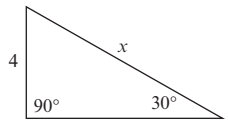
Instructor's Supplement Problems

CHAPTER 1 PROBLEMS

Engineering Fluid Mechanics (§1.1)

Prof 1.1 For the given problem, present a solution that demonstrates the standard structure of critical thinking.

PROBLEM STATEMENT. Calculate x for this triangle.



Prof Problem 1.1

Modeling in Fluid Mechanics (§1.2)

Prof 1.2 Based on molecular mechanisms, explain why aluminum melts at 660°C, whereas ice melts at 0°C.

Weight, Mass, and NLUG (§1.4)

Prof 1.3 (T/F) The constant $g = 9.81$ m/s^2 can also be written as $g = 9.81$ N/kg.

Prof 1.4 On planet Y, an 8 lbm object weighs 5 lbf on a spring balance. In units of m/s^2, what is the value of g on planet Y?

(a) 14.7 **(b)** 13.0 **(c)** 15.7 **(d)** 9.8 **(e)** 6.1

Essential Math Topics (§1.5)

Prof 1.5 If $F = pA$, $p = 74{,}000$ Pa, and $A = 1\text{e-}06$ m^2, then the force F is

(a) 74 mN **(b)** 0.0074 N **(c)** 740 μN **(d)** 74 μN
(e) 74×10^{-5} N

Density and Specific Weight (§1.6)

Prof 1.6 What is the weight in kN of a spa that is filled with 1500 L of water? The mass of the spa when it is empty is 250 kg.

(a) 13 **(b)** 15 **(c)** 17 **(d)** 21 **(e)** 23

Prof 1.7 A fluid tank in the shape of a cube holds a mass m of a liquid. Each side of the tank has a length L. What length is required to hold 11 times as much mass of the same liquid, also in a cube-shaped tank?

(a) 1.14L **(b)** 2.22L **(c)** 3.67L **(d)** 4.91L **(e)** 2.83L

Prof 1.8 A tank holds $x = 12$ kN of a liquid. What formula gives the volume of the tank?

a. γ/x
b. x/γ
c. γx
d. $1/(\gamma x)$
e. $x\gamma/\rho$

Ideal Gas Law (IGL) (§1.7)

Prof 1.9 (T/F) If nitrogen in a steel tank is heated, then the density of the nitrogen will decrease.

Prof 1.10 Determine the density of methane gas at a pressure of 200 kN/m^2 absolute and a temperature of 80°C.

Prof 1.11 At a temperature of 100°C and an absolute pressure of 4 atmospheres, what is the ratio of the density of water to the density of air, ρ_w/ρ_a?

Quantity, Units, and Dimensions (§1.8)

Prof 1.12 Apply the grid method to calculate the density of an ideal gas using the formula $\rho = p/RT$. Express your answer in lbm/ft^3. Use the following data: the absolute pressure is $p = 60$ psi, the gas constant is $R = 1716$ ft·lbf/slug·°R, and the temperature is $T = 180$°F.

Prof 1.13 The dimensions of mass are

(a) FL/T^2 **(b)** FT^2/L **(c)** FL/T **(d)** FT/L **(e)** FT/L^2

Prof 1.14 The power provided by a centrifugal pump is given by $P = \dot{m}gh$, where $\dot{m}$ is mass flow rate, g is the gravitational constant, and h is pump head. Prove that this equation is dimensionally homogeneous.