(1) (20) The clutch system shown in Fig. 1 is used to transmit torque through a 2-mm-thick oil film with μ = 0.38 N•s/m^2 between two identical 30-cm-diameter disks. When the driving shaft rotates at a speed of 1450 rpm, the driven shaft is observed to rotate at 1398 rpm. Assuming a linear velocity profile for the oil film, determine the transmitted torque.

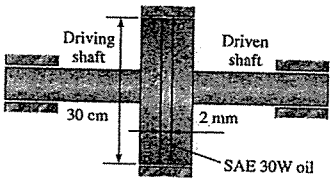

FIGURE 1

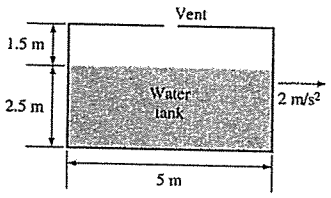

FIGURE 2

(2) (20) As shown in Fig. 2, A 5-m-long, 4-m-high tank contains 2.5-m-deep water when not in motion and is open to the atmosphere through a vent in the middle. The tank is now accelerated to the right on a level surface at 2 m/s^2. Determine the maximum pressure in the tank relative to the atmospheric pressure. (density of water = 1000 kg/m^3, g = 9.81 m/s^2)

(3) (20) A lawn sprinkler with three identical arms is used to water a garden by rotating in a horizontal plane. Water enters the sprinkler along the axis of rotation at a rate of 60 L/s and leaves the 1.5-cm-diameter nozzles in the tangential direction. The bearing applies a retarding torque of T_0 = 50 N · m due to friction at the anticipated operating speeds. For a normal distance of 40 cm between the axis of rotation and the center of the nozzles, determine the angular velocity of the sprinkler shaft.

(4) (20) The aerodynamic drag of a new sports car is to be predicted at a speed of 95 km/h at an air temperature of 25°C. A one-third scale model of the car was built to test in a wind tunnel. The temperature of the wind tunnel air is also 25°C. The drag force is measured with a drag balance, and the moving belt is used to simulate the moving ground. (a) (12) Determine how fast the engineers should run the wind tunnel to achieve similarity between the model and the prototype. Assume aerodynamic drag, F_D, is a function of Reynolds number only. ρ_{air} = 1.184 kg/m^3 and μ_{air}= 1.849 × 10^{-5} kg/m·s. (b) (8) If the drag on the model car is 150 N, determine the drag force on the prototype car. Define the nondimensionalized drag coefficient as

$$C_D = \frac{F_D}{\rho V^2 L^2}$$

(5) (20) Two pipes of identical diameter and material are connected in parallel. The length of pipe A is three times the length of pipe B. Assuming the flow is fully rough turbulent in both pipes and thus the friction factor is independent of the Reynolds number and disregarding minor losses, determine the ratio of the flow rates in the two pipes.

試題隨卷繳回