Tutorial 1

January 20, 2021

Momentum Transfer

Q1 Determine the difference in pressure between the inside and outside of a soap film bubble at 20°C if the diameter of the bubble is 4 mm.

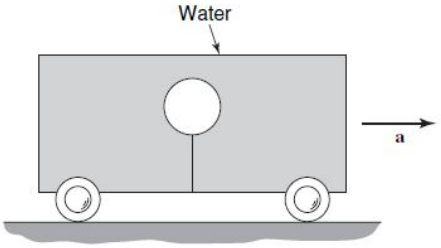
Q2 A glass tube having an inside diameter of 0.25mm and an outside diameter of 0.35mm is inserted into a pool of mercury at 20°C such that the contact angle is 130°. Determine the upward force on the glass.

Q3 Given the following expression for the pressure field where x, y, and z are space coordinates, t is time, and P_0, r, V_∞, and L are constants, find the pressure gradient.

$$P = P_0 + \frac{1}{2}\rho V_\infty \left(2\frac{xyz}{L^3} + 3(\frac{x}{L})^2 + \frac{V_\infty t}{L} \right) \tag{1}$$

Fluid Statics

Q4 The car shown in the figure is accelerated to the right at a uniform rate. What way will the balloon move relative to the car?



Q5 A watertight bulkhead 22 ft high forms a temporary dam for some construction work. The top 12 ft behind the bulkhead consists of sea water with a density of 2 slugs/ft^3, but the bottom 10 ft begin a mixture of mud and water can be considered a fluid of density 4 slugs/ft^3. Calculate the total horizontal load per unit width and the location of the center of pressure measured from the bottom.

Q6 The float in a toilet tank is a sphere of radius R and is made of a material with density ρ. An upward buoyant force F is required to shut the ballcock valve. The density of water is designated ρ_w. Develop an expression for x, the fraction of the float submerged, in terms of R, ρ, F, g, and ρ_w.