5. A metal block that measures 3 cm on each side has a mass of 0.51 kg. What pure substance is the cube made of? Refer to Table 3 on page 235 of the student textbook.

Formula	Data	Calculation
$\rho = \frac{m}{V}$	$m = 510\ g$ $V = (3 \times 3 \times 3)\ cm^3$ $= 27\ cm^3$	$\rho = \frac{510\ g}{27\ cm^3}$ $\rho = 18.9\ g/cm^3$

Answer: *It is made of gold.*

6. Explain why a cork stopper floats on water. Refer to Tables 3 and 4 on page 235 of the student textbook.

With a density of 0.24 g/cm³, the cork stopper is less dense than water, which has a density of 1 g/mL or 1 g/cm³. As a result, the cork floats on water.

7. During a laboratory experiment, you are given two differently shaped solids that have different weights. You make the following measurements and observations:

	Solid A	Solid B
Shape	Spherical	Cylindrical
Mass	39.50 g	59.25 g
Initial volume of the water in the graduated cylinder	30.0 mL	30.0 mL
Final volume of the water (with the solid) in the graduated cylinder	35.0 mL	37.5 mL

Are the two solids made of the same pure substance? Explain your answer.

Formula	Data	Calculation
$\rho = \frac{m}{V}$	Solid A: $m = 3.50\ g$ $V = 5\ mL$	$\rho = \frac{39.50\ g}{5\ mL} = 7.9\ g/mL$
	Solid B: $m = 59.25\ g$ $V = 7.5\ mL$	$\rho = \frac{59.25\ g}{7.5\ mL} = 7.9\ g/mL$

Answer: *Yes, because the two solids have the same density.*

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Calculating Concentration

1. Determine the concentrations of the following solutions in g/L:

a) 30 g of solute in 2.5 L of solution

$C = \frac{m}{V} = \frac{30\ g}{2.5\ L}$

Answer: *12 g/L*

b) 14 g of solute in 250 mL of solution

$C = \frac{m}{V} = \frac{14\ g}{0.25\ L}$

Answer: *56 g/L*

2. Determine the concentrations of the following solutions in % m/V:

a) 1.5 g of solute in 60 mL of solution

$C\ (\%\ m/V) = \frac{m}{V} \times 100$

$\frac{1.5\ g \times 100}{60\ mL}$

Answer: *2.5% m/V*

b) 90 g of solute in 1.5 L of solution

$C\ (\%\ m/V) = \frac{m}{V} \times 100$

$\frac{90\ g \times 100}{1500\ mL}$

Answer: *6% m/V*

3. Convert the following concentrations:

a) 27 mL/L into % V/V

$\frac{27\ mL}{1000\ mL} = \frac{x}{100\ mL}$

$x = \frac{27\ mL \times 100\ mL}{1000\ mL}$ $x = 2.7\ mL/100\ mL$

Answer: *2.7% V/V*

b) 18% m/V into g/L

$\frac{18\ g}{100\ mL} = \frac{x}{1000\ mL}$

$x = \frac{18\ mL \times 1000\ mL}{100\ mL}$ $x = 180\ g/1000\ mL$

Answer: *180 g/L*

4. Calculate the volume of the solute needed to obtain the following solutions:

a) 500 mL of solution at 15% m/V

$\frac{15\ g}{100\ mL} = \frac{x}{500\ mL}$

$x = \frac{15\ g \times 500\ mL}{100\ mL}$

Answer: *75 g*

b) 35 mL of solution at 50 g/L

$\frac{50\ g}{1000\ mL} = \frac{x}{35\ mL}$

$x = \frac{50\ g \times 35\ mL}{1000\ mL}$

Answer: *1.75 g*

5. Sophie dissolved 15 g of sugar in 50 mL of water. She then topped up the volume of the solution to 400 mL. Calculate the concentration of the solution she made in % m/V.

$C = \frac{m}{V} = \frac{15\ g}{0.4\ L} \rightarrow 37.5\ g/L$

Answer: 3.75% m/V

6. Which of the following solutions are at the same concentration?

- **Solution 1**: 9 g of solute in 2 L of solution.
- **Solution 2**: 3 g of solute in 250 mL of solution.
- **Solution 3**: 4 g of solute in 0.5 L of solution.
- **Solution 4**: 12 g of solute in 1.5 L of solution.

a) 2 and 3 (*b*) 3 and 4 *c)* 1 and 4 *d)* 1 and 2

7. Which of the following has the highest concentration?

a) 60 g of solute in 6 L of solution (*b*) 1.5 g of solute in 0.1 L of solution
c) 3 g of solute in 0.25 L of solution *d)* 30 g of solute in 7.5 L of solution

8. List the following solutions from lowest to highest concentration:

a) 0.5% m/V *b)* 10 g/100 mL *c)* 2 g/L *d)* 30 g of solute in 1.5 L of solution

Answer: c), a), d), b)

9. Annie, Julien and Marie-Josée have made lemonade from a powder. Annie dissolved 60 g of powder in 2.5 L of water. Julien used 75 g of powder to make 3 L of lemonade and Marie-Josée made a 300 mL glass of the drink with 9 g of powder.

a) Calculate the concentration of each preparation in g/L.

Annie	Julien	Marie-Josée
$C = \frac{m}{V} = \frac{60\ g}{2.5\ L}$	$C = \frac{m}{V} = \frac{75\ g}{3\ L}$	$C = \frac{m}{V} = \frac{9\ g}{0.3\ L}$
$C_{Annie} = 24\ g/L$	$C_{Julien} = 25\ g/L$	$C_{Marie\text{-}Josée} = 30\ g/L$

b) Whose lemonade was the least sweet? Annie's

10. How much water is there in a bottle containing 250 mL of vinegar (7% dilution of acetic acid)?

- *Quantity of acetic acid in bottle containing 250 mL of vinegar*

$\frac{7\ mL}{100\ mL} = \frac{x}{250\ mL}$ $x = \frac{7\ mL \times 250\ mL}{100\ mL}$

$x = 17.5\ mL$ of acetic acid

- *Quantity of water in bottle containing 250 mL of vinegar*

$250\ mL - 17.5\ mL = 232.5\ mL$ of water

Answer: 232.5 mL of water

11. Calculate the maximum volume of solution at 3.5 g/L that could be obtained from 10.5 g of solute.

$\frac{3.5\ g}{1\ L} = \frac{10.5\ g}{x}$ $x = \frac{1\ L \times 10.5\ g}{3.5\ g}$

Answer: 3 L of solution

12. You have been asked to prepare 130 mL of an aqueous solution of NaOH at a concentration of 20 g/L for a laboratory experiment. Describe the tasks you need to perform to prepare the solution.

$\frac{20\ g}{1\ L} = \frac{x}{0.130\ L} \rightarrow \frac{20\ g \times 0.130\ L}{1\ L} = 2.6\ g$

Tasks:

1. Weigh 2.6 g of NaOH with a scale.
2. Place the NaOH in an Erlenmeyer flask.
3. Measure out approximately 65 mL of water.
4. Pour the distilled water into the Erlenmeyer flask and shake it until the solute is completely dissolved.
5. Pour the solution into a graduated cylinder.
6. Top up the solution with distilled water until there is 130 mL of the solution.