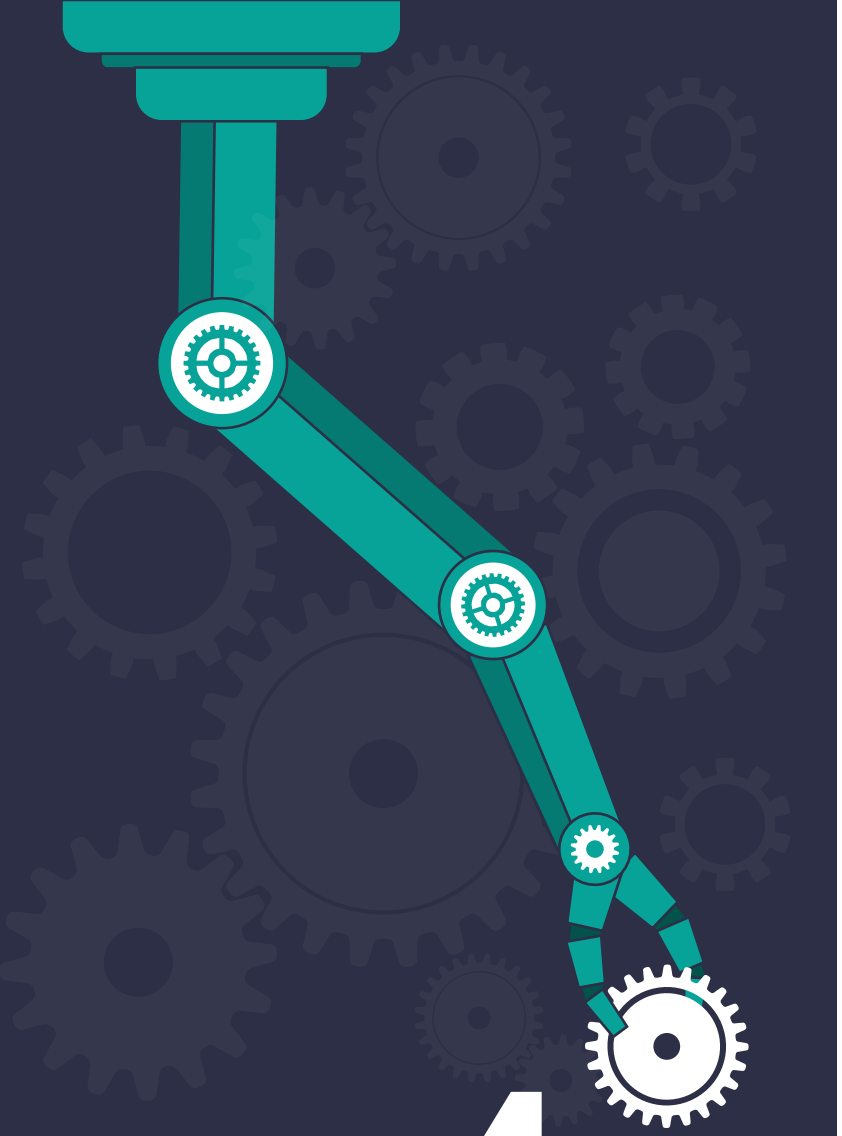
9.3 Density calculations



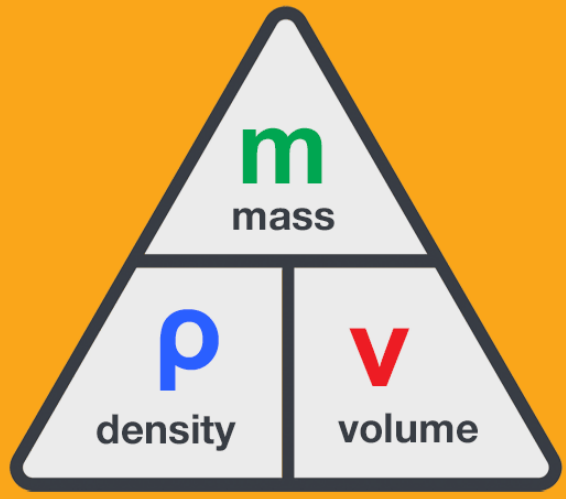
4. INDUSTRY

Density Formula

density = mass ÷ volume

$$\rho = \frac{m}{v}$$

volume



density = mass ÷ volume
mass = density × volume
volume = mass ÷ density

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Calculating mass

Calculating mass

We can rearrange the equation for density like this:

$$\text{mass} = \text{density} \times \text{volume}$$

$$M = D \times V$$

A fish tank.

Example: A fish tank measures 80 cm × 20 cm × 25 cm. It is to be filled with water, density 1.0 g/cm³. Calculate the mass of water in the tank when it is full.

Step 1: Calculate the volume of the tank.

$$\text{volume} = \text{length} \times \text{width} \times \text{height} = 80 \times 20 \times 25 = 40\,000\ \text{cm}^3$$

Step 2: Calculate the mass of the water.

$$\text{mass} = \text{density} \times \text{volume} = 40\,000 \times 1.0 = 40\,000\ \text{g}$$

INDUSTRY

Calculating volume

We can rearrange the equation for density to make volume its subject, like this:

$$\text{volume} = \frac{\text{mass}}{\text{density}}$$

$$V = \frac{M}{D}$$

Example: A builder needs 20 000 kg of sand to make mortar. The sand is sold in 1 m^3 bags. How many bags will he need? (The density of sand is 2500 kg/m^3.)

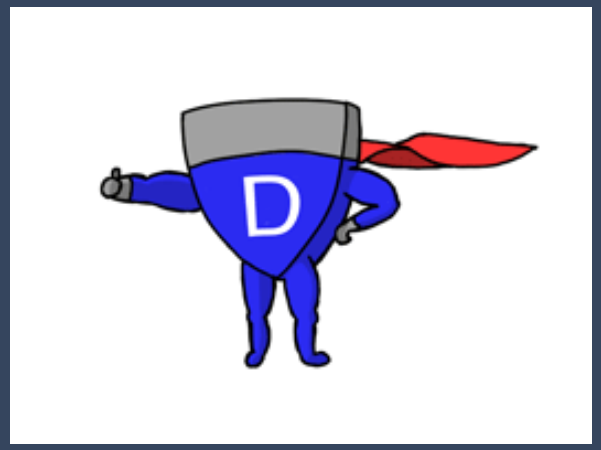
We need to find the volume of the sand.

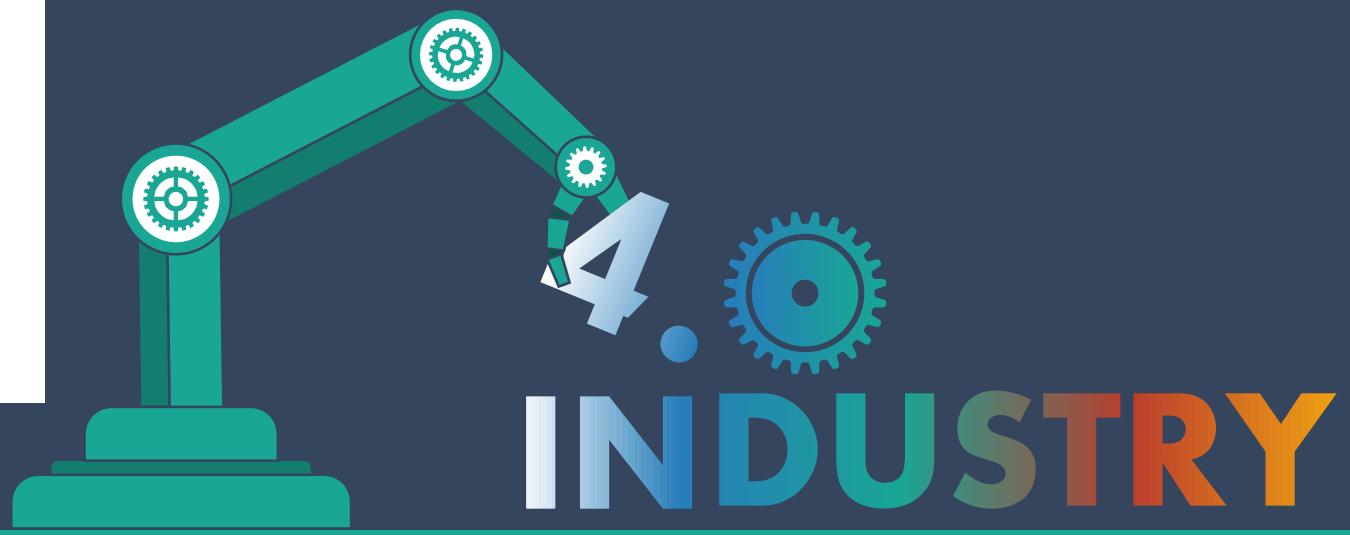
$$\text{volume} = \frac{\text{mass}}{\text{density}} = \frac{20\,000}{2500} = 8\,m^3.$$

(Notice that, because the mass is in units of kg and the density is in kg/m^3, the volume is in m^3.)

Since each bag has a volume of 1 m^3, he will need 8 bags.

Mixing sand, cement and water to make mortar.



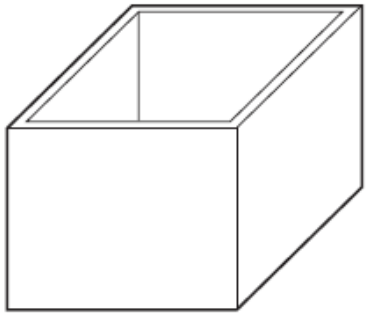


Бодлого

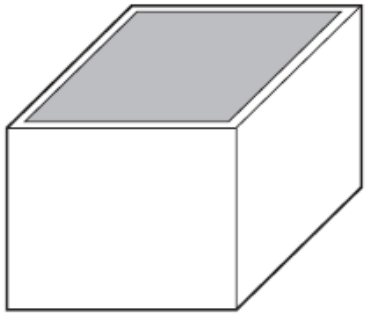
Question 1

The diagrams show an empty rectangular box, and the same box filled with liquid.

The box has a mass of 60 g when empty. When filled with liquid, the total mass of the box and the liquid is 300 g.



empty box
60 g



box filled with liquid
300 g

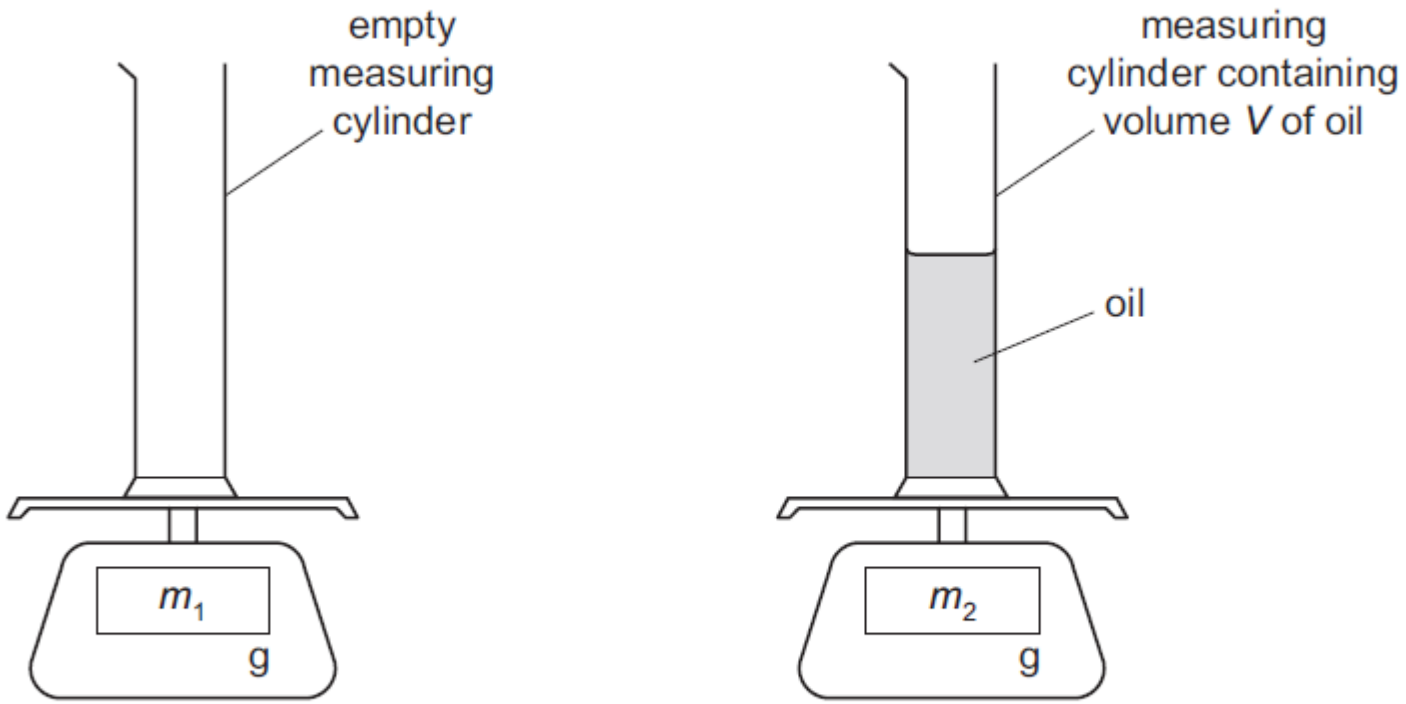
The density of the liquid is 1.2 g / cm^3.

What is the volume of the liquid in the box?

A 50 cm^3 **B** 200 cm^3 **C** 250 cm^3 **D** 300 cm^3

Question 2

A student uses a measuring cylinder and a balance to find the density of oil. The diagram shows the arrangement used.



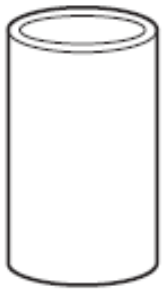
Which calculation gives the density of the oil?

A $\frac{V}{m_2}$ **B** $\frac{V}{(m_2 - m_1)}$ **C** $\frac{m_2}{V}$ **D** $\frac{(m_2 - m_1)}{V}$

Question 3

The diagrams show an empty container, and the same container filled with liquid.

The empty container has a mass of 120 g. When filled with the liquid, the total mass of the container and the liquid is 600 g.



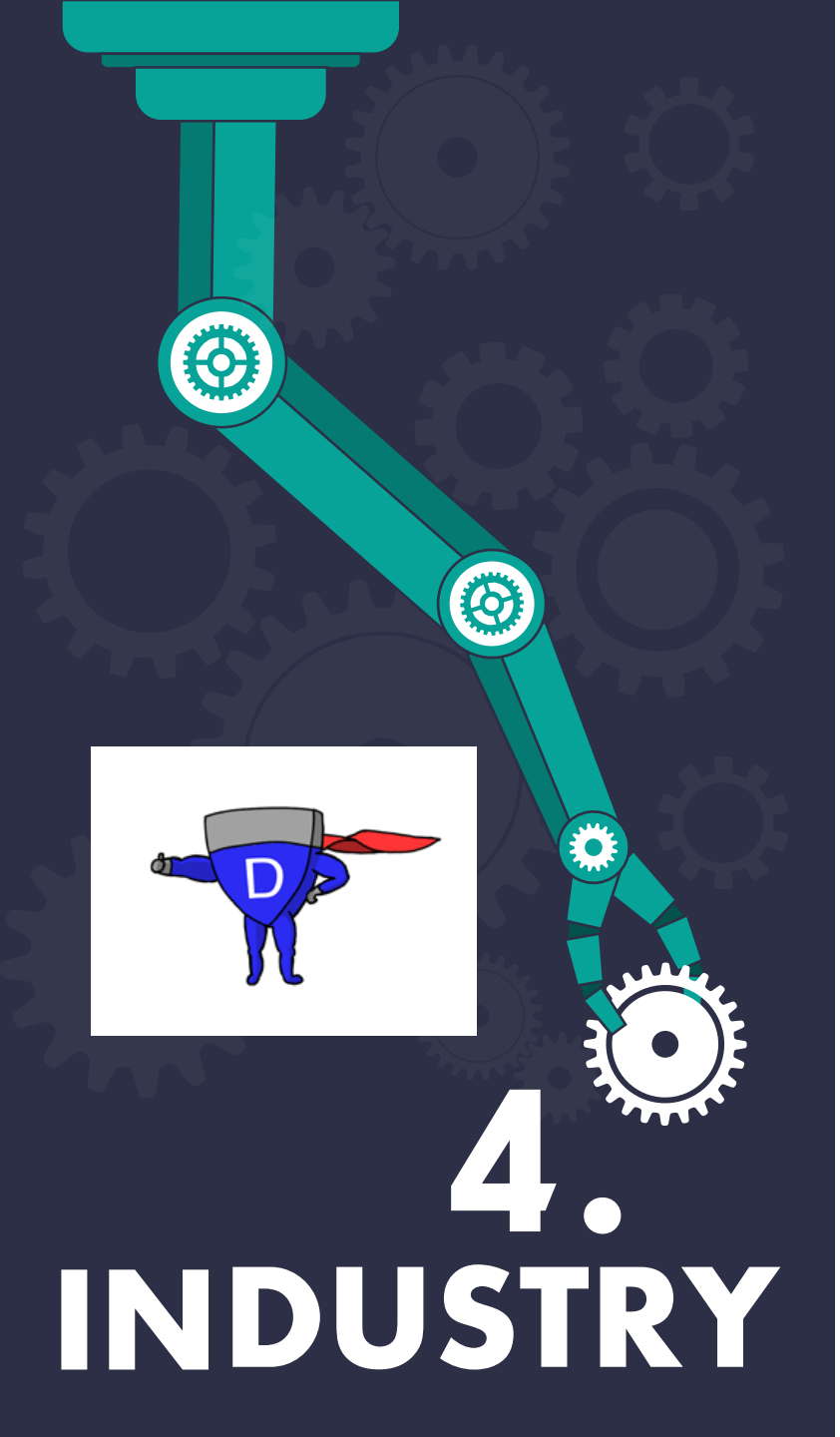
empty container
120 g

container filled with liquid
600 g

The volume of liquid in the container is 600 cm^3.

What is the density of the liquid?

A 0.020 g/cm^3 **B** 0.80 g/cm^3 **C** 1.0 g/cm^3 **D** 1.2 g/cm^3



Summary

1. Density, mass and volume are connected by these three equations: