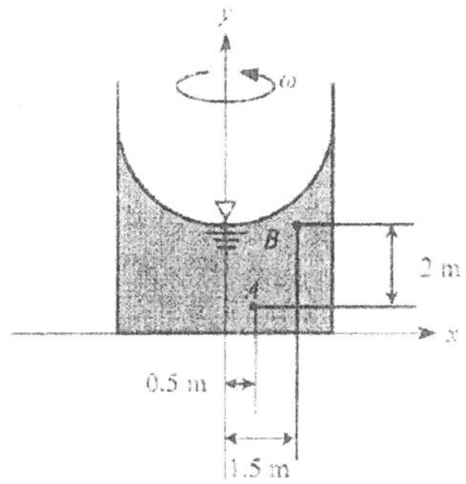
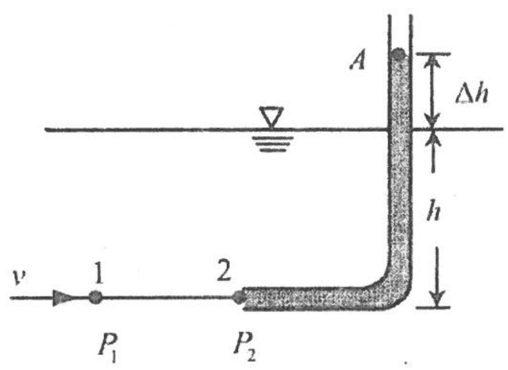
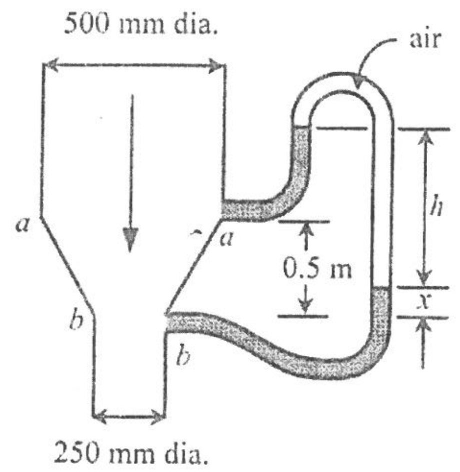
1. A cylindrical container, as shown in the attached figure, filled with water (γ_w=9.81 kN/m^3) rotates at a constant angular speed of ω. If the pressures at points A and B are equal, find the required ω of the rotation. (15%)



2. A simple Pitot tube is located inside a steady, inviscid, and irrotational fluid flow as shown in figure. If the atmospheric pressure is zero, P_{atm}=0, the specific weight of fluid is γ, then use the notations indicated in figure to find (a) P_1; (b) P_2 and (c) ν (15%)



3. A 500 mm diameter vertical water pipeline discharges water through a constriction of 250 mm diameter as shown in Fig. The pressure difference between the normal and constricted sections of the pipe is measured by an inverted U-tube. Determine (a) the difference in pressure between these two sections when the discharge through the system is 600 l/s, and (b) the manometer deflection, h, if the inverted U-tube contains air. (20%)



4. Given energy EQs as EQ1

$$\rho\left[\frac{D}{Dt}(C_P T)-\frac{1}{\rho}\frac{DP}{Dt}\right]=\frac{\partial}{\partial x}\left(k\frac{\partial T}{\partial x}\right)+\frac{\partial}{\partial y}\left(k\frac{\partial T}{\partial y}\right)+\frac{\partial}{\partial z}\left(k\frac{\partial T}{\partial z}\right)+\Phi$$

$$\Phi=2\mu\left[\left(\frac{\partial u}{\partial x}\right)^2+\left(\frac{\partial v}{\partial y}\right)^2+\left(\frac{\partial w}{\partial z}\right)^2\right]+\mu\left(\frac{\partial v}{\partial x}+\frac{\partial u}{\partial y}\right)^2+\mu\left(\frac{\partial w}{\partial y}+\frac{\partial v}{\partial z}\right)^2+$$

$$\mu\left(\frac{\partial u}{\partial z}+\frac{\partial w}{\partial x}\right)^2-\frac{2}{3}\mu\left(\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}\right)^2$$

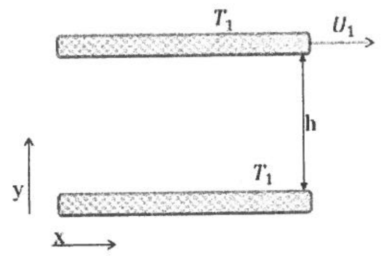
....①

(a) For steady state prove that equation ② and exist conditions.

(10%)

$$u\frac{\partial T}{\partial x}+v\frac{\partial T}{\partial y}=\propto\left(\frac{\partial^2 T}{\partial x^2}+\frac{\partial^2 T}{\partial y^2}\right)+\frac{\mu}{\rho C}\left(\frac{\partial u}{\partial y}\right)^2 \quad \dots②$$

(b) For couette flow between Flat plate plane as



T_1 is up plate Temperature.

T_0 is down plate Temperature.

H is the distance of plate.

U_1 is the velocity of up-plate.

The prove equation ③ and physical means

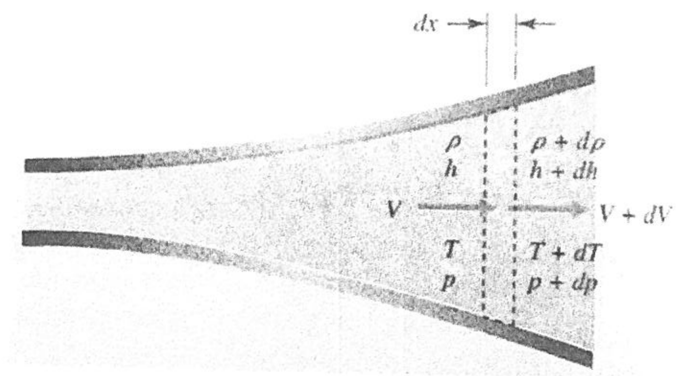
$$-k\frac{\partial^2 T}{\partial y^2}=\mu\left(\frac{\partial u}{\partial y}\right)^2 \dots③$$

Where μ is viscosity, T is temperature, u is velocity of fluid.

(15%)

5. For internal flow through the control volume shown in in Fig. 1.

(25%)



(a) What is conditions for $\rho AV = \text{constant}$ ...④ (5%)

(b) What is conditions for the energy equation as

$$\frac{1}{\dot{m}}\left(\dot{Q}_{in} + \dot{W}_{in,s}\right) = \frac{V_2^2 - V_1^2}{2} + C_P(T_2 - T_1) \quad \ldots⑤$$

And shown that state 1 and 2 on Fig. 1. (5%)

(c) Prove that equation ⑥ from equation ⑤ and shown that conditions.

$$\frac{V^2}{2} + \frac{k}{k-1}\frac{P}{\rho} = constant \quad \ldots⑥$$

Where V is Velocity of fluid flow, k is specific heat ratio with constant pressure to constant volume, $k = \frac{C_P}{C_V}$, ρ is density and P is pressure. (5%)

(d) Prove that $\frac{dV}{V}(M^2 - 1) = \frac{dA}{A}$, where $M \equiv \frac{V}{C}$ and $C^2 = \frac{kP}{\rho}$. (10%)