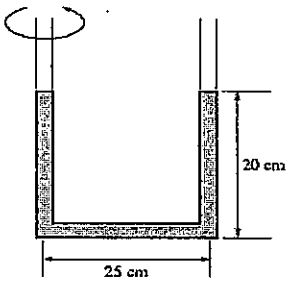
(1) (20) The distance between the centers of the two arms of a U-tube open to the atmosphere is 25 cm, and the U-tube contains 20-cm-high water in both arms. Now the U-tube is rotated about the left arm at 4.2 rad/s. Determine the elevation difference between the fluid surfaces in the two arms.



Hint: $\frac{\partial P}{\partial r} = \rho r\omega^2$, $\frac{\partial P}{\partial \theta} = 0$, and $\frac{\partial P}{\partial z} = -\rho g$

(2) (20) (a) (12)Define static, dynamic, and hydrostatic pressure. Under what conditions is their sum constant for a flow stream?(b)(8) What is stagnation pressure? Explain how it can be measured.

(3) (20) A 5-cm-diameter horizontal jet of water with a velocity of 30 m/s strikes a flat plate that is moving in the same direction as the jet at a velocity of 10 m/s. The water splatters in all directions in the plane of the plate. How much force does the water stream exert on the plate?

(4) (20) The velocity profile in fully developed laminar flow in a circular pipe, in m/s, is given by $u(r) = 6(1-100r^2)$, where r is the radial distance from the centerline of the pipe in m. Determine (*a*) (6) the radius of the pipe, (*b*) (8) the average velocity through the pipe, and (*c*) (6) the maximum velocity in the pipe.

(5) (20) Consider the two-dimensional velocity field, $\vec{V} = (u, v) = (ax + b)\vec{i} + (-ay + c)\vec{j}$, where a, b, and c are constants. (a) (6) Is the flow steady and incompressible? Why? (b) (14) Calculate the pressure as a function of x and y. Given: $\rho \frac{D\vec{V}}{Dt} = -\vec{\nabla}P + \rho\vec{g} + \mu\nabla^2\vec{V}$

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