

# Density: why things float or sink

Grade 6 science (Year 7 · Class 6) · Worksheet

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Class: \_\_\_\_\_

These twenty problems train you to calculate density from mass and volume, to rearrange the formula, and to decide whether an object floats or sinks. You will read a graph, compare materials and explain real situations such as ships, ice and swimmers.

The first problems use one-step calculations, and the last five ask for several steps and clear reasoning. They suit Grade 6, Year 7 and Class 6 science courses.

**Level:** Grade 6 science (Year 7 · Class 6) · **Curriculum:** MS-PS1-2

## Problem 1 Density basics (easy)

1. Write the formula for density.
2. State two units in which density can be given.
3. State the density of water in  $\text{g/cm}^3$ .

## Problem 2 Aluminium block (easy)

Amara in Abuja measures an aluminium block with mass 135 g and volume  $50 \text{ cm}^3$ .

1. Write the formula.
2. Calculate the density.

## Problem 3 Cooking oil (easy)

A bottle holds  $500 \text{ cm}^3$  of cooking oil with a density of  $0.92 \text{ g/cm}^3$ .

1. Write the formula that gives the mass.
2. Calculate the mass of oil in grams.

## Problem 4 Float or sink (easy)

Water has a density of  $1.00 \text{ g/cm}^3$ . Decide whether each material floats or sinks in water.

1. Cork,  $0.24 \text{ g/cm}^3$
2. Brick,  $1.9 \text{ g/cm}^3$
3. Olive oil,  $0.91 \text{ g/cm}^3$
4. Glass,  $2.5 \text{ g/cm}^3$
5. A plastic bag of beads,  $0.95 \text{ g/cm}^3$

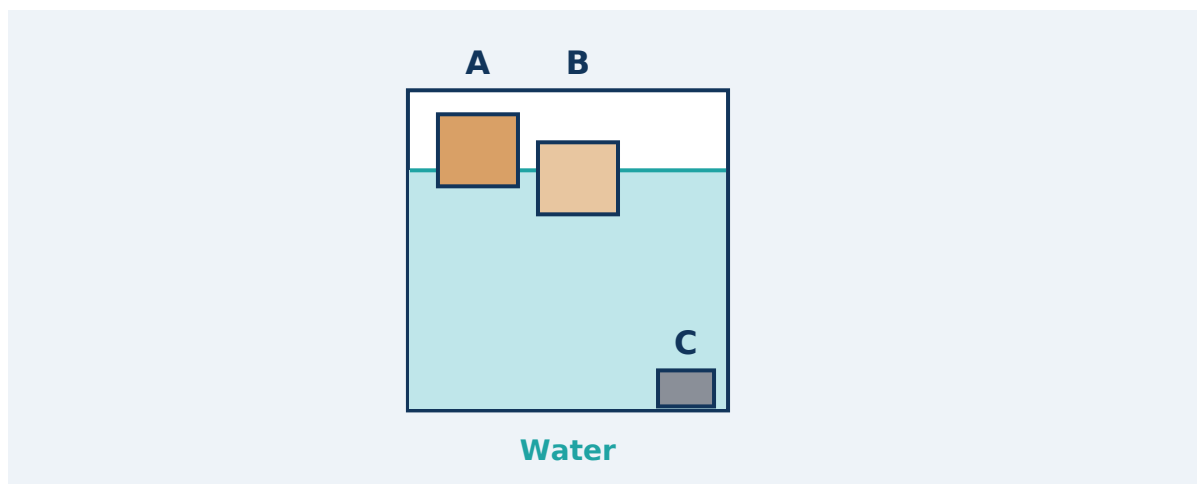
### Problem 5 Density units (easy)

1. Convert  $7.9 \text{ g/cm}^3$  to  $\text{kg/m}^3$ .
2. Convert  $920 \text{ kg/m}^3$  to  $\text{g/cm}^3$ .
3. Convert  $2700 \text{ kg/m}^3$  to  $\text{g/cm}^3$ .

### Problem 6 Three objects in water (easy)

Look at the beaker. The water has a density of  $1.00 \text{ g/cm}^3$ .

1. Which objects are less dense than water?
2. Which object is the most dense?
3. Which of A and B has the lower density? Give a reason.



The three objects for Problem 6.

### Problem 7 Gold pendant (medium)

Hana in Tokyo has a pure gold pendant of mass  $38.6 \text{ g}$ . The density of gold is  $19.3 \text{ g/cm}^3$ .

1. Write the formula for volume.
2. Calculate the volume.

### Problem 8 Density of a liquid (medium)

An empty measuring cylinder has a mass of  $92.0 \text{ g}$ . With  $80 \text{ cm}^3$  of liquid it has a mass of  $164.0 \text{ g}$ .

1. Calculate the mass of the liquid.
2. Calculate its density.
3. Say whether it floats on water.

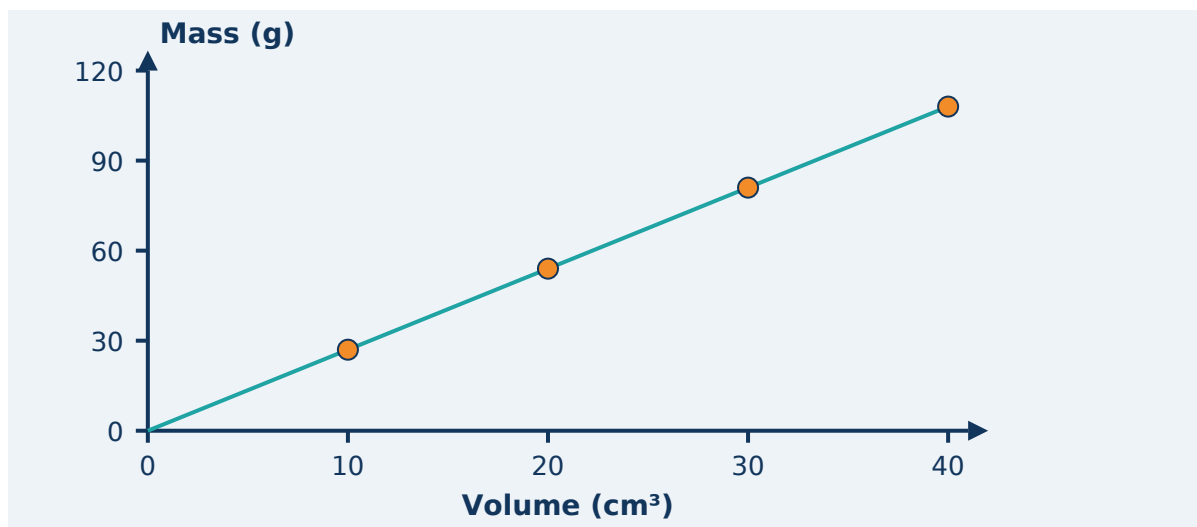
### Problem 9 Mass against volume (medium)

The graph shows measurements for a metal.

1. Read the mass of  $30 \text{ cm}^3$  of the metal.
2. Calculate the density from the point ( $40 \text{ cm}^3$ ,  $108 \text{ g}$ ).
3. Use the table value for aluminium,  $2.7 \text{ g/cm}^3$ , to say whether the metal could be

aluminium.

4. Predict the mass of  $25\text{ cm}^3$ .



Mass against volume for a metal sample.

### Problem 10 Two cubes (medium)

Cube A and cube B each have a volume of  $100\text{ cm}^3$ . Cube A has a mass of 790 g and cube B has a mass of 270 g.

1. Calculate each density.
2. State which cube is denser.
3. Calculate how many times denser it is, to one decimal place.

### Problem 11 Nail and ship (medium)

A small steel nail sinks, but a large steel ship floats.

1. Explain why the nail sinks.
2. Explain why the ship floats although it is made of steel.

### Problem 12 Layers in a jar (medium)

Lucas in Texas pours four liquids that do not mix into a jar: corn syrup ( $1.38\text{ g/cm}^3$ ), water ( $1.00\text{ g/cm}^3$ ), sunflower oil ( $0.92\text{ g/cm}^3$ ) and paraffin ( $0.80\text{ g/cm}^3$ ).

1. List the layers from top to bottom.
2. A plastic button has a density of  $1.1\text{ g/cm}^3$ . Between which two layers does it rest?

### Problem 13 Concrete slab (medium)

A concrete slab for a garden path measures 2.0 m by 1.5 m by 0.10 m. Concrete has a density of  $2400\text{ kg/m}^3$ .

1. Calculate the volume in  $\text{m}^3$ .
2. Calculate the mass in kg.

### Problem 14 Which metal? (medium)

Santiago measures four unknown metal samples. Known densities: aluminium 2.7, iron 7.9, copper 8.9, lead 11.3 g/cm<sup>3</sup>.

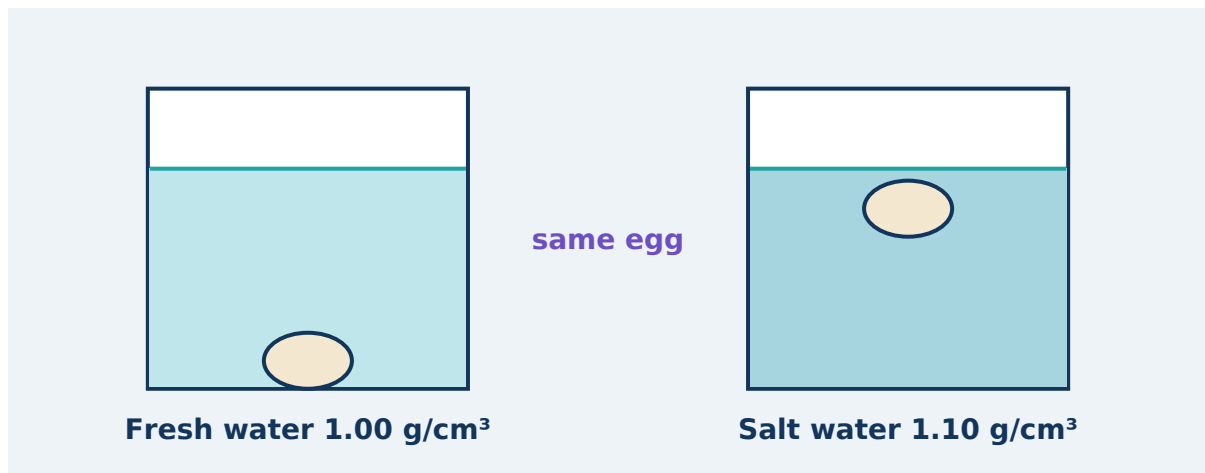
Sample 1: 56.7 g, 21 cm<sup>3</sup>. Sample 2: 89 g, 10 cm<sup>3</sup>. Sample 3: 113 g, 10 cm<sup>3</sup>. Sample 4: 39.5 g, 5 cm<sup>3</sup>.

1. Calculate the density of each sample.
2. Identify each metal.

### Problem 15 Egg in two liquids (hard)

The same egg is placed in fresh water and in salt water.

1. State what happens to the egg in each liquid.
2. Explain the difference using density.
3. Write an inequality that links the density of the egg to the two liquids.
4. Explain why adding salt raises the density of the water.



*The same egg in two different liquids.*

### Problem 16 Heavy means sinks? (hard)

Tariq says: heavy things sink and light things float. A 5 kg wooden plank floats. A pebble of mass 2.0 g has a volume of 0.80 cm<sup>3</sup>.

1. Calculate the density of the pebble.
2. Say whether it sinks in water.
3. Use this example and the plank to show why Tariq is wrong.

### Problem 17 Hollow iron ball (hard)

A metal ball has a mass of 600 g and an outer volume of 150 cm<sup>3</sup>. Iron has a density of 7.9 g/cm<sup>3</sup>.

1. Calculate the density of the ball as a whole.
2. Explain how this shows it is hollow.
3. Calculate the volume of iron in it, to one decimal place.

4. Calculate the volume of the hollow space.

**Problem 18 Mixing two liquids** (hard)

Hana mixes  $200 \text{ cm}^3$  of liquid X ( $1.2 \text{ g/cm}^3$ ) with  $300 \text{ cm}^3$  of liquid Y ( $0.8 \text{ g/cm}^3$ ). Assume the volumes simply add.

1. Calculate the mass of each liquid.
2. Calculate the total mass and total volume.
3. Calculate the density of the mixture.
4. State whether a drop of the mixture floats on water.

**Problem 19 Floating ice** (hard)

A block of ice has a mass of 460 g. Ice has a density of  $0.92 \text{ g/cm}^3$  and water has  $1.00 \text{ g/cm}^3$ . A floating object displaces water of the same mass as itself.

1. Calculate the volume of the ice block.
2. Calculate the volume of water displaced.
3. Calculate the volume of ice above the surface.
4. Express the part under water as a percentage of the whole.

**Problem 20 Floating in the Dead Sea** (hard)

A swimmer of mass 60 kg has an average body density of  $1.01 \text{ g/cm}^3$  after breathing out. Water in the Dead Sea has a density of  $1.24 \text{ g/cm}^3$ .

1. Convert the swimmer's mass to grams.
2. Calculate the volume of the swimmer in litres, to one decimal place.
3. Explain why the swimmer floats in the Dead Sea.
4. Calculate the fraction of the body under water, to the nearest per cent.