

8 Density and pressure – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary

Write each word three times.

English

Write it 3 times (English)

fluid

Density

Pressure

depth

Recall

You already know a lot about liquids and gases:

- Some things float on water and some sink.
- Deep water presses harder – your ears feel it at the bottom of a pool.
- Air and water can both flow. We call anything that flows a **fluid**.

This sheet turns these everyday facts into exact formulas. Each idea has a worked example.

New ideas

■ 1 Fluids and density

A **fluid** is a liquid or gas – its particles can move past each other, so it flows.

Density is how much mass is packed into each unit of volume:

$$\rho = \frac{m}{V}.$$

Something less dense than the fluid around it floats; something denser sinks.

Worked example. A 2.0 kg block has volume 0.0025 m³, so $\rho = \frac{m}{V} = \frac{2.0}{0.0025} =$

800 kg/m^3 – less than water (1000), so it floats.

■ 2 Pressure

Pressure is force spread over an area, measured in pascals (Pa):

$$P = \frac{F}{A}.$$

The same force on a smaller area gives a bigger pressure (why a sharp knife cuts).

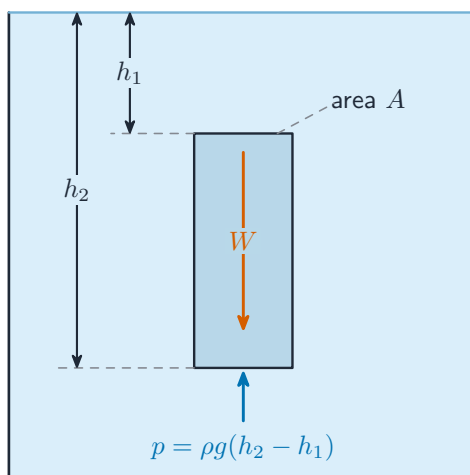
Worked example. A force of 50 N on an area of 0.010 m^2 gives $P = \frac{F}{A} = \frac{50}{0.010} = 5000 \text{ Pa}$.

■ 3 Pressure and depth

In a still fluid, pressure grows with **depth**, because of the weight of fluid above:

$$P = P_0 + \rho gh,$$

where P_0 is the pressure at the surface and h is the depth.



Worked example. At 10 m deep in water ($\rho = 1000 \text{ kg/m}^3$, $P_0 = 1.0 \times 10^5 \text{ Pa}$):
 $P = P_0 + \rho gh = 1.0 \times 10^5 + 1000 \times 9.8 \times 10 = 1.98 \times 10^5 \text{ Pa}$.

Watch out: the pressure at a depth depends only on the **depth**, not on the shape or width of the container. A thin tube and a wide lake have the same pressure at the same depth.

Practice

Try these in order. The methods are all above.

2.1 A 3.0 kg object has a volume of 0.0015 m^3 . Find its density. [2]

2.2 A force of 80 N acts on an area of 0.020 m^2 . Find the pressure. [2]

2.3 An object has density 1200 kg/m^3 . State whether it floats or sinks in water (1000 kg/m^3), and why. [2]

2.4 Find the extra pressure (ρgh) at a depth of 5.0 m in water ($\rho = 1000 \text{ kg/m}^3$, $g = 9.8 \text{ m/s}^2$). [2]

2.5 Explain why a diver feels the same pressure at a given depth whether in a narrow well or a wide sea. [2]