AP PHYSICS 1 • EXERCISE SHEET

8.4 Fluids and Conservation Laws

Name: _____ Class: _____ Date: _____ **Total: 9 marks**

Objective

Build the skills to answer exam questions on **fluids and conservation laws**.

You must be able to:

- apply **conservation of mass** with the **continuity equation** 连续性方程 $A_1v_1 = A_2v_2$
- apply **conservation of energy** with **Bernoulli's principle** 伯努利原理
- explain why a fluid speeds up through a narrow section and its pressure drops

1 Worked examples

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

Continuity (conservation of mass)

$A_1v_1 = A_2v_2$: a **narrower** pipe forces the fluid to flow **faster**.

Bernoulli (conservation of energy)

Where a fluid flows **faster**, its **pressure is lower**. This lift-and-spray effect explains aeroplane wings and perfume atomisers.

Example

Flow narrowing from 0.02 m^2 to 0.005 m^2 with $v_1 = 1.0$ m s^{-1}: $v_2 = \dfrac{0.02 \times 1.0}{0.005} = 4.0$ m s^{-1}.

2 Practice

2.1 Water flows through a pipe that narrows from 0.020 m^2 to 0.0050 m^2. If $v = 1.0$ m s^{-1} in the wide part, find the speed in the narrow part. [2]

2.2 State what happens to the fluid pressure where the flow speeds up. [1]

2.3 State the continuity equation. [1]

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3 Exam-style questions

3.1 As a fluid flows into a narrower pipe, its speed [1]

- **A** decreases
- **B** increases
- **C** stays constant
- **D** drops to zero

3.2 Where a fluid flows faster, its pressure is [1]

- **A** higher
- **B** lower
- **C** unchanged
- **D** zero

3.3 Water (incompressible) flows at 2.0 m s^{-1} through a pipe of area 0.010 m^2 that narrows to 0.0040 m^2.

(a) Find the speed in the narrow section. [2]

(b) Explain what happens to the pressure there. [1]

4 Go further

- work through the **8.4 Fluids and Conservation Laws** lesson on the **Learn** page;
- read the **Fluids** section of the AP Physics 1 handout on the **Know** page.

Solutions

2.1 $v_2 = \dfrac{A_1 v_1}{A_2} = \dfrac{0.020 \times 1.0}{0.0050} = 4.0 \text{ m s}^{-1}$.

2.2 it drops (Bernoulli's principle).

2.3 $A_1 v_1 = A_2 v_2$.

3.1 B.

3.2 B.

3.3 (a) $v_2 = \dfrac{0.010 \times 2.0}{0.0040} = 5.0 \text{ m s}^{-1}$. (b) the pressure drops, since the fluid moves faster there (Bernoulli).