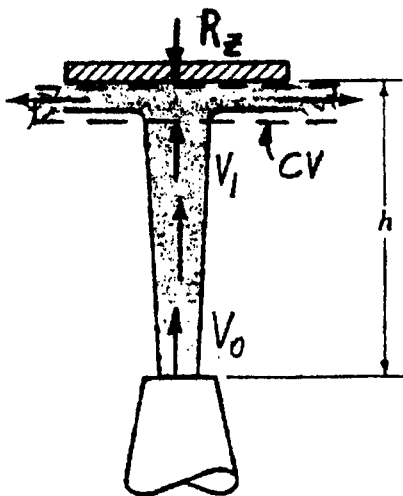


本試題是否可以使用計算機: 可使用, 不可使用 (請命題老師勾選)

1. (20%)

A vertical jet of water leaves a nozzle at a speed of 10m/s and a diameter of 25mm. It suspends a plate having a mass of 1.2 Kg as shown on the following figure.

- Write down the continuity equation and momentum equation for this flow field.
- Calculate the mass flow rate of nozzle.
- Calculate the jet momentum on nozzle exit.
- Find the vertical distance h .



2. (20%)

A car is moving in the air at speed 120 ft/s with drag coefficient 0.4. The front view sectional area is 20 square ft. The air density is 0.00238 slug/cubic ft.

- calculate the drag acting on the car
- calculate the power (unit: horse power or KW) required to move the car at the above speed (neglecting the tire frictional force).

(背面仍有題目, 請繼續作答)

編號： 187 系所：航空太空工程學系甲組、丁組 科目：流體力學

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3. (20%)

Consider a steady velocity field with a velocity potential

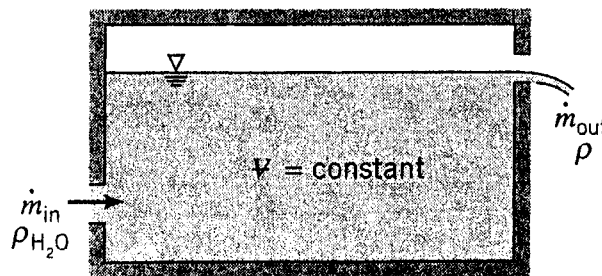
$$\phi(x, y) = -x^2 + y^2$$

where (x, y) is the position in Cartesian coordinates.

- Verify (prove) whether this flow is incompressible or compressible.
- Derive the equation for the streamline passing through point $(2, 2)$.
- Let us follow a fluid element P when it flows in this velocity field. What is the acceleration vector \bar{a} experienced by P when it flows?
- Suppose at time $t=0$ the fluid element P is located at (x_0, y_0) . Find the position (x, y) of P at $t > 0$ as a function of x_0, y_0 and t .

4. (20%)

A tank of fixed volume contains brine with initial density, ρ_i , greater than water. Pure water enters the tank steadily and mixes thoroughly with the brine in the tank. The liquid level in the tank remains constant. Derive expressions for (a) the rate of change of density of the liquid mixture in the tank and (b) the time required for the density to reach the value ρ_f , where $\rho_i > \rho_f > \rho_{H_2O}$.



本試題是否可以使用計算機: 可使用, 不可使用 (請命題老師勾選)

5. (20%)

In two-dimensional incompressible, viscous flow: (u, v) is velocity, p is pressure.

- a) Please write down the equation of continuity and the momentum equations.
- b) For the steady Poiseuille flow:
 - i) Write down the steady-state momentum equation.
 - ii) Assume that u is independent on x and $v = 0$, write down the simplified momentum equation.
 - iii) Obtain the solution for the Poiseuille flow.

