國立雲林科技大學
101 學年度碩士班暨碩士在職專班招生考試試題

系所：環安系
科目：流體力學(2)

1. A shaft 6.00 cm in diameter is being pushed axially through a bearing sleeve 6.02 cm in diameter and 40 cm long. The clearance, assumed uniform, is filled with oil whose properties are $\nu = 0.003\,\text{m}^2/\text{s}$ and $SG = 0.88$. Estimate the force required to pull the shaft at a steady velocity of 0.4 m/s. (20 points)

2. The cylindrical container in Fig.1 is 20 cm in diameter and has a conical contraction at the bottom with an exit hole 3 cm in diameter. The tank contains fresh water at standard sea-level conditions. If the water surface is falling at the nearly steady rate $dh/dt \approx -0.072\,\text{m/s}$, estimate the average velocity V out of the bottom exit. (30 points)

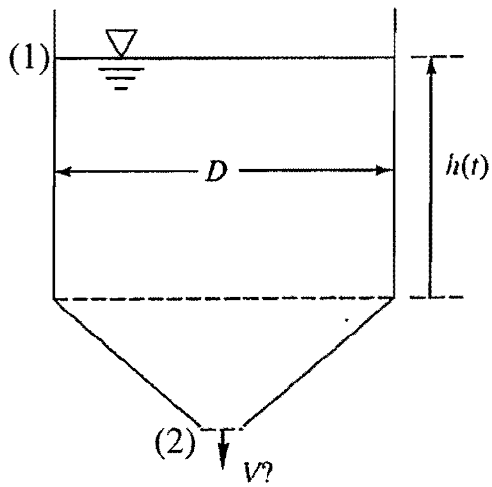

Fig. 1

3. A two-dimensional steady flow, the stream function can be expressed as

$$\psi = xy$$

Find the fluid acceleration at the point (x=1, y=1). (15 points)

4. A sharp flat plate with 1 m of length and 3 m of width is immersed parallel to a stream of velocity 2 m/s. Find the drag force on one side of the plate for (a) air, $\rho = 1.23\,\text{kg/m}^3$ and $\nu = 1.46\times10^{-5}\,\text{m}^2/\text{s}$; and (b) water, $\rho = 1000\,\text{kg/m}^3$ and $\nu = 1.02\times10^{-6}\,\text{m}^2/\text{s}$. Assuming $C_D = \dfrac{1.328}{\text{Re}_L^{1/2}}$. (15 points)

5. At low velocities (laminar flow), the volume flux Q through a small-bore tube is a function only of the pipe radius r, the fluid viscosity μ, and the pressure drop per unit pipe length dp/dx. Using the power-product method, rewrite the suggested relationship $Q = f(r, \mu, dp/dx)$ in dimensionless form. (20 points)