

Density, pressure and pressure in liquids

Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Worksheet

Name: _____ Date: _____ Class: _____

These 20 problems train you to use $\rho = m \div V$, $p = F \div A$ and $p = \rho g h$. You convert units, find volume by displacement, read graphs, decide whether objects float and explain everyday pressure effects. The problems rise from recall to multi-step reasoning. They suit GCSE P3, IGCSE 1.8, O Level and Class 9-10 courses.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** GCSE P3, IGCSE 1.8

Problem 1 Formulas and units (easy)

Revise the key facts.

1. Write the equation for density.
2. Write the equation for pressure.
3. Convert 2.7 g/cm^3 to kg/m^3 .
4. State the unit of pressure and what it equals in N and m^2 .

Problem 2 Wooden plank (easy)

A wooden plank has a mass of 3.6 kg and a volume of 0.0050 m^3 .

1. Calculate its density.
2. State whether it floats in water (1000 kg/m^3).

Problem 3 Petrol tanker (easy)

A tanker carries 25 m^3 of petrol with a density of 740 kg/m^3 .

1. Rearrange $\rho = m \div V$ to make m the subject.
2. Calculate the mass of petrol.

Problem 4 Volume of mercury (easy)

A thermometer manufacturer needs 0.50 kg of mercury ($13\,600 \text{ kg/m}^3$).

1. Rearrange the equation to make V the subject.
2. Calculate the volume in m^3 .
3. Convert the volume to cm^3 ($1 \text{ m}^3 = 1\,000\,000 \text{ cm}^3$).

Problem 5 Float or sink? (easy)

Decide whether each material floats or sinks in water (1000 kg/m^3) and give a reason.

1. Pine, 520 kg/m^3 .
2. Brick, 2100 kg/m^3 .
3. Ice, 920 kg/m^3 .
4. Glycerine, 1260 kg/m^3 .

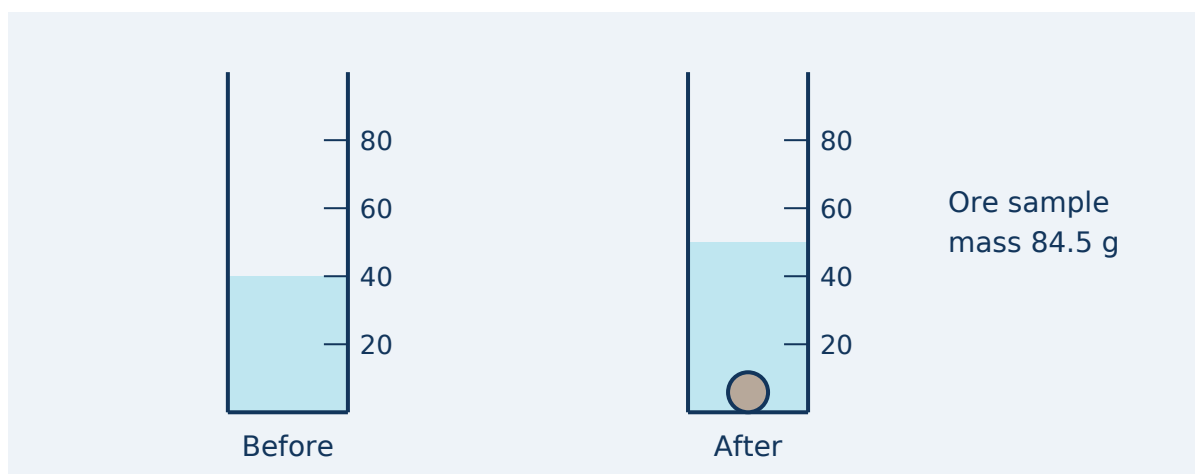
Problem 6 Pressure of a press (easy)

A press pushes down with a force of 300 N on an area of 0.0020 m^2 .

1. Calculate the pressure in pascals.
2. Convert the answer to kilopascals.

Problem 7 Ore sample (medium)

Wanjiru in Nairobi finds a lump of ore of mass 84.5 g and measures its volume as in the figure.



Volume of an ore sample by displacement.

1. Read the volume of the ore from the two levels.
2. Calculate the density in g/cm^3 .
3. Convert the answer to kg/m^3 .

Problem 8 Steel bar (medium)

A steel bar measures $0.50 \text{ m} \times 0.040 \text{ m} \times 0.025 \text{ m}$. Steel has a density of 7800 kg/m^3 .

1. Calculate the volume of the bar.
2. Calculate its mass.

Problem 9 Tractor tyres (medium)

A tractor of mass 4500 kg stands on four tyres. The total contact area is 0.60 m^2 . Use $g = 9.8 \text{ N/kg}$.

1. Calculate the weight of the tractor.
2. Calculate the pressure on the ground.
3. Narrower tyres have a total contact area of 0.20 m^2 . Calculate the new pressure.

Problem 10 Drawing pin (medium)

Kofi presses a drawing pin with a force of 20 N. The head has an area of $1.0 \times 10^{-4} \text{ m}^2$ and the tip has an area of $1.0 \times 10^{-7} \text{ m}^2$.

1. Calculate the pressure on his thumb.
2. Calculate the pressure at the tip.
3. Explain why the pin goes into the board but not into the thumb.

Problem 11 Rearranging $p = F \div A$ (medium)

Use the equation $p = F \div A$.

1. A force of 800 N gives a pressure of 40 kPa. Calculate the area.
2. A pressure of 25 kPa acts on a surface of area 0.60 m^2 . Calculate the force.

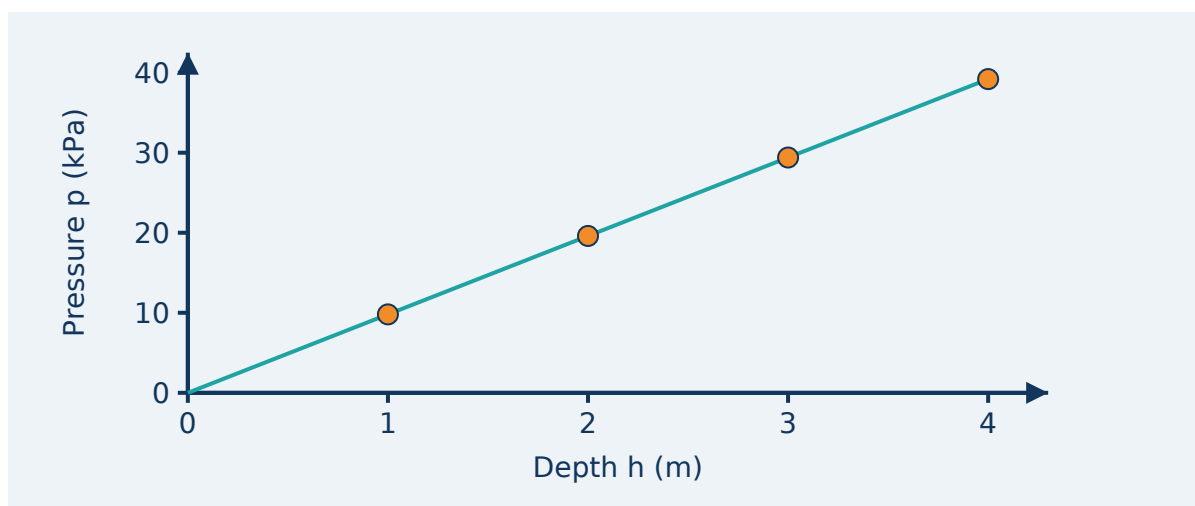
Problem 12 Water tower (medium)

The water in a village tower is 25 m deep. Use $\rho = 1000 \text{ kg/m}^3$ and $g = 9.8 \text{ N/kg}$.

1. Calculate the pressure due to the water at the bottom of the tank.
2. Convert your answer to kilopascals.

Problem 13 Pressure-depth graph (medium)

The graph shows measurements in a lake.



Pressure due to the water at different depths in a lake.

1. Read the pressure at a depth of 3.0 m.
2. Calculate the gradient of the line in kPa per metre.
3. Use the gradient to find the density of the water.

Problem 14 Sluice gate (medium)

A sluice gate of size $0.50 \text{ m} \times 0.40 \text{ m}$ is at the base of a dam, 30 m below the lake surface. Treat the pressure over the gate as constant. Use $\rho = 1000 \text{ kg/m}^3$ and $g = 9.8 \text{ N/kg}$.

1. Calculate the pressure at the gate.
2. Calculate the area of the gate.
3. Calculate the force on the gate due to the water.

Problem 15 Sea and river (medium)

Diego swims 5.0 m below the surface in a river (1000 kg/m^3) and then 5.0 m below the surface in the sea (1030 kg/m^3). Use $g = 9.8 \text{ N/kg}$.

1. Calculate the pressure due to the water in the river.
2. Calculate the pressure due to the water in the sea.
3. Calculate the difference.

Problem 16 Model steel boat (hard)

A model boat made of thin steel has a mass of 0.80 kg. The outer volume of the hull is $1.2 \times 10^{-3} \text{ m}^3$. Steel has a density of 7800 kg/m^3 .

1. Calculate the average density of the boat.
2. State whether it floats in water (1000 kg/m^3).
3. Calculate the volume of the steel in the hull.
4. Explain why a solid block of the same steel would sink.

Problem 17 Brass key (hard)

A brass alloy is made from 60 g of copper (8.9 g/cm^3) and 40 g of zinc (7.1 g/cm^3). Assume that the volumes simply add.

1. Calculate the volume of the copper.
2. Calculate the volume of the zinc.
3. Calculate the density of the alloy.
4. State why the density is between the densities of the two metals.

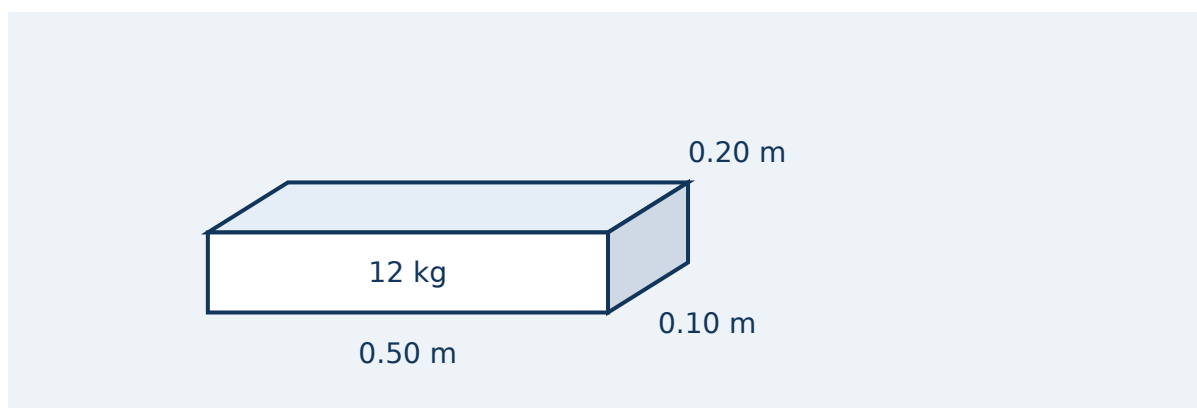
Problem 18 Diver at 18 m (hard)

Mei dives to 18 m in the sea (1030 kg/m^3). Atmospheric pressure is $1.01 \times 10^5 \text{ Pa}$. Use $g = 9.8 \text{ N/kg}$.

1. Calculate the pressure due to the water at 18 m.
2. Calculate the total pressure on her.
3. Her face mask has an area of 0.015 m^2 . Calculate the force of the water on the mask.

Problem 19 Block on its faces (hard)

The block in the figure has a mass of 12 kg. Use $g = 9.8 \text{ N/kg}$.



A cuboid block of mass 12 kg.

1. Calculate the density of the block.
2. Calculate the weight of the block.
3. Calculate the greatest and smallest pressures when the block rests on a table.
4. State which face gives each pressure.

Problem 20 Submarine data (hard)

A research vessel measures the pressure due to the water in the sea at different depths. Use $g = 9.8 \text{ N/kg}$.

Depth (m)	Pressure due to water (kPa)
10	101
20	203
30	303
40	405

1. Calculate the density of the sea water from each measurement.
2. Calculate the mean density.
3. Predict the pressure due to the water at 55 m using the mean density.