

Problem 1.29

[Difficulty: 1]

1.29 The density of mercury is given as 26.3 slug/ft^3 . Calculate the specific gravity and the specific volume in m^3/kg of the mercury. Calculate the specific weight in lbf/ft^3 on Earth and on the moon. Acceleration of gravity on the moon is 5.47 ft/s^2 .

Given: Density of mercury.

Find: Specific gravity, volume and weight.

Solution: Use basic definitions

$$SG = \frac{\rho}{\rho_w} \quad \text{From Appendix A} \quad \rho_w = 1.94 \frac{\text{slug}}{\text{ft}^3} \quad \text{so} \quad SG = \frac{26.3}{1.94} \quad SG = 13.6$$

$$v = \frac{1}{\rho} \quad \text{so} \quad v = \frac{1}{26.3} \cdot \frac{\text{ft}^3}{\text{slug}} \times \left(\frac{0.3048 \text{ m}}{1 \cdot \text{ft}} \right)^3 \times \frac{1 \cdot \text{slug}}{32.2 \cdot \text{lbm}} \times \frac{1 \cdot \text{lbm}}{0.4536 \text{ kg}} \quad v = 7.37 \times 10^{-5} \frac{\text{m}^3}{\text{kg}}$$

$$\gamma = \rho \cdot g$$

$$\text{Hence on earth} \quad \gamma_E = 26.3 \cdot \frac{\text{slug}}{\text{ft}^3} \times 32.2 \cdot \frac{\text{ft}}{\text{s}^2} \times \frac{1 \cdot \text{lbf} \cdot \text{s}^2}{1 \cdot \text{slug} \cdot \text{ft}} \quad \gamma_E = 847 \frac{\text{lbf}}{\text{ft}^3}$$

$$\text{On the moon} \quad \gamma_M = 26.3 \cdot \frac{\text{slug}}{\text{ft}^3} \times 5.47 \cdot \frac{\text{ft}}{\text{s}^2} \times \frac{1 \cdot \text{lbf} \cdot \text{s}^2}{1 \cdot \text{slug} \cdot \text{ft}} \quad \gamma_M = 144 \frac{\text{lbf}}{\text{ft}^3}$$

Note that mass-based quantities are independent of gravity