

Exercise walk-through

8.1

Internal Structure and Density

AP Physics 1

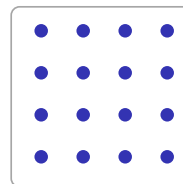
Density

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

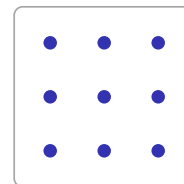
Mass per volume

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

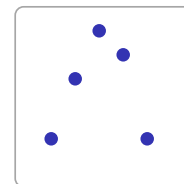
Solids and liquids are dense (particles almost touching); gases are far less dense.



solid



liquid



gas

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

What makes something a fluid

a fluid

liquid or gas – it has **no fixed shape** and takes the shape of its container

why they differ

solids, liquids and gases differ in **how strongly their particles interact**

density

$\rho = m/V$ – a **scalar**, and a property of the material rather than of the object

incompressible

a liquid's density barely changes with pressure, which is what lets the fluid equations be so simple

an ideal fluid

incompressible, with no **viscosity** – the model AP uses throughout

real fluids

have viscosity, so some energy is always lost to internal friction

Every fluid result on this paper assumes the ideal model. Saying which assumption you are using is often itself a marked step.

Exercises 2.1-2.3

2.1 A 240 g block has a volume of 30 cm^3 . Find its density. [2]

2.2 State which state of matter is usually the least dense. [1]

2.3 A liquid has density 800 kg m^{-3} . Find the mass of 2.0 m^3 of it. [2]

Exercises 2.1-2.3

2.1 A 240 g block has a volume of 30 cm³. Find its density. [2]

2.1

- $\rho = \frac{m}{V} = \frac{240}{30} = 8.0 \text{ g cm}^{-3}$

2.2 State which state of matter is usually the least dense. [1]

2.2

- a gas

2.3 A liquid has density 800 kg m⁻³. Find the mass of 2.0 m³ of it. [2]

2.3

- $m = \rho V = 800 \times 2.0 = 1600 \text{ kg}$

Exercises 3.1-3.2

3.1 Density is defined as

[1]

☐

A $\text{mass} \times \text{volume}$

B $\text{mass} \div \text{volume}$

C $\text{volume} \div \text{mass}$

D $\text{force} \div \text{area}$

3.2 Which state of matter is usually the densest?

[1]

☐

A gas

B liquid

C solid

D all are equal

Exercises 3.1-3.2

3.1 Density is defined as

[1]

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3.1 B

- $\text{mass} \div \text{volume}$.

3.2 Which state of matter is usually the densest?

[1]

☐

A gas

B liquid

C solid

D all are equal

3.2 C

- solid.

Exercise 3.3 (a)

3.3 A metal cube of side 0.10 m has a mass of 2.7 kg .

(a) Find its volume.

[1]

Exercise 3.3 (a)

3.3 A metal cube of side 0.10 m has a mass of 2.7 kg.

(a) Find its volume.

[1]

(a)

- $V = (0.10)^3 = 1.0 \times 10^{-3} \text{ m}^3$

Exercise 3.3 (b)

3.3 A metal cube of side 0.10 m has a mass of 2.7 kg.

(b) Find its density.

[2]

Exercise 3.3 (b)

3.3 A metal cube of side 0.10 m has a mass of 2.7 kg.

(b) Find its density.

[2]

(b)

- $\rho = \frac{2.7}{1.0 \times 10^{-3}} = 2700 \text{ kg m}^{-3}$