

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）

考試日期：0301，節次：2

1. (20%) Velocity field in xy plane is $\mathbf{v} = a \mathbf{i} + bx \mathbf{j}$, where $a = 2 \text{ m/s}$ and $b = 1 \text{ s}^{-1}$
 - a) Find the equation for streamline through $(x, y) = (2, 5)$.
 - b) Find the coordinates at $t = 2 \text{ s}$ for the particle $(0, 4)$ at $t = 0$.
2. (20%) A parallel disk apparatus is shown in Figure 1. Find a) algebraic expression for the shear stress at any radial location. b) Expression for the torque needed to turn the upper disk.

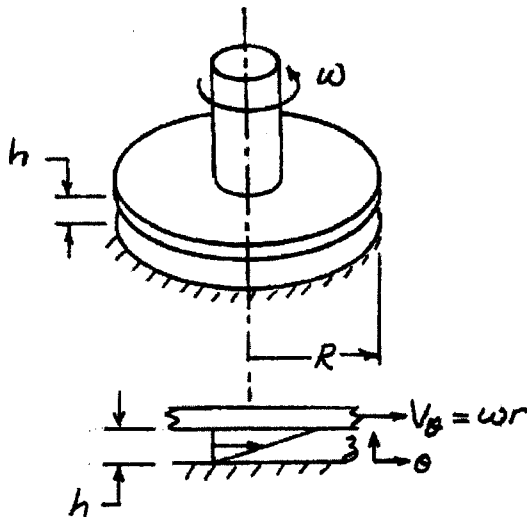


Figure 1

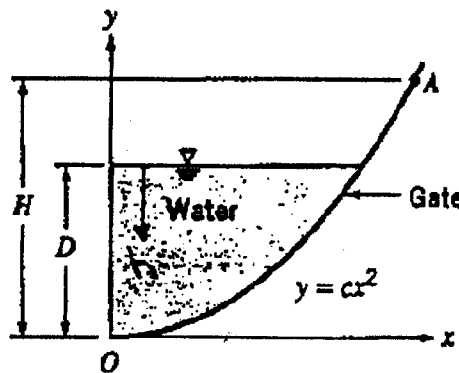


Figure 2

3. (20%) A parabolic gate, hinged at O , has width $b = 2 \text{ m}$, $c = 0.25 \text{ m}^{-1}$, $D = 2 \text{ m}$, $H = 3 \text{ m}$ (Figure 2). Find a) magnitude and line of action of vertical force on gate due to water, b) horizontal force applied at A needed for equilibrium, c) vertical force applied at A need for equilibrium.

4. (20%) The stream function for an incompressible

$$\psi = -U r \sin\theta + \frac{q}{2\pi} \theta$$

- a) Find an expression for the velocity field.
- b) Find points where $|\mathbf{v}| = 0$.
- c) Show $\psi = 0$ where $|\mathbf{v}| = 0$.

5. (20%) The fully developed laminar flow in a pipe with

$$u = -\frac{R^2}{4\mu} \frac{\partial p}{\partial x} \left[1 - \left(\frac{r}{R} \right)^2 \right]$$

Find the radius from pipe axis at which u equals the average velocity, \bar{v}