

16.8: Some Simple Examples

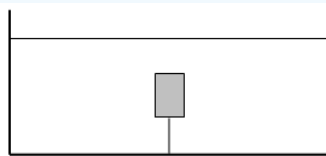
As we pointed out in the introduction to this chapter, this chapter is less demanding than some of the others, and indeed it has been quite trivial so far. Just to show how easy the topic is, here are a few quick examples.

✓ Example 16.8.1

A cylindrical vessel of cross-sectional area A is partially filled with water. A mass m of ice floats on the surface. The density of water is ρ_0 and the density of ice is ρ . Calculate the change in the level of the water when the ice melts, and state whether the water level rises or falls.

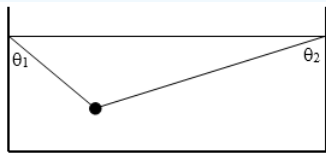
✓ Example 16.8.2

A cork of mass m , density ρ , is held under water (density ρ_0) by a string. Calculate the tension in the string. Calculate the initial acceleration if the string is cut.



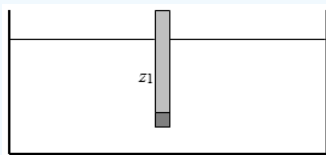
✓ Example 16.8.3

A lump of lead (mass m , density ρ) is held hanging in water (density ρ_0) by two strings as shown. Calculate the tension in the strings.



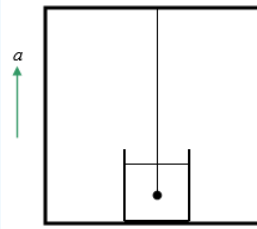
✓ Example 16.8.4

A hydrometer (for our purposes a hydrometer is a wooden rod weighted at the bottom for stability when it floats vertically) floats in equilibrium to a depth z_1 in water of density ρ_1 . If salt is added to the water so that the new density is ρ_2 , what is the new depth z_2 ?



✓ Example 16.8.5

A mass m , density ρ , hangs in a fluid of density ρ_0 from the ceiling of an elevator (lift). The elevator accelerates upwards at a rate a . Calculate the tension in the string.

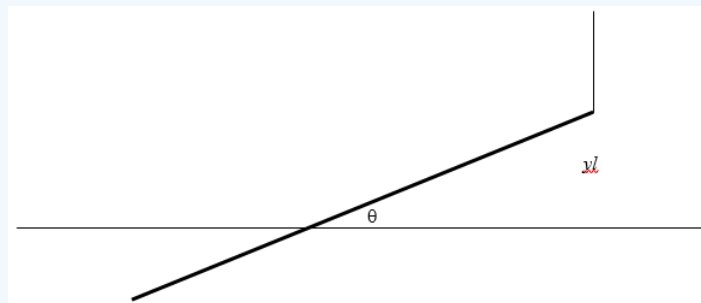


✓ Example 16.8.6

A hydrometer of mass m and cross-sectional area A floats in equilibrium to a depth h in a liquid of density ρ . The hydrometer is then gently pushed down and released. Determine the period of oscillation.

✓ Example 16.8.7

A rod of length l and density $s\rho$ ($s < 1$) floats in a liquid of density ρ . One end of the rod is lifted up through a height yl so that a length xl remains immersed. I have drawn it with the rope vertical. Must it be?)



- Find x as a function of s .
- Find θ as a function of y and s .
- Find the tension T in the rope as a function of m , g and s .

Draw the following graphs:

- x and $\frac{T}{(mg)}$ versus s .
- θ versus y for several s .
- θ versus s for several y .
- x versus y for several s .
- $\frac{T}{(mg)}$ versus y for several s .

? Answers

- No, it does not.
- $T = \left(\frac{\rho_0 - \rho}{\rho} \right) mg$
- $T_1 = \frac{\left(\frac{\rho - \rho_0}{\rho} \right) mg}{\cos \theta_1 + \frac{\sin \theta_1}{\tan \theta_2}} \quad T_2 = \frac{\left(\frac{\rho - \rho_0}{\rho} \right) mg}{\cos \theta_2 + \frac{\sin \theta_2}{\tan \theta_1}}$
- $z_2 = \frac{\rho_1}{\rho_2} z_1$
- $T = m \left[a + g \left(\frac{\rho - \rho_0}{\rho} \right) \right]$

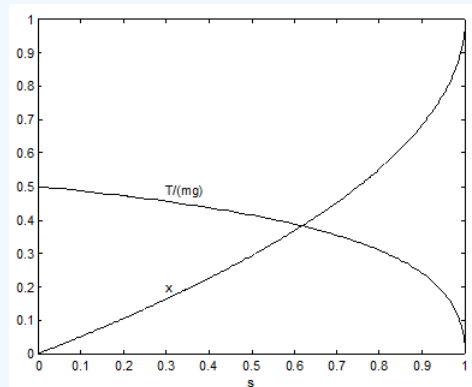
6. $P = 2\pi\sqrt{\frac{m}{\rho Ag}}$

7.

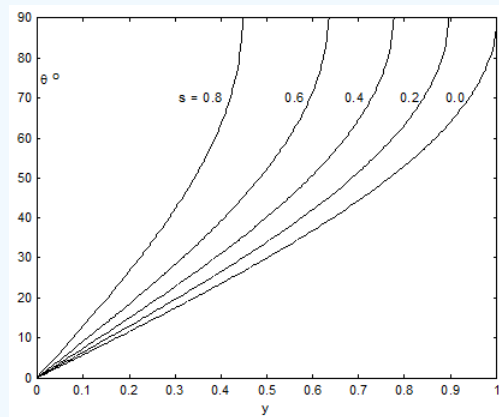
i. $x = 1 - \sqrt{1-s}$

ii. $\sin\theta = \frac{y}{\sqrt{1-s}}$

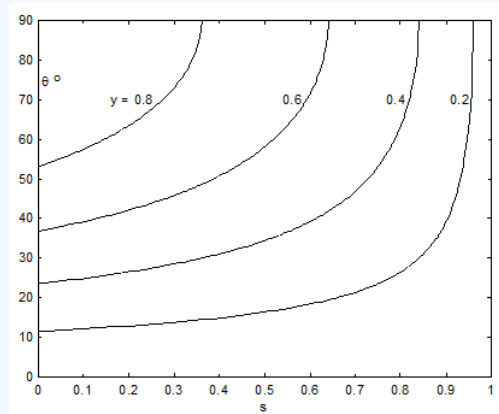
iii. $T = mg\left(\frac{\sqrt{1-s} - (1-s)}{s}\right)$



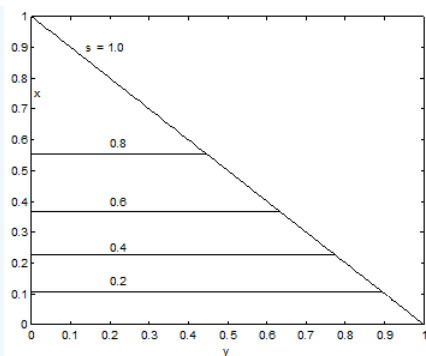
a.



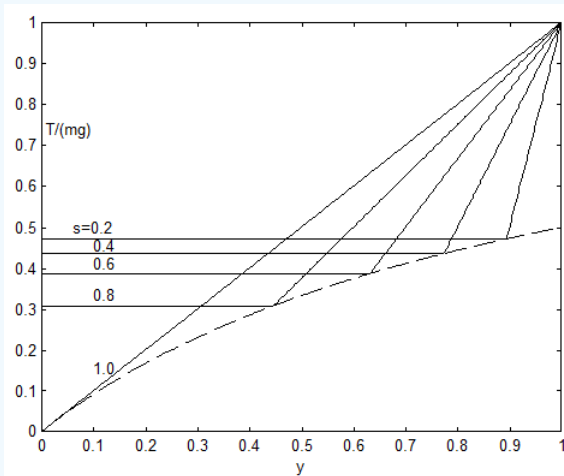
b.



c.



d.



e.

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