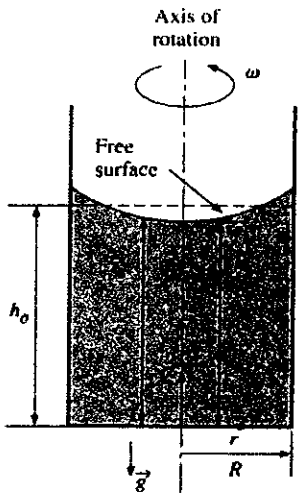
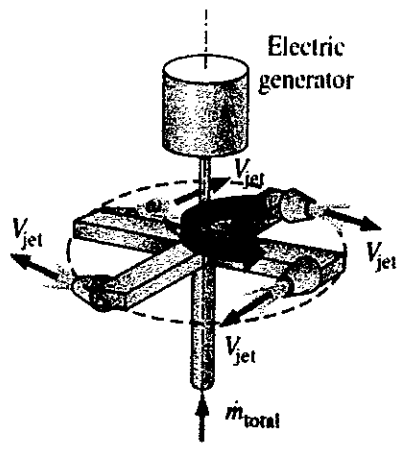
(1) (20) Consider a vertical cylindrical container partial filled with water. The radius of container is R and the still water depth in it is h_0. Now it is rotated steadily at a constant angular velocity of ω. Assume the water will move as a rigid body, please find the equation of the free surface.





(2) (20) A barometer is used to measure the height of a building as shown in the above figure. The readings at the top and at the bottom of the building are 755 mmHg and 730 mmHg, respectively. Air density is 1.18 kg/m^3 and the density of mercury is 13600 kg/m^3, please find the height of the building? (Gravitational acceleration = 9.807 m/s^2)

(3) (20) Derive the Bernoulli equation along a streamline for steady, incompressible flow.

(4) (20) A generator is attached to a large lawn sprinkler with four identical arms as shown in the figure. Water enters the sprinkler from the base along the axis of rotation at a rate of $\dot{V}$ and leaves the nozzles in the tangential direction. The sprinkler rotates at a rate of ω in a horizontal plane. The diameter of each jet is *d*, and the normal distance between the axis of rotation and the center of each nozzle is *r*. At what rotation rate, the generator can produce maximum power and what the power is in terms of $\dot{V}$, *d*, ρ and *r*. (Plot control volume diagram)

(5) (20) Define

(a) (10) Prove curves of constant ψ are streamlines of the flow.

(b) (10) A uniform stream of speed V is inclined at angle α form the x-axis (Fig. P9-55). The flow is steady, two-dimensional, and incompressible. The Cartesian velocity components are $u = V\cos\alpha$ and $v = V\sin\alpha$. Generate an expression for the stream function for this flow.

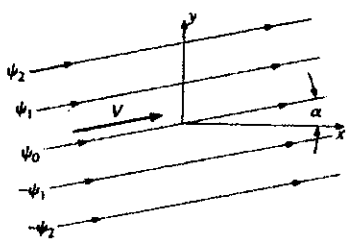


FIGURE P9–55

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