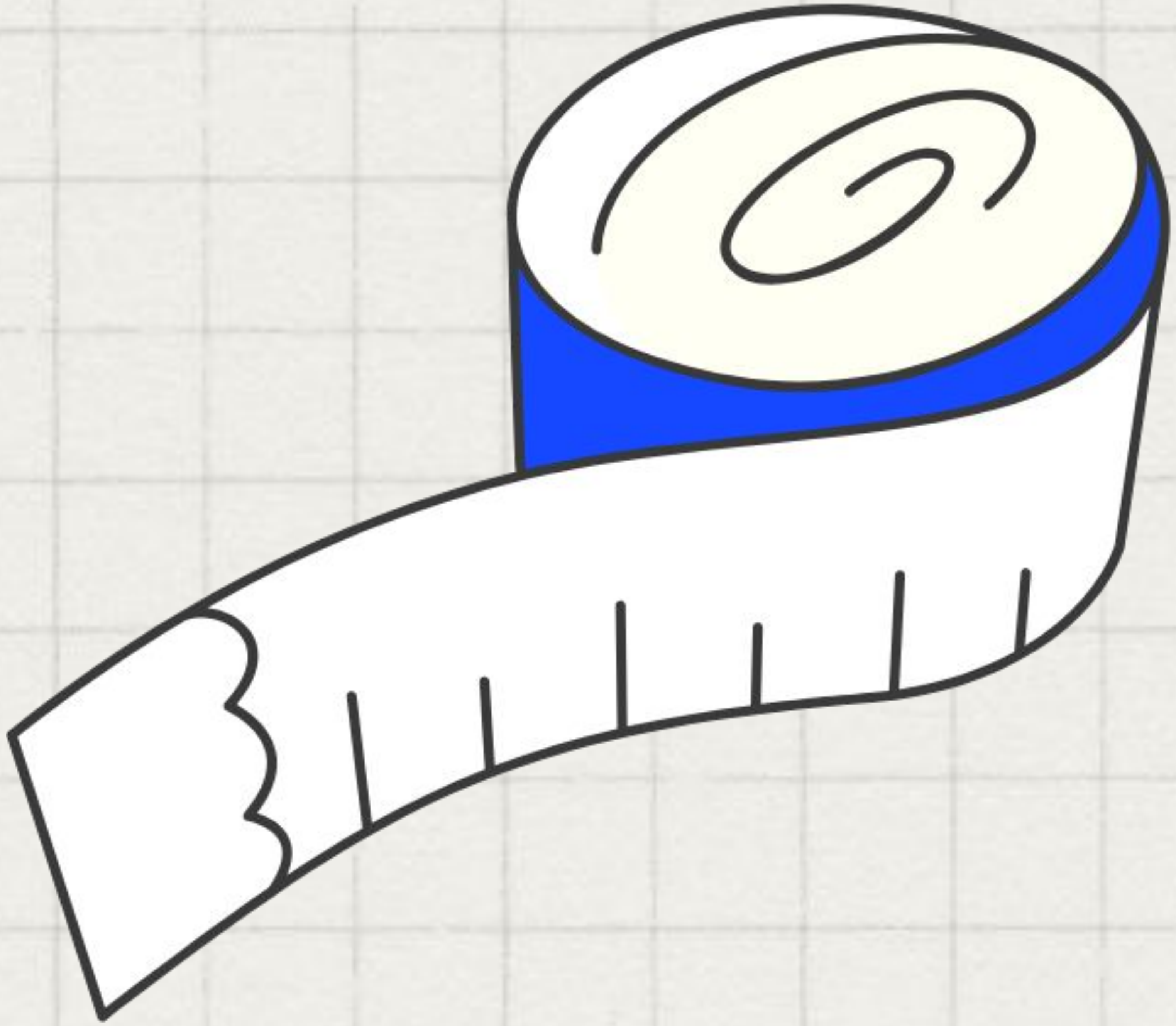
$$\rho = \frac{m}{V}$$



Chapter 1

Making Measurements

Mr Hazhi Rozh

In this chapter you will:

- learn how to take measurements of length, volume and time
- perform experiments to determine the density of an object
- predict whether an object will float
- predict whether one liquid will float on another

Keywords:

- standard, precise, calibrated, volume, meniscus, displace, immerse, mass, density, weight, analogue, digital, plumb bob, oscillation, period

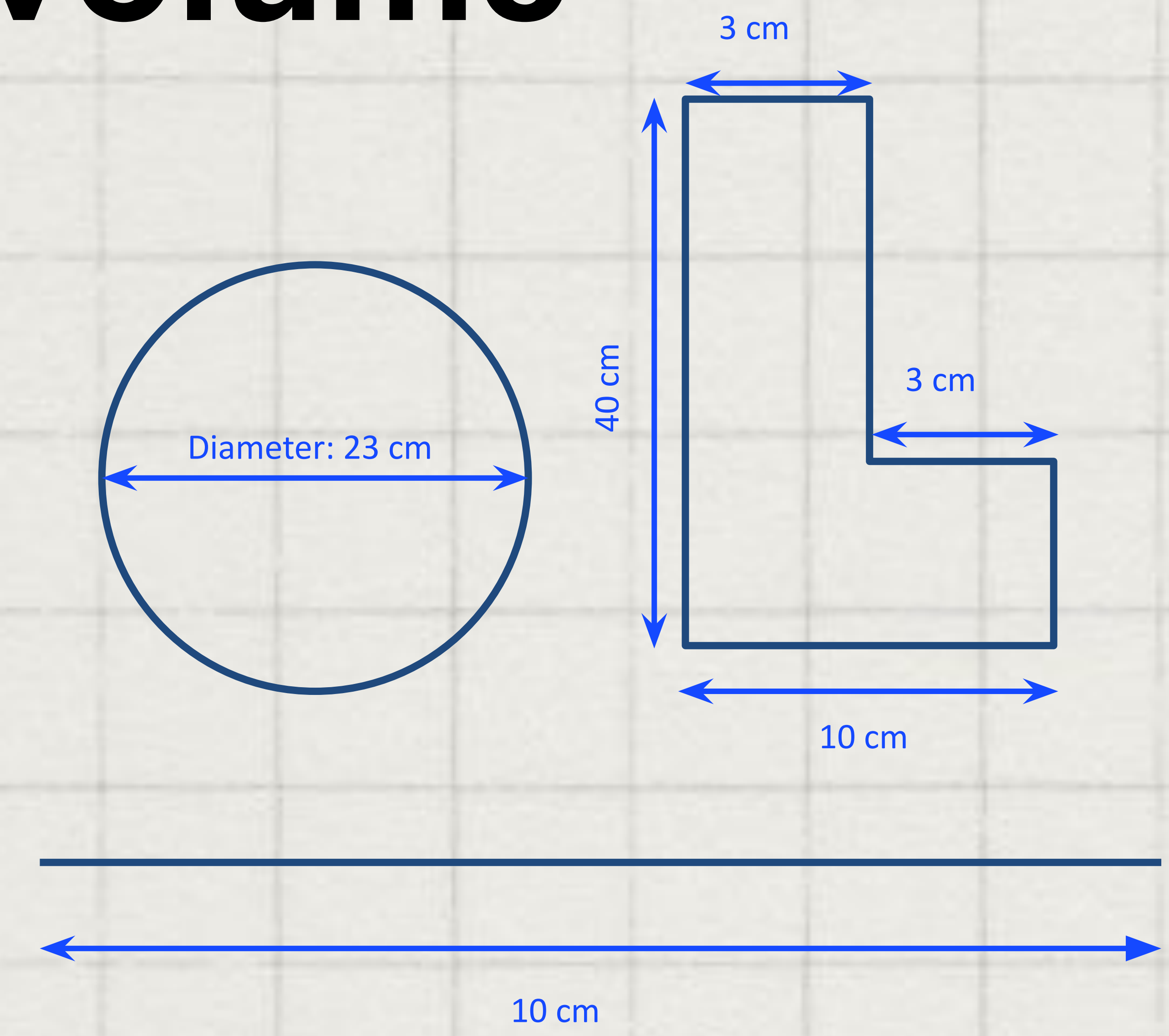
Group Discussion

Why having a standard measurement is important?

Should we measure the way we want to?

Why it is dangerous to have different measuring standards?

1.1 Measuring length and volume



In physics, we make measurements of many different lengths, for example, the length of a piece of wire, the height of liquid in a tube, the distance moved by an object, the diameter of a planet or the radius of its orbit. In the laboratory, lengths are often measured using a ruler (such as a metre ruler).

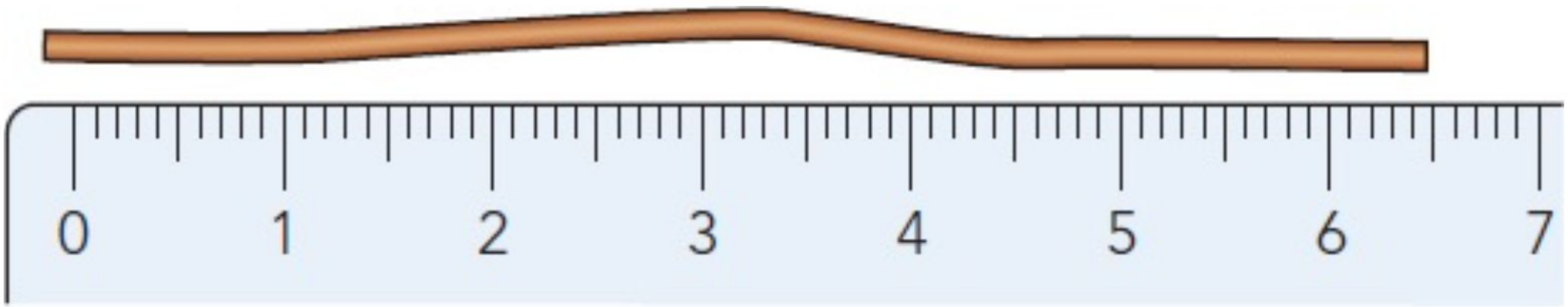
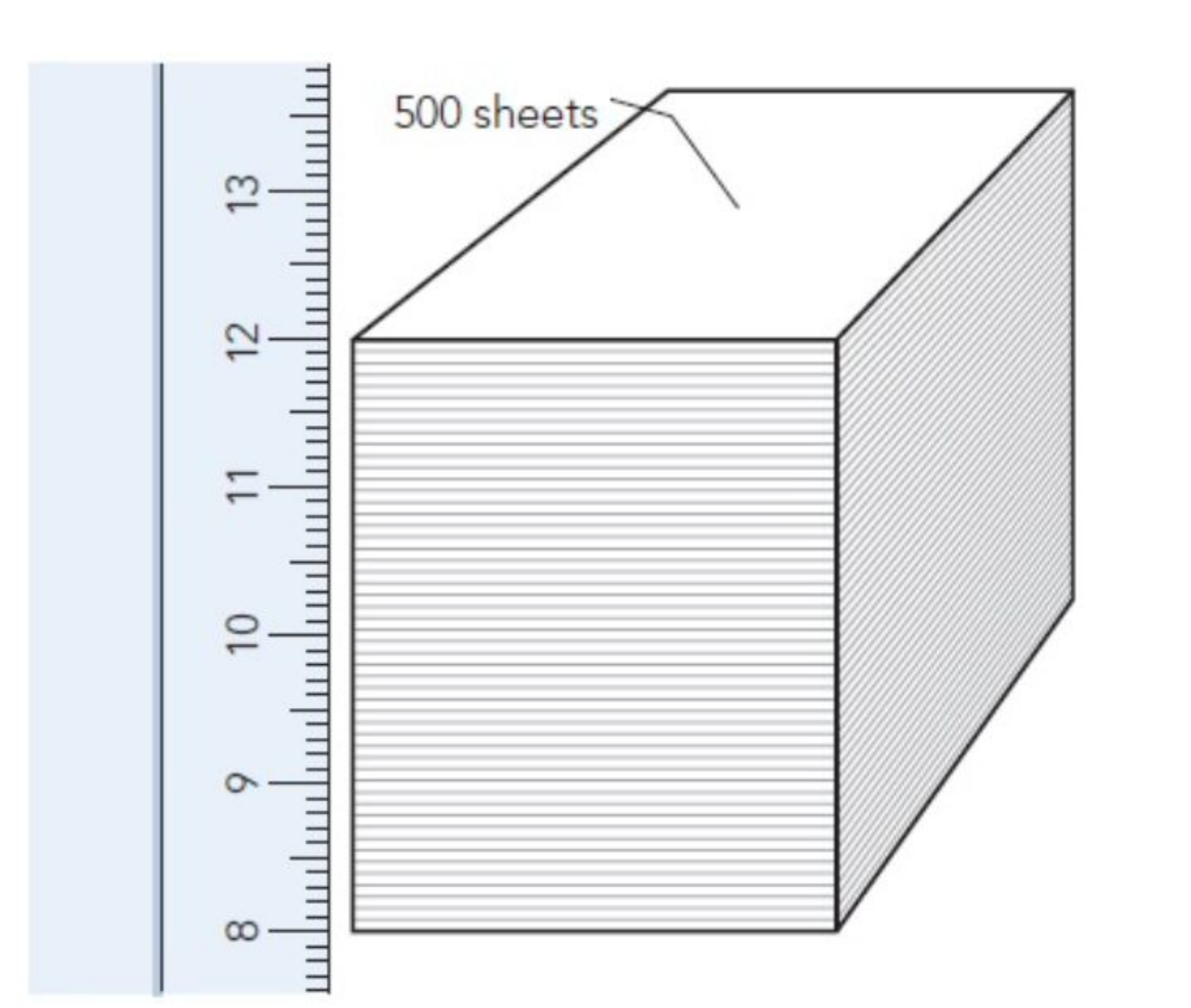


Figure 1.4: Simple measurements still require careful technique, for example, finding the length of a wire.



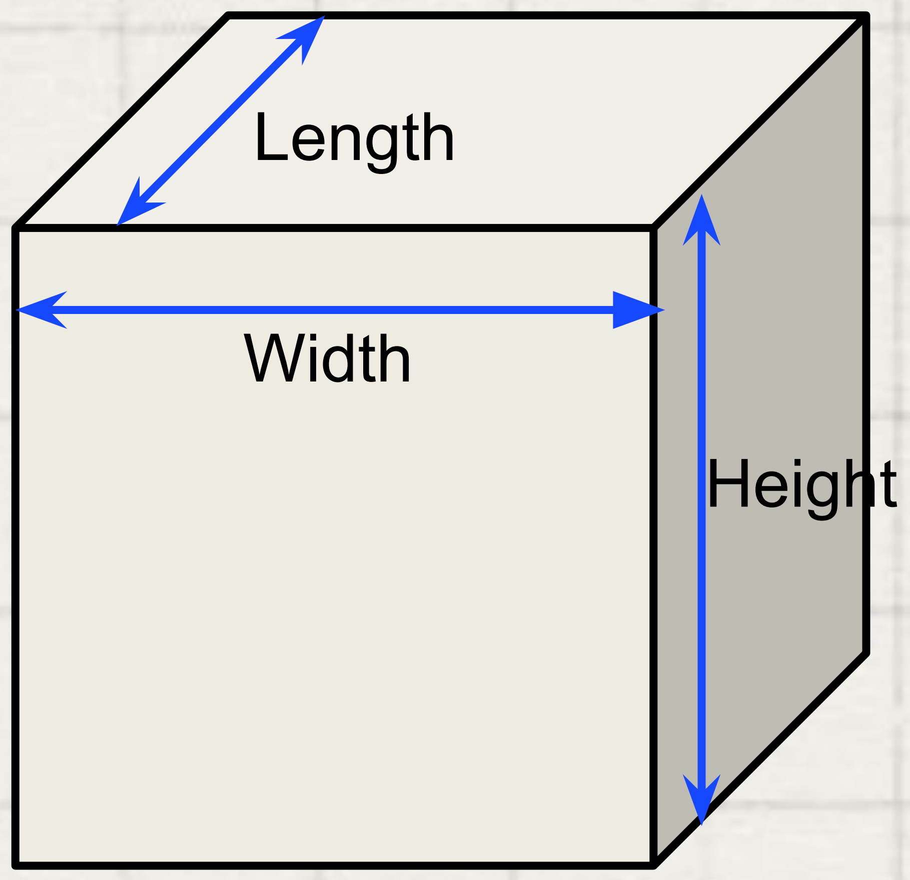
More measurement techniques

If you have to measure a small length, such as the thickness of a wire, it may be better to measure several thicknesses and then calculate the average.

Your measurements need to be **precise**. You can probably determine the length of the wire to within a millimetre. But there is something else to think about – the ruler itself. How sure can you be that it is correctly **calibrated**? Are the marks at the ends of a metre ruler separated by exactly one metre? Any error in this will lead to an inaccuracy (probably small) in your result.

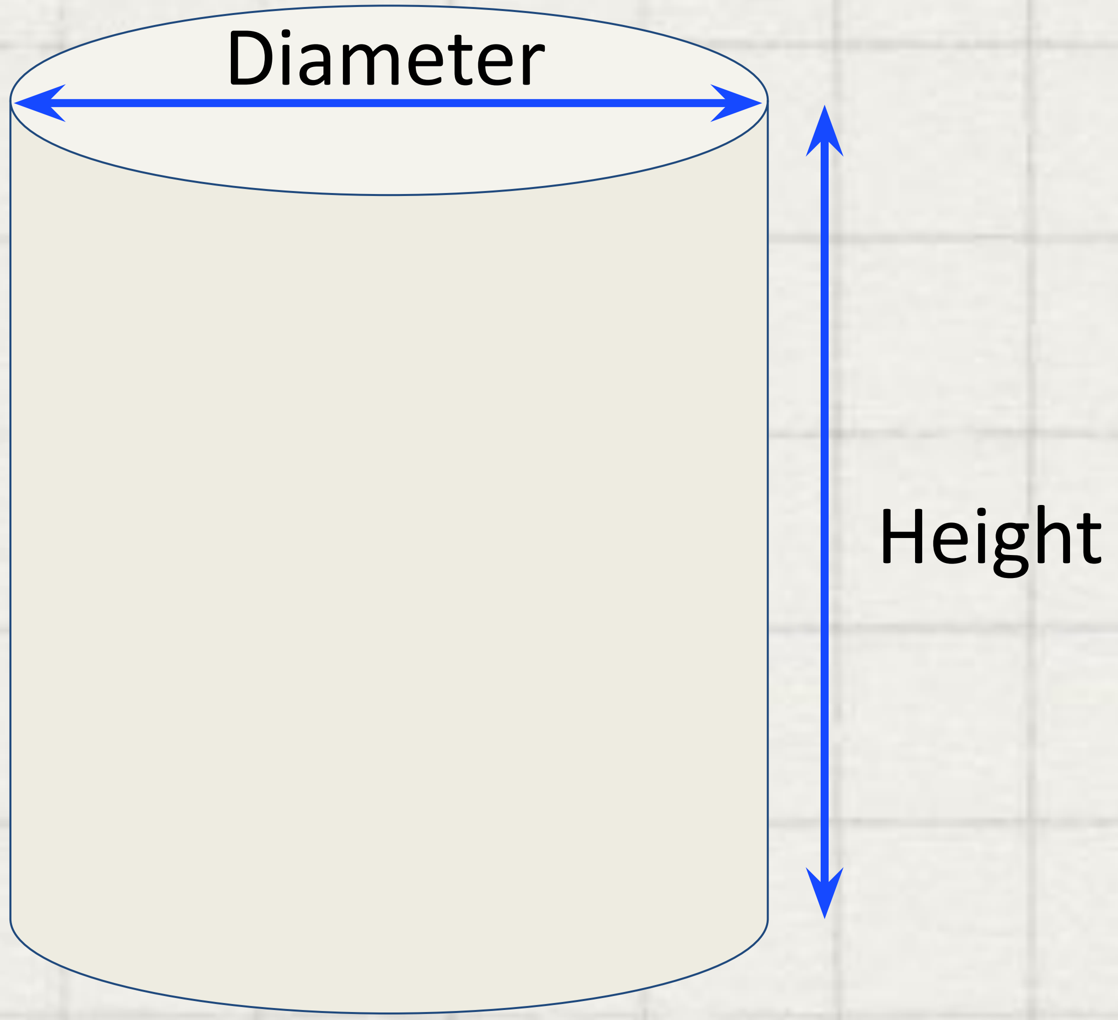
Measuring volumes

For regular shapes (meaning a two-dimensional enclosed figure made by joining three or more straight lines is known as a polygon) the sides are multiplied together. **A cube or cuboid is a regular shape.**

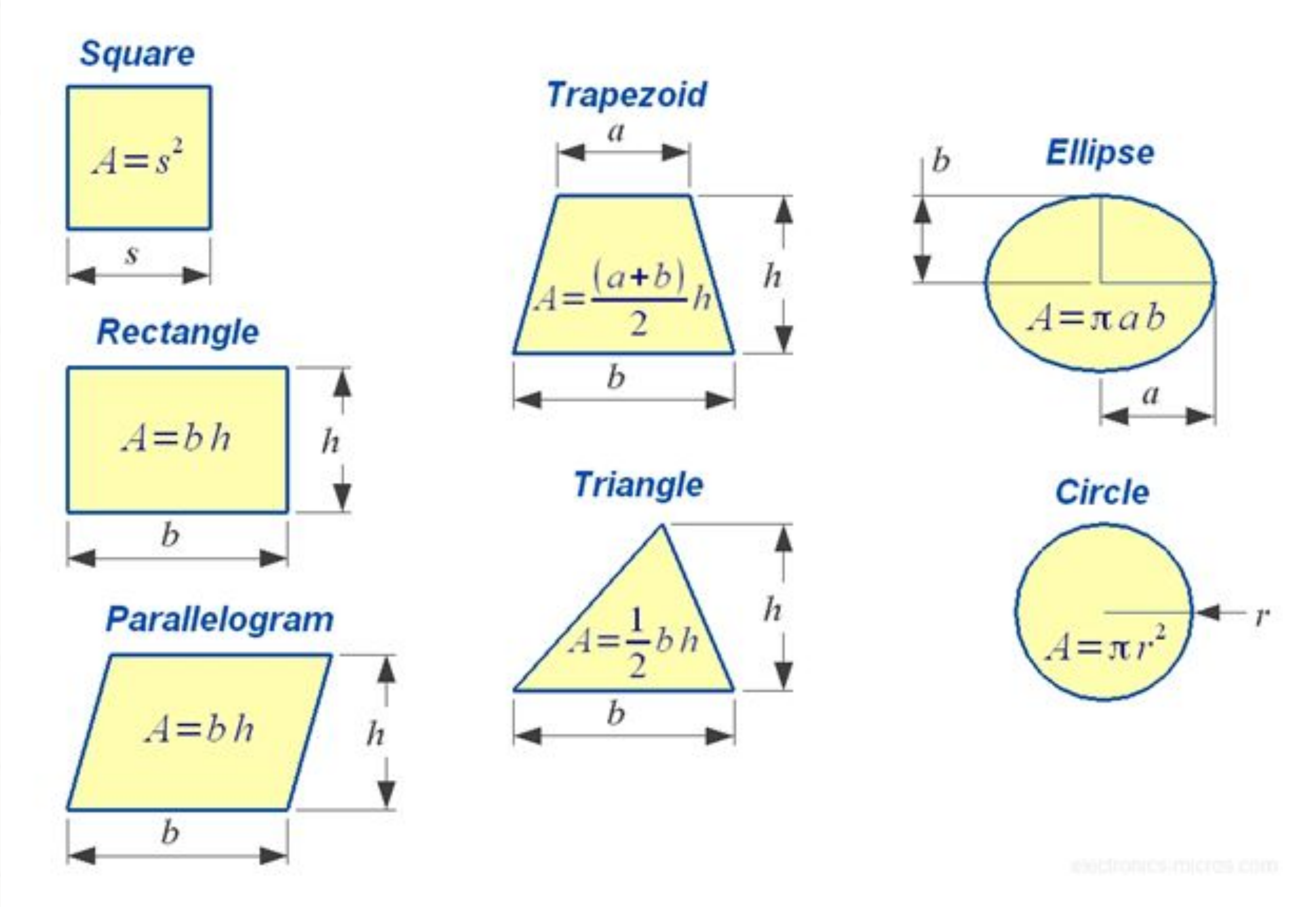


Measuring volumes

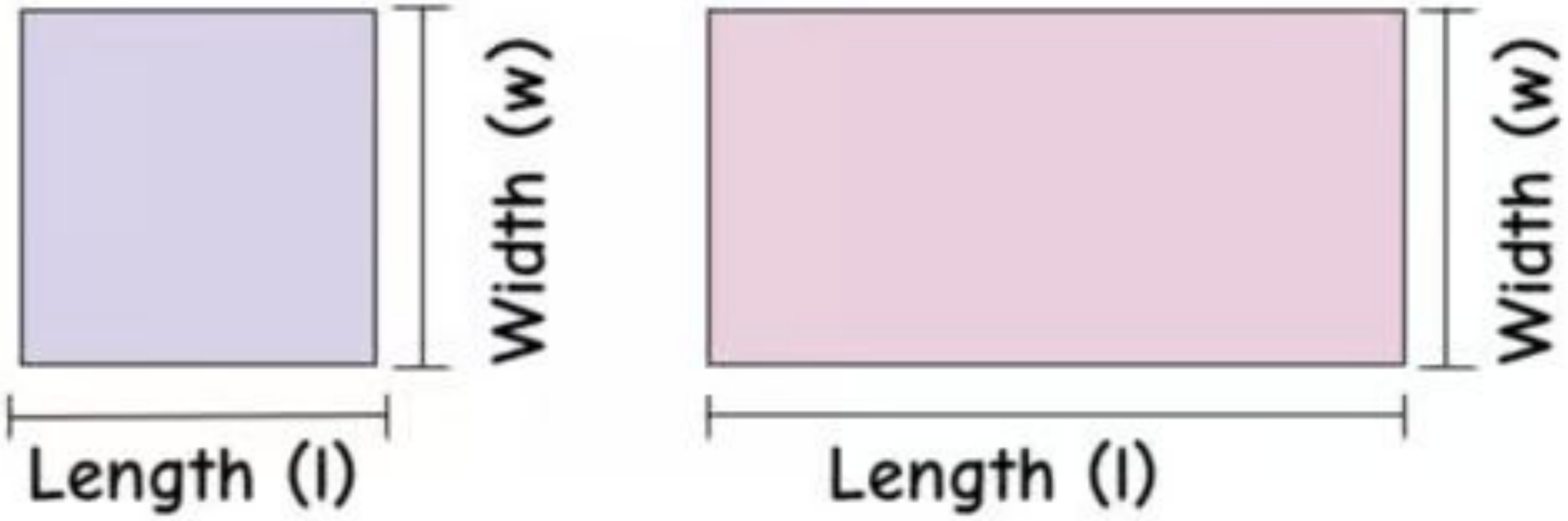
For objects of other regular shapes, such as spheres or cylinders, you may have to make one or two measurements and then look up the equation for the **volume**.



Common areas



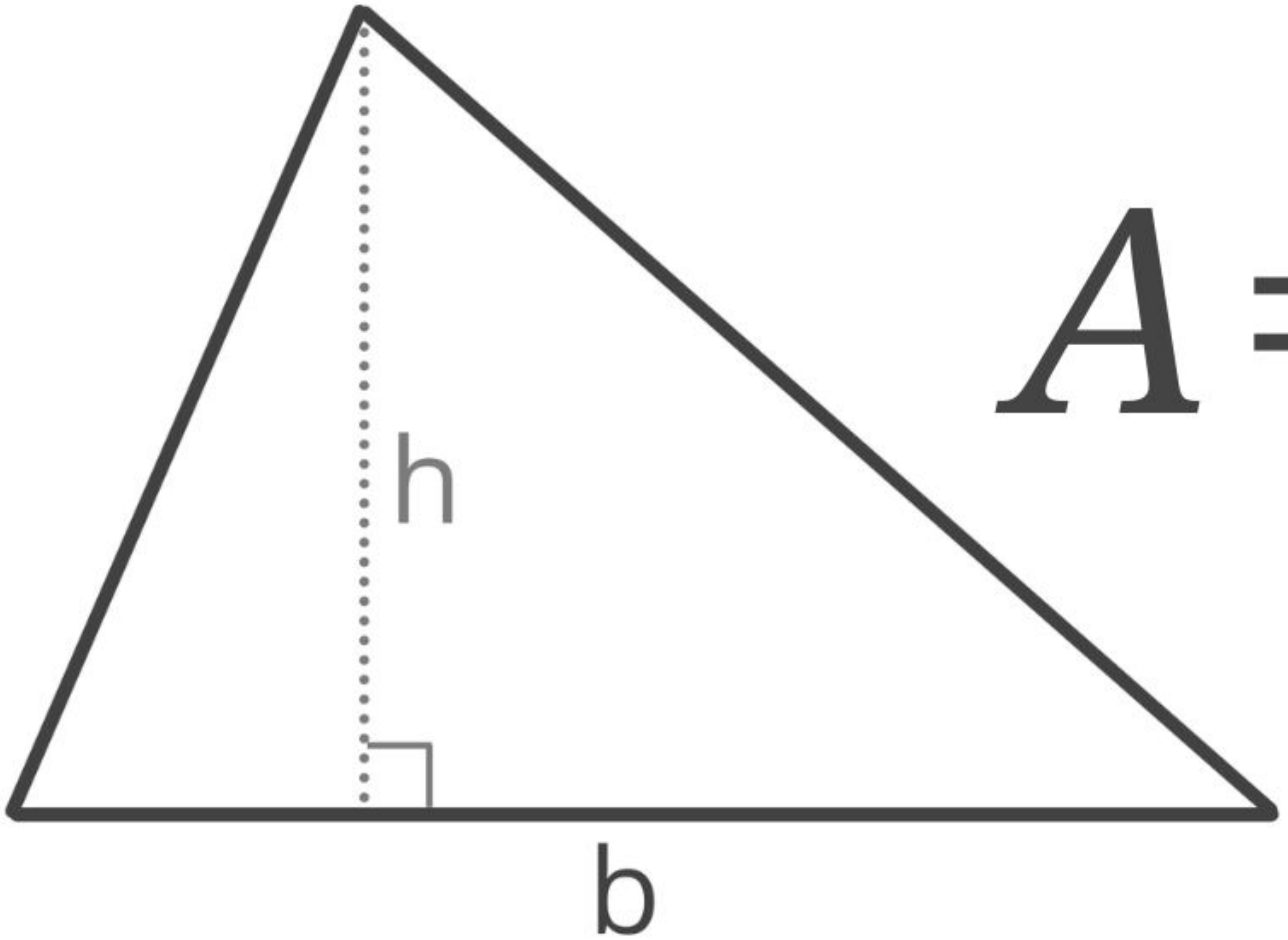
Area of a Square and Rectangle



$$\text{Area} = \text{length} \times \text{width}$$

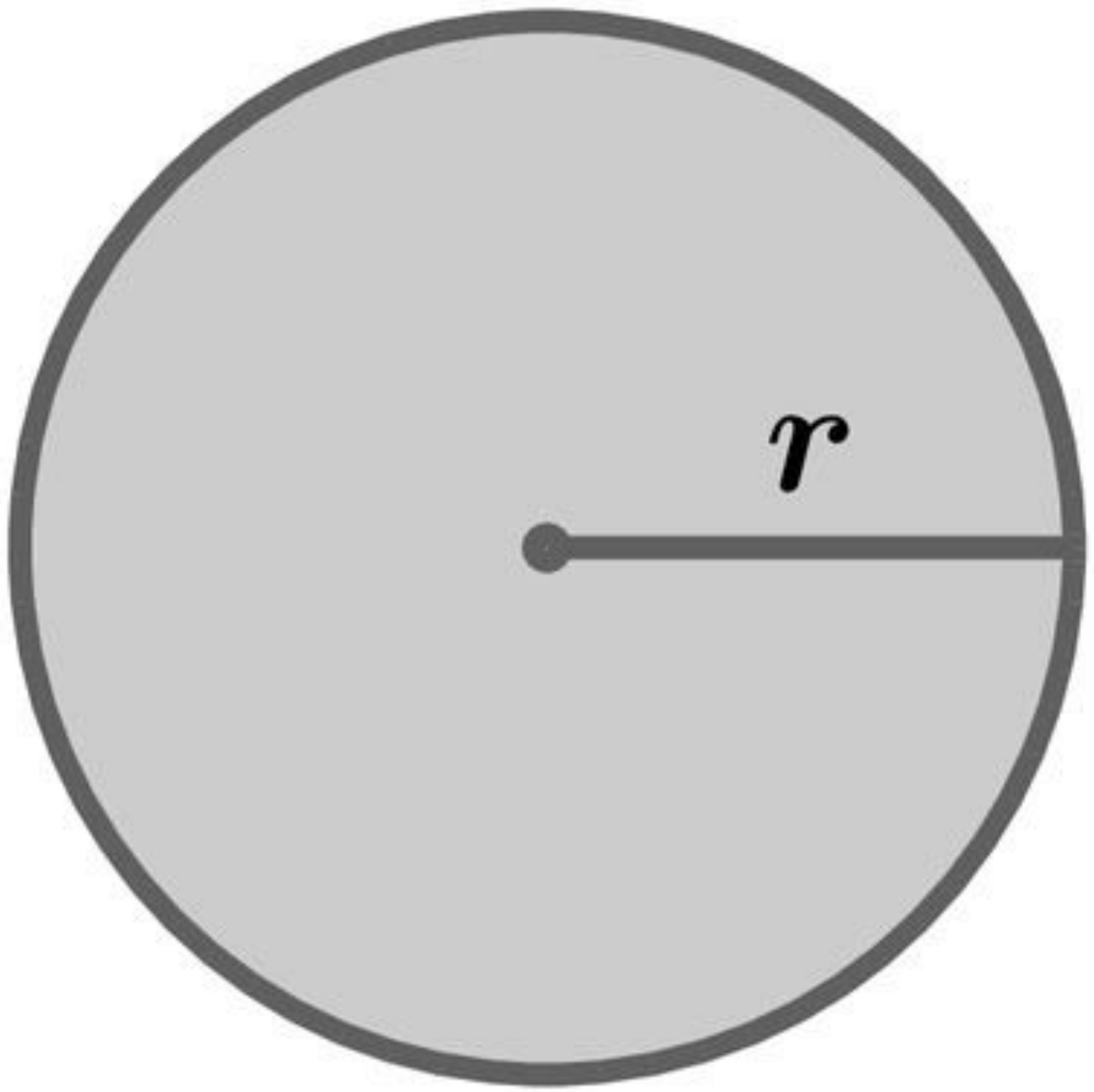
$$A = l \times w$$

Triangle Area Formula



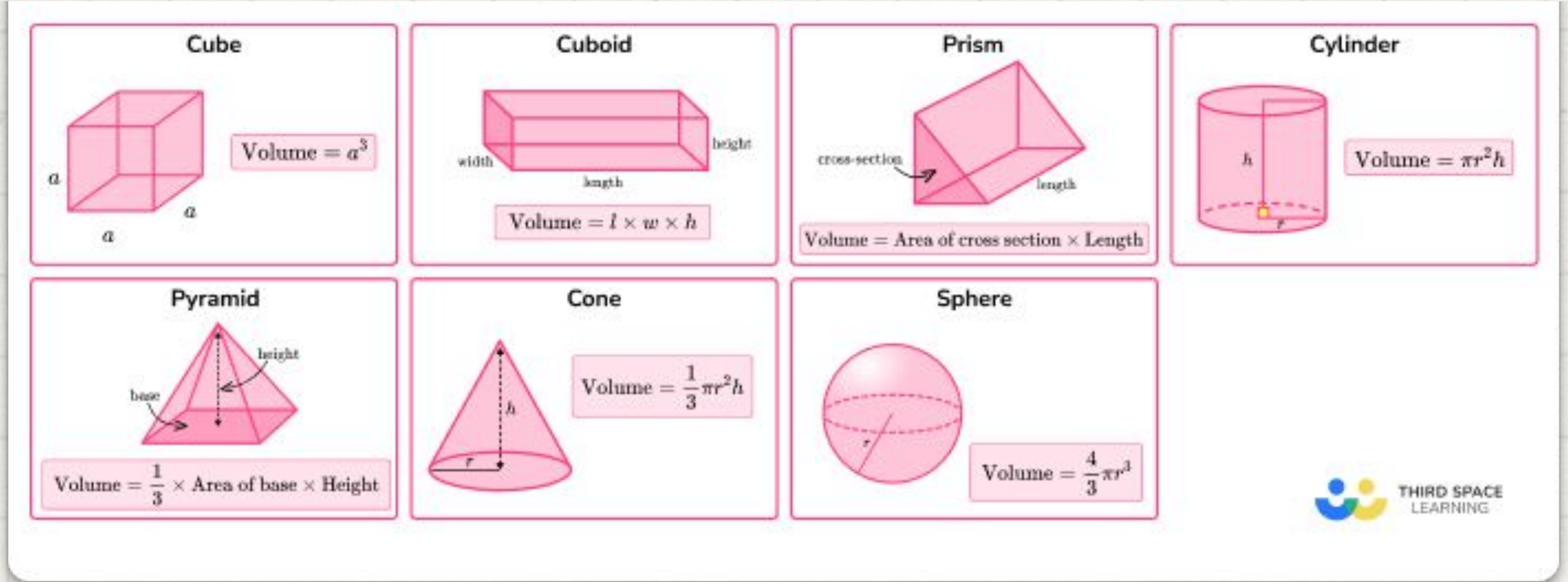
$$A = \frac{1}{2} b h$$

Area of Circle



$$\boldsymbol{A = \pi r^2}$$

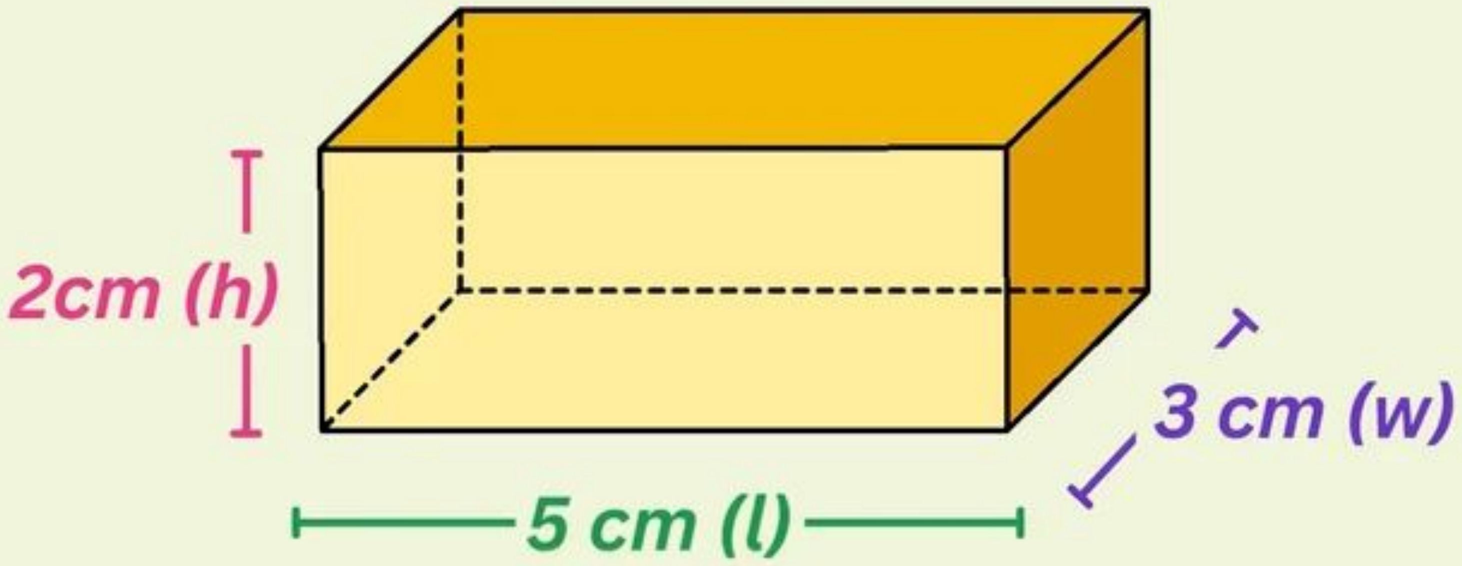
Common Volumes



Maths Angel

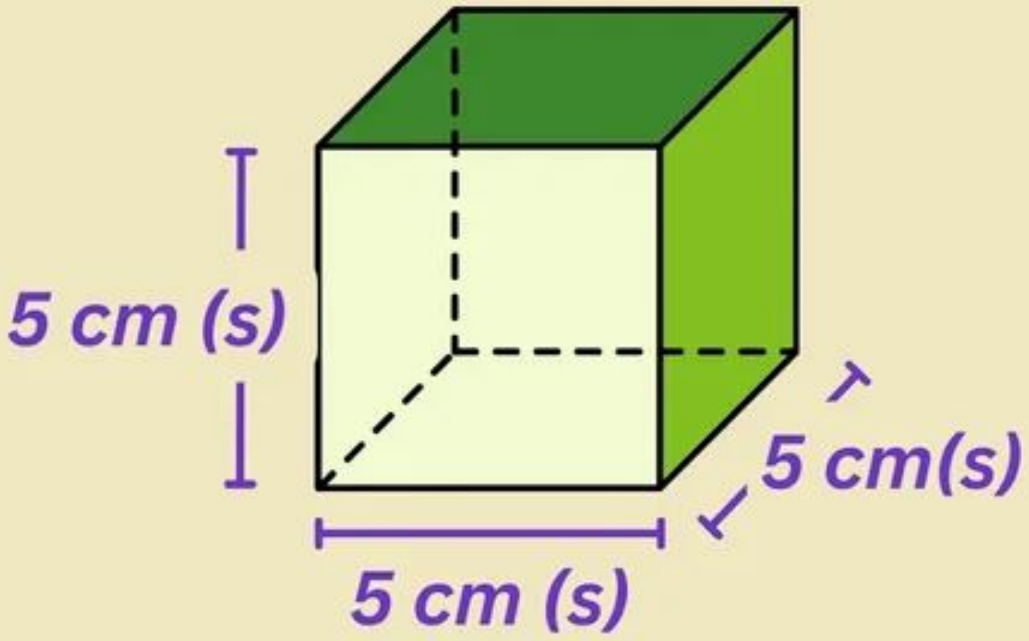
Volume of Cuboids and Cubes

Cuboids

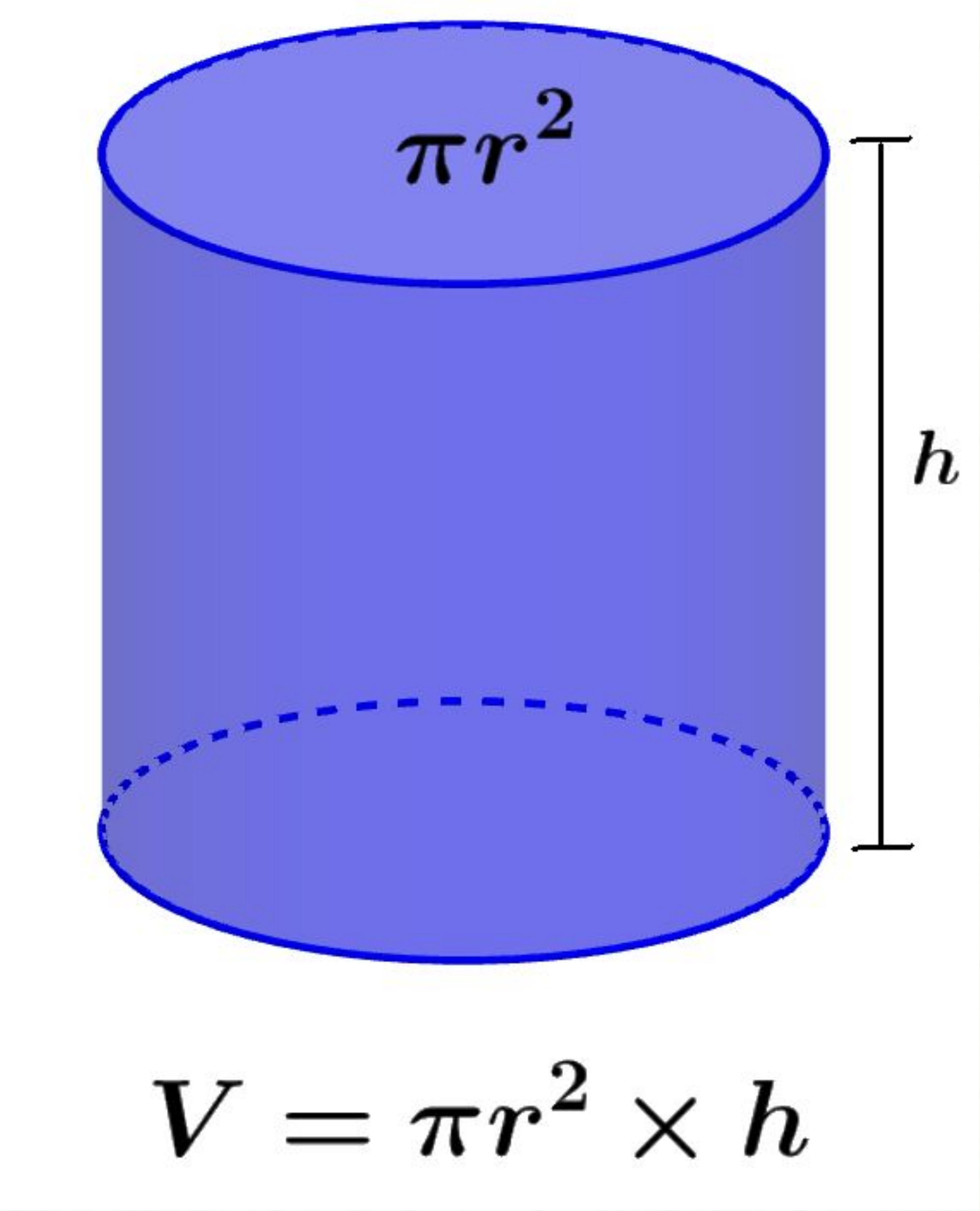


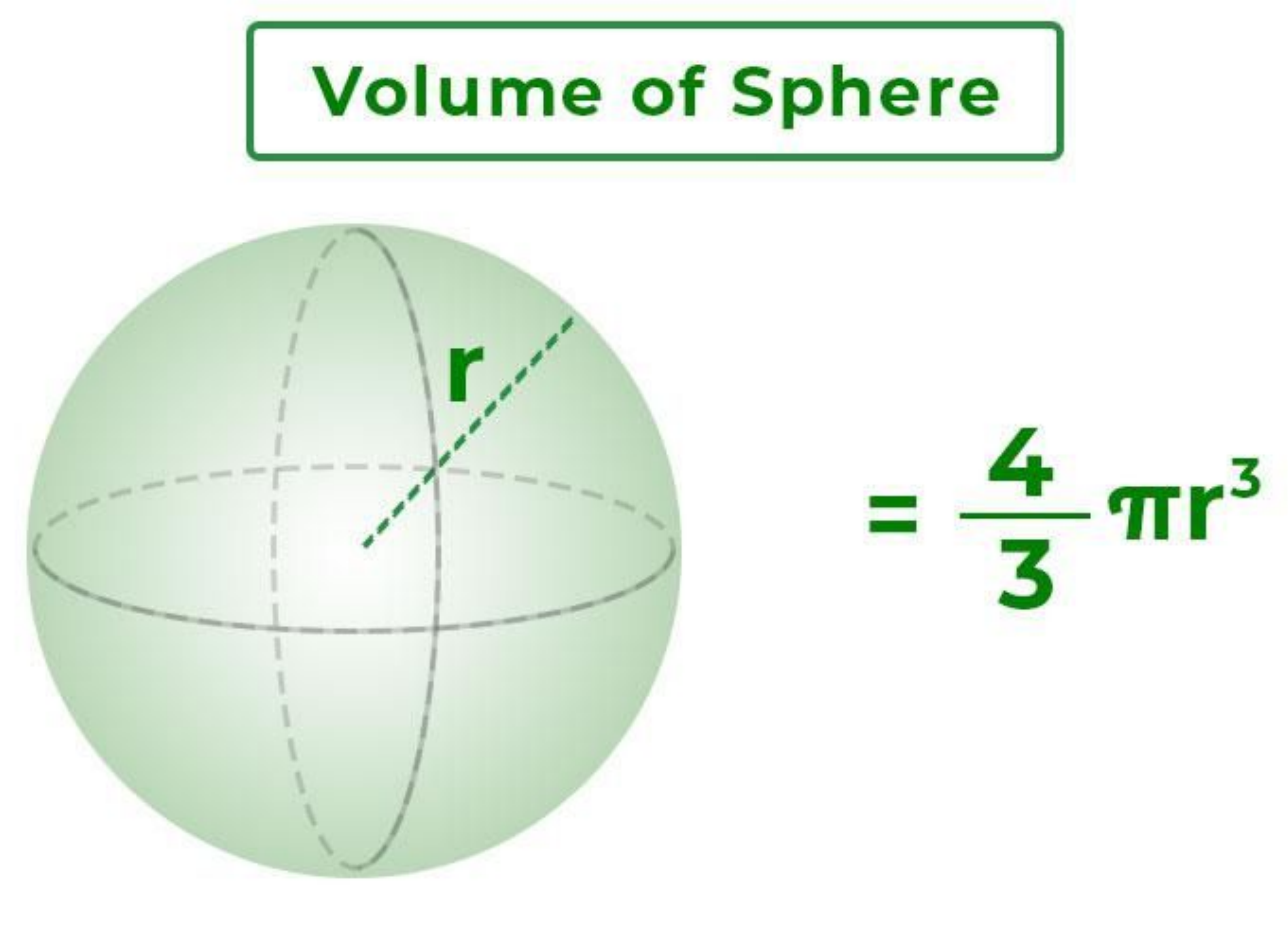
Volume (V) $= l \times w \times h$

Cubes



Volume (V) $= s \times s \times s$


πr^2
h
$V = \pi r^2 \times h$


Volume of Sphere
r
$= \frac{4}{3}\pi r^3$

Measuring volume by displacement

What is the volume?

Most objects do not have a regular shape, so we cannot find their volumes simply by measuring the lengths of their sides.

Measuring volume by displacement

What is the volume?

Here is how to find the volume of an irregularly shaped object. This technique is known as measuring volume by **displacement**

HOW TAKING A BATH LED TO ARCHIMEDES' PRINCIPLE

TED Ed

Measuring volume by displacement

What is the volume?

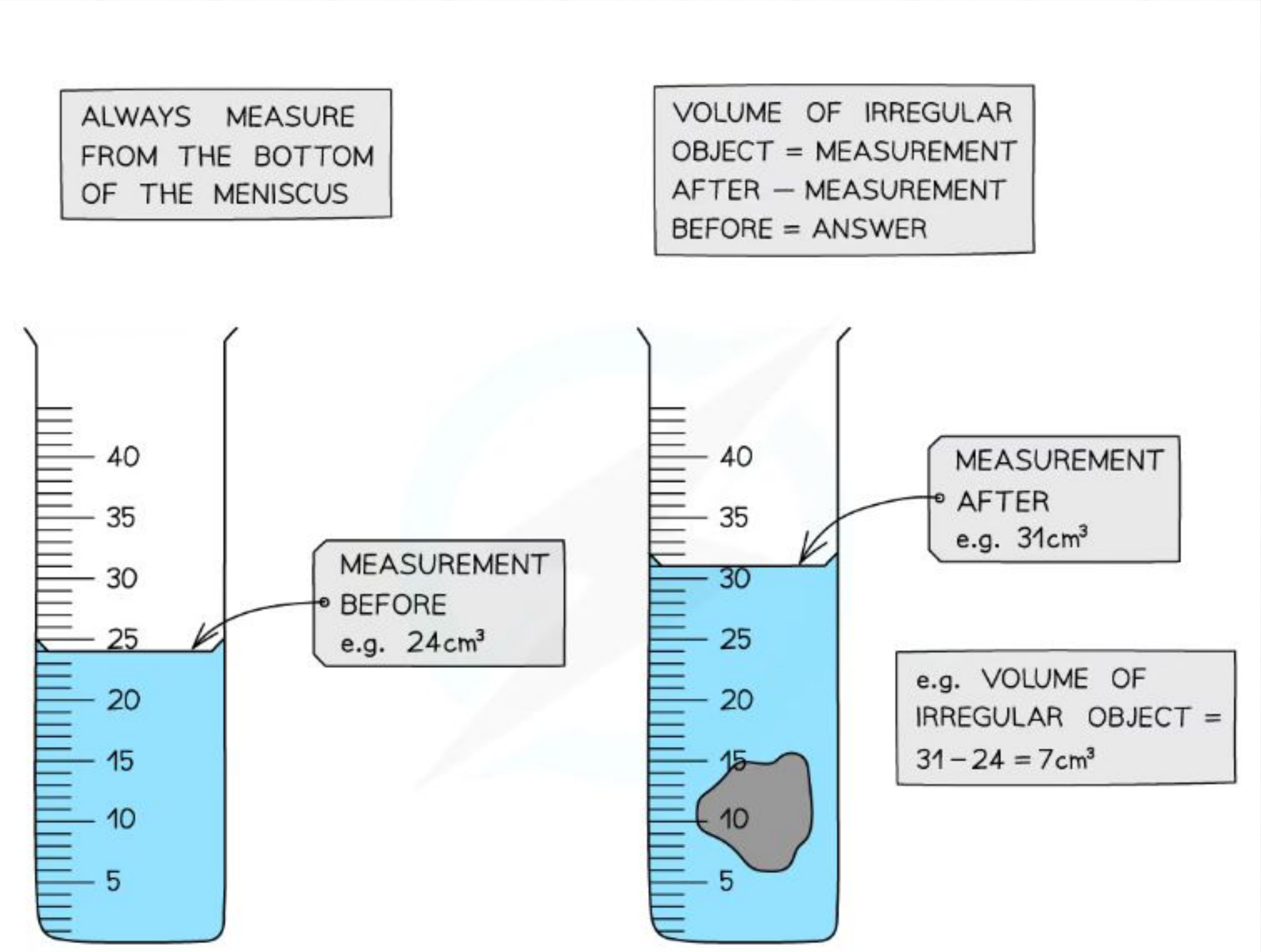
1. Select a measuring cylinder that is about three or four times larger than the object. Partially fill it with water, enough to cover the object. Note the volume of the water.

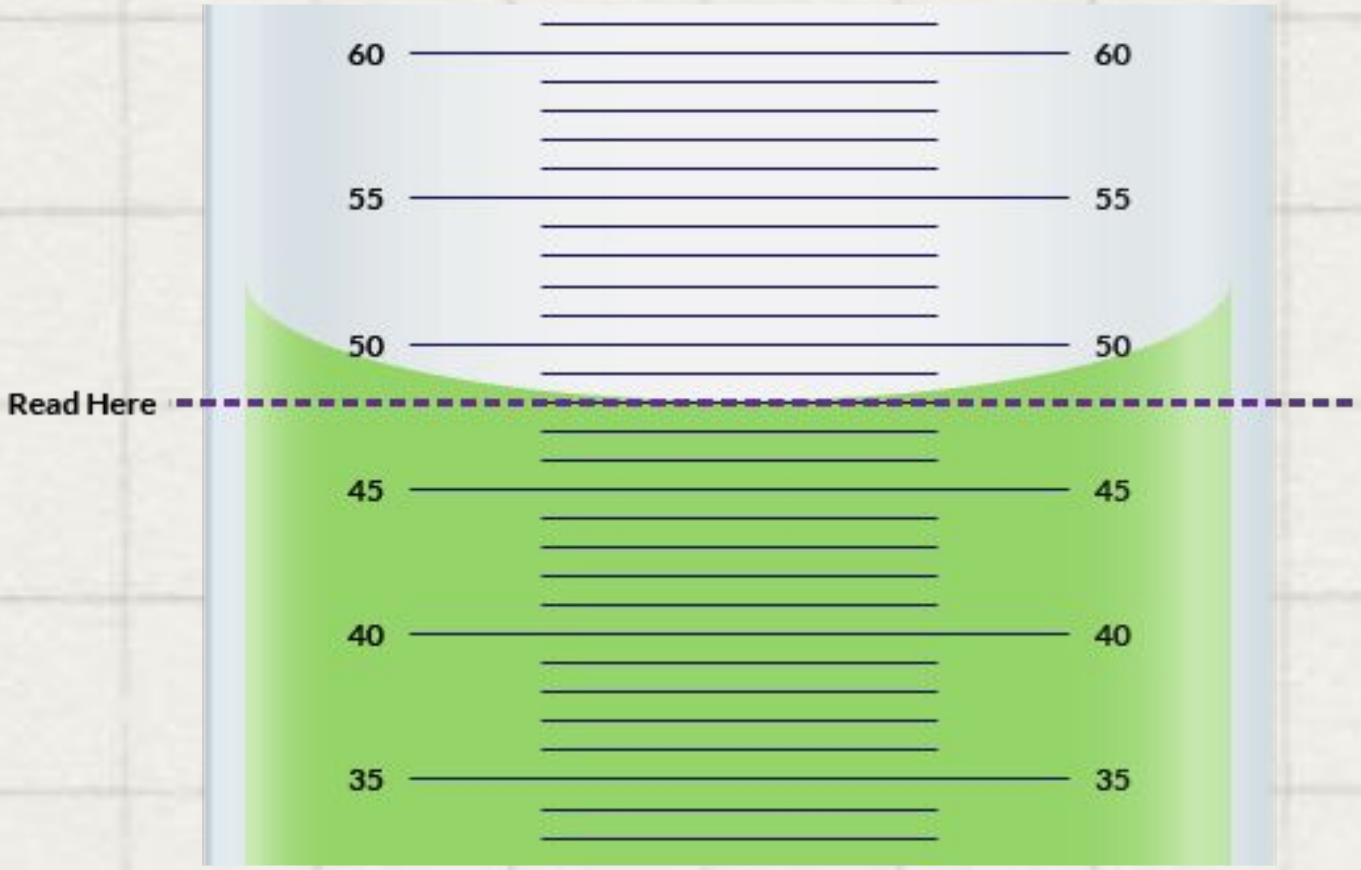
Measuring volume by displacement

What is the volume?

1. **Immerse** the object in the water. The level of water in the cylinder will increase, because the object pushes the water out of the way and the only way it can move is upwards. The increase in its volume is equal to the volume of the object.

Volume by displacement



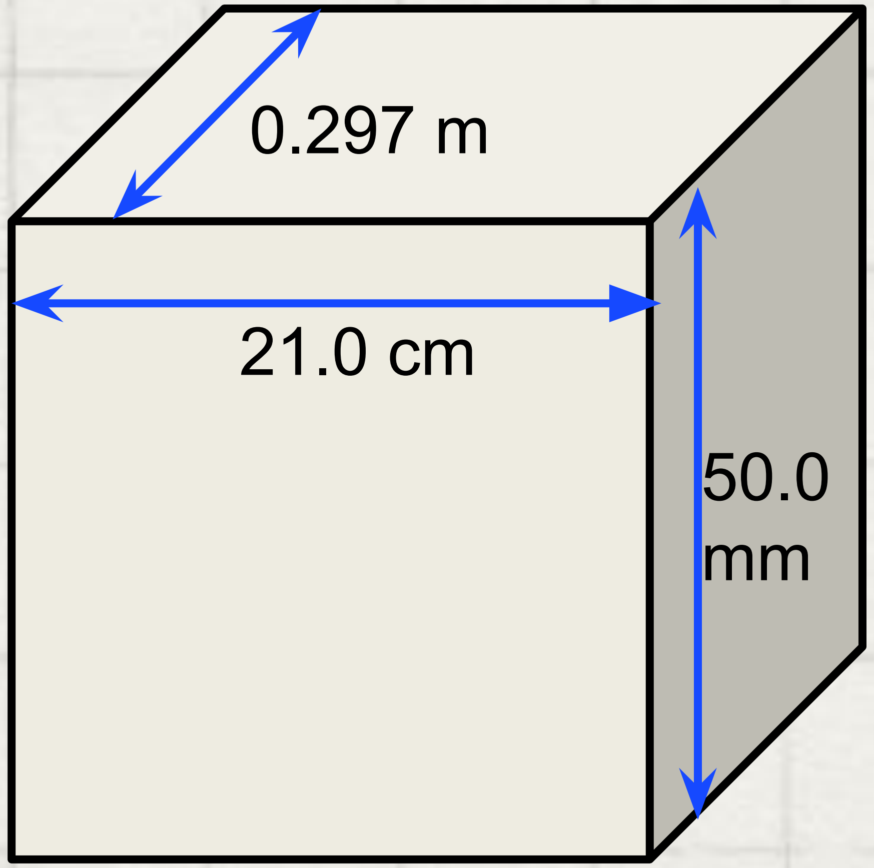


For liquids, measuring cylinders can be used as shown in the figure above. These cylinders are designed so that you look at the scale horizontally and not at an oblique angle. You read the level of the bottom of the **meniscus**

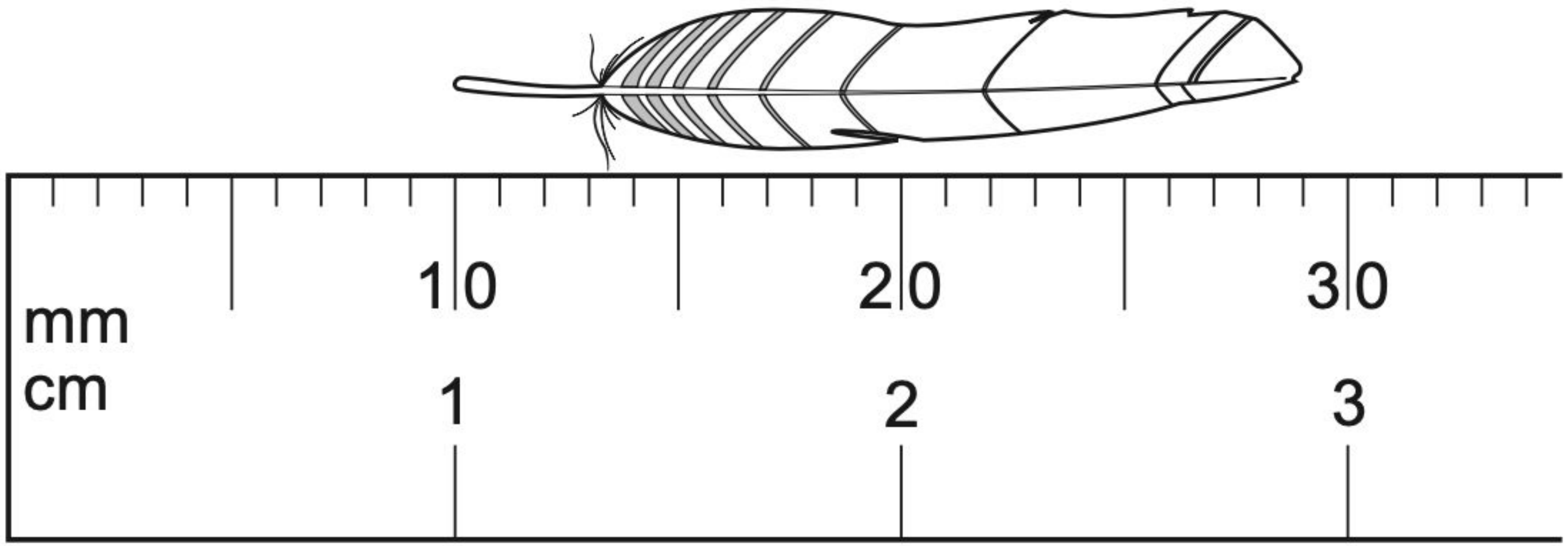
Question

A stack of paper contains 500 sheets of paper. The stack has dimensions of 0.297 m x 21.0 cm x 50.0 mm

Answer: 3118.5 cm^3



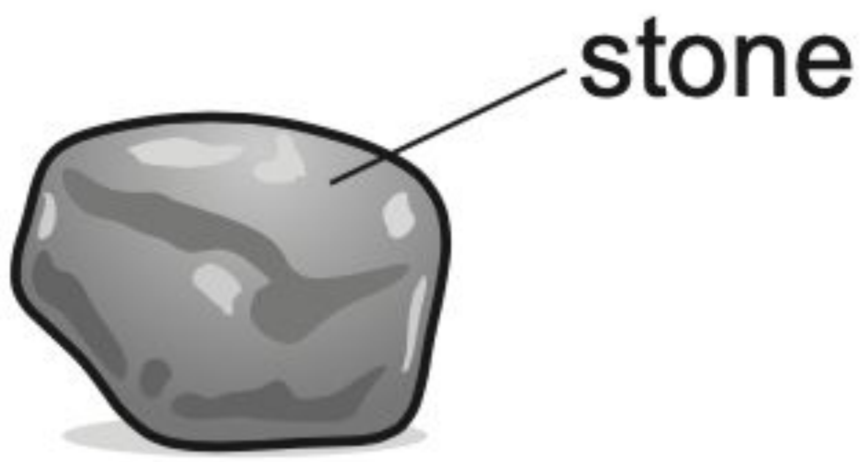
The diagram shows an enlarged drawing of the end of a metre ruler. It is being used to measure the length of a small feather.



What is the length of the feather?

A 19 mm B 29 mm C 19 cm D 29 cm

A student wishes to find the volume of a small, irregularly shaped stone.



A ruler and a measuring cylinder containing some water are available.

Which apparatus is needed?

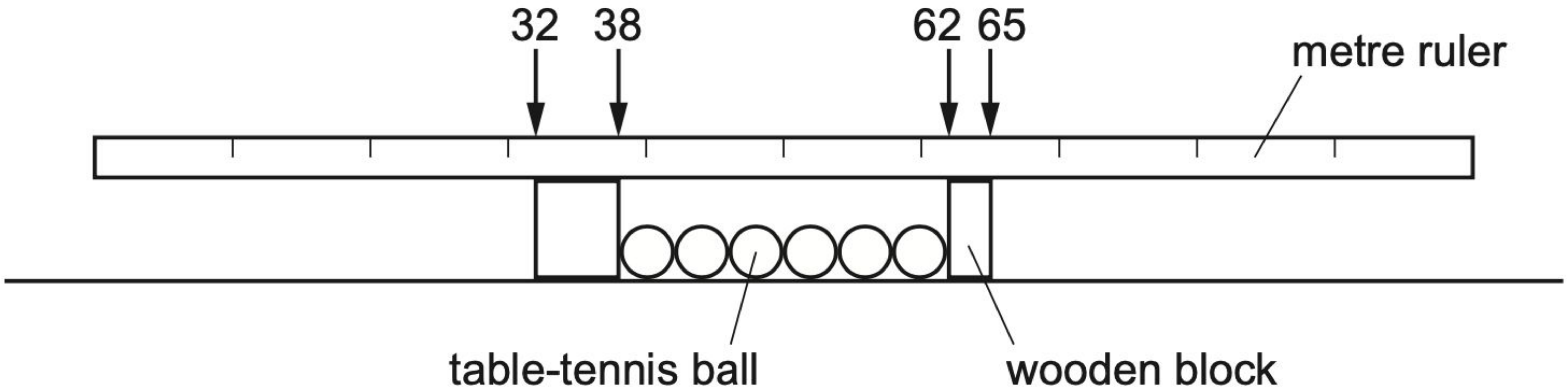
A neither the ruler nor the measuring cylinder

B the measuring cylinder only

C the ruler and the measuring cylinder

D the ruler only

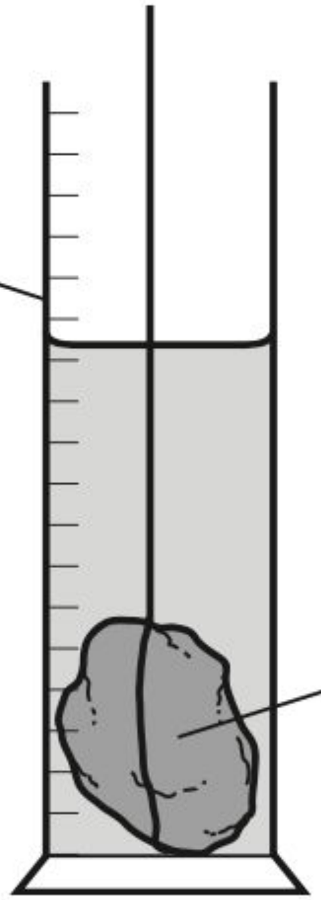
A student uses a metre ruler to measure the length of six identical table-tennis balls placed between two wooden blocks.



What is the diameter of one ball?

A 4 cm　　**B** 5 cm　　**C** 6 cm　　**D** 8 cm

A student determines the density of an irregularly shaped stone. The stone is slowly lowered into a measuring cylinder partly filled with water.



Which other apparatus does the student need to calculate the density of the irregularly shaped stone?

A a balance

B a thermometer

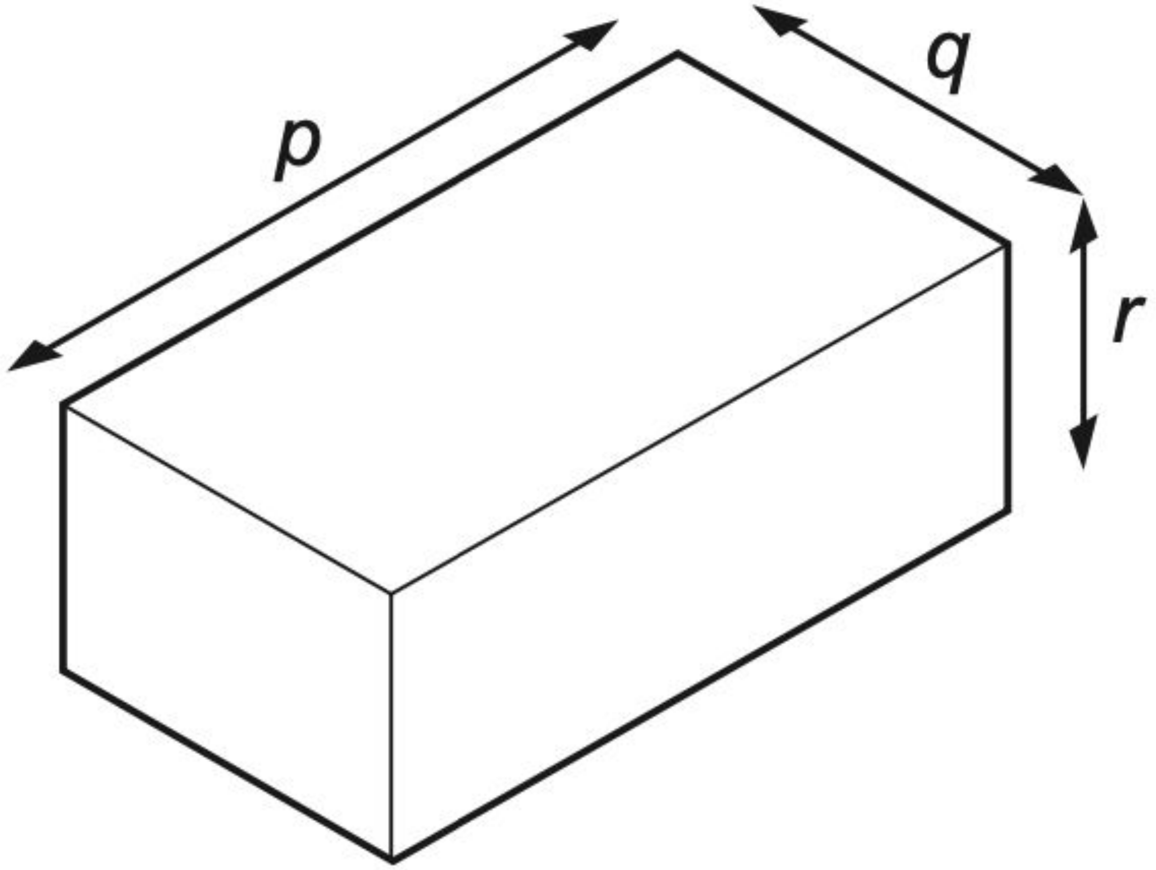
C a metre rule

D a stop-watch

Which single apparatus is used to find the volume of a solid cube and which single apparatus is used to find the volume of a quantity of liquid?

	volume of solid cube	volume of liquid
A	balance	balance
B	balance	measuring cylinder
C	ruler	balance
D	ruler	measuring cylinder

The diagram shows the dimensions of a solid rectangular block of metal of mass m.



Which expression is used to calculate the density of the metal?

A $\dfrac{m}{(p \times q)}$

B $\dfrac{m}{(p \times q \times r)}$

C $m \times p \times q$

D $m \times p \times q \times r$

A student uses a ruler to measure the length of a spring.

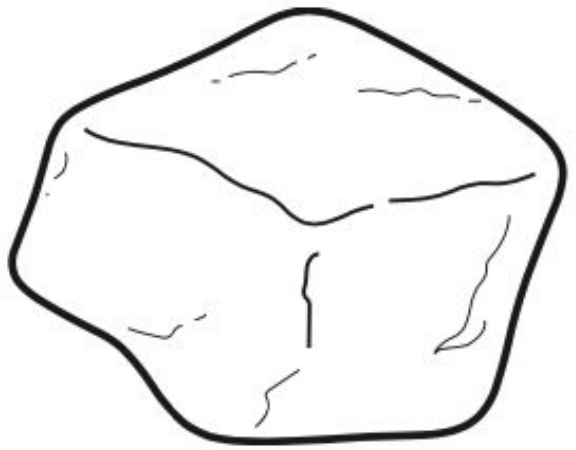
His results are shown.

14.9 cm	14.8 cm	14.8 cm	14.7 cm

What is the average length of the spring to three significant figures?

A 14.8 cm **B** 14.9 cm **C** 15.0 cm **D** 15 cm

The diagram shows a stone of irregular shape.



Which property of the stone can be found by lowering it into a measuring cylinder half-filled with water?

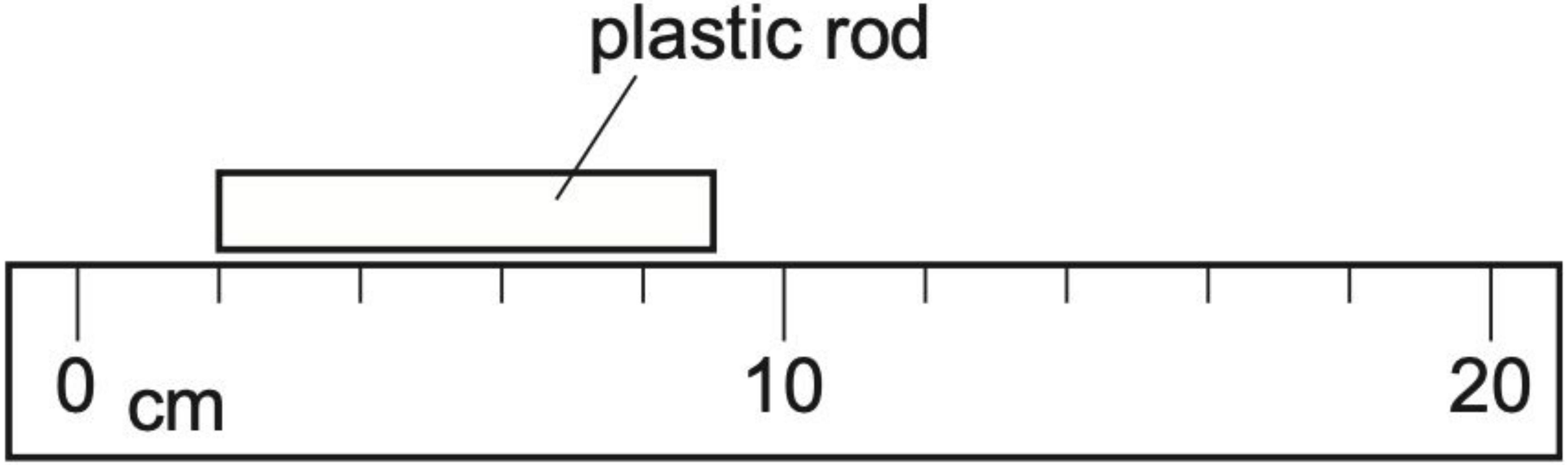
A length

B mass

C volume

D weight

The diagram shows a plastic rod alongside a ruler.



What is the length of the rod?

A 2.5 cm **B** 3.5 cm **C** 7.0 cm **D** 9.0 cm

A student measures the diameter of some identical steel balls. Fig. 1.1 shows the arrangement she uses.

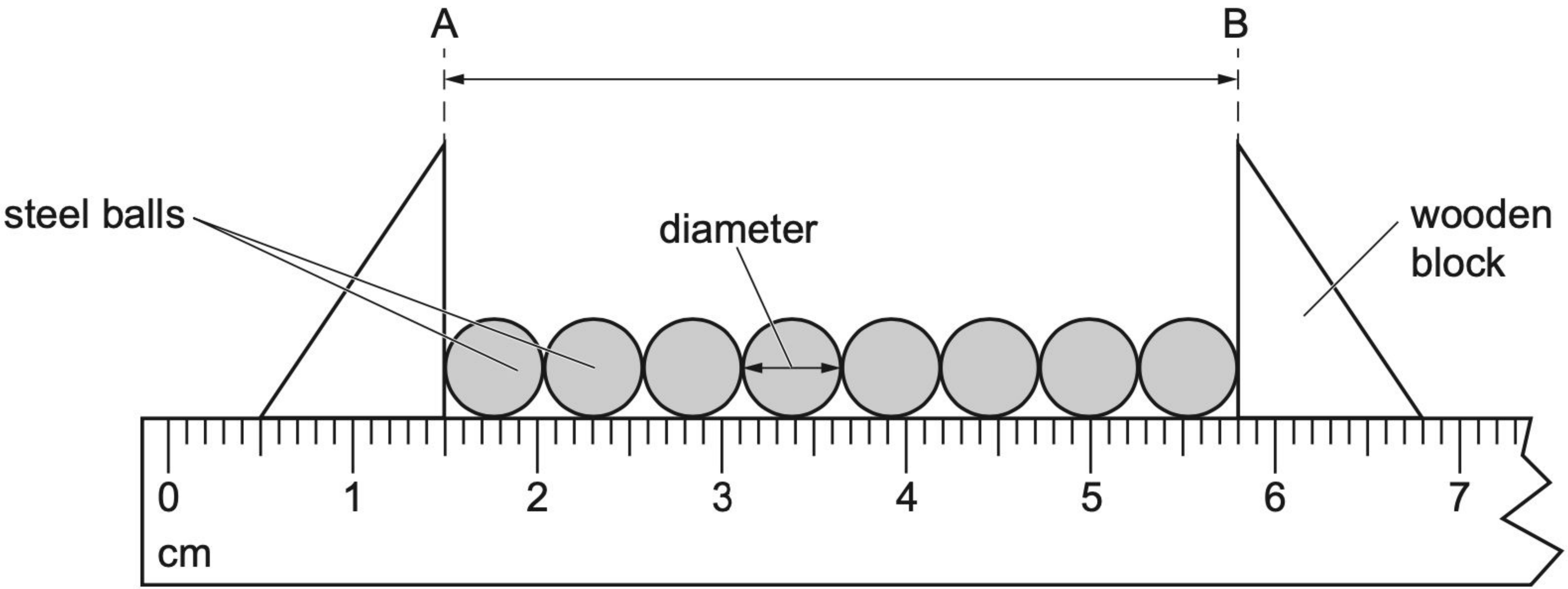


Fig. 1.1 (not to scale)

(a) **(i)** Using the ruler in Fig. 1.1, determine the distance AB on Fig. 1.1.

Fig. 1.1 shows children about to run a race. They have to run 25 m, pick up a small plastic ring and run back to the base line. Each child finishes when they cross the base line holding the plastic ring.

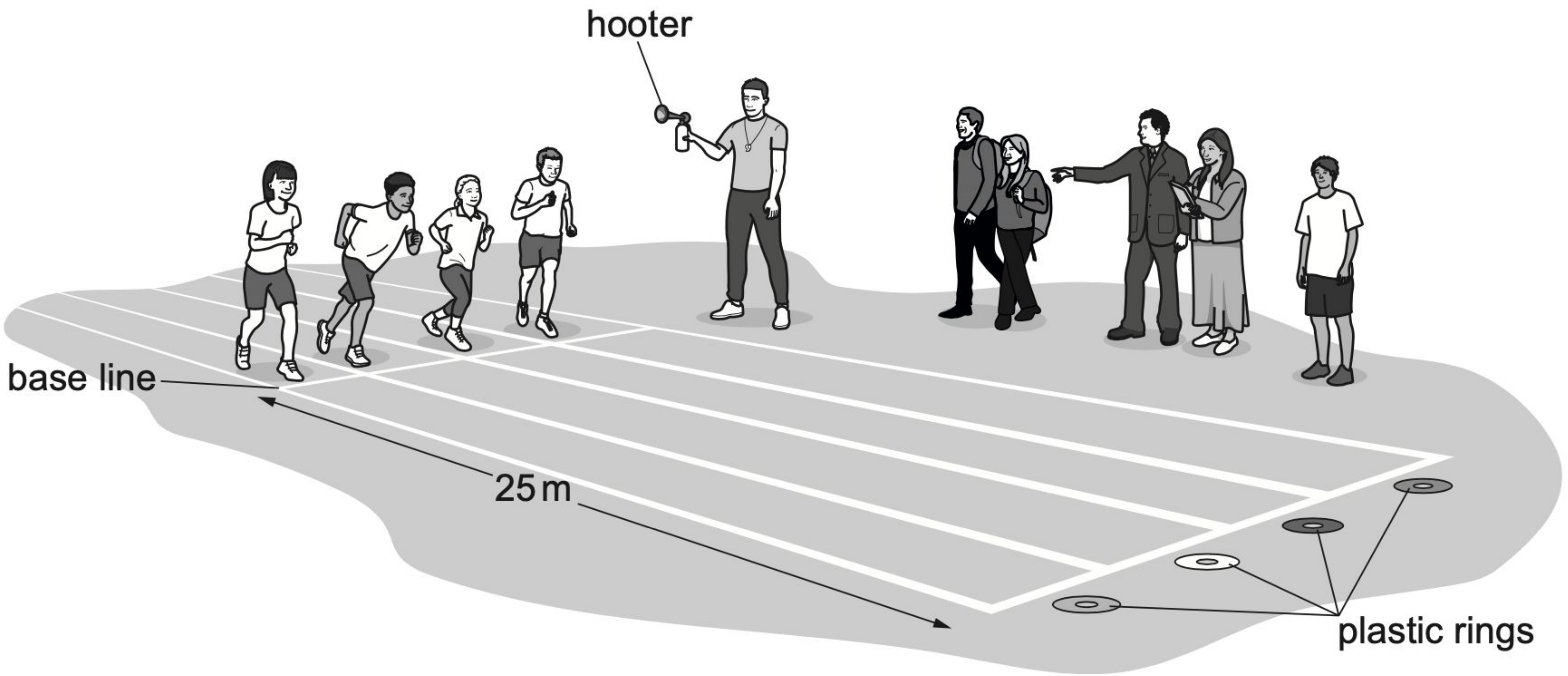
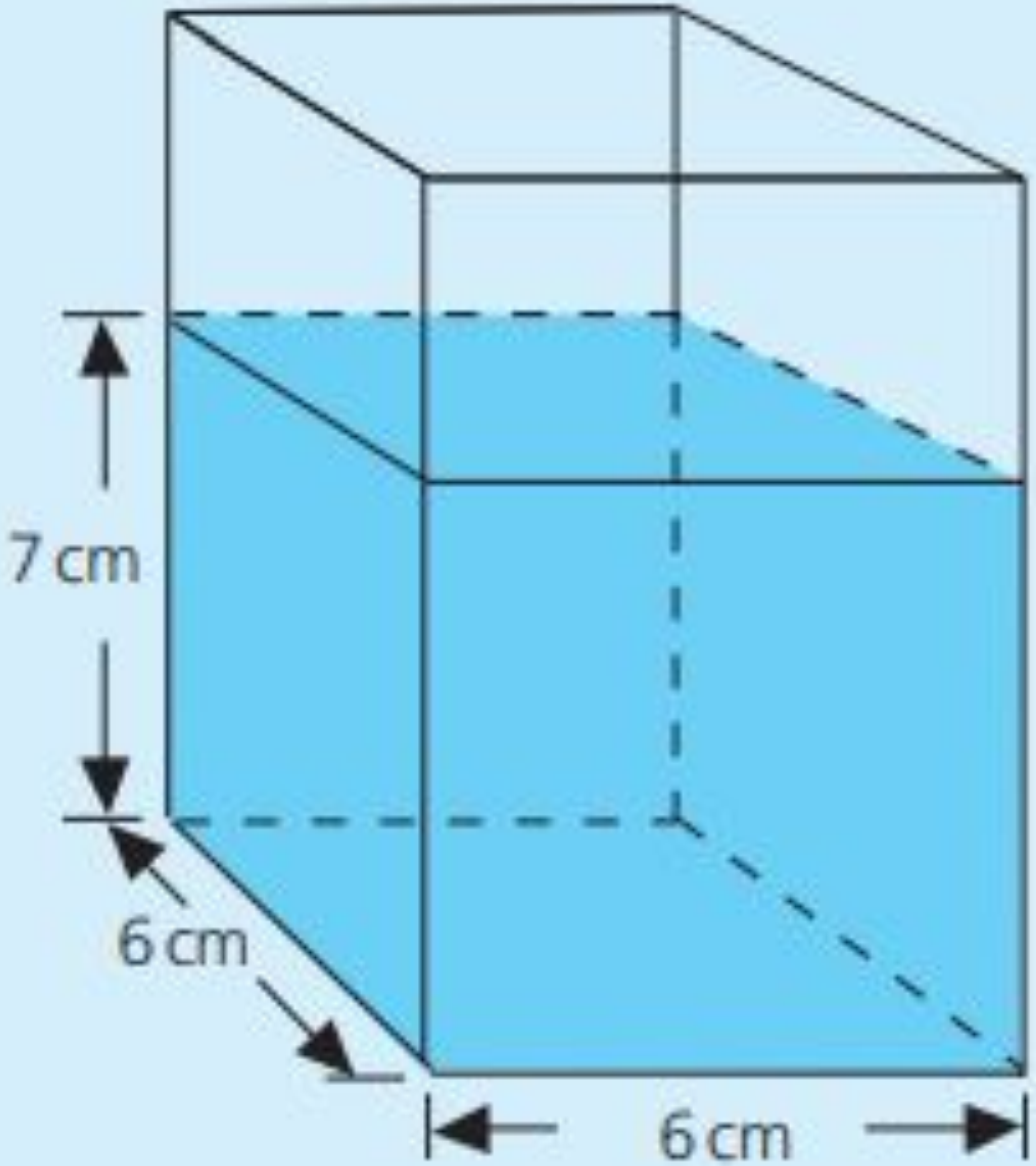


Fig. 1.1

(a) **(i)** Suggest what equipment the teacher uses to measure the length of 25 m.



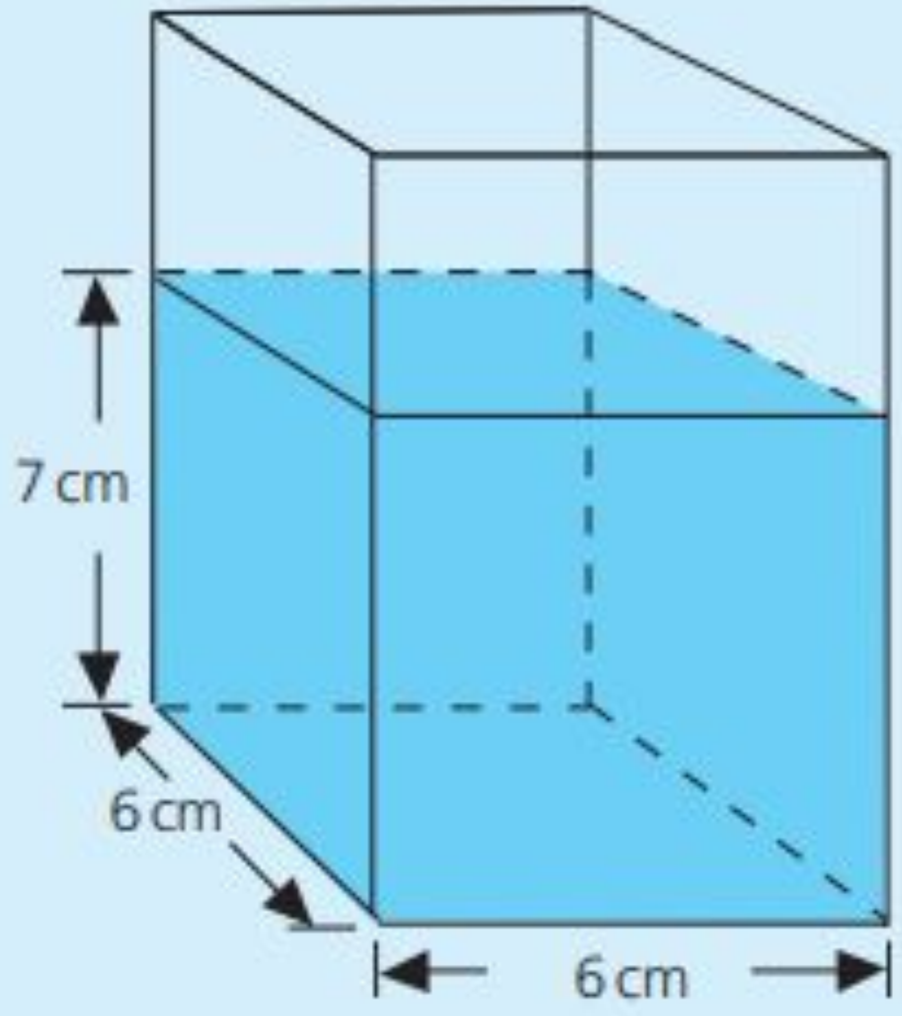
▲ **Figure 1.1.13**

3 A Perspex container has a 6 cm square base and contains water to a height of 7 cm (Figure 1.1.13).

a Calculate the volume of the water. [3]

b A stone is lowered into the water so as to be completely covered and the water rises to a height of 9 cm. Calculate the volume of the stone. [4]

[Total: 7]



▲ **Figure 1.1.13**

Question

Answer:

a. 252 cm^3

b. 72 cm^3

The international System

In physics, we generally use SI units. The SI system is a set of metric units now used in many countries. It is a decimal system in which units are divided or multiplied by 10 to give smaller or larger units.

Units of length and volume

Quantity	Units
length	metre (m) 1 decimetre (dm) = 0.1 m 1 centimetre (cm) = 0.01 m 1 millimetre (mm) = 0.001 m 1 micrometre (μm) = 0.000 001 m 1 kilometre (km) = 1000 m
volume	cubic metre (m^3) 1 cubic centimetre (cm^3) = 0.000 001 m^3 1 cubic decimetre (dm^3) = 0.001 m^3

Units of length and volume

Volume is the amount of space occupied. The unit of volume is the **cubic metre (m^3)** but as this is rather large, for most purposes the **cubic centimetre (cm^3)** is used. The volume of a cube with 1 cm edges is 1 cm^3.

cubic metre (m^3)
1 cubic centimetre (cm^3) = 0.000 001 m^3
1 cubic decimetre (dm^3) = 0.001 m^3

Question

State the standard units of length and volume

Answer

- **Length: metres, decimetres, centimetres, millimetres**
- **Volume: cubic metre, cubic decimetre and cubic centimetre**

Question

Write down expressions for

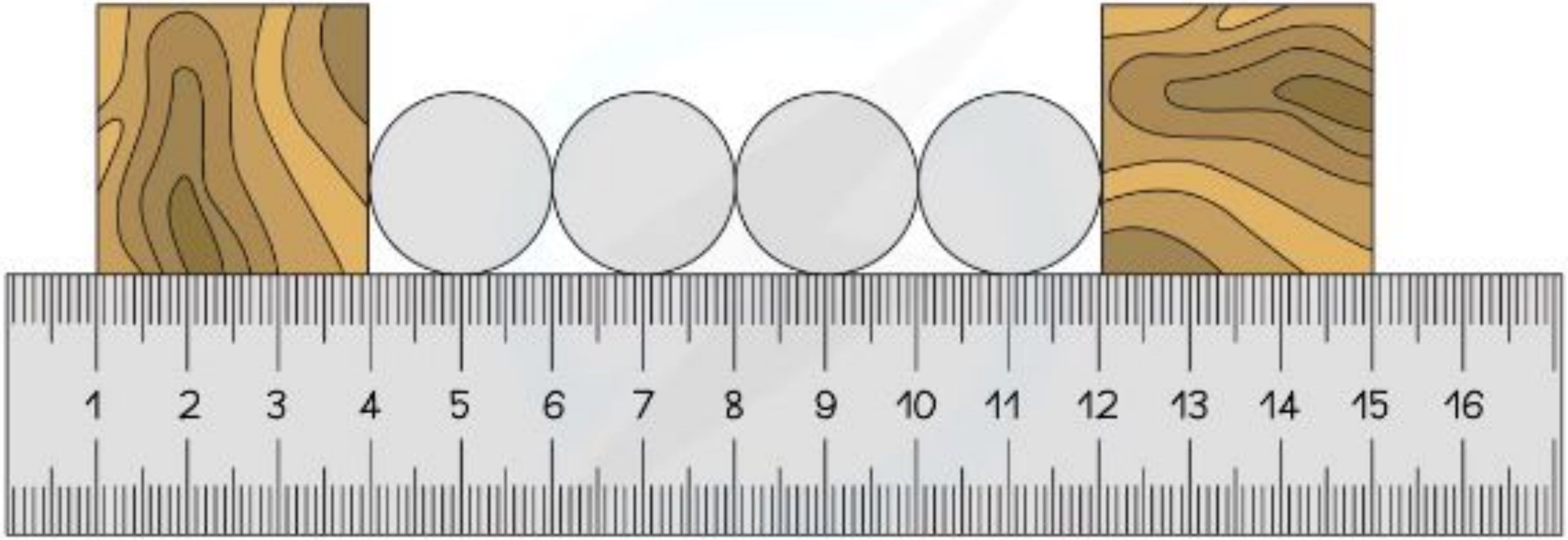
- the area of a circle
- the volume of a sphere
- the volume of a cylinder

Answer

- $A = \pi r^2$
- $(4 \pi r^3)/3$
- $\pi r^2 h$

Question

The diagram shows four identical ball-bearings placed between two blocks on a steel ruler.



Calculate the diameter of one ball-bearing.

Question

Step 1: Measure the length of all four ball-bearings

- The blocks mark the edges of the first and last ball bearings
- The blocks make it easier to measure the length of all four ball-bearings

$$\text{total length} = 12 - 4$$

$$\text{total length} = 8 \text{ cm}$$

Step 2: Find the diameter by dividing the total length by the number of ball-bearings

$$\text{diameter} = \frac{\text{total length}}{\text{number of ball bearings}}$$

$$\text{diameter} = \frac{8}{4}$$

$$\text{diameter} = 2 \text{ cm}$$

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

1.2 Density

The mass of an object is the quantity (amount) of matter it is made of. **Mass** is measured in kilograms. But **density** is a property of a material. It tells us how concentrated its mass is.

Density is a measure of the amount of **mass** per unit volume. To calculate density, we divide the total mass of a substance by its total volume (the total amount of space it occupies).

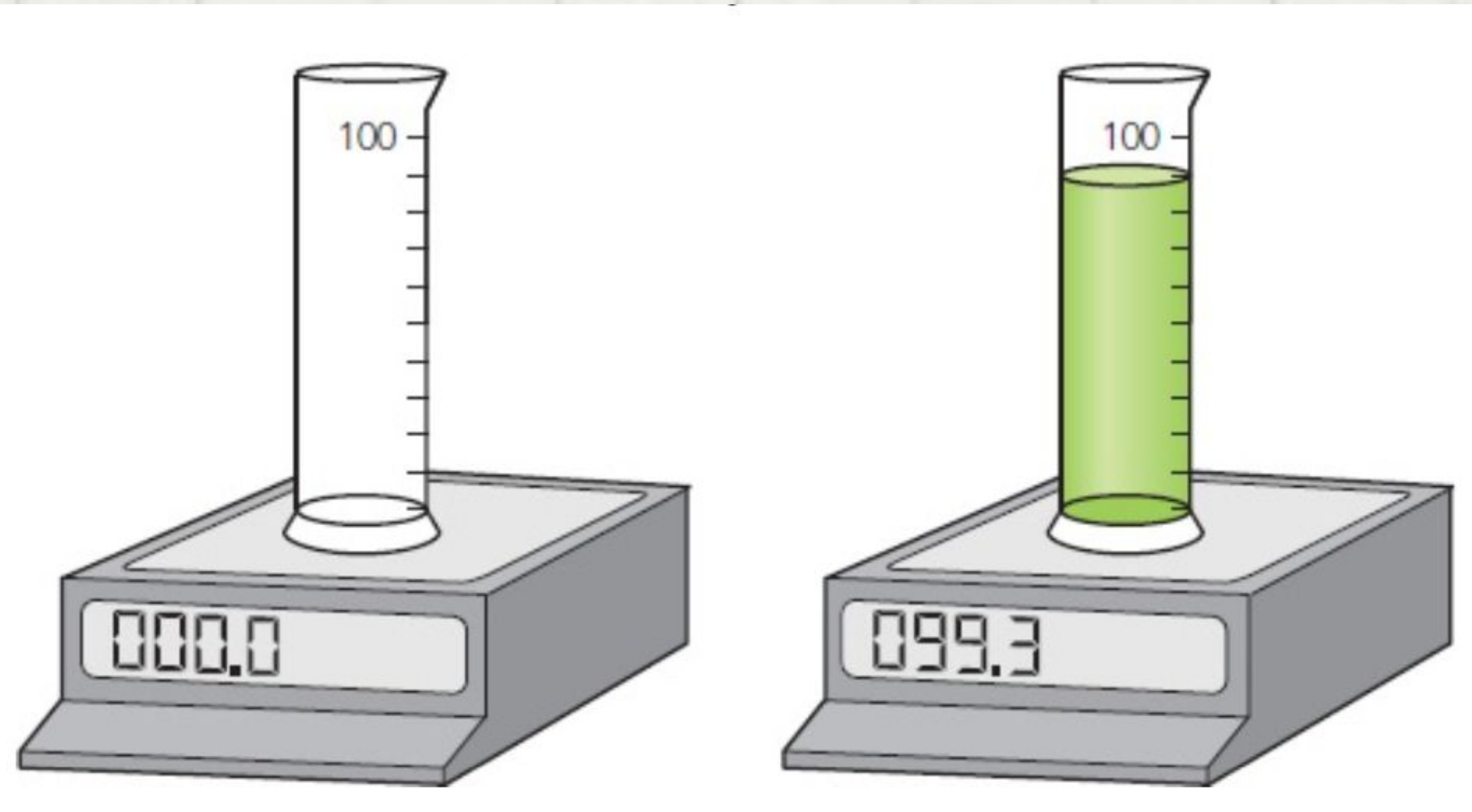
Unit of mass	Unit of volume	Unit of density	Density of water
kilogram, kg	cubic metre, m^3	kilograms per cubic metre	1000 kg/m^3
kilogram, kg	cubic decimetre, dm^3	kilograms per cubic decimetre	1.0 kg/dm^3
gram, g	cubic centimetre, cm^3	grams per cubic centimetre	1.0 g/cm^3

The equation for density is the **mass** divided by the **volume**. The symbol for density is ρ, the Greek letter rho. The SI unit of density is kg/m^3 (kilograms per cubic metre). You may come across other units, as shown in Table 1.2 page 5.

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

Finding the density of a liquid

Place a measuring cylinder on a balance. Set the balance to zero. Now pour liquid into the cylinder. Read the volume from the scale on the cylinder. The balance shows the mass.



Question

A sample of ethanol has a volume of 240 cm^3. Its mass is found to be 190.0 g. What is the density of ethanol?

Answer

- **0.792 g/cm^3**

	Material	Density / kg/m^3
Gases	air	1.29
	hydrogen	0.09
	helium	0.18
	carbon dioxide	1.98
Liquids	water	1000
	alcohol (ethanol)	790
	mercury	13 600
Solids	ice	920
	wood	400–1200
	polyethene	910–970
	glass	2500–4200
	steel	7500–8100
	lead	11 340
	silver	10 500
	gold	19 300

Table 1.3: Densities of some substances. For gases, these are given at a temperature of 0 °C and a pressure of 1.0×10^5 Pa.

An object that **is less dense than water will float**. Ice is less dense than water which explains why icebergs float in the sea, rather than sinking to the bottom. Only about one tenth of an iceberg is above the water surface. If any part of an object is above the water surface, then it is less dense than water.

Question

What is the density of water? And Why?

	Material	Density / kg/m^3
Liquids	water	1000

When liquids with different densities are poured into the same container, they will arrange themselves so that the liquid with the lowest density will be at the top and the ones with the highest density will be at the bottom. This is because the denser liquids displace the less dense liquids. This is easier to see when each liquid is given a different colour. In Figure 1.13, the green liquid is less dense than the red liquid and so on.

Question

A brick has a mass of 2.8 kg and dimensions of 215mm by 65mm by 102.5mm.

- Give the dimensions of the brick in metres.
- Calculate the volume of the brick
- Calculate the density of the brick

Answer

- **0.215m, 0.065m, 0.1025m**
- **1.43×10^{-3} m^3**
- **1955 kg/m^3**

Question

A box full of 35 matches has a mass of 6.77 g. The box itself has a mass of 3.37 g

- What is the mass of one match in grams?
- What is the volume (in cm^3) of each match. A match has dimensions of 42 mm × 2.3 mm × 2.3 mm?
- What is the density of the matches?
- How do you know if these matches will float?

Answer

- **0.0971 g or 9.71×10^{-2} g**
- **0.222 cm^3**
- **0.44 g/cm^3**
- **The density is smaller than the density of water**

Question

The Earth has a mass of 6×10^{24} kg and a radius of about 6400 km. What is the density of the Earth (in kg/m^3)? The volume of a sphere is given by the equation $V = 4/3\ \pi r^3$, where r is the radius.

Answer

- **Volume of the earth = $1.098 \times 10^{21}\ m^3$**
- **Density of the earth = $6 \times 10^{24} / 1.098 \times 10^{21} = 5464.48$ or $5.5 \times 10^3\ kg/m^3$**

Question

40 drawing pins (thumb tacks) like those shown below have a mass of 17.55 g. What is the volume (in mm^3) of one pin when they are made of metal with a density of 8.7 g/cm^3?

Answer: 50.43 mm^3 or 0.05 cm^3

Question

A young girl from the Kayan people in northern Thailand wears a neck ring made of brass. It looks as if there are 21 individual rings but the ring is actually one continuous length of brass fashioned (bent) into a coil. The height of the brass coil is 12 cm and its average circumference is 40 cm. Neck rings are usually only removed to be replaced with a bigger one as the girl grows. However, we can estimate the mass of this neck ring without removing it.

Question

What looks like 21 individual rings around the girl's neck is actually 21 turns of a coil of brass. Each turn has a circumference of 40 cm. Calculate (in cm) the total length of brass used to make the girl's neck ring.

Answer: 840 cm

Question

The coil has a height of 12 cm and the coil has 21 turns. Calculate the radius of the brass in cm.

Answer: 0.29 cm

Question

If the brass coil is unwound from the girl's neck and straightened out, it would be a long, thin, cylinder. Calculate the volume of this cylinder in cm^3. The volume of a cylinder is given by the equation $V = \pi r^2 h$

where

r = radius and h = height.

Answer: 221.93 cm^3

Question

Calculate the mass of brass used to make the neck ring and express your answer in kg.

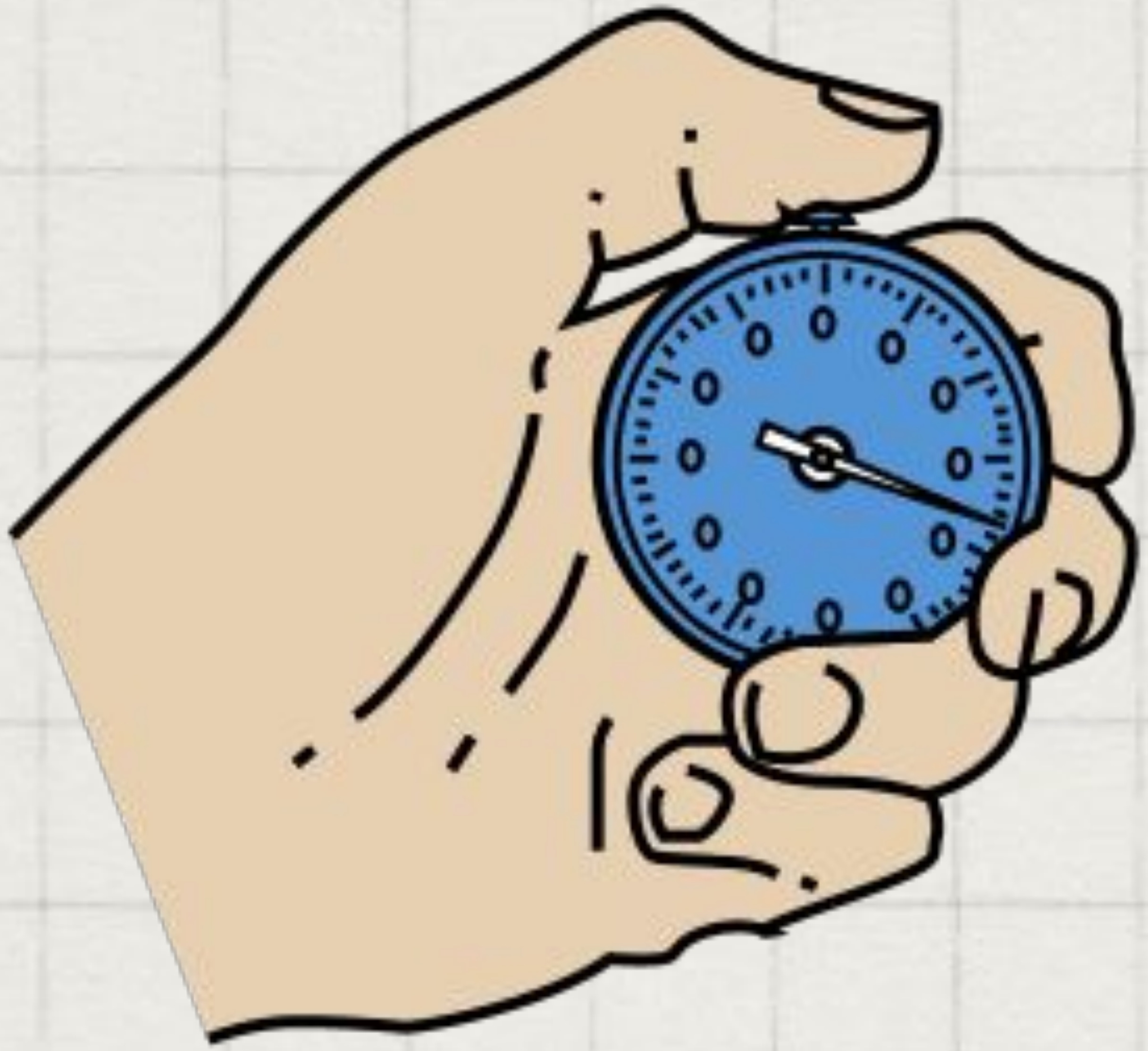
The density of brass = 8.73 g/cm^3

Answer: 1.94 kg

Finding the density an irregular shaped solid

First, fill a measuring cylinder with water to about half its volume and record the volume of the water in the cylinder. Then carefully drop the solid into the water, making sure not to splash the water. Record the new volume. The initial volume reading is the volume of the water, and the final volume reading is the volume of the water + solid, so the difference between the two volume readings is the volume of the solid.

Finding density in a lab



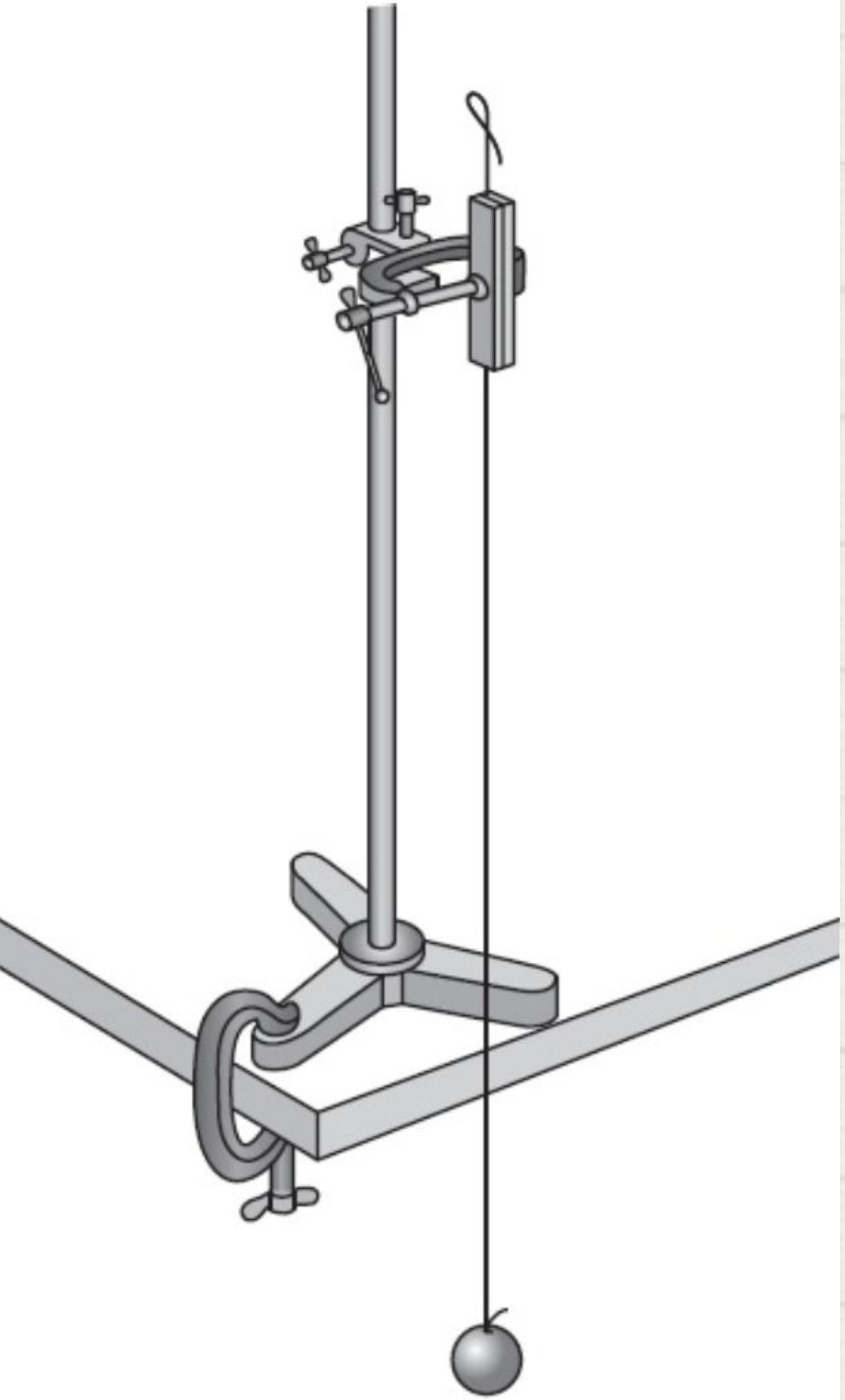
1.3 Measuring time

The unit of time is the **second (s)**, which used to be based on the length of a day, this being the time for the Earth to revolve once on its axis. However, days are not all of exactly the same duration and the second is now defined as the time interval for a certain number of energy changes to occur in the caesium atom.

Analogue vs. digital

An **analogue** clock is like a traditional clock whose hands move round the clock's face. A **digital** clock or stopwatch is one that gives a direct reading of the time in numerals. A digital clock records time to a precision of at least one hundredth of a second.

How time was invented



Measuring short intervals of time

The time for one **oscillation** of a pendulum (when it swings from left to right and back again) is called its **period**. Because a pendulum swings at a steady rate, you can use a stopwatch to measure the time for a large number of oscillations (perhaps 20 or 50), and calculate the average time per oscillation.

9 A student was investigating how the period of a pendulum varied with the length of the string and obtained the results in Table 1.4.

Length of string / m	Time for 20 oscillations / s	Time for 1 oscillation / s
0.00	0.0	
0.20	18.1	
0.40	25.1	
0.60	28.3	
0.80	39.4	
1.00	40.5	
1.20	44.4	
1.40	47.9	

Question

How many seconds are in one minute? How many minutes are in one hour? How many seconds are in one hour?

- **60 seconds in one minutes**
- **60 minutes in one hour**
- **3600 seconds in one hour**

Question

A stopwatch is used to measure the time taken for a runner to complete a lap of a 400 m track.

The images below give the readings on the stopwatch at the start and the end of the lap.

Calculate how long it took the runner to complete the lap. Give your answer in seconds.

Calculate how long it took the runner to complete the lap. Give your answer in seconds.

Answer:

Step 1: Identify the start time for the lap

- The stopwatch was already at 0:55:10 when the runner started the lap
- Start time = **55.10 seconds (s)**

Step 2: Identify the finish time for the lap

- The stopwatch reads 1:45:10 at the end of the lap
- Finish time = **1 minute and 45.10 s**

Step 3: Convert the finish time into seconds

$$1 \text{ minute} = 60 \text{ seconds}$$

$$\text{finish time} = 60 \text{ s} + 45.10 \text{ s}$$

$$\text{finish time} = 105.10 \text{ s}$$

Step 4: Calculate the total time taken to complete the lap

$$\text{total time} = \text{finish time} - \text{start time}$$

$$\text{total time} = 105.10 \text{ s} - 55.10 \text{ s}$$

$$\text{total time} = 50 \text{ s}$$

Question

A student wants to take a particularly accurate measurement of the volume of liquid in a measuring cylinder.

Which of the following procedures would make her measurement **less** accurate?

A. Putting her eyes level with the height of the measurement to be taken.

B. Reading the liquid level from the bottom of the meniscus.

C. Using the largest measuring cylinder she could find.

D. Using a set-square to make sure the cylinder is perfectly vertical.

Question

A student is timing the rate of cooling of a beaker of water. On a repeat run of the investigation, the student forgets to zero the stopwatch.

The readings on the stopwatch at the start time and the end time are shown in Fig. 1.1

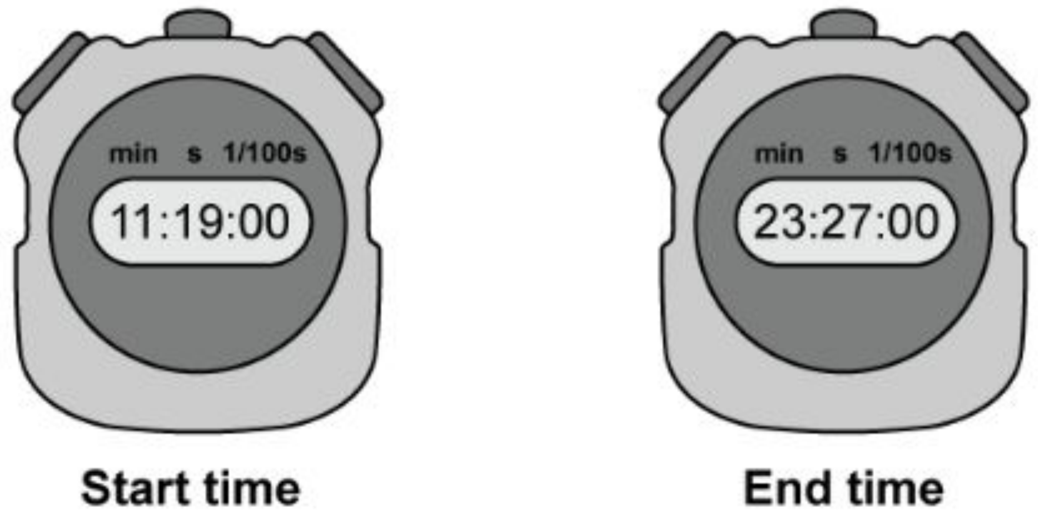


Fig. 1.1

Calculate how long it took the beaker to cool.

A. 11 minutes

B. 11 minutes and 8 seconds

C. 12 minutes

D. 12 minutes and 8 seconds

Question

A person wishes to roast a chicken. The chicken requires 1 hour and 20 minutes in the oven to be properly cooked.

The oven must be switched on 10 minutes before any food is put in, in order to pre-heat, and reach the correct temperature for cooking.

The chicken needs to be ready at 4:30 pm. At what time must the oven be switched on?

A. 2:10 pm

B. 3:10 pm

C. 2:00 pm

D. 3:00 pm

Worked example

Calculate the area of the triangles shown in Figure 1.1.4.

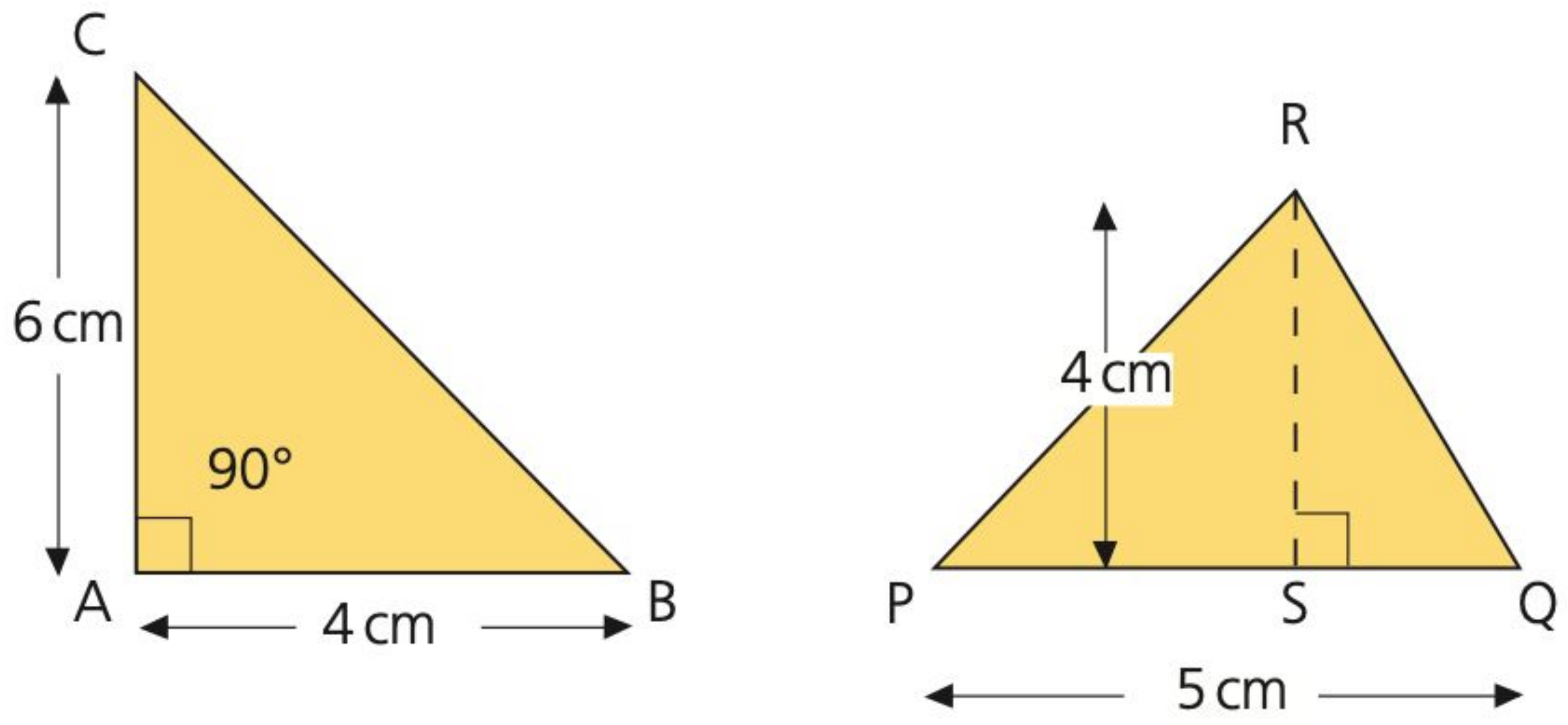
a area of triangle $= \frac{1}{2} \times \text{base} \times \text{height}$

so area of triangle ABC $= \frac{1}{2} \times \text{AB} \times \text{AC}$

$$= \frac{1}{2} \times 4\,\text{cm} \times 6\,\text{cm} = 12\,\text{cm}^2$$

b area of triangle PQR $= \frac{1}{2} \times \text{PQ} \times \text{SR}$

$$= \frac{1}{2} \times 5\,\text{cm} \times 4\,\text{cm} = 10\,\text{cm}^2$$



Worked example

a Calculate the volume of a block of wood which is 40 cm long, 12 cm wide and 5 cm high in cubic metres.

volume $V = \text{length} \times \text{breadth} \times \text{height}$

$$= 40\,\text{cm} \times 12\,\text{cm} \times 5\,\text{cm}$$

$$= 2400\,\text{cm}^3$$

$$= 2400 \times 10^{-6}\,\text{m}^3$$

$$= 2.4 \times 10^{-3}\,\text{m}^3$$

b Calculate the volume of a cylinder of radius 10 mm and height 5.0 cm in cubic metres.

volume of cylinder $V = \pi r^2 h$

$r = 10\,\text{mm} = 1.0\,\text{cm}$ and $h = 5.0\,\text{cm}$

so $V = \pi r^2 h$

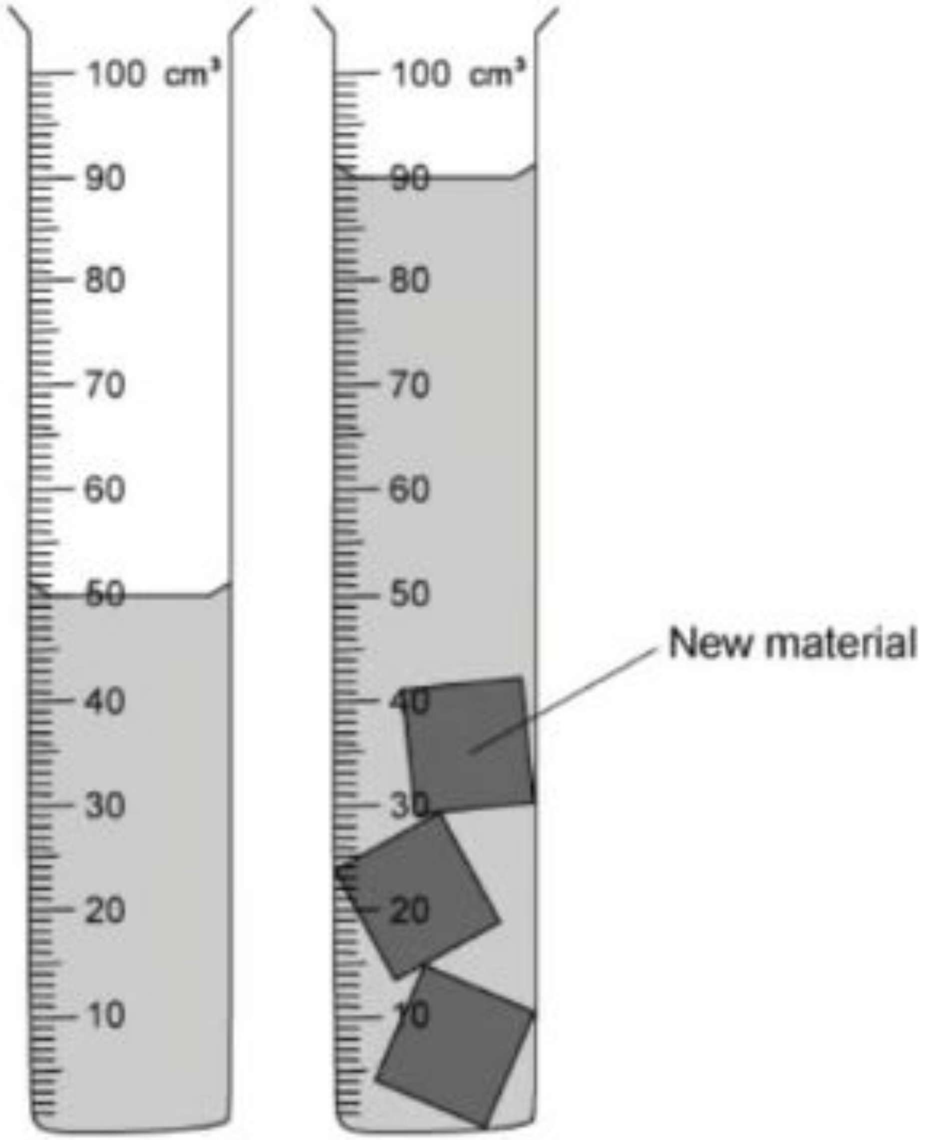
$$= \pi \times (1.0\,\text{cm})^2 \times 5.0\,\text{cm}$$

$$= 16\,\text{cm}^3 = 16 \times 10^{-6}\,\text{m}^3 = 1.6 \times 10^{-5}\,\text{m}^3$$

Question

A scientist is trying to determine the volume of three identical pieces of a new material. She places them in a measuring cylinder, as shown in the diagram.

The first cylinder shows the level of water in the measuring cylinder before the pieces are added, and the second cylinder shows the measuring cylinder with the pieces of the new material inside.



What is the volume of each piece of the new material?

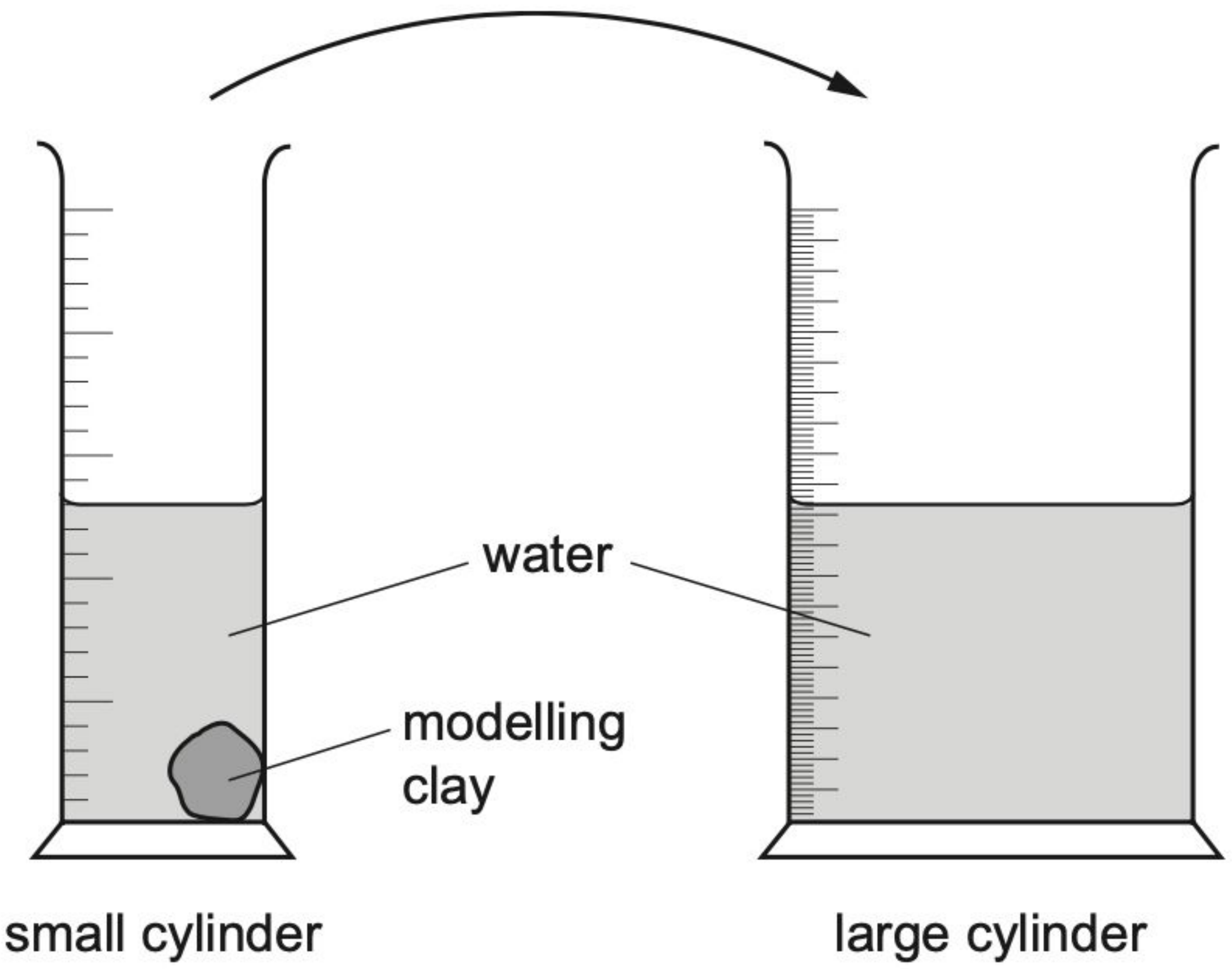
A. 30.0 cm^3

B. 13.3 cm^3

C. 16.7 cm^3

D. 40.0 cm^3

1 A lump of modelling clay is moved from a small measuring cylinder to a large measuring cylinder that has twice the diameter.



The reading on the small measuring cylinder goes down by 20 cm^3.

By how much does the reading on the large cylinder go up?

A 10 cm^3 **B** 20 cm^3 **C** 40 cm^3 **D** 80 cm^3

1 A student measures the diameter of some identical steel balls. Fig. 1.1 shows the arrangement she uses.

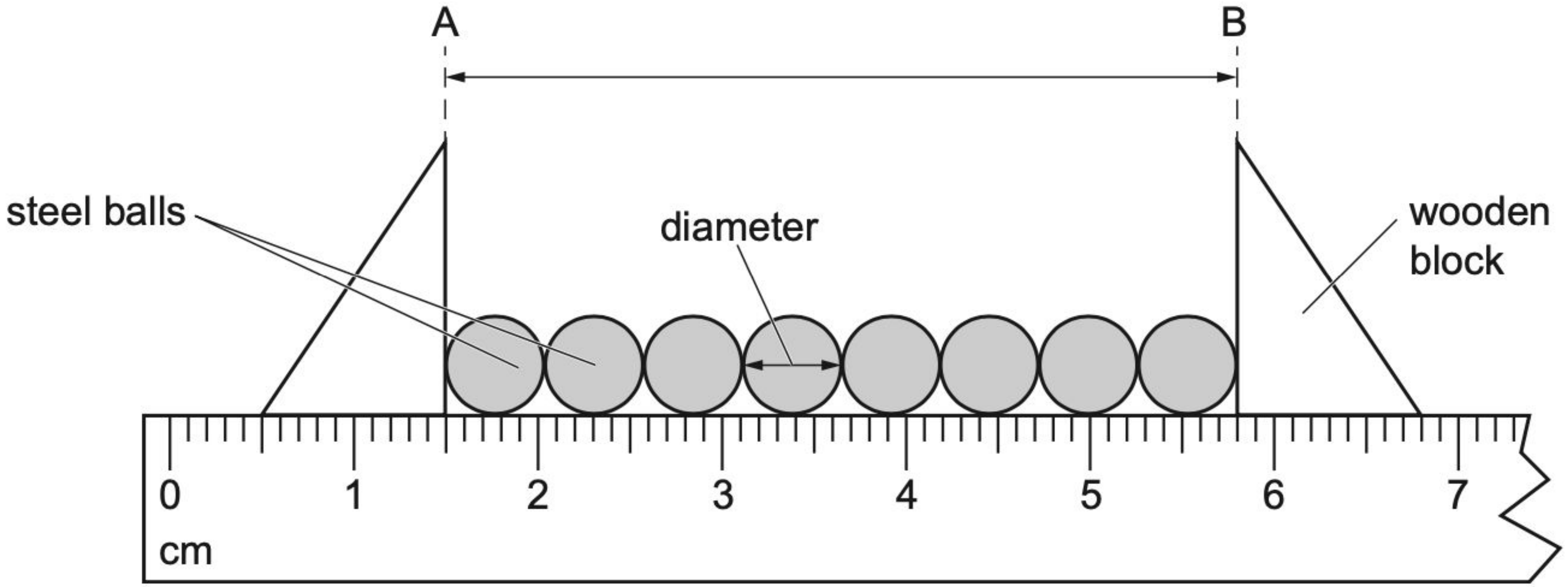


Fig. 1.1 (not to scale)

(a) **(i)** Using the ruler in Fig. 1.1, determine the distance AB on Fig. 1.1.

distance AB = ... cm [2]

(ii) Use the distance AB to determine the diameter of one steel ball.

diameter of one steel ball = ... cm [2]

1 Fig. 1.1 shows children about to run a race. They have to run 25 m, pick up a small plastic ring and run back to the base line. Each child finishes when they cross the base line holding the plastic ring.

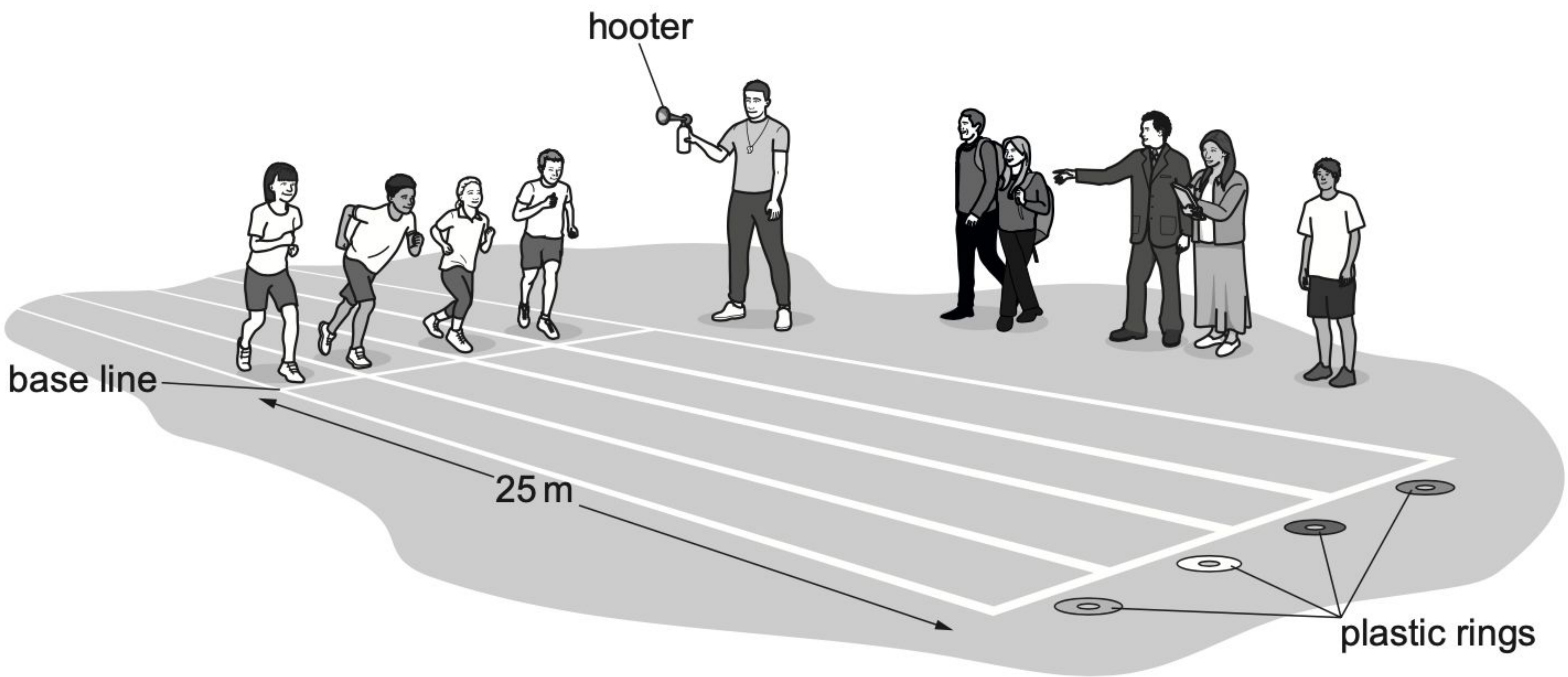


Fig. 1.1

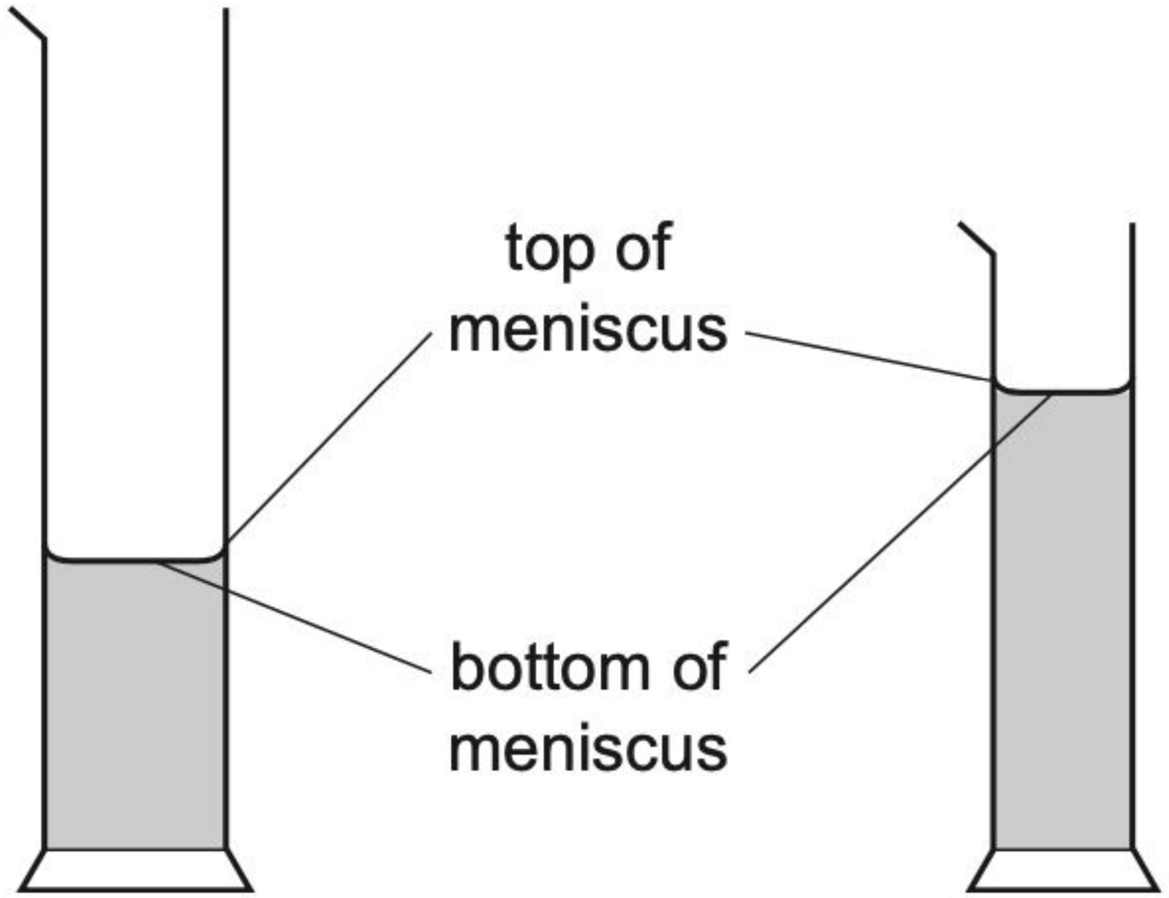
(a) **(i)** Suggest what equipment the teacher uses to measure the length of 25 m.

.... [1]

(ii) Determine the total distance for the race.

distance = ... m [1]

1 A student wishes to measure accurately the volume of approximately 40 cm^3 of water. She has two measuring cylinders, a larger one that can hold 100 cm^3, and a smaller one that can hold 50 cm^3. The water forms a meniscus where it touches the glass.



Which cylinder and which water level does the student use to ensure an accurate result?

	cylinder	water level
A	larger one	bottom of meniscus
B	larger one	top of meniscus
C	smaller one	bottom of meniscus
D	smaller one	top of meniscus

1 Fig. 1.1 shows a dripping tap and a measuring cylinder. The water drops all have the same volume. The drops fall from the tap at equal time intervals.

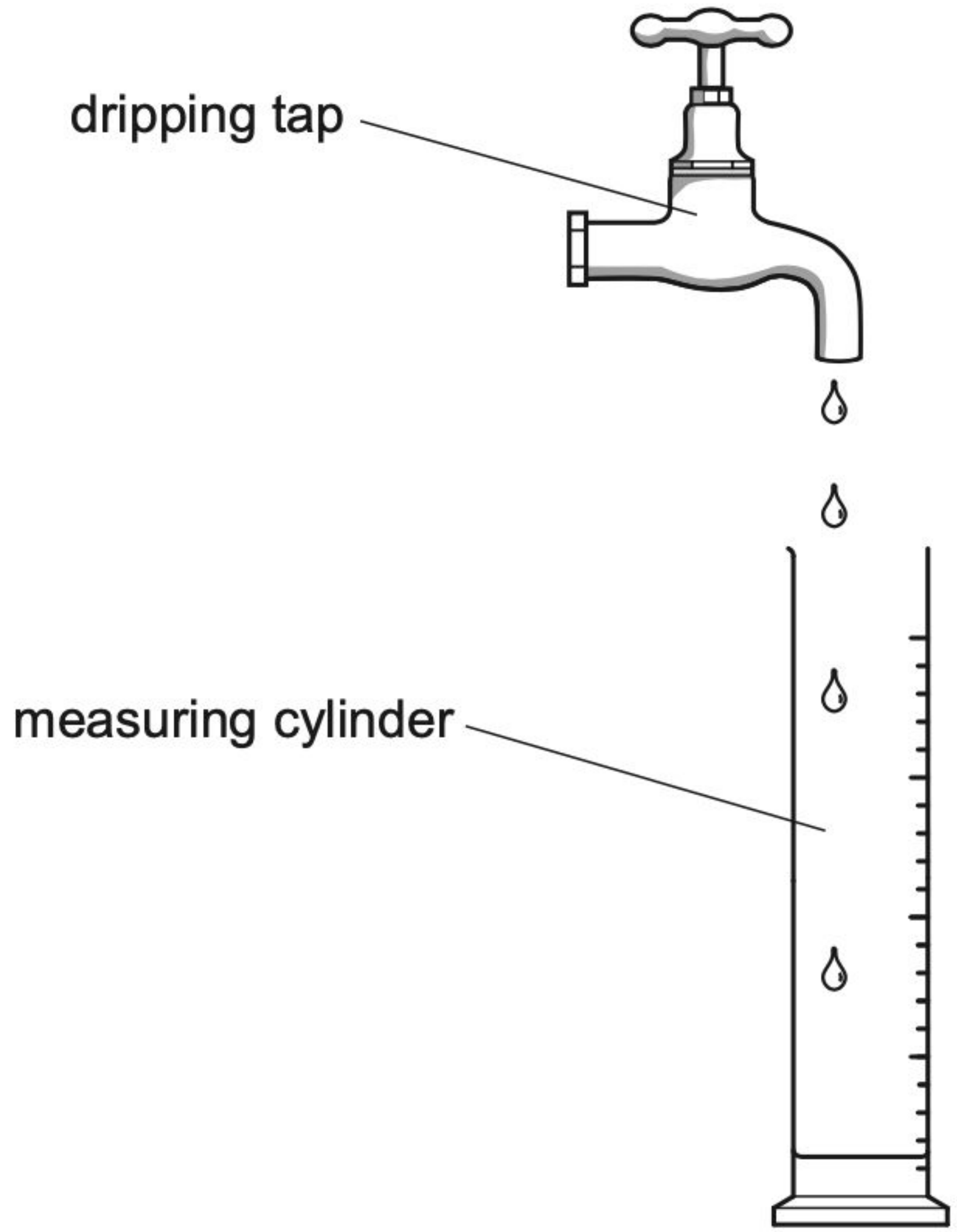
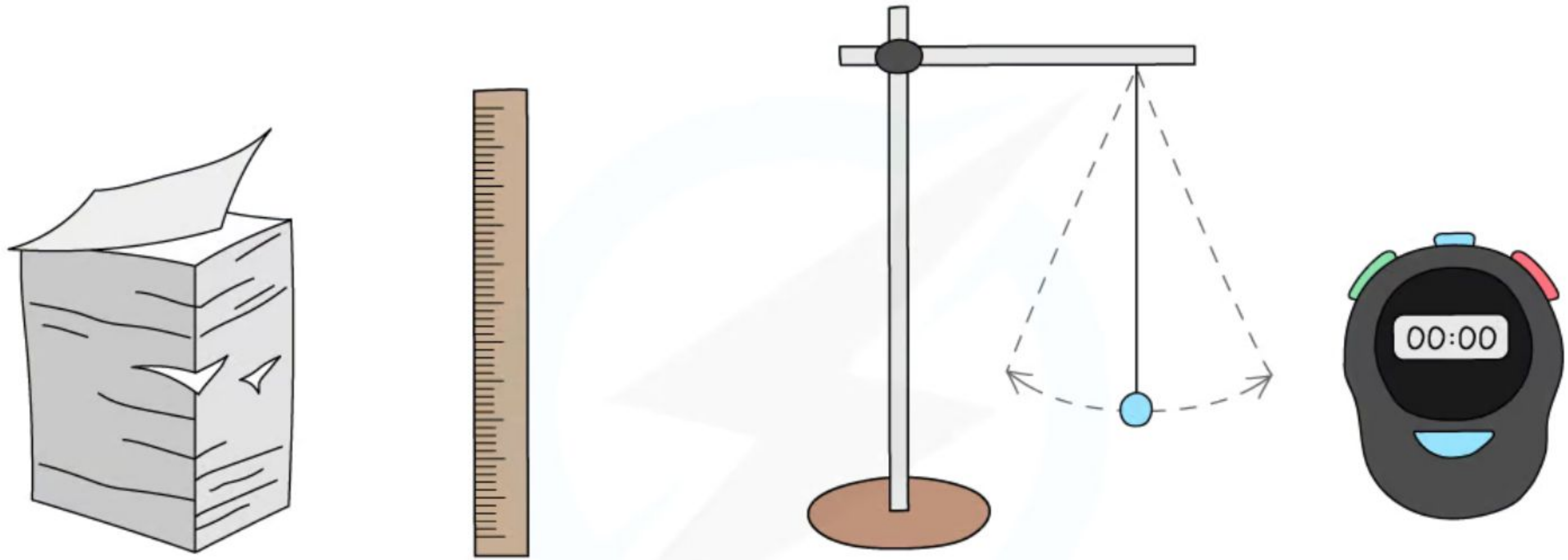


Fig. 1.1 (not to scale)

(a) **(i)** The student collects 200 of the drops in a measuring cylinder. The total volume collected is 60 cm^3.

Calculate the average volume of **one** drop of water.

Taking multiple measurements in physics



THICKNESS OF STACK ÷ NUMBER OF SHEETS = THICKNESS OF ONE SHEET

IF A STACK OF 100 SHEETS IS 23mm, THE THICKNESS OF ONE WILL BE 23 ÷ 100 = 0.23mm

TIME TAKEN FOR 10 SWINGS ÷ NUMBER OF SWINGS = TIME TAKEN FOR 1 SWING

IF THE TIME TAKEN FOR THE PENDULUM TO SWING 10 TIMES IS 15s, THE TIME FOR ONE SWING IS 1.5s

- The measurement of the thickness of a single sheet of paper is so small that it would be very difficult to get an **accurate** answer
    - However, measuring the thickness of **100 sheets** of paper can be done much more accurately
    - **Dividing** the answer by 100 then gives an accurate figure for the **average** thickness of **one sheet**

- Measuring the time period of a simple pendulum would incur a human reaction time error at the start of the measurement **and** at the end of the measurement
- If the measurement is small, the uncertainty in the measurement is huge
- Therefore, **multiple readings** can be taken to reduce the uncertainty of the measurement
    - The time taken for **10 swings** of the pendulum can be measured
    - **Dividing** the answer by 10 gives a more **accurate** figure for the **average** time taken for **one swing**

SUMMARY

Length can be measured using a ruler.
The period of one oscillation can be measured by measuring the time for 20 oscillations and then dividing the time by 20.
The volume of a cube or cuboid can be found by measuring the length of the three sides and multiplying the measurements together.
The volume of a liquid can be measured using a measuring cylinder where the bottom of the meniscus appears on the scale when looked at horizontally.
All objects that sink in water displace their own volume of water.
The volume of an irregularly shaped object can be found from the change in the height of liquid in a measuring cylinder when it is immersed in the liquid.
Density is the ratio of mass to volume for a substance: $\rho = \frac{m}{V}$.
The density of water is 1000 kg/m^3 or 1.0 g/cm^3.
Anything less dense than water will float in water and anything denser than water will sink in water.
Ice floats because it is less dense than water.
One liquid will float on top of another liquid if it is less dense.
Time can be measured using a clock or watch.
An analogue clock has hands and can only measure time to the nearest second.
A digital clock displays numbers and records time to a precision of at least one hundredth of a second.

Thank You