Mathematics Level 6

Chapter 5 — Measurement

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Contents

Converting between common metric units

Content description `VC2M6M01`: convert between common metric units of length, mass and capacity; choose and use decimal representations of metric measurements relevant to the context of a problem

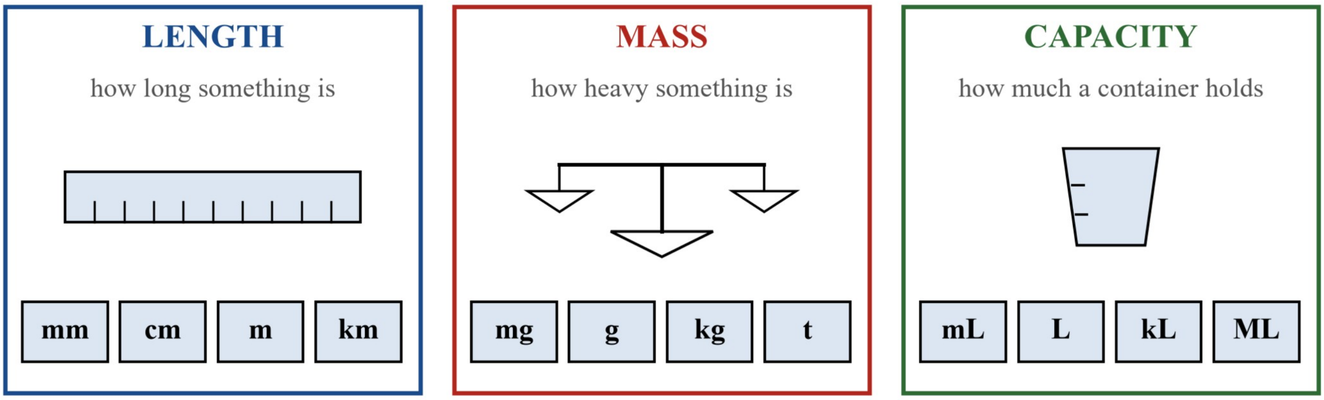
At Level 5 you learned to choose the unit that fits the job — kilometres for the distance between towns, grams for a letter. This subtopic builds the whole system: the full list of units in all three families, what the prefixes mean, and the one idea behind all converting — multiply or divide by 10, 100 or 1000. After that, any amount can wear the name that fits the context.

Theory

The three metric families

The **metric system** is the measurement system built on tens, used in most countries of the world. Everything in it grows out of three **base units**: the **metre** (m) for length, the **gram** (g) for mass, and the **litre** (L) for capacity. Larger and smaller units are made by putting a **prefix** in front of the base name — and the same prefixes work the same way in every family.

Three families of metric units



Three panels for the metric families: length (mm, cm, m, km), mass (mg, g, kg, t) and capacity (mL, L, kL, ML), each with its base unit named

Length, mass and capacity each keep their own ladder of units. Converting means moving along a ladder — and every move is a multiply or a divide.

What the prefixes mean

Each prefix fixes a size, and it means the same in every family:

- **milli-** means one thousandth: 1 mm is one thousandth of 1 m, 1 mg is one thousandth of 1 g, 1 mL is one thousandth of 1 L;
- **centi-** means one hundredth: 1 cm is one hundredth of 1 m;
- **kilo-** means one thousand: 1 km is 1000 m, 1 kg is 1000 g, 1 kL is 1000 L;
- **mega-** means one million: 1 ML is 1 000 000 L.

The prefixes tell you the size

milli-	centi-	kilo-	mega-
one thousandth	one hundredth	one thousand	one million
÷ 1000	**÷ 100**	**× 1000**	**× 1 000 000**
1 mm is one thousandth of 1 m	1 cm is one hundredth of 1 m	1 km is one thousand metres	1 ML is one million litres

The same prefix means the same thing in every family: a milligram and a millilitre are both one thousandth of their unit.

Four cards: milli- means one thousandth, centi- means one hundredth, kilo- means one thousand, mega- means one million, with an example unit on each

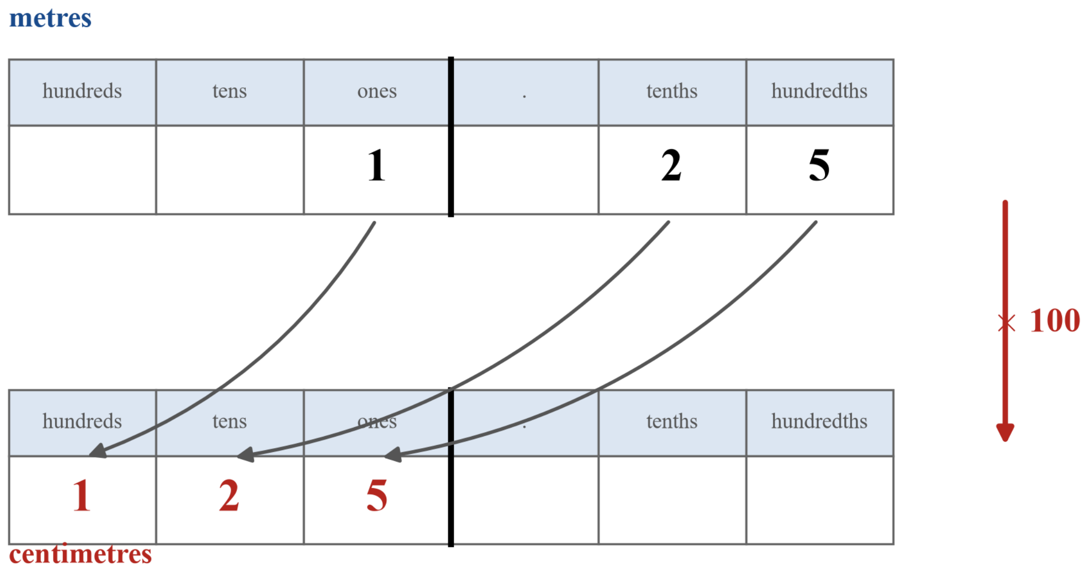
Reading the prefixes both ways gives the facts worth keeping close: 1000 mm = 1 m, 100 cm = 1 m, 1000 m = 1 km, 1000 mg = 1 g, 1000 g = 1 kg, 1000 kg = 1 t, 1000 mL = 1 L, 1000 L = 1 kL and 1000 kL = 1 ML. The **tonne** (t) is for heavy loads: 1 t = 1000 kg.

Converting: multiply or divide by 10, 100, 1000

To **convert** is to change the unit without changing the amount. Going to a **smaller** unit, the number gets larger — multiply. Going to a **larger** unit, the number gets smaller — divide. Counting the jumps on a ladder tells you by how much: one jump is × 10, × 100 or × 1000, two jumps is two of those in a row.

The elaboration's own example: 1.25 m is the same as 125 cm. Metres to centimetres is one jump of × 100, so multiply — and the digits move two places.

1.25 m = 125 cm — multiply by 100 and the digits move two places



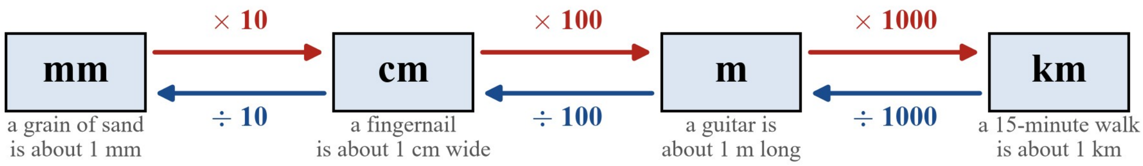
The amount does not change — only the unit, and the names of the places.

Two place-value charts showing 1.25 m and 125 cm: multiplying by 100 moves the digits two places to the left

Check the other way: 125 cm ÷ 100 = 1.25 m. The amount never changes — only the unit, and the names of the places. That is the whole trick: every convert in this subtopic is a multiply or a divide by 10, 100, 1000, or two of those jumps in a row.

Length: watch the jumps

Length — watch the jumps: they are not all the same



mm to cm is × 10, cm to m is × 100, m to km is × 1000.

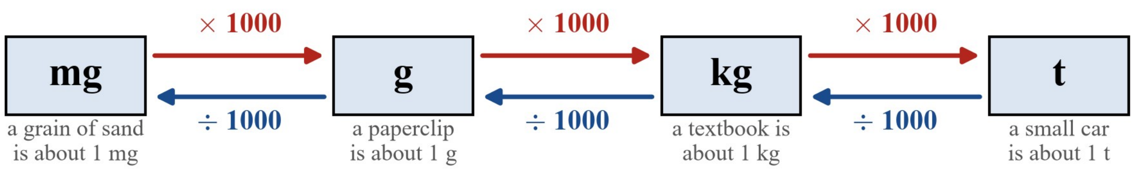
The length ladder: mm to cm is times 10, cm to m is times 100, m to km is times 1000, with the reverse divisions and an everyday object for each unit

The length ladder is the odd one out — its jumps are **not** all the same: mm → cm is × 10, cm → m is × 100, m → km is × 1000. Reading the ladder back the other way, cm → mm is ÷ 10, m → cm is ÷ 100 and km → m is ÷ 1000.

Everyday amounts to hold in mind: a grain of sand is about 1 mm long; a fingernail is about 1 cm wide; a guitar is about 1 m long; a 15-minute walk is about 1 km.

Mass: every jump is × 1000

Mass — every jump is × 1000 (or ÷ 1000)



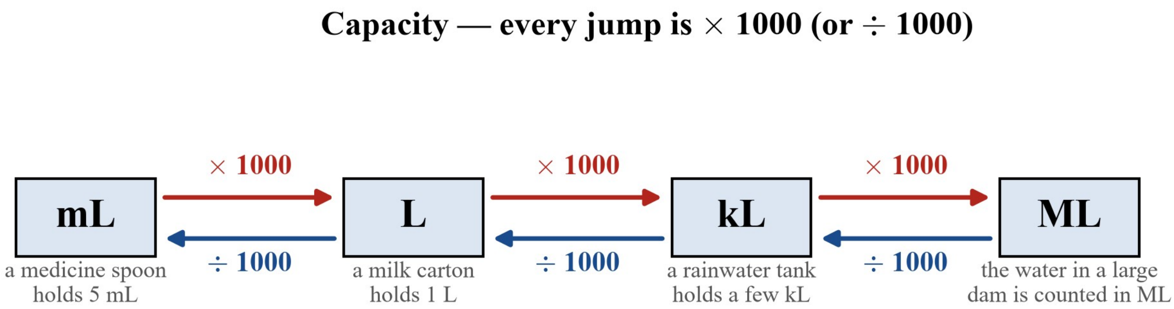
The tonne (t) measures heavy loads: 1 t = 1000 kg.

The mass ladder: mg to g, g to kg and kg to t are each times 1000, with the reverse divisions and an everyday object for each unit

On the mass ladder every jump is × 1000 (and ÷ 1000 going back): mg → g → kg → t. Two jumps is × 1000 twice: 1 t = 1000 kg = 1 000 000 g.

Everyday amounts: a grain of sand has a mass of about 1 mg; a paperclip is about 1 g; a textbook is about 1 kg; a small car is about 1 t.

Capacity: every jump is × 1000



Megalitres suit very large amounts: 1 ML = 1 000 000 L.

The capacity ladder: mL to L, L to kL and kL to ML are each times 1000, with the reverse divisions and an everyday object for each unit

The capacity ladder works exactly like mass: mL → L → kL → ML, every jump × 1000. So 1 ML = 1000 kL = 1 000 000 L — megalitres suit very large amounts, like the water in a dam.

Everyday amounts: a medicine spoon holds about 5 mL; a milk carton holds 1 L; a rainwater tank holds a few kL.

Choosing the name that fits the context

One amount can wear several names. All three forms in each row below are the same amount:

One quantity, three names

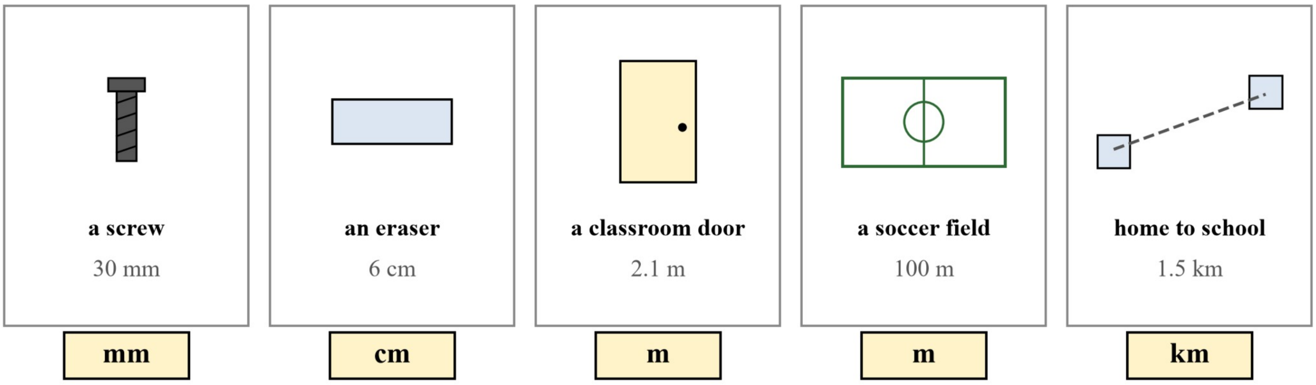
	decimal form		mixed form		smaller unit only
length	**1.25 m**	=	1 m 25 cm	=	125 cm
mass	**2.35 kg**	=	2 kg 350 g	=	2350 g
capacity	**1.5 L**	=	1 L 500 mL	=	1500 mL

All three names in a row describe the same amount. Pick the one that fits the context.

One quantity, three names: 1.25 m = 1 m 25 cm = 125 cm; 2.35 kg = 2 kg 350 g = 2350 g; 1.5 L = 1 L 500 mL = 1500 mL

The second half of the content description asks you to **choose** the name that fits the context. The best unit is usually the one that keeps the number easy to picture:

Pick the unit that keeps the number simple



Five objects with the unit that keeps the number simple: a screw 30 mm, an eraser 6 cm, a classroom door 2.1 m, a soccer field 100 m, home to school 1.5 km

A screw is 30 mm, not 0.03 m; the walk from home to school is 1.5 km, not 1500 m. Both names in each pair are correct — one is just much easier to use. Decimal forms shine when you compare amounts or calculate with them; the smaller unit only is best when a whole number is cleaner; the mixed form is handy for saying it out loud.

Words for this subtopic

Word	Meaning
metric system	the measurement system built on tens: metre, gram, litre and their prefix relatives
base unit	metre, gram, litre — the unit names the prefixes attach to
prefix	the piece put in front of a unit name to fix its size: milli-, centi-, kilo-, mega-
convert	change a measurement from one unit to another without changing the amount
unit symbol	the short code for a unit: mm, cm, m, km, mg, g, kg, t, mL, L, kL, ML
mixed form	a measure written with two units, like 1 m 25 cm
decimal form	the same measure written with one unit and a decimal point, like 1.25 m

Worked examples

In the with-help examples the steps are labelled for you; in the on-your-own examples you carry them out yourself. Every example ends with a check.

Example 1 — with help

A ribbon is 1.25 m long. How many centimetres is that?

Step	Working	Comment
Read	1.25 m; want cm. On the length ladder, m → cm is one jump towards the smaller unit.	Smaller unit means a larger number — multiply.
Plan	Multiply by 100; the digits move two places left, as in the place-value figure.	One jump of × 100, not two jumps of × 10: length jumps differ.
Work out	$1.25 \times 100 = 125$, so 1.25 m =	The place-value chart shows the 1,

Step	Working	Comment
	125 cm.	2, 5 sliding two places.
Check	$125 \div 100 = 1.25$ — back to the start. ✓ And 125 cm is a little more than a metre: sensible for a ribbon.	Dividing undoes multiplying.

The ribbon is **125 cm** long.

Example 2 — with help

A parcel has a mass of 3750 g. Write its mass in kilograms.

Step	Working	Comment
Read	3750 g; want kg. On the mass ladder, g → kg is one jump towards the larger unit.	Larger unit means a smaller number — divide.
Plan	Divide by 1000; the digits move three places right.	Every mass jump is × 1000, so the way back is ÷ 1000.
Work out	$3750 \div 1000 = 3.75$, so 3750 g = 3.75 kg.	Three places: 3750. becomes 3.750.
Check	$3.75 \times 1000 = 3750$ ✓ — and a few kilograms suits a parcel.	Size check against the paperclip-and-textbook feel.

The parcel has a mass of **3.75 kg**.

Example 3 — with help

(a) A walking track is 4.08 km long. Write its length in metres. (b) A bridge is 925 m long. Write its length in kilometres.

Step	Working	Comment
Read	(a) km → m, one jump to a smaller unit. (b) m → km, one jump to a larger unit.	Same ladder, opposite directions.
Plan	(a) Multiply by 1000. (b) Divide by 1000.	m ↔ km is the × 1000 jump on the length ladder.
Work out	(a) $4.08 \times 1000 = 4080$, so 4.08 km = 4080 m. (b) $925 \div 1000 = 0.925$, so 925 m = 0.925 km.	Digits move three places each way.
Check	$4080 \div 1000 = 4.08$ ✓; $0.925 \times 1000 = 925$ ✓. A bridge under 1 km and a track over 4 km both make sense.	Each answer checks against its start.

The track is **4080 m**; the bridge is **0.925 km**.

Example 4 — with help

A bottle holds 6 L 40 mL. Write its capacity as a decimal in litres, and in millilitres only.

Step	Working	Comment
Read	Mixed form: 6 L and 40 mL. Want (i) L as a decimal, (ii) mL only.	Two targets; one amount.
Plan	(i) Change 40 mL to L by ÷ 1000, then add. (ii) Change 6 L to mL by × 1000, then add.	A millilitre is a thousandth of a litre, so 40 mL = 0.04 L.

Step	Working	Comment
Work out	(i) $40 \div 1000 = 0.04$; $6 + 0.04 = 6.04$ L. (ii) $6 \times 1000 = 6000$; $6000 + 40 = 6040$ mL.	40 mL sits in the hundredths, not the tenths.
Check	$6040 \div 1000 = 6.04$ ✓ — both names agree.	The two answers must convert into each other.

The bottle holds **6.04 L**, which is **6040 mL**.

Example 5 — on your own

(a) A truck carries a load of 7.3 t. Write the load in kilograms. (b) A small motorbike has a mass of 450 kg. Write it in tonnes.

Plan. (a) t → kg is one jump to a smaller unit: × 1000. (b) kg → t is one jump to a larger unit: ÷ 1000.

Work out. (a) $7.3 \times 1000 = 7300$, so 7.3 t = **7300 kg**. (b) $450 \div 1000 = 0.45$, so 450 kg = **0.45 t**.

Check. $7300 \div 1000 = 7.3$ ✓; $0.45 \times 1000 = 450$ ✓. A load of a few tonnes and a motorbike under half a tonne both fit the everyday feel. ✓

Example 6 — on your own

(a) Write 5 kg 80 g as a decimal in kilograms. (b) A tablet of medicine has a mass of 500 mg. Write it in grams.

Plan. (a) Change 80 g to kg by ÷ 1000 and add it to the 5 kg. (b) mg → g is one jump to a larger unit: ÷ 1000.

Work out. (a) $80 \div 1000 = 0.08$; $5 + 0.08 = $ **5.08 kg**. (b) $500 ÷ 1000 = $ **0.5 g**.

Check. $5.08 \times 1000 = 5080$ g = 5 kg 80 g ✓; $0.5 \times 1000 = 500$ mg ✓. Notice 80 g is 0.08 kg — the 8 sits in the hundredths, not the tenths.

Example 7 — on your own

(a) A farm dam holds 120 kL of water. Write the capacity in litres. (b) A larger dam holds 2.5 ML. Write its capacity in kilolitres.

Plan. (a) kL → L: × 1000. (b) ML → kL: × 1000.

Work out. (a) $120 × 1000 = $ **120 000 L**. (b) $2.5 × 1000 = $ **2500 kL**.

Check. $120\,000 \div 1000 = 120$ ✓; $2500 \div 1000 = 2.5$ ✓. Counting two jumps agrees too: 2.5 ML = 2 500 000 L, and 2500 kL = 2 500 000 L — the same amount. ✓

Example 8 — on your own

Three friends measure the same doorway. Ada says 2100 mm, Ben says 2.1 m, and Cara says 0.0021 km. (a) Show that all three are right. (b) Which name would you use to describe the doorway? Give a reason.

Plan. Put all three on the same step of the length ladder — change each to metres — then compare; choose the name whose number is easiest to picture.

Work out. (a) Ada: $2100 \div 1000 = 2.1$ m. Cara: $0.0021 \times 1000 = 2.1$ m. Ben: 2.1 m. All three names are the same length. ✓ (b) Use **2.1 m**: a small number that matches how doorways are talked about. 2100 mm suits a builder's tape, and 0.0021 km is a hard-to-picture decimal for a doorway.

Check. $2.1 \times 1000 = 2100$ mm ✓; $2.1 \div 1000 = 0.0021$ km ✓ — the three names convert into each other, so the amount is unchanged.

Practice questions

With help

Q1. Sort each unit into its family (length, mass or capacity): (i) mm, (ii) kg, (iii) mL, (iv) km, (v) mg, (vi) L, (vii) t, (viii) cm.

Q2. Fill in the gaps: (a) 1 cm = __ mm; (b) 1 m = __ cm; (c) 1 km = __ m; (d) 1 kg = __ g; (e) 1 t = __ kg; (f) 1 L = __ mL; (g) 1 kL = __ L; (h) 1 ML = __ kL.

Q3. Use the prefix cards. What does each prefix mean, and give one unit that uses it: (a) milli-, (b) centi-, (c) kilo-, (d) mega-.

Q4. Convert the lengths. (a) 5 m to cm. (b) 300 cm to m. (c) 2 km to m.

Q5. Convert the masses. (a) 4 kg to g. (b) 6000 g to kg. (c) 3 t to kg.

Q6. Convert the capacities. (a) 7 L to mL. (b) 2500 mL to L. (c) 5 kL to L.

Q7. Like the choosing figure, pick the better unit: (a) the length of a pencil — cm or km? (b) the mass of a loaded truck — g or t? (c) the capacity of a water bottle — mL or kL?

Q8. Like the middle column of the three-names figure, write as a decimal in the larger unit: (a) 3 m 25 cm; (b) 2 kg 350 g; (c) 1 L 500 mL.

Q9. Like the right column of the three-names figure, write in the smaller unit only: (a) 4.6 m; (b) 1.8 kg; (c) 2.5 L.

Q10. Choose the unit that fits, and give one everyday object that matches it: (a) the width of a grain of sand; (b) the mass of a textbook; (c) the capacity of a milk carton.

On your own

Q11. Convert the lengths. (a) 8 m to cm. (b) 450 cm to m. (c) 6 km to m. (d) 2500 m to km.

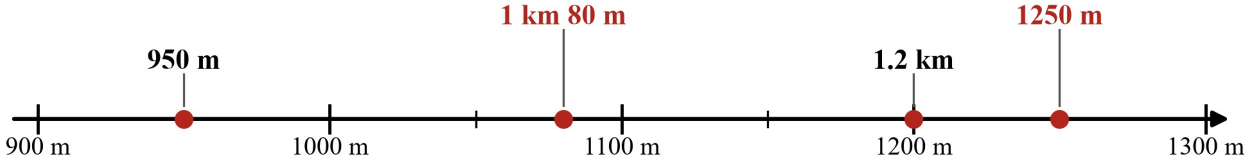
Q12. Convert the masses. (a) 9 kg to g. (b) 7000 g to kg. (c) 2.5 t to kg. (d) 8500 kg to t.

Q13. Convert the capacities. (a) 3 L to mL. (b) 4000 mL to L. (c) 6 kL to L. (d) 0.5 L to mL.

Q14. (a) Write 4.2 m in cm. (b) Write 3080 g in kg. (c) Write 12.5 L in mL. (d) Write 45 mL in L.

Q15. Put these lengths in order, smallest first: 1.2 km, 950 m, 1250 m, 1 km 80 m.

Put the lengths in order — first give them all the same unit



A number line from 900 m to 1300 m with 950 m, 1 km 80 m, 1.2 km and 1250 m marked in order

Q16. Noah writes 3 km 50 m as 3.5 km. What has he got wrong? Write 3 km 50 m correctly in km, and say what 3.5 km actually is, in metres.

Q17. Write as a decimal in the unit asked. (a) 2 m 8 cm in metres. (b) 4 kg 90 g in kilograms. (c) 3 L 25 mL in litres.

Q18. (a) A bridge is 480 m long. Write its length in km. (b) A bag of flour has a mass of 1.5 kg. Write it in g. (c) A pool holds 250 kL of water. Write it in L.

Q19. Compare using <, > or =. (a) 1.2 km ? 1200 m. (b) 450 g ? 0.5 kg. (c) 2 L 5 mL ? 2.5 L.

Q20. Fill in the gaps. (a) 6 km = __ m. (b) 0.75 kg = __ g. (c) 8000 mL = __ L. (d) 4 t = __ kg.

Q21. A small car has a mass of about 1 t, and a truck has a mass of about 8 t. (a) Write the truck's mass in kg. (b) How many small cars have about the same mass as the truck?

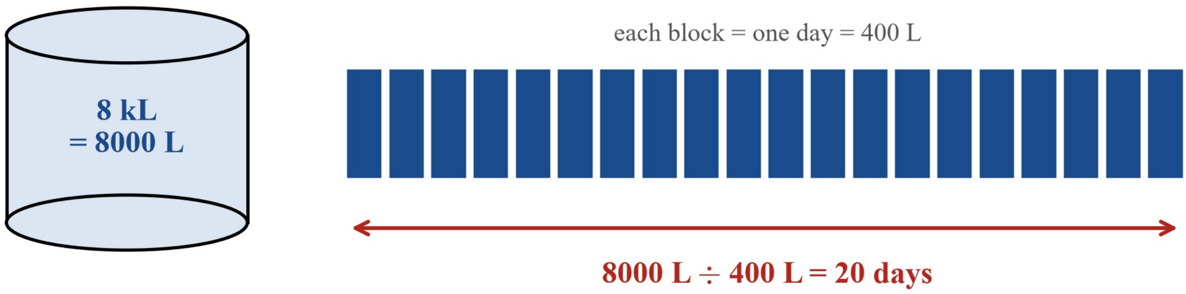
Q22. A jug holds 2 L, and a cup holds 250 mL. How many cupfuls fill the jug?

Maths in real life

Q23. A recipe asks for 1.5 L of milk, and you only have a 250 mL cup. How many cupfuls do you need?

Q24. A farm tank holds 8 kL of water, and the farm uses 400 L each day. How many whole days does a full tank last?

An 8 kL tank, used at 400 litres per day



The tank lasts 20 whole days.

An 8 kL tank (8000 L) drawn beside 20 blocks of 400 L each: 8000 L divided by 400 L is 20 days

Q25. Talia's watch says she has walked 5200 m today. (a) Write it in km. (b) Her goal is 6 km. How many more metres does she need to walk?

Choosing your strategy

Q26. Put these masses in order, smallest first: 1 kg 50 g, 705 g, 0.75 kg.

Q27. Sam says 205 cm = 2.5 m. Is he right? If not, write 205 cm correctly in metres, and say what 2.5 m is in centimetres.

Q28. One length, three names: write 4500 m as (a) kilometres; (b) kilometres and metres combined; (c) centimetres.

Q29. Make your own. Pick something in your classroom, choose the unit that fits, and record its measure. Then write the same amount in two other units. Swap with a partner and check each other's converting.

Answers

Q1. Length: i, viii, iv (mm, cm, km). Mass: ii, v, vii (kg, mg, t). Capacity: iii, vi (mL, L). **Q2.** (a) 10; (b) 100; (c) 1000; (d) 1000; (e) 1000; (f) 1000; (g) 1000; (h) 1000. **Q3.** (a) one thousandth — mm, mg or mL; (b) one hundredth — cm; (c) one thousand — km, kg or kL; (d) one million — ML. **Q4.** (a) 500 cm; (b) 3 m; (c) 2000 m. **Q5.** (a) 4000 g; (b) 6 kg; (c) 3000 kg. **Q6.** (a) 7000 mL; (b) 2.5 L; (c) 5000 L. **Q7.** (a) cm; (b) t; (c) mL. **Q8.** (a) 3.25 m; (b) 2.35 kg; (c) 1.5 L. **Q9.** (a) 460 cm; (b) 1800 g; (c) 2500 mL. **Q10.** (a) mm — a grain of sand; (b) kg — a textbook; (c) L — a milk carton. **Q11.** (a) 800 cm; (b) 4.5 m; (c) 6000 m; (d) 2.5 km. **Q12.** (a) 9000 g; (b) 7 kg; (c) 2500 kg; (d) 8.5 t. **Q13.** (a) 3000 mL; (b) 4 L; (c) 6000 L; (d) 500 mL. **Q14.** (a) 420 cm; (b) 3.08 kg; (c) 12 500 mL; (d) 0.045 L. **Q15.** 950 m < 1 km 80 m < 1.2 km < 1250 m. **Q16.** The 50 m is 0.05 km, not 0.5 km: 3 km 50 m = 3.05 km. 3.5 km would be 3500 m, which is 3 km 500 m. **Q17.** (a) 2.08 m; (b) 4.09 kg; (c) 3.025 L. **Q18.** (a) 0.48 km; (b) 1500 g; (c) 250 000 L. **Q19.** (a) =; (b) <; (c) <. **Q20.** (a) 6000; (b) 750; (c) 8; (d) 4000. **Q21.** (a) 8000 kg; (b) 8 small cars. **Q22.** 8 cupfuls. **Q23.** 6 cupfuls. **Q24.** 20 days. **Q25.** (a) 5.2 km; (b) 800 m. **Q26.** 705 g < 0.75 kg < 1 kg 50 g. **Q27.** No: 205 cm = 2.05 m; and 2.5 m = 250 cm. **Q28.** (a) 4.5 km; (b) 4 km 500 m; (c) 450 000 cm. **Q29.** Answers will vary.

All the working

Q1. The symbols give it away: mm, cm and km end in m (metres — length); kg, mg and t measure mass; mL and L measure capacity.

Q2. (a) cm → mm is × 10. (b) m → cm is × 100. (c)–(h) every other single jump on the three ladders is × 1000.

Q3. (a) milli- = one thousandth: 1 mm is one thousandth of 1 m (also mg, mL). (b) centi- = one hundredth: 1 cm is one hundredth of 1 m. (c) kilo- = one thousand: 1 km is 1000 m (also kg, kL). (d) mega- = one million: 1 ML is 1 000 000 L.

Q4. (a) \$5 × 100 = \$ **500 cm**. (b) \$300 ÷ 100 = \$ **3 m**. (c) \$2 × 1000 = \$ **2000 m**.

Q5. (a) \$4 × 1000 = \$ **4000 g**. (b) \$6000 ÷ 1000 = \$ **6 kg**. (c) \$3 × 1000 = \$ **3000 kg**.

Q6. (a) \$7 × 1000 = \$ **7000 mL**. (b) \$2500 ÷ 1000 = \$ **2.5 L**. (c) \$5 × 1000 = \$ **5000 L**.

Q7. (a) **cm** — a pencil is about 15 cm; in km it would be a tiny decimal. (b) **t** — a loaded truck is many tonnes; in grams the number would run into the millions. (c) **mL** — a bottle is a few hundred mL; kL suits a tank.

Q8. (a) 25 cm = 0.25 m, so **3.25 m**. (b) 350 g = 0.35 kg, so **2.35 kg**. (c) 500 mL = 0.5 L, so **1.5 L**.

Q9. (a) \$4.6 × 100 = \$ **460 cm**. (b) \$1.8 × 1000 = \$ **1800 g**. (c) \$2.5 × 1000 = \$ **2500 mL**.

Q10. (a) **mm** — a grain of sand is about 1 mm wide. (b) **kg** — a textbook is about 1 kg. (c) **L** — a milk carton holds 1 L.

Q11. (a) \$8 × 100 = \$ **800 cm**. (b) \$450 ÷ 100 = \$ **4.5 m**. (c) \$6 × 1000 = \$ **6000 m**. (d) \$2500 ÷ 1000 = \$ **2.5 km**.

Q12. (a) \$9 × 1000 = \$ **9000 g**. (b) \$7000 ÷ 1000 = \$ **7 kg**. (c) \$2.5 × 1000 = \$ **2500 kg**. (d) \$8500 ÷ 1000 = \$ **8.5 t**.

Q13. (a) \$3 × 1000 = \$ **3000 mL**. (b) \$4000 ÷ 1000 = \$ **4 L**. (c) \$6 × 1000 = \$ **6000 L**. (d) \$0.5 × 1000 = \$ **500 mL**.

Q14. (a) \$4.2 × 100 = \$ **420 cm**. (b) \$3080 ÷ 1000 = \$ **3.08 kg**. (c) \$12.5 × 1000 = \$ **12 500 mL**. (d) \$45 ÷ 1000 = \$ **0.045 L**.

Q15. In metres: 1.2 km = 1200 m; 1 km 80 m = 1080 m. So 950 m < 1080 m < 1200 m < 1250 m: **950 m < 1 km 80 m < 1.2 km < 1250 m**, as the number line shows.

Q16. 50 m is $50 \div 1000 = 0.05$ km, so 3 km 50 m = **3.05 km**. Noah put the 5 in the tenths, where it stands for 500 m: 3.5 km = \$3.5 × 1000 = \$ **3500 m**, which is 3 km 500 m — 450 m too far.

Q17. (a) 8 cm = 0.08 m, so **2.08 m**. (b) 90 g = 0.09 kg, so **4.09 kg**. (c) 25 mL = 0.025 L, so **3.025 L**.

Q18. (a) \$480 ÷ 1000 = \$ **0.48 km**. (b) \$1.5 × 1000 = \$ **1500 g**. (c) \$250 × 1000 = \$ **250 000 L**.

Q19. (a) 1.2 km = 1200 m, so **=**. (b) 0.5 kg = 500 g and 450 g < 500 g, so **<**. (c) 2 L 5 mL = 2.005 L and 2.005 L < 2.5 L, so **<**.

Q20. (a) $6 × 1000 = $ **6000 m**. (b) $0.75 × 1000 = $ **750 g**. (c) $8000 ÷ 1000 = $ **8 L**. (d) $4 × 1000 = $ **4000 kg**.

Q21. (a) $8 × 1000 = $ **8000 kg**. (b) $8 ÷ 1 = $ **8 small cars** (8000 kg ÷ 1000 kg).

Q22. 2 L = 2000 mL; $2000 ÷ 250 = $ **8 cupfuls**. Check: 8 × 250 = 2000 mL ✓.

Q23. 1.5 L = 1500 mL; $1500 ÷ 250 = $ **6 cupfuls**. Check: 6 × 250 = 1500 mL ✓.

Q24. 8 kL = 8000 L; $8000 ÷ 400 = $ **20 days**, as the twenty blocks in the figure show. Check: 20 × 400 = 8000 L ✓.

Q25. (a) $5200 ÷ 1000 = $ **5.2 km**. (b) 6 km = 6000 m; $6000 − 5200 = $ **800 m**.

Q26. In grams: 1 kg 50 g = 1050 g; 0.75 kg = 750 g. So 705 g < 750 g < 1050 g: **705 g < 0.75 kg < 1 kg 50 g**.

Q27. Not right. 205 ÷ 100 = 2.05, so 205 cm = **2.05 m**; Sam’s 2.5 m would be $2.5 × 100 = $ **250 cm**. The 5 in 205 cm sits in the ones of centimetres — the hundredths of a metre.

Q28. (a) $4500 ÷ 1000 = $ **4.5 km**. (b) 4500 m = **4 km 500 m**. (c) $4500 × 100 = $ **450 000 cm**.

Q29. Answers will vary. A correct answer names a sensible unit for the object, and the two other names convert back to the original by multiplying or dividing by 10, 100 or 1000 — e.g. a door at 2 m = 200 cm = 2000 mm.

Establishing and using the formula for the area of a rectangle

Content description `VC2M6M02`: establish the formula for the area of a rectangle and use it to solve practical problems

In Year 5 you measured area by covering shapes with square units and counting them, and you found perimeters by adding the sides. This subtopic turns that counting into a formula you establish for yourself — then puts the formula to work on practical problems.

Theory

Area and square units

The **area** of a shape is the amount of surface it covers. You measure it by counting **square units** — squares of a fixed size that cover the shape with no gaps and no overlaps. A square that is 1 cm on each side has an area of **1 square centimetre**, written **1 cm²**; a square that is 1 m on each side has an area of **1 square metre**, **1 m²**.

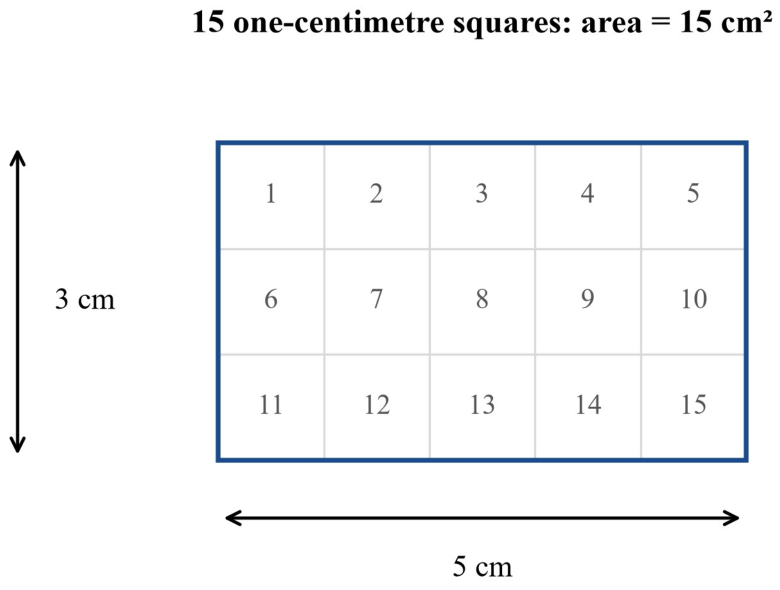
area = 1 square centimetre = 1 cm² **six unit squares: area = 6 cm²**

One square centimetre, a square with sides of 1 cm, next to a rectangle tiled with six numbered unit squares, whose area is 6 cm²

The rectangle on the right is tiled by six unit squares, so its area is 6 cm². Counting squares works for any shape you can tile — it is just slow.

Counting squares on grid paper

One-centimetre grid paper makes the counting easy: line the shape up with the squares and count the squares inside.

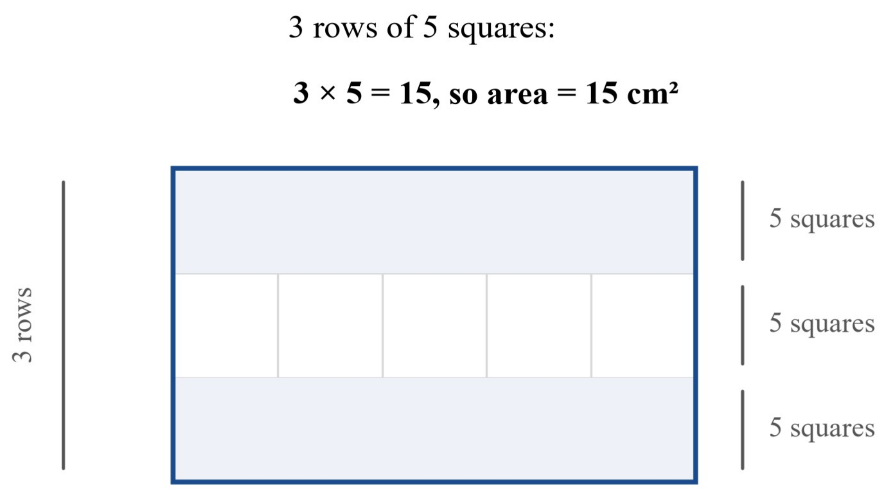


A 5 cm by 3 cm rectangle on 1 cm grid paper, with its 15 squares numbered 1 to 15, so the area is 15 cm²

Counting gives 15 squares, so the area of the rectangle is **15 cm²**.

Seeing the array

You do not have to count one by one. The squares sit in **rows and columns** — an **array**, the row-and-column structure behind multiplication. There are 3 rows with 5 squares in each row, so instead of counting you can multiply: $3 \times 5 = 15$.

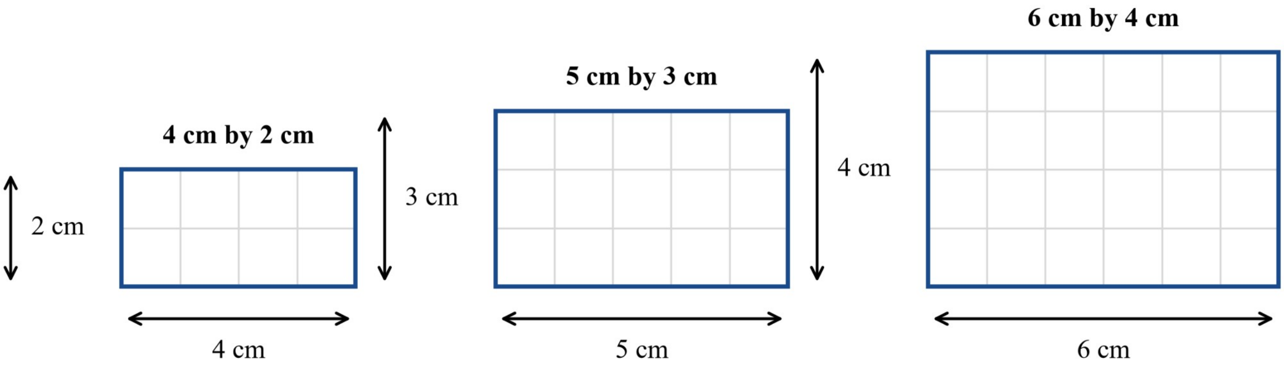


The same 5 cm by 3 cm rectangle shown as an array of 3 rows of 5 squares, with 3 × 5 = 15, so the area is 15 cm²

The number of squares in one row is the **length** of the rectangle (5 cm). The number of rows is the **width** (3 cm).

Establishing the formula from grid paper

Make a few rectangles on 1 cm grid paper, count the squares in each, and record the side lengths and the area in a table.



Length (cm)	Width (cm)	Area (cm²)
4	2	8
5	3	15
6	4	24

Each area is found by counting the squares — then the pattern shows.

Three rectangles on 1 cm grid paper — 4 cm by 2 cm, 5 cm by 3 cm, and 6 cm by 4 cm — above a table recording length, width and area: 8, 15 and 24 cm²

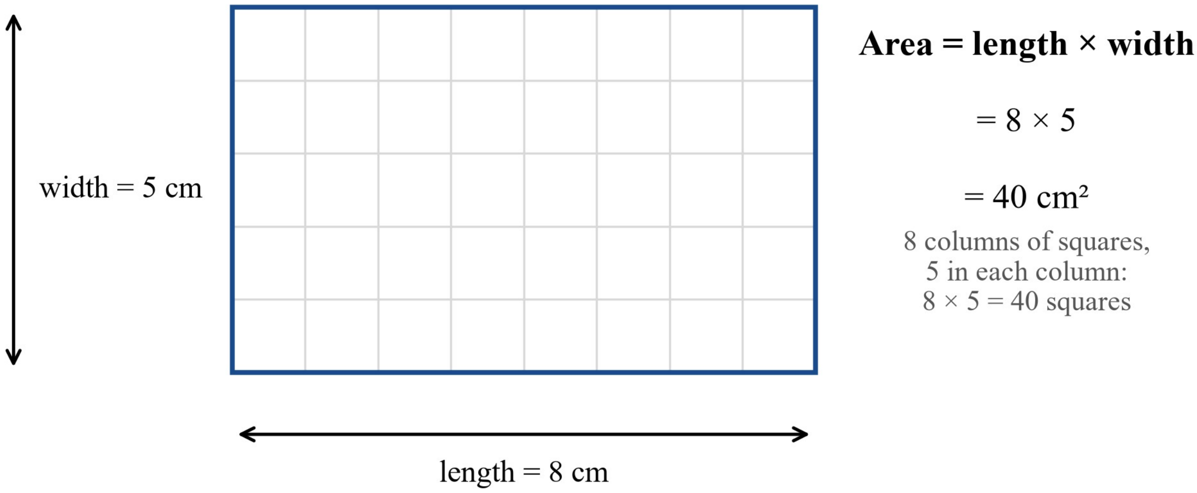
Length (cm)	Width (cm)	Area (cm²)
4	2	8
5	3	15
6	4	24

Now look for the pattern. In every row of the table, the area is the length **times** the width: $4 \times 2 = 8$, $5 \times 3 = 15$, $6 \times 4 = 24$. The array shows why: the length says how many squares are in a row, the width says how many rows, and multiplying rows by squares-in-a-row counts every square once.

The formula

That pattern, true for every rectangle, is the formula:

Area of a rectangle = length × width



An 8 cm by 5 cm rectangle on a grid with its length and width labelled, beside the working Area = length × width = 8 × 5 = 40 cm²

Check it against the figure: $8 \times 5 = 40$, and counting the squares in the grid gives 40 as well. Two things are worth noticing:

- **Order does not matter.** $8 \times 5 = 5 \times 8$: the same rectangle reads as 8 columns of 5 or 5 rows of 8. Turning the rectangle swaps length and width and leaves the area the same.
- **The units multiply too.** cm × cm gives cm², and m × m gives m². That is why areas are always written in *square* units.

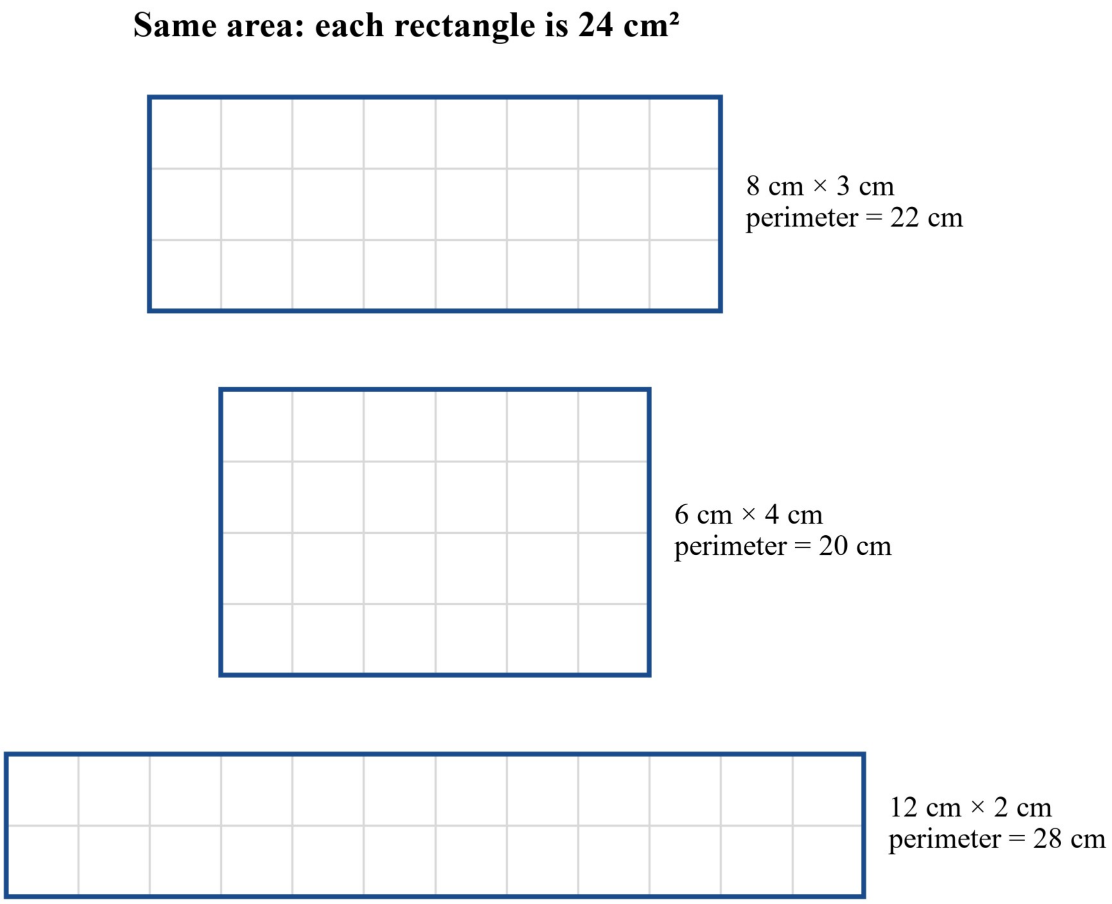
Choosing the right unit

Pick the square unit to suit what you measure, the same judgement you make with length units: a book cover is sensibly measured in cm², a classroom floor in m². When you compare two areas, measure both in the same unit, or the comparison means nothing.

Area and perimeter are different measures

The **perimeter** is the distance *around* a shape — a length, in cm or m. The **area** is the surface *inside* — in cm² or m². A rectangle 6 cm by 4 cm has perimeter $6 + 4 + 6 + 4 = 20$ cm and area $6 \times 4 = 24$ cm²: two different numbers, in different units, from the same rectangle. One does not tell you the other, as the next two figures make plain.

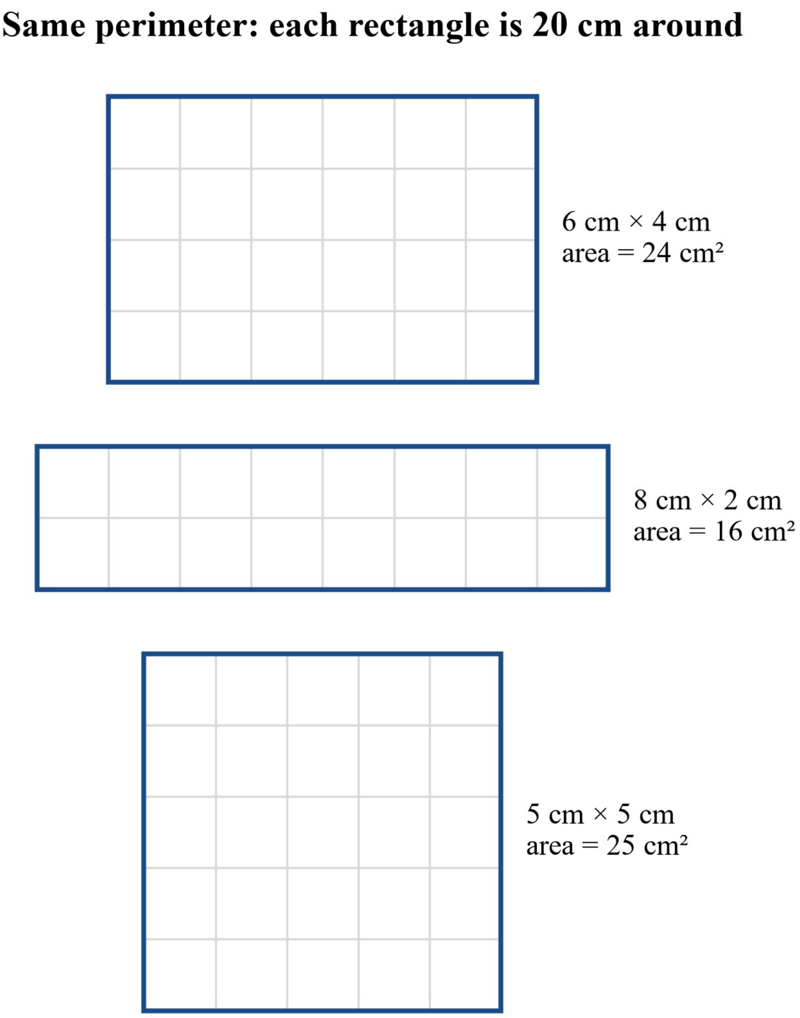
__Same area, different perimeters__



Three rectangles, each of area 24 cm², drawn to scale: 8 cm by 3 cm with perimeter 22 cm, 6 cm by 4 cm with perimeter 20 cm, and 12 cm by 2 cm with perimeter 28 cm

All three rectangles cover 24 cm², yet their perimeters are 22 cm, 20 cm and 28 cm. **The same area does not mean the same perimeter** — the longer and thinner the rectangle, the longer its perimeter for the same area.

Same perimeter, different areas



Three rectangles, each of perimeter 20 cm, drawn to scale: 6 cm by 4 cm with area 24 cm², 8 cm by 2 cm with area 16 cm², and 5 cm by 5 cm with area 25 cm²

All three rectangles are 20 cm around, yet their areas are 24 cm², 16 cm² and 25 cm². **The same perimeter does not mean the same area** — the closer the rectangle is to a square, the more area the same perimeter encloses.

Words for this subtopic

Word	Meaning
area	the amount of surface a shape covers, counted in square units
square unit	a square of a fixed size used to measure area: 1 cm², 1 m²
perimeter	the distance around a shape — a length, not an area
length / width	the long side / the short side of a rectangle
array	rows and columns of equal squares, as in multiplication
formula	a rule that tells you how to calculate something, here: Area = length × width

Worked examples

In the with-help examples the steps are labelled for you; in the on-your-own examples you carry them out yourself. Every example ends with a check.

Example 1 — with help

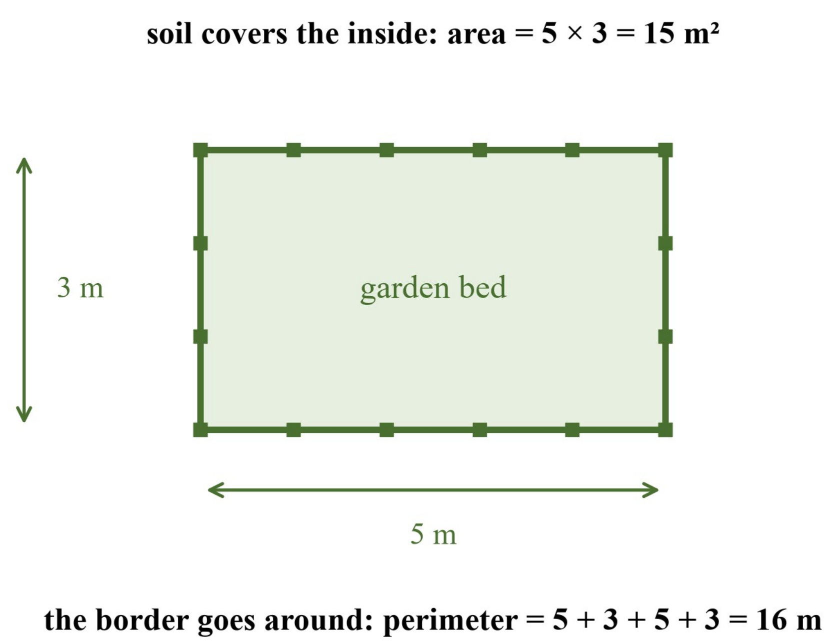
Find the area of a rectangle 7 cm long and 4 cm wide. Check your answer a second way.

Step	Working	Comment
Read	Length 7 cm, width 4 cm; the area is wanted.	Draw the rectangle if it helps.
Plan	Use the formula: Area = length × width.	The formula counts the array of squares.
Work out	$7 \times 4 = 28$	Area = **28 cm²** — square units, always.
Check	$4 \times 7 = 28$ as well.	Turning the rectangle swaps length and width; the area is unchanged. ✓

The area is **28 cm²**.

Example 2 — with help

Mia’s garden bed is a rectangle 5 m long and 3 m wide. She fills the inside with soil and puts a border around the outside. (a) What area of soil does she fill? (b) What length of border does she put around it?



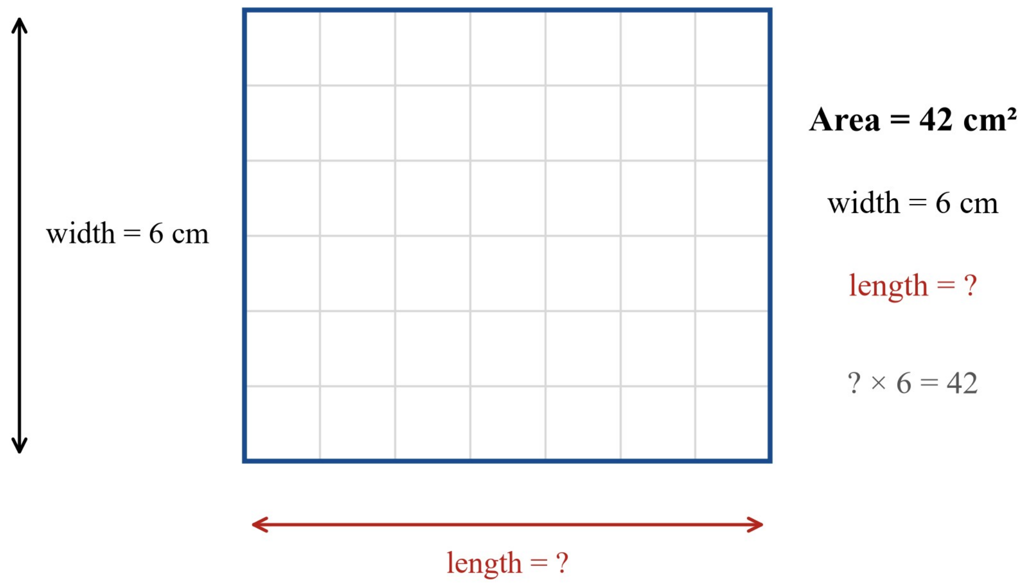
A plan of the rectangular garden bed, 5 m by 3 m: the soil covers the inside, area 5 × 3 = 15 m², and the border goes around the outside, perimeter 5 + 3 + 5 + 3 = 16 m

Step	Working	Comment
Read	Length 5 m, width 3 m. (a) asks for the cover inside; (b) for the distance around.	Inside = area; around = perimeter.
Plan	(a) Area = length × width. (b) Add the four sides.	Two different measures, two different units.
Work out	(a) $5 \times 3 = 15$, so 15 m². (b) $5 + 3 + 5 + 3 = 16$, so 16 m.	m² for the cover, m for the border.
Check	The units say which is which: a cover in square units, a border in plain metres. ✓	If both answers carried the same unit, one would be wrong.

She fills **15 m²** of soil and puts **16 m** of border around it.

Example 3 — on your own

A rectangle has an area of 42 cm² and a width of 6 cm. Find its length.



A rectangle of area 42 cm² drawn on 1 cm grid paper, its width marked 6 cm and its length marked with a question mark

Plan. The formula says length × width = area, so length × 6 = 42. Division undoes the multiplication: length = 42 ÷ 6.

Work out. $42 \div 6 = 7$. The length is **7 cm**.

Check. $7 \times 6 = 42$ cm² — the area given. ✓ And the figure shows it: a 7 cm by 6 cm rectangle holds 42 squares.

Example 4 — on your own

(a) Two rectangles both have area 12 cm²: one is 4 cm by 3 cm, the other is 6 cm by 2 cm. Find the perimeter of each. (b) Two rectangles both have perimeter 16 cm: one is 5 cm by 3 cm, the other is 6 cm by 2 cm. Find the area of each. What do you notice?

Plan. Perimeter: add the four sides. Area: length × width. Then compare the pairs.

Work out. (a) 4 cm by 3 cm: $4+3+4+3=14$ cm. 6 cm by 2 cm: $6+2+6+2=16$ cm. (b) 5 cm by 3 cm: $5 \times 3 = 15$ cm². 6 cm by 2 cm: $6 \times 2 = 12$ cm².

Check and notice. Same area (12 cm²), different perimeters (14 cm and 16 cm); same perimeter (16 cm), different areas (15 cm² and 12 cm²). ✓ Area and perimeter are different measures — one does not fix the other.

Practice questions

With help

Q1. Use the formula to find the area of each rectangle. (a) 6 cm by 3 cm (b) 9 cm by 4 cm (c) 10 cm by 7 cm (d) 5 cm by 5 cm

Q2. Complete the table.

Length (cm)	Width (cm)	Area (cm²)
8	2	?
7	3	?

Length (cm)	Width (cm)	Area (cm²)
?	5	35
12	?	36

Q3. Use the grid-paper figure in the theory. (a) How many squares are in the 4 cm by 2 cm rectangle? (b) How many in the 6 cm by 4 cm rectangle? (c) Which of the three rectangles has the greatest area?

Q4. Choose the better square unit (cm² or m²) for measuring the area of: (a) a book cover (b) a classroom floor (c) a postcard (d) a soccer field

Q5. For each rectangle, find the area and the perimeter. (a) 7 cm by 2 cm (b) 8 cm by 3 cm

Q6. Which rectangle has the greater area: 9 cm by 4 cm, or 6 cm by 5 cm? By how much? Compare their perimeters too.

On your own

Q7. Find the area of each rectangle. (a) 12 cm by 8 cm (b) 15 cm by 6 cm (c) 11 m by 9 m

Q8. Find the missing side. (a) Area 56 cm², length 8 cm — find the width. (b) Area 45 cm², width 5 cm — find the length. (c) Area 63 cm², length 9 cm — find the width.

Q9. Tom’s bedroom floor is a rectangle 4 m by 3 m. (a) What area of carpet covers it? (b) A border strip runs around the edge of the floor. What length is the strip?

Q10. Three rectangles each have area 18 cm²: 9 cm by 2 cm, 6 cm by 3 cm, and 18 cm by 1 cm. Find the perimeter of each. Which has the shortest perimeter?

Q11. Three rectangles each have perimeter 24 cm: 7 cm by 5 cm, 10 cm by 2 cm, and 6 cm by 6 cm. Find the area of each. Which has the greatest area?

Q12. Two posters hang in the school hall. Poster A is 60 cm by 40 cm; poster B is 50 cm by 45 cm. (a) Find the area of each poster. (b) Which poster has the greater area, and by how much? (c) Find the perimeter of each — here, does the poster with the greater area also have the greater perimeter?

Q13. True or false? Use the figures in the theory to explain each answer. (a) Two rectangles with the same area always have the same perimeter. (b) Two rectangles with the same perimeter always have the same area. (c) A rectangle with a longer perimeter always has a greater area.

Q14. On 1 cm grid paper, draw: (a) two different rectangles that each have area 20 cm², and write down the perimeter of each; (b) two different rectangles that each have perimeter 20 cm, and write down the area of each.

Answers

Q1. (a) 18 cm^2; (b) 36 cm^2; (c) 70 cm^2; (d) 25 cm^2. **Q2.** 16; 21; 7; 3. **Q3.** (a) 8; (b) 24; (c) the 6 cm by 4 cm rectangle (24 cm^2). **Q4.** (a) cm^2; (b) m^2; (c) cm^2; (d) m^2. **Q5.** (a) area 14 cm^2, perimeter 18 cm; (b) area 24 cm^2, perimeter 22 cm. **Q6.** The 9 cm by 4 cm rectangle, by 6 cm^2; its perimeter (26 cm) is also the greater of the two (22 cm). **Q7.** (a) 96 cm^2; (b) 90 cm^2; (c) 99 m^2. **Q8.** (a) 7 cm; (b) 9 cm; (c) 7 cm. **Q9.** (a) 12 m^2; (b) 14 m. **Q10.** 22 cm, 18 cm, 38 cm; the 6 cm by 3 cm rectangle is shortest. **Q11.** 35 cm^2, 20 cm^2, 36 cm^2; the 6 cm by 6 cm rectangle is greatest. **Q12.** (a) A: 2400 cm^2, B: 2250 cm^2; (b) A, by 150 cm^2; (c) yes here — 200 cm against 190 cm — but not always (see Q13). **Q13.** (a) false; (b) false; (c) false. **Q14.** Answers will vary.

All the working

Q1. (a) \$6 × 3 = \$ **18 cm^2**. (b) \$9 × 4 = \$ **36 cm^2**. (c) \$10 × 7 = \$ **70 cm^2**. (d) \$5 × 5 = \$ **25 cm^2**.

Q2. \$8 × 2 = \$ **16**; \$7 × 3 = \$ **21**; \$35 ÷ 5 = \$ **7**; \$36 ÷ 12 = \$ **3**. Check the last two by multiplying back: $7 \times 5 = 35$ ✓, $12 \times 3 = 36$ ✓.

Q3. (a) 2 rows of 4: **8** squares. (b) 4 rows of 6: **24** squares. (c) Areas 8, 15 and 24 cm^2 — the **6 cm by 4 cm** rectangle.

Q4. (a) **cm^2** — a book cover is a small surface. (b) **m^2**. (c) **cm^2**. (d) **m^2** — a soccer field is far too big for cm^2 to be sensible.

Q5. (a) Area \$7 × 2 = \$ 14 cm^2; perimeter \$7 + 2 + 7 + 2 = \$ 18 cm. (b) Area \$8 × 3 = \$ 24 cm^2; perimeter \$8 + 3 + 8 + 3 = \$ 22 cm.

Q6. Areas: $9 \times 4 = 36$ cm^2 and $6 \times 5 = 30$ cm^2 — the **9 cm by 4 cm** rectangle is greater by \$36 − 30 = \$ **6 cm^2**. Perimeters: $9 + 4 + 9 + 4 = 26$ cm and $6 + 5 + 6 + 5 = 22$ cm.

Q7. (a) \$12 × 8 = \$ **96 cm^2**. (b) \$15 × 6 = \$ **90 cm^2**. (c) \$11 × 9 = \$ **99 m^2**.

Q8. (a) \$56 ÷ 8 = \$ **7 cm**. (b) \$45 ÷ 5 = \$ **9 cm**. (c) \$63 ÷ 9 = \$ **7 cm**. Each checks by multiplying back: $8 \times 7 = 56$, $9 \times 5 = 45$, $9 \times 7 = 63$. ✓

Q9. (a) \$4 × 3 = \$ **12 m^2**. (b) \$4 + 3 + 4 + 3 = \$ **14 m**.

Q10. 9 cm by 2 cm: $9 + 2 + 9 + 2 = 22$ cm. 6 cm by 3 cm: $6 + 3 + 6 + 3 = 18$ cm. 18 cm by 1 cm: $18 + 1 + 18 + 1 = 38$ cm. The **6 cm by 3 cm** rectangle has the shortest perimeter — the one closest to a square.

Q11. 7 cm by 5 cm: $7 \times 5 = 35$ cm^2. 10 cm by 2 cm: $10 \times 2 = 20$ cm^2. 6 cm by 6 cm: $6 \times 6 = 36$ cm^2. The **6 cm by 6 cm** rectangle (a square is a special rectangle) has the greatest area for the same perimeter.

Q12. (a) A: $60 \times 40 = 2400$ cm^2; B: $50 \times 45 = 2250$ cm^2. (b) A is greater by \$2400 − 2250 = \$ **150 cm^2**. (c) A: $60 + 40 + 60 + 40 = 200$ cm; B: $50 + 45 + 50 + 45 = 190$ cm — yes here, A has both. But Q13 shows that greater perimeter does not *always* mean greater area.

Q13. (a) **False** — the same-area figure: all three rectangles are 24 cm^2, yet the perimeters are 22 cm, 20 cm and 28 cm. (b) **False** — the same-perimeter figure: all three rectangles are 20 cm around, yet the areas are 24 cm^2, 16 cm^2 and 25 cm^2. (c) **False** — from the same-area figure, the 12 cm by 2 cm rectangle has a *longer* perimeter (28 cm) than the 6 cm by 4 cm rectangle (20 cm) but the *same* area (24 cm^2), not a greater one.

Q14. Answers will vary. For example: (a) 5 cm by 4 cm (perimeter 18 cm) and 10 cm by 2 cm (perimeter 24 cm) — both 20 cm^2; (b) 6 cm by 4 cm (area 24 cm^2) and 7 cm by 3 cm (area 21 cm^2) — both 20 cm around. Any correct answer draws true rectangles, counts the squares for the area and adds the four sides for the perimeter.

Elapsed time, timetables and itineraries

Content description VC2M6M03: measure, calculate and compare elapsed time; interpret and use timetables and itineraries to plan activities and determine the duration of events and journeys

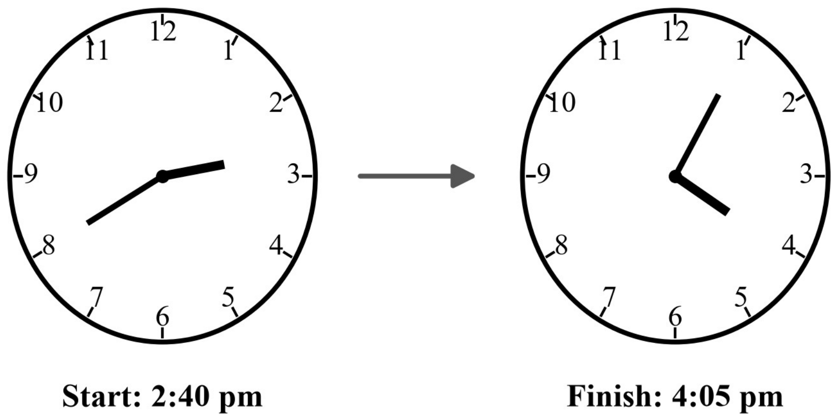
At Level 5 you learned to read and write 12-hour and 24-hour time. This subtopic puts that skill to work in the real world: how long things take, how to read the timetables that run Melbourne's trains and trams, and how to plan a journey of your own — leg by leg, change by change.

Theory

Elapsed time

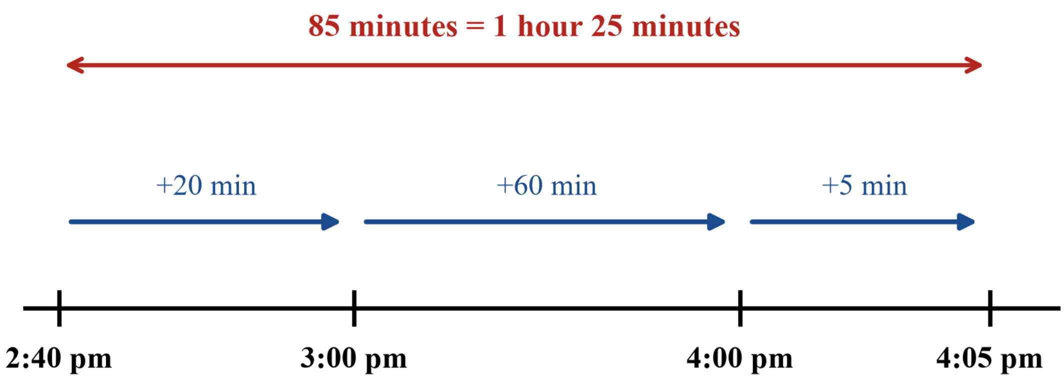
The **elapsed time** between two moments is the time that passes between them. A lesson that starts at 9:00 am and finishes at 9:50 am has an elapsed time of 50 minutes. Elapsed time is also called the **duration** — how long something lasts.

The surest way to find an elapsed time is to **count on** along a timeline, jumping to friendly times: first to the next o'clock, then whole hours, then the leftover minutes. Remember the key fact: **60 minutes = 1 hour**.



Two clock faces, one showing the start time 2:40 pm and one showing the finish time 4:05 pm

Suppose a film starts at 2:40 pm and finishes at 4:05 pm.



A jump timeline from 2:40 pm to 4:05 pm: a jump of 20 minutes to 3:00 pm, a jump of 60 minutes to 4:00 pm, and a jump of 5 minutes to 4:05 pm, totalling 85 minutes or 1 hour 25 minutes

Count on: 2:40 pm → 3:00 pm is **20 minutes**; 3:00 pm → 4:00 pm is **60 minutes**; 4:00 pm → 4:05 pm is **5 minutes**. Add the jumps: $20+60+5=85$ minutes. Because 60 minutes makes an hour, 85 minutes is **1 hour 25 minutes**. Both names describe the same duration, and you should be happy writing either.

Checking is easy: count **back** the same jumps. 4:05 pm − 5 minutes = 4:00 pm; − 60 minutes = 3:00 pm; − 20 minutes = 2:40 pm — the start. ✓

The 24-hour clock

Real timetables almost always use **24-hour time**, because it cannot be read the wrong way: 14:35 can never be mistaken for 2:35 am. Remember the rules from Level 5:

- before midday, the number is the same, usually written with a leading zero: 9:15 am is **09:15**;
- at midday, 12:00 midday is **12:00**;
- after midday, **add 12 hours**: 2:35 pm is $2+12=14$, so **14:35**;
- 11:45 pm is **23:45**, and 12:00 midnight is **00:00**.

After midday, add 12 hours: 2:35 pm → 14:35

12-hour time

6:00 am	9:15 am	12:00 midday	2:35 pm	6:30 pm	11:45 pm
06:00	**09:15**	**12:00**	**14:35**	**18:30**	**23:45**

24-hour time

Six matching pairs of times: 6:00 am is 06:00, 9:15 am is 09:15, 12:00 midday is 12:00, 2:35 pm is 14:35, 6:30 pm is 18:30, 11:45 pm is 23:45, with the rule "after midday, add 12 hours"

Reading the other way, subtract 12 from any time after 12:59: 16:40 is $16-12=4$, so 4:40 pm.

Reading a timetable

A **timetable** is a table of times. In the train timetable below, each **row** is one **service** — one run of a train — and each **column** is one station. The left column shows when the service **departs** (leaves) Flinders Street; read across the row to see when it arrives at each station.

Lilydale line — weekday morning services towards Lilydale

Departs Flinders Street	Richmond	Box Hill	Ringwood	Croydon	Lilydale
07:07	07:10	07:28	07:43	07:49	08:01
07:29	07:32	07:56	08:11	08:17	08:28
07:55	07:58	08:16	08:31	08:37	08:48
08:15	08:18	08:38	08:53	08:59	09:10
08:45	08:48	09:05	09:20	09:26	09:37
09:07	09:10	09:31	09:46	09:52	10:03

Source: Department of Transport and Planning, 'GTFS Schedule' (PTV timetable data, Victorian Government open data), 2026 (as at August 2026). Times are 24-hour. Yellow cells are used in the worked examples.

A timetable of six weekday morning Lilydale line services from Flinders Street, with columns for Richmond, Box Hill, Ringwood, Croydon and Lilydale

Source: Department of Transport and Planning, 'GTFS Schedule' (PTV timetable data, Victorian Government open data), 2026 (as at August 2026). Retrieved 20 August 2026.

To find a journey time, read the departure and the arrival, then count on. The 07:55 service departs Flinders Street at 07:55 and arrives at Box Hill at 08:16. 07:55 → 08:00 is 5 minutes; 08:00 → 08:16 is 16 minutes; $5+16=21$ minutes.

Notice that not every service takes the same time. The 07:29 service takes 59 minutes to reach Lilydale (07:29 → 08:28), while the 08:45 service takes only 52 minutes (08:45 → 09:37). Timetables are real data — comparing them is part of reading them.

The Upfield line timetable below works the same way. One fact makes it special: **Royal Park station is the station for Melbourne Zoo.**

Upfield line — weekday morning services towards Upfield

Departs Flinders Street	Southern Cross	North Melbourne	Royal Park	Brunswick	Upfield
08:34	08:38	08:41	08:48	08:51	09:10
08:50	08:54	08:57	09:04	09:07	09:26
09:10	09:14	09:17	09:24	09:27	09:46
09:50	09:54	09:57	10:04	10:07	10:26
10:06	10:10	10:13	10:20	10:23	10:42
10:26	10:30	10:33	10:40	10:43	11:02

Source: Department of Transport and Planning, 'GTFS Schedule' (PTV timetable data, Victorian Government open data), 2026 (as at August 2026). Royal Park station is the station for Melbourne Zoo. Times are 24-hour.

A timetable of six weekday morning Upfield line services from Flinders Street, with columns for Southern Cross, North Melbourne, Royal Park, Brunswick and Upfield

Source: Department of Transport and Planning, 'GTFS Schedule' (PTV timetable data, Victorian Government open data), 2026 (as at August 2026). Retrieved 20 August 2026. Royal Park as the zoo's station: Zoos Victoria, Getting to Melbourne Zoo, 2026. Retrieved 20 August 2026.

Every service in the table takes 36 minutes from Flinders Street to Upfield, and 14 minutes from Flinders Street to Royal Park — on this line, every morning service takes the same time.

Comparing journey times

Because durations come in minutes and hours, **compare them in minutes first**. Which is longer: 1 hour 28 minutes, or 95 minutes? Write 1 hour 28 minutes as $60+28=88$ minutes; 88 < 95, so 95 minutes is longer, by $95-88=7$ minutes.

The Geelong line timetable gives real comparisons. The 08:10 service takes 63 minutes from Southern Cross to Geelong; the 10:13 service takes 66 minutes. The 08:10 service is $66-63=3$ minutes faster.

V/Line Geelong line — Thursday morning services towards Geelong

Departs Southern Cross	Footscray	Sunshine	Tarneit	Wyndham Vale	Lara	North Geelong	Geelong
07:48	07:56	08:01	08:15	08:24	08:38	08:49	08:53
08:10	08:18	08:23	08:37	08:46	08:58	09:09	09:13
08:30	08:38	08:43	08:57	09:06	09:20	09:29	09:33
08:50	08:58	09:03	09:17	09:26	09:38	09:49	09:53
09:10	09:18	09:23	09:37	09:46	10:00	10:09	10:13
09:30	09:38	09:43	09:57	10:06	10:18	10:29	10:33
09:50	09:58	10:03	10:17	10:26	10:40	10:49	10:53
10:13	10:21	10:26	10:40	10:49	11:04	11:15	11:19
10:30	10:38	10:43	10:57	11:06	11:20	11:29	11:33

Source: Department of Transport and Planning, 'GTFS Schedule' (PTV timetable data, Victorian Government open data), 2026 (as at August 2026). Times are 24-hour.

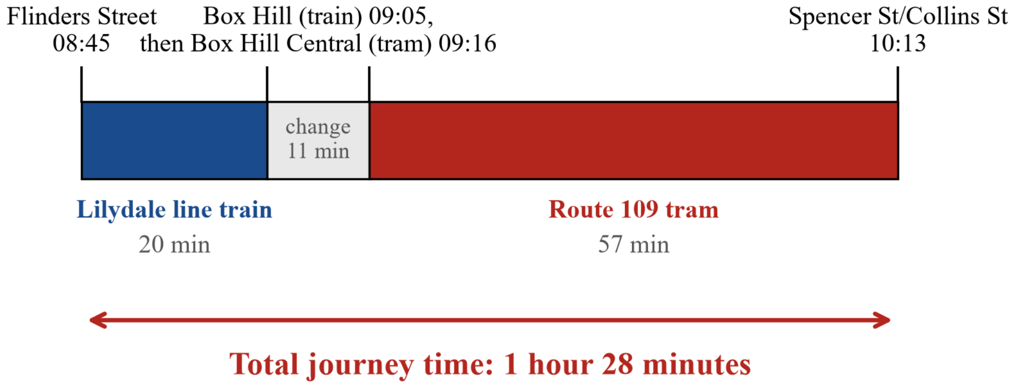
A timetable of nine Thursday morning V/Line Geelong line services from Southern Cross, with columns for Footscray, Sunshine, Tarneit, Wyndham Vale, Lara, North Geelong and Geelong

Source: Department of Transport and Planning, 'GTFS Schedule' (PTV timetable data, Victorian Government open data), 2026 (as at August 2026). Retrieved 20 August 2026.

Itineraries — journeys with more than one leg

An **itinerary** is a written plan of a journey. When a journey uses more than one service, the itinerary lists each **leg** — one part of the journey, from a departure to the next arrival — and the waits in between.

One journey, two legs: Flinders Street to Spencer Street



A bar diagram of a two-leg journey from Flinders Street at 08:45 to Spencer Street/Collins Street at 10:13: a 20-minute Lilydale line train to Box Hill, an 11-minute change to Box Hill Central, then a 57-minute route 109 tram, totalling 1 hour 28 minutes

The journey above has two legs and one change:

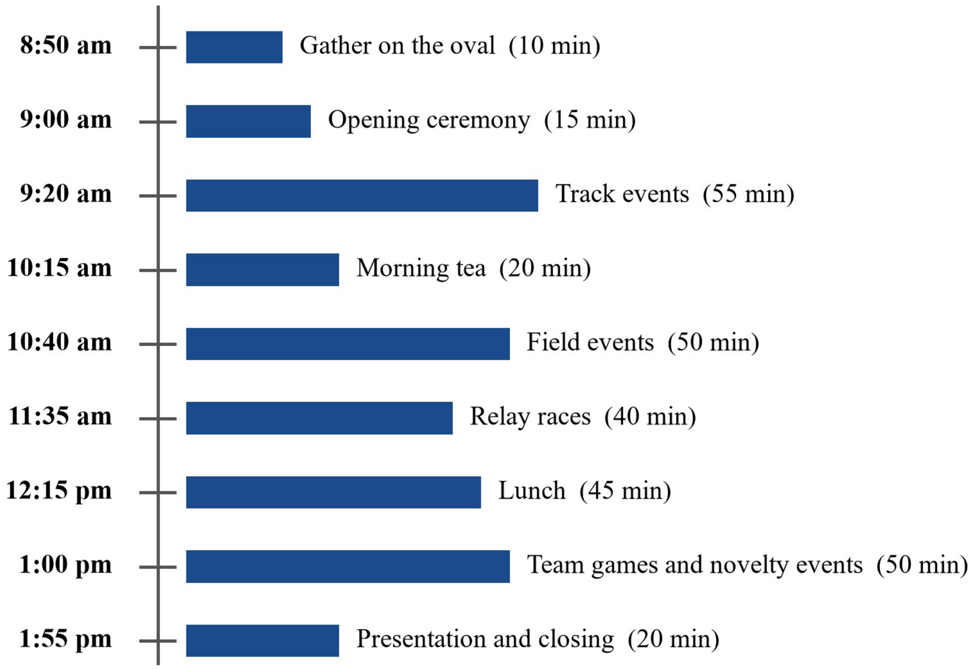
- **Leg 1 — train:** departs Flinders Street 08:45, arrives Box Hill 09:05 (20 minutes);
- **change:** walk to the Box Hill Central tram stop; the next tram leaves 09:16 (wait 11 minutes);
- **Leg 2 — tram:** departs 09:16, arrives Spencer St/Collins St 10:13 (57 minutes).

The **total journey time** runs from the very first departure to the very last arrival: 08:45 → 10:13. Count on: 08:45 → 09:45 is 60 minutes; 09:45 → 10:13 is 28 minutes; $60 + 28 = 88$ minutes = 1 hour 28 minutes. It must also equal the pieces added up: $20 + 11 + 57 = 88$ minutes. Two ways, one answer — that is the check. An itinerary leaves out the waits at your own risk: the legs alone give only 77 minutes, and you would plan to arrive 11 minutes later than you actually will.

Making a timetable for a planned event

Timetables are not only for transport. Whoever runs a big day — a sports carnival, a fete, a concert — writes one: each activity gets a start time and a duration, and the finish time is found by **counting on**.

Sports carnival — day program



The 5-minute gaps between some events are moving time.

A vertical day-program timeline for a school sports carnival: gather on the oval 8:50 am (10 min), opening ceremony 9:00 am (15 min), track events 9:20 am (55 min), morning tea 10:15 am (20 min), field events 10:40 am (50 min), relay races 11:35 am (40 min), lunch 12:15 pm (45 min), team games and novelty events 1:00 pm (50 min), presentation and closing 1:55 pm (20 min)

Read the program forwards: track events start at 9:20 am and last 55 minutes, so they finish at 10:15 am. You can also read it the other way: morning tea finishes at 10:35 am and field events start at 10:40 am, so there are 5 minutes of moving time between them. A good timetable plans those gaps on purpose — an event whose finish time is later than the next event's start time is a timetable that cannot work.

How timetables show duration

Different timetables show duration in different ways, and a good reader can use them all:

- the **full grid** (Lilydale, Upfield, Geelong): every stop has its own time; the duration is not printed, so you calculate it — arrival − departure;
- the **departure and arrival pair** (tram route 109): each row gives both ends of the trip, and the difference is the trip time — here, every trip takes 57 minutes;
- the **departure-only list**: some timetables print only departures and a note such as "every 10 minutes". The next departure is 10 minutes after the last one you can see, and the trip time has to come from somewhere else.

Tram route 109 — Thursday morning services

Box Hill Central to Spencer Street/Collins Street

Departs Box Hill Central	Arrives Spencer St/Collins St
09:06	10:03
09:16	**10:13**
09:26	10:23
09:36	10:33
09:46	10:43
09:56	10:53
10:06	11:03
10:16	11:13

Source: Department of Transport and Planning, 'GTFS Schedule' (PTV timetable data, Victorian Government open data), 2026 (as at August 2026).

A tram departs every 10 minutes. Every trip takes 57 minutes.

A two-column timetable for tram route 109 from Box Hill Central to Spencer Street/Collins Street: eight Thursday morning departures every 10 minutes from 09:06, each arriving 57 minutes later

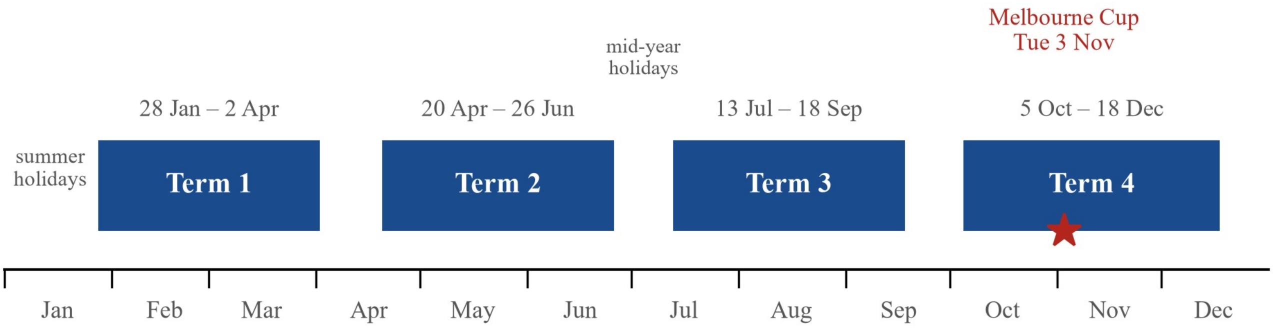
Source: Department of Transport and Planning, ‘GTFS Schedule’ (PTV timetable data, Victorian Government open data), 2026 (as at August 2026). Retrieved 20 August 2026.

Duration itself can be written several ways — 88 minutes, 1 h 28 min, or 1 hour 28 minutes are the same length of time. Being able to move between those names is part of the skill.

Dates worth knowing in Victoria

The school year and the public-holiday calendar are timetables too. The 2026 Victorian government school year runs in four terms.

Victorian school terms, 2026



Source: Victorian Government, 'School term dates and holidays in Victoria', 2026.

A strip of the 2026 calendar year showing the four Victorian school terms: Term 1 28 January to 2 April, Term 2 20 April to 26 June, Term 3 13 July to 18 September, Term 4 5 October to 18 December, with the school holiday gaps and a star marking Melbourne Cup day, Tuesday 3 November

Source: Victorian Government, ‘School term dates and holidays in Victoria’, 2026. Retrieved 20 August 2026. Public holiday: Business Victoria, ‘Victorian public holidays 2026’, 2026. Retrieved 20 August 2026.

Melbourne Cup day, Tuesday 3 November 2026, is a Victorian public holiday — it falls inside Term 4. And one last timetable fact for Victoria: Melbourne time is **AEST** (Australian Eastern Standard Time, UTC+10), but in **daylight saving** — **AEDT**, UTC+11 — the clocks run one hour ahead. Daylight saving begins at 2 am on the first Sunday in October (clocks jump forward to 3 am) and ends at 2 am on the first Sunday in April (clocks fall back one hour). On the two changeover nights, the clock difference between two times is **not** the elapsed time — the missing or repeated hour has to be counted too.

Words for this subtopic

Word	Meaning
elapsed time	the time that passes between a start and a finish
duration	how long something lasts — the same as its elapsed time
timetable	a table showing when services or events start and finish
itinerary	a written plan of a journey, leg by leg, with the times
leg	one part of a journey, from one departure to the next arrival
service	one run of a train, tram or bus — one row of a timetable
departs / arrives	leaves / gets there; the times are the departure and arrival
change	swapping from one service to another; the wait in between is change time
24-hour time	times written 00:00–23:59, with no am or pm
AEST / AEDT	Melbourne time: standard (UTC+10) / daylight saving (UTC+11)

Worked examples

In the with-help examples the steps are labelled for you; in the on-your-own examples you carry them out yourself. Every example ends with a check.

Example 1 — with help

A film starts at 2:40 pm and finishes at 4:05 pm. How long does it run? Give your answer in minutes, and in hours and minutes.

Step	Working	Comment
Read	Start 2:40 pm, finish 4:05 pm. The elapsed time is what passes between them.	The clock faces in the first figure show the two moments.
Plan	Count on along a timeline: jump to the next o'clock, then whole hours, then leftover minutes; add the jumps.	Friendly jumps keep the adding easy.
Work out	2:40 → 3:00 is 20 min; 3:00 → 4:00 is 60 min; 4:00 → 4:05 is 5 min. $20+60+5=85$ min, and 85 min = 1 h 25 min.	60 minutes makes an hour.
Check	Count back: 4:05 pm − 5 min = 4:00 pm; − 1 h = 3:00 pm; − 20 min = 2:40 pm — the start. ✓	Counting back undoes counting on.

The film runs for **85 minutes, which is 1 hour 25 minutes**.

Example 2 — with help

Use the Geelong line timetable. How long does the 08:10 service take from Southern Cross to Geelong? Write the departure in 12-hour time as well.

Step	Working	Comment
Read	The 08:10 row: departs Southern Cross 08:10, arrives Geelong 09:13.	One row = one service.
Plan	Journey time = arrival − departure; count on to the next hour, then add.	Duration is never printed — calculate it.
Work out	08:10 → 09:10 is 60 min; 09:10 → 09:13 is 3 min; $60+3=63$ min = 1 h 3 min. In 12-hour time the service departs at 8:10 am.	Before midday, only the name changes.
Check	08:10 + 63 min: + 50 min gives 09:00, + 13 min gives 09:13 — the printed arrival. ✓	Adding the duration back must land on the arrival.

The journey takes **63 minutes (1 hour 3 minutes)**, departing at **8:10 am**.

Example 3 — with help

Use the Lilydale line timetable. Which service is faster from Flinders Street to Lilydale — the one that departs at 07:29, or the one that departs at 08:45? By how many minutes?

Step	Working	Comment
Read	07:29 service arrives Lilydale 08:28; 08:45 service arrives 09:37.	Compare like with like: same two stations.
Plan	Find each duration in minutes, then subtract.	Compare in minutes first.
Work out	07:29 → 08:28: 31 min to 08:00, then 28 min: $31+28=59$ min. 08:45 → 09:37: 15 min to 09:00, then 37 min: $15+37=52$ min. $59-52=7$ min.	Both durations, then the gap.
Check	07:29 + 59 min = 08:28 ✓ and 08:45	Every duration checks against the

Step	Working	Comment
	+ 52 min = 09:37 ✓ — both match the printed arrivals.	table.

The **08:45 service is faster, by 7 minutes** (52 min against 59 min).

Example 4 — with help

Use the itinerary figure. A student travels from Flinders Street to Spencer St/Collins St: the 08:45 Lilydale line train to Box Hill, then the 09:16 route 109 tram. Find the total journey time, and check it two ways.

Step	Working	Comment
Read	Leg 1: 08:45–09:05 (20 min). Change: 09:05–09:16 (11 min). Leg 2: 09:16–10:13 (57 min).	An itinerary lists legs **and** waits.
Plan	Add the three pieces; then check by counting on from the first departure to the last arrival.	Two methods must agree.
Work out	$20+11+57=88$ min. Count on: 08:45 → 09:45 is 60 min; → 10:13 is 28 min; $60+28=88$ min. 88 min = 1 h 28 min.	The wait is part of the journey.
Check	Both methods give 88 minutes. ✓	One answer, two roads to it.

The total journey time is **1 hour 28 minutes**.

Example 5 — on your own

A school assembly starts at 11:20 am and finishes at 1:05 pm. How long does it run? Give your answer in hours and minutes.

Plan. The finish time is after midday, so the timeline crosses 12:00. Jump 11:20 am → 12:20 pm (one whole hour), then count on to 1:05 pm.

Work out. 11:20 am → 12:20 pm is 1 h. 12:20 pm → 1:05 pm is 45 min. Total: **1 hour 45 minutes** (= 105 minutes).

Check. 1:05 pm − 1 h 45 min: − 1 h gives 12:05 pm; − 45 min gives 11:20 am — the start. ✓

Example 6 — on your own

Use the sports carnival program. The printer left three finish times blank. Find them: (a) the track events, (b) the relay races, (c) the presentation and closing. (d) How long does the whole carnival day run, from gathering on the oval to the end of the presentation?

Plan. Each finish time = start time + duration; count on. The whole day runs from 8:50 am to the last finish time.

Work out. (a) 9:20 am + 55 min = **10:15 am**. (b) 11:35 am + 40 min = **12:15 pm**. (c) 1:55 pm + 20 min = **2:15 pm**. (d) 8:50 am → 2:15 pm: 8:50 → 1:50 pm is 5 h; 1:50 → 2:15 is 25 min; **5 hours 25 minutes**.

Check. Count back on the program: 10:15 am − 55 min = 9:20 am ✓; 2:15 pm − 20 min = 1:55 pm ✓. And the gaps are sensible — morning tea finishes at 10:35 am, 5 minutes before field events start. ✓

Example 7 — on your own

You reach the Box Hill Central tram stop at 9:50 am on a Thursday morning. Use the route 109 timetable. When does the next tram leave, how long do you wait, and when do you arrive at Spencer St/Collins St?

Plan. Find the first departure after 9:50 am; the wait is 9:50 am → that departure; the arrival is printed in the same row.

Work out. Departures run every 10 minutes: …, 09:46, 09:56, … The next tram after 9:50 am is the **09:56** — a wait of **6 minutes**. That tram arrives at **10:53**. Check the trip time: 09:56 → 10:53 is 57 minutes, the same as every other trip in the table. ✓

Answer. The 09:56 tram, after a 6-minute wait, arriving at 10:53.

Example 8 — on your own

Priya takes the 09:10 Upfield line service from Flinders Street to visit Melbourne Zoo, getting off at Royal Park. The zoo is open 9 am to 5 pm, every day of the year. She stays until 2:30 pm. How long does she spend at the zoo?

Source: Department of Transport and Planning, ‘GTFS Schedule’ (PTV timetable data, Victorian Government open data), 2026 (as at August 2026). Retrieved 20 August 2026. Zoos Victoria, Melbourne Zoo opening hours, 2026. Retrieved 20 August 2026.

Plan. Find her arrival at Royal Park from the timetable, then count on from that arrival to 2:30 pm. (The zoo opened at 9 am, and she arrives after that, so the opening time does not cut her visit short.)

Work out. The 09:10 service reaches Royal Park at 09:24 — 14 minutes after leaving Flinders Street. 9:24 am → 2:24 pm is 5 h; 2:24 → 2:30 is 6 min. She spends **5 hours 6 minutes** at the zoo.

Check. 2:30 pm − 5 h 6 min = 9:24 am — her arrival. ✓ And 9:24 am is after the 9 am opening, as the plan assumed. ✓

Practice questions

With help

Q1. Match each 12-hour time to its 24-hour twin: (i) 3:10 pm, (ii) 7:45 am, (iii) 12:00 midnight, (iv) 5:20 pm, (v) 11:30 pm — against (a) 07:45, (b) 23:30, (c) 15:10, (d) 00:00, (e) 17:20.

Q2. Find the elapsed time. (a) 3:10 pm → 3:45 pm. (b) 7:20 am → 8:00 am. (c) 10:15 am → 11:05 am.

Q3. Find the elapsed time, crossing the hour. (a) 4:40 pm → 5:15 pm. (b) 11:20 am → 12:05 pm. (c) 9:45 am → 10:30 am.

Q4. Use the Lilydale line timetable. (a) When does the 07:55 service reach Ringwood? (b) How many minutes does the 08:15 service take from Flinders Street to Croydon? (c) Mia catches the 08:45 service from Flinders Street and rides it to Lilydale. When does she arrive?

Q5. Use the Geelong line timetable. (a) When does the 08:30 service arrive at Geelong? (b) How long does the 09:10 service take from Southern Cross to Lara? (c) How long is the whole journey on the 10:13 service?

Q6. Use the route 109 tram timetable. (a) Which tram departs straight after the 09:26? (b) The 09:46 tram arrives at 10:43. How long is the trip? (c) You reach the stop at 10:00. When does the next tram leave, and when do you arrive?

Q7. Count on to find the finish time. (a) Soccer training starts at 4:15 pm and runs for 50 minutes. (b) A lesson starts at 11:45 am and runs for 40 minutes. (c) A film starts at 1:50 pm and runs for 1 hour 20 minutes.

Q8. Count back to find the start time. (a) An assembly finishes at 12:00 pm after running 45 minutes. (b) A film finishes at 2:50 pm after running 1 hour 20 minutes.

Q9. Rename the duration. (a) 1 h 25 min in minutes. (b) 2 h in minutes. (c) 90 min in hours and minutes. (d) 128 min in hours and minutes.

Q10. Melbourne Zoo is open 9 am to 5 pm, every day of the year. (a) How many hours is it open each day? (b) A family arrives at 10:00 am and leaves at 3:00 pm. How long are they inside?

Source for Q10: Zoos Victoria, Melbourne Zoo opening hours, 2026. Retrieved 20 August 2026.

On your own

Q11. Find the elapsed time. (a) 8:05 am → 9:30 am. (b) 3:45 pm → 5:20 pm. (c) 11:50 am → 1:10 pm. Give each in hours and minutes.

Q12. Use the Upfield line timetable. (a) When does the 09:50 service reach Brunswick? (b) How long does the 10:26 service take from Flinders Street to Upfield? (c) Priya catches the 09:10 service. When is she at Royal Park?

Q13. Use the Lilydale line timetable. Of the six morning services, which takes the longest from Flinders Street to Lilydale, and which takes the shortest? What is the difference between them, in minutes?

Q14. Use the Upfield line timetable and the zoo opening hours (9 am to 5 pm). (a) Jack takes the 09:10 service from Flinders Street. When is he at Royal Park? (b) If he stays at the zoo until it closes at 5 pm, how long does he spend there?

Q15. Use the sports carnival program. (a) When do the relay races finish? (b) How long is morning tea? (c) Field events finish at 11:30 am and relay races start at 11:35 am. How long is the gap? (d) How long does the whole day run, from 8:50 am to the end of the presentation at 2:15 pm?

Q16. Use the Geelong line timetable. Sofia must be in Geelong by 9:30 am. What is the latest service she can catch, and how many minutes before 9:30 does she arrive?

Q17. Ben travels from Flinders Street to Spencer St/Collins St: the 09:07 Lilydale line service to Box Hill, then the 09:36 route 109 tram. Find (a) the train leg, (b) his change time at Box Hill, (c) the tram leg, and (d) the total journey time from 09:07 to his arrival.

Q18. Rename the duration. (a) 1 h 28 min in minutes. (b) 1 h 3 min in minutes. (c) 95 min in hours and minutes. (d) 2 h 5 min in minutes.

Q19. (a) Write 14:35 in 12-hour time. (b) Write 7:05 pm in 24-hour time. (c) Write 12:00 midday in 24-hour time. (d) Write 21:50 in 12-hour time.

Q20. A Geelong line service takes 63 minutes and departs Southern Cross at 09:30. When does it arrive at Geelong?

Q21. Use the 2026 school terms figure. (a) Term 1 ends on Thursday 2 April and Term 2 starts on Monday 20 April. How many days run from 2 April to 20 April? (b) Term 2 ends on Friday 26 June and Term 3 starts on Monday 13 July. How many days run from 26 June to 13 July?

Source for Q21: Victorian Government, ‘School term dates and holidays in Victoria’, 2026. Retrieved 20 August 2026.

Q22. Melbourne Cup day 2026 is Tuesday 3 November — a public holiday, and the zoo is open as usual, 9 am to 5 pm. A family arrives at 10:20 am and leaves at 3:05 pm. (a) How long are they at the zoo? (b) Write that duration in minutes.

Source for Q22: Business Victoria, ‘Victorian public holidays 2026’, 2026. Retrieved 20 August 2026. Zoos Victoria, Melbourne Zoo opening hours, 2026. Retrieved 20 August 2026.

Maths in real life

Q23. Plan a zoo morning with real timetables. You are at Flinders Street at 8:30 am and want to visit Melbourne Zoo (Royal Park station). The zoo opens at 9 am. (a) Name the two Upfield line services you could catch. (b) For each, find your arrival at Royal Park and your wait until the gates open. (c) Which service would you choose? Give one reason.

Source: Department of Transport and Planning, ‘GTFS Schedule’ (PTV timetable data, Victorian Government open data), 2026 (as at August 2026). Retrieved 20 August 2026. Zoos Victoria, Melbourne Zoo opening hours, 2026. Retrieved 20 August 2026.

Q24. A school concert starts at 6:30 pm. The doors open 45 minutes before the start, and the choir’s warm-up finishes as the doors open, having run for 25 minutes. When do the doors open, and when does the warm-up start?

Q25. In Victoria, daylight saving ends at 2 am on the first Sunday in April: the clocks fall back from 3:00 am to 2:00 am. In 2026 that night was Saturday 4 to Sunday 5 April. A bus departs at 1:40 am (daylight saving time) and arrives at 2:20 am (standard time). How long did the journey really take? (Hint: count 1:40 am → 3:00 am, then 2:00 am → 2:20 am.)

Source for Q25: Business Victoria, ‘Daylight saving’, 2026. Retrieved 20 August 2026.

Choosing your strategy

Q26. Work back from the timetable. (a) A Lilydale line service arrives at Lilydale at 08:48 after a 53-minute run. When did it depart Flinders Street? (b) A Geelong line service arrives at Geelong at 10:13 after a 63-minute run. When did it depart Southern Cross?

Q27. The Chen family must be at Lilydale by 9:00 am. (a) If they catch the 08:15 service, when do they arrive — are they on time? (b) Which service should they catch instead, and how many minutes early does it get them there?

Q28. Liam walks 15 minutes to Flinders Street, waits 8 minutes for his train, rides the train for 22 minutes, then walks 10 minutes to school. He leaves home at 8:20 am. (a) When does he reach the station? (b) When does he reach school? (c) What is his total travel time?

Q29. Make your own. Using the four real timetables in this subtopic, plan a journey with exactly one change that leaves before 10:00 am. Write it as an itinerary like Example 4 — every leg, the change, and the total journey time — then swap with a partner and check each other’s times.

Answers

Q1. i–c, ii–a, iii–d, iv–e, v–b. **Q2.** (a) 35 min; (b) 40 min; (c) 50 min. **Q3.** (a) 35 min; (b) 45 min; (c) 45 min. **Q4.** (a) 08:31; (b) 44 min; (c) 09:37. **Q5.** (a) 09:33; (b) 50 min; (c) 66 min. **Q6.** (a) 09:36; (b) 57 min; (c) 10:06, arriving 11:03. **Q7.** (a) 5:05 pm; (b) 12:25 pm; (c) 3:10 pm. **Q8.** (a) 11:15 am; (b) 1:30 pm. **Q9.** (a) 85 min; (b) 120 min; (c) 1 h 30 min; (d) 2 h 8 min. **Q10.** (a) 8 hours; (b) 5 hours. **Q11.** (a) 1 h 25 min; (b) 1 h 35 min; (c) 1 h 20 min. **Q12.** (a) 10:07; (b) 36 min; (c) 09:24. **Q13.** Longest: the 07:29 service (59 min); shortest: the 08:45 service (52 min); a difference of 7 minutes. **Q14.** (a) 09:24; (b) 7 h 36 min. **Q15.** (a) 12:15 pm; (b) 20 min; (c) 5 min; (d) 5 h 25 min. **Q16.** The 08:10 service; 17 minutes early. **Q17.** (a) 24 min; (b) 5 min; (c) 57 min; (d) 1 h 26 min. **Q18.** (a) 88 min; (b) 63 min; (c) 1 h 35 min; (d) 125 min. **Q19.** (a) 2:35 pm; (b) 19:05; (c) 12:00; (d) 9:50 pm. **Q20.** 10:33. **Q21.** (a) 18 days; (b) 17 days. **Q22.** (a) 4 h 45 min; (b) 285 min. **Q23.** (a) 08:34 and 08:50; (b) 08:34 → Royal Park 08:48, wait 12 min; 08:50 → Royal Park 09:04, no wait; (c) answers will vary — the 08:50 service has no wait; the 08:34 service gives a 12-minute spare-time gap if a train runs late. **Q24.** Doors 5:45 pm; warm-up starts 5:20 pm. **Q25.** 1 h 40 min. **Q26.** (a) 07:55; (b) 09:10. **Q27.** (a) 09:10 — no, 10 minutes late; (b) the 07:55 service, 12 minutes early. **Q28.** (a) 8:35 am; (b) 9:15 am; (c) 55 min. **Q29.** Answers will vary.

All the working

Q1. After midday, add 12: 3:10 pm → 15:10 (c); 5:20 pm → 17:20 (e); 11:30 pm → 23:30 (b). Before midday the number keeps: 7:45 am → 07:45 (a). Midnight is 00:00 (d).

Q2. (a) 3:10 → 3:45: $45-10=35$ min. (b) 7:20 → 8:00: $60-20=40$ min. (c) 10:15 → 11:05: 45 min to 11:00, then 5 min: $45+5=50$ min.

Q3. (a) 4:40 → 5:15: 20 min to 5:00, then 15 min: 35 min. (b) 11:20 → 12:05: 40 min to 12:00, then 5 min: 45 min. (c) 9:45 → 10:30: 15 min to 10:00, then 30 min: 45 min.

Q4. (a) Read the 07:55 row across to Ringwood: **08:31**. (b) 08:15 → 08:59: 45 min to 09:00, take away 1: **44 min**. (c) Read the 08:45 row to Lilydale: **09:37**.

Q5. (a) Read the 08:30 row to Geelong: **09:33**. (b) 09:10 → 10:00: **50 min**. (c) 10:13 → 11:19: 60 min to 11:13, then 6 min: **66 min**.

Q6. (a) Departures run every 10 minutes: after 09:26 comes **09:36**. (b) 09:46 → 10:43: 14 min to 10:00, then 43 min: $14 + 43 = $ **57 min**. (c) At the stop at 10:00, the next tram is **10:06**; it arrives at **11:03**.

Q7. (a) 4:15 pm + 50 min: + 45 min gives 5:00 pm, + 5 min gives **5:05 pm**. (b) 11:45 am + 40 min: + 15 min gives 12:00 pm, + 25 min gives **12:25 pm**. (c) 1:50 pm + 1 h 20 min: + 1 h gives 2:50 pm, + 20 min gives **3:10 pm**.

Q8. (a) 12:00 pm − 45 min: − 45 min from 12:00 is **11:15 am**. (b) 2:50 pm − 1 h 20 min: − 1 h gives 1:50 pm, − 20 min gives **1:30 pm**.

Q9. (a) $60 + 25 = $ **85 min**. (b) $2 × 60 = $ **120 min**. (c) 90 min = 60 min + 30 min = **1 h 30 min**. (d) 128 min = 120 min + 8 min = **2 h 8 min**.

Q10. (a) 9 am → 5 pm is **8 hours**. (b) 10:00 am → 3:00 pm is **5 hours**.

Q11. (a) 8:05 → 9:30: 55 min to 9:00, then 30 min: 85 min = **1 h 25 min**. (b) 3:45 → 5:20: 15 min to 4:00, 60 min to 5:00, 20 min to 5:20: 95 min = **1 h 35 min**. (c) 11:50 → 1:10: 10 min to 12:00, 60 min to 1:00, 10 min to 1:10: 80 min = **1 h 20 min**.

Q12. (a) Read the 09:50 row to Brunswick: **10:07**. (b) 10:26 → 11:02: 34 min to 11:00, then 2 min: **36 min**. (c) Read the 09:10 row to Royal Park: **09:24**.

Q13. Durations to Lilydale: 07:07 → 08:01 is 54 min; 07:29 → 08:28 is 59 min; 07:55 → 08:48 is 53 min; 08:15 → 09:10 is 55 min; 08:45 → 09:37 is 52 min; 09:07 → 10:03 is 56 min. Longest is the **07:29 service (59 min)**, shortest the **08:45 service (52 min)**; the difference is $59 − 52 = $ **7 minutes**.

Q14. (a) The 09:10 service reaches Royal Park at **09:24**. (b) 9:24 am → 5:00 pm: 9:24 → 4:24 pm is 7 h; 4:24 → 5:00 is 36 min: **7 h 36 min**.

Q15. (a) 11:35 am + 40 min = **12:15 pm**. (b) 10:15 am → 10:35 am = **20 min**. (c) 11:30 am → 11:35 am = **5 min**. (d) 8:50 am → 2:15 pm: 8:50 → 1:50 pm is 5 h; + 25 min: **5 h 25 min**.

Q16. The 08:30 service arrives at 09:33 — after 9:30, too late. The 08:10 service arrives at 09:13 — in time. So she catches the **08:10 service**, $30 − 13 = $ **17 minutes** before 9:30.

Q17. (a) 09:07 → 09:31: **24 min**. (b) 09:31 → 09:36: **5 min**. (c) 09:36 → 10:33: **57 min**. (d) $24+5+57=86$ min = **1 h 26 min**; check by counting on 09:07 → 10:33: 53 min to 10:00, + 33 min = 86 min ✓.

Q18. (a) $60 + 28 = $ **88 min**. (b) $60 + 3 = $ **63 min**. (c) 95 min = 60 min + 35 min = **1 h 35 min**. (d) $120 + 5 = $ **125 min**.

Q19. (a) $14-12=2$: **2:35 pm**. (b) $7+12=19$: **19:05**. (c) Midday keeps its number: **12:00**. (d) $21-12=9$: **9:50 pm**.

Q20. 09:30 + 63 min: + 30 min gives 10:00, + 33 min gives **10:33**.

Q21. (a) 2 April → 20 April: $20 − 2 = $ **18 days**. (b) 26 June → 13 July: 4 days to 30 June, then 13 days: $4 + 13 = $ **17 days**.

Q22. (a) 10:20 am → 3:05 pm: 10:20 → 2:20 pm is 4 h; 2:20 → 3:05 is 45 min: **4 h 45 min**. (b) $4 × 60 + 45 = 240 + 45 = $ **285 min**.

Q23. (a) The **08:34** and **08:50** services (the 09:10 gets you there after opening with time lost). (b) 08:34 → Royal Park 08:48: the gates open at 9:00, so you wait **12 minutes**. 08:50 → Royal Park 09:04: the gates are already open — **no wait**. (c) Answers will vary; e.g. the 08:50 service, because there is no wait outside the gates — or the 08:34 service, because the 12-minute gap means a late train still gets you there for opening.

Q24. Doors: 6:30 pm − 45 min = **5:45 pm**. Warm-up: 5:45 pm − 25 min = **5:20 pm**. Check forwards: 5:20 + 25 min = 5:45; 5:45 + 45 min = 6:30 ✓.

Q25. Before the jump: 1:40 am → 3:00 am is 80 min. After it: 2:00 am → 2:20 am is 20 min. $80+20=100$ min = **1 h 40 min**. The clocks show only “40 minutes” between 1:40 and 2:20 — the fallen-back hour hides the other 60 minutes.

Q26. (a) 08:48 − 53 min: − 48 min gives 08:00, − 5 min gives **07:55** — the printed departure ✓. (b) 10:13 − 63 min: − 13 min gives 10:00, − 50 min gives **09:10** — the printed departure ✓.

Q27. (a) The 08:15 service arrives at Lilydale at 09:10 — **10 minutes after 9:00, so not on time**. (b) The **07:55 service** arrives at 08:48: $60 − 48 = $ **12 minutes early**.

Q28. (a) 8:20 am + 15 min = **8:35 am**. (b) 8:35 + 8 min wait = 8:43 train; 8:43 + 22 min = 9:05; 9:05 + 10 min walk = **9:15 am**. (c) $15+8+22+10=55$ min; check: 8:20 am → 9:15 am is **55 min** ✓.

Q29. Answers will vary. A correct itinerary names a first departure before 10:00 am, a change, and a second service; each leg’s time and the change time are read from the tables, and the total equals the pieces added up and the count-on from first departure to last arrival. Example: 09:07 Lilydale service to Box Hill (09:31, 24 min), 09:36 tram to Spencer St/Collins St (10:33, 57 min), change 5 min; total $24+5+57=86$ min = 1 h 26 min, matching 09:07 → 10:33.

Angles on a straight line, at a point, and vertically opposite

Content description VC2M6M04: identify the relationships between angles on a straight line, angles at a point and vertically opposite angles; use these to determine unknown angles, communicating reasoning

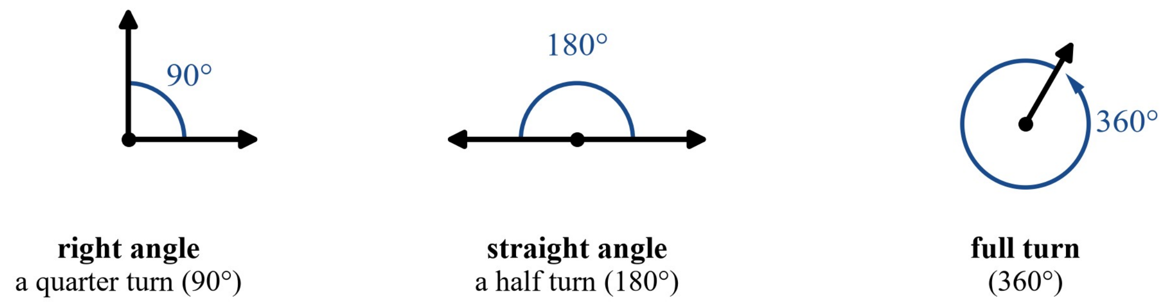
At Level 5 you drew and measured angles in degrees with a protractor, and you learned the names right angle, straight angle and full turn. This subtopic turns those three facts into rules you can reason with — rules that find angles you never measured — and it is the first subtopic in the series where every answer must carry its reason.

Theory

Three facts you already know

Three angle facts from Level 5 do all the work in this subtopic:

- a **right angle** is 90° — a quarter turn;
- a **straight angle** is 180° — a half turn, the angle along a straight line;
- a **full turn** is 360° — all the way around a point, back to the start.

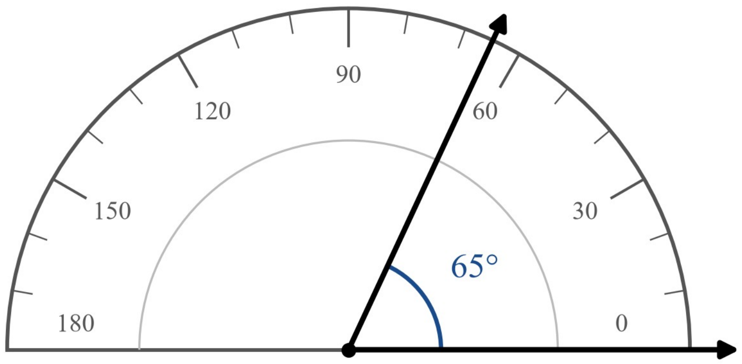


Three turns side by side: a right angle of 90° (a quarter turn) with the little square mark, a straight angle of 180° along a line (a half turn), and a full turn of 360° drawn as a loop back to the start

In figures, a right angle is usually shown with a **little square** instead of a curved line — when you see the square, read it as 90° without measuring.

Measuring and checking angles

The tool for measuring angles is the **protractor**, just as at Level 5: put its centre on the point of the angle, sit its baseline along one arm, and read the scale where the other arm crosses it.

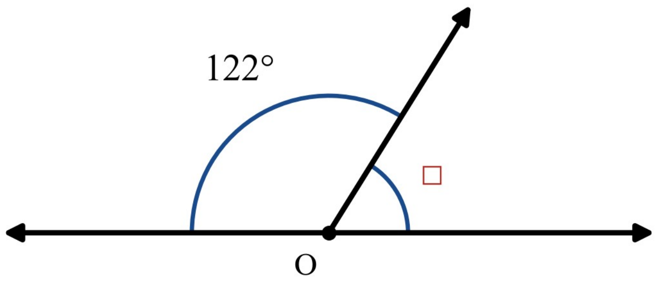


A protractor placed on an angle with its centre on the point and its baseline along the lower arm; the upper arm crosses the scale at 65°

The angle in the figure measures 65°. Where a class has dynamic geometry software, it makes a good check on any figure — but a protractor and a careful eye are all this subtopic needs.

Angles on a straight line

When angles sit side by side along a straight line, together they make a straight angle. So **angles on a straight line add to 180°**.

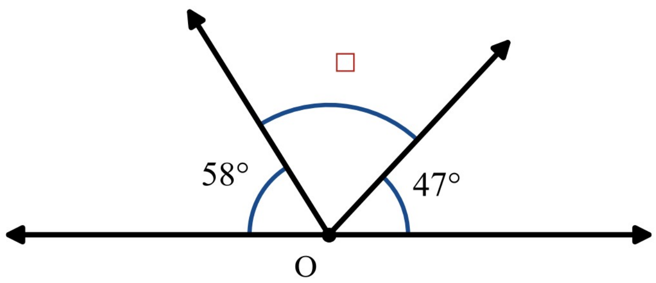


A straight line with one ray rising from the point O, making two angles: 122° on the left and □ on the right

The two angles share the straight line, so $122° + \square = 180°$. From this subtopic on, every step is written with its reason in brackets:

$\square = 180° - 122° = 58°$ *(angles on a straight line add to 180°)*

The line can carry three angles or more — the rule is the same: **all** the angles along one side of a straight line add to 180°.

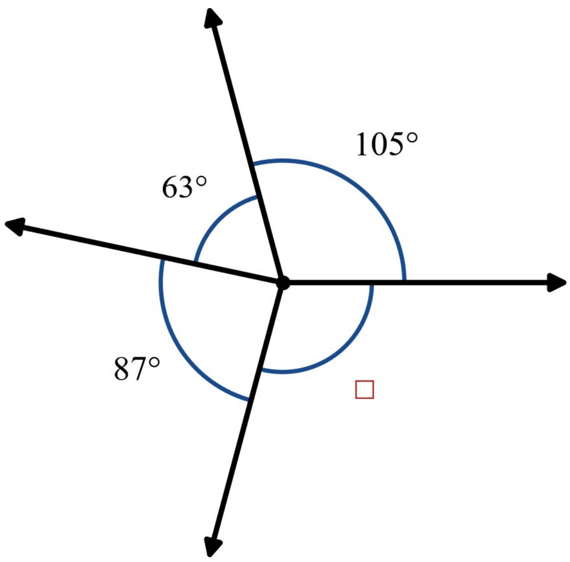


A straight line with two rays rising from the point O, making three angles: 47° on the right, □ in the middle, 58° on the left

$47° + \square + 58° = 180°$, so $\square = 180° - 47° - 58° = 75°$ *(angles on a straight line add to 180°).*

Angles at a point

All the angles around one point make a full turn, so **angles at a point add to 360°**.

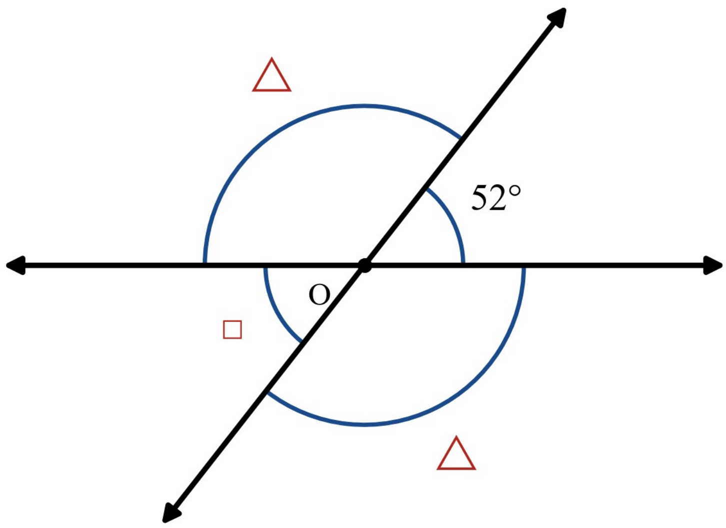


Four angles around the point O: 105°, 63°, 87° and □, filling the full turn

$105° + 63° + 87° + \square = 360°$. The three known angles add to $255°$, so □ $= 360° - 255° = 105°$ *(angles at a point add to 360°)*.

Vertically opposite angles

Now let two straight lines cross at a point O.



Two straight lines crossing at the point O, making four angles: 52° at the top right, □ opposite it at the bottom left, and △ at the top left and bottom right

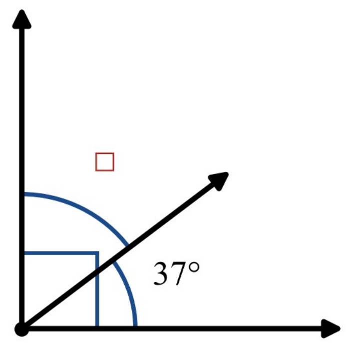
The angle marked □ sits **opposite** the 52° angle, facing it across the crossing point. A facing pair like this is called **vertically opposite angles**. They are always equal — and you can show why using only the straight-line rule. The 52° angle and the △ angle beside it sit on one straight line, so △ $= 180° - 52° = 128°$ *(angles on a straight line add to 180°)*. Then □ and that △ sit on the other straight line, so □ $= 180° - 128° = 52°$ *(angles on a straight line add to 180°)*.

Vertically opposite angles are equal. You have just built a new rule out of an older one — that is what reasoning in geometry means.

The supplement and the complement

Two angle pairs carry special names:

- an angle and its **supplement** add to 180° — together they make a straight angle. The supplement of 30° is 150°; the supplement of 122° is 58°.
- an angle and its **complement** add to 90° — together they make a right angle. The complement of 30° is 60°.



A right angle, shown by the square mark, split by one ray into 37° and □

Here $\square = 90° - 37° = 53°$ *(an angle and its complement add to 90°)*. Notice that a supplement and a complement are just the straight-line and right angle rules wearing names.

Reasons, not bare numbers

The content description ends with the words *communicating reasoning*. From this subtopic on, an answer without its reason is only half done. The house form for a step is a number sentence followed by the rule that makes it true:

$\square = 180° - 122° = 58°$ *(angles on a straight line add to 180°)*

Three habits make this easy:

- **name the rule** in brackets after every step — one of the three relationships, or the right angle fact;
- **check at a point**: once every angle around a point is known, they must add to 360°. In the crossing-lines figure above, $52° + 128° + 52° + 128° = 360°$ ✓;
- **check on a line**: the angles along any one straight line must add to 180°.

Words for this subtopic

Word	Meaning
straight angle	an angle of 180° — the angle along a straight line
full turn	360° — turning all the way around a point
angles on a straight line	angles side by side along one line; they add to 180°
angles at a point	all the angles around one point; they add to 360°
vertically opposite angles	the facing pair when two straight lines cross; always equal
supplement	the angle that makes 180° with a given angle
complement	the angle that makes 90° with a given angle
right angle mark	the little square that means 90° without measuring

Word	Meaning
reason	the rule that makes a step true, written in brackets after it

Worked examples

In the with-help examples the steps are labelled for you; in the on-your-own examples you carry them out yourself. Every step carries its reason, and every example ends with a check.

Example 1 — with help

Two angles sit on a straight line. One of them is 65°. Find □, the other angle.

Step	Working	Comment
Read	Two angles on one straight line: 65° and □.	Angles on a straight line add to 180°.
Plan	Write $65° + \square = 180°$, then take 65° from 180°.	The rule gives the number sentence.
Work out	□ $= 180° - 65° = 115°$ *(angles on a straight line)*.	One subtraction does it.
Check	$65° + 115° = 180°$ ✓	The pair must make the straight angle.

□ = 115°.

Example 2 — with help

Three angles sit on a straight line: 52°, □ and 71°. Find □.

Step	Working	Comment
Read	Three angles along one straight line: 52°, □, 71°.	All the angles on the line add to 180°.
Plan	Add the two known angles first, then take the total from 180°.	$52° + \square + 71° = 180°$.
Work out	$52° + 71° = 123°$; □ $= 180° - 123° = 57°$ *(angles on a straight line)*.	Known total first, then one subtraction.
Check	$52° + 57° + 71° = 180°$ ✓	The three must remake the straight angle.

□ = 57°.

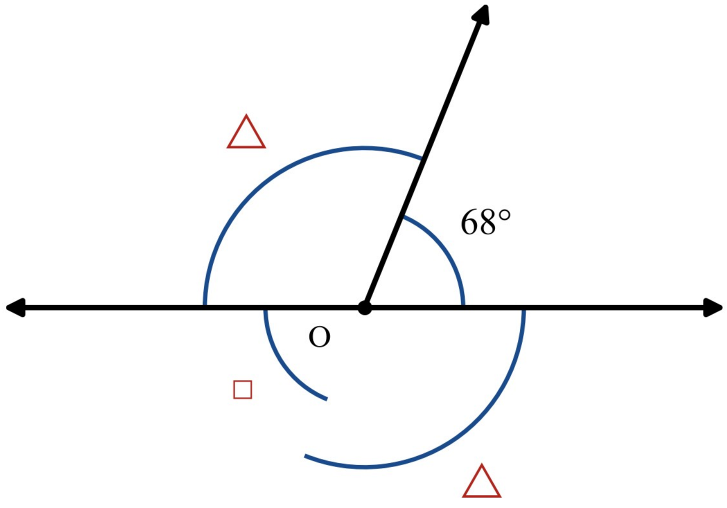
Example 3 — with help

Four angles around a point are 96°, 112°, 81° and □. Find □.

Step	Working	Comment
Read	Four angles filling the full turn at one point: 96°, 112°, 81°, □.	Angles at a point add to 360°.
Plan	Add the three known angles, then take that total from 360°.	$96° + 112° + 81° + \square = 360°$.
Work out	$96° + 112° + 81° = 289°$; □ $= 360° - 289° = 71°$ *(angles at a point)*.	Known total first, then one subtraction.
Check	$96° + 112° + 81° + 71° = 360°$ ✓	The four must remake the full turn.

□ = 71°.

Example 4 — with help



Two straight lines crossing at the point O, making four angles: 68° at the top right, □ opposite it at the bottom left, and △ at the top left and bottom right

Two straight lines cross at O; the marked angle is 68°. Find □, and the two angles marked △.

Step	Working	Comment
Read	68° is given; □ faces it across O; the two △ angles sit beside it.	Facing pairs are vertically opposite.
Plan	□ by the vertically opposite rule; each △ on a straight line with the 68° angle.	Two rules, one figure.
Work out	$\square = 68°$ *(vertically opposite angles are equal)*. $\triangle = 180° - 68° = 112°$ *(angles on a straight line)*; the other △ faces the first, so it is also 112° *(vertically opposite angles are equal)*.	Every step names its rule.
Check	$68° + 112° + 68° + 112° = 360°$ ✓	The four angles at O must make a full turn.

□ = 68°, and the two △ angles are 112° each.

Example 5 — on your own

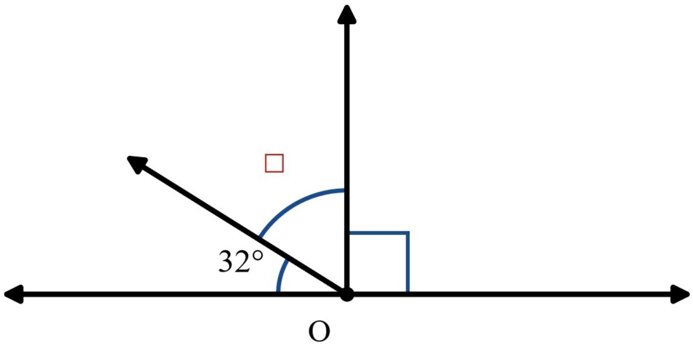
An angle is 24°. Its complement is □. Find □.

Plan. An angle and its complement add to 90°, so $24° + \square = 90°$.

Work out. $\square = 90° - 24° = 66°$ *(an angle and its complement add to 90°)*.

Check. $24° + 66° = 90°$ — a right angle. ✓

Example 6 — on your own



A straight line with two rays rising from the point O: the square right angle mark between the right ray and the upright ray, then □, then 32° down to the left ray

On a straight line, a right angle, □ and 32° sit side by side. Find □.

Plan. The square mark is 90°. Three angles on the line: $90° + \square + 32° = 180°$.

Work out. $90° + 32° = 122°$; $\square = 180° - 122° = 58°$ *(angles on a straight line)*.

Check. $90° + 58° + 32° = 180°$ ✓

Example 7 — on your own

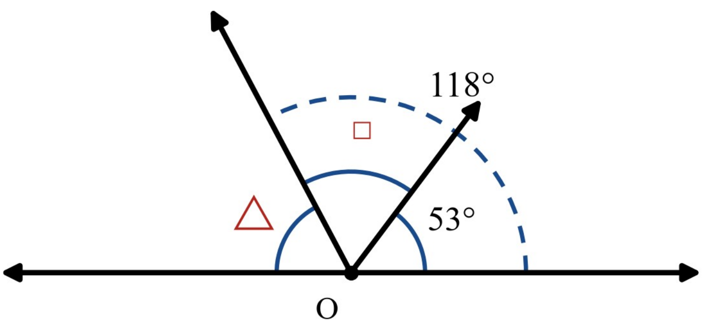
Two straight lines cross. One of the four angles is 133°. Find the other three.

Plan. The angle facing 133° is vertically opposite it; the two angles beside 133° each sit on a straight line with it.

Work out. Facing angle $= 133°$ *(vertically opposite angles are equal)*. Each beside angle $= 180° - 133° = 47°$ *(angles on a straight line)*.

Check. $133° + 47° + 133° + 47° = 360°$ ✓ — the four make a full turn.

Example 8 — on your own



A straight line with two rays rising from the point O: from the right ray, 53° to the first ray, then □ to the second ray, then △ down to the left ray; a broken curve marks the 53° and □ together as 118°

On a straight line, the 118° angle is split by one ray into 53° and □, and △ completes the line. Find □ and △.

Plan. □ is the missing part of the 118° angle; △ sits on the straight line with the whole 118° angle.

Work out. □ $= 118° - 53° = 65°$ *(the parts of an angle add to the whole)*. △ $= 180° - 118° = 62°$ *(angles on a straight line)*.

Check. $53° + 65° + 62° = 180°$ ✓ — the three parts remake the straight angle.

Practice questions

With help

Q1. Match each description to its name: (i) an angle of 90°, (ii) an angle of 180°, (iii) a full turn of 360°, (iv) the facing pair when two straight lines cross, (v) two angles that add to 90° — against (a) straight angle, (b) right angle, (c) full turn, (d) vertically opposite angles, (e) an angle and its complement.

Q2. □ and the given angle sit on a straight line. Find □. (a) 40°. (b) 115°. (c) 90°.

Q3. The angles at a point are the two given angles and □. Find □. (a) 100° and 120°. (b) 90° and 90°. (c) 150° and 150°.

Q4. Two straight lines cross. The angle vertically opposite □ is 70°. Find □, with its reason.

Q5. Find the complement of: (a) 20°. (b) 45°. (c) 8°.

Q6. Three angles sit on a straight line: 62°, □ and 48°. Find □.

Q7. Find the supplement of: (a) 30°. (b) 90°. (c) 122°.

Q8. Four equal angles fill the full turn at a point. How many degrees is each? What is the usual name for that angle?

Q9. Two straight lines cross; one of the four angles is 110°. Write the other three angles, with a reason for each.

Q10. With your protractor, draw an angle of 70°, as in the protractor figure in the theory. Then draw one more ray so that the two angles sit on a straight line. The new angle is the supplement of 70°: predict its size, then measure it with the protractor to check.

On your own

Q11. □ and the given angle sit on a straight line. Find □. (a) 83°. (b) 126°. (c) 45°.

Q12. The angles at a point are 85°, 95°, 100° and □. Find □.

Q13. Two straight lines cross; one of the four angles is 108°. Find the other three, with reasons.

Q14. Find the supplement of: (a) 151°. (b) 61°. (c) 179°. (d) 90°.

Q15. Find the complement of: (a) 45°. (b) 68°. (c) 43°. (d) One of these four angles has no complement — which one, and why?

Q16. Five angles at a point are 70°, 80°, 90°, 60° and □. Find □.

Q17. On a clock face, each hour-step is 30°. Find the angle between the hands at: (a) 2:00. (b) 3:00. (c) 6:00. Name the angles in (b) and (c).

Q18. Two straight lines cross. □ = 35°, and △ is vertically opposite □. Find △ and the other two angles.

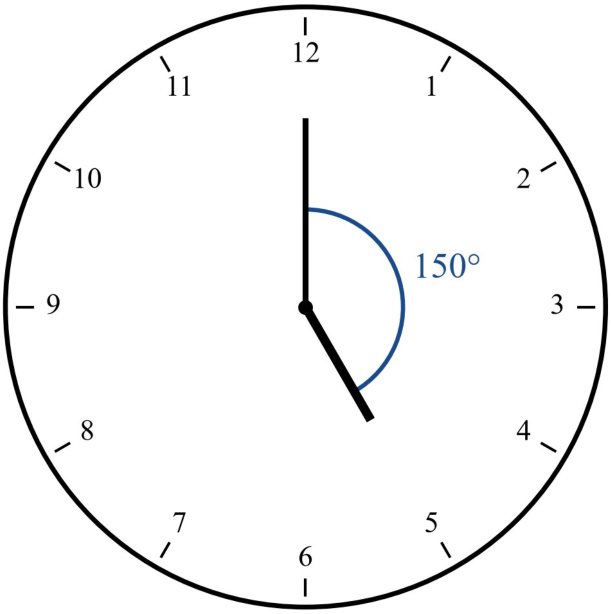
Q19. Five angles at a point: four of them are 72° each, and the fifth is □. Find □. What do you notice?

Q20. A door opens 145° from closed. How many more degrees must it turn to open flat — a straight angle?

Q21. On a straight line sit a right angle mark, 55° and □. Find □.

Q22. On a straight line sit a right angle, □ and 23°. Find □.

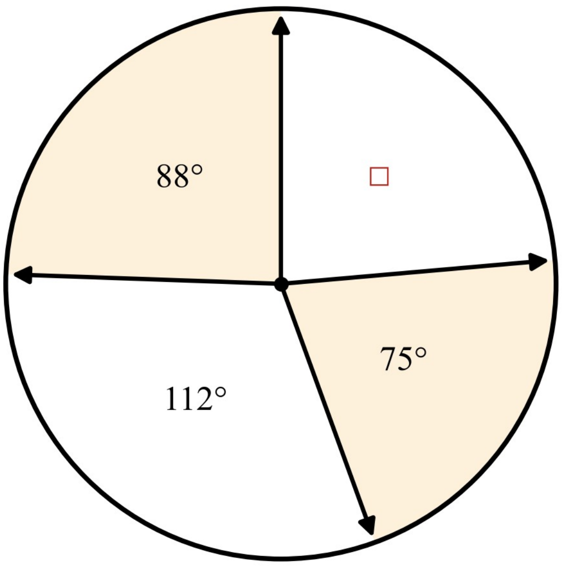
Maths in real life



5:00 — five hour-steps of 30° each

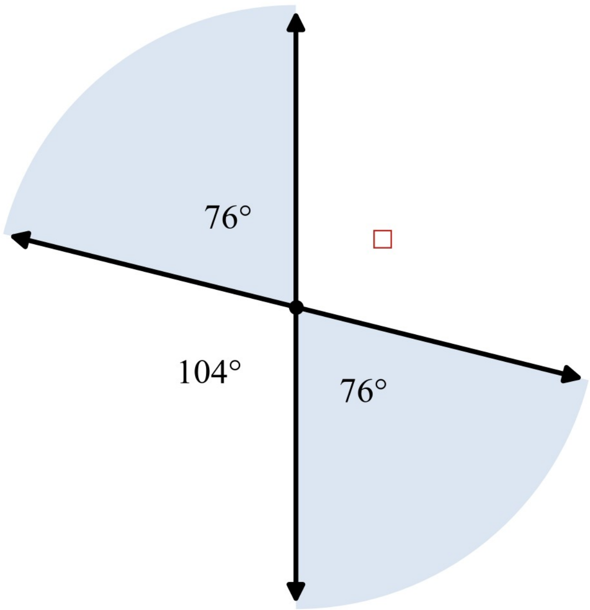
Q23.

At 5:00 the hour hand points at the 5 and the minute hand at the 12. (a) Count the hour-steps between the hands and show that the marked angle is 150°. (b) The larger angle on the other side of the hands and the 150° angle are the two angles at the clock’s centre point: find the larger one. (c) At which times do the hands make a straight angle, and at which a right angle?



Q24.

A pizza is cut into four slices from its centre. Three slices measure 88°, 112° and 75°. (a) Find □, the fourth slice. (b) Which slice is the biggest? (c) Check your answer by adding all four slices.



Q25.

Two straight sticks cross at the centre of a pinwheel, making four angles: 76°, 104°, 76° and □. (a) Find □, with its reason. (b) Compare the facing pairs of angles. What do you notice, and which rule explains it?

Choosing your strategy

Q26. Two angles sit on a straight line. One of them is 24° larger than the other. Find both angles. (Hint: take the extra 24° away first, then share what is left equally.)

Q27. Two angles sit on a straight line. One of them is twice the other. Find both. (Hint: the larger angle is two shares of the smaller — how many equal shares make 180°?)

Q28. The angles at a point are a right angle and three equal angles. Find the three equal angles. What do you notice about all four angles?

Q29. Make your own. With a ruler and a protractor, draw two straight lines crossing at a point. Measure one of the four angles. Use the three rules of this subtopic to predict the other three — writing each prediction with its reason — then measure them to check your predictions.

Answers

Q1. i–b, ii–a, iii–c, iv–d, v–e. **Q2.** (a) 140°; (b) 65°; (c) 90°. **Q3.** (a) 140°; (b) 180°; (c) 60°. **Q4.** 70° — vertically opposite angles are equal. **Q5.** (a) 70°; (b) 45°; (c) 82°. **Q6.** 70°. **Q7.** (a) 150°; (b) 90°; (c) 58°. **Q8.** 90° each — a right angle. **Q9.** 110° (vertically opposite), and 70° and 70° (angles on a straight line). **Q10.** 110°. **Q11.** (a) 97°; (b) 54°; (c) 135°. **Q12.** 80°. **Q13.** 108° (vertically opposite), 72° and 72° (angles on a straight line). **Q14.** (a) 29°; (b) 119°; (c) 1°; (d) 90°. **Q15.** (a) 45°; (b) 22°; (c) 47°; (d) 149° has no complement — it is already larger than 90°. **Q16.** 60°. **Q17.** (a) 60°; (b) 90°, a right angle; (c) 180°, a straight angle. **Q18.** △ = 35°; the other two are 145° each. **Q19.** 72° — all five angles are equal. **Q20.** 35°. **Q21.** 35°. **Q22.** 67°. **Q23.** (a) 5 hour-steps: 5 × 30° = 150°; (b) 210°; (c) a straight angle at 6:00; a right angle at 3:00 (and 9:00). **Q24.** (a) 85°; (b) the 112° slice; (c) 88° + 112° + 75° + 85° = 360° ✓. **Q25.** (a) 104° — vertically opposite the 104° angle; (b) the facing pairs are equal (76° = 76°, 104° = 104°): vertically opposite angles are equal. **Q26.** 78° and 102°. **Q27.** 60° and 120°. **Q28.** 90° each — all four angles are right angles. **Q29.** Answers will vary.

All the working

Q1. A right angle is 90° (i–b); a straight angle is 180° (ii–a); a full turn is 360° (iii–c); the facing pair at a crossing is vertically opposite (iv–d); an angle and its complement add to 90° (v–e).

Q2. Angles on a straight line add to 180°. (a) $180° − 40° = $ **140°**. (b) $180° − 115° = $ **65°**. (c) $180° − 90° = $ **90°**.

Q3. Angles at a point add to 360°. (a) $360° − 100° − 120° = $ **140°**. (b) $360° − 90° − 90° = $ **180°**. (c) $360° − 150° − 150° = $ **60°**.

Q4. □ $= $ **70°** *(vertically opposite angles are equal)*.

Q5. An angle and its complement add to 90°. (a) $90° − 20° = $ **70°**. (b) $90° − 45° = $ **45°**. (c) $90° − 8° = $ **82°**.

Q6. 62° + 48° = 110°; □ $= 180° − 110° = $ **70°** *(angles on a straight line)*.

Q7. An angle and its supplement add to 180°. (a) $180° − 30° = $ **150°**. (b) $180° − 90° = $ **90°**. (c) $180° − 122° = $ **58°**.

Q8. $360° ÷ 4 = $ **90°** *(angles at a point)* — a **right angle**.

Q9. Facing angle $= $ **110°** *(vertically opposite angles are equal)*; the two beside angles $= 180° − 110° = $ **70° each** *(angles on a straight line)*. Check: 110° + 70° + 110° + 70° = 360° ✓.

Q10. The two angles sit on a straight line, so the prediction is $180° − 70° = $ **110°** — and the protractor measure should agree.

Q11. (a) $180° − 83° = $ **97°**. (b) $180° − 126° = $ **54°**. (c) $180° − 45° = $ **135°** *(angles on a straight line)*.

Q12. 85° + 95° + 100° = 280°; □ $= 360° − 280° = $ **80°** *(angles at a point)*.

Q13. Facing angle $= $ **108°** *(vertically opposite)*; beside angles $= 180° − 108° = $ **72° each** *(angles on a straight line)*. Check: 108° + 72° + 108° + 72° = 360° ✓.

Q14. (a) $180° − 151° = $ **29°**. (b) $180° − 61° = $ **119°**. (c) $180° − 179° = $ **1°**. (d) $180° − 90° = $ **90°**.

Q15. (a) $90° − 45° = $ **45°**. (b) $90° − 68° = $ **22°**. (c) $90° − 43° = $ **47°**. (d) **149° has no complement**: a complement would have to be 90° − 149°, which is negative — the angle is already larger than a right angle.

Q16. 70° + 80° + 90° + 60° = 300°; □ $= 360° − 300° = $ **60°** *(angles at a point)*.

Q17. (a) 2 hour-steps: $2 × 30° = $ **60°**. (b) 3 steps: $3 × 30° = $ **90°, a right angle**. (c) 6 steps: $6 × 30° = $ **180°, a straight angle**.

Q18. △ $= $ **35°** *(vertically opposite angles are equal)*; the other two $= 180° − 35° = $ **145° each** *(angles on a straight line)*.

Q19. $4 \times 72° = 288°$; $\square = 360° - 288° =$ **72°** *(angles at a point)*. All five angles are equal — 72° is exactly one-fifth of a full turn.

Q20. A flat door makes a straight angle: $180° - 145° =$ **35°** more.

Q21. The square mark is 90°: $\square = 180° - 90° - 55° =$ **35°** *(angles on a straight line)*.

Q22. $\square = 180° - 90° - 23° =$ **67°** *(angles on a straight line)*.

Q23. (a) From the 12 to the 5 is 5 hour-steps: $5 \times 30° = 150°$ ✓. (b) Angles at the centre point add to 360°: $360° - 150° =$ **210°**. (c) **6:00** — the hands point opposite ways, $6 \times 30° = 180°$, a straight angle; **3:00 and 9:00** — $3 \times 30° = 90°$, a right angle.

Q24. (a) $88° + 112° + 75° = 275°$; $\square = 360° - 275° =$ **85°** *(angles at a point)*. (b) The **112° slice**. (c) $88° + 112° + 75° + 85° = 360°$ ✓ — the four slices remake the full turn.

Q25. (a) □ faces the 104° angle across the centre: $\square =$ **104°** *(vertically opposite angles are equal)*. (b) The facing pairs are equal — 76° = 76° and 104° = 104° — which is exactly the vertically opposite rule; check $76° + 104° + 76° + 104° = 360°$ ✓.

Q26. Take the extra 24° away: $180° - 24° = 156°$. Share equally: $156° \div 2 = 78°$. The smaller angle is **78°**; the larger is $78° + 24° =$ **102°**. Check: $78° + 102° = 180°$ ✓ and $102° - 78° = 24°$ ✓.

Q27. The larger angle is two shares of the smaller, so three equal shares make 180°: $180° \div 3 = 60°$. The smaller angle is **60°**; the larger is $2 \times 60° =$ **120°**. Check: $60° + 120° = 180°$ ✓.

Q28. $360° - 90° = 270°$; $270° \div 3 =$ **90° each** *(angles at a point)*. All four angles are right angles — the two lines meet at right angles.

Q29. Answers will vary. A correct attempt measures one angle, predicts the facing angle by the vertically opposite rule and the two beside angles by the straight-line rule, each with its reason written, and the three measured checks agree with the predictions (allow 1° of protractor wobble).

What comes next

That closes Chapter 5. Next in this book, **6A** (`VC2M6SP01`) takes measurement into 3D shapes. The angle rules of this subtopic themselves return at Level 7: `VC2M7M04` and `VC2M7M05` put angles on a straight line, angles at a point and vertically opposite angles to work inside larger figures — the reasoning habits you built here are exactly what those subtopics will lean on.

Test

Test T5 · Chapter 5 — Measurement

Mathematics Level 6 (Year 6) · Victorian Curriculum 2.0

Codes assessed: `VC2M6M01` · `VC2M6M02` · `VC2M6M03` · `VC2M6M04`

Name: ________________________________ Date: _______________

Total marks	20
Guidance duration	25 minutes
Timing	This is a classroom check, not an exam. Guidance is about 1 minute per mark plus 5 minutes reading. There is no strict time limit. Your teacher will let you finish.
Equipment	You will need a ruler and a protractor. The timetable extract you need is supplied with this paper, inside Question 3. You will also need a pencil.
Calculators	No calculator. None of the content descriptions in this test permits a calculator, and no question needs one — every step can be done in your head or on paper.

> This is a school-designed paper. It is not a VCAA instrument. Achievement in the Victorian Curriculum is reported against the Level 6 achievement standard, not against a mark on this paper.

Attempt every question, and show your working where a question asks for it. Durations may be written in minutes or in hours and minutes — either name is fine. In Question 4, every angle answer must carry its reason.

Question 1 — Converting between common metric units (5 marks)

(a) Circle the letter of the right answer. (1 mark)

The **capacity** (how much a container can hold) of a farm rainwater tank is a large amount of water. Which unit is best for measuring it?

A	B	C	D
millilitres (mL)	litres (L)	kilolitres (kL)	tonnes (t)

(b) **To convert** is to change the unit without changing the amount. Convert each measurement. (2 marks)

(c) 3.6 m to cm

(ii) 4500 g to kg

(iii) 7 km to m

(iv) 250 mL to L

(v) Write 3 m 6 cm as a decimal in metres. (1 mark)

(vi) Write <, > or = for each pair. (1 mark)

(vii) 3 kg 50 g ? 3.5 kg

(viii) 0.4 L ? 400 mL

Question 2 — Area of a rectangle (5 marks)

(a) Write the formula for the **area** (the amount of surface a shape covers) of a rectangle, in words. (1 mark)

(b) A rectangle has an area of 72 cm² and a length of 9 cm. Find its width. Show how you found it. (1 mark)

(c) A rectangular vegetable patch is 6 m long and 4 m wide. (2 marks)

(d) What area of soil covers the inside of the patch?

(ii) What length of border goes around the outside of the patch?

(iii) Two rectangles both have a **perimeter** (the distance around a shape) of 28 cm. One is 9 cm by 5 cm, and the other is 7 cm by 7 cm. Find the area of each rectangle, and write one thing this shows about perimeter and area. (1 mark)

Question 3 — Elapsed time and timetables (5 marks)

(a) A soccer match starts at 10:40 am and finishes at 11:55 am. How long does it run? Give your answer in hours and minutes. (1 mark)

(b) **24-hour time** writes the times of the day from 00:00 to 23:59, with no am or pm. (1 mark)

(c) Write 3:20 pm in 24-hour time.

(ii) Write 07:45 in 12-hour time.

Use the timetable extract below for parts (c) and (d). Each row of the first table is one ***service*** *— one run of a train — on the Lilydale line on a weekday morning. Each row of the second table is one route 109 tram on a Thursday morning.*

Timetable extract — supplied with the paper

Lilydale line, weekday mornings, from Flinders Street:

Departs Flinders Street	Box Hill	Lilydale
07:55	08:16	08:48
08:45	09:05	09:37
09:07	09:31	10:03

Tram route 109, Thursday mornings, from Box Hill Central to Spencer St/Collins St:

Departs Box Hill Central	Arrives Spencer St/Collins St
09:16	10:13
09:26	10:23
09:36	10:33
09:46	10:43

Source: Department of Transport and Planning, ‘GTFS Schedule’ (PTV timetable data, Victorian Government open data), 2026 (as at August 2026). Retrieved 20 August 2026.

(c) How many minutes does the 09:07 service take from Flinders Street to Lilydale? (1 mark)

(d) Noah catches the 08:45 service from Flinders Street and rides it to Box Hill. He walks to the Box Hill Central tram stop and catches the 09:26 route 109 tram to Spencer St/Collins St. A written plan of a journey like this, leg by leg, is called an **itinerary**. (2 marks)

(e) Find the time for the train **leg** (one part of a journey, from a departure to the next arrival), and his **change** time at Box Hill.

(ii) Find the total journey time, from the first departure to the last arrival. Check it a second way.

Question 4 — Angles (5 marks)

(a) Two angles sit on a straight line. One of them is 67°. Find □, the other angle, and write the reason for your answer. (1 mark)

(b) Four angles at a point are 118°, 94°, 76° and □. Find □, and write the reason for your answer. (1 mark)

(c) Two straight lines cross. One of the four angles is 58°. Find the other three angles, and write a reason for each one. (2 marks)

(d) You will need your protractor for this part. Draw an angle of 75°. Then draw one more ray from the point so that your two angles sit on a straight line. The new angle is the **supplement** of 75° — the angle that makes 180° with it. Predict its size first, with its reason, then measure it with your protractor to check your prediction. (1 mark)

Total: 20 marks

Solutions

Teacher-facing. Test T5 is a classroom check, not an exam: a 25-minute guidance duration (about 1 minute per mark plus 5 minutes reading), a ruler, a protractor and the timetable extract supplied with the paper, and no calculator — none of the four Chapter 5 content descriptions names a calculator or a digital tool (D8), and 5A, 5B, 5C and 5D were all authored calculator-free. Level discipline holds throughout (D9): every convert is a × 10, × 100 or × 1000 jump or its reverse (no decimal × decimal); every area is a whole-number product of the rectangle formula only; every duration is counted on, with no speed or rate; the unknown angle is □, never a letter; and the angle items use strictly the three relationships 5D teaches — angles on a straight line, angles at a point, and vertically opposite angles. The timetable data in Question 3 is the real GTFS data already printed in 5C, re-cited with its source line; every question is otherwise newly authored for this paper.

Marking guide

Administration (per TOC §7). Guidance duration 25 minutes: about 5 minutes reading plus about 1 minute per mark. Equipment, exactly as the §7 table row for T5: ruler, protractor, timetable extract supplied with the paper. No calculator (D8). The paper carries the §7 standing notice: it is a school-designed paper, not a VCAA instrument, and achievement is reported against the Level 6 achievement standard, not against a mark.

Marks by item and CD. Only Chapter 5 CDs are assessed (§4). Each of the four subtopics carries exactly 5 marks (§7 marking rule: 5 marks per subtopic).

Item	CD code	Subtopic	Type	Marks
Q1	`VC2M6M01`	5A	MC (A–D) + short answer	5
Q2	`VC2M6M02`	5B	Short answer / worked response	5
Q3	`VC2M6M03`	5C	Short answer / worked response, using the supplied timetable extract	5
Q4	`VC2M6M04`	5D	Short answer / worked response, incl. one protractor item	5
			Total	**20**

MC total: 1 mark of 20 — sparingly per §7, used only because choosing the unit that fits a context is genuinely a selection skill. Elaboration links are illustrative only (D3): Q1 leans on `VC2M6M01.E02–.E03`, Q2(d) on `VC2M6M02.E04`, Q3 on `VC2M6M03.E01` and `.E03`, Q4 on `VC2M6M04.E02–.E03`.

Rubrics, by CD. The achievement-standard extract is quoted verbatim from `maths_6.json`. `VC2M6M02` and `VC2M6M04` share one extract; each carries its own copy, and each rubric scores its own half of it.

`VC2M6M01` (5A) — 5 marks (Q1 5). *"They convert between common units of length, mass and capacity."* Observable actions:

- selects the unit that fits a large capacity — C, kilolitres (1 mark);
- converts 3.6 m to 360 cm, 4500 g to 4.5 kg, 7 km to 7000 m and 250 mL to 0.25 L — each a single × 100, ÷ 1000, × 1000 or ÷ 1000 jump (2 marks: ½ each);
- writes the mixed form as a decimal — 3 m 6 cm = 3.06 m (1 mark);
- compares across forms — 3 kg 50 g < 3.5 kg, and 0.4 L = 400 mL (1 mark: ½ each).

`VC2M6M02` (5B) — 5 marks (Q2 5). *"They use the formula for the area of a rectangle and angle properties to solve problems."* — the rectangle-formula half. Observable actions:

- states the formula in words — Area of a rectangle = length × width (1 mark);
- finds a missing side by undoing the formula — 72 ÷ 9 = 8 cm (1 mark);
- uses the formula and the perimeter on the one rectangle, with the right units — soil 24 m², border 20 m (2 marks: 1 each);
- finds both areas for the same perimeter and states what it shows — 45 cm² and 49 cm²; the same perimeter does not mean the same area (1 mark).

`VC2M6M03` (5C) — 5 marks (Q3 5). *"Students interpret and use timetables, and measure, calculate and compare elapsed time."* Observable actions:

- finds an elapsed time by counting on — 10:40 am to 11:55 am is 1 hour 15 minutes (1 mark);
- moves between 12-hour and 24-hour time — 3:20 pm = 15:20, and 07:45 = 7:45 am (1 mark: ½ each);

- reads a service from the supplied grid and calculates its duration — 09:07 → 10:03 is 56 minutes (1 mark);
- reads a two-leg journey with a change — train leg 20 minutes, change 21 minutes (1 mark), and finds the total journey time with a second-way check — 98 minutes = 1 hour 38 minutes (1 mark).

`VC2M6M04` (5D) — 5 marks (Q4 5). *"They use the formula for the area of a rectangle and angle properties to solve problems."* — the angle-properties half. Every angle answer carries its reason, as the CD's *communicating reasoning* clause requires. Observable actions:

- finds the missing angle on a straight line with the reason stated — □ = 180° − 67° = 113° *(angles on a straight line add to 180°)* (1 mark);
- finds the missing angle at a point with the reason stated — □ = 360° − 288° = 72° *(angles at a point add to 360°)* (1 mark);
- finds all three unknown angles at a crossing, each with its reason — 58° *(vertically opposite angles are equal)* and 122°, 122° *(angles on a straight line add to 180°)* (2 marks: 1 for the facing angle with its reason, 1 for both beside angles with their reasons);
- draws an angle of 75°, predicts its supplement with the reason stated, and checks by measuring — prediction 105° *(angles on a straight line add to 180°)* (1 mark).

MCQ key. Q1(a) **C**. One mark for the correct letter; no part marks.

General marking notes.

- Q1(b): each convert earns ½; the working may be shown as a jump (× 100, ÷ 1000 …) or stated in words. Accept trailing-zero forms such as 4.50 kg, but the unit must be right.
- Q1(c): the 6 sits in the hundredths — 3.06 m. An answer of 3.6 m earns 0: that is 3 m 60 cm, the exact trap 5A's Q16 worked against.
- Q2(a): the formula is asked for in words — letters as variables are not taught in this book (D9). Accept any correct wording (length × width or width × length); a correct letter form such as A = l × w may be accepted at the teacher's discretion, but words are the taught form.
- Q2(b): the mark needs the inverse step shown or stated (72 ÷ 9) as well as the correct width. A check by multiplying back (9 × 8 = 72) is encouraged but not required.
- Q2(c): the units decide the marks — m² for the soil, m for the border. An answer with the two units swapped, or both the same, loses the mark for the wrong part.
- Q2(d): the observation must say that the same perimeter does not fix the area — or, better, that the closer the rectangle is to a square, the more area the same perimeter encloses.
- Q3(a): accept 75 minutes or 1 hour 15 minutes; the counting-on (or an equivalent subtraction) should be shown.
- Q3(c): accept any valid count-on (09:07 → 10:00 → 10:03 is 53 + 3; 09:07 → 10:07 take away 4). A bare "56" with no working earns 0.
- Q3(d): (i) needs both the 20-minute leg and the 21-minute change.
  (ii) awards the mark for a total reached either way — adding the pieces (20 + 21 + 57) or counting on end-to-end (08:45 → 10:23) — with the two ways agreeing, as 5C's Example 4 taught. An answer of 77 minutes (the legs without the change) earns 0: leaving out the wait was 5C's named trap.
- Q4(a)–(c): the reason is part of the mark — a bare number with no reason earns 0, per the CD's *communicating reasoning* clause and 5D's house rule. Accept any wording that names the relationship correctly.
- Q4(d): allow 1° of protractor wobble on both the drawn 75° angle and the measured check, as in 5D's Q29. The mark needs the prediction (105°) with its reason and a measured check; a prediction with no drawing earns 0.

Answer key

Q	Part	Answer	Marks
1	(a)	C — kilolitres (kL)	1
1	(b)	(i) 360 cm · (ii) 4.5 kg ·	2

Q	Part	Answer	Marks
		(iii) 7000 m · (iv) 0.25 L	
1	(c)	3.06 m	1
1	(d)	(i) < · (ii) =	1
2	(a)	Area of a rectangle = length × width	1
2	(b)	8 cm	1
2	(c)	(i) 24 m² · (ii) 20 m	2
2	(d)	45 cm² and 49 cm²; same perimeter, different areas	1
3	(a)	1 hour 15 minutes (75 minutes)	1
3	(b)	(i) 15:20 · (ii) 7:45 am	1
3	(c)	56 minutes	1
3	(d)	(i) train leg 20 min, change 21 min · (ii) 98 minutes = 1 hour 38 minutes	2
4	(a)	□ = 113° — angles on a straight line add to 180°	1
4	(b)	□ = 72° — angles at a point add to 360°	1
4	(c)	58°, 122° and 122°, each with its reason	2
4	(d)	prediction 105° — angles on a straight line add to 180°; measure to check	1
		Total	**20**

All the working

Q1. (a) A farm rainwater tank holds a large amount of water — in 5A's everyday amounts, a rainwater tank holds a few kL. Millilitres and litres would give a very large, hard-to-picture number, and tonnes measure mass, not capacity. ∴ **C, kilolitres (kL)**.

(b) Converting is a jump along the ladder: to a smaller unit, multiply; to a larger unit, divide.

(c) m → cm is one jump towards the smaller unit: × 100. $3.6 × 100 = $ **360 cm**.

(ii) g → kg is one jump towards the larger unit: ÷ 1000. $4500 ÷ 1000 = $ **4.5 kg**.

(iii) km → m is one jump towards the smaller unit: × 1000. $7 × 1000 = $ **7000 m**.

(iv) mL → L is one jump towards the larger unit: ÷ 1000. $250 ÷ 1000 = $ **0.25 L**.

Each checks in reverse: $360 \div 100 = 3.6$ ✓, $4.5 \times 1000 = 4500$ ✓, $7000 \div 1000 = 7$ ✓, $0.25 \times 1000 = 250$ ✓.

(c) 6 cm is 6 hundredths of a metre: $6 \div 100 = 0.06$. So 3 m 6 cm = **3.06 m**. Watch the place: 3.6 m would be 3 m 60 cm. Check: $3.06 \times 100 = 306$ cm = 3 m 6 cm ✓.

(d)

(i) Put both in grams: 3 kg 50 g = 3050 g, and $3.5 \times 1000 = 3500$ g. $3050 < 3500$, so 3 kg 50 g **<** 3.5 kg.
(ii) $0.4 \times 1000 = 400$ mL, so 0.4 L = 400 mL.

Q2. (a) The formula comes from the array of square units: the length says how many squares sit in a row, and the width says how many rows. **Area of a rectangle = length × width.**

(b) The formula says length × width = area, so $9 \times$ width $= 72$. Division undoes the multiplication: width $= 72 \div 9 =$ **8 cm**. Check: $9 \times 8 = 72$ cm² — the area given ✓.

(c)

(i) Inside is area: $6 \times 4 =$ **24 m²** of soil. (ii) Around is perimeter: $6 + 4 + 6 + 4 =$ **20 m** of border. The units say which is which — square metres for the cover, plain metres for the border.

(d) Areas: $9 \times 5 =$ **45 cm²** and $7 \times 7 =$ **49 cm²**. Check the perimeters: $9+5+9+5=28$ cm ✓ and $7+7+7+7=28$ cm ✓. Both rectangles are 28 cm around, yet their areas are different — **the same perimeter does not mean the same area**. The 7 cm by 7 cm rectangle is a square, and the closer a rectangle is to a square, the more area the same perimeter encloses.

Q3. (a) Count on along the timeline: 10:40 am → 11:40 am is 60 minutes; 11:40 am → 11:55 am is 15 minutes. $60+15=75$ minutes. Because 60 minutes makes an hour, 75 minutes is **1 hour 15 minutes**. Check by counting back: 11:55 am − 1 h 15 min = 10:40 am ✓.

(b)

(i) After midday, add 12 hours: $3+12=15$, so 3:20 pm is **15:20**.

(ii) Before midday, the number keeps: 07:45 is **7:45 am**.

(iii) Read the 09:07 row: it arrives at Lilydale at 10:03. Count on: 09:07 → 10:00 is 53 minutes; 10:00 → 10:03 is 3 minutes; $53 + 3 =$ **56 minutes**. Check: 09:07 + 56 min = 10:03 — the printed arrival ✓.

(iv)

(i) Train leg: 08:45 → 09:05 is **20 minutes**. Change: the tram leaves at 09:26, and 09:05 → 09:26 is **21 minutes**. (ii) Tram leg: 09:26 → 10:23 — count on: 09:26 → 10:00 is 34 minutes; 10:00 → 10:23 is 23 minutes; $34+23=57$ minutes. Add the three pieces: $20+21+57=98$ minutes. Since 98 minutes is $60+38$, the total journey time is **98 minutes, or 1 hour 38 minutes**. Check the second way — count on from the first departure to the last arrival: 08:45 → 09:45 is 60 minutes; 09:45 → 10:23 is 38 minutes; $60+38=98$ minutes ✓. Two ways, one answer — and the 21-minute change is part of the journey, not an extra.

Q4. (a) The two angles share the straight line, so □ $= 180° - 67° =$ **113°** *(angles on a straight line add to 180°)*. Check: $67° + 113° = 180°$ ✓.

(b) The three known angles add to $118° + 94° + 76° = 288°$. The four angles fill the full turn, so □ $= 360° - 288° =$ **72°** *(angles at a point add to 360°)*. Check: $118° + 94° + 76° + 72° = 360°$ ✓.

(c) The angle facing 58° is vertically opposite it: **58°** *(vertically opposite angles are equal)*. Each angle beside 58° sits with it on one straight line: $180° - 58° =$ **122°** *(angles on a straight line add to 180°)* — and the fourth angle faces the first 122° angle, so it is also **122°** *(vertically opposite angles are equal)*. Check: $58° + 122° + 58° + 122° = 360°$ — the four make a full turn ✓.

(d) Prediction first: the new angle and the 75° angle sit on one straight line, so the supplement is $180° - 75° =$ **105°** *(angles on a straight line add to 180°)*. Draw the 75° angle with the protractor's centre on the point and its baseline along one arm, then draw the second ray along the straight line. Measuring the new angle should give 105° (allow 1° of protractor wobble) — the check agrees with the prediction ✓.