CAMBRIDGE IGCSE™ PHYSICS 0625 | TOPICS 1.1 · 1.3 · 1.4

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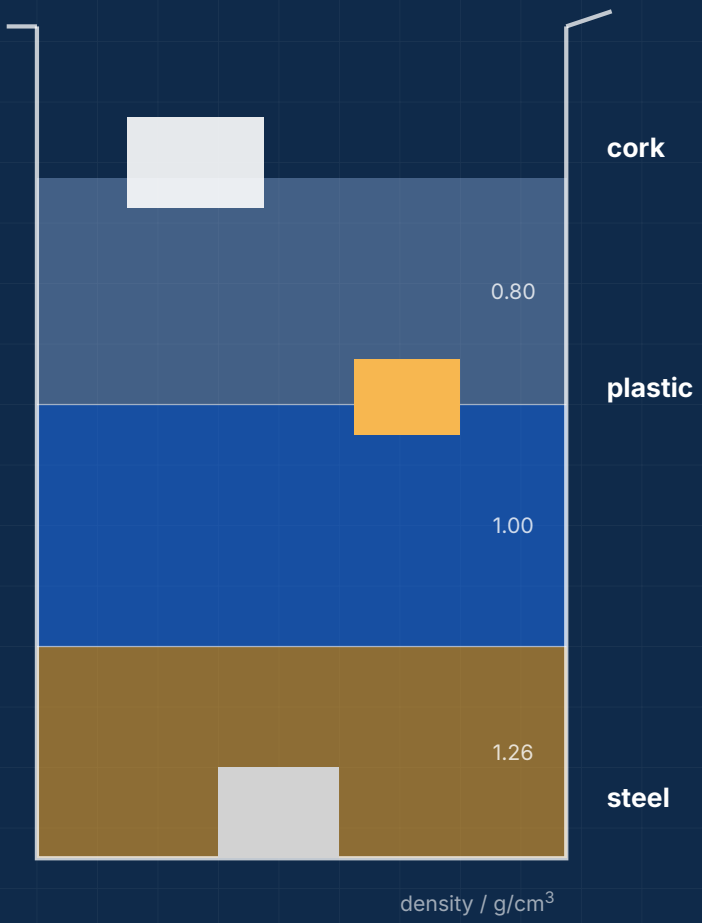
Mass, Weight & Density

Free sample: knowledge organiser and Worksheet 1 with answers

Measuring length & volume | Mass and weight | Density calculations | Density practicals | Floating & sinking | Exam-style questions

$$\rho = m / V$$

$$W = mg$$



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Free sample

Full pack: worksheets, exam paper, answers

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Knowledge organiser

MASS, WEIGHT & DENSITY ON ONE PAGE

Key words

Mass – a measure of the quantity of matter in an object at rest relative to the observer. Unit: kg. It is the same everywhere.

Weight – the gravitational force on an object that has mass. Unit: N. It depends on where you are.

Gravitational field strength – force per unit mass. Unit: N/kg. On Earth $g \approx 9.8$ N/kg, the same number as the acceleration of free fall.

Density – mass per unit volume. Unit: g/cm^3 or kg/m^3.

Equations and units

$g = \frac{W}{m}$ so $W = mg$ weight

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

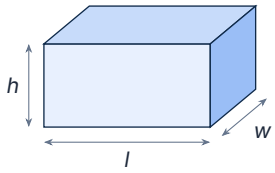
$1\,\text{g/cm}^3 = 1000\,\text{kg/m}^3$

$1\,\text{cm}^3 = 1\,\text{ml} \qquad 1\,\text{dm}^3 = 1000\,\text{cm}^3$

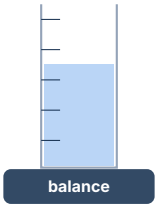
$1\,\text{m}^3 = 1\,000\,000\ \text{cm}^3$

Water: $1.00\,\text{g/cm}^3 = 1000\,\text{kg/m}^3$

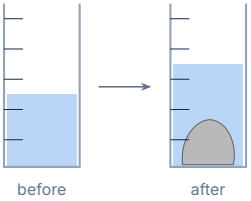
Three ways to find density



Regular solid
Measure l, w and h with a ruler: $V = l \times w \times h$. Find m on a balance.



Liquid
Find the mass of the empty cylinder, then with liquid: $m =$ difference. Read V from the cylinder.



Irregular solid (sinks)
Find m on a balance. $V =$ rise in water level (displacement).

Floating and sinking

An object **floats** in a liquid if its density is *less* than the liquid's, and **sinks** if it is *greater*.

SUPPLEMENT Liquids that do not mix form layers: the least dense liquid on top, the densest at the bottom. An object settles at the boundary between a liquid denser than it and a liquid less dense than it.

Good measurements

Measuring cylinder: eye level with the liquid; read the bottom of the curved surface (meniscus).

Small things: measure many and divide (200 sheets of paper, 20 swings of a pendulum).

Repeat readings and take a mean. Results agree if they are within about ±10 %.

Worked example

Question. A pebble has a mass of 45 g. When it is lowered into a measuring cylinder, the water level rises from 60 cm^3 to 78 cm^3. Find the density of the pebble. Will it float in water?

$V = 78 - 60 = 18\,\text{cm}^3$

$\rho = \frac{m}{V} = \frac{45}{18} = 2.5\,\text{g/cm}^3$

$2.5 > 1.00$, so the pebble **sinks** in water.

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Interactive simulations

TRY IT LIVE

Explore the physics before (or after) you try the worksheets. Each simulation runs in any web browser on a phone, tablet or computer, with nothing to install. Scan the QR code, or click the link in the PDF.

Scan or click

1.4 DENSITY

Density by Displacement

Weigh an irregular object, lower it into a measuring cylinder and calculate its density.

Use with: Worksheet 4: Density practicals

benfizikyapamiyorum.com/icdp/density-lab.html

Scan or click

1.4 DENSITY

Float or Sink?

Change the density of a block and the liquid it is in. Does it float or sink?

Use with: Worksheet 3: Density calculations

benfizikyapamiyorum.com/icdp/density-float.html

How to get the most from them Make a prediction first, then test it in the simulation. Change one thing at a time and note what happens to the readings. Each simulation ends with a quick *Check yourself* question.

All simulations for every pack: benfizikyapamiyorum.com/icdp/

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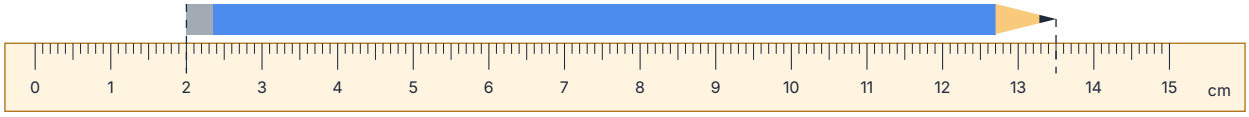
Measuring length, volume and time

WORKSHEET 1
CORE

You will: read rulers and measuring cylinders correctly, and use repeated or multiple measurements to get more accurate results.

CORE all students SUPPLEMENT Extended (Supplement) students CHALLENGE stretch question

1 CORE The diagram shows a pencil placed next to a ruler.



(a) State the length of the pencil in cm. [1]

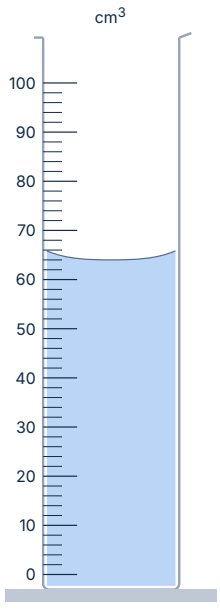
.....

length = _____

(b) The pencil does not start at the zero mark. Explain how this affects the way you work out its length. [1]

.....

2 CORE The diagram shows some water in a measuring cylinder.



(a) State the volume of water. [1]

volume = _____

(b) State which part of the curved surface you read the scale against. [1]

.....

(c) State where your eye should be when you take the reading. Explain why. [2]

.....

.....

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3 CORE A student wants to find the thickness of one sheet of paper. A ruler cannot measure one sheet directly, so she measures a stack of 200 sheets. The stack is 2.0 cm thick.

(a) Calculate the thickness of one sheet in cm and in mm. [2]

.....

.....

(b) Explain why measuring 200 sheets gives a more accurate result than measuring one sheet. [1]

.....

4 CORE A student uses a stopwatch to time 20 complete oscillations of a pendulum. He does this twice.

	Trial 1	Trial 2
time for 20 oscillations / s	32.4	32.8

(a) Calculate the mean time for 20 oscillations. [1]

.....

mean time = _____

(b) Calculate the time for one oscillation (the period). [1]

.....

period = _____

(c) Explain why timing 20 oscillations is better than timing one oscillation. [2]

.....

.....

5 CORE Ten identical marbles are placed touching each other in a straight line. The row is 15.0 cm long. Calculate the diameter of one marble. [2]

.....

diameter = _____

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6 CORE Choose the best instrument from the box to measure each quantity. [3]

measuring cylinder	30 cm ruler	stopwatch	tape measure

(a) the volume of a small amount of cooking oil _____

(b) the time for a toy car to roll down a ramp _____

(c) the width of a textbook _____

Exam tip Record readings to the precision of the instrument: a ruler marked in mm gives readings like 7.4 cm, not 7 cm.

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Answers: Worksheet 1

Mark codes: B1 independent mark C1 method mark, implied by a correct final answer A1 correct answer with unit. Accept answers that round correctly; allow error carried forward from earlier parts.

Worksheet 1 – Measuring length, volume and time

1 **(a)** $13.5 - 2.0 = 11.5\ \text{cm}$ B1
(b) Subtract the reading at the start of the pencil from the reading at the end. B1

2 **(a)** $64\ \text{cm}^3$ B1
(b) The bottom of the curved surface (meniscus). B1
(c) Level with the bottom of the meniscus B1, to avoid a parallax error (reading too high or too low). B1

3 **(a)** $2.0 \div 200 = 0.010\ \text{cm}$ B1 $= 0.10\ \text{mm}$ B1
(b) The error in reading the ruler is shared between 200 sheets, so it is much smaller for each sheet (smaller percentage error). B1

4 **(a)** $(32.4 + 32.8) \div 2 = 32.6\ \text{s}$ B1
(b) $32.6 \div 20 = 1.63\ \text{s}$ B1
(c) Reaction time when starting and stopping the stopwatch causes an error B1; over 20 oscillations this error is a much smaller fraction of the time measured. B1

5 $15.0 \div 10$ C1 $= 1.50\ \text{cm}$ A1

6 **(a)** measuring cylinder B1 **(b)** stopwatch B1 **(c)** 30 cm ruler B1

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Get the full pack

You have just used Worksheet 1. The full Mass, Weight & Density pack contains:

- **Worksheet 1:** Measuring length, volume and time
- **Worksheet 2:** Mass and weight
- **Worksheet 3:** Density calculations
- **Worksheet 4:** Density practicals
- **Multiple-choice practice:** 10 Paper 1/2-style questions
- **Practical skills:** an Alternative to Practical (Paper 6) question
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