AP PHYSICS 1 • EXERCISE SHEET

8.3 Fluids and Newton's Laws

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

Objective

Build the skills to answer exam questions on **fluids and Newton's laws**.

You must be able to:

- treat **buoyancy** 浮力 as a net upward force from a fluid
- state **Archimedes' principle** 阿基米德原理: the buoyant force equals the weight of the displaced fluid
- explain floating and sinking by comparing an object's weight with the buoyant force

1 Worked examples

Study these first. Each one shows the method for a question type used later.

Archimedes' principle

The **buoyant force** equals the weight of the fluid displaced: $F_b = \rho_{fluid}\, g\, V_{displaced}$.

Float or sink

Compare weight and buoyant force. Float if $F_b \geq$ weight —equivalently, if the object's density is less than the fluid's.

Example

An object of weight 10 N displacing fluid of weight 12 N feels a net upward force → it floats up.

2 Practice

2.1 State Archimedes' principle. [2]

2.2 An object weighs 8.0 N in air and displaces fluid weighing 5.0 N when submerged. Find the buoyant force on it. [1]

2.3 State the condition, in terms of density, for an object to float. [1]

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3 Exam-style questions

3.1 The buoyant force on a submerged object equals the weight of the [1]

- **A** object
- **B** displaced fluid
- **C** container
- **D** air above it

3.2 An object floats when its density is [1]

- **A** greater than the fluid's
- **B** exactly equal to the fluid's
- **C** less than or equal to the fluid's
- **D** unrelated to the fluid's

3.3 A 2.0 kg block of volume 1.0×10^{-3} m^3 is fully submerged in water ($\rho = 1000$ kg m^{-3}, $g = 10$ m s^{-2}).

(a) Find the buoyant force on it. [2]

(b) State whether it sinks or rises, with a reason. [2]

4 Go further

- work through the **8.3 Fluids and Newton's Laws** lesson on the **Learn** page;
- read the **Fluids** section of the AP Physics 1 handout on the **Know** page.

Solutions

2.1 the buoyant force on an object equals the weight of the fluid it displaces.

2.2 5.0 N (equal to the weight of displaced fluid).

2.3 the object's density must be less than (or equal to) the fluid's density.

3.1 B.

3.2 C.

3.3 (a) $F_b = \rho g V = 1000 \times 10 \times 1.0 \times 10^{-3} = 10$ N. (b) weight $= mg = 20$ N > 10 N, so it sinks —the buoyant force cannot support it.