Exercise 1.38

(**a**) After the label fell off a bottle containing a clear liquid believed to be benzene, a chemist measured the density of the liquid to verify its identity. A 25.0-mL portion of the liquid had a mass of 21.95 g. A chemistry handbook lists the density of benzene at 15 °C as 0.8787 g/mL. Is the calculated density in agreement with the tabulated value? (**b**) An experiment requires 15.0 g of cyclohexane, whose density at 25 °C is 0.7781 g/mL. What volume of cyclohexane should be used? (**c**) A spherical ball of lead has a diameter of 5.0 cm. What is the mass of the sphere if lead has a density of 11.34 g/cm^3? (The volume of a sphere is $(4/3)\pi r^3$, where r is the radius.)

Solution

Part (a)

The density of the liquid is

$$\text{density} = \frac{\text{mass}}{\text{volume}} = \frac{21.95 \text{ g}}{25.0 \text{ mL}} = 0.878 \ \frac{\text{g}}{\text{mL}}.$$

The calculated density is in agreement with the tabulated value.

Part (b)

The volume of cyclohexane is

$$\text{volume} = \frac{\text{mass}}{\text{density}} = \frac{15.0 \ \cancel{\text{g}}}{0.7781 \ \frac{\cancel{\text{g}}}{\text{mL}}} \approx 19.3 \text{ mL}.$$

Part (c)

The mass of lead is

$$\text{mass} = \text{density} \times \text{volume} = 11.34 \ \frac{\text{g}}{\text{cm}^3} \times \frac{4}{3}\pi \left(\frac{5.0 \text{ cm}}{2}\right)^3 \approx 7.4 \times 10^2 \text{ g}.$$