

VCE VM Numeracy Unit 1

Chapter 4 — Quantity and measures

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Chapter 4 Quantity and measures — 4A Metric units and one-step conversion

Theory

In the study design (Unit 1, Area of Study 3), the key knowledge here is the everyday metric units and how to change a measurement from one metric unit to another. The key skill is to make each change in a single step. The study design's examples are units of mass (grams, kilograms), capacity (millilitres, litres) and length (millimetres, centimetres, metres, kilometres), and degrees Celsius for temperature.

Source: VCAA, VCE Vocational Major Numeracy Study Design, retrieved 2026-10-09.

Chapter 1 already used these unit facts as a tool for estimating and checking. This section teaches them in full: what each metric unit is, how the units in a family fit together, and the one-step move that converts a measurement from one unit to another — every time, without guessing.

About the data in this section. The lengths, masses, capacities and temperatures in this section are **made up** (not real): pretend gardens, pretend canteens and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

Numbers need units. A *measurement* is a number and a *unit* said together. The unit is the thing you are counting: metres, kilograms, litres. On its own the number 2.4 means nothing at all. As 2.4 m it is a length a bit taller than a door; as 2.4 kg it is a mass like a big bag of flour; as 2.4 L it is a capacity like a large milk bottle. Same number, three completely different measurements. That is why every answer in this section is written with its unit attached.

The metric system. The *metric system* is the measuring system built on tens: each unit is 10, 100 or 1000 times the next one down. Almost every measurement you meet in Australia is metric. This section uses four families:

- **length** — how long or how far something is;
- **mass** — how heavy something is (how much stuff it holds);
- **capacity** — how much a container can hold;
- **temperature** — how hot or how cold something is.

The four families of metric units

LENGTH	MASS	CAPACITY	TEMPERATURE
how long, how far, how tall	how heavy something is	how much a container holds	how hot or how cold
mm cm m km	g kg	mL L	°C
a pencil (cm) a room (m) a drive (km)	a spoon of sugar (g) a person (kg)	a medicine dose (mL) a jug of milk (L)	the weather an oven your body

Every conversion in this book happens inside one family — never between families.

Each unit has a full name and a short form. The short form never takes a full stop and never takes a plural s: write 5 kg, not 5 kgs or 5kg. Always leave a space between the number and the unit: 35 km, 800 g, 250 mL.

Family	Units used in this section	Short forms
Length	millimetre, centimetre, metre, kilometre	mm, cm, m, km
Mass	gram, kilogram	g, kg
Capacity	millilitre, litre	mL, L
Temperature	degrees Celsius	°C

The names are built from word parts, and the parts tell you the size:

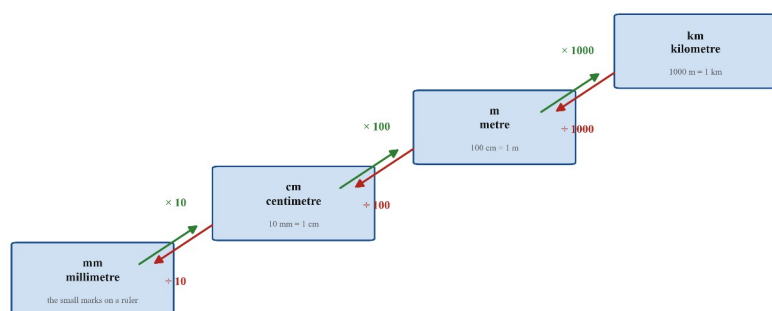
Word part	Means	Example
kilo-	1000	a kilometre is 1000 metres
centi-	one hundredth	a centimetre is one hundredth of a metre
milli-	one thousandth	a millimetre is one thousandth of a metre; a millilitre is one thousandth of a litre

The conversion facts. These six facts are the whole engine of metric conversion. Learn them as a set:

Family	Fact
Length	10 mm = 1 cm
Length	100 cm = 1 m
Length	1000 mm = 1 m
Length	1000 m = 1 km
Mass	1000 g = 1 kg
Capacity	1000 mL = 1 L

Every factor is 10, 100 or 1000 — never anything else. That is the gift of the metric system: converting a measurement is never hard multiplication, it is only moving digits along a place-value line.

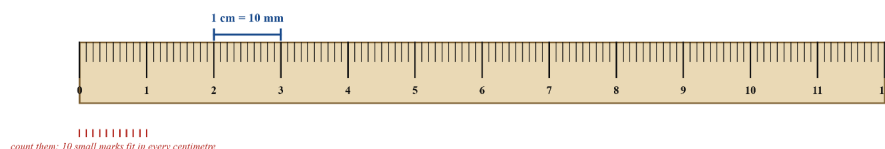
The length ladder: each step is one conversion



Going up (smaller unit → bigger unit): DIVIDE. Going down: MULTIPLY.
One step uses one factor: 10, 100 or 1000. (Two rungs at once, like m → mm, still use one factor: 1000 mm = 1 m.)

The ladder reads both ways. Climbing a rung to the right (m to cm, kg to g) packs the same amount into smaller units, so there are more of them: multiply. Coming back down (cm to m, g to kg) packs it into bigger units, so there are fewer: divide.

A ruler: the small marks are millimetres



On a ruler the fact 10 mm = 1 cm is there to see: ten small marks fit inside every centimetre.

Refresher: multiplying and dividing by 10, 100 and 1000. Because every conversion factor is 10, 100 or 1000, every conversion is one of these six moves. Multiplying shifts the digits left; dividing shifts them right. Empty places fill with 0s.

Calculation	Answer	What the digits did
3.6×10	36	moved one place left

Calculation	Answer	What the digits did
$45 \div 10$	4.5	moved one place right
0.45×100	45	moved two places left
2.4×100	240	moved two places left; a 0 fills the empty ones place
2.4×1000	2400	moved three places left; two 0s fill in
$750 \div 1000$	0.75	moved three places right; a 0 goes in front of the point

Digits shift: multiplying moves them left, dividing moves them right

$$2.4 \times 100$$



digits move two places left - the empty ones place fills with a 0

$$750 \div 1000$$



digits move three places right - a 0 goes in front of the decimal point

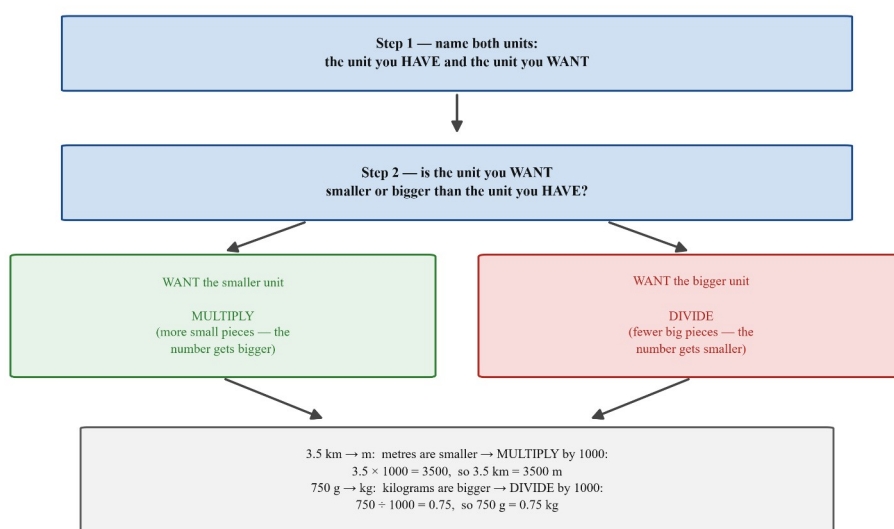
Every metric conversion is one of these two moves — by 10 (one place), 100 (two places) or 1000 (three places).

The direction rule. One line decides multiply or divide, and it is the same line every time:

Big to small, multiply. Small to big, divide.

Converting into a *smaller* unit means you need *more* of them, so multiply. Converting into a *bigger* unit means you need *fewer*, so divide. The factor comes straight from the facts table: 10, 100 or 1000, whichever joins the two units you are moving between.

Which way? Multiply or divide



Step 3 — size-check your answer:

smaller unit → bigger number · bigger unit → smaller number

Big to small, multiply. Small to big, divide.

Two models of the rule in action:

- **3.5 km to metres.** Kilometres are bigger than metres, so this is big to small: multiply. The factor joining km and m is 1000. $3.5 \times 1000 = 3500$, so $3.5 \text{ km} = 3500 \text{ m}$. Size check: the smaller unit gave the bigger number (3500 is bigger than 3.5), as it must.
- **750 g to kilograms.** Grams are smaller than kilograms, so this is small to big: divide. The factor joining g and kg is 1000. $750 \div 1000 = 0.75$, so $750 \text{ g} = 0.75 \text{ kg}$. Size check: the bigger unit gave the smaller number (0.75 is smaller than 750), as it must.

The size check is your free error-catcher. If you convert to a smaller unit and the number gets smaller, you divided when you should have multiplied — and the check tells you so before anyone marks it.

Refresher: what the decimal places mean in a measurement. Decimals in a bigger unit are usually tidy whole numbers in a smaller unit, because the first decimal place is tenths and the second is hundredths:

Measurement	Means
0.1 kg	100 g (one tenth of a kilogram)
0.01 kg	10 g (one hundredth of a kilogram)
0.1 L	100 mL
0.01 L	10 mL
0.1 m	10 cm
0.01 m	1 cm

So 0.75 kg is not a strange amount: it is 750 g, three quarters of a kilogram.

Decimals and mixed units. The same mass or length can be written two ways — as a decimal in the bigger unit, or as a mixed amount in both units. Both are correct; jobs and recipes use both:

- $1.5 \text{ kg} = 1500 \text{ g} = 1 \text{ kg } 500 \text{ g}$
- $2.05 \text{ kg} = 2050 \text{ g} = 2 \text{ kg } 50 \text{ g}$ (watch the inside zero: 0.05 kg is 50 g, not 500 g)
- $13.7 \text{ cm} = 137 \text{ mm} = 13 \text{ cm } 7 \text{ mm}$
- $1.25 \text{ L} = 1250 \text{ mL} = 1 \text{ L } 250 \text{ mL}$

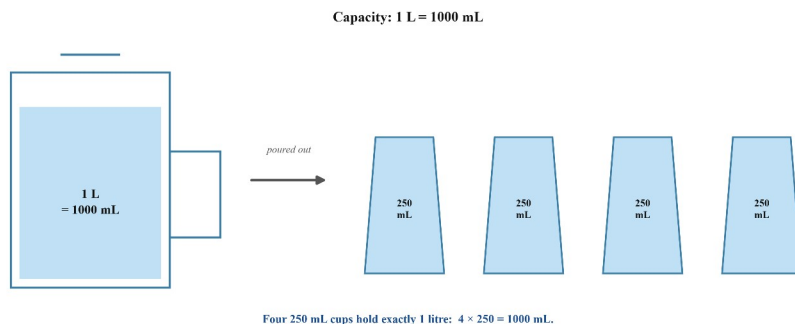
The same mass, two ways of writing it



$1.5 \text{ kg} = 1500 \text{ g}$ (kg $\rightarrow$ g is bigger-to-smaller: multiply by 1000)

The bag says 1.5 kg and the scale says 1500 g. Neither is wrong: $1.5 \times 1000 = 1500$, so they are the same mass written in two units.

Capacity in everyday life. Capacity answers often come in cups and jugs, so this fact is worth knowing cold: a standard drinking cup holds about 250 mL, and four of them fill a 1 L jug exactly, because $4 \times 250 = 1000 \text{ mL}$ and $1000 \text{ mL} = 1 \text{ L}$.

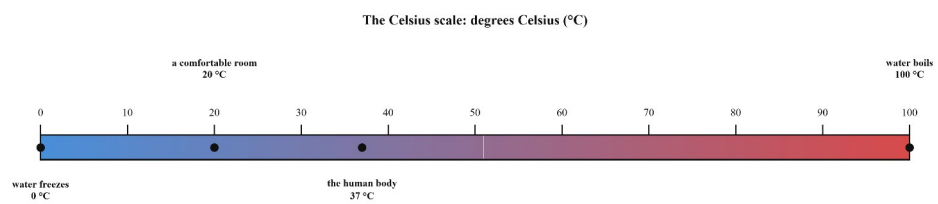


Refresher: dividing by numbers like 250 and 500. Cup-and-bottle questions divide by 250 or 500 rather than by 10, 100 or 1000. Count how many of them make 1000 and the division follows: four 250s make 1000, so $1000 \div 250 = 4$; then $2000 \div 250 = 8$ (two lots of four), and $1000 \div 500 = 2$ (two 500s make 1000).

Choosing a sensible unit. Part of knowing units is picking the one that fits the job. A sensible unit gives a number that is easy to say: nobody measures a room in millimetres or a drive between towns in metres.

Thing being measured	Sensible unit
length of a pencil	cm
length of a room	m
a drive between towns	km
thickness of a phone	mm
a spoon of medicine	mL
a jug of cordial	L
mass of an apple	g
mass of a person	kg
warmth of a room	°C

Temperature: degrees Celsius. The metric unit of temperature is the **degree Celsius**, short form °C. It is written after the number with a space — 23 °C — and said “twenty-three degrees Celsius”. Four markers fix the scale in your head: water freezes at 0 °C, a comfortable room sits near 20 °C, the human body sits near 37 °C, and water boils at 100 °C.



Temperatures are written with the unit after the number: 23 °C is said “twenty-three degrees Celsius”.

Temperature does not convert into another metric unit in this section; instead it rises and falls, and a one-step rise or fall is one addition or subtraction. A morning at 18 °C that rises 5 degrees reaches $18 + 5 = 23$, so 23 °C. If it then falls 6 degrees it sits at $23 - 6 = 17$, so 17 °C.

One step, every time. Every conversion in this section is one step. Run the same four moves:

1. **Name the two units** — the unit you have and the unit you want.
2. **Decide the direction** — bigger to smaller (multiply) or smaller to bigger (divide).
3. **Take the factor** from the facts table: 10, 100 or 1000.
4. **Multiply or divide, then size-check** — a smaller unit must give a bigger number, a bigger unit must give a smaller number.

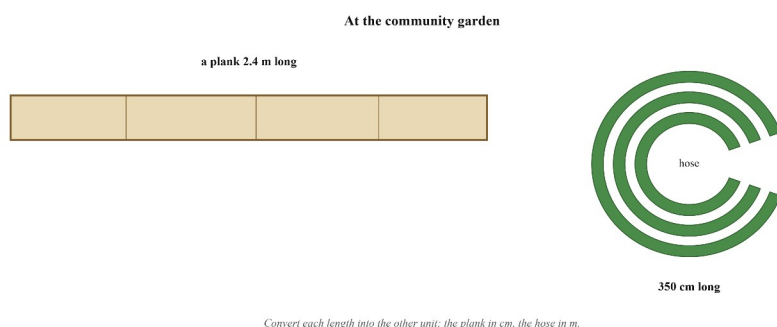
Key ideas.

- A measurement is a number *and* a unit; the short form takes no full stop and no plural s, and a space sits between number and unit.
- The four families: length (mm, cm, m, km), mass (g, kg), capacity (mL, L), temperature (°C).
- The six facts: 10 mm = 1 cm, 100 cm = 1 m, 1000 mm = 1 m, 1000 m = 1 km, 1000 g = 1 kg, 1000 mL = 1 L.
- Big to small, multiply; small to big, divide — by 10, 100 or 1000, so the digits only shift places.
- Size-check every answer: smaller unit, bigger number; bigger unit, smaller number.
- Temperatures in °C rise by adding and fall by subtracting, one step at a time.

Worked examples

Example 1 — scaffolded

The working bee at the community garden has two jobs to measure up.



- (a) A plank measures 2.4 m. Write its length in centimetres.
- (b) The old hose measures 350 cm. Write its length in metres.

Working

Comment

(a) Units: m to cm. A metre is bigger than a centimetre, so big to small: multiply.

The direction rule comes first, before any arithmetic.

Factor: 100 cm in 1 m. $2.4 \times 100 = 240$. The plank is **240 cm** long.

The factor comes straight from the facts table.

Size check: cm is the smaller unit and 240 is bigger than 2.4. ✓

Smaller unit, bigger number.

(b) Units: cm to m. A centimetre is smaller than a metre, so small to big: divide.

Same rule, other direction.

$350 \div 100 = 3.5$. The hose is **3.5 m** long.

Dividing by 100 moves the digits two places right.

Size check: m is the bigger unit and 3.5 is smaller than 350. ✓

The check would have caught a multiply here.

The 2.4 m plank is 240 cm long, and the 350 cm hose is 3.5 m long — the same two lengths, written in the unit each job asked for.

Example 2 — scaffolded

The canteen kitchen takes a delivery: a sack of potatoes labelled 3.6 kg, and a milk urn labelled 4500 mL.

- (a) Write the mass of the potato sack in grams.
- (b) Write the capacity of the milk urn in litres.

Working	Comment
(a) Units: kg to g. A kilogram is bigger than a gram, so big to small: multiply. Factor: 1000 g in 1 kg. $3.6 \times 1000 = 3600$. The sack is 3600 g. Size check: g is the smaller unit and 3600 is bigger than 3.6. ✓	Direction first. Multiplying by 1000 moves the digits three places left. Smaller unit, bigger number.
(b) Units: mL to L. A millilitre is smaller than a litre, so small to big: divide. $4500 \div 1000 = 4.5$. The urn holds 4.5 L. Size check: L is the bigger unit and 4.5 is smaller than 4500. ✓	Other direction, same rule. Dividing by 1000 moves the digits three places right. Bigger unit, smaller number.

The sack holds 3600 g of potatoes and the urn holds 4.5 L of milk. Notice the 0 that fills in on the way: 3.6 becomes 3600, not 36.

Example 3 — unscaffolded

A bakery shelf holds two loaves of the same bread with different labels: one reads 900 g, the other reads 1 kg. Which loaf is heavier, and by how many grams?

Which loaf is heavier? By how many grams?



One label is in grams. The other is in kilograms. Convert, then compare.

Solution. The labels are in different units, so compare them in one unit. The question asks for grams, so convert 1 kg into grams. Kilograms are bigger than grams — big to small, multiply — and the factor is 1000: $1 \times 1000 = 1000$, so $1 \text{ kg} = 1000 \text{ g}$.

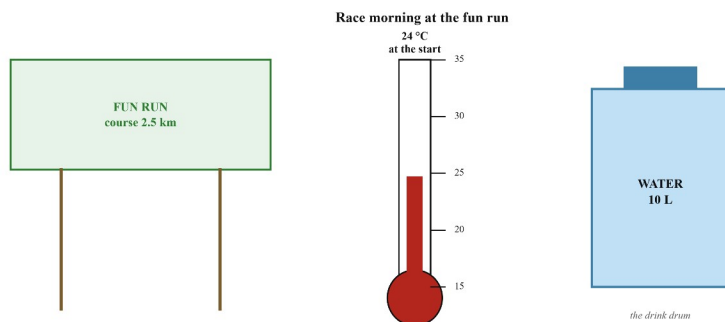
Now both labels are in grams: 1000 g against 900 g. 1000 is bigger than 900, so the 1 kg loaf is the heavier one.

The difference is $1000 - 900 = 100 \text{ g}$.

∴ The 1 kg loaf is heavier, by 100 g. Size check on the conversion: grams are the smaller unit and 1000 is bigger than 1, as it should be.

Example 4 — unscaffolded

Race morning at the fun run. The course sign reads 2.5 km, the thermometer at the start reads 24 °C, and the drinks drum at the finish holds 10 L of water.



- (a) The course markers are placed every 100 m. Write the course length in metres.
- (b) By midday the temperature has risen 7 degrees from the start. What is the midday temperature?
- (c) The equipment sheet records all capacities in millilitres. Write the drum's capacity in millilitres.

Solution. (a) Units: km to m, big to small, multiply. The factor joining km and m is 1000: $2.5 \times 1000 = 2500$. The course is 2500 m long, so 25 markers at every 100 m. Size check: metres are smaller and 2500 is bigger than 2.5. ✓

(b) A rise is an addition: $24 + 7 = 31$. The midday temperature is 31 °C.

(c) Units: L to mL, big to small, multiply. The factor joining L and mL is 1000: $10 \times 1000 = 10\,000$. The drum holds 10 000 mL. Size check: millilitres are smaller and 10 000 is bigger than 10. ✓

∴ The course is 2500 m long, the midday temperature is 31 °C, and the drum holds 10 000 mL of water.

Practice questions

Scaffolded

For Q1–Q6, use the facts table and the direction rule from the theory: name the two units, decide multiply or divide, shift the digits, then run the size check.

Q1. Write the missing number in each fact.

- (a) 1 m = ... cm
- (b) 1 kg = ... g
- (c) 1 L = ... mL

Q2. Write the missing number in each fact.

- (a) 1 km = ... m
- (b) 1 cm = ... mm
- (c) 1 m = ... mm

Q3. Convert into the smaller unit.

- (a) 5 m to cm
- (b) 6 kg to g
- (c) 3 L to mL

Q4. Convert into the bigger unit.

- (a) 70 mm to cm
- (b) 4000 g to kg
- (c) 900 mL to L

Q5. Convert, watching the decimal point.

- (a) 2.5 m to cm
- (b) 1.4 kg to g
- (c) 0.75 L to mL

Q6. A packet of rice is labelled 2.05 kg.

- (a) Show that $2.05 \text{ kg} = 2050 \text{ g}$.
- (b) Write the mass in kilograms and grams together (mixed units).
- (c) Write 2050 g as a decimal number of kilograms.

Unscaffolded

Q7–Q18 are whole questions, the way they arrive in real jobs: choose the method yourself. Every conversion is still one step.

Q7. Choose the more sensible metric unit for each measurement and write its short form.

- (a) the length of a classroom
- (b) the mass of an apple
- (c) the capacity of a spoon of medicine
- (d) the distance between two towns
- (e) the capacity of a jug of cordial
- (f) the warmth of a room

Q8. Convert each length.

- (a) 7 m to cm
- (b) 3.5 km to m
- (c) 24 cm to mm

Q9. Convert each length.

- (a) 60 mm to cm
- (b) 450 cm to m
- (c) 2500 m to km

Q10. At the deli counter:

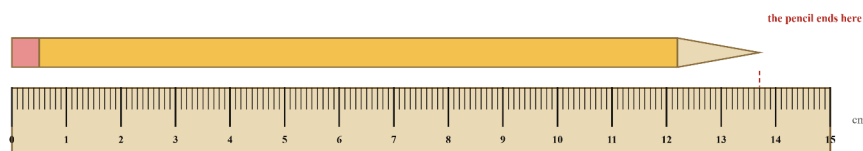
- (a) a cheese wheel weighs 2.35 kg — write its mass in grams;
- (b) a salami weighs 850 g — write its mass in kilograms;
- (c) a pumpkin weighs 5 kg — write its mass in grams.

Q11. In the canteen:

- (a) a tea urn holds 4.6 L — write its capacity in millilitres;
- (b) a juice box holds 350 mL — write its capacity in litres;
- (c) a drink bottle holds 1.25 L — write its capacity in millilitres.

Q12. A pencil is measured on a ruler.

A pencil measured on a ruler



It starts at 0. The end sits 7 small mm marks past the 13 cm mark.

- (a) Write the length of the pencil in millimetres.
- (b) Write the length of the pencil in centimetres.
- (c) A second pencil measures 210 mm. Write its length in centimetres.

Q13. Two ropes lie on the floor of a workshop. One is labelled 2.4 m, the other 235 cm.

- (a) Write 2.4 m in centimetres.
- (b) Which rope is longer?
- (c) How many centimetres longer is it?

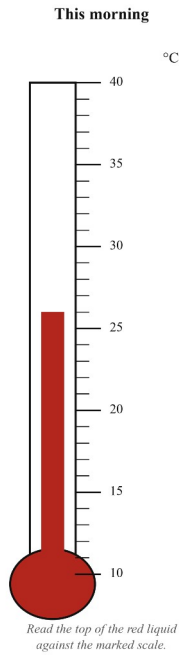
Q14. Baking day at the canteen:

- (a) a bag of flour weighs 1.5 kg — write its mass in grams;
- (b) a recipe asks for 1 kg 250 g of flour — write this mass in grams only;
- (c) write 1250 g as a decimal number of kilograms.

Q15. A jug holds 2 L of cordial. Each cup holds 250 mL.

- (a) Write the jug's capacity in millilitres.
- (b) How many full cups can be poured from the jug?

Q16. The thermometer outside the workshop reads the morning temperature.



- (a) Read the morning temperature from the thermometer.
- (b) By evening the temperature has fallen 9 degrees from the morning reading. What is the evening temperature?
- (c) Write “twenty-three degrees Celsius” using a number and the short form of the unit.

Q17. Tom converts 4500 mL to litres and writes 45 L.

- (a) Is Tom correct?
- (b) Explain what went wrong.
- (c) Write the correct answer.

Q18. The fete stall is being set up.

- (a) The bunting along the stall is 3.6 m long — write its length in centimetres.
- (b) A container of cordial holds 1.9 L — write its capacity in millilitres.
- (c) A bag of flour weighs 2.05 kg — write its mass in grams.
- (d) The stall has 1 kg of sugar and 950 g of sultanas. Which is heavier, and by how many grams?

Answers

Q1. (a) 100 (b) 1000 (c) 1000 **Q2.** (a) 1000 (b) 10 (c) 1000 **Q3.** (a) 500 cm (b) 6000 g (c) 3000 mL **Q4.** (a) 7 cm (b) 4 kg (c) 0.9 L **Q5.** (a) 250 cm (b) 1400 g (c) 750 mL **Q6.** (a) $2.05 \times 1000 = 2050$, so $2.05 \text{ kg} = 2050 \text{ g}$ (b) 2 kg 50 g (c) 2.05 kg **Q7.** (a) m (b) g (c) mL (d) km (e) L (f) °C **Q8.** (a) 700 cm (b) 3500 m (c) 240 mm **Q9.** (a) 6 cm (b) 4.5 m (c) 2.5 km **Q10.** (a) 2350 g (b) 0.85 kg (c) 5000 g **Q11.** (a) 4600 mL (b) 0.35 L (c) 1250 mL **Q12.** (a) 137 mm (b) 13.7 cm (c) 21 cm **Q13.** (a) 240 cm (b) the 2.4 m rope (c) 5 cm **Q14.** (a) 1500 g (b) 1250 g (c) 1.25 kg **Q15.** (a) 2000 mL (b) 8 cups **Q16.** (a) 26 °C (b) 17 °C (c) 23 °C **Q17.** (a) no (b) he divided by 100 instead of 1000 (c) 4.5 L **Q18.** (a) 360 cm (b) 1900 mL (c) 2050 g (d) the sugar, by 50 g

Fully-worked solutions

Q1. These are facts from the table: (a) 100 cm in 1 m. (b) 1000 g in 1 kg. (c) 1000 mL in 1 L.

Q2. (a) 1000 m in 1 km. (b) 10 mm in 1 cm. (c) 1000 mm in 1 m (ten mm in each of the 100 cm).

Q3. All three are big to small, so multiply. (a) m to cm, factor 100: $5 \times 100 = 500 \text{ cm}$. (b) kg to g, factor 1000: $6 \times 1000 = 6000 \text{ g}$. (c) L to mL, factor 1000: $3 \times 1000 = 3000 \text{ mL}$. Size check each time: smaller unit, bigger number. ✓

Q4. All three are small to big, so divide. (a) mm to cm, factor 10: $70 \div 10 = 7 \text{ cm}$. (b) g to kg, factor 1000: $4000 \div 1000 = 4 \text{ kg}$. (c) mL to L, factor 1000: $900 \div 1000 = 0.9 \text{ L}$. Size check: bigger unit, smaller number — 0.9 is smaller than 900. ✓

Q5. Same moves, decimal starting points. (a) m to cm, multiply by 100: $2.5 \times 100 = 250 \text{ cm}$. (b) kg to g, multiply by 1000: $1.4 \times 1000 = 1400 \text{ g}$. (c) L to mL, multiply by 1000: $0.75 \times 1000 = 750 \text{ mL}$. In (c) the digits 7 and 5 move three places left and a 0 fills the ones place.

Q6. (a) kg to g is big to small, factor 1000: $2.05 \times 1000 = 2050$, so $2.05 \text{ kg} = 2050 \text{ g}$. (b) 2050 g splits into 2000 g + 50 g, and $2000 \text{ g} = 2 \text{ kg}$, so the mixed form is 2 kg 50 g. (c) g to kg is small to big, factor 1000: $2050 \div 1000 = 2.05 \text{ kg}$ — back where (a) started, which is the check that both directions agree.

Q7. (a) A classroom is a few metres long: m. (b) An apple is a few hundred grams: g. (c) A spoon of medicine is a few millilitres: mL. (d) Towns are many kilometres apart: km. (e) A jug of cordial is a litre or two: L. (f) Warmth is measured in degrees Celsius: °C. A sensible unit keeps the number easy to say.

Q8. All big to small, multiply. (a) m to cm, factor 100: $7 \times 100 = 700 \text{ cm}$. (b) km to m, factor 1000: $3.5 \times 1000 = 3500 \text{ m}$. (c) cm to mm, factor 10: $24 \times 10 = 240 \text{ mm}$. Each answer is a bigger number than it started as, as the size check requires.

Q9. All small to big, divide. (a) mm to cm, factor 10: $60 \div 10 = 6 \text{ cm}$. (b) cm to m, factor 100: $450 \div 100 = 4.5 \text{ m}$. (c) m to km, factor 1000: $2500 \div 1000 = 2.5 \text{ km}$. Each answer is a smaller number than it started as. ✓

Q10. (a) kg to g, multiply by 1000: $2.35 \times 1000 = 2350 \text{ g}$. (b) g to kg, divide by 1000: $850 \div 1000 = 0.85 \text{ kg}$. (c) kg to g, multiply by 1000: $5 \times 1000 = 5000 \text{ g}$. Size checks: (a) and (c) grew, (b) shrank — matching the unit sizes.

Q11. (a) L to mL, multiply by 1000: $4.6 \times 1000 = 4600 \text{ mL}$. (b) mL to L, divide by 1000: $350 \div 1000 = 0.35 \text{ L}$. (c) L to mL, multiply by 1000: $1.25 \times 1000 = 1250 \text{ mL}$. The 0 in front of the point in (b) is the placeholder: 0.35, not .35.

Q12. (a) The pencil runs from 0 to the 13 cm mark plus 7 more small marks. $13 \text{ cm} = 130 \text{ mm}$, and $130 + 7 = 137$, so the pencil is 137 mm long. (b) mm to cm, divide by 10: $137 \div 10 = 13.7 \text{ cm}$. (c) mm to cm, divide by 10: $210 \div 10 = 21 \text{ cm}$.

Q13. (a) m to cm, multiply by 100: $2.4 \times 100 = 240 \text{ cm}$. (b) In the same unit the ropes are 240 cm and 235 cm, and 240 is bigger, so the 2.4 m rope is longer. (c) $240 - 235 = 5 \text{ cm}$ longer. Converting first is the only safe way to compare — 2.4 looks smaller than 235 until both wear the same unit.

Q14. (a) kg to g, multiply by 1000: $1.5 \times 1000 = 1500 \text{ g}$. (b) $1 \text{ kg} = 1000 \text{ g}$, so $1 \text{ kg } 250 \text{ g}$ is $1000 + 250 = 1250 \text{ g}$. (c) g to kg, divide by 1000: $1250 \div 1000 = 1.25 \text{ kg}$. (b) and (c) are the same mass written both ways, so each checks the other.

Q15. (a) L to mL, multiply by 1000: $2 \times 1000 = 2000$ mL. (b) Each cup takes 250 mL, so count 250s in 2000: $2000 \div 250 = 8$ full cups. Check: $8 \times 250 = 2000$ mL, the whole jug, with nothing left over.

Q16. (a) The scale is marked every 5 degrees with small marks 1 degree apart. The top of the red liquid sits one small mark above 25, so the morning temperature is 26 °C. (b) A fall is a subtraction: $26 - 9 = 17$, so the evening temperature is 17 °C. (c) Twenty-three degrees Celsius writes as 23 °C — the number first, a space, then the short form.

Q17. (a) No. (b) Tom divided by 100: $4500 \div 100 = 45$. But mL to L is small to big with a factor of 1000, not 100 — his answer is 10 times too big. The size check should have warned him: litres are bigger than millilitres, so the number must shrink a lot, and 4500 to 45 is not the right shrink. (c) $4500 \div 1000 = 4.5$, so 4500 mL = 4.5 L.

Q18. (a) m to cm, multiply by 100: $3.6 \times 100 = 360$ cm. (b) L to mL, multiply by 1000: $1.9 \times 1000 = 1900$ mL. (c) kg to g, multiply by 1000: $2.05 \times 1000 = 2050$ g. (d) Compare in grams: 1 kg = 1000 g against 950 g. 1000 is bigger, so the sugar is heavier, by $1000 - 950 = 50$ g.

Chapter 4 Quantity and measures — 4B Perimeter and area of rectangles

About the data in this section. The plans, job sheets and measurements here are **made up** (not real): pretend job sites and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

Theory

Two questions about every flat surface.

Every job that touches a flat surface asks one of two questions: how much goes *around* it, or how much *covers* it? You buy fencing, edging, trim or tape to go around an edge. You buy turf, tiles, felt, carpet or paint to cover a surface. These two measurements have their own names: **perimeter** and **area**. Getting the wrong one means ordering the wrong thing — tape when you needed felt, or felt when you needed tape.

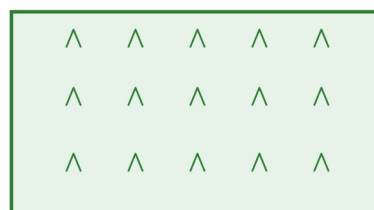
PERIMETER



the fence goes AROUND the edge

measured in length units (m, cm)

AREA



the grass COVERS the surface

measured in square units (m², cm²)

Length and distance.

A **length** is how long something is from one end to the other. A **distance** is the length between two places. Both are measured with a tape measure or a ruler (Section 1E), in metric units: millimetres (mm), centimetres (cm), metres (m) and kilometres (km). Perimeter is a distance, so it uses these units too.

Refresher: one-step metric length conversions. Changing between neighbouring units is one step (Section 4A). Multiply to go to a smaller unit, divide to go to a bigger one.

Change	Do this	Example
m → cm	× 100	2.5 m = 250 cm
cm → mm	× 10	4 cm = 40 mm
m → km	÷ 1000	1500 m = 1.5 km
mm → cm	÷ 10	30 mm = 3 cm
cm → m	÷ 100	80 cm = 0.8 m

Perimeter — the distance around the outside.

The **perimeter** of a shape is the total distance around its outside. Picture walking around the edge of a park and back to the gate where you started: the distance you walked is the perimeter. For any shape, the rule is the same — add up the lengths of all the sides.

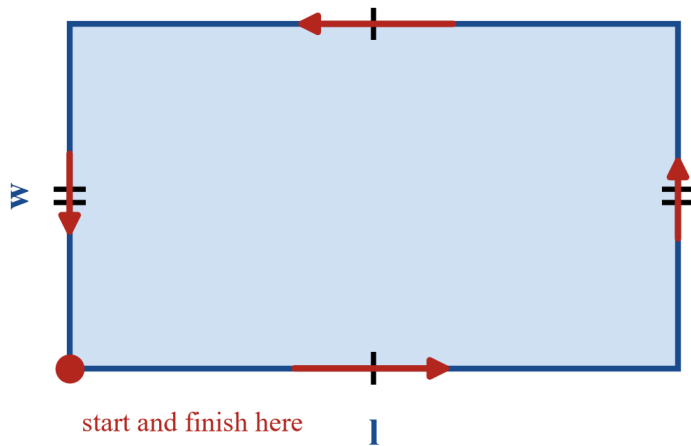
A rectangle makes this easy. Its opposite sides are equal (Section 3A), so the length l appears twice and the width w appears twice:

$$P = l + w + l + w = 2 \times (l + w)$$

Here P is the perimeter, l is the length and w is the width. For a square, all four sides are the same length s , so:

$$P = s + s + s + s = 4 \times s$$

The walk around the edge is the perimeter.



$$P = l + w + l + w = 2 \times (l + w)$$

Worked model. A rectangle is 12 cm long and 4 cm wide. Then $l + w = 12 + 4 = 16$, and $P = 2 \times 16 = 32$, so the perimeter is 32 cm. The units of a perimeter are the same units as the sides you added.

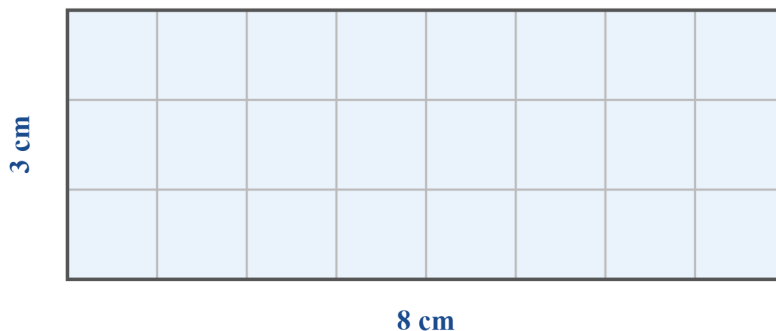
Finding a missing side. Because $P = 2 \times (l + w)$, half of the perimeter is exactly $l + w$. So $P \div 2$ gives the length and width added together, and taking away the side you know leaves the side you do not. For the rectangle above, $32 \div 2 = 16$, and $16 - 12 = 4$ cm — the width, just as the plan said.

Area — the amount of surface covered.

The **area** of a shape is the amount of flat surface it covers. Area is measured in **square units**. A square that is 1 cm by 1 cm covers one **square centimetre**, written 1 cm^2 (say “one square centimetre”). A square that is 1 m by 1 m covers 1 m^2 . The little ^{2} is the sign that a measurement is an area, not a length.

One way to find an area is to count square units on grid paper.

A rectangle 8 cm by 3 cm on grid paper

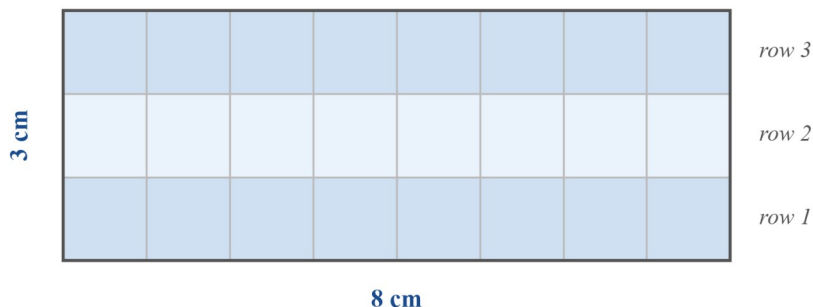


Each small square is 1 cm by 1 cm — its area is 1 cm^2 .

Count the squares: 24 squares, so the area is 24 cm^2 .

Counting every square works, but there is a faster way. Look at the same rectangle as rows: it is 3 rows of 8 squares. Counting rows is multiplying:

The same rectangle counted by rows



3 rows of 8 squares: $3 \times 8 = 24$ squares = 24 cm^2

Counting rows is multiplying: $A = l \times w$

That is where the rectangle area rule comes from — the number of squares in a row is the length, and the number of rows is the width:

$$A = l \times w$$

Here A is the area. For a square with side s , the rows and the squares in each row are both s :

$$A = s \times s$$

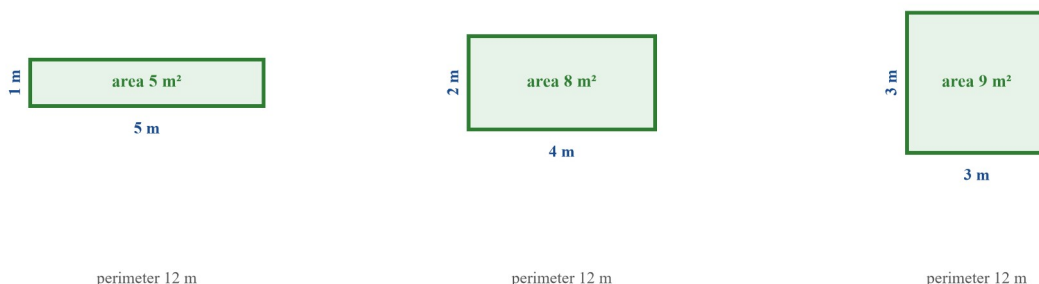
Refresher: adding decimals. Line up the decimal points before you add, so tenths sit under tenths: $1.75 + 2.6 = 4.35$. Perimeters often need this, because $l + w$ comes first.

Refresher: multiplying decimals. Count the decimal places in the two numbers you multiply, and the answer has that many places altogether: 2.4×3 has one place, giving 7.2; 0.5×0.4 has two places, giving 0.2. Areas need this whenever a side is a decimal.

Perimeter and area are different questions.

The same shape gives two different numbers: the perimeter in length units, the area in square units. And two shapes can have the *same* perimeter with *different* areas — the same length of fence can surround quite different yards.

Same length of fence (12 m) — three different areas



So a bigger perimeter does not always mean a bigger area. Before you calculate, always ask: is this job *around* the shape, or *covering* it?

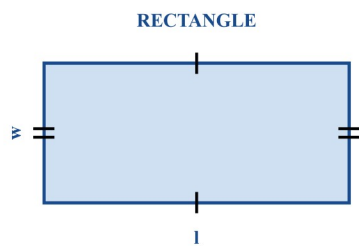
The job says...

fence, edging, trim, kerb, skirting, tape around, one lap
turf, tiles, felt, carpet, rubber base, paint on a surface

You need

perimeter (length units)
area (square units)

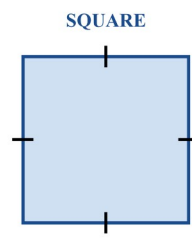
The rule card.



$$P = 2 \times (l + w)$$

$$A = l \times w$$

l = length, w = width



$$P = 4 \times s$$

$$A = s \times s$$

s = side (all four sides equal)

Shape	Perimeter	Area
Rectangle	$P = 2 \times (l + w)$	$A = l \times w$
Square	$P = 4 \times s$	$A = s \times s$

Reading plans and job sheets.

A plan or job sheet draws the shape and prints some of its measurements, called its **dimensions**. Often only two sides of a rectangle are printed: the equal-side tick marks on the plan tell you the other two, because opposite sides of a rectangle are equal. Two checks before you calculate anything:

- Are all the measurements in the same unit? If a plan mixes cm and mm, convert first (refresher above) — 45 cm and 300 mm cannot be added until 300 mm becomes 30 cm.
- Is the job around the shape or covering it? The word list above answers this.

Key ideas.

- Perimeter is the distance around the outside: add all the sides. Its units are length units (m, cm).
- Rectangle: $P = 2 \times (l + w)$. Square: $P = 4 \times s$.
- Area is the amount of surface covered. Its units are square units (m^2 , cm^2).
- Rectangle: $A = l \times w$. Square: $A = s \times s$.
- On grid paper, count the 1 cm^2 squares — or count rows $\times$ columns, which is multiplying.
- Half of a rectangle's perimeter is $l + w$; use it to find a missing side.
- Same perimeter can mean different areas, so always check: around, or covering?

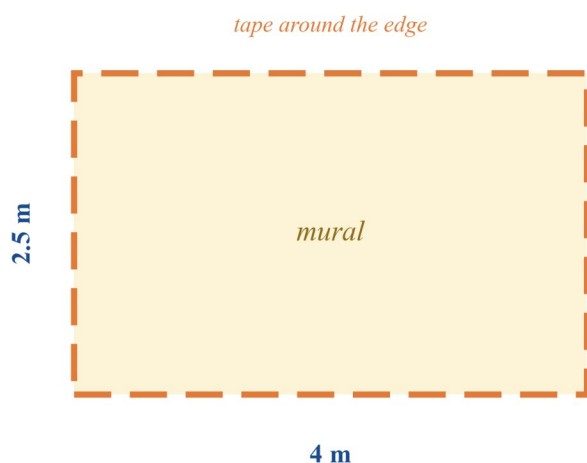
Worked examples

Example 1 — scaffolded

Ivy is painting a mural (a large painting on a wall) on a flat wall at school. The mural is a rectangle 4 m long and 2.5 m high. She runs masking tape around the edge first, then paints the surface inside the tape.

- Find the length of masking tape Ivy needs.
- Find the area the paint must cover.

(c) One of your answers is a length and one is an area. Which is which, and how do the units tell you?



The wall is 4 m long and 2.5 m high.

Working	Comment
$l + w = 4 + 2.5 = 6.5$	add the two different sides; line up the decimal points
$P = 2 \times 6.5 = 13 \text{ m}$	tape goes around all four sides: twice (length + width)
$A = l \times w = 4 \times 2.5 = 10 \text{ m}^2$	paint covers the flat surface: length $\times$ width
Tape: 13 m. Paint: 10 m ²	around the edge is a length (m); covering is an area (m ²)

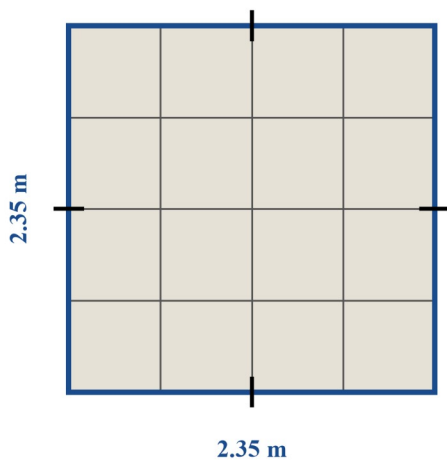
Example 2 — scaffolded

A square paved area outside a shopping centre is being repaired. Edging stones go around the outside and new paving covers the surface. Each side of the square is 2.35 m long.

- Find the length of edging stones needed.
- Find the paved area, to 2 decimal places.

(c) Check your area is reasonable by comparing it with two easy squares.

A square: all four sides are equal.



The ticks show the four sides are the same length.

Working

all four sides are 2.35 m

$$P = 4 \times s = 4 \times 2.35 = 9.4 \text{ m}$$

$$A = s \times s = 2.35 \times 2.35 = 5.5225 \text{ m}^2$$

to 2 d.p.: 5.52 m²

$2 \times 2 = 4$ and $3 \times 3 = 9$; 5.52 sits between them ✓

Comment

a square has four equal sides — the ticks on the plan show it

around the outside: four equal sides, so side $\times$ 4

covering the surface: $2 + 2 = 4$ decimal places in the product

the third decimal is 2 (less than 5), so round down

the side 2.35 m is between 2 m and 3 m, so the area must be between 4 m² and 9 m²

Example 3 — unscaffolded

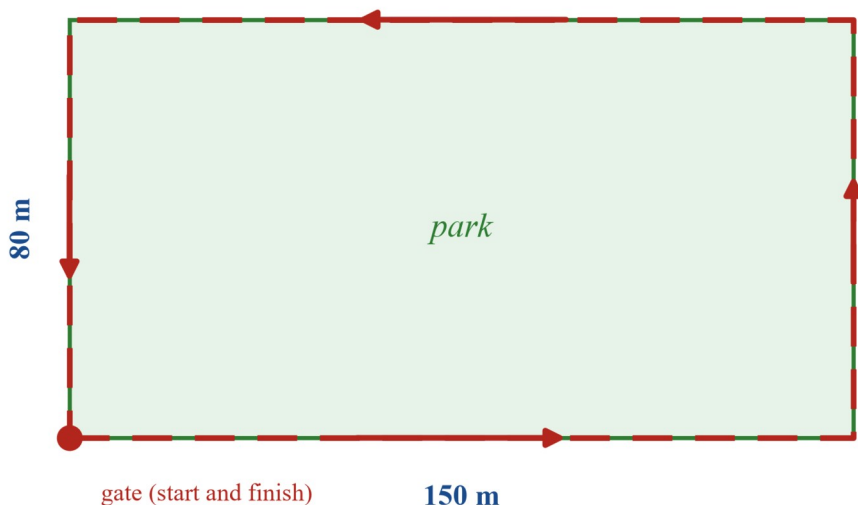
A rectangular park is 150 m long and 80 m wide. Georgia walks one lap around the edge of the park every morning, starting and finishing at the gate. Later the council returfes the whole park.

(a) How far does Georgia walk each morning?

(b) Write this distance in kilometres.

(c) What area of turf did the council lay?

Georgia's walk is one lap around the edge.



The walk goes around the edge, so the distance walked is the perimeter of the rectangle.

$$P = 2 \times (l + w) = 2 \times (150 + 80)$$

$$P = 2 \times 230 = 460$$

$\therefore$ Georgia walks 460 m each morning.

Metres to kilometres is one step, $\div 1000$: $460 \div 1000 = 0.46$, so the morning walk is 0.46 km.

Turf covers the surface, so the turf is the area of the park.

$$A = l \times w = 150 \times 80 = 12\,000$$

$\therefore$ the council laid 12 000 m² of turf.

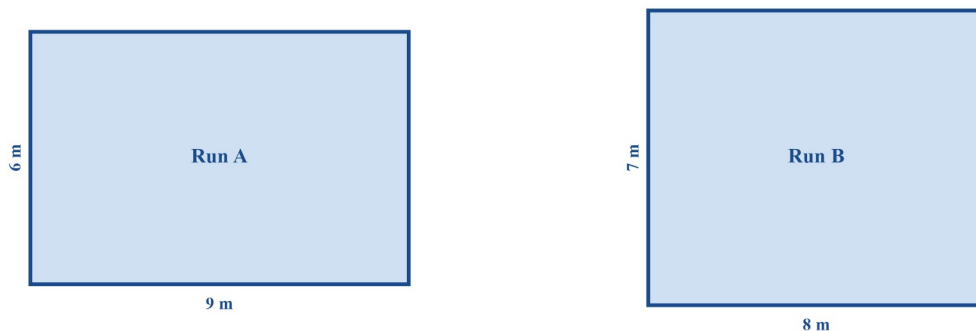
Example 4 — unscaffolded

An animal rescue is building two rectangular dog runs. Run A is 9 m long and 6 m wide. Run B is 8 m long and 7 m wide. Each run is fenced around its edge and covered with gravel.

- (a) Show that the two runs need the same length of fencing.
- (b) Find the area of each run.

(c) Which run needs more gravel, and by how much?

Two rectangular dog runs at the animal rescue



(a) Fencing goes around the edge, so find each perimeter, one step per line.

Run A:

$$9 + 6 = 15$$

$$2 \times 15 = 30$$

Run A needs 30 m of fencing.

Run B:

$$8 + 7 = 15$$

$$2 \times 15 = 30$$

Run B needs 30 m of fencing.

$\therefore$ the two runs need the same length of fencing: 30 m each.

(b) Gravel and fencing are different questions, so now find the areas. Run A: $A = 9 \times 6 = 54 \text{ m}^2$. Run B: $A = 8 \times 7 = 56 \text{ m}^2$.

(c) Gravel covers the surface, so compare the areas: $56 - 54 = 2$.

$\therefore$ Run B needs more gravel, by 2 m^2 , even though the fencing is the same.

Practice questions

Scaffolded

Q1. Find the perimeter of each rectangle.

- (a) 7 cm by 3 cm
- (b) 10 m by 4 m
- (c) 7.5 m by 2 m

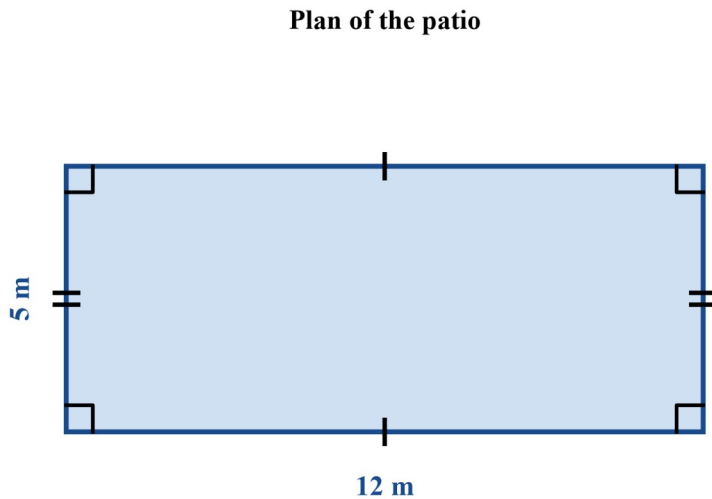
Q2. Find the area of each rectangle.

- (a) 8 cm by 5 cm
- (b) 6 m by 7 m
- (c) 3.5 m by 2 m

Q3. A square has sides of length 6 cm.

- (a) Find its perimeter.
- (b) Find its area.
- (c) A second square has sides of length 2.5 m. Find its perimeter.

Q4. The plan below shows a rectangular patio.



The ticks show opposite sides are equal.

- (a) Find the perimeter of the patio.
- (b) Find the area of the patio.
- (c) One of your two answers is in square units. Which one, and what is that measurement called?

Q5. A rectangular classroom has a perimeter of 40 m and a length of 13 m.

- (a) Use half of the perimeter to find $l + w$.
- (b) Hence find the width, w .
- (c) Check your width by adding all four sides together.

Q6. A rectangular table top is 1.2 m long and 0.8 m wide.

- (a) How many centimetres is 1.2 m?
- (b) Find the perimeter of the table top, in metres.
- (c) Find the area of the table top, in square metres.

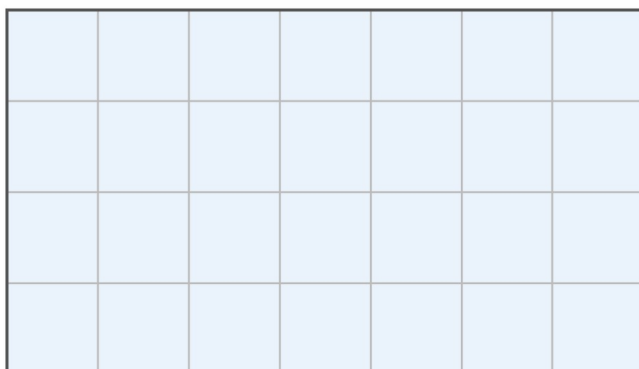
Unscaffolded

Q7. A teacher is making a rectangular noticeboard 2 m long and 1.2 m wide. Trim runs around the edge and felt covers the surface.

- (a) Find the length of trim needed.
- (b) Find the area of felt needed.
- (c) The trim is sold only in whole 2 m lengths. How many lengths must the teacher buy? Round up to the next whole length.

Q8. Finn draws a rectangular sticker on grid paper. Each small square is 1 cm by 1 cm. The sticker is 7 squares long and 4 squares wide.

The bookmark drawn on grid paper



Each small square is 1 cm by 1 cm.

The sticker covers the whole rectangle.

- (a) Find the area of the sticker by counting squares.
- (b) Check your area with $A = l \times w$.
- (c) Find the perimeter of the sticker.

Q9. A square sandpit at a child-care centre has sides of length 3.75 m. A rubber base covers the bottom of the sandpit and timber edging runs around its edge.

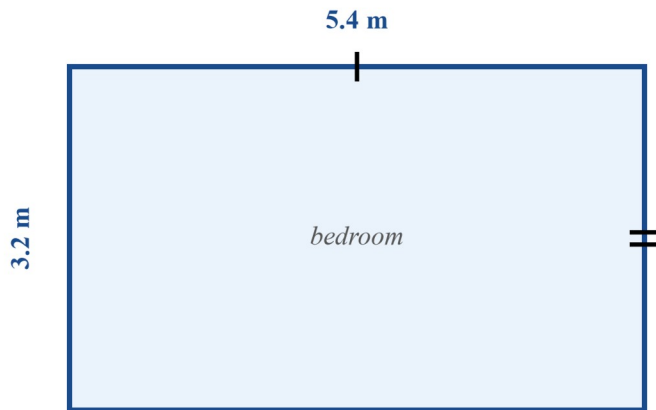
- (a) Find the area of the rubber base, to 2 decimal places.
- (b) Find the length of timber edging needed.
- (c) The edging is sold only in whole 2 m lengths. How many lengths are needed? Round up to the next whole length.

Q10. A rectangular paddock (a fenced field) has a perimeter of 46 m and a width of 8 m.

- (a) Show that the length of the paddock is 15 m.
- (b) Find the area of the paddock.

Q11. A floor plan shows a rectangular bedroom. Only two measurements are printed on the plan.

Floor plan — only two measurements are printed



The ticks show the unmarked sides equal the marked ones.

- (a) Explain why the other two sides of the room are 5.4 m and 3.2 m.
- (b) Skirting board (the timber strip around the base of a wall) runs around all four walls. Find the length of skirting board needed.
- (c) Carpet covers the floor. Find the area to be carpeted.

Q12. A rectangular mirror is 45 cm long and 300 mm wide.

- (a) Convert 300 mm to centimetres.
- (b) Find the perimeter of the mirror, in centimetres.
- (c) Find the area of the mirror, in square centimetres.

Q13. A rectangular car park at a shopping centre is 28 m long and 15 m wide. A kerb (the raised edge) runs right around it.

- (a) Find the length of the kerb.
- (b) Find the area of the car park surface.
- (c) A worker walks around the edge twice to check the kerb. How far does the worker walk?

Q14. Dean is fencing his rectangular backyard, 24 m long and 18 m wide. The fence runs around all four sides, with a 4 m gate on one side. Fencing costs \$12 per metre.

- (a) Find the perimeter of the backyard.
- (b) Find how many metres of fencing are needed (the gate is not fenced).
- (c) Find the cost of the fencing.

Q15. An artist stretches canvas over two wooden frames. Canvas A is a rectangle 85 cm long and 50 cm wide. Canvas B is a square with sides of 80 cm. Framing timber runs around the edge of each canvas.

- (a) Find the length of framing timber for each canvas.
- (b) Find the area of canvas on each frame.
- (c) Which canvas needs more framing timber? Which needs more canvas?

Q16. A landscaper's job sheet lists three rectangular areas to prepare.

Area	Length	Width
Lawn	10 m	5.5 m
Paving	4 m	3 m
Garden bed	3 m	2 m

Made-up data: the job-sheet names and every number in the table are made up for this section.

- (a) Find the area of the paving.
- (b) Which of the three areas is the smallest? Give its area.
- (c) Find the total of the three areas.

Q17. Hugo is asked to find the area of a rectangle 5 m long and 3 m wide. He writes $5 + 3 + 5 + 3 = 16$ and says the answer is 16 m.

- (a) What measurement has Hugo actually found?
- (b) What is wrong with the unit he gave for an area?
- (c) Work out the area of the rectangle correctly.

Q18. A rectangular stage in a community hall is 7.5 m long and 4 m wide. Skirting timber runs around the edge of the stage, and the timber costs \$9 per metre.

- (a) Find the area of the stage floor.
- (b) Find the length of skirting timber needed.
- (c) Find the cost of the skirting timber.

Answers

Q1. (a) 20 cm. (b) 28 m. (c) 19 m.

Q2. (a) 40 cm^2 . (b) 42 m^2 . (c) 7 m^2 .

Q3. (a) 24 cm. (b) 36 cm^2 . (c) 10 m.

Q4. (a) 34 m. (b) 60 m^2 . (c) the area, 60 m^2 — area is measured in square units.

Q5. (a) 20 m. (b) 7 m. (c) $13 + 7 + 13 + 7 = 40 \text{ m}$ ✓ matches the given perimeter.

Q6. (a) 120 cm. (b) 4 m. (c) 0.96 m^2 .

Q7. (a) 6.4 m. (b) 2.4 m^2 . (c) 4 lengths (rounded up from 3.2).

Q8. (a) 28 cm^2 . (b) $7 \times 4 = 28$ ✓ same as counting. (c) 22 cm.

Q9. (a) 14.06 m^2 (to 2 d.p.). (b) 15 m. (c) 8 lengths (rounded up from 7.5).

Q10. (a) length 15 m, shown. (b) 120 m^2 .

Q11. (a) opposite sides of a rectangle are equal. (b) 17.2 m. (c) 17.68 m^2 .

Q12. (a) 30 cm. (b) 150 cm. (c) $1\,350 \text{ cm}^2$.

Q13. (a) 86 m. (b) 420 m^2 . (c) 172 m.

Q14. (a) 84 m. (b) 80 m. (c) \$960.

Q15. (a) A: 270 cm; B: 320 cm. (b) A: $4\,250 \text{ cm}^2$; B: $6\,400 \text{ cm}^2$. (c) Canvas B needs more framing and more canvas.

Q16. (a) 12 m^2 . (b) the garden bed, 6 m^2 . (c) 73 m^2 .

Q17. (a) the perimeter — he added the four sides. (b) an area must be in square units (m^2 here); m is a length unit. (c) 15 m^2 .

Q18. (a) 30 m^2 . (b) 23 m. (c) \$207.

Fully-worked solutions

Q1. Perimeter is around the outside: $P = 2 \times (l + w)$.

(a) $P = 2 \times (7 + 3) = 2 \times 10 = 20 \text{ cm}$.

(b) $P = 2 \times (10 + 4) = 2 \times 14 = 28 \text{ m}$.

(c) $P = 2 \times (7.5 + 2) = 2 \times 9.5 = 19 \text{ m}$.

Q2. Area covers the surface: $A = l \times w$.

(a) $A = 8 \times 5 = 40 \text{ cm}^2$.

(b) $A = 6 \times 7 = 42 \text{ m}^2$.

(c) $A = 3.5 \times 2 = 7 \text{ m}^2$.

Q3. A square has four equal sides, s.

(a) $P = 4 \times 6 = 24 \text{ cm}$.

(b) $A = 6 \times 6 = 36 \text{ cm}^2$.

(c) $P = 4 \times 2.5 = 10 \text{ m}$.

Q4. The plan prints 12 m and 5 m; the tick marks say the other two sides match them.

(a) $P = 2 \times (12 + 5) = 2 \times 17 = 34$ m.

(b) $A = 12 \times 5 = 60$ m².

(c) The area, 60 m². Square units (the ²) mark an area; a perimeter stays in plain length units.

Q5. (a) Half of the perimeter is $l + w$: $40 \div 2 = 20$ m.

(b) $w = 20 - 13 = 7$ m.

(c) $13 + 7 + 13 + 7 = 40$ m ✓ — the same as the perimeter given, so the width is right.

Q6. (a) m $\rightarrow$ cm is $\times 100$: $1.2 \times 100 = 120$ cm.

(b) $P = 2 \times (1.2 + 0.8) = 2 \times 2 = 4$ m.

(c) $A = 1.2 \times 0.8 = 0.96$ m² (two decimal places in the product).

Q7. (a) Trim goes around the edge: $P = 2 \times (2 + 1.2) = 2 \times 3.2 = 6.4$ m.

(b) Felt covers the surface: $A = 2 \times 1.2 = 2.4$ m².

(c) $6.4 \div 2 = 3.2$ lengths. Lengths are sold whole, so round up: 4 lengths (3 lengths would be only 6 m, not enough).

Q8. (a) Counting the squares: 7 squares along and 4 down gives 28 squares, each 1 cm², so the area is 28 cm².

(b) $A = l \times w = 7 \times 4 = 28$ cm² ✓ — the same as counting.

(c) $P = 2 \times (7 + 4) = 2 \times 11 = 22$ cm.

Q9. (a) $A = s \times s = 3.75 \times 3.75 = 14.0625$ m²; to 2 decimal places, 14.06 m² (the third decimal is 2, so round down).

(b) $P = 4 \times 3.75 = 15$ m.

(c) $15 \div 2 = 7.5$ lengths. Round up to whole lengths: 8 lengths.

Q10. (a) One step per line: half of the perimeter is $l + w$.

$$46 \div 2 = 23$$

$$23 - 8 = 15$$

$\therefore$ the length of the paddock is 15 m.

(b) $A = l \times w = 15 \times 8 = 120$ m².

Q11. (a) Opposite sides of a rectangle are equal, so the unmarked long side equals the printed 5.4 m and the unmarked short side equals the printed 3.2 m — that is what the tick marks on the plan show.

(b) Skirting goes around all four walls: $P = 2 \times (5.4 + 3.2) = 2 \times 8.6 = 17.2$ m.

(c) Carpet covers the floor: $A = 5.4 \times 3.2 = 17.68$ m².

Q12. (a) mm $\rightarrow$ cm is $\div 10$: $300 \div 10 = 30$ cm.

(b) Both sides in cm now: $P = 2 \times (45 + 30) = 2 \times 75 = 150$ cm.

(c) $A = 45 \times 30 = 1\,350$ cm².

Q13. (a) The kerb goes around the edge: $P = 2 \times (28 + 15) = 2 \times 43 = 86$ m.

(b) $A = 28 \times 15 = 420$ m².

(c) Twice around: $2 \times 86 = 172$ m.

Q14. (a) $P = 2 \times (24 + 18) = 2 \times 42 = 84$ m.

(b) The gate replaces 4 m of fence: $84 - 4 = 80$ m of fencing.

(c) $80 \times \$12 = \$960$.

Q15. (a) Around the edge of each: Canvas A: $P = 2 \times (85 + 50) = 2 \times 135 = 270$ cm. Canvas B (square): $P = 4 \times 80 = 320$ cm.

(b) Covering each frame: Canvas A: $A = 85 \times 50 = 4\,250$ cm². Canvas B: $A = 80 \times 80 = 6\,400$ cm².

(c) $320 > 270$ and $6\,400 > 4\,250$, so Canvas B needs more framing timber and more canvas.

Q16. Each row of the job sheet is a rectangle: lawn $10 \times 5.5 = 55$ m², paving $4 \times 3 = 12$ m², garden bed $3 \times 2 = 6$ m².

(a) The paving is 12 m².

(b) The smallest is the garden bed, 6 m² ($6 < 12 < 55$).

(c) $55 + 12 + 6 = 73$ m² altogether.

Q17. (a) $5 + 3 + 5 + 3$ adds the four sides, so Hugo found the **perimeter**, not the area.

(b) An area is measured in square units, so the area here must be in m². The unit m is a length unit — right for his perimeter, wrong for the area he was asked for.

(c) $A = l \times w = 5 \times 3 = 15$ m².

Q18. (a) The floor is covered: $A = 7.5 \times 4 = 30$ m².

(b) The skirting goes around the edge: $P = 2 \times (7.5 + 4) = 2 \times 11.5 = 23$ m.

(c) $23 \times \$9 = \$207$.

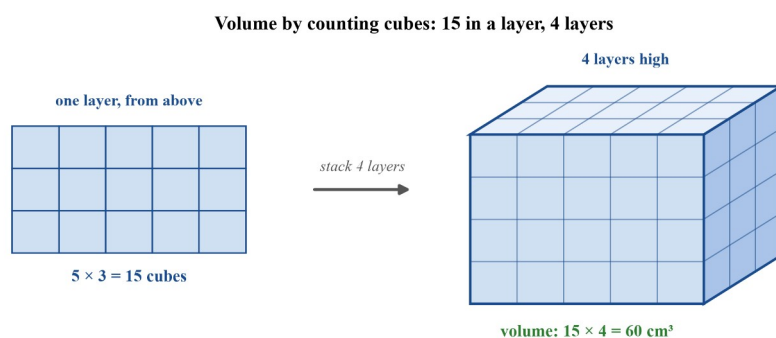
Chapter 4 Quantity and measures — 4C Volume and capacity of rectangular-based objects

Theory

This section is about how much space a box takes up, and how much a container holds. The Key Knowledge for this part of the course is about everyday measures — volume and capacity, and also distance, perimeter and area — but only for simple shapes based on rectangles (see the study design's Unit 1, Area of Study 3). This section covers the volume and capacity part of that line — for boxes only. Source: VCAA, VCE Vocational Major Numeracy Study Design, retrieved 2026-10-08.

About the data in this section. The boxes, tanks, pools, prices and numbers here are **made up** (not real): pretend containers and pretend measurements, built for this book so you can practise the maths. Nothing here is real data about a real product, person or place.

What volume means. The **volume** of a solid is the amount of space it takes up. Section 3B (Everyday three-dimensional objects) met the **box** — the everyday name for a rectangular prism — and every solid in this section is a box: a rectangular base with straight sides going up. Volume is measured in **cubic units**. A cube 1 cm on each side takes up 1 cubic centimetre, written 1 cm^3 . A cube 1 m on each side takes up 1 cubic metre, written 1 m^3 . The counting picture below is a box 5 cm long, 3 cm wide and 4 cm high, packed with 1 cm cubes. The bottom layer holds $5 \times 3 = 15$ cubes, and the box stacks 4 layers high, so the whole box holds $15 \times 4 = 60$ cubes: its volume is 60 cm^3 .

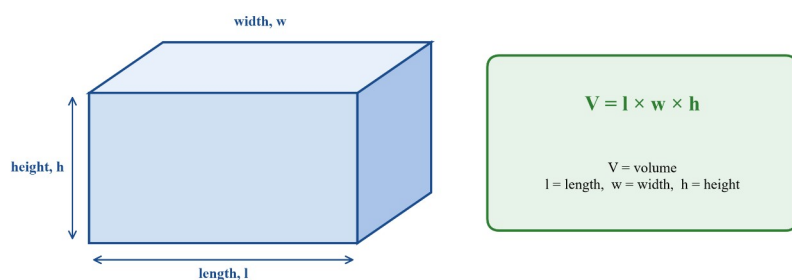


The volume formula. Counting cubes one layer at a time works, but the formula does it in one go. For any box,

$$V = l \times w \times h$$

where V is the volume, l the length, w the width and h the height. In practice you work in two steps: first the **base area** ($l \times w$), then multiply by the height. The base area tells you how many cubes sit in one layer; the height tells you how many layers there are — the formula is the counting picture, written short.

The volume formula for a box (rectangular prism)



Multiply the three measurements in any order — the answer is the same. Units: $\text{cm} \times \text{cm} \times \text{cm}$ gives cm^3 .

The units multiply too: $\text{cm} \times \text{cm} \times \text{cm}$ gives cm^3 , and $\text{m} \times \text{m} \times \text{m}$ gives m^3 . The order of the three numbers does not matter — $5 \times 3 \times 4$, $4 \times 5 \times 3$ and $3 \times 4 \times 5$ all give 60.

Refresher: area of a rectangle. Section 4B (Perimeter and area of rectangles) built the area of a rectangle: $A = l \times w$. Every volume in this section stands on a base area, so this fluency needs to be automatic. Note the units: $\text{cm} \times \text{cm}$ gives cm^2 , $\text{m} \times \text{m}$ gives m^2 .

Rectangle	Area
5 cm by 3 cm	$5 \times 3 = 15 \text{ cm}^2$
12 m by 7 m	$12 \times 7 = 84 \text{ m}^2$
2.5 m by 1.2 m	$2.5 \times 1.2 = 3.00 \text{ m}^2$

Refresher: multiplying decimals. Garden beds, slabs and pools are measured in decimals of a metre, so volume work multiplies decimals constantly. Multiply the numbers as if the decimal points were not there, then put the decimal point back: the answer has as many decimal places as the two numbers have between them. Trailing zeros in the count still count — that is why $2.5 \times 1.2 = 3.00$, which you can write as 3.

Multiplication	Decimal places	Answer
0.4×3	$1 + 0 = 1$	1.2
2.5×1.2	$1 + 1 = 2$	3.00
1.8×1.5	$1 + 1 = 2$	2.70
0.1×4.5	$1 + 1 = 2$	0.45

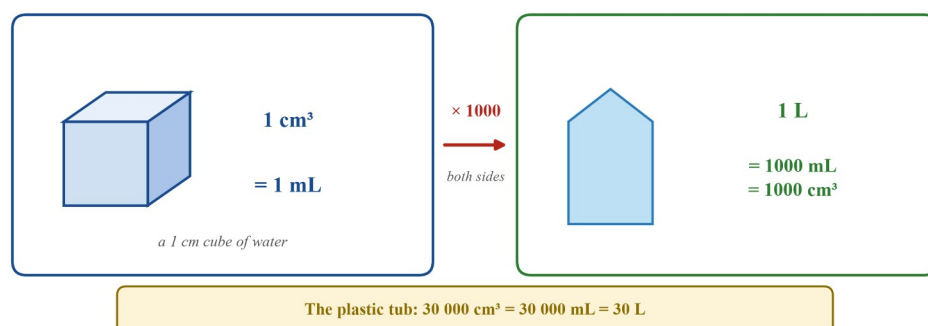
The formula in action. A plastic tub is 40 cm long, 30 cm wide and 25 cm high on the inside. Its base area is $40 \times 30 = 1200 \text{ cm}^2$, so its volume is $1200 \times 25 = 30\,000 \text{ cm}^3$. Keep this tub in mind — it comes back when volume meets capacity below.

Big jobs need cubic metres. Centimetres suit small boxes, but garden beds, concrete slabs, pools and rooms are measured in metres, and their volumes come out in cubic metres. A concrete path is 3 m long, 1.5 m wide and poured to a depth of 0.1 m. The base area is $3 \times 1.5 = 4.5 \text{ m}^2$, so the concrete needed is $4.5 \times 0.1 = 0.45 \text{ m}^3$. Depth works exactly like height — it is just the word used when the box lies flat on the ground.

Capacity — how much a container holds. Capacity is how much a container can hold: water in a tank, drinks in a bottle, soil in a planter. Capacity is measured in millilitres (mL) and litres (L), and the bridges between capacity and volume are single-step facts worth knowing cold:

- 1 mL fills exactly 1 cm^3 — a little cube of water 1 cm on each side.
- 1 L = 1000 mL, so $1000 \text{ cm}^3 = 1 \text{ L}$.
- A 2 L bottle of soft drink holds $2 \times 1000 = 2000 \text{ mL}$, which is 2000 cm^3 .

The bridge between volume and capacity

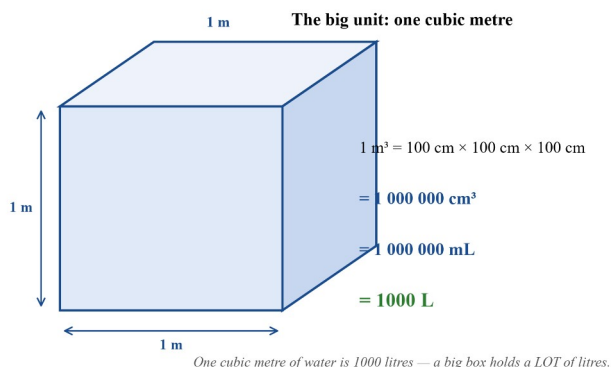


Back to the plastic tub: its volume is $30\,000 \text{ cm}^3$, so filled to the top it holds 30 000 mL of water, and $30\,000 \div 1000 = 30 \text{ L}$. Around the house: a teaspoon holds about 5 mL, a cup about 250 mL, a bucket about 10 L, and a big bottle of soft drink about 2 L. When a question asks for litres, find the volume first — in cm^3 or m^3 — and then cross the bridge once.

One cubic metre is a lot. Since $1\text{ m} = 100\text{ cm}$, a cube 1 m on each side is 100 cm by 100 cm by 100 cm :

$$100 \times 100 \times 100 = 1\,000\,000$$

so $1\text{ m}^3 = 1\,000\,000\text{ cm}^3$. Through the bridge, $1\,000\,000\text{ mL}$ is 1000 L — one cubic metre of water fills 1000 litres. That last bridge, $1\text{ m}^3 = 1000\text{ L}$, is the one used for pools, tanks and truckloads.



Refresher: times 1000, divide by 1000. Section 4A (Metric units and one-step conversion) built the pattern: converting to a SMALLER unit makes the number BIGGER (multiply by 1000), and converting to a bigger unit makes the number smaller (divide by 1000). Every bridge in this section is one of these two moves.

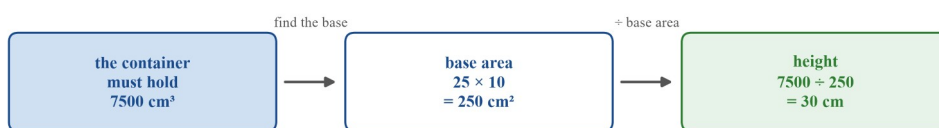
Convert	Working	Answer
2.5 L to mL	2.5×1000	2500 mL
750 mL to L	$750 \div 1000$	0.75 L
0.4 m^3 to L	0.4×1000	400 L
8 m^3 to L	8×1000	8000 L

Finding a missing height. Sometimes the volume is fixed and one measurement is missing: the caterer's container that must hold 9 L , the shelf a box has to fit under. Rearrange the two-step working — $\text{height} = \text{volume} \div \text{base area}$. A container must hold 7500 cm^3 and its base is 25 cm by 10 cm . The base area is $25 \times 10 = 250\text{ cm}^2$, and the height is

$$7500 \div 250 = 30$$

so the container must be 30 cm high. Always multiply back to check: $250 \times 30 = 7500\text{ cm}^3$, which is the volume the container must hold.

Finding a missing height



volume $\div$ base area = height. Check: $250 \times 30 = 7500\text{ cm}^3$.

Refresher: dividing, dropping zeros. Volume work divides big numbers by base areas, and both often end in zeros. Drop the SAME number of zeros from both numbers and the answer does not change — it is the same division wearing smaller shoes.

Divide	Drop zeros	Answer
$2700 \div 270$	$270 \div 27$	10
$8000 \div 400$	$80 \div 4$	20
$6500 \div 1000$	move the decimal point three places	6.5

Filling a box with smaller boxes. Packing problems ask how many small boxes (cubes, cartons, bricks) fit inside a big one. When every edge divides exactly, there are two methods that must agree. A storage box is 20 cm by 10 cm by 10 cm inside, and cubes 5 cm on each side are packed into it, all facing the same way.

- Count along the edges: $20 \div 5 = 4$ along the length, $10 \div 5 = 2$ along the width, $10 \div 5 = 2$ up the height, so $4 \times 2 \times 2 = 16$ cubes fit.
- Divide the volumes: the box holds $20 \times 10 \times 10 = 2000 \text{ cm}^3$ and one cube holds $5 \times 5 \times 5 = 125 \text{ cm}^3$, so $2000 \div 125 = 16$ cubes.

Both methods say 16. If the edges do NOT divide exactly, count along the edges — leftover space is wasted, and dividing volumes would claim cubes that cannot actually fit.

Choosing the right unit.

What you are measuring	Sensible units
A small box, a carton, an ice-cream tub	cm^3 , then mL or L for capacity
A drink, a bottle, a bucket	mL or L
A garden bed, a concrete slab, a planter	m^3
A pool or tank full of water	m^3 , then across the bridge to L

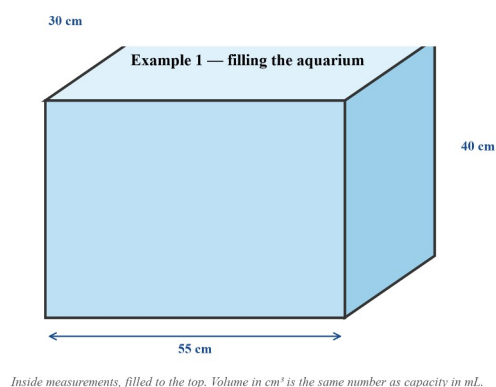
Rounding and whole answers. Most volumes in this section come out exact. When they do not, round only where the question says to, and say what you did. Two everyday cases point opposite ways: if you are BUYING whole bags or packs, round UP — 6 bags that hold too little do not help; if you are FITTING whole tubs or boxes inside a space, round DOWN — half a tub does not count and the next whole one will not fit. Q13 and Q16 ask you to do each.

Technology. A basic calculator does every multiplication and division in this section in one go — type the three measurements in any order for the volume. A spreadsheet can check a whole list of boxes: put length, width and height in columns A, B and C, and in column D type $=A2*B2*C2$ and fill down. Nothing here needs a device, though — pen, paper and a basic calculator are always enough, and technology is a way to check your answer, not a way to skip the thinking.

Worked examples

Example 1 — scaffolded

The classroom aquarium is 55 cm long, 30 cm wide and 40 cm high on the inside. It is filled with water to the top. How many litres of water does it hold?



Inside measurements, filled to the top. Volume in cm^3 is the same number as capacity in mL.

Working	Comment
$55 \times 30 = 1650 \text{ cm}^2$	Base area — the floor of the aquarium.
$1650 \times 40 = 66\,000 \text{ cm}^3$	Volume = base area $\times$ height.
$66\,000 \text{ cm}^3 = 66\,000 \text{ mL}$	The bridge: 1 cm^3 holds exactly 1 mL.
$66\,000 \div 1000 = 66$	mL to L is divide by 1000.

The aquarium holds 66 L of water.

Example 2 — scaffolded

A caterer needs a rectangular container that holds exactly 9 L. The base of the container is 30 cm by 15 cm on the inside. How tall must the container be?

Working

$$9 \times 1000 = 9000 \text{ mL}$$

$$9000 \text{ mL} = 9000 \text{ cm}^3$$

$$30 \times 15 = 450 \text{ cm}^2$$

$$9000 \div 450 = 20 \text{ cm}$$

$$\text{Check: } 450 \times 20 = 9000 \text{ cm}^3$$

Comment

Turn the capacity into a number of mL first.

The bridge again: 1 mL fills exactly 1 cm³.

Base area of the container.

Height = volume $\div$ base area.

Multiply back — 9000 cm³ is 9000 mL, which is 9 L.

The container must be 20 cm tall.

Example 3 — unscaffolded

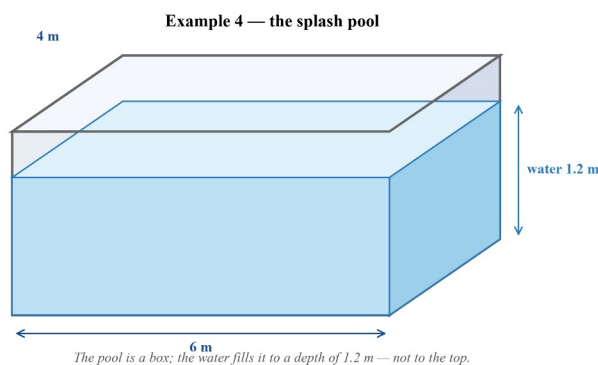
A rectangular garden bed is 2.4 m long and 1.5 m wide. Soil is spread into it to a depth of 0.25 m. How many cubic metres of soil does the garden bed need?

The soil forms a box: 2.4 m by 1.5 m by 0.25 m deep. Base area: $2.4 \times 1.5 = 3.6 \text{ m}^2$. Volume: $3.6 \times 0.25 = 0.9 \text{ m}^3$.

$\therefore$ The garden bed needs 0.9 m³ of soil.

Example 4 — unscaffolded

A rectangular splash pool at the holiday park is 6 m long and 4 m wide. It is filled with water to a depth of 1.2 m. How many litres of water are in the pool?



The water is itself a box, 6 m by 4 m and 1.2 m deep — not to the top, because the question gives the water depth. Base area: $6 \times 4 = 24 \text{ m}^2$. Volume of water: $24 \times 1.2 = 28.8 \text{ m}^3$. Cross the big bridge, $1 \text{ m}^3 = 1000 \text{ L}$: $28.8 \times 1000 = 28800 \text{ L}$.

$\therefore$ The pool holds 28800 L of water.

Practice questions

Scaffolded

Q1. A box is 8 cm long, 5 cm wide and 3 cm high. It is packed with 1 cm cubes.

- (a) How many cubes are in the bottom layer?
- (b) What is the volume of the box in cm³?
- (c) A twin box has the same length and width but is 6 cm high. What is its volume in cm³?

Q2. Convert each measurement.

- (a) 4.5 L to mL
- (b) 5000 mL to L
- (c) 2500 mL to L

Q3. A rectangular esky is 50 cm long, 25 cm wide and 30 cm high on the inside.

- (a) What is its volume in cm^3 ?
- (b) Filled to the top, how many mL does it hold?
- (c) How many litres is that?

Q4. A rectangular biscuit tin must hold 2400 cm^3 . Its base is 20 cm by 12 cm.

- (a) What is the area of the base?
- (b) How tall must the tin be?
- (c) Check your height by multiplying the three measurements back together.

Q5. A rectangular garden bed is 2 m long and 1.5 m wide. Mulch is spread into it to a depth of 0.2 m.

- (a) What is the area of the bed in m^2 ?
- (b) How many m^3 of mulch are needed?
- (c) How many litres of mulch is that?

Q6. Two toolboxes have these inside measurements: Box A is 40 cm by 20 cm by 15 cm; Box B is 38 cm by 22 cm by 15 cm.

- (a) What is the volume of Box A?
- (b) What is the volume of Box B?
- (c) Which box holds more, and by how much?

Un scaffolded

Q7. A tools box is 45 cm long, 30 cm wide and 20 cm high on the inside.

- (a) What is its volume in cm^3 ?
- (b) What is its capacity in litres?
- (c) A bag holds 25 L of sand. Will the whole bag fit inside the box? Explain how you know.

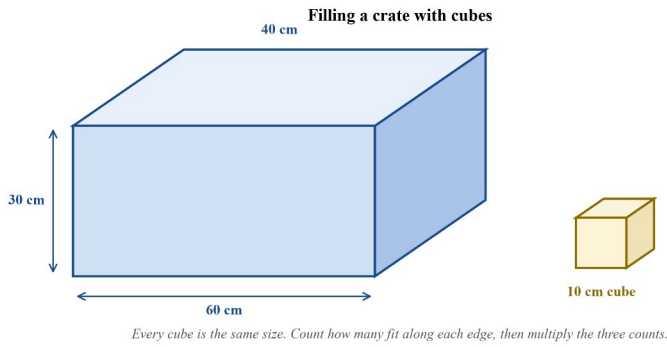
Q8. Josie fills a 3 L camp jug with water and pours it into 500 mL bottles.

- (a) How many mL does the jug hold?
- (b) How many full 500 mL bottles can she fill?
- (c) Josie wants to fill 8 bottles. How many mL would that need, and is one jug enough?

Q9. A concrete slab for a garden shed is 4 m long, 3 m wide and 0.15 m thick.

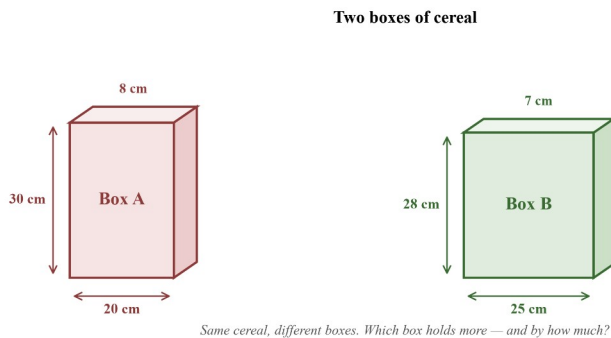
- (a) What area does the slab cover?
- (b) How many m^3 of concrete are needed?
- (c) A driveway is 6 m long, 2.5 m wide and poured to the same 0.15 m thickness. How many m^3 of concrete does the driveway need?

Q10. A crate is 60 cm long, 40 cm wide and 30 cm high on the inside. Cubes 10 cm on each side are packed into it, all facing the same way.



- How many cubes fit along the length, along the width, and up the height?
- How many cubes fit in the crate altogether?
- Check your answer by dividing the volume of the crate by the volume of one cube.

Q11. Two boxes of cereal have these measurements: Box A is 20 cm by 8 cm by 30 cm; Box B is 25 cm by 7 cm by 28 cm.



- What is the volume of Box A?
- What is the volume of Box B?
- Which box holds more cereal, and by how much?

Q12. A rectangular rainwater tank is 2 m long, 1.5 m wide and 1.8 m high on the inside.

- What is the volume of the tank in m^3 ?
- How many litres does the tank hold when full?
- The garden uses 300 L of tank water a day. How many days will a full tank last?

Q13. A freezer compartment is 50 cm long, 45 cm wide and 35 cm high on the inside.

- What is its volume in cm^3 ?
- What is its capacity in litres?
- Ice-cream tubs hold 2.5 L each. How many whole tubs fit in the compartment? State how you rounded and why.

Q14. A lunch box is 24 cm long, 15 cm wide and 10 cm high on the inside.

- Show that the volume of the lunch box is 3600 cm^3 .
- What is its capacity in litres?
- A water bottle holds 4 L. Will its water fit inside the empty lunch box? Explain how you know.

Q15. A rectangular planter holds 0.6 m^3 of soil when full. Its base is 2 m by 1.25 m.

- (a) What is the area of the base in m^2 ?
- (b) How deep is the soil, in m?
- (c) Convert the depth to cm.

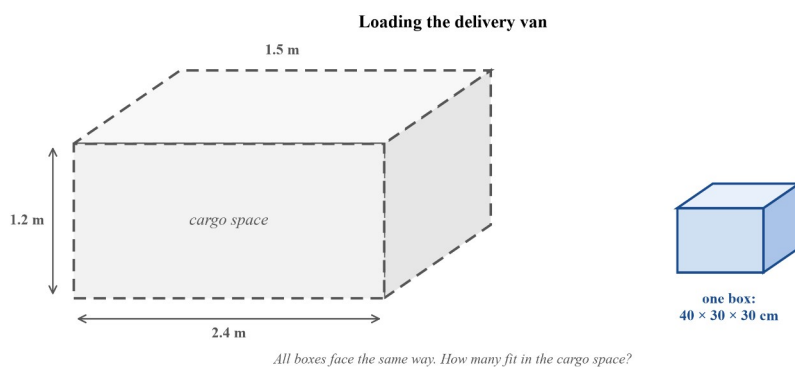
Q16. Declan's planter box is 1.25 m long, 0.4 m wide and 0.5 m deep on the inside. Potting mix comes in 40 L bags at \$9.50 a bag, and Declan can only buy whole bags.

- (a) What is the volume of the planter box in m^3 ?
- (b) How many litres of potting mix fill it?
- (c) How many bags must Declan buy, and what do they cost in total? State how you rounded and why.

Q17. Juice is sold in 250 mL cartons at \$0.60 each, and in 1 L bottles at \$1.80 each.

- (a) How many cartons hold the same as 1 L?
- (b) What do that many cartons cost?
- (c) Which way is cheaper for 1 L of juice, and by how much?

Q18. The cargo space of a delivery van is a box 2.4 m long, 1.5 m wide and 1.2 m high. Delivery boxes are 40 cm long, 30 cm wide and 30 cm high, and every box is loaded facing the same way.



- (a) What is the volume of the cargo space in m^3 ?
- (b) What is the volume of one delivery box in cm^3 ?
- (c) How many delivery boxes fit in the cargo space? (Convert the cargo space to cm and count along each edge.) Check your answer against the two volumes.

Answers

Q1. (a) 40 cubes (b) 120 cm^3 (c) 240 cm^3 **Q2.** (a) 4500 mL (b) 5 L (c) 2.5 L **Q3.** (a) $37\,500 \text{ cm}^3$ (b) 37 500 mL (c) 37.5 L **Q4.** (a) 240 cm^2 (b) 10 cm (c) $20 \times 12 \times 10 = 2400 \text{ cm}^3$ — the tin holds what it must **Q5.** (a) 3 m^2 (b) 0.6 m^3 (c) 600 L **Q6.** (a) $12\,000 \text{ cm}^3$ (b) $12\,540 \text{ cm}^3$ (c) Box B, by 540 cm^3 **Q7.** (a) $27\,000 \text{ cm}^3$ (b) 27 L (c) yes — 25 L = 25 000 mL, which is less than 27 000 mL **Q8.** (a) 3000 mL (b) 6 bottles (c) 4000 mL; no — the jug holds only 3000 mL, which is 1000 mL short **Q9.** (a) 12 m^2 (b) 1.8 m^3 (c) 2.25 m^3 **Q10.** (a) 6, 4 and 3 (b) 72 cubes (c) $72\,000 \div 1000 = 72$ cubes — the same **Q11.** (a) 4800 cm^3 (b) 4900 cm^3 (c) Box B, by 100 cm^3 **Q12.** (a) 5.4 m^3 (b) 5400 L (c) 18 days **Q13.** (a) $78\,750 \text{ cm}^3$ (b) 78.75 L (c) 31 whole tubs — 31.5 rounded DOWN, because only whole tubs fit **Q14.** (a) shown (b) 3.6 L (c) no — 4 L = 4000 mL, which is more than the 3600 mL the box holds **Q15.** (a) 2.5 m^2 (b) 0.24 m (c) 24 cm **Q16.** (a) 0.25 m^3 (b) 250 L (c) 7 bags — 6.25 rounded UP to whole bags — costing \$66.50 **Q17.** (a) 4 cartons (b) \$2.40 (c) the 1 L bottle, by \$0.60 **Q18.** (a) 4.32 m^3 (b) $36\,000 \text{ cm}^3$ (c) 120 boxes

Fully-worked solutions

Q1. (a) The bottom layer is $8 \times 5 = 40$ cubes. (b) With 3 layers, the volume is $40 \times 3 = 120 \text{ cm}^3$. (c) The twin box has the same 40-cube layer and is 6 cm high, so its volume is $40 \times 6 = 240 \text{ cm}^3$ — twice the height, twice the volume.

Q2. (a) L to mL is $\times 1000$: $4.5 \times 1000 = 4500 \text{ mL}$. (b) mL to L is $\div 1000$: $5000 \div 1000 = 5 \text{ L}$. (c) $2500 \div 1000 = 2.5 \text{ L}$.

Q3. (a) Base area: $50 \times 25 = 1250 \text{ cm}^2$; volume: $1250 \times 30 = 37\,500 \text{ cm}^3$. (b) 1 cm^3 holds 1 mL, so the esky holds 37 500 mL. (c) $37\,500 \div 1000 = 37.5 \text{ L}$.

Q4. (a) $20 \times 12 = 240 \text{ cm}^2$. (b) Height = volume $\div$ base area: $2400 \div 240 = 10 \text{ cm}$. (c) Check: $20 \times 12 \times 10 = 2400 \text{ cm}^3$ — the volume the tin must hold.

Q5. (a) $2 \times 1.5 = 3 \text{ m}^2$. (b) $3 \times 0.2 = 0.6 \text{ m}^3$. (c) $1 \text{ m}^3 = 1000 \text{ L}$, so $0.6 \times 1000 = 600 \text{ L}$.

Q6. (a) Box A: base $40 \times 20 = 800 \text{ cm}^2$, volume $800 \times 15 = 12\,000 \text{ cm}^3$. (b) Box B: base $38 \times 22 = 836 \text{ cm}^2$, volume $836 \times 15 = 12\,540 \text{ cm}^3$. (c) Box B holds more, by $12\,540 - 12\,000 = 540 \text{ cm}^3$. Box B is shorter-looking but wider, and the extra width wins.

Q7. (a) Base area: $45 \times 30 = 1350 \text{ cm}^2$; volume: $1350 \times 20 = 27\,000 \text{ cm}^3$. (b) $27\,000 \text{ cm}^3 = 27\,000 \text{ mL}$, and $27\,000 \div 1000 = 27 \text{ L}$. (c) The bag holds 25 L = 25 000 mL. Since $25\,000 < 27\,000$, the whole bag fits, with room to spare.

Q8. (a) $3 \times 1000 = 3000 \text{ mL}$. (b) $3000 \div 500 = 6$ bottles. (c) Eight bottles need $8 \times 500 = 4000 \text{ mL}$; one jug holds only 3000 mL, which is 1000 mL short, so one jug is not enough.

Q9. (a) $4 \times 3 = 12 \text{ m}^2$. (b) $12 \times 0.15 = 1.8 \text{ m}^3$ of concrete. (c) Driveway base: $6 \times 2.5 = 15 \text{ m}^2$; concrete: $15 \times 0.15 = 2.25 \text{ m}^3$.

Q10. (a) Length: $60 \div 10 = 6$; width: $40 \div 10 = 4$; height: $30 \div 10 = 3$. (b) $6 \times 4 \times 3 = 72$ cubes. (c) Crate: $60 \times 40 \times 30 = 72\,000 \text{ cm}^3$; one cube: $10 \times 10 \times 10 = 1000 \text{ cm}^3$; $72\,000 \div 1000 = 72$ cubes — the two methods agree.

Q11. (a) Box A: $20 \times 8 \times 30 = 4800 \text{ cm}^3$. (b) Box B: $25 \times 7 \times 28 = 4900 \text{ cm}^3$. (c) Box B holds more, by $4900 - 4800 = 100 \text{ cm}^3$.

Q12. (a) Base: $2 \times 1.5 = 3 \text{ m}^2$; volume: $3 \times 1.8 = 5.4 \text{ m}^3$. (b) $1 \text{ m}^3 = 1000 \text{ L}$, so $5.4 \times 1000 = 5400 \text{ L}$. (c) $5400 \div 300 = 18$ days.

Q13. (a) Base: $50 \times 45 = 2250 \text{ cm}^2$; volume: $2250 \times 35 = 78\,750 \text{ cm}^3$. (b) $78\,750 \text{ cm}^3 = 78\,750 \text{ mL}$, and $78\,750 \div 1000 = 78.75 \text{ L}$. (c) $78.75 \div 2.5 = 31.5$. Only whole tubs fit, and 32 tubs would not all fit, so round DOWN: 31 whole tubs.

Q14. (a) Base area: $24 \times 15 = 360 \text{ cm}^2$. Volume: $360 \times 10 = 3600 \text{ cm}^3$. So the volume is 3600 cm^3 , as required. (b) $3600 \text{ cm}^3 = 3600 \text{ mL}$, and $3600 \div 1000 = 3.6 \text{ L}$. (c) The bottle's water is 4 L = 4000 mL. Since $4000 > 3600$, the water will NOT fit in the lunch box.

Q15. (a) $2 \times 1.25 = 2.5 \text{ m}^2$. (b) Depth = volume $\div$ base area: $0.6 \div 2.5 = 0.24 \text{ m}$. (c) $0.24 \times 100 = 24 \text{ cm}$.

Q16. (a) Base: $1.25 \times 0.4 = 0.5 \text{ m}^2$; volume: $0.5 \times 0.5 = 0.25 \text{ m}^3$. (b) $0.25 \times 1000 = 250 \text{ L}$. (c) Bags: $250 \div 40 = 6.25$. Declan can only buy whole bags, and 6 bags hold only $6 \times 40 = 240 \text{ L}$ — not enough — so round UP to 7 bags. Cost: $7 \times \$9.50 = \$66.50$.

Q17. (a) $1 \text{ L} = 1000 \text{ mL}$, and $1000 \div 250 = 4$ cartons. (b) $4 \times \$0.60 = \$2.40$. (c) The bottle costs $\$1.80$ for the same litre, and $\$2.40 - \$1.80 = \$0.60$, so the bottle is cheaper by $\$0.60$ a litre.

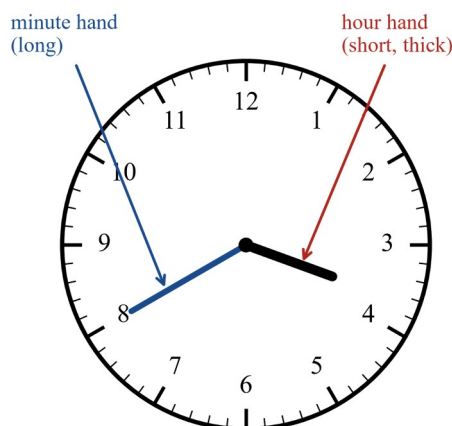
Q18. (a) Base: $2.4 \times 1.5 = 3.6 \text{ m}^2$; volume: $3.6 \times 1.2 = 4.32 \text{ m}^3$. (b) Base: $40 \times 30 = 1200 \text{ cm}^2$; volume: $1200 \times 30 = 36\,000 \text{ cm}^3$. (c) Convert the cargo space: $2.4 \text{ m} = 240 \text{ cm}$, $1.5 \text{ m} = 150 \text{ cm}$, $1.2 \text{ m} = 120 \text{ cm}$. Along the length: $240 \div 40 = 6$; along the width: $150 \div 30 = 5$; up the height: $120 \div 30 = 4$. Boxes: $6 \times 5 \times 4 = 120$. Check: $120 \times 36\,000 = 4\,320\,000 \text{ cm}^3$, and $4.32 \text{ m}^3 = 4\,320\,000 \text{ cm}^3$ — the volumes agree, so 120 boxes fit.

Chapter 4 Quantity and measures — 4D Time: analogue, digital and durations

About the data in this section. The timetable, rosters and dates here are **made up** (not real): pretend businesses, pretend clubs and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

Theory

Reading an analogue clock. An analogue clock has a round face with the numbers 1 to 12 on it, a short **hour hand** and a long **minute hand**. The hour hand points between two numbers: the hour is the number it has **passed**. The minute hand points at a number on the face: the minutes are that number times 5. On the clock below the hour hand has passed 3 (not yet 4), and the minute hand points at 8, which is $8 \times 5 = 40$ minutes, so the time is 3:40.

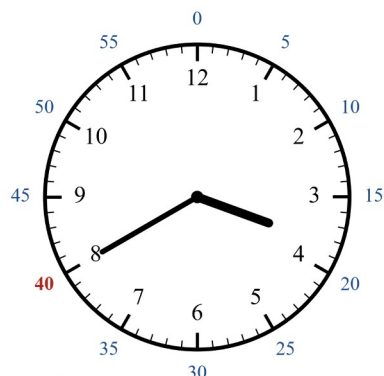


3:40 — “forty past three”, or “twenty to four”

Refresher — the five-times table (the minute hand). The minute hand only ever points at a number on the face, and each number on the face stands for a number of minutes. Learn this table and reading minutes is quick.

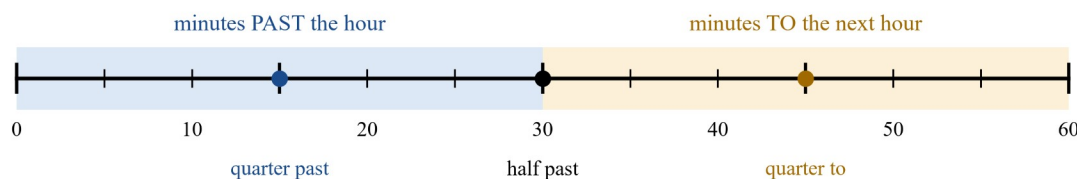
Hand at	Minutes	Hand at	Minutes
1	5	7	35
2	10	8	40
3	15	9	45
4	20	10	50
5	25	11	55
6	30	12	60 (o'clock)

The picture below shows the same table written around the face: the minute hand at 8 means 40 minutes.

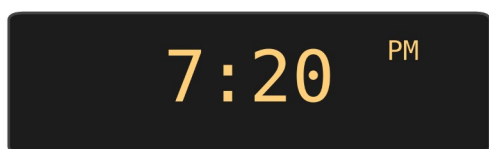


The minute hand on the 8 reads 40 minutes ($8 \times 5 = 40$).

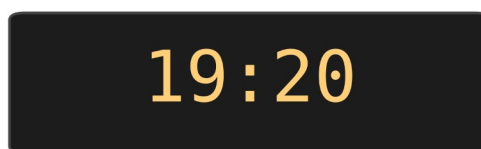
Saying the time in words: past and to. Count minutes from the hour, up to 30: say **past**. After half past, count minutes down to the *next* hour: say **to**. To get the minutes to, take the minutes shown away from 60. So 3:40 is “twenty to four”, because $60 - 40 = 20$. The quarter points have their own words: 15 minutes is **quarter past**, 30 minutes is **half past**, 45 minutes is **quarter to**.



Digital time: 12-hour and 24-hour. A digital clock writes hours and minutes with a colon, like 7:20. The **12-hour** form repeats the numbers 1 to 12 twice a day, so it needs **am** (after midnight, before noon) or **pm** (after noon, before midnight) to say which half of the day. The **24-hour** form writes the hour from 00 to 23 and never needs am or pm. To go from pm to 24-hour, add 12 to the hour; to go back, take 12 away. Morning times keep the same numbers (7:20 am is 07:20). Two specials to learn: midnight is 12:00 am or 00:00, and noon is 12:00 pm or 12:00.



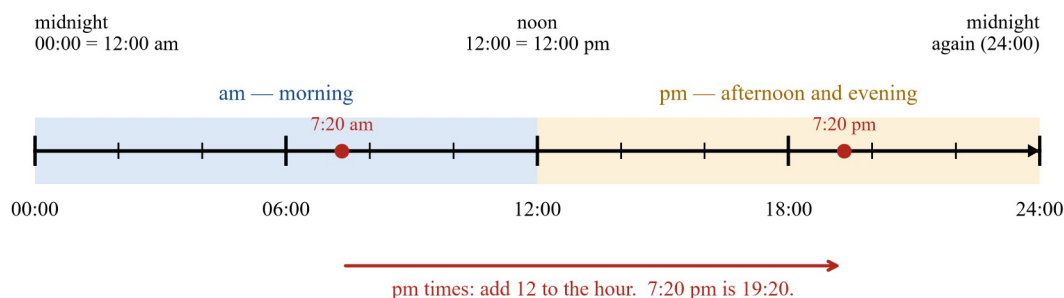
12-hour display: 7:20 pm



24-hour display: 19:20

Both displays show the same time of day: $7 + 12 = 19$.

The 24-hour line below shows one whole day in order. 7:20 pm sits 12 hours after 7:20 am, so it is $7 + 12 = 19$, written 19:20.



Units of time. Time does not count in tens. It counts in 60s and 24s, and that is the one thing to hold on to through this section.

1 minute = 60 seconds	1 hour = 60 minutes	1 day = 24 hours	1 week = 7 days	1 year = 12 months = 365 days (366 leap)
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Time is NOT base 10: the steps are 60, 60, 24 and 7 — not 10s.

- 1 minute = 60 seconds
- 1 hour = 60 minutes
- 1 hour = $60 \times 60 = 3600$ seconds
- 1 day = 24 hours

- 1 week = 7 days = $7 \times 24 = 168$ hours
- 1 year = 12 months = 365 days (366 in a leap year)

To change units, decide which way you are going. Bigger unit to smaller unit: **multiply**. Smaller unit to bigger unit: **divide**. If a divide leaves a remainder, the remainder is the left-over smaller unit.

Change	Do	Example
bigger to smaller	multiply	$4 \text{ min} = 4 \times 60 = 240 \text{ s}$
smaller to bigger	divide	$300 \text{ s} = 300 \div 60 = 5 \text{ min}$

Refresher — multiplying and dividing by 60 and 24. These come up over and over: $7 \times 60 = 420$; $9 \times 60 = 540$; $240 \div 60 = 4$; $480 \div 60 = 8$; $155 \div 60 = 2$ remainder 35, so 155 min is 2 h 35 min; $4 \times 24 = 96$.

Decimal hours. A digital roster or payslip often writes part of an hour as a decimal, like 6.5 h. The part after the point is a **part of 60 minutes**, not a part of 100. So 0.5 h is 30 minutes, 0.25 h is 15 minutes and 6.5 h is 6 h 30 min. The trap: 6.25 h is **not** 6 h 25 min. It is 6 h plus 0.25 of 60 minutes, which is 15 minutes, so 6.25 h is 6 h 15 min.

How long between two times: columns. To find how long something took, take the start time away from the finish time. Writing both times in 24-hour form first keeps it simple. Line the hours up under the hours and the minutes under the minutes, then subtract. If the top minutes are smaller than the bottom minutes, **borrow** 1 h from the hours column and change it to 60 minutes. Below, 11:40 am to 2:15 pm becomes $14:15 - 11:40$. The 15 cannot lose 40, so borrow: 14:15 becomes 13:75. Then $75 - 40 = 35$ minutes and $13 - 11 = 2$ hours, so the time is 2 h 35 min.

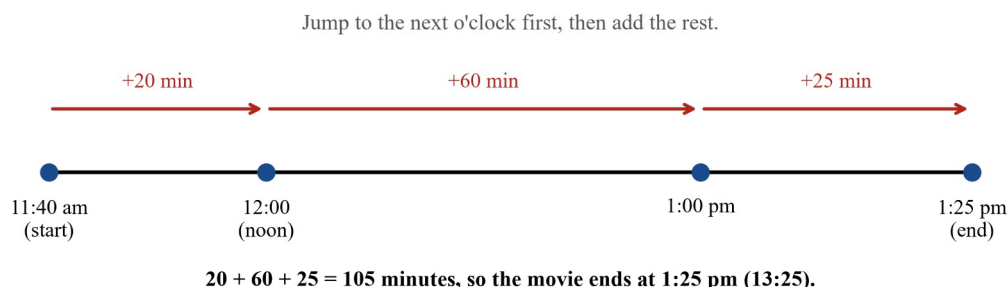
From 11:40 am to 2:15 pm

write 2:15 pm as 14:15, then
end – start in columns

	h	min	
	14	15	
	-1	↓	+60
	13	75	15 – 40 cannot be done: borrow 1 hour, and 1 h = 60 min, so 14:15 becomes 13:75.
–	11	40	
	2	35	75 – 40 = 35 min, and 13 – 11 = 2 h

So 11:40 am to 2:15 pm is 2 h 35 min.

How long between two times: timeline jumps. The other way is to jump along a timeline in easy bits and add the jumps up. From 11:40 am: jump 20 minutes to 12:00 noon, jump 60 minutes to 1:00 pm, jump 25 minutes to 1:25 pm. Add the jumps: $20 + 60 + 25 = 105$ minutes, which is 1 h 45 min. Both ways give the same answer; use whichever you trust.



The calendar: days, weeks and months. Australian dates are written day first: 3/2/2026 means 3 February 2026. Weeks are always 7 days, but months are not all the same length, so counting months means checking the month. The strip below gives the length of every month in 2026.

January 31 days	February 28 days* (29 leap)	March 31 days	April 30 days	May 31 days	June 30 days
July 31 days	August 31 days	September 30 days	October 31 days	November 30 days	December 31 days

* In a leap year (such as 2024 or 2028) February has 29 days and the year has 366 days.

A **leap year** is a year that divides by 4 exactly, like 2024 and 2028. In a leap year February has 29 days instead of 28. The year 2026 does not divide by 4 exactly, so 2026 is not a leap year and February 2026 has 28 days. Day names repeat every 7 days, so a date exactly one week (or two, or three) after another lands on the same day name.

Refresher — counting days and adding months. To count days across two months, count to the end of the first month, then count into the second. From 27 January to 3 February: January has 31 days, so $31 - 27 = 4$ days left in January, then 3 days into February, so $4 + 3 = 7$ days. To add a month to a date, move to the same number next month; if that month has no such day, move the date back to that month's last day. 31 October 2026 plus one month would be 31 November, but November has 30 days, so the date is 30 November 2026. 29 January 2026 plus one month would be 29 February, but 2026 is not a leap year, so the date is 28 February 2026.

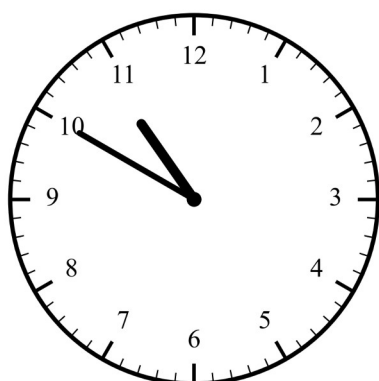
Key ideas.

- The hour is the number the short hand has passed; the minutes are the number the long hand points at, times 5.
- Up to 30 minutes say **past**; after that say **to**, with the minutes taken away from 60.
- The 12-hour form needs am or pm; the 24-hour form does not. Evening hours change by 12.
- Time units: 60 s in a minute, 60 min in an hour, 24 h in a day, 7 days in a week, 12 months in a year.
- Bigger to smaller units: multiply. Smaller to bigger: divide, and keep the remainder.
- To find a time between two times: 24-hour columns with borrowing, or timeline jumps.
- A decimal part of an hour is a part of 60 minutes: 0.5 h is 30 min, never 50 min.
- Months differ in length, and February gains a day only in a leap year (a year that divides by 4 exactly).

Worked examples

Example 1 — scaffolded

Amara visits her grandmother in hospital in the evening. The ward clock looks like this.



- (a) Write the time in words, using *past* or *to*.
- (b) Write the time on a 12-hour digital clock.

- (c) Write the time on a 24-hour digital clock.

Working	Comment
Minute hand points at 10: $10 \times 5 = 50$ minutes.	The long hand counts minutes in fives.
Hour hand has passed 10 (not yet 11): the hour is 10.	The short hand gives the hour.
$60 - 50 = 10$, so ten to eleven (fifty past ten also works).	After half past, <i>to</i> is often easier.
12-hour digital: 10:50 pm.	Evening, so pm.
$10 + 12 = 22$, so 24-hour: 22:50.	Evening hours add 12.

Example 2 — scaffolded

Gus bakes bread. The dough rises for 1 h 40 min, then the bread bakes for 45 min.

- (a) Show that the rising time is 100 min.
- (b) Show that rising plus baking is 145 min, and that this is 2 h 25 min.
- (c) Gus starts the dough at 9:50 am. What time does the rising finish?

Working	Comment
(a) 1 h 40 min is $60 + 40 = 100$ min.	1 h = 60 min.
(b) $100 + 45 = 145$ min.	Add the two stages.
$145 \div 60 = 2$ remainder 25, so 145 min is 2 h 25 min.	Every full 60 min is one hour.
(c) 9:50 am + 1 h = 10:50 am.	Add the hour part first.
10:50 am + 40 min = 11:30 am.	Then the minutes part.

Example 3 — unscaffolded

A film session starts at 11:40 am. The film runs for 105 min. What time does the film finish? Give the time in 12-hour and in 24-hour form.

Work: $105 \div 60 = 1$ remainder 45, so the film runs for 1 h 45 min. Jump along a timeline from 11:40 am: 20 minutes to 12:00 noon, 60 minutes to 1:00 pm, 25 minutes to 1:25 pm. Check the jumps: $20 + 60 + 25 = 105$ minutes, the film's length.

$\therefore$ The film finishes at 1:25 pm, which is 13:25 in 24-hour form.

Example 4 — unscaffolded

Noah's night shift at a bakery starts at 22:30 and finishes at 06:15 the next morning. How long is the shift?

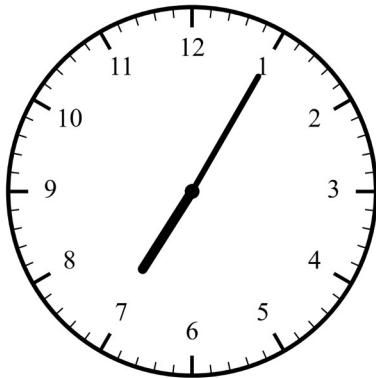
Work: from 22:30 to midnight (24:00) is 1 h 30 min. From midnight (00:00) to 06:15 is 6 h 15 min. Add the two parts across midnight: 1 h 30 min + 6 h 15 min is 7 h 45 min.

$\therefore$ The shift is 7 h 45 min long.

Practice questions

Scaffolded

Q1. The classroom clock looks like this in the morning.



- - (a) Write the time in words.
- - (b) Write the time on a 12-hour digital clock.
- - (c) Write the time on a 24-hour digital clock.

Q2. Change each digital time to the other form.

- - (a) 3:45 pm to 24-hour form.
- - (b) 08:15 to 12-hour form.
- - (c) 12:20 am to 24-hour form.

Q3. Change to the smaller unit.

- - (a) 5 min to seconds.
- - (b) 3 h to minutes.
- - (c) Show that 4 days is 96 h.

Q4. Rename each time.

- - (a) 130 min in hours and minutes.
- - (b) 2 h 15 min in minutes.
- - (c) 90 s in minutes and seconds.

Q5. How long is it between these times? Give each answer in hours and minutes.

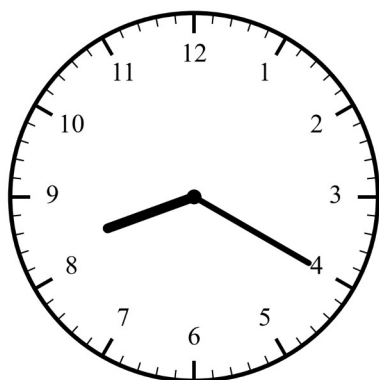
- (a) 2:15 pm to 3:00 pm.
- (b) 9:20 am to 11:05 am.
- (c) 14:30 to 16:10.

Q6. Calendar facts.

- (a) How many days are in September 2026?
- (b) How many days are in February 2026? Say why.
- (c) 5 August 2026 is a Wednesday. What day name is 19 August 2026?

Un scaffolded

Q7. The lounge-room clock shows this time in the evening. Write the time in words, on a 12-hour digital clock and on a 24-hour digital clock.



Q8. Bayline Coaches runs Route 55 between Wattle Flat and Seabrook. The daytime timetable is below.

BAYLINE COACHES — Route 55	
Wattle Flat to Seabrook	
Depart Wattle Flat	Arrive Seabrook
06:50	07:33
07:42	08:25
09:15	09:58
12:05	12:48
16:55	17:38
19:30	20:13
22:40	23:23
All times are 24-hour times. Every service takes 43 minutes.	

Made-up data: Bayline Coaches and every time in this timetable are made up for this section.

- (a) How long does one run of the route take? Check a second run to be sure.
- (b) Write the 16:55 departure in 12-hour form.
- (c) Write the 23:23 arrival in Seabrook in 12-hour form.

Q9. Unit changes.

- (a) Change 2.5 h to minutes.
- (b) Show that 1 week is 168 h.
- (c) Change 360 s to minutes.

Q10. A parking machine gives a ticket for 1.5 h. Mia buys her ticket at 10:50 am.

- (a) Change 1.5 h to minutes.
- (b) Write your answer to (a) in hours and minutes.
- (c) What time does the ticket run out?

Q11. Lena starts a night shift at 21:45 and finishes at 05:15 the next morning.

- - (a) How long is it from 21:45 to midnight?
- - (b) How long is the whole shift?
- - (c) Write the whole shift in decimal hours.

Q12. A phone plan starts on 31 May 2026 and renews each month on the same date.

- - (a) The plan renews one month later. What is the date?
- - (b) What is the date 12 months after the plan starts?
- - (c) The plan's contract runs into February 2028. How many days are in that month? Say why.

Q13. A library loan runs for one month from the day the book is borrowed. A book is borrowed on Thursday 29 January 2026.

- - (a) The library counts three weeks instead. What is the due date, and what day name?
- - (b) Using the one-month rule, what is the due date in 2026, and what day name?
- - (c) The same book is borrowed on 29 January 2028. Using the one-month rule, what is the due date?

Q14. Sam takes medicine every 6 hours. The first dose is at 8:20 am.

- - (a) What time is the second dose?
- - (b) What time is the third dose?
- - (c) Write all three dose times in 24-hour form.

Q15. A netball match starts at 11:10 am. It has four quarters of 15 min each. Between the quarters there are breaks of 3 min, then 10 min at half time, then 3 min.

- - (a) How many minutes of play are there in total?
- - (b) How many minutes of breaks are there in total?
- - (c) What time does the match finish?

Q16. One music track runs for 254 s.

- - (a) Show that 254 s is 4 min 14 s.
- - (b) Round 254 s to the nearest minute.
- - (c) A playlist has two tracks, one of 254 s and one of 187 s. How long is the playlist, in minutes and seconds?

Q17. Zara's timesheet for Monday shows a start of 08:45 and a finish of 15:30, with a 30 min unpaid lunch break.

- - (a) How many hours was Zara paid for on Monday?
- - (b) Zara works the same paid time each day from Monday to Friday. How many paid hours is that for the week?
- - (c) Write your answer to (a) in decimal hours, exact to two decimal places.

Q18. Priya catches the 07:18 train from Wattle Flat on Tuesday 12 May 2026. The train reaches Central at 08:41. She has an appointment at Central at 9:15 am.

- - (a) How long is the train trip?
- - (b) How long is it from the train arriving to the appointment?
- - (c) The clinic is a 25 min walk from Central station. If Priya catches this train, what time does she reach the clinic? Does she make her appointment?

Answers

Q1 (a) Five past seven. (b) 7:05 am. (c) 07:05. **Q2** (a) 15:45. (b) 8:15 am. (c) 00:20. **Q3** (a) 300 s. (b) 180 min. (c) $4 \times 24 = 96$, so 4 days is 96 h. **Q4** (a) 2 h 10 min. (b) 135 min. (c) 1 min 30 s. **Q5** (a) 45 min. (b) 1 h 45 min. (c) 1 h 40 min. **Q6** (a) 30 days. (b) 28 days, because 2026 is not a leap year. (c) Wednesday. **Q7** Twenty past eight; 8:20 pm; 20:20. **Q8** (a) 43 min. (b) 4:55 pm. (c) 11:23 pm. **Q9** (a) 150 min. (b) $7 \times 24 = 168$, so 168 h. (c) 6 min. **Q10** (a) 90 min. (b) 1 h 30 min. (c) 12:20 pm. **Q11** (a) 2 h 15 min. (b) 7 h 30 min. (c) 7.5 h. **Q12** (a) 30 June 2026. (b) 31 May 2027. (c) 29 days, because 2028 is a leap year. **Q13** (a) Thursday 19 February 2026. (b) Saturday 28 February 2026. (c) 29 February 2028. **Q14** (a) 2:20 pm. (b) 8:20 pm. (c) 08:20, 14:20 and 20:20. **Q15** (a) 60 min. (b) 16 min. (c) 12:26 pm. **Q16** (a) 4 min 14 s. (b) 4 min, to the nearest minute. (c) 7 min 21 s. **Q17** (a) 6 h 15 min. (b) 31 h 15 min. (c) 6.25 h. **Q18** (a) 1 h 23 min. (b) 34 min. (c) 09:06, so yes, she makes it.

Fully-worked solutions

Q1. (a) The minute hand points at 1, which is $1 \times 5 = 5$ minutes, and the hour hand has passed 7, so the time is five past seven. (b) It is morning, so am: 7:05 am. (c) Morning times keep the same numbers: 07:05.

Q2. (a) pm to 24-hour: $3 + 12 = 15$, so 15:45. (b) 08:15 is before noon, so 8:15 am. (c) 12:20 am is just after midnight, so 00:20.

Q3. (a) $5 \times 60 = 300$, so 300 s. (b) $3 \times 60 = 180$, so 180 min. (c) 1 day is 24 h, and $4 \times 24 = 96$, so 4 days is 96 h.

Q4. (a) $130 \div 60 = 2$ remainder 10, so 130 min is 2 h 10 min. (b) $2 \times 60 = 120$, and $120 + 15 = 135$, so 135 min. (c) $90 \div 60 = 1$ remainder 30, so 90 s is 1 min 30 s.

Q5. (a) From 2:15 pm to 3:00 pm is $60 - 15 = 45$ min. (b) Jump: 9:20 am to 10:00 am is 40 min, 10:00 am to 11:00 am is 60 min, 11:00 am to 11:05 am is 5 min; $40 + 60 + 5 = 105$ min, which is 1 h 45 min. (c) Columns: $16:10 - 14:30$; borrow, so 16:10 becomes 15:70; $70 - 30 = 40$ min and $15 - 14 = 1$ h, so 1 h 40 min.

Q6. (a) September has 30 days. (b) 2026 does not divide by 4 exactly, so 2026 is not a leap year and February 2026 has 28 days. (c) 19 August is exactly two weeks after 5 August, and day names repeat every 7 days, so it is a Wednesday.

Q7. The minute hand points at 4, which is $4 \times 5 = 20$ minutes, and the hour hand has passed 8, so the time is twenty past eight. It is evening, so 8:20 pm. In 24-hour form, $8 + 12 = 20$, so 20:20.

Q8. (a) Take the first run: 09:15 to 09:58 is $58 - 15 = 43$ min. Check the second run: 10:35 to 11:18 is 43 min as well ($35 + 43 = 78$, which is 1 h 18 min). So one run takes 43 min. (b) $16 - 12 = 4$, so 16:55 is 4:55 pm. (c) $23 - 12 = 11$, so 23:23 is 11:23 pm.

Q9. (a) $2.5 \times 60 = 150$, so 150 min. (b) 1 week is 7 days and 1 day is 24 h, and $7 \times 24 = 168$, so 1 week is 168 h. (c) $360 \div 60 = 6$, so 6 min.

Q10. (a) $1.5 \times 60 = 90$, so 90 min. (b) $90 \div 60 = 1$ remainder 30, so 1 h 30 min. (c) 10:50 am + 1 h is 11:50 am, and 11:50 am + 30 min is 12:20 pm, so the ticket runs out at 12:20 pm.

Q11. (a) 21:45 to 24:00 is 2 h 15 min. (b) Midnight to 05:15 is 5 h 15 min, and 2 h 15 min + 5 h 15 min is 7 h 30 min. (c) 30 min is $30 \div 60 = 0.5$ h, so 7 h 30 min is 7.5 h.

Q12. (a) One month after 31 May would be 31 June, but June has only 30 days, so the date moves back to 30 June 2026. (b) Twelve months on is the same date a year later, and May has 31 days, so 31 May 2027. (c) 2028 divides by 4 exactly, so 2028 is a leap year and February 2028 has 29 days.

Q13. (a) Three weeks is 21 days. From 29 January, 2 days finish January (31 January), then 19 days into February: the due date is 19 February 2026. Twenty-one days is exactly three weeks, so the day name is still Thursday. (b) One month after 29 January would be 29 February, but 2026 is not a leap year, so the date moves back to 28 February 2026, which is a Saturday. (c) 2028 is a leap year, so February 2028 has a 29th day and the due date is 29 February 2028.

Q14. (a) $8:20 \text{ am} + 6 \text{ h}$ is $2:20 \text{ pm}$. (b) $2:20 \text{ pm} + 6 \text{ h}$ is $8:20 \text{ pm}$. (c) $8:20 \text{ am}$ is $08:20$, $2:20 \text{ pm}$ is $2 + 12 = 14$, so $14:20$, and $8:20 \text{ pm}$ is $8 + 12 = 20$, so $20:20$.

Q15. (a) $4 \times 15 = 60$ min of play. (b) $3 + 10 + 3 = 16$ min of breaks. (c) Play plus breaks is $60 + 16 = 76$ min, which is $1 \text{ h } 16 \text{ min}$. Follow the match: $11:10 \text{ am} + 15 \text{ min} = 11:25 \text{ am}$; $+ 3 \text{ min} = 11:28 \text{ am}$; $+ 15 \text{ min} = 11:43 \text{ am}$; $+ 10 \text{ min} = 11:53 \text{ am}$; $+ 15 \text{ min} = 12:08 \text{ pm}$; $+ 3 \text{ min} = 12:11 \text{ pm}$; $+ 15 \text{ min} = 12:26 \text{ pm}$. The match finishes at $12:26 \text{ pm}$.

Q16. (a) $4 \times 60 = 240$, and $254 - 240 = 14$, so 254 s is $4 \text{ min } 14 \text{ s}$. (b) The 14 s left over is less than half a minute, so to the nearest minute 254 s is 4 min . (c) $254 + 187 = 441 \text{ s}$. $441 \div 60 = 7$ remainder 21 , so the playlist is $7 \text{ min } 21 \text{ s}$. (Check: 187 s is $3 \text{ min } 7 \text{ s}$, and $4 \text{ min } 14 \text{ s} + 3 \text{ min } 7 \text{ s}$ is $7 \text{ min } 21 \text{ s}$.)

Q17. (a) $08:45$ to $15:30$ is $6 \text{ h } 45 \text{ min}$. Take away the 30 min unpaid break: $6 \text{ h } 45 \text{ min} - 30 \text{ min}$ is $6 \text{ h } 15 \text{ min}$ paid. (b) $6 \text{ h } 15 \text{ min}$ is $6 \times 60 + 15 = 375 \text{ min}$. Five days: $5 \times 375 = 1875 \text{ min}$, and $1875 \div 60 = 31$ remainder 15 , so $31 \text{ h } 15 \text{ min}$ for the week. (c) 15 min is $15 \div 60 = 0.25 \text{ h}$, so $6 \text{ h } 15 \text{ min}$ is 6.25 h (exact to two decimal places).

Q18. (a) Columns: $08:41 - 07:18$ gives $41 - 18 = 23 \text{ min}$ and $8 - 7 = 1 \text{ h}$, so $1 \text{ h } 23 \text{ min}$. (b) $08:41$ to $09:00$ is 19 min and $09:00$ to $09:15$ is 15 min , so $19 + 15 = 34 \text{ min}$. (c) $08:41 + 25 \text{ min}$ is $09:06$. That is before $9:15 \text{ am}$, so yes, Priya makes her appointment.

Chapter 4 Quantity and measures — 4E Temperature

Theory

The study design names the skill this section builds: reading time and temperature in both analogue and digital forms, and making sense of the readings (Unit 1, Area of Study 3). This section takes the temperature half of that line, from the tube thermometer on a wall to the digits on a fridge door. Source: VCAA, VCE Vocational Major Numeracy Study Design, retrieved 2026-10-08.

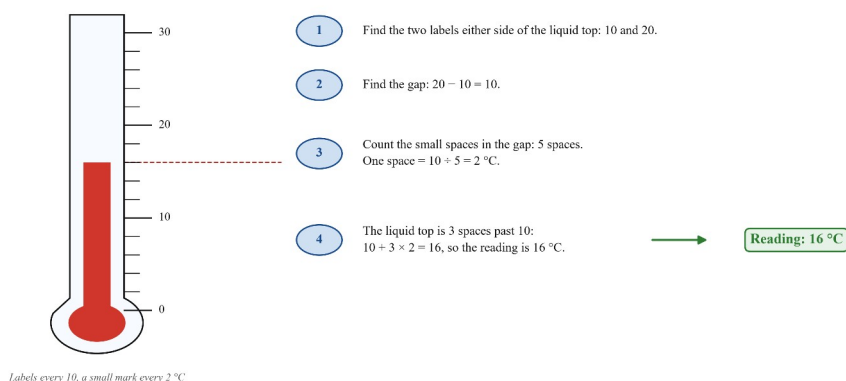
About the data in this section. The weather readings, fridges, towns and numbers here are **made up** (not real): pretend weather, pretend fridges and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

What temperature is. Temperature is how hot or cold something is. This book measures it in **degrees Celsius**, written $^{\circ}\text{C}$. A measurement is a number and a unit written together: 23°C means 23 degrees Celsius. Always write the unit — a bare number on an answer sheet tells nobody what was measured.

Analogue and digital displays. An **analogue** display shows a number by the position of something: the top of the liquid in a tube thermometer, or a needle on a dial. You read the number off a scale. A **digital** display shows the number for you, as digits on a screen: 4.5°C , 36.5°C . Both give a temperature in $^{\circ}\text{C}$. The only difference is who does the reading.

Reading an analogue thermometer: the four steps. Section 1E gives four steps for reading any scale. Here they are on a tube thermometer:

1. Find the two labels either side of the liquid top.
2. Find the gap between those labels.
3. Count the small spaces in the gap; one space = gap $\div$ spaces.
4. Count the spaces from the lower label up to the liquid top, and add.



On that thermometer the labels either side of the liquid top are 10 and 20. The gap is $20 - 10 = 10$, and the gap holds 5 small spaces, so one space is

$$10 \div 5 = 2^{\circ}\text{C}$$

The liquid top sits 3 spaces past 10:

$$10 + 3 \times 2 = 16^{\circ}\text{C}$$

So the scale reads 16°C .

Refresher: sharing a gap out over spaces. Step 3 is always one division: the gap shared out over the spaces in it.

Gap between labels	Spaces in the gap	One space
10	5	$10 \div 5 = 2$

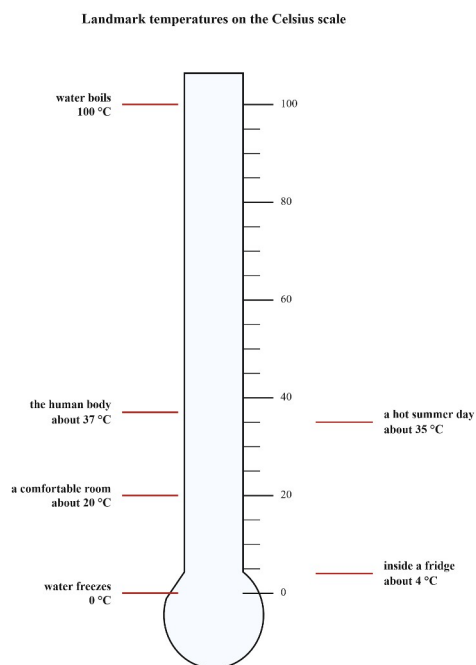
Gap between labels	Spaces in the gap	One space
5	5	$5 \div 5 = 1$
50	5	$50 \div 5 = 10$
10	4	$10 \div 4 = 2.5$

Reading a digital display. A digital display hands you the number already read: 4.5 °C, 36.5 °C, 12.8 °C. The skill left for you is interpreting the number — knowing what the part after the decimal point means, and comparing the reading with another number or with a limit such as “keep at 5 °C or below”.

Refresher: halves and tenths. The first place after the decimal point is *tenths*. 0.5 is five tenths, which is one half, so 36.5 °C sits halfway between 36 °C and 37 °C — half a degree warmer than 36 °C. A display showing 4.5 °C means four and a half degrees.

Landmark temperatures to know. Some temperatures come up often enough to keep in mind. They give you something to check a reading against.

Landmark	Temperature
Water freezes	0 °C
Inside a fridge	about 4 °C
A comfortable room	about 20 °C
A very hot day	about 35 °C
Normal body temperature	about 37 °C
A fever starts	38 °C or above
Water boils	100 °C
An oven baking a cake	about 180 °C



If a reading lands nowhere near its landmark, read the scale again. A fridge reading of 40 °C would be hotter than a person — a sign to check the scale.

Comparing and ordering temperatures. To **compare** two temperatures is to say which is hotter. To **order** three or more is to line them up, coldest to hottest or hottest to coldest. With whole numbers, the bigger number is the hotter temperature. With decimals, compare the whole-number parts first; if those are equal, the tenths decide.

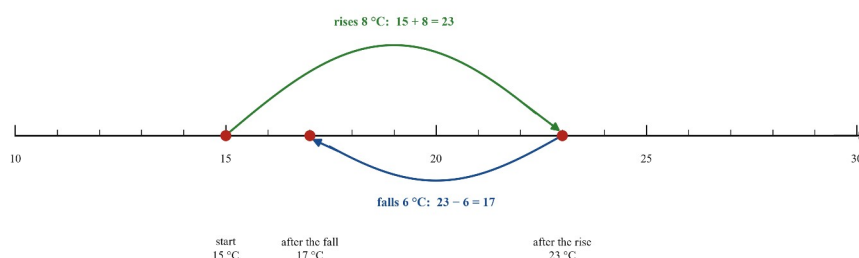
Refresher: comparing and ordering decimals. Compare whole-number parts first: $36.9 < 37.5$, because $36 < 37$. If the whole-number parts are equal, the tenths decide: $36.5 < 36.9$, because five tenths is less than nine tenths. So coldest to hottest those three readings run 36.5, 36.9, 37.5.

Rises and falls. When something warms up, its temperature **rises**: add. When something cools, its temperature **falls**: subtract. The **difference** between two temperatures is how much hotter one is than the other: take the smaller number from the bigger one.

Picture a day that starts at 15°C , rises 8°C by midday, then falls 6°C by night:

$$15 + 8 = 23^{\circ}\text{C}$$

$$23 - 6 = 17^{\circ}\text{C}$$



Refresher: finding the difference (counting on). To find the difference between 19 and 27, count on from 19: up 1 to 20, then up 7 more to 27. The count-on is $1 + 7 = 8$, so the difference is 8°C . Counting on and subtracting give the same answer: $27 - 19 = 8$.

Rounding temperatures. Displays and probes often show tenths (38.6°C). Reports and forecasts usually give whole degrees. To round to the nearest whole degree, look at the tenths digit: 5 or more, round up; 4 or less, keep the whole part as it is.

Refresher: rounding to the nearest whole degree.

Reading	Tenths digit	Nearest whole degree
38.6°C	6, round up	39°C
36.4°C	4, keep	36°C
31.4°C	4, keep	31°C

Always say what you rounded to — “to the nearest whole degree” — so the reader knows how exact the number is.

Temperatures in tables and charts. Forecasts and temperature logs put readings in tables and line charts. A table like this one gives the **minimum** (the lowest reading of the day, usually overnight) and the **maximum** (the highest reading of the day, usually mid-afternoon) for each day:

Day	Minimum	Maximum
Wednesday	8°C	19°C
Thursday	10°C	21°C
Friday	12°C	25°C

Made-up data: this forecast table is made up for this section.

Read a line chart in three moves: read the **title** (what was measured, and where); read the **axis labels** (times along the bottom, $^{\circ}\text{C}$ up the side); then find each **point** and read across to the $^{\circ}\text{C}$ axis. The highest point is the hottest time of the day; the lowest point is the coldest.

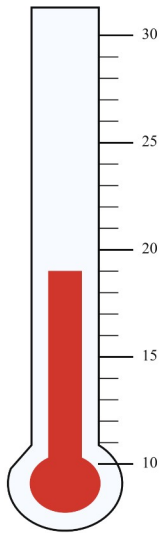
Technology. Weather apps, food probes and oven displays all read temperature for you, and a calculator will do the arithmetic. Good to know: pen, paper and the steps in this section are always enough. Every reading and every calculation here can be done by hand.

Worked examples

Example 1 — scaffolded

The picture shows the thermometer at the sports ground. Labels sit every 5, with five small spaces between labels. Read the temperature.

The thermometer
at the sports ground



Working	Comment
Labels either side of the liquid top: 15 and 20	Step 1
Gap: $20 - 15 = 5$	Step 2
Five spaces in the gap, so one space = $5 \div 5 = 1\text{ }^{\circ}\text{C}$	Step 3
Liquid top is 4 spaces past 15: $15 + 4 \times 1 = 19$	Step 4
The thermometer reads $19\text{ }^{\circ}\text{C}$	Answer, with the unit

Example 2 — scaffolded

A food-safety fridge shows $4.5\text{ }^{\circ}\text{C}$ on its digital display. The sign on the door says “keep food at $5\text{ }^{\circ}\text{C}$ or below”. Is the food stored safely?



The fridge display



Working

Comment

Display: 4.5°C

A digital display gives the number

The limit is 5°C or below

“Or below” means 5 itself is safe

$4.5 < 5$

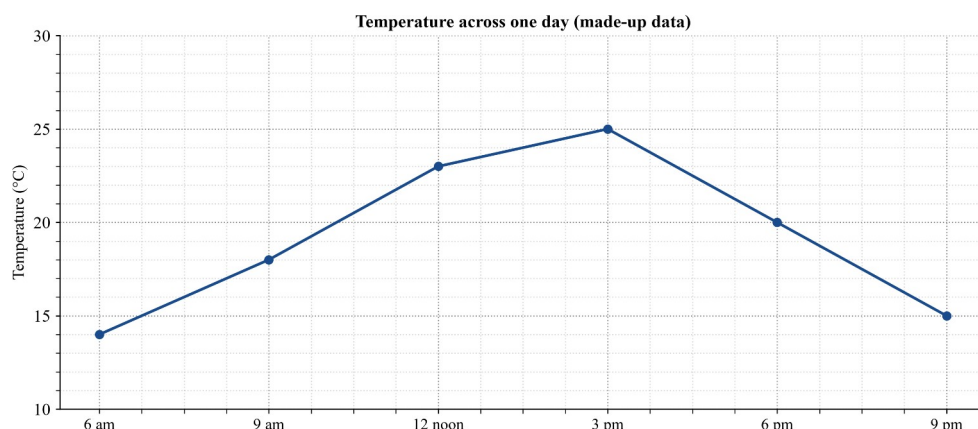
Compare the whole parts: $4 < 5$

Yes — the food is stored safely

Answer in words

Example 3 — unscaffolded

The chart shows the temperature outside a shop across one day. Find the temperature at noon, the rise from 6 am to 3 pm, and the hottest time on the chart.



The point above 12 noon reads across to 23, so the temperature at noon is 23°C . The rise from 6 am to 3 pm is the difference between those two readings: $25 - 14 = 11$, so the temperature rose 11°C . The highest point on the chart is 25°C , above 3 pm, so 3 pm is the hottest time shown.

$\therefore$ At noon it is 23°C ; the rise from 6 am to 3 pm is 11°C ; and the hottest time on the chart is 3 pm.

Example 4 — unscaffolded

A cafe must keep soup at 60°C or above. A probe in the pot reads 54°C , so the soup is not hot enough yet. The heater is turned up and the soup rises 8°C . Is the soup now hot enough to serve?

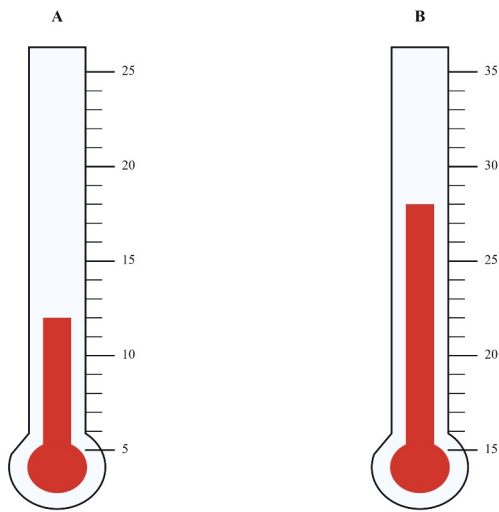
The gap to the limit is $60 - 54 = 6$, so the soup starts 6°C short of 60°C . After the rise the probe reads $54 + 8 = 62^{\circ}\text{C}$. The rule is 60°C or above, and $62 \geq 60$, so the soup is now hot enough.

$\therefore$ The soup reaches 62°C , which is at or above 60°C , so it is safe to serve.

Practice questions

Scaffolded

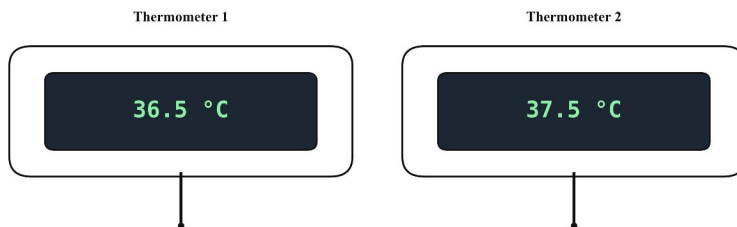
Q1. Two tube thermometers are shown. Each has labels every 5, with five small spaces between labels.



Two tube thermometers

- (a) What is one small space worth on either thermometer?
- (b) Read thermometer A.
- (c) Read thermometer B.

Q2. Two digital bath thermometers are shown.



Two digital bath thermometers

- (a) What does thermometer 1 read?
- (b) What does thermometer 2 read?
- (c) Which bath is hotter? How do you know?

Q3. Give each landmark temperature from memory.

- (a) Water boils at about how many °C?
- (b) Normal body temperature is about how many °C?
- (c) A comfortable room is about how many °C?

Q4. A food-safety fridge shows 6.5 °C on its display. The sign on the door says “keep food at 5 °C or below”.

- (a) What temperature does the display show?
- (b) Is 6.5 °C above or below 5 °C?
- (c) Is the food stored safely?

Q5. The temperature at a market is 13°C at 7 am. By 2 pm it has risen 8°C . Overnight it falls 6°C from the 2 pm reading.

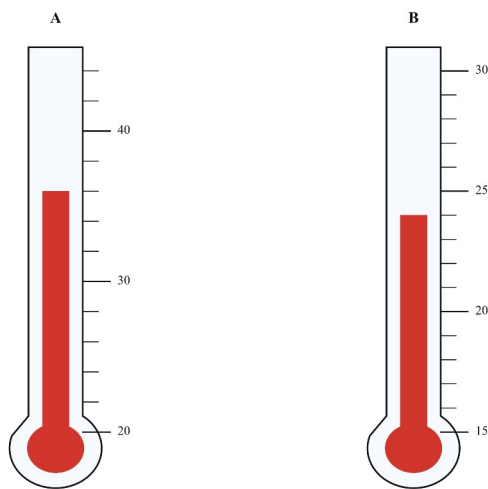
- (a) Write the calculation for the 2 pm temperature.
- (b) What is the 2 pm temperature?
- (c) What is the overnight temperature?

Q6. At the pool, the water is 26°C and the air is 33°C . Swimmers want the water at 30°C .

- (a) Which is warmer, the air or the water?
- (b) How much warmer is it?
- (c) How many degrees must the water rise to reach 30°C ?

Unscaffolded

Q7. Read both thermometers below.



Read each scale with the four steps from Section 1E.

- (a) What is one small space worth on thermometer A?
- (b) What does thermometer A read?
- (c) What does thermometer B read?

Q8. A digital weather station shows the day's maximum as 31.4°C and the day's minimum as 18.6°C .

- (a) What is the difference between the maximum and the minimum?
- (b) Round the maximum to the nearest whole degree.
- (c) Round the minimum to the nearest whole degree.

Q9. A nurse takes four bath readings: 36.9°C , 37.5°C , 36.5°C and 38.2°C .

- (a) Which reading is the coldest?
- (b) Which reading is the hottest?
- (c) Order the four readings from coldest to hottest.

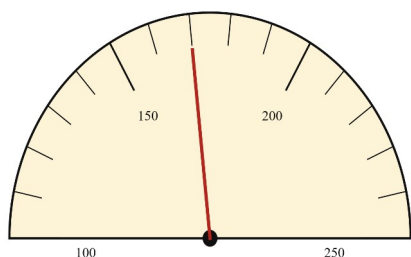
Q10. Choose from 0°C , 4°C and 180°C .

- (a) A cake baking in an oven.
- (b) Inside a fridge.
- (c) Water freezing.

Q11. The temperature is 8°C at 6 am. By noon it has risen 11°C . By 8 pm it has fallen 7°C from the noon reading.

- (a) What is the noon temperature?
- (b) What is the 8 pm temperature?
- (c) How much warmer is 8 pm than 6 am?

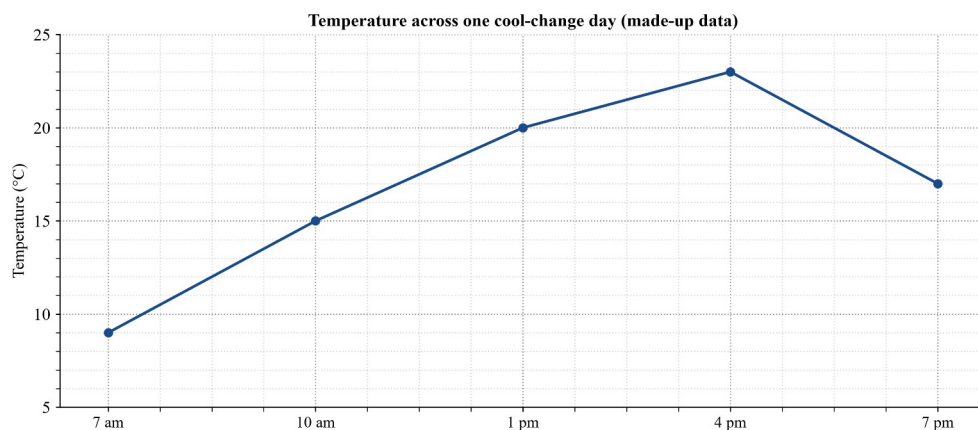
Q12. The picture shows an oven dial. Labels sit every 50, with five small spaces between labels.



The oven dial

- (a) What is one small space worth?
- (b) Read the needle.
- (c) A cake needs 180°C . How many more degrees must the oven rise?

Q13. The chart shows the temperature in a park across one day.



Made-up data: this chart is made up for this section.

- (a) What is the temperature at 1 pm?
- (b) What is the hottest time on the chart?
- (c) What is the fall in temperature from 4 pm to 7 pm?

Q14. A five-day forecast:

Day	Minimum	Maximum
Monday	6 °C	17 °C
Tuesday	8 °C	20 °C
Wednesday	11 °C	23 °C
Thursday	14 °C	28 °C
Friday	9 °C	19 °C

Made-up data: this forecast table is made up for this section.

- (a) Which day has the hottest maximum, and what is it?
- (b) What is the minimum on Wednesday?
- (c) How much higher is Thursday's maximum than Wednesday's maximum?

Q15. A pie must reach 75 °C in its middle before it is served. A temperature probe reads 66 °C.

- (a) How many more degrees must the pie rise?
- (b) The pie then rises 12 °C. What does the probe read now?
- (c) Is the pie hot enough to serve?

Q16. A child's temperature reads 38.6 °C. A fever is 38 °C or above, and normal body temperature is about 37 °C.

- (a) Does the child have a fever?
- (b) How many degrees above 37 °C is the reading?
- (c) Round the reading to the nearest whole degree.

Q17. A greenhouse is kept between 18 °C and 26 °C. At 8 am the display reads 15 °C.

- (a) Is 15 °C between 18 °C and 26 °C?
- (b) The heater lifts the temperature 6 °C. What is the new reading?
- (c) Is the new reading between 18 °C and 26 °C?

Q18. At noon, Northgate reads 27 °C and Westhaven reads 19 °C. By 6 pm Northgate has fallen 9 °C, while Westhaven still reads 19 °C.

Made-up data: Northgate and Westhaven are made-up towns.

- (a) How much hotter than Westhaven is Northgate at noon?
- (b) What does Northgate read at 6 pm?
- (c) Which town is warmer at 6 pm?

Answers

Q1. (a) 1°C (b) 12°C (c) 28°C **Q2.** (a) 36.5°C (b) 37.5°C (c) thermometer 2, because $37.5 > 36.5$ **Q3.** (a) 100°C (b) 37°C (c) 20°C **Q4.** (a) 6.5°C (b) above (c) no, 6.5 is not 5 or below **Q5.** (a) $13 + 8$ (b) 21°C (c) 15°C **Q6.** (a) the air (b) 7°C (c) 4°C **Q7.** (a) 2°C (b) 36°C (c) 24°C **Q8.** (a) 12.8°C (b) 31°C (c) 19°C , both to the nearest whole degree **Q9.** (a) 36.5°C (b) 38.2°C (c) $36.5, 36.9, 37.5, 38.2^{\circ}\text{C}$ **Q10.** (a) 180°C (b) 4°C (c) 0°C **Q11.** (a) 19°C (b) 12°C (c) 4°C **Q12.** (a) 10°C (b) 170°C (c) 10°C **Q13.** (a) 20°C (b) 4 pm (c) 6°C **Q14.** (a) Thursday, 28°C (b) 11°C (c) 5°C **Q15.** (a) 9°C (b) 78°C (c) yes, $78 \geq 75$ **Q16.** (a) yes, $38.6 \geq 38$ (b) 1.6°C (c) 39°C , to the nearest whole degree **Q17.** (a) no, 15 is under 18 (b) 21°C (c) yes **Q18.** (a) 8°C (b) 18°C (c) Westhaven, 19°C against 18°C

Fully-worked solutions

Q1. (a) The gap between labels is $20 - 15 = 5$, shared over 5 spaces: $5 \div 5 = 1^{\circ}\text{C}$ per space. (b) A: the liquid top is 2 spaces past 10: $10 + 2 \times 1 = 12^{\circ}\text{C}$. (c) B: the liquid top is 3 spaces past 25: $25 + 3 \times 1 = 28^{\circ}\text{C}$.

Q2. (a) 36.5°C . (b) 37.5°C . (c) Thermometer 2: the whole parts differ ($37 > 36$), so $37.5 > 36.5$.

Q3. (a) Water boils at about 100°C . (b) Normal body temperature is about 37°C . (c) A comfortable room is about 20°C .

Q4. (a) 6.5°C . (b) Above: $6.5 > 5$. (c) No — the sign allows 5°C or below, and 6.5°C is above 5°C , so the food is not stored safely.

Q5. (a) $13 + 8$. (b) $13 + 8 = 21^{\circ}\text{C}$. (c) $21 - 6 = 15^{\circ}\text{C}$.

Q6. (a) The air: $33 > 26$. (b) $33 - 26 = 7^{\circ}\text{C}$. (c) $30 - 26 = 4^{\circ}\text{C}$.

Q7. (a) A: the gap $40 - 30 = 10$ is shared over 5 spaces: $10 \div 5 = 2^{\circ}\text{C}$ per space. (b) The liquid top is 3 spaces past 30: $30 + 3 \times 2 = 36^{\circ}\text{C}$. (c) B: the gap $25 - 20 = 5$ over 5 spaces gives 1°C per space; the liquid top is 4 spaces past 20: $20 + 4 \times 1 = 24^{\circ}\text{C}$.

Q8. (a) $31.4 - 18.6 = 12.8^{\circ}\text{C}$. (b) The tenths digit is 4, so keep the whole part: 31°C to the nearest whole degree. (c) The tenths digit is 6, so round up: 19°C to the nearest whole degree.

Q9. (a) 36.5°C . (b) 38.2°C . (c) Whole parts first, then tenths: $36.5, 36.9, 37.5, 38.2^{\circ}\text{C}$.

Q10. (a) A cake baking in an oven: about 180°C . (b) Inside a fridge: about 4°C . (c) Water freezing: 0°C .

Q11. (a) $8 + 11 = 19^{\circ}\text{C}$. (b) $19 - 7 = 12^{\circ}\text{C}$. (c) $12 - 8 = 4^{\circ}\text{C}$.

Q12. (a) The gap $150 - 100 = 50$ is shared over 5 spaces: $50 \div 5 = 10^{\circ}\text{C}$ per space. (b) The needle sits 2 spaces past 150: $150 + 2 \times 10 = 170^{\circ}\text{C}$. (c) $180 - 170 = 10^{\circ}\text{C}$.

Q13. (a) The point above 1 pm reads across to 20°C . (b) The highest point is 23°C , above 4 pm. (c) $23 - 17 = 6^{\circ}\text{C}$.

Q14. (a) Thursday, with a maximum of 28°C . (b) 11°C . (c) $28 - 23 = 5^{\circ}\text{C}$.

Q15. (a) $75 - 66 = 9^{\circ}\text{C}$. (b) $66 + 12 = 78^{\circ}\text{C}$. (c) Yes: $78 \geq 75$, so the pie is hot enough to serve.

Q16. (a) Yes: a fever is 38°C or above, and $38.6 \geq 38$. (b) $38.6 - 37 = 1.6^{\circ}\text{C}$. (c) The tenths digit is 6, so round up: 39°C to the nearest whole degree.

Q17. (a) No: 15 is under the low limit of 18 , so it is not between 18 and 26 . (b) $15 + 6 = 21^{\circ}\text{C}$. (c) Yes: 21 sits between 18 and 26 .

Q18. (a) $27 - 19 = 8^{\circ}\text{C}$. (b) $27 - 9 = 18^{\circ}\text{C}$. (c) Westhaven: at 6 pm Westhaven reads 19°C and Northgate reads 18°C , and $19 > 18$.

Chapter 4 Quantity and measures — 4F Estimation, measurement tools and accuracy

Theory

In the study design (Unit 1, Area of Study 3), the key knowledge for this section covers the usual measuring tools, the usual ways to estimate a measurement, and how accurate a measurement needs to be. The key skill is to estimate and to measure everyday objects and distances that you know, using measuring tools.

Source: VCAA, VCE Vocational Major Numeracy Study Design, retrieved 2026-10-09.

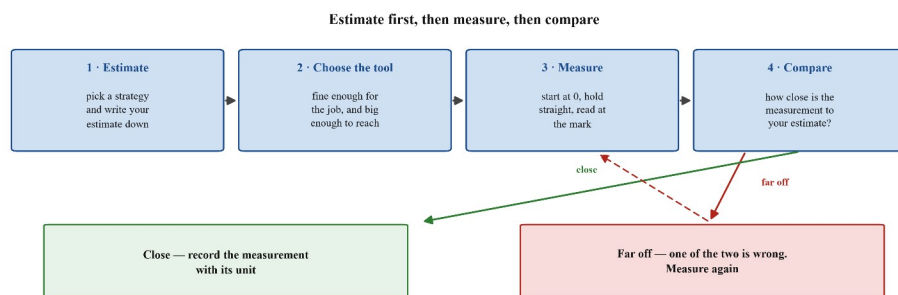
Chapter 1 already gave you the pieces this section joins together: benchmarks and estimation as a checking habit (Section 1C), and how to hold a tool and read its marks (Section 1E). This section puts them to work on real measuring jobs: how to estimate a length, a mass, a capacity or a distance *before* you measure it, how to pick a tool that is fine enough for the job, and how to record a measurement at the accuracy the job actually needs.

About the data in this section. The shelves, gardens, kitchens, fences and readings in this section are **made up** (not real): pretend jobs and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

Estimate, then measure. An *estimate* is a sensible near-number you build from something you already know — it is not a wild guess. You estimate before you measure for three reasons:

- the estimate tells you roughly what to expect, so a silly reading jumps out at you;
- the estimate is a check on the measurement afterwards — if the two are far apart, one of them is wrong;
- plenty of jobs never need a measurement at all: will the couch fit through the door, is 3 m of hose enough or 30 m?

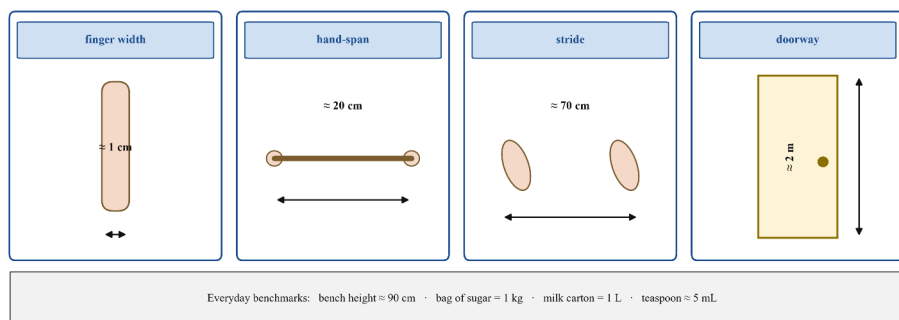
The habit for the whole section is this loop:



Strategy 1: use a benchmark. A *benchmark* is a size you already know, carried in your head or on your body. Hold the thing you are estimating against a benchmark and count how many benchmarks fit.

Benchmark	About
width of your little finger	1 cm
hand-span, thumb tip to little-finger tip	20 cm
one stride (a normal walking step)	70 cm
a doorway, floor to top	2 m
a kitchen bench, floor to top	90 cm
a bag of sugar from the shop	1 kg
a carton of milk	1 L
a teaspoon of liquid	5 mL

Benchmarks you carry with you



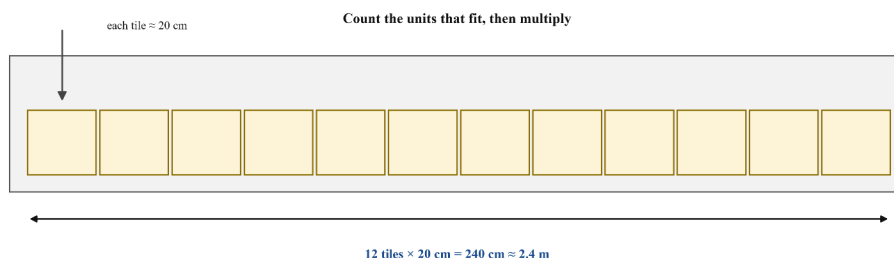
Worked model: a kitchen bench fits about 10 of your hand-spans end to end. Ten lots of about 20 cm is $10 \times 20 = 200$ cm, and 200 cm is 2 m — so the bench is about 2 m long, which matches the 90 cm-high bench being a bit longer than it is tall.

Refresher: the unit facts this section leans on. Estimating and measuring keep crossing between units, so these five facts from Section 4A stay close at hand:

Family	Fact
Length	10 mm = 1 cm
Length	100 cm = 1 m
Length	1000 m = 1 km
Mass	1000 g = 1 kg
Capacity	1000 mL = 1 L

Strategy 2: count the units that fit. When something is built out of repeats — floor tiles, pavers, fence panels, bricks — count the repeats and multiply by the size of one.

Worked model: a bathroom wall is tiled with square tiles, and 12 tiles fit along it. Each tile is about 20 cm wide, so the wall is about $12 \times 20 = 240$ cm, which is about 2.4 m.



Strategy 3: break it into easier parts. An awkward length often splits into two or three easy pieces. Estimate each piece and add.

Worked model: a walking track runs about 400 m from the car park to the creek, then about 300 m along the creek to the lookout. The whole track is about $400 + 300 = 700$ m.

Strategy 4: give a range, then close it in. A range is safe: if the true size sits inside your range, your range was right. Name the two ends first, then say which end it is closer to and land on a single near-number.

Worked model: a parcel on the bathroom scale sits between 1 kg and 2 kg, clearly closer to 2 kg — so call it about 1.8 kg. The range did the thinking; the single number is just the range closed in.

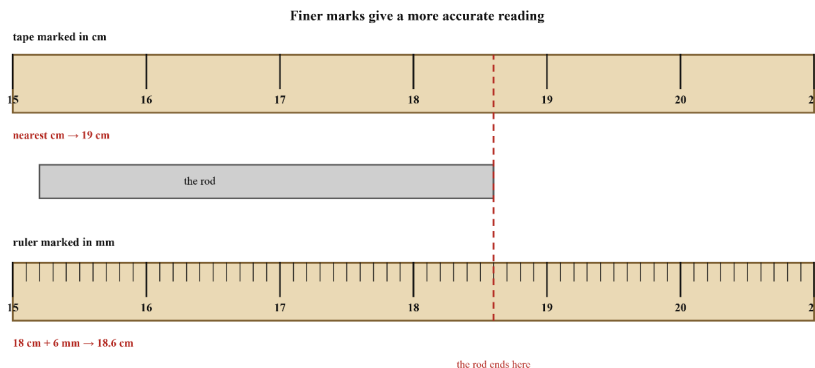
The tools, and how finely each one reads. Section 1E taught you how to hold these tools and read their marks. Here they are again with the question this section adds: what is the *smallest mark* on the tool? The smallest mark is the finest reading the tool can honestly give you.

Tool	Measures	Smallest mark	Jobs it suits
30 cm ruler	length	1 mm	desks, shelves, craft — anything up to 30 cm
tape measure	length	1 mm (some tapes 1 cm)	rooms, furniture, fabric, around curves
trundle wheel	long distances	1 m	paths, fence lines, ovals
kitchen scale	mass	1 g digital, about 50 g on a dial	ingredients, parcels
bathroom scale	mass	100 g	people, suitcases
measuring jug	capacity	25 mL (some jugs 10 mL)	liquids in recipes
measuring cup and spoons	capacity	5 mL (one teaspoon)	small amounts in recipes
oven or fridge thermometer	temperature	5 or 10 °C	ovens, fridges

A trundle wheel is the tool for long outdoor distances: a wheel on a handle that counts one metre per turn as you roll it along, so its readings come out in whole metres — and that is exactly as fine as those jobs need.

Refresher: reading a marked scale. When the labels on a tool skip past the mark you need, the four steps from Section 1E still do the work: read two labels that sit either side of the pointer; find the gap between them; divide the gap by the number of spaces to get one small space; then count on from the lower label. On a dial with labels 800 g and 1000 g and 4 spaces between them, the gap is 200 g and $200 \div 4 = 50$, so one small space is 50 g.

The smallest mark decides how finely you can read. Measure the same rod with two tools and the difference shows at once. On a tape marked in whole centimetres the rod's end sits between 18 cm and 19 cm, closer to 19, so the tape's honest reading is 19 cm to the nearest cm. On a ruler marked in millimetres the same end sits 6 small marks past 18 cm, so the ruler's reading is 18.6 cm. Neither tool is “wrong” — the mm ruler simply reads more finely.



Accuracy means how close a measurement is to the true size: the closer, the more accurate. A tool with finer marks can give a more accurate reading, because it leaves less guessing between marks.

Appropriate accuracy. *Appropriate accuracy* is the accuracy the job needs — no finer, no coarser. Three habits keep your recordings honest:

- **Record to the tool's smallest mark, and always with its unit.** A cm tape gives whole centimetres; write whole centimetres. A number written without its unit is not a measurement at all.
- **Match the fineness to the job.** Cutting glass wants the finest marks you have; buying a hose does not.
- **Never record finer than the tool can show.** Writing 142.37 cm off a tape marked in centimetres invents two decimal places the tape never measured. That is not accuracy, it is make-believe.

Job	Accuracy that fits	Why
cutting a pane of glass to fit a window frame	nearest mm	glass is cut once and cannot stretch
cutting a mount for a framed photo	nearest mm	millimetres show in a frame

Job	Accuracy that fits	Why
sewing a curtain	nearest cm	hems and folds hide a centimetre
buying a garden hose	nearest m	hose is sold in whole metres, and spare length is fine
planning a walk along a track	nearest 100 m	the plan only needs “about an hour or so”

Refresher: rounding to a stated accuracy. Rounding a measurement to a stated accuracy uses the rule from Section 2C: look at the digit one place right of the place you are rounding to; 0–4 rounds down, 5–9 rounds up.

Measurement	Round to	The digit you check	Answer
183 cm	nearest 10 cm	ones digit 3, down	180 cm
358 cm	nearest 10 cm	ones digit 8, up	360 cm
950 m	nearest 100 m	tens digit 5, up	1000 m
4370 m	nearest km	hundreds digit 3, down	4000 m
1.94 kg	nearest 100 g	1940 g, tens digit 4, down	1900 g, that is 1.9 kg

And every time you round, say what you rounded to — “to the nearest 10 cm”, “to the nearest kg” — because a rounded number without its stated accuracy tells the reader nothing.

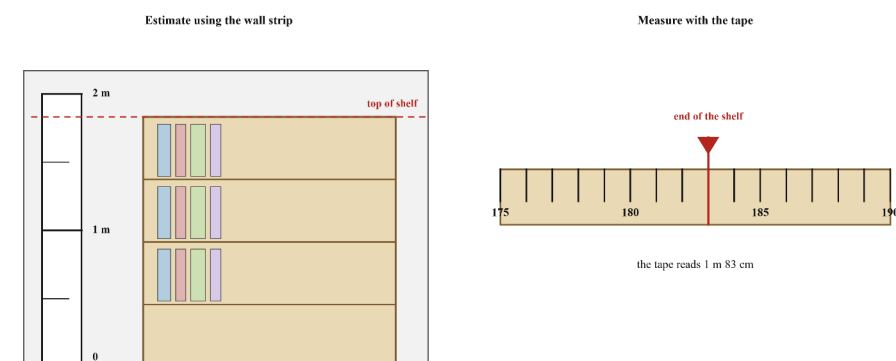
Key ideas.

- An estimate is a near-number built from something you know, not a guess; write it down before you measure.
- Four strategies carry most estimates: a benchmark, counting the units that fit, breaking into easier parts, and a range closed in.
- Estimate, measure, compare: if the measurement lands far from the estimate, one of the two is wrong — measure again.
- The smallest mark on a tool is the finest reading it can honestly give; finer marks mean a more accurate reading.
- Record only what the tool can show, always with its unit.
- Appropriate accuracy is the accuracy the job needs: millimetres for glass, metres for a hose.
- When you round a measurement, state the accuracy you rounded to.

Worked examples

Example 1 — scaffolded

Mia is buying a cover for a bookshelf. Before she touches the tape, she estimates the shelf’s height using a strip of marks painted on the wall beside it.



- Estimate the height of the shelf in metres, using the wall strip.
- Mia then measures with the tape, which reads 1 m 83 cm. Write that measurement in centimetres.

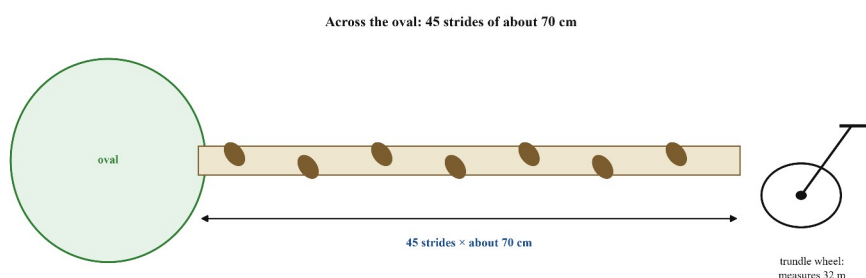
(c) Round the measurement to the nearest 10 cm. Does the rounded measurement agree with her estimate?

Working	Comment
(a) The top of the shelf sits between the 1 m and 2 m wall marks, much closer to 2 m. It looks about a hand-span (20 cm) under the 2 m mark: $200 - 20 = 180$ cm, so about 1.8 m. (b) 1 m 83 cm is $100 + 83 = 183$, so the shelf measures 183 cm. (c) Nearest 10 cm: the ones digit is 3, so round down: 180 cm. 180 cm is 1.8 m — the same number as her estimate.	A range first: between 1 m and 2 m. A benchmark closes the range in. Mixed units become one unit. The stated accuracy: nearest 10 cm. Estimate and measurement agree. ✓

Mia's estimate of 1.8 m and her tape reading of 183 cm (180 cm to the nearest 10 cm) tell the same story, so the measurement passes the check and she can buy the cover.

Example 2 — scaffolded

On sports-day morning, Mr Nguyen wants the straight-line distance across the oval. He walks it, counting strides, before the trundle wheel comes out of the shed.



- He counts 45 strides and his stride is about 70 cm. Estimate the distance in centimetres.
- Write the estimate in metres.
- The trundle wheel measures 32 m. Find the gap between the estimate and the measurement, in centimetres, and say whether the estimate was reasonable.

Working	Comment
(a) 45 strides of about 70 cm each: $45 \times 70 = 3150$, so about 3150 cm. (b) cm to m is small to big, so divide by 100: $3150 \div 100 = 31.5$, about 31.5 m. (c) Same units first: the gap is $32 - 31.5 = 0.5$ m, and $0.5 \times 100 = 50$, so 50 cm. 50 cm on a distance of 31.5 m is a small miss, so the estimate was reasonable.	Counting units: strides $\times$ stride length. One unit fact does the conversion. Compare in one unit, then convert. “Reasonable” means close enough for the job.

The stride estimate of 31.5 m and the trundle wheel's 32 m sit 50 cm apart on more than 30 m of oval — close enough that both numbers can be trusted.

Example 3 — unscaffolded

A glazier is cutting a new pane of glass to fit an old window frame. On the bench are three tools: a trundle wheel, a tape marked in centimetres, and a steel ruler marked in millimetres.

- Which tool should the glazier measure the opening with? Give a reason.

(b) Should the opening be recorded to the nearest metre, the nearest centimetre, or the nearest millimetre? Give a reason.

(c) The steel ruler shows the opening as 44.6 cm wide. Write that measurement in millimetres.

Solution. (a) The steel ruler marked in millimetres. Its smallest mark is 1 mm, the finest of the three, and the opening is small enough to sit along a ruler. The trundle wheel counts whole metres and suits paths and fences; the cm tape could only read the opening to the nearest centimetre.

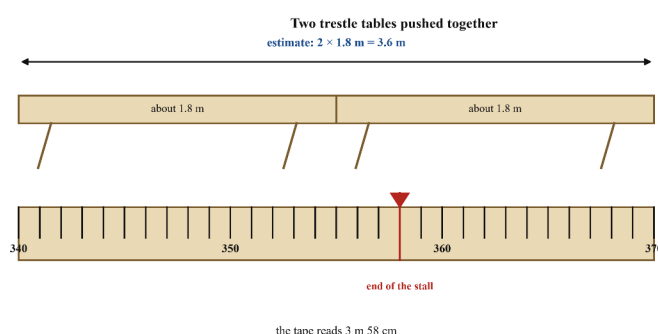
(b) To the nearest millimetre. Glass is cut once and cannot be stretched or squeezed afterwards, so the measurement has to be as fine as the tool allows — and the mm ruler allows millimetres.

(c) cm to mm is big to small, so multiply by 10: $44.6 \times 10 = 446$. The opening is 446 mm wide.

∴ The glazier measures with the mm-marked ruler, records to the nearest millimetre, and the opening is 446 mm wide.

Example 4 — unscaffolded

The school fete stall is two trestle tables pushed together end to end. Each table is about 1.8 m long, and the stall holder estimates the whole stall before measuring it properly.



(a) Estimate the length of the stall in metres.

(b) The tape shows the true length as 3 m 58 cm. Write that measurement in centimetres.

(c) Round the measurement to the nearest 10 cm and compare it with the estimate.

Solution. (a) Counting units: two tables of about 1.8 m each is $2 \times 1.8 = 3.6$, so the stall is about 3.6 m long.

(b) 3 m 58 cm is $300 + 58 = 358$, so the stall measures 358 cm.

(c) Nearest 10 cm: the ones digit is 8, so round up to 360 cm. Back in metres, $360 \div 100 = 3.6$ m — exactly the estimate, so the measurement and the estimate agree and both can be trusted.

∴ The stall is about 3.6 m by estimate, measures 358 cm on the tape, and rounds to 360 cm (3.6 m) to the nearest 10 cm.

Practice questions

Scaffolded

For Q1–Q6, work the parts in order: each one steps you through a single habit from the theory — rounding to a stated accuracy, benchmarks, counting units, ranges, choosing a tool, and recording honestly.

Q1. Round each measurement to the accuracy stated.

(a) 186 cm to the nearest 10 cm

(b) 4370 m to the nearest km

(c) 1.94 kg to the nearest 100 g

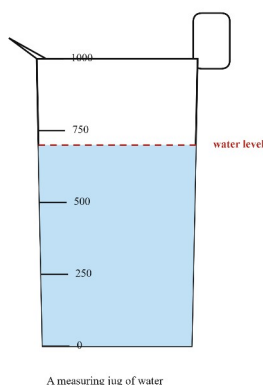
Q2. Use the benchmark table to estimate each length.

- (a) A garden hose lies along a path that takes about 8 of Priya's strides. Estimate the path in centimetres, then in metres.
- (b) A side table is about 4 hand-spans wide. Estimate its width in centimetres.
- (c) A bookshelf reaches about three-quarters of the way up a doorway. Estimate its height in metres.

Q3. A courtyard path is paved with a single row of 14 square pavers, and each paver is about 25 cm wide.

- (a) Estimate the length of the path in centimetres.
- (b) Write your estimate in metres.
- (c) A tape measures the path at 346 cm. How many centimetres apart are the estimate and the measurement, and was the estimate reasonable?

Q4. The measuring jug in the picture has lines at 0, 250, 500, 750 and 1000 mL.



- (a) The water level sits between two of the marked lines. Which two?
- (b) Estimate the amount of water to the nearest 50 mL.
- (c) A recipe wants 750 mL. Using your estimate, about how much more water is needed?

Q5. Choose the best tool from the tools table for each job, and name the unit you would read it in.

- (a) the distance along a walking track between two signs (about 800 m)
- (b) 250 g of flour for a cake
- (c) the width of a photo frame (about 20 cm)
- (d) 400 mL of buttermilk for a recipe

Q6. A carpenter measures a door frame with a tape marked in centimetres.

- (a) The end of the frame sits closer to the 83 cm mark than to the 82 cm mark. Record the measurement to the nearest centimetre.
- (b) The carpenter writes “82.63 cm” on the job sheet. Why is that recording wrong?
- (c) For which job is measuring to the nearest metre good enough: buying a garden hose, or cutting a trim to fit this door frame? Give a one-line reason.

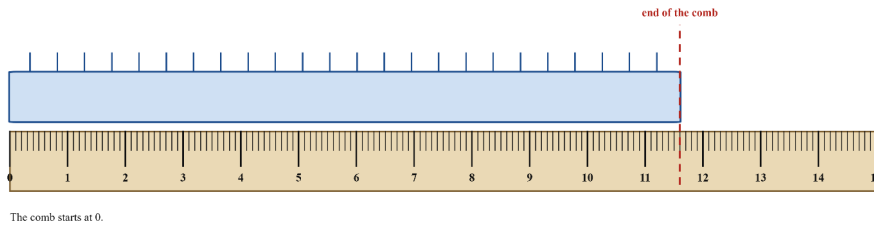
Un scaffolded

Q7–Q18 are whole jobs, the way they arrive: choose the strategy, the tool and the accuracy yourself. Every answer still needs its unit, and every rounded answer needs its stated accuracy.

Q7. A farm track runs about 600 m from the gate to the creek crossing, then about 350 m along the creek to the shed.

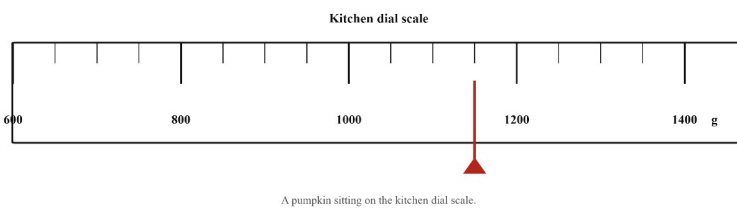
- Estimate the whole distance from gate to shed in metres.
- Write your estimate in kilometres.
- Round the estimate to the nearest 100 m.

Q8. A comb lies on a ruler, starting at 0.



- Before reading the marks, estimate the length of the comb to the nearest 5 cm.
- Read the length of the comb in centimetres, to the accuracy the ruler shows.
- Write that reading in millimetres.

Q9. A pumpkin sits on a kitchen dial scale whose labels read every 200 g, with four small spaces between labels. The needle stands three small marks past the 1000 g label. Before weighing, the cook estimated the pumpkin at about 1 kg.



- What is one small space worth, in grams?
- What does the scale read, in grams?
- Round the reading to the nearest kilogram. Does it support the cook's estimate?

Q10. Wei measures a desk with a tape marked in centimetres and writes “142.37 cm” in the notebook.

- What is the smallest mark on Wei's tape?
- Record the desk's length properly, to the accuracy the tape can show.
- In one sentence, say why “142.37 cm” is the wrong thing to write.

Q11. For each job, say whether measuring to the nearest millimetre, the nearest centimetre or the nearest metre is most appropriate, and give a one-line reason.

- cutting a pane of glass to fit a window frame
- buying a garden hose to reach from the tap to a bed about 15 m away
- cutting a trim to run along a shelf 86 cm long

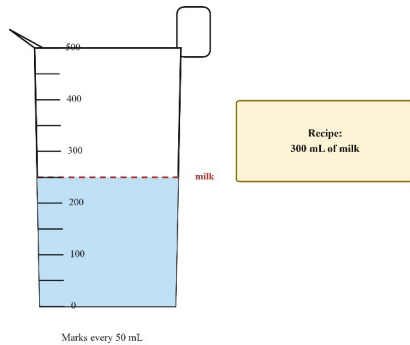
Q12. A front fence is built from 8 panels, each about 1.8 m wide.

- Estimate the length of the fence in metres.
- A trundle wheel measures the fence at 14.5 m. Find the difference between the estimate and the measurement, in centimetres.
- Was the estimate reasonable? Answer in one sentence.

Q13. Give a sensible estimate, with its unit, for each. Any estimate in a sensible range is accepted.

- (a) the height of a kitchen bench
- (b) the mass of a full water bottle a student carries
- (c) the length of a soccer field
- (d) the capacity of a teaspoon

Q14. A recipe wants 300 mL of milk. Pouria pours what he thinks is about 300 mL into a measuring jug marked every 50 mL.

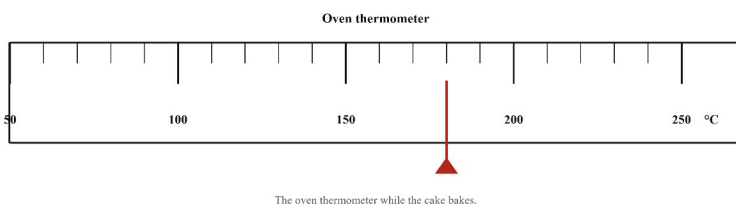


- (a) Read the amount of milk in the jug.
- (b) How much more milk does the recipe need?
- (c) Pouria's friend suggests just using an unmarked mug instead. In one sentence, why is the marked jug the better tool?

Q15. A farmer walks a fence line counting strides to estimate its length. She counts 65 strides and her stride is about 70 cm.

- (a) Estimate the fence line in centimetres.
- (b) Write the estimate in metres.
- (c) A trundle wheel measures 46 m. Find the gap between the estimate and the measurement in centimetres, and say whether the estimate was reasonable.

Q16. A cook checks the oven with an oven thermometer whose labels read every 50 °C, with five small spaces between labels. The needle stands three small marks past the 150 °C label.



- (a) What is one small space worth, in degrees Celsius?
- (b) What does the thermometer read?
- (c) The recipe says to bake at about 180 °C. Is the oven at the temperature the recipe wants?

Q17. Rani measures the classroom rug with a tape. Its length is 2 m 46 cm.

- (a) Write the length in centimetres.
- (b) Round the length to the nearest 10 cm.
- (c) Round the length to the nearest metre.
- (d) Before measuring, Rani estimated “about two and a half metres”. Which of your rounded answers agrees with her estimate?

Q18. The community garden group is getting a new bed ready. The bed runs along 6 railway sleepers laid end to end, each about 1.5 m long.

- (a) Estimate the length of the bed in metres.
- (b) A trundle wheel measures the bed at 9.2 m. Plastic edging is sold in 1 m lengths. How many whole lengths must the group buy to cover 9.2 m? Give a reason.
- (c) The group measures the greenhouse door at 84 cm and 6 mm more, using a tape marked in millimetres. Write the door’s width in millimetres.
- (d) Round the door’s width to the nearest centimetre. A greenhouse fan 86 cm wide is waiting by the door. Will it fit through?

Answers

Q1. (a) 190 cm (b) 4000 m, that is 4 km (c) 1900 g, that is 1.9 kg **Q2.** (a) 560 cm, that is 5.6 m (b) 80 cm (c) 1.5 m
Q3. (a) 350 cm (b) 3.5 m (c) 4 cm apart — yes, reasonable **Q4.** (a) the 500 mL and 750 mL lines (b) about 700 mL (c) about 50 mL **Q5.** (a) trundle wheel, m (b) kitchen scale, g (c) 30 cm ruler, cm (d) measuring jug, mL **Q6.** (a) 83 cm (b) a cm-marked tape cannot show hundredths of a centimetre — record only what the tool shows (c) buying the hose, because hose is sold in whole metres **Q7.** (a) 950 m (b) 0.95 km (c) 1000 m, that is 1 km **Q8.** (a) about 10 cm (b) 11.6 cm (c) 116 mm **Q9.** (a) 50 g (b) 1150 g (c) 1 kg — yes, it supports the estimate **Q10.** (a) 1 cm (b) 142 cm (c) the tape shows whole centimetres only, so the digits after the point were invented **Q11.** (a) nearest mm (b) nearest m (c) nearest cm **Q12.** (a) 14.4 m (b) 10 cm (c) yes — 10 cm on a 14.4 m fence is close **Q13.** sensible estimates: (a) about 90 cm (b) about 600 g (c) about 100 m (d) about 5 mL **Q14.** (a) 250 mL (b) 50 mL (c) the marks show how much is in the jug; an unmarked mug shows nothing **Q15.** (a) 4550 cm (b) 45.5 m (c) 50 cm apart — yes, reasonable **Q16.** (a) 10 °C (b) 180 °C (c) yes — the reading is the temperature the recipe wants **Q17.** (a) 246 cm (b) 250 cm (c) 2 m (d) (b), because 250 cm is 2.5 m **Q18.** (a) 9 m (b) 10 lengths (c) 846 mm (d) 85 cm; no, the fan will not fit

Fully-worked solutions

Q1. (a) The ones digit is 6, so 186 rounds up to the next 10: 190 cm. (b) 4370 m: the hundreds digit is 3, so round down to 4000 m, which is 4 km. (c) 1.94 kg is 1940 g; to the nearest 100 g the tens digit 4 rounds down, giving 1900 g, that is 1.9 kg.

Q2. (a) Counting units: 8 strides of about 70 cm is $8 \times 70 = 560$ cm, and $560 \div 100 = 5.6$, so about 5.6 m. (b) 4 hand-spans of about 20 cm is $4 \times 20 = 80$ cm. (c) Three-quarters of a 2 m doorway: half of 2 m is 1 m and a quarter is 0.5 m, so three-quarters is 1.5 m.

Q3. (a) Counting units: $14 \times 25 = 350$, so about 350 cm. (b) $350 \div 100 = 3.5$ m. (c) $350 - 346 = 4$ cm apart; 4 cm on a 3.5 m path is a tiny miss, so the estimate was reasonable.

Q4. (a) The water level sits above the 500 mL line and below the 750 mL line, so between those two. (b) It is much closer to 750 than to 500, so about 700 mL to the nearest 50 mL. (c) $750 - 700 = 50$, so about 50 mL more.

Q5. (a) A track of about 800 m is a trundle wheel job, read in metres. (b) 250 g of flour wants the kitchen scale, read in grams. (c) A 20 cm frame fits a 30 cm ruler, read in centimetres off its millimetre marks. (d) 400 mL of buttermilk wants the measuring jug, read in millilitres.

Q6. (a) Closer to 83 than to 82 means the nearest centimetre is 83 cm. (b) The tape's smallest mark is 1 cm, so it cannot show tenths or hundredths of a centimetre; a recording may only be as fine as the tool. (c) Buying the hose: hose is sold in whole metres and spare length is welcome, so the nearest metre is fine — a door trim has to fit, so it wants centimetres.

Q7. (a) Breaking into parts: $600 + 350 = 950$ m. (b) m to km is small to big, divide by 1000: $950 \div 1000 = 0.95$ km. (c) To the nearest 100 m the tens digit is 5, so round up: 1000 m, which is 1 km.

Q8. (a) The comb looks a little longer than 10 cm and well short of 15 cm, so about 10 cm to the nearest 5 cm. (b) The end sits 6 small marks past the 11 cm mark, and the ruler's smallest mark is 1 mm, so the reading is 11.6 cm. (c) cm to mm is big to small, multiply by 10: $11.6 \times 10 = 116$ mm.

Q9. (a) The gap between labels is 200 g over 4 spaces: $200 \div 4 = 50$ g a space. (b) Three spaces past 1000 g: $1000 + 3 \times 50 = 1150$ g. (c) 1150 g to the nearest kg: the hundreds digit 1 rounds down, so 1 kg — the same as the cook's estimate, so the scale supports it.

Q10. (a) The tape is marked in centimetres, so its smallest mark is 1 cm. (b) The honest record is the nearest centimetre: 142 cm. (c) The tape never showed tenths or hundredths of a centimetre, so those digits were invented rather than measured.

Q11. (a) Nearest millimetre: glass is cut once and must fit the opening exactly. (b) Nearest metre: hose is sold in whole metres and a little extra is fine. (c) Nearest centimetre: a trim can be trimmed again, so centimetre accuracy is plenty — millimetres would be wasted care.

Q12. (a) Counting units: $8 \times 1.8 = 14.4$ m. (b) Same units: $14.5 - 14.4 = 0.1$ m, and $0.1 \times 100 = 10$ cm. (c) Yes: 10 cm on a 14.4 m fence is a small miss, so the estimate did its job.

Q13. Sensible estimates include: (a) about 90 cm (80–100 cm is fine). (b) about 600 g (500 g–1 kg is fine — a full bottle weighs about the same as its water). (c) about 100 m (90–110 m is fine). (d) about 5 mL (2–10 mL is fine).

Q14. (a) The milk sits exactly on the mark one small space above 200 mL: 250 mL. (b) $300 - 250 = 50$ mL more. (c) The jug's marks show how much liquid is inside, to the nearest 50 mL; an unmarked mug shows no amount at all, so it cannot measure the recipe.

Q15. (a) Counting units: $65 \times 70 = 4550$ cm. (b) $4550 \div 100 = 45.5$ m. (c) $46 - 45.5 = 0.5$ m, and $0.5 \times 100 = 50$ cm; half a metre on 45.5 m of fence is close, so the estimate was reasonable.

Q16. (a) The gap between labels is 50°C over 5 spaces: $50 \div 5 = 10^\circ\text{C}$ a space. (b) Three spaces past 150°C : $150 + 3 \times 10 = 180^\circ\text{C}$. (c) Yes: the reading is 180°C , the temperature the recipe asks for.

Q17. (a) 2 m 46 cm is $200 + 46 = 246$ cm. (b) Nearest 10 cm: the ones digit 6 rounds up, so 250 cm. (c) Nearest metre: 246 cm is 2.46 m and the tenths digit 4 rounds down, so 2 m. (d) Part (b): 250 cm is 2.5 m, which is exactly “about two and a half metres”.

Q18. (a) Counting units: $6 \times 1.5 = 9$ m. (b) Ten lengths: nine 1 m lengths cover only 9 m, leaving 0.2 m of bed with no edging, so the group rounds up to 10. (c) 84 cm and 6 mm is 84.6 cm, and cm to mm is big to small: $84.6 \times 10 = 846$ mm. (d) Nearest centimetre: the tenths digit 6 rounds up, so 85 cm; the fan is 86 cm wide and the door is 85 cm, so no — the fan will not fit through.

Chapter 04 — Test A (multiple choice)

Chapter 4 Quantity and measures (Sections 4A–4F). Allowed materials: one basic calculator. Section A: 12 questions (12 marks). Time: about 25 minutes.

About the data in this test. Every name, place, price, time and measurement in this test is **made up** (not real). They are built for this book so you can practise the mathematics from Chapter 4. Nothing here is real data about a real person, business or place.

Section A — Multiple-choice questions

Choose the response that is correct for the question.

Question 1

A garden hose is 3.8 m long. What is the length of the hose in centimetres?

- A. 38 cm
- B. 380 cm
- C. 0.38 cm
- D. 3800 cm

Question 2

A pumpkin has a mass of 2500 g. What is the mass of the pumpkin in kilograms?

- A. 25 kg
- B. 250 kg
- C. 0.25 kg
- D. 2.5 kg

Question 3

A rectangular vegetable patch is 9 m long and 4 m wide. What is the distance around the vegetable patch?

- A. 13 m
- B. 36 m
- C. 26 m
- D. 18 m

Question 4

A rectangle is 5.5 m long and 4 m wide. What is the area of the rectangle?

- A. 22 m²
- B. 9.5 m²
- C. 19 m²
- D. 220 m²

Question 5

A box is 6 cm long, 4 cm wide and 3 cm high. What is the volume of the box?

- A. 24 cm^3
- B. 13 cm^3
- C. 720 cm^3
- D. 72 cm^3

Question 6

A rectangular tank holds 1.5 m^3 of water when it is full. Use $1 \text{ m}^3 = 1000 \text{ L}$. How many litres of water does the full tank hold?

- A. 1500 L
- B. 15 L
- C. 150 L
- D. 15 000 L

Question 7

What is 19:40 written in 12-hour time?

- A. 9:40 pm
- B. 7:40 am
- C. 7:40 pm
- D. 19:40 pm

Question 8

Mia catches a bus at 11:45 am. The bus arrives at 3:20 pm. How long is the bus ride?

- A. 4 h 25 min
- B. 3 h 35 min
- C. 3 h 25 min
- D. 4 h 35 min

Question 9

A thermometer has labels at every 5 degrees, with five small spaces between each pair of labels. The top of the liquid is three spaces above the 20 label. What is the temperature?

- A. 35°C
- B. 26°C
- C. 20.3°C
- D. 23°C

Question 10

At 8:00 am the temperature is 12°C . By noon it has risen by 9°C . By 6:00 pm it has fallen by 5°C from the noon reading. What is the temperature at 6:00 pm?

- A. 16°C
- B. 21°C
- C. 8°C
- D. 26°C

Question 11

Wei measures a shelf with a tape marked in centimetres only. The end of the shelf is just past the 86 cm mark. Which is the correct way to record this length?

- A. 86.42 cm
- B. 86 cm
- C. 86.4 cm
- D. 86.5 cm

Question 12

Ravi counts 30 strides along a walking track. His stride is about 70 cm long. How long is the track, in metres?

- A. 2100 m
- B. 210 m
- C. 21 m
- D. 2.1 m

End of Section A

Test A — Answers

Que stio n	1	2	3	4	5	6	7	8	9	10	11	12
Ans wer	B	D	C	A	D	A	C	B	D	A	B	C

Test A — Fully-worked solutions

Question	Answer	Working
1	B	m → cm multiplies by 100: $3.8 \times 100 = 380$ cm. Option A multiplies by 10, option C divides instead of multiplying, and option D uses the factor 1000 (that would give mm).
2	D	g → kg is small to big, so divide: $2500 \div 1000 = 2.5$ kg. The other options divide by 10 or 100, or divide twice.
3	C	The distance around is the perimeter: $P = 2 \times (l + w) = 2 \times (9 + 4) = 2 \times 13 = 26$ m. Option A is only $l + w$ (half the perimeter), option B is the area ($9 \times 4 = 36$), and option D doubles only the length ($9 \times 2 = 18$).
4	A	$A = l \times w = 5.5 \times 4 = 22$ m ² . Option B adds the sides ($5.5 + 4 = 9.5$), option C is the perimeter ($2 \times 9.5 = 19$), and option D slips the decimal point ($55 \times 4 = 220$).
5	D	$V = l \times w \times h = 6 \times 4 \times 3 = 72$ cm ³ . Option A is only the base ($6 \times 4 = 24$), option B adds the three sides ($6 + 4 + 3 = 13$), and option C slips the place value.
6	A	$1 \text{ m}^3 = 1000 \text{ L}$, so multiply: $1.5 \times 1000 = 1500$ L. The other options move the decimal point the wrong number of places.
7	C	19:40 is after noon, so take 12 off the hour: $19 - 12 = 7$, and the minutes stay the same: 7:40 pm. Option A takes away 10 instead of 12, option B is the wrong half of the day, and option D puts pm on a 24-hour time — 24-hour time never uses am or pm.
8	B	Write both times in 24-hour time: 3:20 pm is 15:20, so the ride is $15:20 - 11:45$. Borrow 1 h: 15:20 becomes 14:80. Then $80 - 45 = 35$ minutes and $14 - 11 = 3$ hours, so the ride is 3 h 35 min. The other options come from not borrowing, or from subtracting the smaller minutes from the bigger ones.
9	D	The gap between labels is 5 degrees and there are five spaces, so each

Question	Answer	Working
		space is $5 \div 5 = 1$ degree. Count on three spaces: $20 + 3 \times 1 = 23$ °C. Option A counts each space as 5 degrees, option B counts each space as 2 degrees, and option C writes “20 and 3” as a decimal.
10	A	A rise means add and a fall means subtract: $12 + 9 = 21$, then $21 - 5 = 16$ °C. Option B stops at the noon reading, option C subtracts the rise and adds the fall on to 12 instead ($12 - 9 + 5 = 8$), and option D adds both changes.
11	B	The tape’s smallest mark is 1 cm, so an honest reading is a whole number of centimetres: 86 cm. Options A, C and D record finer than the tape can show — those extra decimal places are make-believe.
12	C	$30 \times 70 = 2100$ cm. cm $\rightarrow$ m is small to big, so divide by 100: $2100 \div 100 = 21$ m. Option A forgets to convert, option B divides by 10, and option D divides by 1000.

Chapter 04 — Test B (written response)

Chapter 4 Quantity and measures (Sections 4A–4F). Allowed materials: one basic calculator. Section B: 7 questions (35 marks). Time: about 40 minutes. Answer every question in the space provided. Show your working for every part. Only round where the question tells you to, and give each rounded answer at the precision asked for.

About the data in this test. Every name, place, price, time and measurement in this test is **made up** (not real). They are built for this book so you can practise the mathematics from Chapter 4. Nothing here is real data about a real person, business or place.

Section B — Written-response questions

Question 1 (4 marks)

A community kitchen is checking its orders before a big cooking day.

- a. A bag of rice is labelled 3.45 kg. Write the mass of the bag in grams. 1 mark

- b. A bottle of cordial holds 650 mL. Write the capacity of the bottle in litres. 1 mark

- c. A plank of timber is 2.7 m long. Write the length of the plank in centimetres. 1 mark

- d. A box of sultanas is labelled 3 kg 60 g. Write the mass of the box in grams only. 1 mark

Question 2 (5 marks)

A rectangular vegetable patch is 6.5 m long and 3 m wide. Timber edging runs around the outside of the patch, and mulch covers the patch.

- a. Find the length of timber edging needed to go all the way around the patch. 1 mark

- b. Find the area that the mulch covers. 1 mark

- c. The edging costs \$ 4 per metre. Find the cost of the edging for the whole patch. 2 marks

- d. The edging is sold only in 3 m lengths, and only whole lengths can be bought. How many lengths are needed? 1 mark

Question 3 (5 marks)

A farm has a rectangular rainwater tank. Measured inside, the tank is 2.5 m long, 1.2 m wide and 0.8 m high.

a. Find the volume of the tank in cubic metres (m^3).

2 marks

b. The tank is full. How many litres of water does it hold?

1 mark

c. The garden uses 150 L of water each day. How many days will the full tank last?

2 marks

Question 4 (5 marks)

Kai works a shift at a food hall.

a. The shift finishes at 6:10 pm. Write this time in 24-hour time.

1 mark

b. The shift starts at 10:40 am and finishes at 6:10 pm. How long is the shift? Give your answer in hours and minutes.

2 marks

c. Kai takes a 45-minute unpaid break during the shift. Write his paid time in hours and minutes.

1 mark

d. Write the paid time from part **c** in decimal hours.

1 mark

Question 5 (5 marks)

A cook is checking temperatures in a kitchen.

a. A thermometer has labels at every 10 degrees, with four small spaces between each pair of labels. The top of the liquid is three spaces above the 40 label. What temperature does the thermometer show?

2 marks

b. A pot of soup reads 52°C on a probe. The soup must reach 65°C or above before it can be served. How many more degrees must the soup rise?

1 mark

c. The soup then rises by 16°C . Write the new reading, and say whether the soup is now safe to serve. Give a reason. 2 marks

Question 6 (5 marks)

A team is laying a paved path in a park.

- a.** The path is laid with 16 pavers placed end to end. Each paver is about 25 cm long. Estimate the length of the path in centimetres, and then in metres. 2 marks

- b.** A tape measure shows the path is 408 cm long. Find the difference between the estimate and the tape reading, in centimetres. 1 mark

- c.** Round the tape reading of 408 cm to the nearest 10 cm. 1 mark

- d.** For the next job, Sam has to measure a fence line about 120 m long. Which tool is the better choice: a 30 cm ruler or a trundle wheel? Give a reason. 1 mark

Question 7 (6 marks)

A school fete is setting up a drinks stall.

- a.** The drinks esky is a rectangular box. Measured inside, it is 50 cm long, 30 cm wide and 40 cm high. Find the volume of the esky in cm^3 . 2 marks

- b.** How many litres does the esky hold when it is full? 1 mark

- c.** Each cup holds 250 mL. A carton of cordial holds 10 L. How many full cups can be poured from the carton? 2 marks

- d.** The stall opens at 9:20 am and runs for 3 h 45 min. Write the closing time in 12-hour time. 1 mark

End of Section B

Test B — Answers

Q1. (a) 3450 g. (b) 0.65 L. (c) 270 cm. (d) 3060 g.

Q2. (a) 19 m. (b) 19.5 m^2 . (c) \$76. (d) 7 lengths.

Q3. (a) 2.4 m^3 . (b) 2400 L. (c) 16 days.

Q4. (a) 18:10. (b) 7 h 30 min. (c) 6 h 45 min. (d) 6.75 h.

Q5. (a) 47.5°C . (b) 13°C . (c) 68°C — yes, the soup is safe to serve.

Q6. (a) 400 cm, which is 4 m. (b) 8 cm. (c) 410 cm. (d) The trundle wheel — it is made for long distances, and a 30 cm ruler would have to be moved hundreds of times.

Q7. (a) $60\,000 \text{ cm}^3$. (b) 60 L. (c) 40 full cups. (d) 1:05 pm.

Test B — Fully-worked solutions

Question 1.

- a. $\text{kg} \rightarrow \text{g}$ is big to small, so multiply: $3.45 \times 1000 = 3450$. The bag has a mass of 3450 g.
- b. $\text{mL} \rightarrow \text{L}$ is small to big, so divide: $650 \div 1000 = 0.65$. The bottle holds 0.65 L.
- c. $\text{m} \rightarrow \text{cm}$ is big to small, so multiply: $2.7 \times 100 = 270$. The plank is 270 cm long.
- d. $3 \text{ kg} = 3 \times 1000 = 3000 \text{ g}$, then $3000 + 60 = 3060$. The box has a mass of 3060 g. Watch the zero in the middle: 3 kg 60 g is not 3600 g.

Question 2.

- a. The edging goes around the patch, so this is the perimeter: $P = 2 \times (l + w) = 2 \times (6.5 + 3) = 2 \times 9.5 = 19$. The edging needed is 19 m.
- b. The mulch covers the patch, so this is the area: $A = l \times w = 6.5 \times 3 = 19.5$. The mulch covers 19.5 m^2 .
- c. Cost = length $\times$ price per metre: $19 \times 4 = 76$. The edging costs \$76.
- d. $19 \div 3 = 6$ remainder 1. Six lengths give $6 \times 3 = 18 \text{ m}$, which is 1 m short of the 19 m needed, so round up to the next whole length: 7 lengths are needed.

Question 3.

- a. Base area first: $2.5 \times 1.2 = 3 \text{ m}^2$. Then volume = base area $\times$ height: $3 \times 0.8 = 2.4$. The volume is 2.4 m^3 .
- b. $1 \text{ m}^3 = 1000 \text{ L}$, so $2.4 \times 1000 = 2400$. The full tank holds 2400 L.
- c. $2400 \div 150 = 16$. The full tank will last 16 days.

Question 4.

- a. 6:10 pm is after noon, so add 12 to the hour: $6 + 12 = 18$. The finish time is 18:10.
- b. Write both times in 24-hour time: 18:10 – 10:40. The top minutes are smaller, so borrow 1 h: 18:10 becomes 17:70. Then $70 - 40 = 30$ minutes and $17 - 10 = 7$ hours. The shift is 7 h 30 min long.
- c. Take the unpaid break off the shift: 7 h 30 min – 45 min. Borrow 1 h: 7 h 30 min becomes 6 h 90 min, and $90 - 45 = 45$. The paid time is 6 h 45 min.
- d. In decimal hours, the part after the point is part of 60 minutes, not part of 100: $45 \div 60 = 0.75$. The paid time is 6.75 h. (Not 6.45 h — 45 minutes is 0.75 of an hour.)

Question 5.

- a. The gap between labels is 10 degrees and there are four spaces, so each space is $10 \div 4 = 2.5$ degrees. Count on three spaces: $3 \times 2.5 = 7.5$. Then $40 + 7.5 = 47.5$. The thermometer shows 47.5 $^{\circ}\text{C}$.
- b. $65 - 52 = 13$. The soup must rise 13 more degrees.
- c. $52 + 16 = 68 \text{ }^{\circ}\text{C}$. Yes — 68 is 65 or above, so the soup is now safe to serve.

Question 6.

- a. $16 \times 25 = 400$ cm. cm $\rightarrow$ m is small to big, so divide by 100: $400 \div 100 = 4$ m. The path is about 400 cm, or about 4 m, long.
- b. $408 - 400 = 8$. The difference is 8 cm.
- c. Round to the nearest 10 cm: the ones digit is 8, which is 5 or more, so round up. 408 cm rounds to 410 cm.
- d. The trundle wheel. A 30 cm ruler would have to be moved hundreds of times along a 120 m fence line ($120 \text{ m} = 12\,000 \text{ cm}$, and $12\,000 \div 30 = 400$ moves), and the small errors would pile up. A trundle wheel is made for long distances and counts the metres as it rolls.

Question 7.

- a. Base area first: $50 \times 30 = 1500 \text{ cm}^2$. Then volume = base area $\times$ height: $1500 \times 40 = 60\,000 \text{ cm}^3$.
- b. $1 \text{ cm}^3 = 1 \text{ mL}$, so the full esky holds 60 000 mL. Then $60\,000 \div 1000 = 60$. The esky holds 60 L.
- c. $10 \text{ L} = 10 \times 1000 = 10\,000 \text{ mL}$. Each cup takes 250 mL: $10\,000 \div 250 = 40$. The carton pours 40 full cups.
- d. From 9:20 am, jump 3 h to 12:20 pm, then 45 min more: $20 + 45 = 65$ minutes past 12, which is 1 h 5 min past, so 1:05 pm. The stall closes at 1:05 pm.