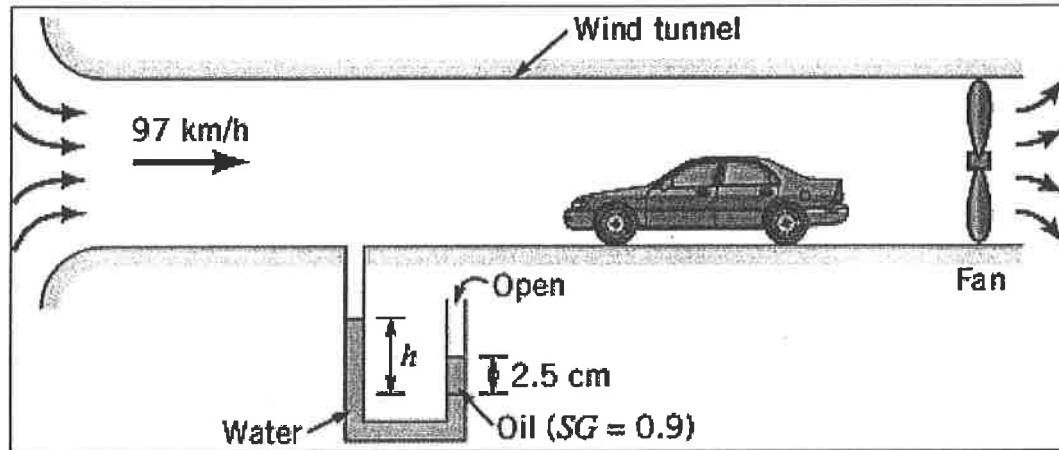


Fig. P3

4. A hydraulic jump occurs in a rectangular channel as shown in Fig. P4. If $V_1 = 12$ m/s, $y_1 = 0.4$ m,
- (1) Determine y_2 and V_2 . (15%)
 - (2) Determine the head loss across the jump. (10%)
 - (3) Explain the flow condition, i.e. supercritical or subcritical flow, at the upstream and downstream of the jump respectively? (5%)

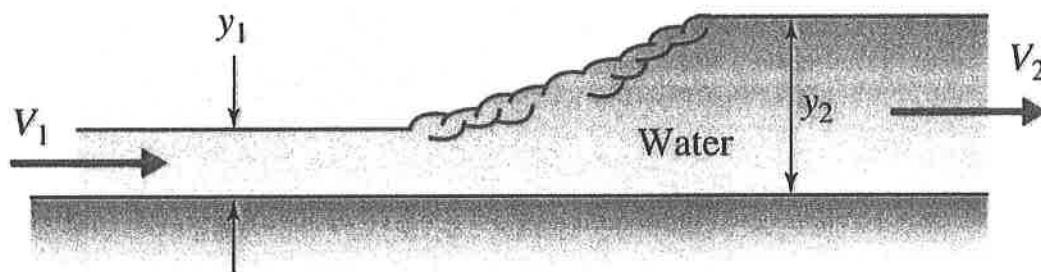


Fig. P4