

Problem 1.5

[Difficulty: 1]

1.5 Make a guess at the order of magnitude of the mass (e.g., 0.01, 0.1, 1.0, 10, 100, or 1000 lbm or kg) of standard air that is in a room 10 ft by 10 ft by 8 ft, and then compute this mass in lbm and kg to see how close your estimate was.

Given: Dimensions of a room

Find: Mass of air

Solution:

Basic equation: $\rho = \frac{p}{R_{\text{air}} \cdot T}$

Given or available data $p = 14.7 \text{ psi}$ $T = (59 + 460) \text{ R}$ $R_{\text{air}} = 53.33 \cdot \frac{\text{ft} \cdot \text{lbf}}{\text{lbm} \cdot \text{R}}$

$V = 10 \cdot \text{ft} \times 10 \cdot \text{ft} \times 8 \cdot \text{ft}$ $V = 800 \cdot \text{ft}^3$

Then $\rho = \frac{p}{R_{\text{air}} \cdot T}$ $\rho = 0.076 \frac{\text{lbm}}{\text{ft}^3}$ $\rho = 0.00238 \frac{\text{slug}}{\text{ft}^3}$ $\rho = 1.23 \frac{\text{kg}}{\text{m}^3}$

$M = \rho \cdot V$ $M = 61.2 \cdot \text{lbm}$ $M = 1.90 \cdot \text{slug}$ $M = 27.8 \cdot \text{kg}$