Exercise 1.85

A 40-lb container of peat moss measures $14 \times 20 \times 30$ in. A 40-lb container of topsoil has a volume of 1.9 gal. (**a**) Calculate the average densities of peat moss and topsoil in units of g/cm^3. Would it be correct to say that peat moss is "lighter" than topsoil? (**b**) How many bags of peat moss are needed to cover an area measuring 15.0 ft $\times$ 20.0 ft to a depth of 3.0 in.?

[TYPO: This should be in^3. Replace "bags" with "40-lb containers."]

Solution

Part (a)

Divide the mass by the volume for peat moss and topsoil to obtain the density. All of the given numbers are assumed to have two significant figures.

$$\text{Peat Moss}: \quad \text{Density} = \frac{\text{Mass}}{\text{Volume}} = \frac{40 \text{ lb}}{14 \times 20 \times 30 \text{ in}^3} = \frac{40 \cancel{\text{lb}} \times \frac{453.59 \text{ g}}{1 \cancel{\text{lb}}}}{14 \times 20 \times 30 \cancel{\text{in}^3} \times \left(\frac{2.54 \text{ cm}}{1 \cancel{\text{in}}}\right)^3} \approx 0.13 \frac{\text{g}}{\text{cm}^3}$$

$$\text{Topsoil}: \quad \text{Density} = \frac{\text{Mass}}{\text{Volume}} = \frac{40 \text{ lb}}{1.9 \text{ gal}} = \frac{40 \cancel{\text{lb}} \times \frac{453.59 \text{ g}}{1 \cancel{\text{lb}}}}{1.9 \cancel{\text{gal}} \times \frac{3.7854 \cancel{\text{L}}}{1 \cancel{\text{gal}}} \times \frac{1000 \cancel{\text{mL}}}{1 \cancel{\text{L}}} \times \frac{1 \text{ cm}^3}{1 \cancel{\text{mL}}}} \approx 2.5 \frac{\text{g}}{\text{cm}^3}$$

It's incorrect to say that peat moss is lighter than topsoil because they both weigh 40 lb. It is correct to say that peat moss is less dense than topsoil.

Part (b)

Multiply the density of peat moss by the given volume to obtain the needed mass. Then convert this mass to containers, using the fact that there's 1 container for every 40 lbs.

$$\frac{40 \cancel{\text{lb}}}{14 \times 20 \times 30 \cancel{\text{in}^3}} \times 15.0 \cancel{\text{ft}} \times 20.0 \cancel{\text{ft}} \times 3.0 \cancel{\text{in}} \times \left(\frac{12 \cancel{\text{in}}}{1 \cancel{\text{ft}}}\right)^2 \times \frac{1 \text{ container}}{40 \cancel{\text{lb}}} \approx 16 \text{ containers}$$

This result is rounded up from approximately 15.4.