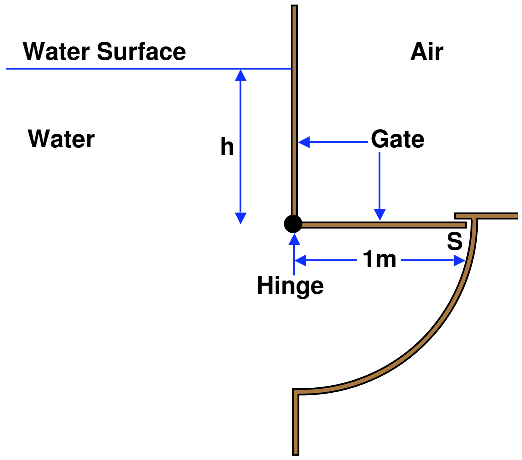
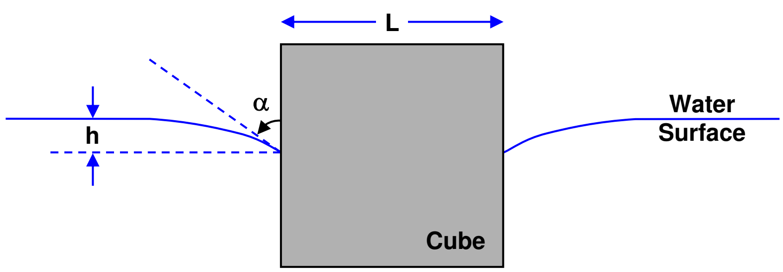
PROBLEM 5

The L-shaped gate shown in the figure can rotate about the hinge. As the water level rises the gate will automatically open when the water level rises to a certain height, h. If the length of the lower arm of the gate is 1 m find the critical height, h. (Assume that when the gate is closed, as shown in the figure, there is a seal at the point S. Neglect the weight of the gate.)



PROBLEM 6

A cube with sides, L, and density, ρ_S, floats in a pool of water whose density is ρ_L and whose surface tension is S. The acceleration due to gravity is denoted by g. The cube is made of hydrophobic material with a contact angle of $\pi - \alpha$ so that it floats in the following configuration:



Because the material is hydrophobic the density of the cube can be greater than that of the water and it will still float. Assuming that

[1] $\alpha = \pi/4$

[2] The surface tension, S, is such that $S/(\rho_L g L^2) = 0.1$

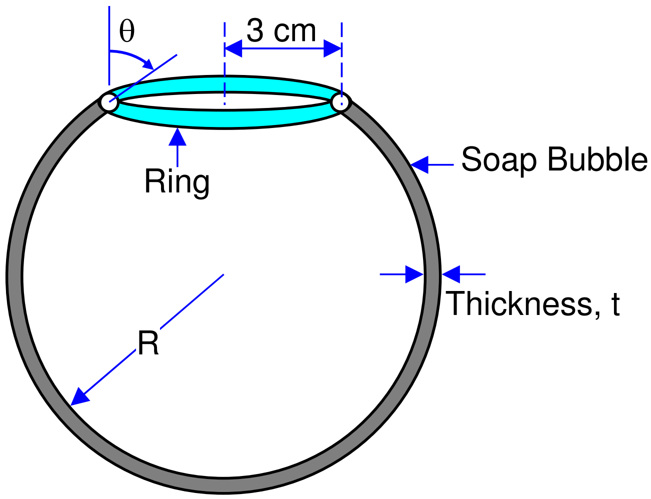
[3] The elevation difference, h, between the line of contact on the sides of the cube and the water surface far from the cube is given by $h = (S/(\rho_L g))^{1/2} \cot \alpha$.

[4] It is stipulated that the water surface can only contact the cube along the vertical faces of that cube.

determine the maximum specific gravity of the cube (ρ_S/ρ_L) for which the cube will still float.

PROBLEM 7

A soap bubble hangs from a horizontal circular ring of radius equal to 3 cm:



The mass of the soapy water comprising the bubble is 0.0014 kg. Assuming the bubble is spherical and neglecting any contact angle effects at the junction of the ring and the bubble, find:

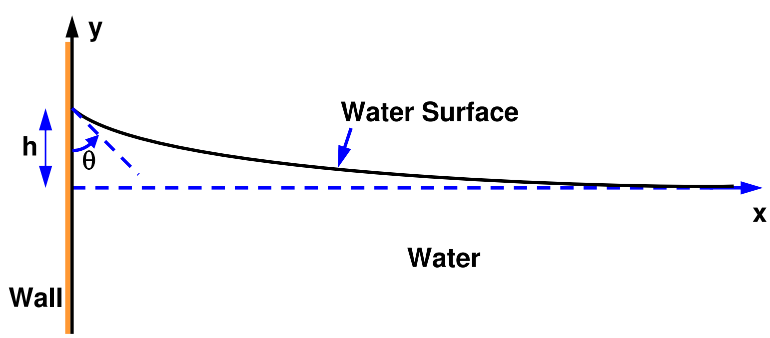
[1] The angle, θ, between a tangent to the bubble at the ring and the vertical if the surface tension of the soapy water is 0.05 kg/s^2. Assume the acceleration due to gravity is 9.8 m/s^2.

[2] The radius of the soap bubble.

[3] The thickness of the soap bubble given that the density of the soapy water is 1000 kg/m^3.

PROBLEM 8

A plane wall is immersed in a large body of liquid of density ρ which is at rest:



The surface tension of the liquid surface is denoted by S and the contact angle with the wall by θ. Find the equation of the water surface in the form $y = y(x)$; the function should contain the quantities S, θ, ρ and the acceleration due to gravity, g. To simplify the problem assume that the curvature of the water surface can be approximated by $\mathrm{d}^2y/\mathrm{d}x^2$. Find the height, h, in terms of S, θ, ρ and g.