Exercise 1.63

Gold can be hammered into extremely thin sheets called gold leaf. An architect wants to cover a 100 ft × 82 ft ceiling with gold leaf that is five-millionths of an inch thick. The density of gold is 19.32 g/cm^3, and gold costs \$1654 per troy ounce (1 troy ounce = 31.1034768 g). How much will it cost the architect to buy the necessary gold?

Solution

To obtain the total cost, multiply the cost density by the mass density by the volume of gold.

$$\text{Mass} = \text{Cost Density} \times \text{Mass Density} \times \text{Volume}$$

$$= \left(1654 \ \frac{\$}{\text{troy ounce}}\right) \times \left(19.32 \ \frac{\text{g}}{\text{cm}^3}\right) \times (100 \text{ ft} \times 82 \text{ ft} \times 0.000005 \text{ in})$$

$$= \left(1654 \ \frac{\$}{\cancel{\text{troy ounce}}} \times \frac{1 \ \cancel{\text{troy ounce}}}{31.1034768 \text{ g}}\right) \times \left(19.32 \ \frac{\text{g}}{\text{cm}^3}\right) \times \left[100 \ \cancel{\text{ft}} \times 82 \ \cancel{\text{ft}} \times \left(\frac{12 \text{ in}}{1 \ \cancel{\text{ft}}}\right)^2 \times 0.000005 \text{ in}\right]$$

$$= \left(\frac{1654}{31.1034768} \ \frac{\$}{\text{g}}\right) \left[19.32 \ \frac{\text{g}}{\cancel{\text{cm}^3}} \times \left(\frac{2.54 \ \cancel{\text{cm}}}{1 \text{ in}}\right)^3\right] (100 \times 82 \times 12^2 \times 0.000005 \text{ in}^3)$$

$$= \left(\frac{1654}{31.1034768} \ \frac{\$}{\cancel{\text{g}}}\right) \left(19.32 \times 2.54^3 \ \frac{\cancel{\text{g}}}{\cancel{\text{in}^3}}\right) \left(100 \times 82 \times 12^2 \times 0.000005 \ \cancel{\text{in}^3}\right)$$

$$\approx \$1 \times 10^5$$

This answer is in disagreement with the one at the back of the book.