Tutorial Sheet-1 (MEC2310)

Q.1 Gate AB in Fig.1 is a homogeneous mass of 180 kg,1.2 m wide into the paper, hinged at A, and resting on a smooth bottom at B. All fluids are at 20°C. For what water depth h will the force at point B be zero?

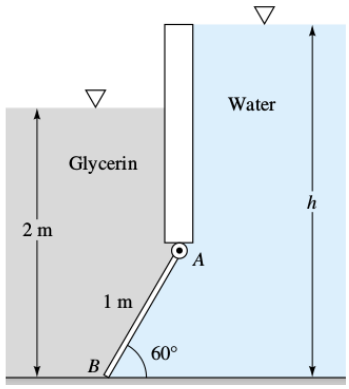


Fig:1

Q.2 Determine (a) the total hydrostatic force on the curved surface AB in Fig.2 and (b) its line of action. Neglect atmospheric pressure, and let the surface have unit width.

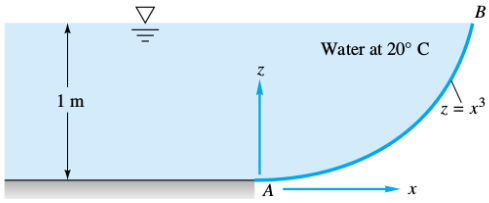


Fig:2

Q.3 A solid cone of angle 2θ, base r_0 , and density ρ_c is rotating with initial angular velocity ω_o inside a conical seat, as shown in Fig. 3. The clearance h is filled with oil of viscosity μ. Neglecting air drag, derive an analytical expression for the cone's angular velocity $\omega(t)$ if there is no applied torque.

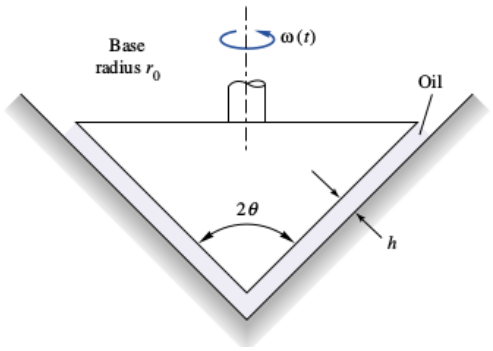


Fig:3

Q.4 Gate AB in Fig.4 is a three-eighths circle, 3 m wide into the paper, hinged at B, and resting against a smooth wall at A. Compute the reaction forces at points A and B.

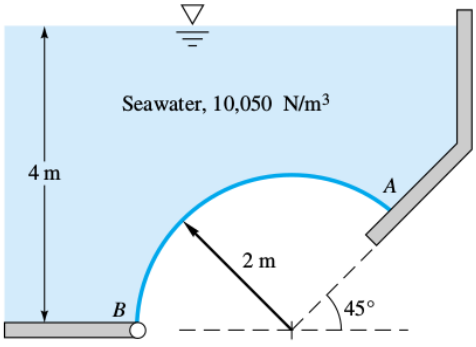
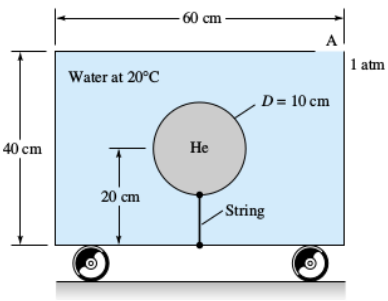


Fig:4

Q.5 The tank in Fig. 5 is filled with water and has a vent hole at point A. The tank is 1 m wide into the paper. Inside the tank, a 10-cm balloon, filled with helium at 130 kPa, is tethered centrally by a string. If the tank accelerates to the right at 5 m/s^2 in rigid-body motion, at what angle will



the balloon lean? Will it lean to the right or to the left?

Fig:5

Q.6 For what uniform rotation rate in r/min about axis C will the U-tube in Fig.6 take the configuration shown? The fluid is mercury at 20°C.

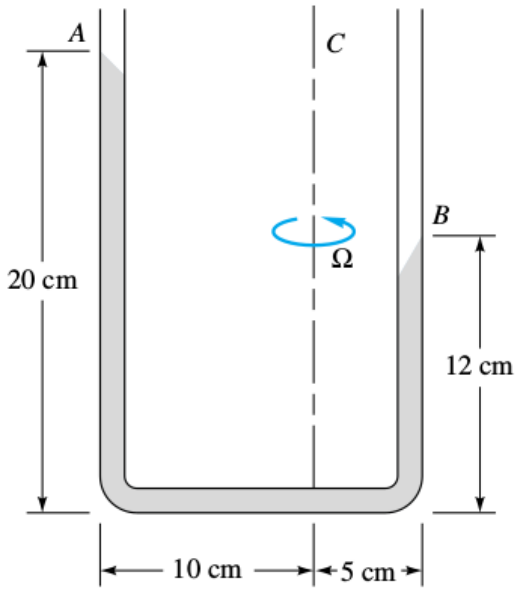


Fig:6

Q.7 A 16-cm-diameter open cylinder 27 cm high is full of water. Compute the rigid-body rotation rate about its central axis, in r/min, (a) for which one-third of the water will spill out and (b) for which the bottom will be barely exposed.

Q.8 The torque M required to turn the cone-plate viscometer depends upon the radius R, rotation rate Ω, fluid viscosity μ , and cone angle θ. Rewrite this relation in dimensionless form. How does the relation simplify it if it is known that M is proportional to θ ?

Q.9 Water flows upward in a pipe slanted at 30°, as in Fig.7. The mercury manometer reads h=12 cm. Both fluids are at 20°C. What is the pressure difference p_1- p_2 in the pipe?

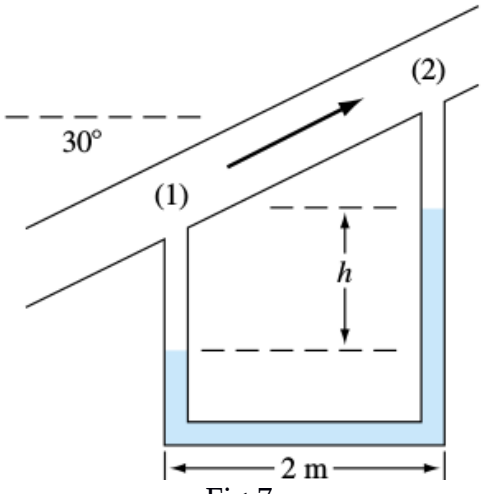


Fig:7

Q.10 Compute the horizontal and vertical components of the hdrostatic force on the quarter-circle panel at the bottom of the water tank in Fig.8.

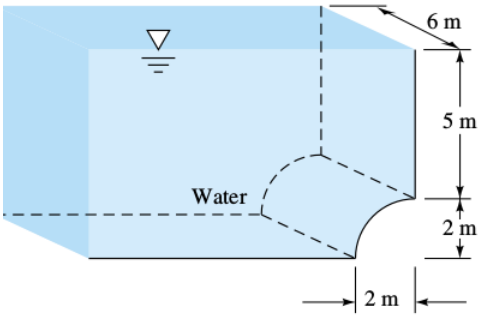


Fig:8