

Mass, Volume and Density

Density is a term used to describe the mass of a unit of volume of a substance. For example, if the density of a metal is 2000 kg/m^3 , then 1 m^3 of the substance has a mass of 2000 kg .

Mass, *volume* and *density* are related by the following equations.

$$\begin{aligned} \text{Mass} &= \text{Volume} \times \text{Density} \\ \text{Volume} &= \frac{\text{Mass}}{\text{Density}} \end{aligned}$$

or

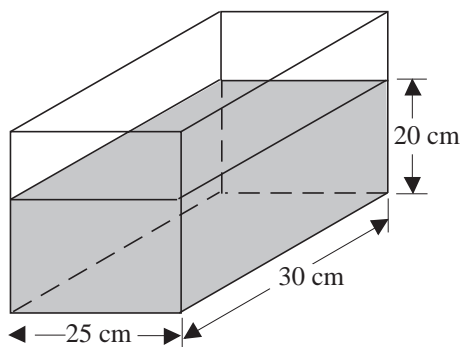
$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

The density of water is 1 gram / cm^3 (or 1 g cm^{-3}) or 1000 kg / m^3 (or 1000 kg m^{-3}).



Worked Example 1

Find the mass of water in the fish tank shown in the diagram.



Solution

First calculate the volume of water.

$$\begin{aligned} V &= 25 \times 30 \times 20 \\ &= 15000 \text{ cm}^3 \end{aligned}$$

Now use

$$\begin{aligned} \text{Mass} &= \text{Volume} \times \text{Density} \\ &= 15000 \times 1 \quad (\text{as density of water} = 1 \text{ g / cm}^3) \\ &= 15000 \text{ grams} \\ &= 15 \text{ kg} \end{aligned}$$

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Worked Example 2

The block of metal shown has a mass of 500 grams.

Find its density in

- (a) g / cm^3 ,
- (b) kg / m^3 .



Solution

- (a) First find the volume.

$$\begin{aligned}\text{Volume} &= 5 \times 8 \times 10 \\ &= 400 \text{ cm}^3\end{aligned}$$

Then use

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$\begin{aligned}\text{Density} &= \frac{500}{400} \\ &= 1.25 \text{ g} / \text{cm}^3\end{aligned}$$

- (b) The process can then be repeated working in kg and m.

$$\begin{aligned}\text{Volume} &= 0.05 \times 0.08 \times 0.1 \\ &= 0.0004 \text{ m}^3\end{aligned}$$

$$\begin{aligned}\text{Density} &= \frac{0.5}{0.0004} \\ &= \frac{5000}{4} \\ &= 1250 \text{ kg} / \text{m}^3\end{aligned}$$

