Problem 23

(a) Assuming that water has a density of exactly 1 g/cm^3, find the mass of one cubic meter of water in kilograms. (b) Suppose that it takes 10.0 h to drain a container of 5700 m^3 of water. What is the "mass flow rate," in kilograms per second, of water from the container?

Solution

Part (a)

Start with the given volume of water and use conversion factors to obtain the mass in kilograms.

$$1\ \cancel{\text{m}^3} \times \left(\frac{100\ \cancel{\text{cm}}}{1\ \cancel{\text{m}}}\right)^3 \times \frac{1\ \cancel{\text{g}}}{1\ \cancel{\text{cm}^3}} \times \frac{1\ \text{kg}}{1000\ \cancel{\text{g}}} = 1000\ \text{kg}$$

Part (b)

Find the mass of water in 5700 m^3.

$$5700\ \cancel{\text{m}^3} \times \left(\frac{100\ \cancel{\text{cm}}}{1\ \cancel{\text{m}}}\right)^3 \times \frac{1\ \cancel{\text{g}}}{1\ \cancel{\text{cm}^3}} \times \frac{1\ \text{kg}}{1000\ \cancel{\text{g}}} = 5.70 \times 10^6\ \text{kg}$$

Find the number of seconds in 10.0 hours.

$$10.0\ \cancel{\text{hours}} \times \frac{60\ \cancel{\text{min}}}{1\ \cancel{\text{hour}}} \times \frac{60\ \text{sec}}{1\ \cancel{\text{min}}} = 3.60 \times 10^4\ \text{s}$$

Divide the mass by the time to get the mass flow rate.

$$\frac{5.70 \times 10^6\ \text{kg}}{3.60 \times 10^4\ \text{s}} \approx 158\ \frac{\text{kg}}{\text{s}}$$