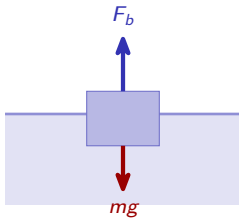


Fluids

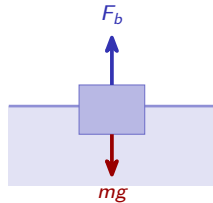
AP Physics 1 ■ Unit 8

AP Physics 1



What we will cover

- 1 Density
- 2 Pressure
- 3 Buoyancy and Archimedes
- 4 Continuity and Bernoulli



Density

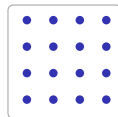
Density 密度 is how tightly matter is packed – mass per unit volume:

Mass per volume

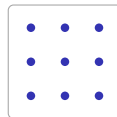
$$\rho = \frac{m}{V}$$

Solids and liquids are dense (particles almost touching); gases are far less dense.

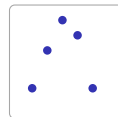
600 g in 200 cm³: $\rho = 3 \text{ g/cm}^3$ – three times water.



solid



liquid



gas

Pressure

Pressure 压强 is force spread over an area:

Two key formulas

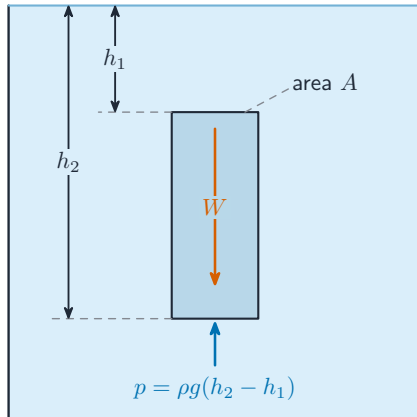
$$P = \frac{F}{A}, \quad P = \rho gh$$

- smaller area $\Rightarrow$ bigger pressure (a sharp knife)
- fluid pressure grows with **depth**, and pushes equally in **all directions**



Pressure is force per unit area

Pressure

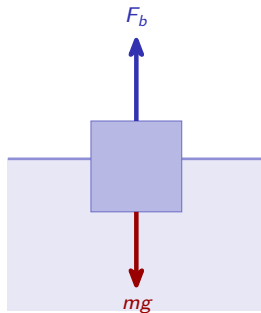


Buoyancy and Archimedes' principle

A fluid pushes up with a **buoyant force** 浮力. **Archimedes' principle** 阿基米德原理: it equals the weight of the fluid displaced.

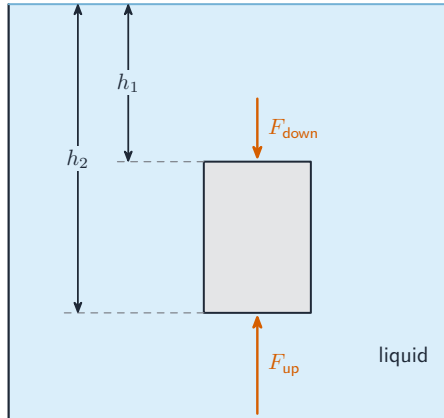
$$F_b > \text{weight} \Rightarrow \text{floats}$$

$$F_b < \text{weight} \Rightarrow \text{sinks}$$



Floats when **less dense** than the fluid.

Buoyancy and Archimedes' principle



Continuity and Bernoulli

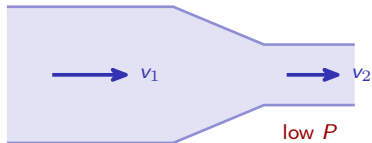
Two conservation laws for flowing fluids:

Continuity (mass)

$$A_1 v_1 = A_2 v_2$$

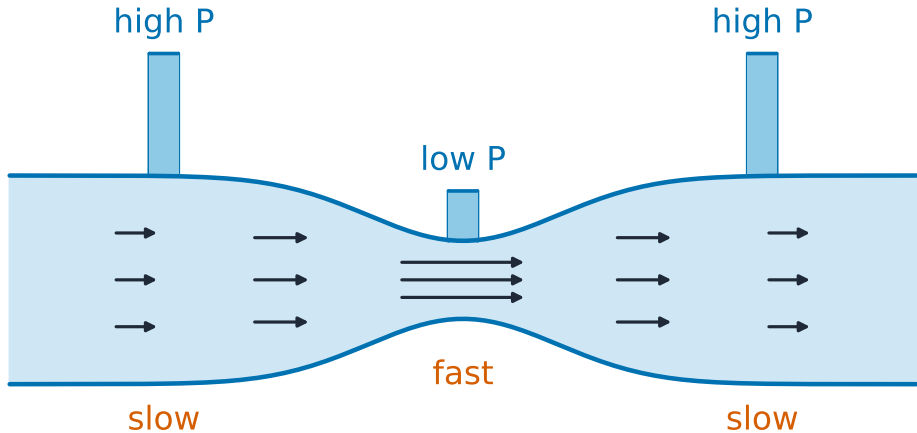
A narrower pipe forces a **faster** flow.

Bernoulli's principle 伯努利原理 (energy): where a fluid flows **faster**, its pressure is **lower**.



$A : 4 \rightarrow 1 \text{ cm}^2$ raises $v : 2 \rightarrow 8 \text{ m/s}$.

Continuity and Bernoulli



Unit 8 – key takeaways

1

Density

$\rho = m/V$; how tightly matter is packed

2

Pressure

$P = F/A$; in a fluid $P = \rho gh$, grows with depth

3

Buoyancy

F_b = weight of displaced fluid;
float if less dense

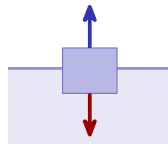
4

Flow

$A_1 v_1 = A_2 v_2$; faster flow means lower pressure

Check yourself

- 1 Dive twice as deep – what happens to the fluid pressure?
- 2 What does the buoyant force equal?
- 3 A pipe narrows. Does the fluid speed up or slow down?
- 4 Where the flow is faster, is the pressure higher or lower?



Answers 1. it doubles 2. the weight of displaced fluid 3. speeds up 4. lower