

VCE VM Numeracy Unit 2

Chapter 2 — Dimension and direction

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Theory

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

Find a seat in a theatre. Find a jar on a shelf. Tell a friend where to put the tent. All of these jobs use the same mathematics: **location** — saying exactly where something is. This section draws on two parts of the study design (Unit 2, Area of Study 5): saying where things are, and which way to go, by using everyday objects and landmarks you know; and describing where something sits in space — along a line, on a flat surface or in three dimensions — with everyday position words, such as the pairs left and right, up and down, in front and behind.

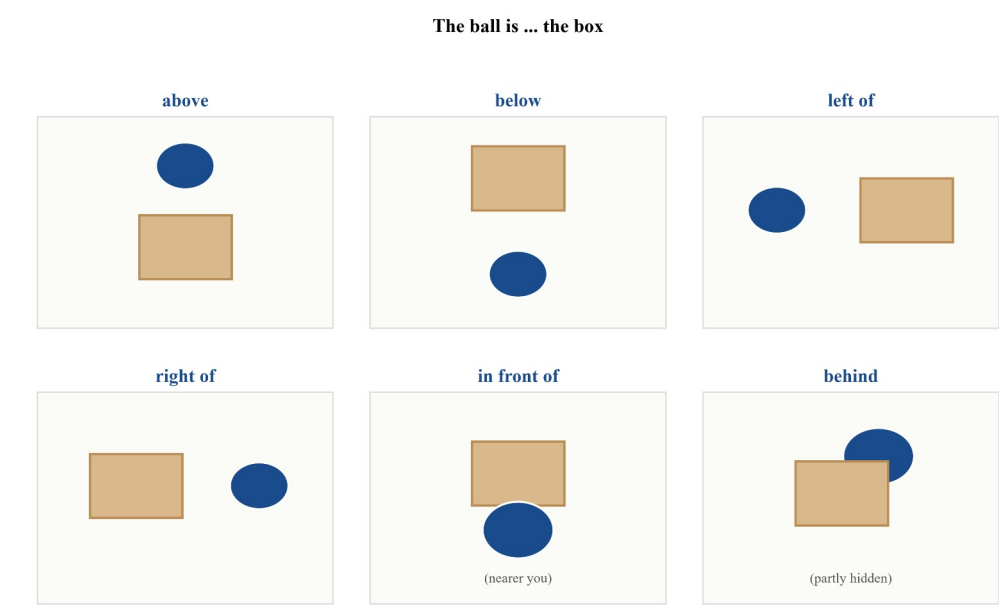
Source: VCAA, VCE Vocational Major Numeracy Study Design, retrieved 2026-10-09.

What this section covers.

Everyday **position words** for saying where something is; **landmarks** — familiar objects everyone knows — for describing a place; counting positions along a line, on a grid of seats, desks or plots, and on shelves and racks with levels; and distances along a tape measure, in centimetres and metres. Compass points and maps are section 2B, giving and following directions is section 2C, and angles are section 2D — they are not needed here.

Position words.

A small set of words does most of the work of saying where something is. The figure shows three pairs of them with a ball and a box; the table lists those pairs and adds the words for things side by side.



Word	What it tells you	Example
above / below	one thing is higher (or lower) than the other	the picture hangs above the couch
left of / right of	which side, as you look at it	the left button of the two
in front of	on the near side, facing you	the mat lies in front of the door
behind	on the far side, partly or fully hidden	the sun is behind a cloud
next to	right beside, sharing a side or an edge	your phone is next to your keys
between	one thing on each side of it	the lamp stands between the two windows

Word	What it tells you	Example
opposite	directly across from, facing it	the two teams line up opposite each other

Refresher — left and right.

Left and right depend on which way you are **facing**. When you look at something — a page, a shelf, a row of seats — your left hand points to its left side, and the left end is where your left hand is. But when you face another person, your right is their left: the two swap. Before answering any “left or right” question, ask one thing first: who is facing which way?

Landmarks.

A **landmark** is an object that is easy to recognise and that everyone knows — a clock tower, a big gum tree, a brightly painted shed. Landmarks make location short. “The tent is behind the big gum tree” beats a long list of turns and steps, because the tree is impossible to miss. A good landmark is big, obvious and not going anywhere. When you describe a place, pick a landmark your listener already knows, then give the position word: *next to*, *opposite*, *behind*.

Position along a line — one dimension.

Chairs in a row, lockers along a wall, crates on a bench: these sit in a line, so a place in the line needs only **one** number — which position it is, counted from one end. Always say which end you counted from. “Sixth from the left” and “sixth from the right” are different chairs. One number along a line is **one dimension**.

Refresher — counting from either end.

In a row of 10, the 4th seat from the left is the 7th from the right, because $10 - 4 + 1 = 7$. The pattern always works: the position from the other end is the total, minus the position, plus 1. In a row of 12 lockers, the 3rd from the right is locker $12 - 3 + 1 = 10$. For things *between* two positions, subtract and take one more off: between seats 5 and 9 sit $9 - 5 - 1 = 3$ seats (they are seats 6, 7 and 8).

Position on a flat surface — two dimensions.

Seats in a theatre, desks in a classroom, plots in a garden: these lie on a flat surface, so one number is not enough — you need **two**. A **grid** labels the two directions separately. **Columns** run across, and are usually labelled with letters; **rows** run front to back (or top to bottom), and are usually labelled with numbers. Every place then gets a short code: **B2** means column B, row 2. As a worked read: in a seat grid, B2 is the seat in the second column from the left and the second row from the front; the seat directly in front of it is B1, and the seat directly behind it is B3. On a grid, left and right live in the column letter, and in front and behind live in the row number. Two directions on a flat surface is **two dimensions**.

Refresher — rows and columns.

A **row** runs across — things side by side, like a row of seats at the cinema or a row of lettuces in a garden. A **column** runs up and down — the word comes from the columns that hold up a building, which stand tall. Memory hook: a column stands up like a pillar; a row lies across like a garden bed. In a code like C4, the letter comes first: column C, row 4.

Position in space — three dimensions.

Shelves and racks add a third direction: **up and down**. Shelf places are counted in **levels** — level 1 is the bottom level, and the levels count up. A place on a shelf needs a column *and* a level: “column 2, level 3” is the top shelf, second space from the left. Stacks add depth as well — crates two deep, front to back. Across, back and up together is **three dimensions**.

Distances along a line.

A tape measure turns “how far along” into a number. An object placed at a mark is that far from the 0 end. The distance *between* two marks is the bigger mark minus the smaller one: from the 20 cm mark to the 50 cm mark is $50 - 20 = 30$ cm.

Refresher — metres and centimetres.

Lengths in this section are measured in metres (m) and centimetres (cm), and 1 m = 100 cm. Metres to centimetres: multiply by 100, so 2.5 m = 250 cm. Centimetres to metres: divide by 100, so 150 cm = 1 m 50 cm. Keep one unit all the way through a calculation, and write the unit on the answer.

When you turn around.

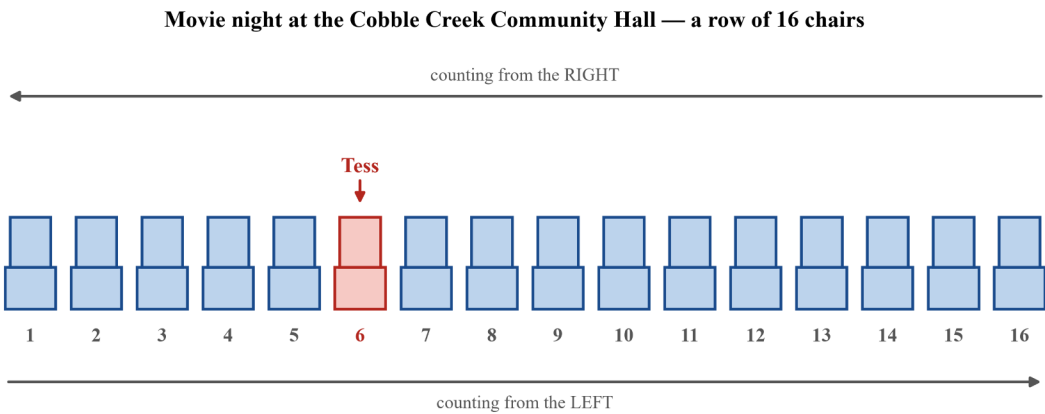
Position words follow the person who is facing. Turn around and what was behind you is now in front of you. Face a friend and your right hand is on their left side. This is why directions like “on the customer’s left” must always name *whose* left — the answer changes with the facing.

Units 3 & 4 preview. In Units 3 and 4 position is pinned down more exactly with pairs of coordinates and compass bearings — not in this book, and not in its tests.

Worked examples

Example 1 — scaffolded

Movie night at the Cobble Creek Community Hall. Sixteen chairs stand in one row, numbered 1 to 16 from the left end as shown. Tess sits in chair 6, counting from the left.



Made-up data: the hall, its chairs and every number here are made up for this section.

Find Tess’s chair counted from the right end, the number of chairs between Tess and the right end, and the number between Tess and the left end.

Working

Purpose and question(s): locate Tess in the row.
Questions: her position from the right end; chairs between her and the right end; chairs between her and the left end.

Mathematics in the context: 16 chairs in a line; Tess is 6th from the left. Counting from either end, and subtraction.

Comment

Three small questions — list all three before starting.

A line of chairs is one dimension: one number, plus the end you count from.

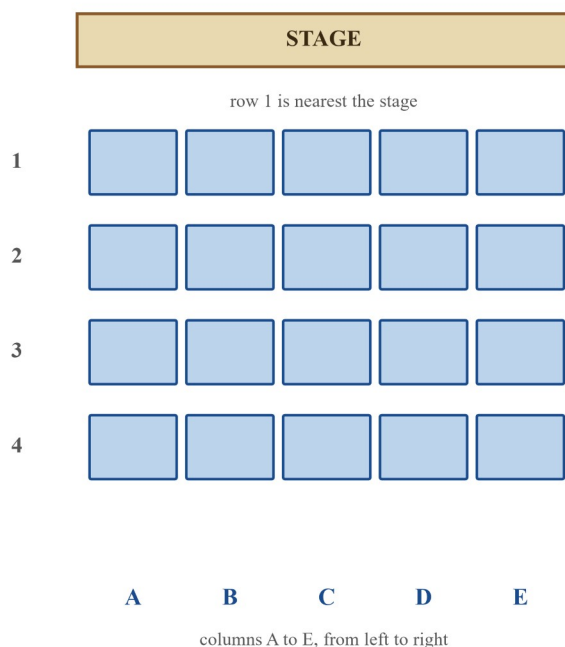
Working	Comment
Step 1: from the right: $16 - 6 + 1 = 11$, so Tess is 11th from the right end.	Total minus position plus 1 swaps the counting end.
Step 2: between Tess and the right end: $16 - 6 = 10$ chairs.	Chairs 7 to 16 all sit on that side of her.
Step 3: between Tess and the left end: $6 - 1 = 5$ chairs.	Chairs 1 to 5 sit on the left side.
Check: $5 + 1 + 10 = 16$ — five chairs, Tess, ten chairs: the whole row.	The three answers must add back to the total.

Tess is 11th from the right end, with 10 chairs between her and the right end and 5 between her and the left end.

Example 2 — scaffolded

The Cobble Creek Little Theatre has seats in a grid: columns A to E from the left, rows 1 to 4 from the front, with row 1 nearest the stage. Bram's ticket says **D3**.

Seat grid — Cobble Creek Little Theatre



Made-up data: the Little Theatre, its seat grid and every seat code here are made up for this section.

Describe seat D3, find the code for the row-1 seat at the right-hand end, and name the seat directly behind D3.

Working	Comment
Purpose and question(s): read a seat code on a grid. Questions: describe D3; the code for the right-hand end of row 1; the seat directly behind D3.	Grid codes are short for “column and row”.
Mathematics in the context: columns A–E left to right; rows 1–4 front to back, row 1 nearest the stage; ticket D3.	Read the grid labels first — they say where the counting starts.
Step 1: D is the 4th letter, so D3 is column 4, row 3: fourth from the left, third from the front.	The letter gives the column; the number gives the row.

Working	Comment
Step 2: the right-hand end of row 1 is column E, row 1, so its code is E1.	Last column across, front row.
Step 3: directly behind D3 is the same column, one row back: D4.	“Behind” adds 1 to the row number; the letter stays.
Check: D4 is in row 4 — the back row of the grid, one row behind row 3.	Trace it on the picture to be sure.

Seat D3 is in column 4, row 3; the right-hand row-1 seat is E1; and the seat directly behind D3 is D4.

Example 3 — unscaffolded

Mabel sells cupcakes at the Cobble Creek Market from a stand with shelves 4 spaces across and 3 levels high. The levels count up from the bottom, so level 1 is the bottom level. How many shelf spaces does the stand have? Which level is the top one, where Mabel puts the special orders? And if every space holds 2 trays stacked front to back, how many trays can the whole stand hold?

The spaces form a grid on the shelf: 4 across and 3 levels gives $4 \times 3 = 12$ spaces. The levels count 1, 2, 3 from the bottom, so the top level is level 3. With 2 trays in every space, the stand holds $12 \times 2 = 24$ trays altogether — the stacking adds depth, the third dimension.

∴ the stand has 12 shelf spaces, the special orders go on level 3, and the stand holds 24 trays in total.

Example 4 — unscaffolded

Three buildings stand side by side along one side of Fern Lane: a greengrocer, a medical centre and a town hall — not necessarily in that order. A notice says:

- The greengrocer is at the left-hand end.
- The medical centre is between the greengrocer and the town hall.
- The bakery, across the lane, is directly opposite the medical centre.
- The newsagency is next to the bakery, on the town-hall side.

Made-up data: Fern Lane, its buildings and the notice are made up for this section.

- (a) Give the order of the three buildings from left to right. (b) Which building is opposite the bakery? (c) Is the newsagency opposite the greengrocer or the town hall?

Work through the clues one at a time. Clue 1 puts the greengrocer at the left-hand end. Clue 2 says the medical centre has a building on each side, so it stands in the middle and the town hall takes the right-hand end: greengrocer, medical centre, town hall. Clue 3 puts the bakery across the lane, facing the middle building, so the bakery is opposite the medical centre. Clue 4 puts the newsagency beside the bakery, towards the town hall — that is on the far side of the bakery, so the newsagency faces the right-hand building.

∴ (a) the order is greengrocer, medical centre, town hall; (b) the medical centre is opposite the bakery; (c) the newsagency is opposite the town hall.

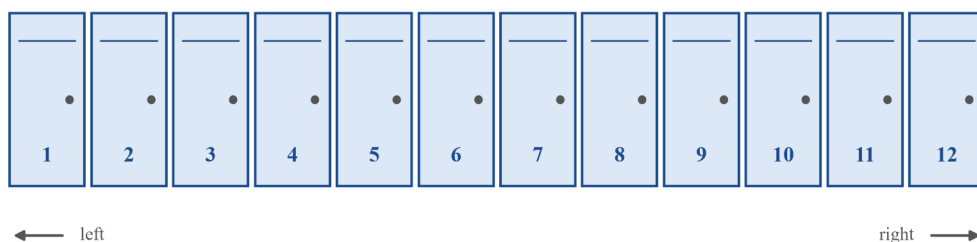
Practice questions

Scaffolded

Q1. Here are six position words: *above* · *between* · *next to* · *opposite* · *behind* · *in front of*. (a) Match each word with its meaning: *higher than something, with one thing on each side of it, right beside something, directly across from something, at the back of something, on the front side of something, facing it*. (b) Your hat sits on your head. Which word says where the hat is? (c) The dog sleeps with the table on one side of it and the chair on the other. Which word says where the dog is?

Q2. The lockers at Cobble Creek School are numbered 1 to 12 from the left end, as shown.

Lockers at Cobble Creek School

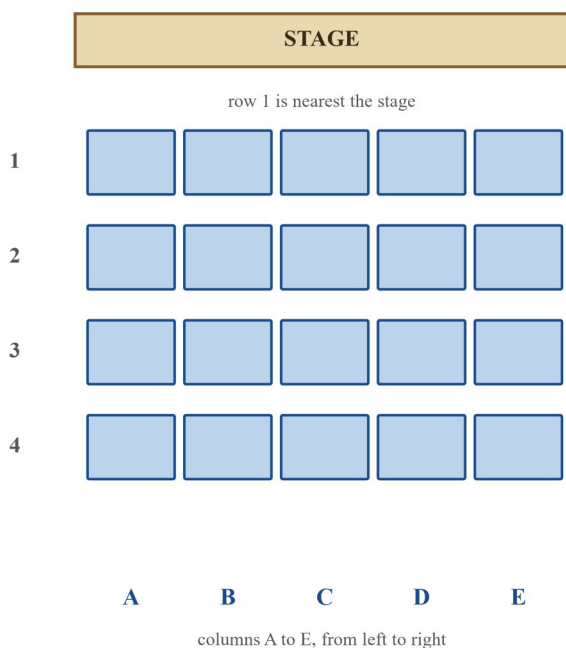


Made-up data: the school, its lockers and every number here are made up for this section.

- Which locker is 3rd from the left end?
- Counting from the right end, which position is locker 9 in?
- Nellie's locker is between locker 5 and locker 7. Which locker is Nellie's?

Q3. The Cobble Creek Little Theatre seat grid is shown below: columns A to E from the left, rows 1 to 4 from the front, with row 1 nearest the stage.

Seat grid — Cobble Creek Little Theatre



Made-up data: the Little Theatre, its seat grid and every seat code here are made up for this section.

- Write the seat code for the seat in column C, row 2.
- Which seat is directly in front of seat A4?
- Describe seat E1: which column and which row is it in, and where does that sit in the theatre?

Q4. Hattie's pantry shelf has 4 columns and 3 levels, as shown. The levels count up from the bottom, so level 1 is the bottom level.

Hattie's pantry shelf

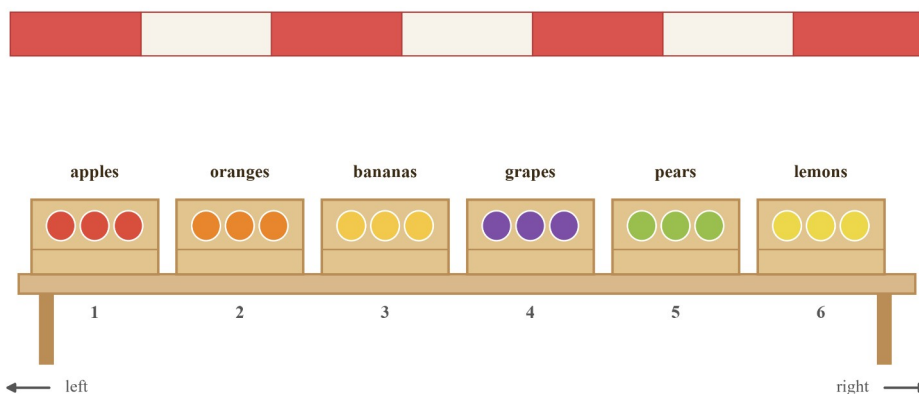
level 3 (top)	biscuits	crackers	chips	(empty)
level 2 (middle)	tomatoes	soup	jam	honey
level 1 (bottom)	cereal	rice	pasta	flour
	column 1	column 2	column 3	column 4

Made-up data: Hattie's pantry and every item on the shelf are made up for this section.

- What sits in column 2, level 3?
- Describe the position of the tomatoes.
- How many items are on the shelf altogether?

Q5. Darcy's fruit stall at the Cobble Creek Market has six crates in a row, numbered from the left, as shown.

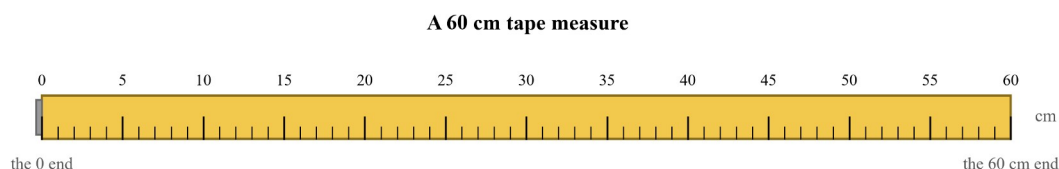
Darcy's fruit stall at the Cobble Creek Market



Made-up data: the market, the stall and every crate in it are made up for this section.

- Which fruit is in the 3rd crate from the left?
- Which crate is between the apples and the bananas?
- Counting from the right end, which position are the grapes in?

Q6. Cleo lines up kitchen things along a 60 cm tape on her bench, with the 0 end at the left. The pot sits at the 15 cm mark and the jug sits at the 40 cm mark. The tape is shown below.



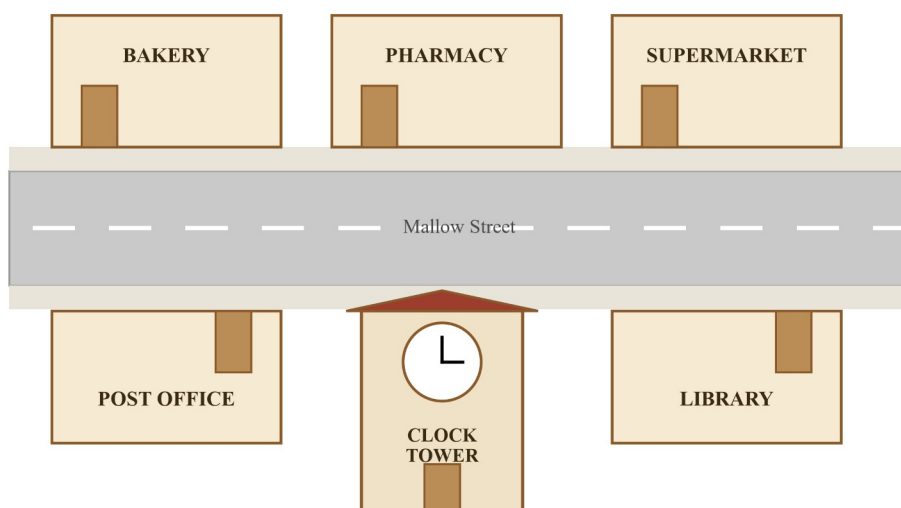
Made-up data: the tape, the objects and every mark here are made up for this section.

- How far is it along the tape from the pot to the jug?
- The bowl sits 20 cm to the right of the jug. At which mark does the bowl sit?
- How far is it along the tape from the pot to the bowl?

Un scaffolded

Q7. Mallow Street in Cobble Creek is shown below. Along the top side, from left to right, stand the bakery, the pharmacy and the supermarket. Along the bottom side, from left to right, stand the post office, the clock tower and the library.

Mallow Street, Cobble Creek

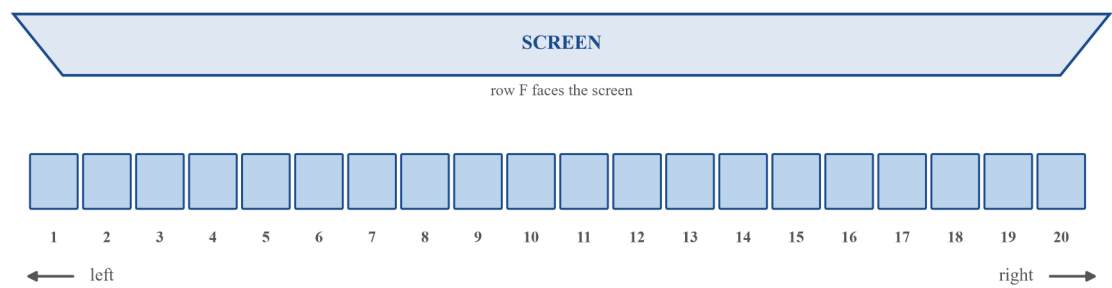


Made-up data: Mallow Street and every building on it are made up for this section.

- Which building is directly opposite the bakery?
- The clock tower is between which two buildings?
- Describe the position of the supermarket with two position words.

Q8. Row F at the Cobble Creek cinema has 20 seats, numbered 1 to 20 from the left end as shown. Rory sits in seat 5 and Silas sits in seat 17.

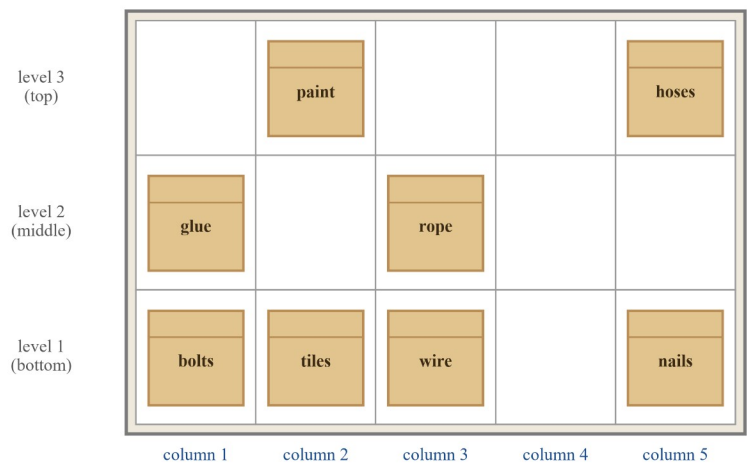
Row F at the Cobble Creek cinema — 20 seats



Made-up data: the cinema, row F and every seat number are made up for this section.

- (a) Counting from the right end of the row, which position is Silas in?
 - (b) How many seats are between Rory and Silas?
 - (c) Mabel wants the seat exactly halfway between the two of them. Which seat number should she take?
- Q9.** The storage rack at the Cobble Creek depot has 5 columns and 3 levels, as shown. Level 1 is the bottom level. Archie keeps the crates of hardware on it.

Storage rack at the Cobble Creek depot

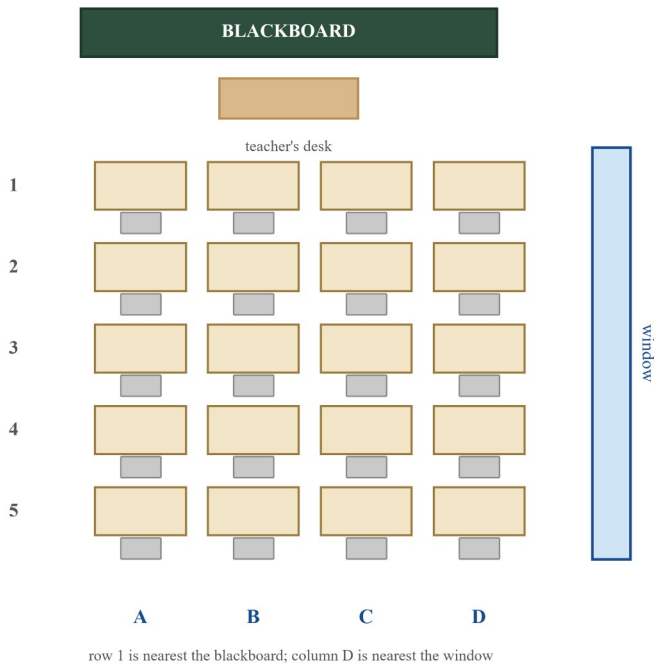


Made-up data: the depot, its rack and every crate on it are made up for this section.

- (a) Which crate sits in column 3, level 2?
- (b) Describe the position of the paint crates.
- (c) How many empty spaces are there on the rack?

Q10. A classroom at Cobble Creek School is shown below. The desks stand in columns A to D from the left and rows 1 to 5 from the front. Row 1 is nearest the blackboard, and column D is nearest the window.

A classroom at Cobble Creek School



Made-up data: the school, the classroom and every desk in it are made up for this section.

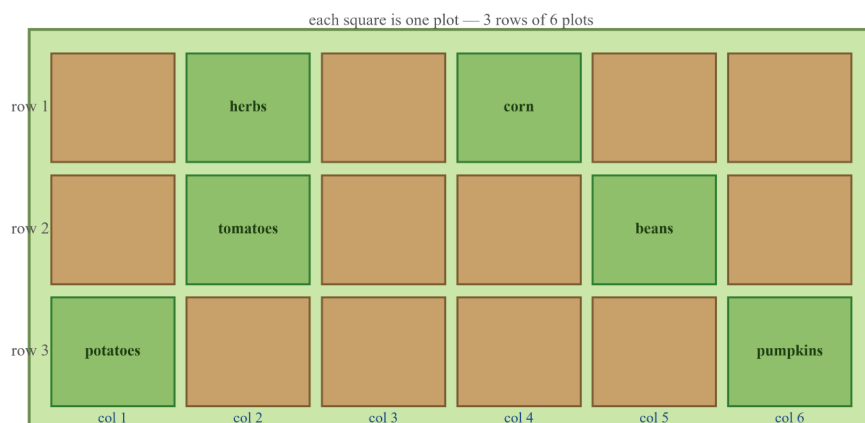
- Describe desk B4: which column is it in, which row from the front, and which row from the back?
- Which desk is directly in front of B4?
- How many desks are in the room altogether?

Q11. In Nellie's garden shed, a bag of potting mix sits on the top shelf. The watering can sits on the middle shelf. On the bottom shelf, the gloves sit directly underneath the watering can, and the trowel sits next to the gloves. (a) Which shelf is the watering can on? (b) What is directly above the gloves? (c) Where is the trowel?

Q12. Silas measures a plank for a garden bed frame. He lays the plank along a long tape measure: one end of the plank sits at the 5 cm mark and the other end at the 55 cm mark. (a) How long is the plank, in cm? (b) Write this length in metres. (c) Silas lays a second plank, 30 cm long, starting at the 10 cm mark on the same tape. At which mark does the second plank finish?

Q13. The Cobble Creek Community Garden is laid out in plots, as shown below. Each square is one plot; there are 3 rows of 6 plots, and row 1 is the back row.

Plots at the Cobble Creek Community Garden



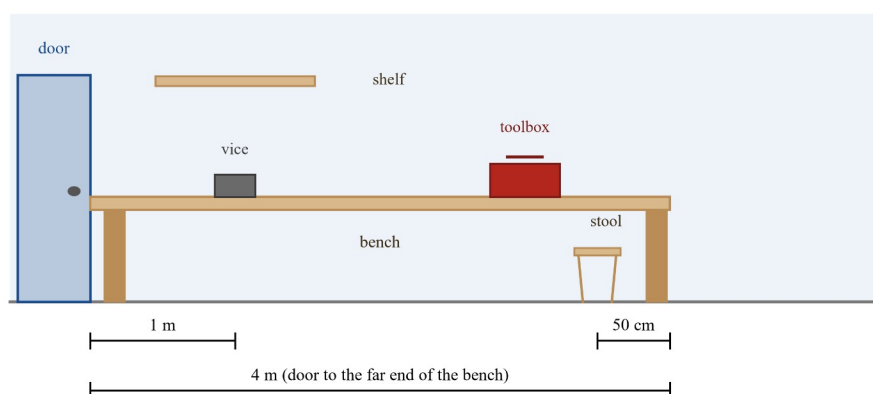
Made-up data: the community garden and every plot in it are made up for this section.

- How many plots are there altogether?
- The beans are planted in row 2, column 5. Which two plot positions share a side with the beans?
- The corner plot at row 1, column 1 is at the back-left of the garden. How many plots share a side with it?

Q14. After Saturday's market, Darcy stacks the empty crates for storage. The bottom layer is 4 crates by 3, the middle layer is 3 crates by 2, and a single crate sits on the very top. (a) How many crates are in the whole stack? (b) How many more crates are in the bottom layer than in the middle layer? (c) Darcy puts the newest crate on top of the stack. Why is it the easiest crate of all to reach? Answer in one sentence.

Q15. Bertie's workroom is shown from the side below. The door is at the left end. Along the wall stands a bench 4 m long, starting at the door. The vice sits 1 m from the door, and the toolbox sits 2 m further along the bench. A shelf is fixed on the wall directly above the vice. The stool stands 50 cm from the far end of the bench.

Bertie's workroom, drawn from the side



Made-up data: the workroom and every measurement in it are made up for this section.

- How far is it from the door to the toolbox?
- Describe the position of the shelf.
- How far is it from the door to the stool? Give your answer in metres and centimetres.

Q16. Cleo runs a sausage-sizzle bench at the Cobble Creek Market. She stands behind the bench, facing her customers. The esky sits on the ground behind her, and the sauce bottles stand on the bench in front of her. (a) Cleo raises her right hand to point at the menu. Is that hand on the customer's left or the customer's right? (b) Where is the esky, relative to the bench? (c) Where are the sauce bottles, relative to Cleo?

Q17. In a classroom, desks stand in columns A, B, C and D from the left, and rows 1 to 5 from the front. The blackboard is in front of row 1, and the window runs along the column-D side. Tess's desk is D1. (a) The teacher moves Tess two rows back and one column to the left. What is her new desk code? (b) Which desk is directly behind Tess's new desk? (c) Which desk column is nearest the window?

Q18. Hattie and Bertie are camping at the Cobble Creek campground. Their tent and their campfire are 5 m apart, along a straight cleared strip. The picnic table stands on the same straight line, 2 m from the fire on the tent side. The esky stands behind the tent, as seen from the fire. (a) How far is the table from the tent? (b) Bertie walks from the fire to the tent and back to the fire. How far does he walk? (c) Is the esky nearer to the fire or further from the fire than the tent is? Give a one-sentence reason that uses the word "behind".

Answers

Q1. (a) above = higher than something; between = with one thing on each side of it; next to = right beside something; opposite = directly across from something; behind = at the back of something; in front of = on the front side of something, facing it. (b) above. (c) between. **Q2.** (a) locker 3. (b) 4th from the right. (c) locker 6. **Q3.** (a) C2. (b) A3. (c) column 5 (E), row 1 — the front-row seat at the right-hand end. **Q4.** (a) crackers. (b) column 1, level 2. (c) 11 items. **Q5.** (a) bananas. (b) oranges. (c) 3rd from the right. **Q6.** (a) 25 cm. (b) the 60 cm mark. (c) 45 cm. **Q7.** (a) the post office. (b) the post office and the library. (c) next to the pharmacy and opposite the library. **Q8.** (a) 4th from the right. (b) 11 seats. (c) seat 11. **Q9.** (a) rope. (b) column 2, level 3 (the top level). (c) 7 empty spaces. **Q10.** (a) column B (2nd from the left), row 4 from the front — 2nd from the back. (b) B3. (c) 20 desks. **Q11.** (a) the middle shelf. (b) the watering can. (c) on the bottom shelf, next to the gloves. **Q12.** (a) 50 cm. (b) 0.5 m. (c) the 40 cm mark. **Q13.** (a) 18 plots. (b) row 2 column 4 and row 2 column 6. (c) 2 plots. **Q14.** (a) 19 crates. (b) 6 more. (c) it is on top of the stack, with no crates above it. **Q15.** (a) 3 m. (b) on the wall directly above the vice, 1 m from the door. (c) 3 m 50 cm (350 cm). **Q16.** (a) the customer's left. (b) behind the bench. (c) in front of Cleo, on the bench. **Q17.** (a) C3. (b) C4. (c) column D. **Q18.** (a) 3 m. (b) 10 m. (c) further — behind the tent means on the far side of the tent from the fire.

Fully-worked solutions

Q1. (a) above = higher than something; between = with one thing on each side of it; next to = right beside something; opposite = directly across from something; behind = at the back of something; in front of = on the front side of something, facing it. (b) The hat is higher than your head, so it is **above** your head. (c) The table is on one side and the chair on the other, so the dog is **between** them.

Q2. (a) Counting from the left end, lockers 1, 2, 3 — the 3rd locker is **locker 3**. (b) From the right end: $12 - 9 + 1 = 4$, so locker 9 is **4th from the right**. (c) The only locker strictly between 5 and 7 is **locker 6** ($5 < 6 < 7$).

Q3. (a) The letter gives the column and the number gives the row, so column C, row 2 is **C2**. (b) In front of A4 is the same column, one row forward: $4 - 1 = 3$, so the seat is **A3**. (c) E1 is **column 5 (E), row 1** — the front-row seat at the right-hand end, nearest the stage.

Q4. (a) Reading the shelf: column 2, level 3 holds the **crackers**. (b) The tomatoes are in **column 1, level 2** — the left-hand column, middle level. (c) The shelf has $4 \times 3 = 12$ spaces and one space is empty, so there are $12 - 1 = 11$ items (or count them one by one: 4 on level 1, 4 on level 2, 3 on level 3).

Q5. (a) Counting crates from the left: 1 apples, 2 oranges, 3 bananas — the 3rd crate holds **bananas**. (b) The apples are in crate 1 and the bananas in crate 3, so the crate between them is crate 2: **oranges**. (c) The grapes are in crate 4 from the left, so from the right: $6 - 4 + 1 = 3$ — the grapes are **3rd from the right**.

Q6. (a) From the 15 cm mark to the 40 cm mark: $40 - 15 = 25$ cm. (b) $40 + 20 = 60$: the bowl sits at the **60 cm mark**, the very end of the tape. (c) From the 15 cm mark to the 60 cm mark: $60 - 15 = 45$ cm.

Q7. (a) Directly across the street from the bakery stands the **post office**. (b) The clock tower has the **post office** on one side and the **library** on the other, so it is between those two. (c) The supermarket is **next to** the pharmacy, at the right-hand end of the top side, and **opposite** the library.

Q8. (a) From the right end: $20 - 17 + 1 = 4$, so Silas is **4th from the right**. (b) Between seats 5 and 17: $17 - 5 - 1 = 11$ seats (seats 6 to 16). (c) Halfway between 5 and 17: $(5 + 17) \div 2 = 22 \div 2 = 11$, so Mabel should take **seat 11** — it has 6 seats on each side ($11 - 5 = 6$ and $17 - 11 = 6$).

Q9. (a) Reading the rack: column 3, level 2 holds the **rope**. (b) The paint crates are in **column 2, level 3** — the top level, second space from the left. (c) The rack has $5 \times 3 = 15$ spaces in total and 8 crates, so $15 - 8 = 7$: there are **7 empty spaces**.

Q10. (a) B4 is in **column B (2nd from the left), row 4 from the front**. Counting from the back: $5 - 4 + 1 = 2$, so it is **2nd from the back**. (b) Directly in front of B4 is the same column, one row forward: **B3**. (c) Desks = $4 \times 5 = 20$: there are **20 desks**.

Q11. (a) The watering can is on the **middle shelf**. (b) The gloves sit directly underneath the watering can, so directly above the gloves is **the watering can**. (c) The trowel sits **on the bottom shelf, next to the gloves**.

Q12. (a) From the 5 cm mark to the 55 cm mark: $55 - 5 = 50$ cm. (b) $50 \div 100 = 0.5$ m (half a metre). (c) Start at 10 cm and add the length: $10 + 30 = 40$, so the plank finishes at the **40 cm mark**.

Q13. (a) There are 3 rows of 6 plots: $3 \times 6 = 18$, so the garden has **18 plots**. (b) The beans are at row 2, column 5. Plots sharing a side with them are one column each way in the same row: **row 2, column 4** (left) and **row 2, column 6** (right). (c) The corner plot at row 1, column 1 has neighbours on only two sides — row 1, column 2 beside it and row 2, column 1 in front of it — so **2 plots** share a side with it.

Q14. (a) Bottom layer: $4 \times 3 = 12$ crates. Middle layer: $3 \times 2 = 6$ crates. Top: 1 crate. Total: $12 + 6 + 1 = 19$ crates. (b) $12 - 6 = 6$ more crates in the bottom layer. (c) The newest crate is **on top of the stack**, so nothing is above it and nothing has to be moved to reach it.

Q15. (a) The vice is 1 m from the door and the toolbox is 2 m further along: $1 + 2 = 3$ m from the door. (b) The shelf is **on the wall directly above the vice** — that is, above the bench, **1 m from the door**. (c) The bench is 4 m, which is $4 \times 100 = 400$ cm. The stool is 50 cm from the far end: $400 - 50 = 350$ cm from the door, and 350 cm = **3 m 50 cm**.

Q16. (a) Cleo faces the customer, so the two facings are opposite and left and right swap: Cleo's right hand appears on **the customer's left**. (b) The esky is on the ground on Cleo's side of the bench, so it is **behind the bench**. (c) The bottles stand on the bench on the customers' side, so they are **in front of Cleo**.

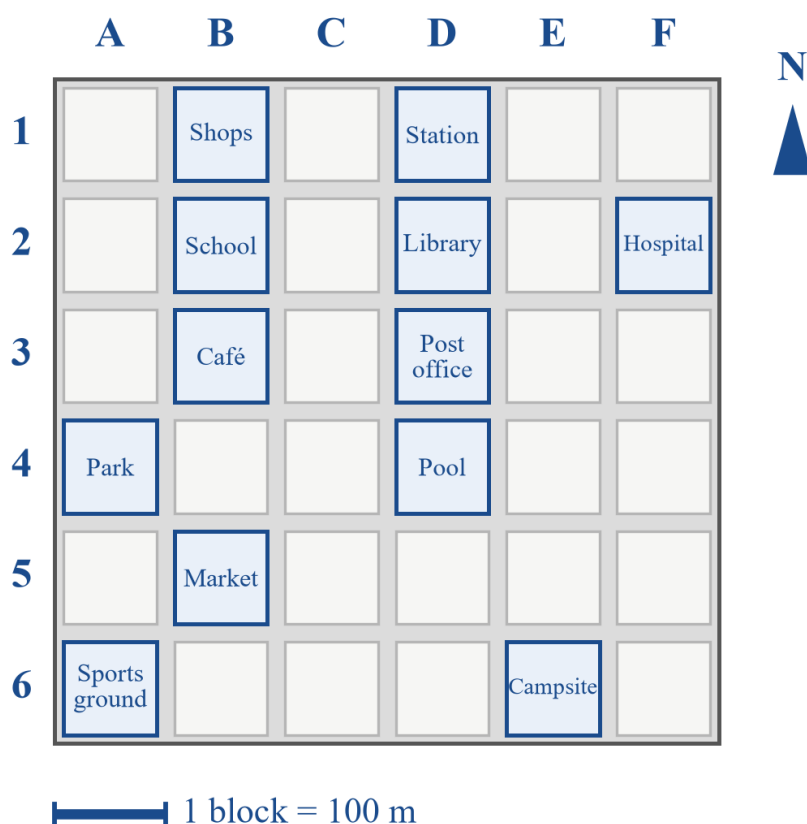
Q17. (a) Two rows back moves the row: $1 + 2 = 3$. One column to the left moves D to C. So Tess's new desk is **C3**. (b) Directly behind C3 is the same column, one row back: $3 + 1 = 4$, so the desk is **C4**. (c) The window runs along the right-hand side of the room, and column D is the right-hand column, so **column D** is nearest the window.

Q18. (a) The fire, the table and the tent sit on one straight line, with the table between: $5 - 2 = 3$ m from the table to the tent. (b) There and back along the same 5 m: $5 + 5 = 10$ m. (c) **Further**. "Behind the tent, as seen from the fire" means on the far side of the tent from the fire, so the esky stands more than 5 m from the fire — further than the tent itself.

Theory

What is a map? A **map** is a drawing of a place as if you were looking straight down on it from high above, made smaller so it fits on a page or a phone screen. Maps let you find places, say where one place is compared with another, and work out how long a walk or a drive will be. In this section you will read a simple map of a made-up town, find places on it, describe places with compass directions, use a map's scale to turn centimetres into metres and kilometres, and see how phone maps and GPS do the same jobs for you. Section 2A covers the everyday position words — *above*, *next to*, *between* — that maps build on.

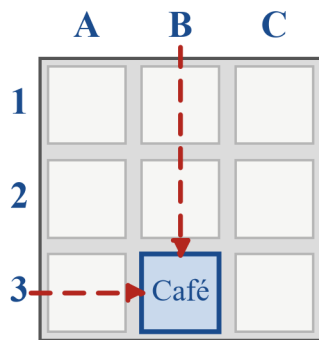
What a map shows. The map below is Emu Crossing, a small made-up town. Each blue block is a **landmark** — a place people know and use, such as the school or the pool. The grey between the blocks is the streets. Three things make the map readable. A **north arrow** shows which way is north; on this map, as on most maps, north is at the top. A **scale** shows how a length on the map matches a length in real life (more on that below). And a **key** — the list that explains what the marks on a map mean — is built in here: every landmark has its name written inside its block.



Made-up data: Emu Crossing is a pretend town; the places and distances are made up for this section.

Blocks. The town is laid out in **blocks**: the rectangles between the streets, sitting under a letter across the top and beside a number down the side. On this map, one block along a street — from one street corner to the next — is 100 m of real walking. So a walk of 3 blocks along streets is $3 \times 100 = 300$ m, no matter which way the walk turns.

Grid references. The letters and numbers around the edge give every square of the map a name, called a **grid reference**. The letter comes first, then the number. The picture below shows how to read one.

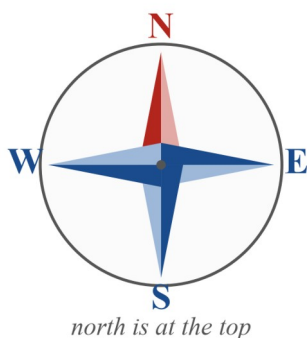


- 1 Find the letter across the top: B
- 2 Find the number down the side: 3
- 3 Letter first, then number:

Grid reference: B3

On the Emu Crossing map the café sits in column B and row 3, so its grid reference is **B3**, said as “B three”. Grid references let you tell somebody exactly which square to look in — over the phone, for example, with no pointing needed.

Compass directions. A **compass direction** names which way one place is from another. The four main points are **north (N)**, **south (S)**, **east (E)** and **west (W)**. On a map with north at the top: north is up, south is down, east is right, west is left. Always check the north arrow first, because a few maps are drawn turned.

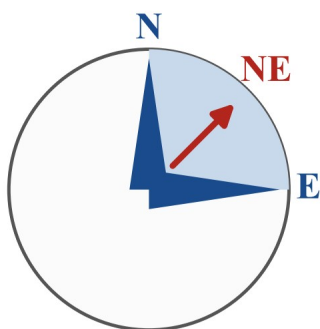


Four quick reads from the Emu Crossing map — stand at the first place in your mind and look toward the second:

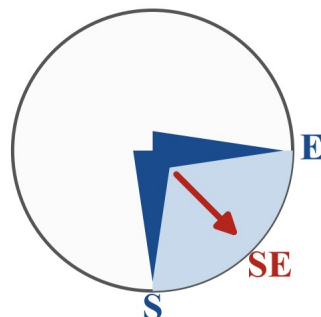
- the hospital is **east** of the school — same row, hospital to the right; that is 4 blocks east, so 400 m of walking
- the market is **south** of the café — same column, market below
- the station is **north** of the library — same column, station above
- the café is **west** of the post office — same row, café to the left

Between the main points. Halfway between two main points sit four more points; this book uses two of them. **Northeast (NE)** is halfway between north and east. **Southeast (SE)** is halfway between south and east.

NE is between N and E



SE is between S and E



Read from the map: the station is **northeast** of the café — from the café, go 2 blocks east and 2 blocks north and you are at the station. Equal parts east and north are what make it northeast, not east or north on its own.

In this book you will only ever need the six points N, S, E, W, NE and SE. A direction that is not one of those six — halfway between west and north, say — is never asked for here.

Units 3 & 4 preview. In Units 3 and 4, maps use finer compass points (such as SSW) and numbered directions (such as N15°W) — that level is beyond this book and is not assessed in this book’s tests.

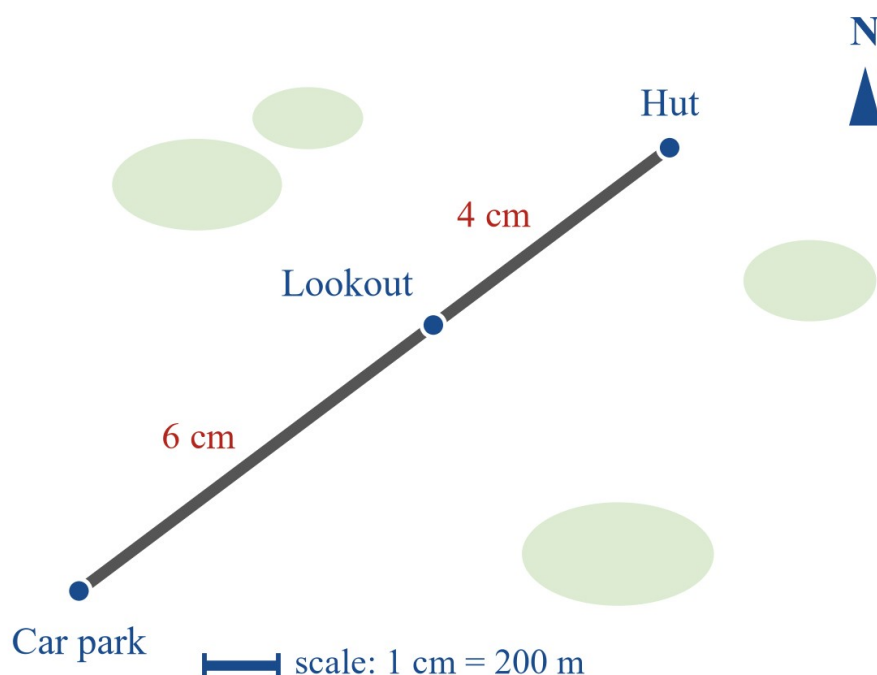
Map scale. A map is smaller than the place it shows, so every length on the map stands for a bigger length in real life. The **scale** says how much bigger. On the walking-track map below the scale is 1 cm = 200 m: each centimetre you measure on the map is 200 m of real track. Measure with a ruler, then multiply by the scale — the car park to the lookout measures 6 cm, so that part of the track is $6 \times 200 = 1\,200$ m of real walking.

Worked model: blocks to metres to kilometres. A walk of 5 blocks on the town map is $5 \times 100 = 500$ m. In kilometres that is $500 \div 1\,000 = 0.5$ km.

Quick trick for multiplying by 200. Double the number, then add two zeros: $9 \times 2 = 18$, so $9 \times 200 = 1\,800$.

Refresher: metric lengths. 100 cm = 1 m, and 1 000 m = 1 km. Metres to kilometres: divide by 1 000. Kilometres to metres: multiply by 1 000.

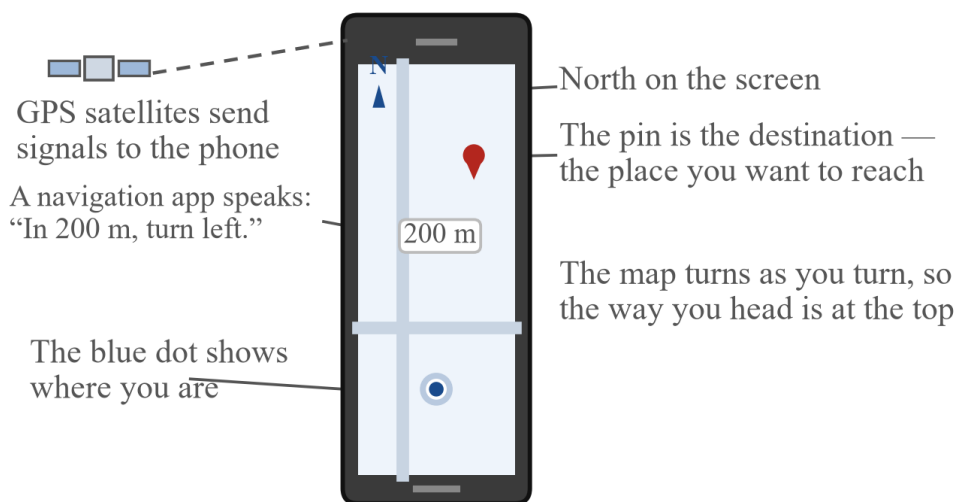
Change	Working	Result
1 500 m to km	$1\,500 \div 1\,000$	1.5 km
700 m to km	$700 \div 1\,000$	0.7 km
3 km to m	$3 \times 1\,000$	3 000 m
250 m to km	$250 \div 1\,000$	0.25 km



Made-up data: the track and its lengths are made up for this section.

Finding and describing places. To describe where one place is, give a direction from a landmark everybody can see, and a distance as well if you can. Here is a model description: “Meet me at the station. From the café, the station is northeast — walk 2 blocks east and 2 blocks north, 4 blocks in all, about 400 m.” Direction first, then the walk: that is a description somebody else can follow without seeing the map.

Maps on phones and GPS. A phone map does everything the paper map above does, and adds two helpers. The **blue dot** is you: the phone works out where you are from signals sent by **GPS satellites** — **GPS** is the worldwide satellite system that fixes your position on Earth, and a **satellite** is a machine in space that sends and receives those signals. The red **pin** is your **destination** — the place you want to reach. A **navigation** app (an app that guides you while you move) then speaks directions out loud, like “In 200 m, turn left.”



Made-up data: the phone screen, the place and the distances on it are made up.

Two habits keep technology a helper and never a trap. Carry a paper map or tell someone your route, because batteries run flat and signals drop out. And if you ever feel lost, stop first: stand still, look at the map, and work out where you are before you walk anywhere. Everything in this section can be done with pencil, paper and a ruler — no question in this book needs a phone to answer it. Section 1F covers phones and digital tools more generally.

Where this book goes next. Section 2C practises giving and following directions in words. Section 2D covers angles — the turns and corners that sit behind the compass points.

About the data in this section. The town, the tracks, the phone screens and all the distances here are **made up** (not real): pretend places and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

Worked examples

Examples 1 and 2 are **scaffolded** — the working is laid out for you, with teaching comments beside it. Examples 3 and 4 are **unscaffolded** — clean solutions, in the style your own working should aim for.

Example 1 — scaffolded

Matt delivers flyers on foot in Emu Crossing. He starts at the school, and his first drop is the library. (a) Give the grid reference of the library. (b) Which compass direction is the library from the school? (c) How far does Matt walk, in metres?

Working	Comment
(a) The library sits in column D, row 2, so its grid reference is D2.	Letter first, then number.
(b) School and library are in the same row, and the library is to the right, so the library is east of the school.	With north at the top, right is east.
(c) School to library is 2 blocks along the street. $2 \times 100 = 200$ m.	Count blocks along the streets, never across them. On this map, one block = 100 m.
Matt walks 200 m east from the school to the library, at D2.	Report every part the question asked for.

Example 2 — scaffolded

Aaron walks the bush track shown in the track map in the theory (scale 1 cm = 200 m). (a) The car park to the lookout measures 6 cm on the map. How many metres of track is that? (b) Write your answer to part (a) in kilometres. (c) Aaron walks on from the lookout to the hut, 4 cm further on the map. How far did Aaron walk in all, in kilometres?

(a) The scale is $1\text{ cm} = 200\text{ m}$, so $6 \times 200 = 1\,200\text{ m}$.

Multiply the measured centimetres by the scale.

(b) $1\,200 \div 1\,000 = 1.2\text{ km}$.

Metres to kilometres: divide by 1 000.

(c) Second leg: $4 \times 200 = 800\text{ m}$.

The same scale works for every leg of the track.

Total: $1\,200 + 800 = 2\,000\text{ m}$.

Add the legs in metres first.

$2\,000 \div 1\,000 = 2\text{ km}$.

Then change to kilometres once, at the end.

Aaron walks 2 km in all.

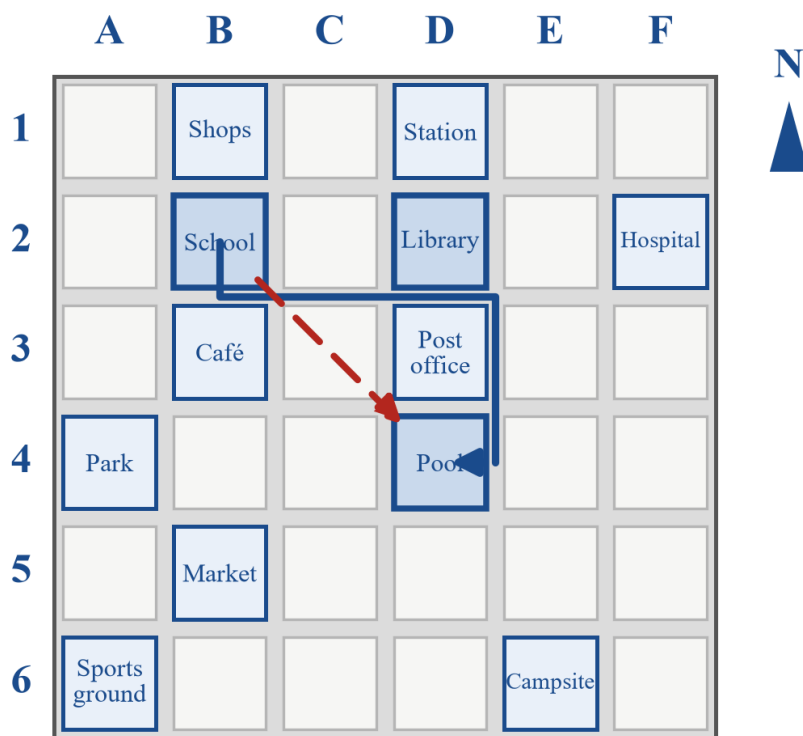
Report in the unit the question asked for.

Example 3 — unscaffolded

Lola is meeting a friend at the pool in Emu Crossing. Starting from the school, describe the pool: give the compass direction from the school, the pool's grid reference, and the walking distance along streets in metres.

Solution

Direction: from the school, the pool is 2 blocks east and 2 blocks south — equal parts east and south — so the pool is **southeast (SE)** of the school. Grid reference: the pool sits in column D, row 4, so its reference is D4. Walk: 2 blocks east then 2 blocks south is $2 + 2 = 4$ blocks, and $4 \times 100 = 400\text{ m}$.



1 block = 100 m red arrow: the direction (southeast)
blue line: the walk (2 blocks east, then 2 blocks south)

$\therefore$ the pool is southeast of the school, at grid reference D4, a 400 m walk along streets.

Example 4 — unscaffolded

Paul checks three places in Emu Crossing in one trip on foot: he walks from the station to the pool, then from the pool to the park. (a) How far does Paul walk in all, in metres? (b) Paul then walks from the park to the sports ground. Give the compass direction and the distance of that leg. (c) What is the walking distance of the whole trip?

Solution

Leg 1: the pool is 3 blocks south of the station, so $3 \times 100 = 300\text{ m}$. Leg 2: the park is 3 blocks west of the pool, so $3 \times 100 = 300\text{ m}$. (a) Total so far: $300 + 300 = 600\text{ m}$. (b) The sports ground is 2 blocks south of the park, so $2 \times 100 = 200\text{ m}$ south. (c) Whole trip: $600 + 200 = 800\text{ m}$.

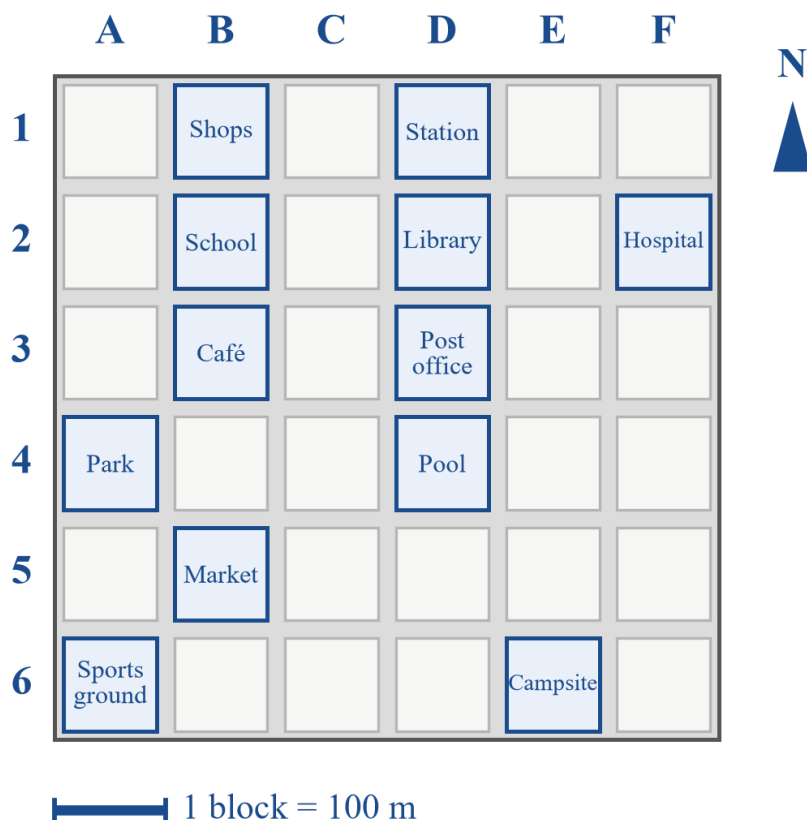
∴ Paul walks 600 m to reach the park, then 200 m south to the sports ground — 800 m in all.

Practice questions

Do every question with the map or picture in front of you, and the north arrow checked first. In the scaffolded block the parts lead you through the steps. In the unscaffolded block, plan the steps yourself and show your working — your teacher may prompt you at any stage, and that is part of how this unit works.

Scaffolded

Use the Emu Crossing map below for Q2 to Q4, where one block along a street is 100 m.



Made-up data: Emu Crossing is a pretend town.

Q1. Look at the compass rose picture in the theory.

- (a) On a map whose north arrow points up, which main compass point is at the top?
- (b) Which main compass point is on the left?
- (c) NE sits halfway between which two main compass points?

Q2. Give the grid reference of:

- (a) the school
- (b) the hospital
- (c) the campsite

Q3. Give the compass direction from the first place to the second:

- (a) library to hospital
- (b) school to café
- (c) pool to post office

Q4. Diagonal directions.

- (a) Name the landmark that is southeast of the shops.
- (b) Which compass direction is the café from the park?
- (c) Which compass direction is the market from the park?

Q5. The walking-track map in the theory has scale 1 cm = 200 m.

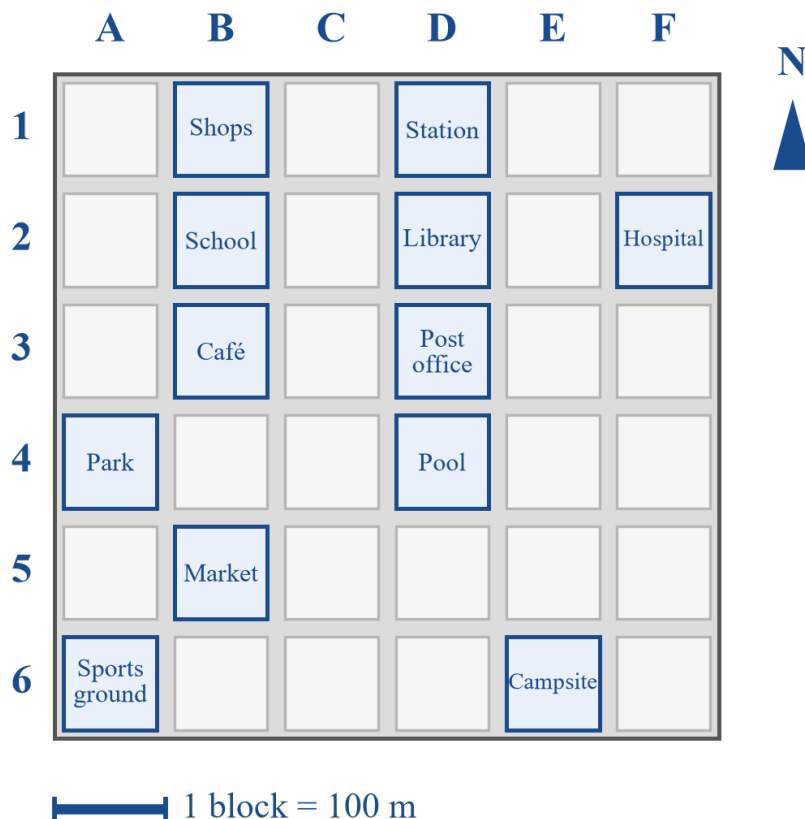
- (a) How many metres of track does 3 cm on the map stand for?
- (b) How many metres of track does 7 cm on the map stand for?
- (c) One stretch of that track is 900 m in real life. Write 900 m in kilometres.

Q6. Look at the phone-map picture in the theory.

- (a) In words, what do GPS satellites do for the phone?
- (b) What does the blue dot on the screen show?
- (c) Give one reason to carry a paper map, or tell someone your route, even when you have a phone map.

Unscaffolded

Use the Emu Crossing map below for Q7, Q8, Q10, Q11, Q16, Q17 and Q18, where one block along a street is 100 m.



Made-up data: Emu Crossing is a pretend town.

Q7. Reading the grid.

- (a) What landmark is at B5?
- (b) What landmark is at A4?
- (c) Give the grid reference of the post office.

Q8. Describe the second place from the first, giving the compass direction and the walking distance in metres:

- (a) the post office from the library
- (b) the market from the school

Q9. The walking-track map in the theory has scale 1 cm = 200 m.

- (a) How many centimetres on the map stand for 1 km of track?
- (b) A section of the track measures 8 cm on the map. How many metres of track is that?
- (c) Write your answer to part (b) in kilometres.

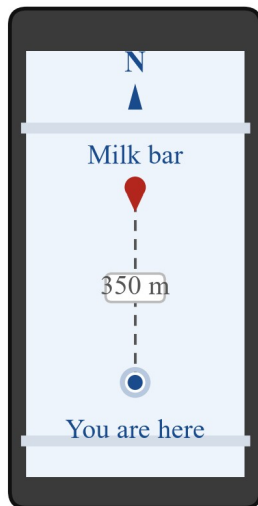
Q10. Two friends walk to the market along streets. Billy walks from the school to the café, then from the café to the market. Brooke walks from the library to the pool, then from the pool to the market.

- (a) How far does Billy walk, in metres?
- (b) How far does Brooke walk, in metres?
- (c) Who walks less, and by how many metres?

Q11. Mixed directions.

- (a) Give the compass direction and the walking distance in metres from the sports ground to the campsite.
- (b) Which compass direction is the café from the shops?
- (c) Name the only landmark directly north of the school.

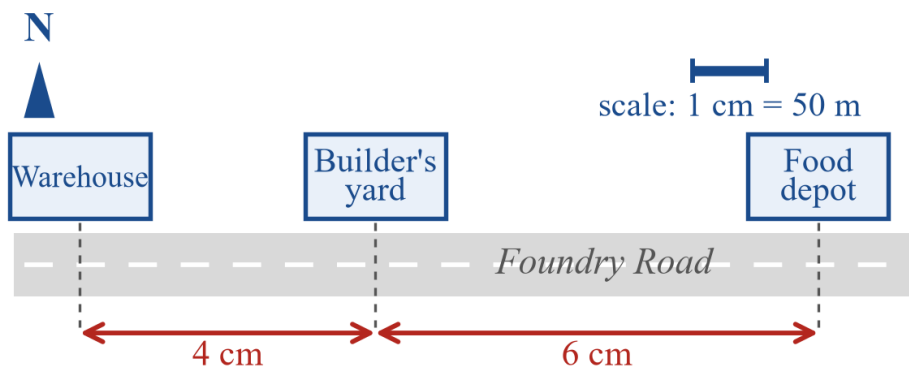
Q12. Nessa's phone map looks like the picture below. North is at the top of the screen, and the pin is the milk bar (a small takeaway food shop).



Made-up data: the phone screen, the milk bar and the distance are made up.

- Which compass direction must Nessa walk to reach the milk bar?
- The screen says 350 m to the pin. After Nessa walks 150 m, how many metres are left to walk?
- Nessa's battery is nearly flat before she leaves home. Give one sensible thing to do before she relies on the phone map.

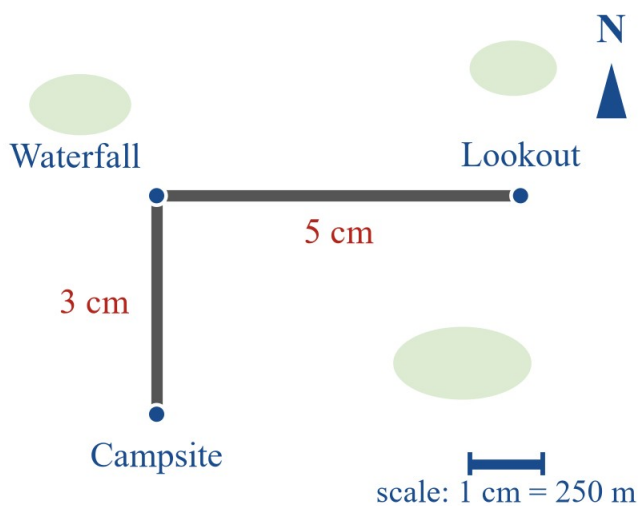
Q13. Gina drives along Foundry Road on the industrial-estate map below (an industrial estate is an area of warehouses and work yards). The scale is 1 cm = 50 m.



Made-up data: Foundry Road, the businesses and the distances are made up.

- The warehouse to the builder's yard measures 4 cm on the map. How many metres is that?
- How far is it from the warehouse to the food depot, in metres?
- Give the compass direction Gina drives from the warehouse to the food depot.

Q14. Evan walks the track on the map below (scale 1 cm = 250 m): from the campsite to the waterfall, then from the waterfall to the lookout.



Made-up data: the track and its lengths are made up for this section.

- The first leg measures 3 cm on the map. How many metres is it?
- The second leg measures 5 cm on the map. How many metres is it?
- Give the two compass directions Evan walks, in order.

Q15. Hannah sets up camp on flat ground. The tent is 30 m north of the camp fire, and the shower block is 40 m east of the camp fire. Every walk in this question follows the camp's straight gravel paths, which run only north–south or east–west.

- Describe the tent's position from the camp fire.
- Hannah walks from the fire to the shower block, then from the shower block to the tent. How far does she walk in all?
- Hannah then walks from the tent back to the fire. What is the total distance she walks for the whole loop?

Q16. Use the Emu Crossing map. Show that the walk from the shops to the market along streets is 400 m, and name the compass direction of that walk.

Q17. Harry writes in his notes: "The hospital is west of the pool." Explain why this is wrong, using the map's letters and numbers, and give the correct compass direction from the pool to the hospital.

Q18. Kendra's delivery run in Emu Crossing is: the library, then the station, then the shops, then the school, walking along streets.

- Find the total walking distance of the run, in metres.
- Give the compass direction of the leg from the station to the shops.
- Kendra's last stop is near the sports ground. Give the sports ground's grid reference.

Answers

Q1. (a) North. (b) West. (c) North and east.

Q2. (a) B2. (b) F2. (c) E6.

Q3. (a) East. (b) South. (c) North.

Q4. (a) The post office. (b) Northeast. (c) Southeast.

Q5. (a) 600 m. (b) 1 400 m. (c) 0.9 km.

Q6. (a) They send signals to the phone, so it can work out where you are. (b) Where you are. (c) Example: a battery runs flat or a signal drops out, and a paper map still works.

Q7. (a) The market. (b) The park. (c) D3.

Q8. (a) South, 100 m. (b) South, 300 m.

Q9. (a) 5 cm. (b) 1 600 m. (c) 1.6 km.

Q10. (a) 300 m. (b) 500 m. (c) Billy, by 200 m.

Q11. (a) East, 400 m. (b) South. (c) The shops.

Q12. (a) North. (b) 200 m. (c) Example: charge the phone first, or take a paper map as well.

Q13. (a) 200 m. (b) 500 m. (c) East.

Q14. (a) 750 m. (b) 1 250 m. (c) North, then east.

Q15. (a) 30 m north. (b) 110 m. (c) 140 m.

Q16. 4 blocks south, and $4 \times 100 = 400$ m.

Q17. The hospital is in column F and row 2; the pool is in column D and row 4. F is east of D, and row 2 is north of row 4, so the hospital is northeast of the pool — not west.

Q18. (a) 400 m. (b) West. (c) A6.

Fully-worked solutions

Q1. (a) The north arrow points up, so north is at the top. (b) With north at the top, west is on the left. (c) NE is the point halfway between north and east.

$\therefore$ (a) north (b) west (c) north and east.

Q2. Read the letter across the top and the number down the side for each block, letter first.

$\therefore$ (a) the school is at B2 (b) the hospital is at F2 (c) the campsite is at E6.

Q3. (a) Library and hospital share row 2, and the hospital is to the right: east. (b) School and café share column B, and the café is below: south. (c) Pool and post office share column D, and the post office is above: north.

$\therefore$ (a) east (b) south (c) north.

Q4. (a) From the shops at B1, one landmark sits equal parts east and south: the post office at D3. (b) From the park at A4, the café at B3 is 1 block east and 1 block north: northeast. (c) From the park at A4, the market at B5 is 1 block east and 1 block south: southeast.

$\therefore$ (a) the post office (b) northeast (c) southeast.

Q5. (a) $3 \times 200 = 600$ m. (b) $7 \times 200 = 1\,400$ m. (c) $900 \div 1\,000 = 0.9$ km.

$\therefore$ (a) 600 m (b) 1 400 m (c) 0.9 km.

Q6. (a) GPS satellites send signals down to the phone, and the phone uses them to work out where you are. (b) The blue dot shows where you are right now. (c) A phone can let you down — a flat battery, a broken screen, no signal — while a paper map keeps working, so carry one or tell someone your route.

$\therefore$ satellites fix your position, the blue dot is you, and a paper backup is the safe habit.

Q7. (a) B5: column B, row 5 — the market. (b) A4: column A, row 4 — the park. (c) The post office sits in column D, row 3.

$\therefore$ (a) the market (b) the park (c) D3.

Q8. (a) The post office is 1 block below the library, same column: south, and $1 \times 100 = 100$ m. (b) The market is 3 blocks below the school, same column: south, and $3 \times 100 = 300$ m.

$\therefore$ (a) south, 100 m (b) south, 300 m.

Q9. (a) 1 km = 1 000 m, and each cm stands for 200 m, so $1\,000 \div 200 = 5$ cm. Check: $5 \times 200 = 1\,000$ m exactly. (b) $8 \times 200 = 1\,600$ m. (c) $1\,600 \div 1\,000 = 1.6$ km.

$\therefore$ (a) 5 cm (b) 1 600 m (c) 1.6 km.

Q10. (a) Billy: school to café is 1 block, café to market is 2 blocks, so 3 blocks: $3 \times 100 = 300$ m. (b) Brooke: library to pool is 2 blocks, pool to market is 2 blocks west and 1 block south = 3 blocks, so 5 blocks: $5 \times 100 = 500$ m. (c) $300 < 500$, so Billy walks less, by $500 - 300 = 200$ m.

$\therefore$ Billy walks 300 m, Brooke walks 500 m, and Billy walks 200 m less.

Q11. (a) Sports ground and campsite share row 6, and the campsite is 4 blocks to the right: east, $4 \times 100 = 400$ m. (b) Café and shops share column B, and the café is below: south. (c) Straight up column B from the school at B2 sits only the shops at B1.

$\therefore$ (a) east, 400 m (b) south (c) the shops.

Q12. (a) North is at the top of the screen, and the pin sits straight above the blue dot, so Nessa walks north. (b) $350 - 150 = 200$ m left to walk. (c) Example: charge the phone before leaving, or take a paper map as well, so a flat battery cannot leave her with no map at all.

$\therefore$ (a) north (b) 200 m (c) charge the phone or carry a paper map.

Q13. (a) $4 \times 50 = 200$ m. (b) Warehouse to food depot measures $4 + 6 = 10$ cm, so $10 \times 50 = 500$ m (check: $200 + 300 = 500$ m). (c) North is at the top and the food depot is to the right of the warehouse along the road, so Gina drives east.

$\therefore$ (a) 200 m (b) 500 m (c) east.

Q14. (a) $3 \times 250 = 750$ m. (b) $5 \times 250 = 1\,250$ m. (c) The first leg runs straight up the map (north) and the second runs straight to the right (east).

$\therefore$ (a) 750 m (b) 1 250 m (c) north, then east.

Q15. (a) The tent is 30 m north of the fire. (b) Fire to shower block: 40 m east. Shower block to tent: 40 m west back to the fire's column, then 30 m north, so $40 + 30 = 70$ m. Total: $40 + 70 = 110$ m. (c) Add the last leg, tent to fire: 30 m south, so $110 + 30 = 140$ m.

$\therefore$ (a) 30 m north (b) 110 m (c) 140 m.

Q16. Shops and market share column B, and the market is 4 blocks below the shops (rows 1 to 5), so the walk runs south: $4 \times 100 = 400$ m.

$\therefore$ the walk is 4 blocks south, which is 400 m, as required.

Q17. The hospital sits at F2 and the pool at D4. Column F is to the right of column D, so the hospital is east of the pool, not west; and row 2 is above row 4, so the hospital is also north of the pool. Equal parts east (2 blocks) and north (2 blocks) give the diagonal point.

$\therefore$ Harry's note is wrong: the hospital is northeast of the pool.

Q18. (a) Leg 1, library to station: 1 block north = 100 m. Leg 2, station to shops: 2 blocks west = 200 m. Leg 3, shops to school: 1 block south = 100 m. Total: $100 + 200 + 100 = 400$ m. (b) The shops are 2 blocks to the left of the station along row 1: west. (c) The sports ground sits in column A, row 6.

$\therefore$ (a) 400 m (b) west (c) A6.

Chapter 2 Dimension and direction — 2C Giving and following everyday directions

Theory

About the data in this section. Every map, plan, distance, walking time and app screen in this section is made up for this book. They are built to look like the directions you meet in real life — excursions, deliveries, camp maps, phone apps — but no real town, shop, camp or app is shown.

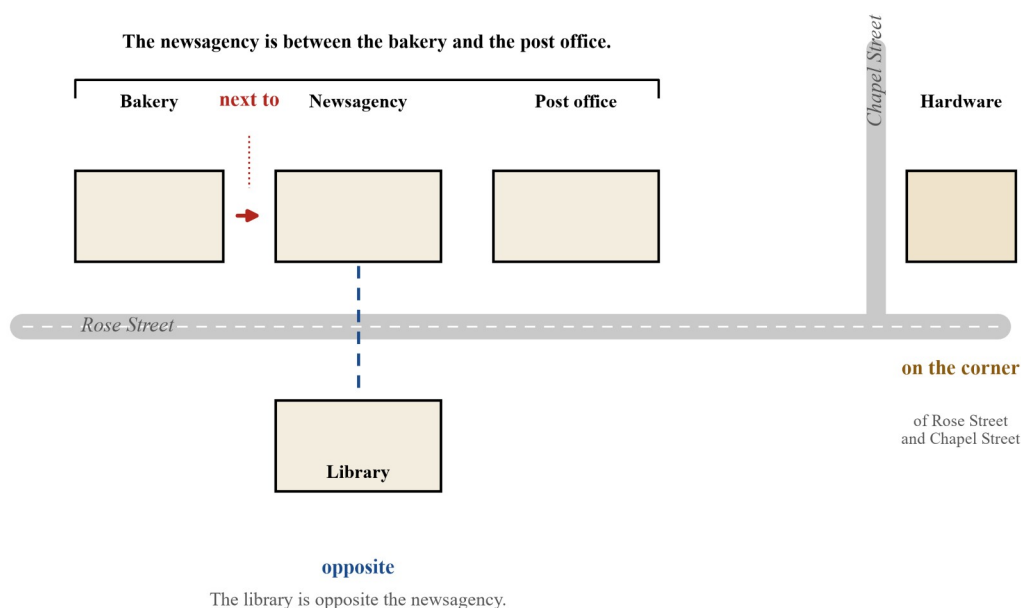
Directions tell a person how to get from one place to another. You meet them every day: a friend saying “turn left at the milk bar”, a printed plan for an excursion, a delivery docket for a new address, a walking app on a phone. In this section you will **follow** directions (read them and work out where they lead) and **give** directions (write them so someone else can follow them).

Four words to know.

- A **route** is the way you go from one place to another.
- The **destination** is the place the route ends.
- A **landmark** is a building or object you can see and use as a marker, such as a milk bar or a gate.
- An **instruction** is one step of the directions, such as “walk 200 m” or “turn left”.

Position words. Directions and maps use short words to say where things sit in relation to each other.

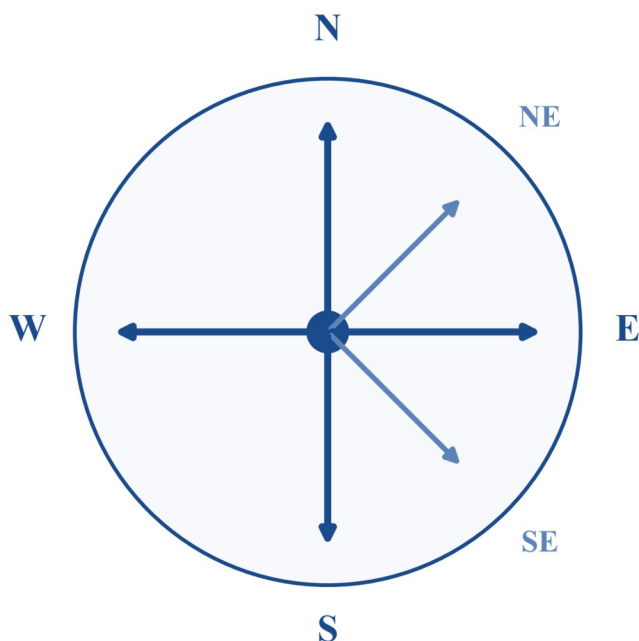
Word	What it means	Example
next to	right beside	The newsagency is next to the bakery.
between	in the middle of two things	The newsagency is between the bakery and the post office.
opposite	on the other side, facing across	The library is opposite the newsagency.
on the corner	where two streets meet	The hardware is on the corner of Rose Street and Chapel Street.



Made-up data: this street sketch is drawn for this book.

Movement words. The verbs in directions are few and fixed: *go* or *walk* (move along), *continue* or *straight ahead* (do not turn), *turn left* / *turn right*, *cross* (go from one side to the other), *follow* (stay along the same street or path).

Refresher — compass points. Maps in this section show a north arrow, drawn as an **N** with an arrowhead. The arrow points to the north of the map. This book uses six compass points: the four cardinal points **north (N)**, **south (S)**, **east (E)** and **west (W)**, plus the two in-between points **north-east (NE)** (halfway between north and east) and **south-east (SE)** (halfway between south and east). Turning from north to NE is a 45° turn.

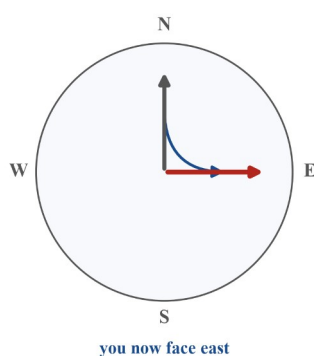


The six compass points used in this book

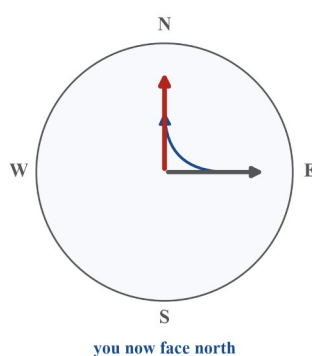
The six compass points used in this book.

Refresher — turns. A **quarter turn** is 90° (a right angle, the turn from facing north to facing east). A **half turn** is 180° (the turn from facing north to facing south). A **full turn** is 360° (back to where you started). When directions say “turn right” or “turn left” they mean a quarter turn unless they say otherwise.

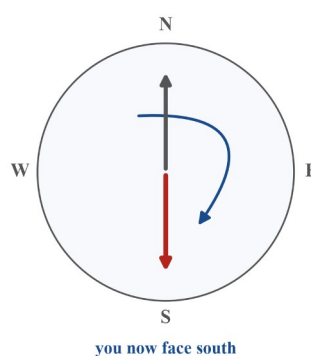
Facing north, turn right



Facing east, turn left



Facing north, half turn



Three quarter- and half-turns, starting from a compass point.

A quick check that always works: face a compass point, make the turn, and read off the new compass point. Facing north, a right turn leaves you facing east. Facing east, a left turn leaves you facing north. Facing north, a half turn leaves you facing south.

Refresher — metric distances. Distances on maps and apps come in metres (m) and kilometres (km). The swap is always the same:

$$1 \text{ km} = 1000 \text{ m}$$

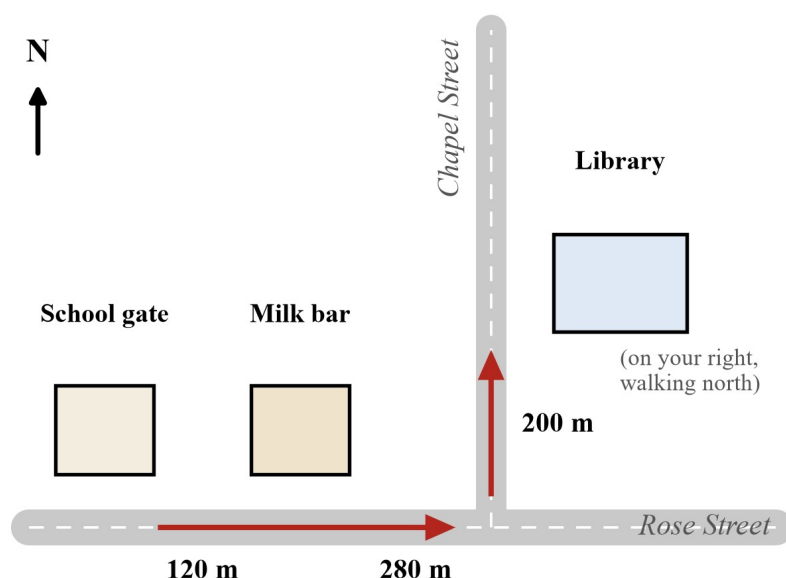
- Metres to kilometres: divide by 1000. Example: $1500 \div 1000 = 1.5$, so 1500 m is 1.5 km.
- Kilometres to metres: multiply by 1000. Example: $0.8 \times 1000 = 800$, so 0.8 km is 800 m.

Refresher — walking time. A person walking at an easy, steady pace covers about **60 m per minute**. That one number lets you turn any walking distance into a walking time:

$$\text{time (minutes)} = \text{distance (m)} \div \text{speed (m per minute)}$$

Example: a 480 m walk at 60 m per minute takes $480 \div 60 = 8$ minutes. If a different speed is given in a question, use that speed instead.

Reading a street map — a worked model. Here is a map of part of Bellhaven, with a route drawn on it in red.



Made-up data: this map is drawn for this book; no real town is shown.

The red route matches these directions:

1. Start at the school gate, facing east along Rose Street.
2. Walk 120 m east to the milk bar.
3. Continue east 280 m to the corner of Chapel Street.
4. Turn left and walk 200 m north.
5. The library is on your right.

Three useful facts fall out of the same map.

- Total distance: $120 + 280 + 200 = 600$ m.
- In kilometres: $600 \div 1000 = 0.6$ km.
- Walking time at 60 m per minute: $600 \div 60 = 10$ minutes.

What makes directions good? Compare these two attempts at sending someone to the library.

Hard to follow

“Head over to the library sometime, it’s not far.”

No starting place, no distance, no landmark, no turn.

Easy to follow

“From the school gate, walk east 120 m along Rose Street to the milk bar.”

Names the start, the way to face, a distance and a

A checklist for giving directions:

- Name the starting place and the way the walker faces.
- Put one instruction in each sentence.
- Give a distance for every step you can.
- Use street names and landmarks.
- Say left or right for every turn.
- Finish with what the walker will see: “The library is on your right.”

Technology. Phone walking apps, GPS units and online trip planners all give directions, distances and walking times — question Q16 shows one. They are worth using to check your own directions and your own arithmetic. Nothing in this section needs a device: every question can be done with pen, paper and a basic calculator.

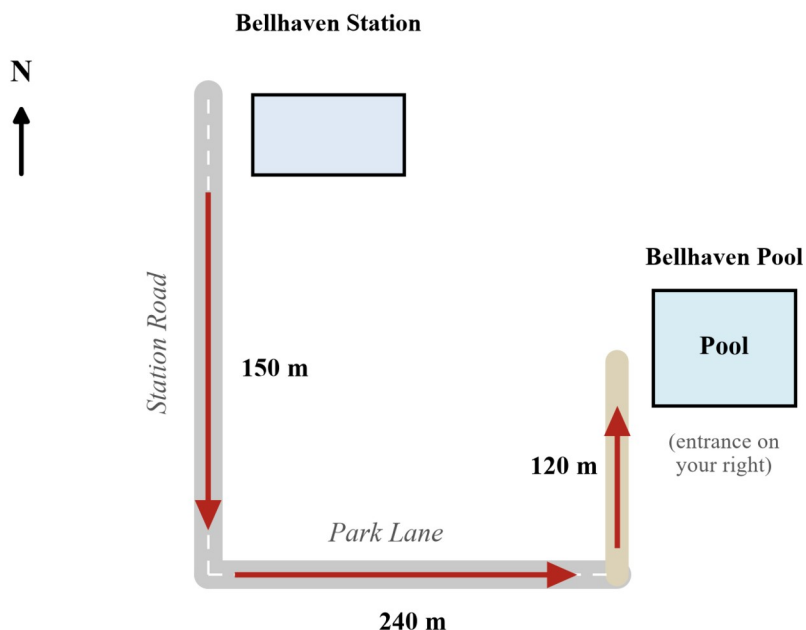
Units 3 and 4 preview: later units extend directions work to longer routes with many destinations and to finer angles. This section stays with one- and two-step directions between familiar places.

Worked examples

Example 1 — scaffolded

Priya is new to Bellhaven. A friend sends her these directions to the pool, with this map.

“Leave Bellhaven Station facing south. Walk 150 m to the corner of Park Lane. Turn left and walk 240 m to the end of the path. Turn left again and walk 120 m. The pool entrance is on your right.”



Made-up data: this map is drawn for this book.

- How far does Priya walk in total?
- At 60 m per minute, how long does the walk take?

(c) Which compass point is Priya facing during the last 120 m?

Working	Comment
$150 + 240 + 120$	The three distances in the directions, in order.
$= 510 \text{ m}$	(a) The total walking distance.
$510 \div 60 = 8.5$	(b) Time = distance $\div$ speed, at 60 m per minute.
8.5 minutes	Exact — no rounding needed.
Facing north	(c) The last turn is left from facing east, and left from east is north. The map agrees: the pool entrance is on her right, the east side.

Example 2 — scaffolded

Use the Rose Street map in the Theory (the school gate, milk bar and library map).

- Write directions from the milk bar to the library.
- How long is that route, in metres and in kilometres?
- How long does it take at 60 m per minute?

Working	Comment
Start at the milk bar, facing east along Rose Street.	Always name the start and the way you face.
Walk 280 m east to the corner of Chapel Street.	The corner is the landmark for the turn.
Turn left and walk 200 m north.	Facing east, a left turn is north.
The library is on your right.	Finish with what the walker sees.
$280 + 200 = 480 \text{ m}$	(b) The two legs added.
$480 \div 1000 = 0.48 \text{ km}$	Metres to kilometres: divide by 1000.
$480 \div 60 = 8$	(c) Time = distance $\div$ speed, at 60 m per minute.
8 minutes	Exact.

So the directions to give are: *“From the milk bar, walk east 280 m along Rose Street to the corner of Chapel Street. Turn left and walk 200 m north. The library is on your right.”*

Example 3 — unscaffolded

Tomas walks from Bellhaven Station to the sports oval. He has two routes.

- Route A follows the streets: 350 m, then 400 m.
 - Route B follows the river path, which winds with the river: 900 m.
- How long is each route?
 - How much shorter is Route A?
 - How long does Route A take at 60 m per minute?

Route A: $350 + 400 = 750 \text{ m}$

Route B: 900 m

Difference: $900 - 750 = 150 \text{ m}$

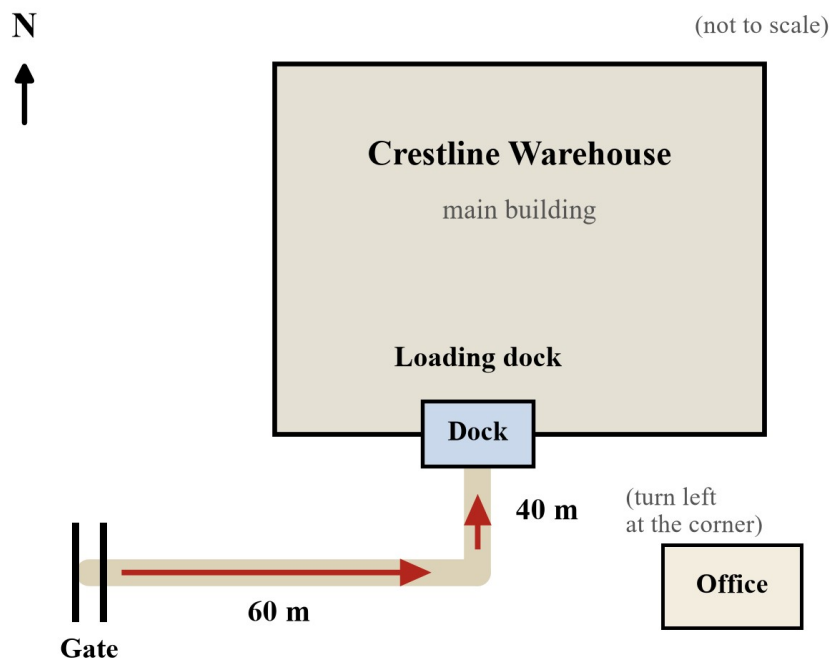
Time on Route A: $750 \div 60 = 12.5 \text{ minutes}$

$\therefore$ Route A is 750 m and Route B is 900 m; Route A is 150 m shorter and takes 12.5 minutes at 60 m per minute.

Example 4 — unscaffolded

Jai works at Crestline Warehouse. The site plan shows the walking route from the gate to the loading dock.

“From the gate, walk east 60 m along the driveway. Turn left and walk 40 m to the loading dock.”



Made-up data: this site plan is drawn for this book (not to scale).

Each morning Jai walks from the gate to the dock and back again, five times.

- (a) How far is one way, from the gate to the dock?
- (b) How far is one return trip (gate to dock to gate)?
- (c) How far does Jai walk in the five return trips, in metres and in kilometres?

One way: $60 + 40 = 100$ m

One return trip: $2 \times 100 = 200$ m

Five return trips: $5 \times 200 = 1000$ m

In kilometres: $1000 \div 1000 = 1$ km

$\therefore$ Jai walks 1000 m, which is 1 km, in the five return trips.

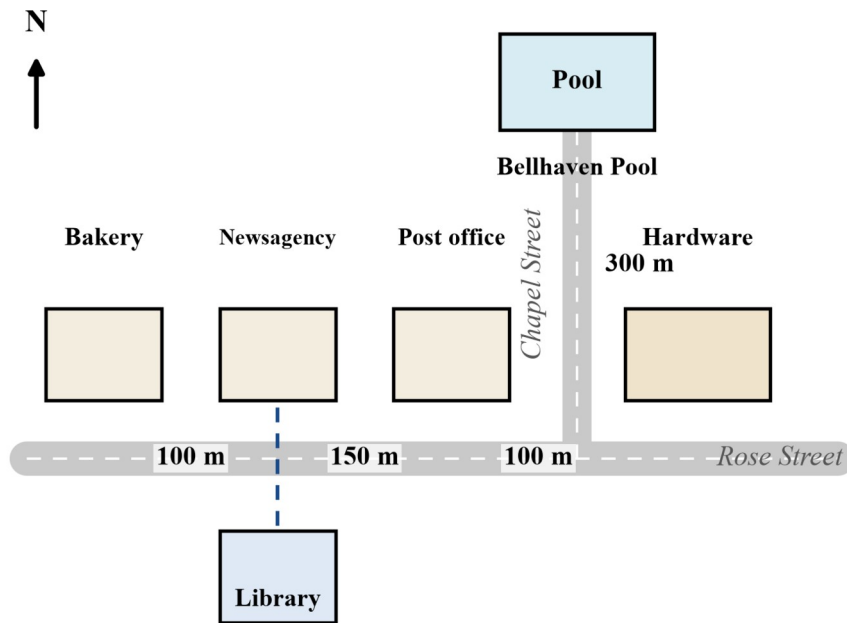
Practice questions

Scaffolded

Q1. Use the compass figure and the turns figure in the Theory.

- (a) Which compass point lies halfway between north and east?
- (b) How many degrees are in a quarter turn?
- (c) You are facing south and you make a half turn. Which compass point do you face now?

Q2. Use this map of Rose Street.



The library is opposite the newsagency.

Made-up data: this map is drawn for this book.

- (a) Which shop is between the bakery and the post office?
- (b) Which building is opposite the newsagency?
- (c) The hardware is on the corner of which two streets?

Q3. Use the same Rose Street map.

- (a) How far is it from the bakery, along Rose Street, to the corner of Chapel Street?
- (b) The pool is 300 m further, north along Chapel Street. How far is the bakery from the pool in total?
- (c) Which compass point are you facing as you walk from the corner to the pool?

Q4. Priya writes down her walking route to the community hall: “Walk 250 m from the house to the gate. Walk 180 m across the oval. Walk 320 m along the track. Walk 150 m to the community hall.”

- (a) How long is the route in metres?
- (b) Write the route length in kilometres.
- (c) How long does the route take at 60 m per minute?

Q5. A quick check on the refreshers.

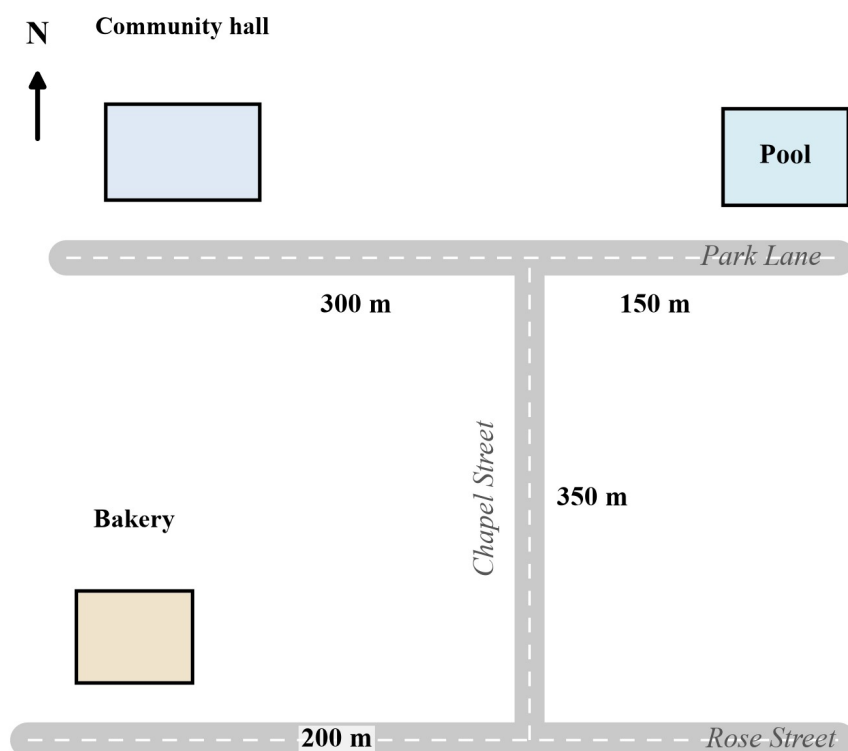
- (a) Write 1500 m in kilometres.
- (b) Write 0.8 km in metres.
- (c) How many minutes does it take to walk 480 m at 60 m per minute?

Q6. Use the walking speed 60 m per minute.

- (a) How long does it take to walk 720 m?
- (b) How long does it take to walk 1.2 km?
- (c) How many metres do you walk in 9 minutes?

Unscaffolded

Q7. Dana walks from the bakery to the pool along the streets shown: 200 m east along Rose Street, 350 m north along Chapel Street, then 150 m east along Park Lane.

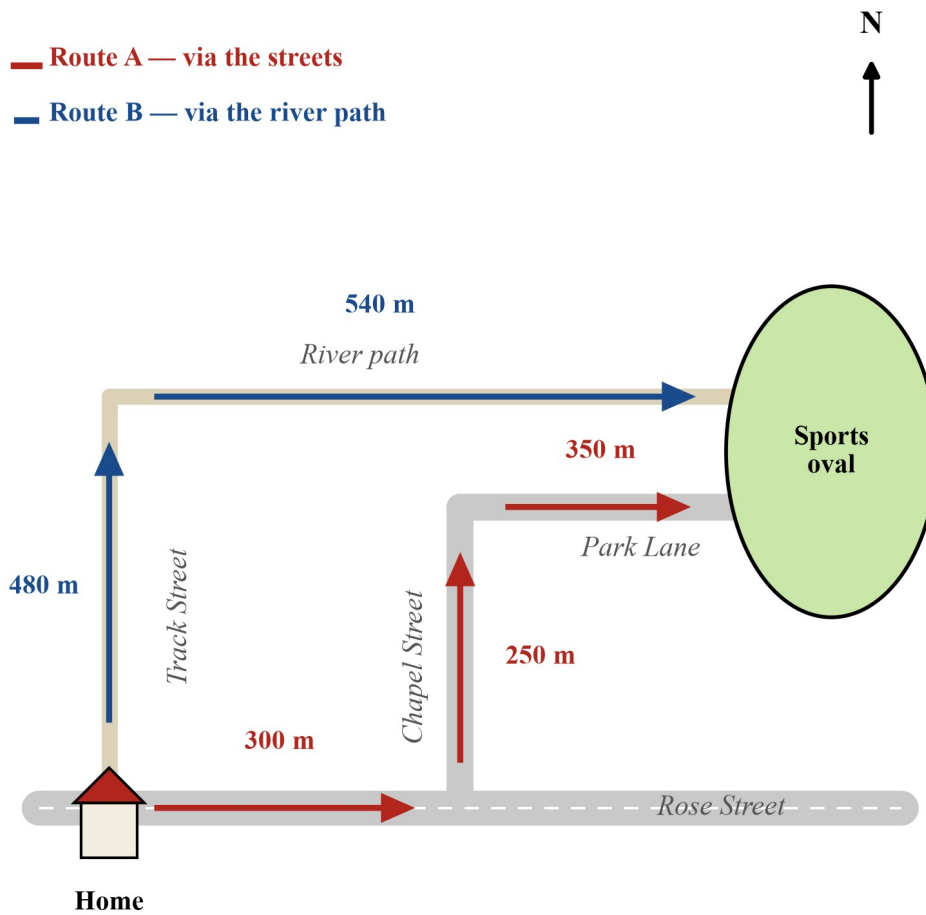


Made-up data: this map is drawn for this book.

- (a) Show that the total walking distance is 700 m.
- (b) At 60 m per minute, how long does the walk take, to the nearest minute?

Q8. Use the map in Q7. Write directions from the community hall to the bakery, and give the total walking distance.

Q9. Ellie walks from home to the sports oval. Route A follows the streets; Route B follows the river path.



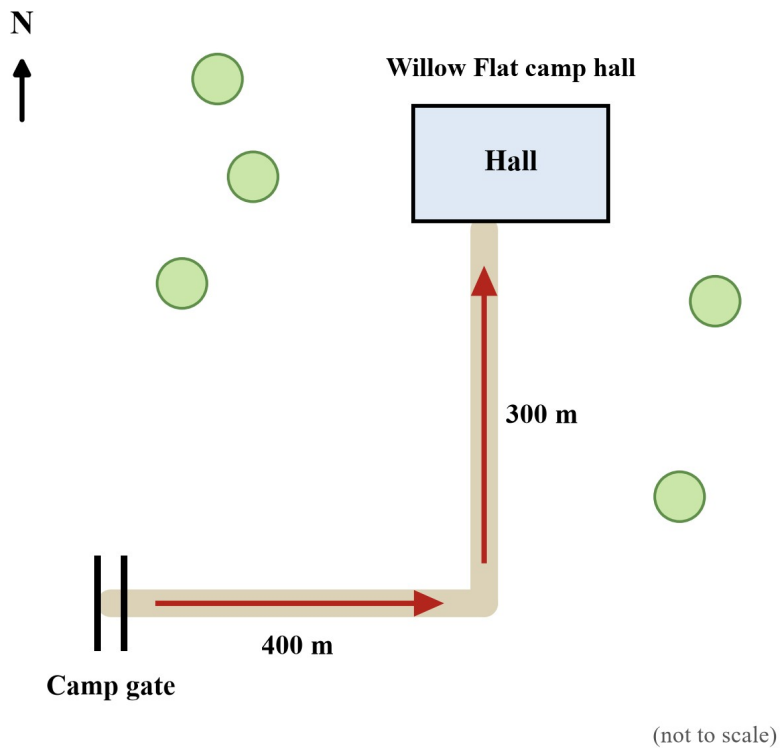
Made-up data: this map is drawn for this book.

- (a) How long is each route?
- (b) How much shorter is Route A than Route B?
- (c) How long does Route A take at 60 m per minute?

Q10. Distances and walking times.

- (a) Write 2.5 km in metres, and 400 m in kilometres.
- (b) A route runs 450 m and then 550 m. How long is it in metres, and in kilometres?
- (c) How long does a 900 m walk take at 60 m per minute?

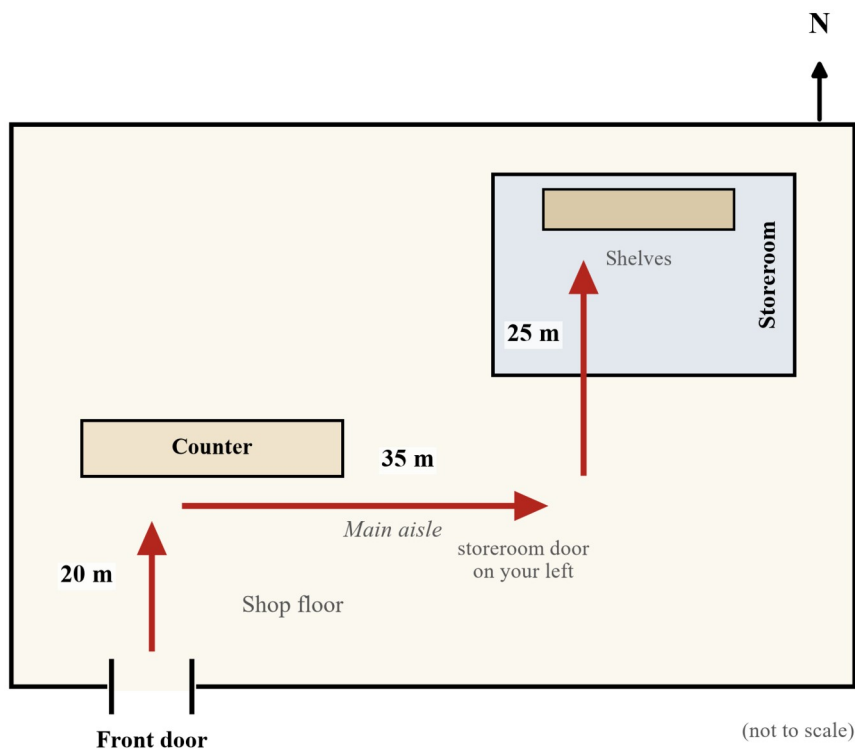
Q11. The plan below shows the walking route from the camp gate to the hall at Willow Flat camp.



Made-up data: this camp plan is drawn for this book (not to scale).

- How far is it from the camp gate to the hall?
- Write directions from the camp gate to the hall, using compass points and one turn.
- Which compass point are you facing when you reach the hall?

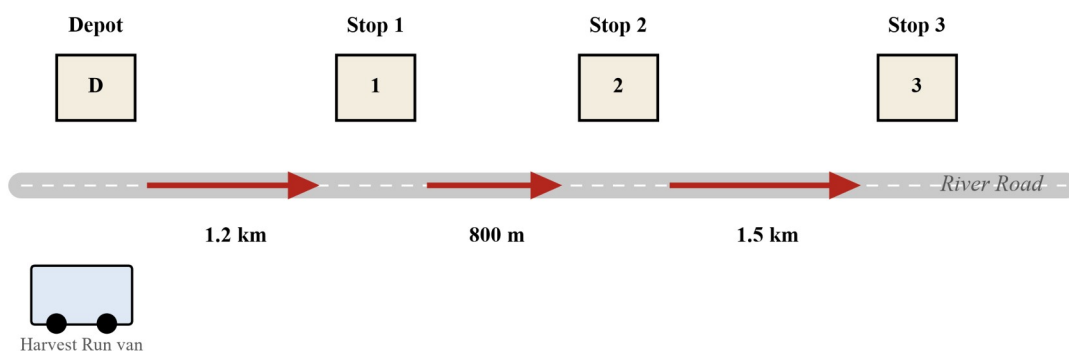
Q12. The floor plan below shows the walking route from the front door of Bellhaven Hardware to the storeroom shelves.



Made-up data: this floor plan is drawn for this book (not to scale).

- How far is it from the front door to the shelves?
- A worker walks from the front door to the shelves and back to the front door. How far is that return trip?
- The worker makes two such return trips. How far does she walk in total?

Q13. The Harvest Run van makes a morning run along River Road: 1.2 km from the depot to Stop 1, 800 m from Stop 1 to Stop 2, then 1.5 km from Stop 2 to Stop 3.



Made-up data: this route sketch is drawn for this book.

- How far is it from the depot to Stop 3, in metres and in kilometres?
- The driver has reached Stop 2. How many metres are left to Stop 3?
- The van drives the whole run to Stop 3 and then straight back to the depot. How far is that in kilometres?

Q14. Marco writes directions from the milk bar to the library on the Rose Street map in the Theory:

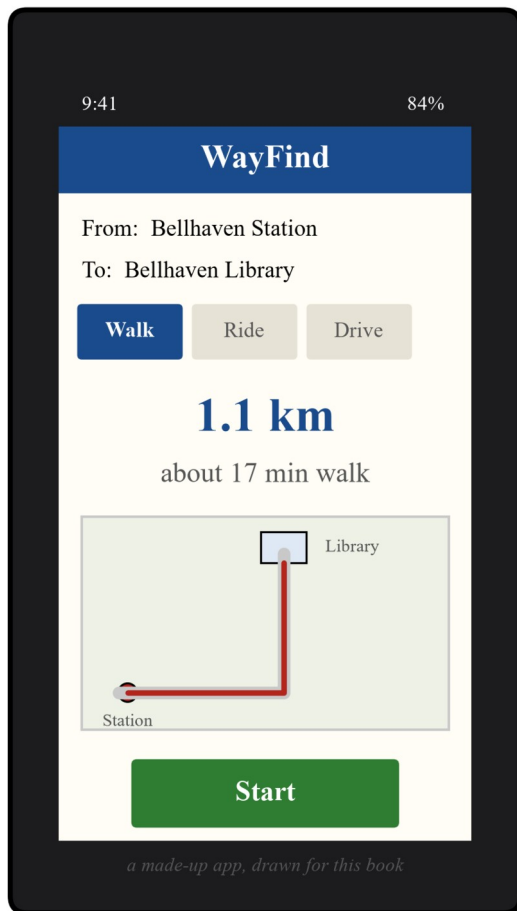
“From the milk bar, walk west 280 m. Turn right and walk 200 m. The library is on your left.”

Three things in Marco’s directions are wrong. Find each one and rewrite the directions correctly.

Q15. Priya walks 480 m each way between her house and her workplace.

- (a) How far is one return trip (house to work and back)?
- (b) How long does one return trip take at 60 m per minute?
- (c) Priya makes the return trip on three days this week. How far does she walk in total, in metres and in kilometres?

Q16. A walking app on Dana's phone shows this screen for the walk from Bellhaven Station to Bellhaven Library.



Made-up data: WayFind is a made-up app, drawn for this book.

- (a) Write the app's distance, 1.1 km, in metres.
- (b) At 60 m per minute, how many minutes does the walk take, to the nearest minute? Compare your answer with the app's own estimate.
- (c) Coming home with shopping, Dana walks at 50 m per minute. How many minutes does the walk take then?

Q17. A sign at the park gate reads: "Bridge 250 m. Lookout 350 m beyond the bridge. Café 200 m beyond the lookout."

- (a) How far is it from the park gate to the café, in metres?
- (b) Write that distance in kilometres.
- (c) A group walks the route at 50 m per minute. How many minutes does it take?

Q18. Ellie guides a tour of the community garden: 120 m from the gate to the rose bed, 90 m from the rose bed to the pond, then 60 m from the pond to the greenhouse.

- (a) How far does the tour walk in total?
- (b) Write directions for the tour from the gate to the greenhouse, using two turns and one landmark.
- (c) The group walks at 45 m per minute. How many minutes does the tour take?

Answers

Q1. (a) North-east (NE) (b) 90° (c) North

Q2. (a) The newsagency (b) The library (c) Rose Street and Chapel Street

Q3. (a) 350 m (b) 650 m (c) North

Q4. (a) 900 m (b) 0.9 km (c) 15 minutes

Q5. (a) 1.5 km (b) 800 m (c) 8 minutes

Q6. (a) 12 minutes (b) 20 minutes (c) 540 m

Q7. (a) 700 m (b) 12 minutes (to the nearest minute)

Q8. “From the community hall, walk east 300 m along Park Lane to the corner of Chapel Street. Turn right and walk 350 m south to Rose Street. Turn right and walk 200 m west. The bakery is on your right.” Total 850 m.

Q9. (a) Route A 900 m, Route B 1020 m (b) 120 m (c) 15 minutes

Q10. (a) 2500 m; 0.4 km (b) 1000 m, which is 1 km (c) 15 minutes

Q11. (a) 700 m (b) “From the camp gate, walk east 400 m. Turn left and walk north 300 m. The hall is straight ahead.” (c) North

Q12. (a) 80 m (b) 160 m (c) 320 m

Q13. (a) 3500 m, which is 3.5 km (b) 1500 m (c) 7 km

Q14. “West” should be east; “turn right” should be turn left; “on your left” should be on your right. Corrected: “From the milk bar, walk east 280 m to the corner of Chapel Street. Turn left and walk 200 m north. The library is on your right.”

Q15. (a) 960 m (b) 16 minutes (c) 2880 m, which is 2.88 km

Q16. (a) 1100 m (b) 18 minutes (to the nearest minute); the app’s “about 17 min” assumes a slightly faster walk (c) 22 minutes

Q17. (a) 800 m (b) 0.8 km (c) 16 minutes

Q18. (a) 270 m (b) For example: “From the gate, walk 120 m to the rose bed. Turn left at the rose bed and walk 90 m to the pond. Turn right at the pond and walk 60 m. The greenhouse is straight ahead.” (c) 6 minutes

Fully-worked solutions

Q1. (a) The point halfway between north and east is **north-east (NE)**. (b) A quarter turn is a right angle: 90° . (c) A half turn reverses your facing. South reversed is **north**.

Q2. (a) Reading along the north side of Rose Street: bakery, newsagency, post office. The shop between the bakery and the post office is the **newsagency**. (b) Across Rose Street from the newsagency, on the south side, is the **library**. (c) The hardware sits where Rose Street meets Chapel Street: the corner of **Rose Street and Chapel Street**.

Q3. (a) Add the three marked lengths along Rose Street: $100 + 150 + 100 = 350$ m. (b) Add the 300 m up Chapel Street: $350 + 300 = 650$ m. (c) Chapel Street runs north from Rose Street, so you face **north**.

Q4. (a) $250 + 180 + 320 + 150 = 900$ m. (b) $900 \div 1000 = 0.9$ km. (c) $900 \div 60 = 15$ minutes.

Q5. (a) $1500 \div 1000 = 1.5$ km. (b) $0.8 \times 1000 = 800$ m. (c) $480 \div 60 = 8$ minutes.

Q6. (a) $720 \div 60 = 12$ minutes. (b) 1.2 km is $1.2 \times 1000 = 1200$ m, and $1200 \div 60 = 20$ minutes. (c) Distance = speed $\times$ time: $60 \times 9 = 540$ m.

Q7. (a) One step per leg:

$$200 + 350 = 550 \text{ m}$$

$$550 + 150 = 700 \text{ m}$$

so the total walking distance is 700 m, as required. (b) $700 \div 60 = 11.666\dots$ minutes, which is **12 minutes to the nearest minute**.

Q8. Face the way the walker starts: the hall is on Park Lane, west of Chapel Street. East 300 m along Park Lane reaches the Chapel Street corner; facing east, a right turn is south; 350 m south reaches Rose Street; facing south, a right turn is west; 200 m west reaches the bakery, which is on the north side, the walker's right. Directions: *"From the community hall, walk east 300 m along Park Lane to the corner of Chapel Street. Turn right and walk 350 m south to Rose Street. Turn right and walk 200 m west. The bakery is on your right."* Total: $300 + 350 + 200 = 850$ m.

Q9. (a) Route A: $300 + 250 + 350 = 900$ m. Route B: $480 + 540 = 1020$ m. (b) $1020 - 900 = 120$ m, so Route A is 120 m shorter. (c) $900 \div 60 = 15$ minutes.

Q10. (a) $2.5 \times 1000 = 2500$ m; $400 \div 1000 = 0.4$ km. (b) $450 + 550 = 1000$ m, and $1000 \div 1000 = 1$ km. (c) $900 \div 60 = 15$ minutes.

Q11. (a) $400 + 300 = 700$ m. (b) The first leg runs east and the second runs north, so the turn is a left turn: *"From the camp gate, walk east 400 m. Turn left and walk north 300 m. The hall is straight ahead."* (c) The last leg runs north, so you face **north**.

Q12. (a) $20 + 35 + 25 = 80$ m. (b) A return trip is twice the one-way distance: $2 \times 80 = 160$ m. (c) Two return trips: $2 \times 160 = 320$ m.

Q13. (a) Put every leg in metres first: 1.2 km is 1200 m and 1.5 km is 1500 m. $1200 + 800 + 1500 = 3500$ m, and $3500 \div 1000 = 3.5$ km. (b) The leg from Stop 2 to Stop 3 is 1.5 km, which is **1500 m**. (c) There and back is twice the run: $2 \times 3.5 = 7$ km.

Q14. Check each instruction against the map. The milk bar is west of the Chapel Street corner, so the walker must go **east**, not west. Facing east, the turn up Chapel Street is **left**, not right. Walking north, the library is on the east side, the walker's **right**, not left. Corrected directions: *"From the milk bar, walk east 280 m to the corner of Chapel Street. Turn left and walk 200 m north. The library is on your right."*

Q15. (a) $2 \times 480 = 960$ m. (b) $960 \div 60 = 16$ minutes. (c) $3 \times 960 = 2880$ m, and $2880 \div 1000 = 2.88$ km.

Q16. (a) $1.1 \times 1000 = 1100$ m. (b) $1100 \div 60 = 18.333\dots$ minutes, which is **18 minutes to the nearest minute**. The app says "about 17 min" because it assumes a slightly faster walking speed than 60 m per minute; both numbers describe the same 1.1 km walk. (c) $1100 \div 50 = 22$ minutes.

Q17. (a) $250 + 350 + 200 = 800$ m. (b) $800 \div 1000 = 0.8$ km. (c) $800 \div 50 = 16$ minutes.

Q18. (a) $120 + 90 + 60 = 270$ m. (b) Any correct set of directions earns the mark; for example: *"From the gate, walk 120 m to the rose bed. Turn left at the rose bed and walk 90 m to the pond. Turn right at the pond and walk 60 m. The greenhouse is straight ahead."* (c) $270 \div 45 = 6$ minutes.

Example checks. Example 1: $150 + 240 + 120 = 510$ m; $510 \div 60 = 8.5$ minutes; last leg facing north. Example 2: $280 + 200 = 480$ m = 0.48 km; $480 \div 60 = 8$ minutes. Example 3: $350 + 400 = 750$ m against 900 m; $900 - 750 = 150$ m; $750 \div 60 = 12.5$ minutes. Example 4: $60 + 40 = 100$ m; $2 \times 100 = 200$ m; $5 \times 200 = 1000$ m = 1 km.

Chapter 2 Dimension and direction — 2D Everyday angles: 45, 90, 180 and 360 degrees

Theory

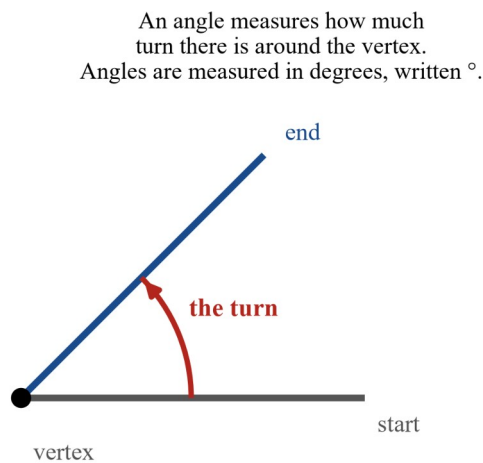
About the places and numbers in this section. The cake shop, park, station, show and tool shed in this section are **made up** (not real): pretend places and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

This section builds one skill from the study design (Unit 2, Area of Study 5): recognising the angles you meet in everyday life — such as 45, 90, 180 or 360 degrees — and showing that you understand them.

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

An angle is an amount of turn.

When something turns around a point, the size of that turn is an **angle**. The point you turn around is called the **vertex**. Angles are measured in **degrees**, written with the little circle symbol $^{\circ}$. So 45° is read as “45 degrees”.



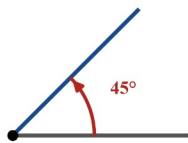
One full turn is 360 degrees.

Everything in this section hangs on one fact: **one full turn — all the way around, back to where you started — is 360°** . A clock hand going once around the face, a carousel doing one full spin, a compass needle swinging all the way back to north: each of those turns is 360° . The four angles in this section are just easy pieces of that full turn.

The four everyday angles.

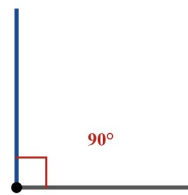
The four everyday angles

45°



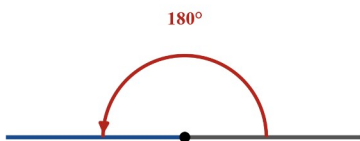
one-eighth of a turn — half a right angle

90°



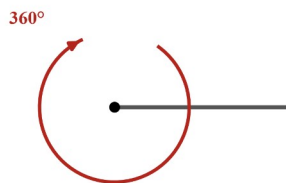
a quarter turn — a right angle (square corner)

180°



a half turn — a straight line

360°



a full turn — back to where you started

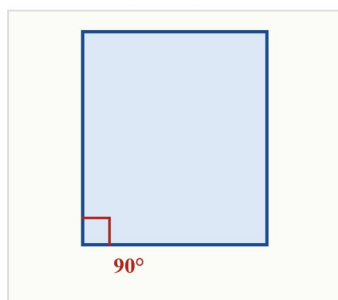
Turn	Angle	What it looks like	Where you meet it
one-eighth of a turn	45°	half of a right angle	one slice of a round cake cut into 8 equal slices; a door halfway open
a quarter turn	90°	a right angle — a square corner	the corner of a page, a tile or a doorway; clock hands from 12 to 3
a half turn	180°	a straight line	clock hands at 6 o'clock; turning around to face the way you came
a full turn	360°	all the way around	a carousel doing one full spin; a minute hand going once around the face

Right angles are everywhere.

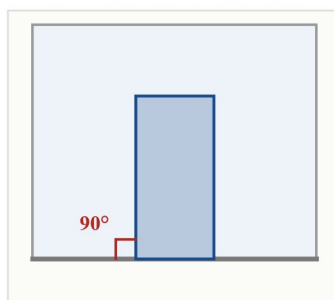
A quarter turn, 90°, is called a **right angle**, and it is the angle you see in every square corner. In diagrams a right angle is marked with a small square in the corner instead of a curved arrow. Builders call a perfect right-angle corner **square**, and they check it with a corner tool called a builder's square.

Right angles (90°) in everyday objects

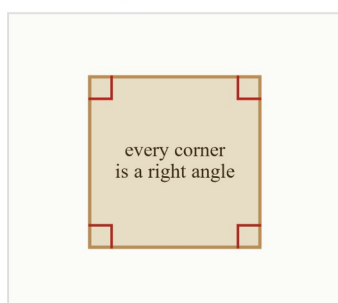
corner of a book



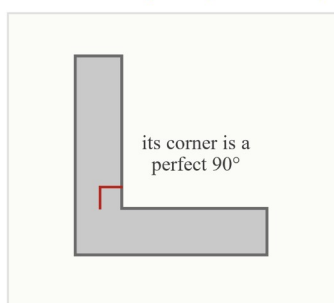
doorway meets the floor



a square floor tile



a builder's square (corner tool)



45 degrees is half a right angle.

Cut a right angle in half and you get two 45° angles, because $45 + 45 = 90$. Cut a full turn into 8 equal pieces and each piece is 45° , because $360 \div 8 = 45$. That is why one slice of a round cake cut into 8 equal slices has 45° at the centre.

Refresher — fractions of a full turn. A **fraction** is a part of a whole. The bottom number (the **denominator**) says how many equal parts the whole is cut into, and the top number says how many of those parts you have. To find a fraction of a full turn, divide 360 by the bottom number:

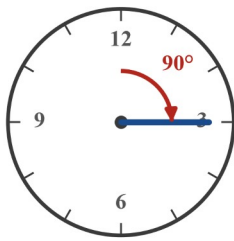
Fraction of a full turn	Working	Angle
$\frac{1}{2}$	$360 \div 2$	180°
$\frac{1}{4}$	$360 \div 4$	90°
$\frac{1}{8}$	$360 \div 8$	45°

Turns on a clock face.

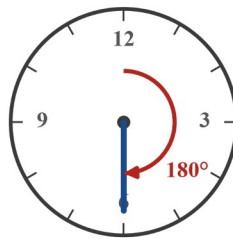
The clock is the easiest place to see the four angles. The minute hand starts at the 12: going to the 3 is a quarter turn (90°), going to the 6 is a half turn (180°), and going once around back to the 12 is a full turn (360°).

Turns on a clock face

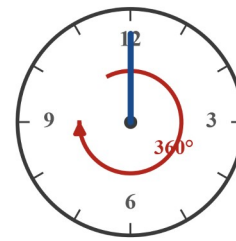
Clock hands turn clockwise — the way the hands of a clock move.



12 to 3
quarter turn = 90°



12 to 6
half turn = 180°



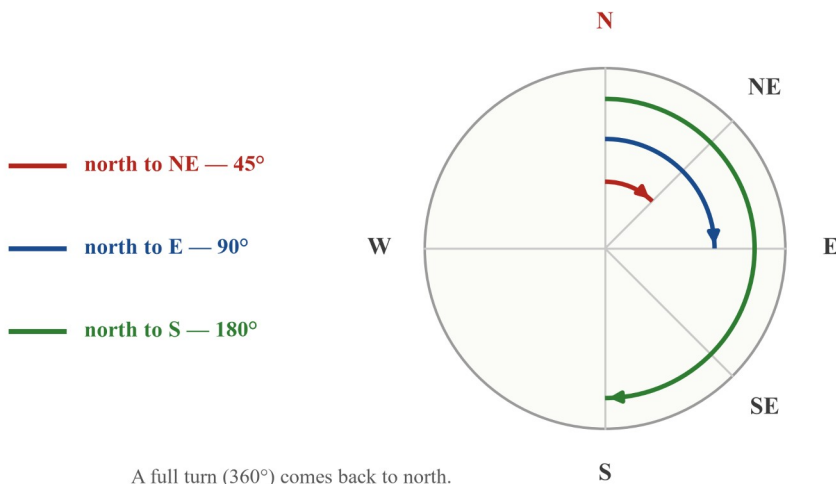
once around
full turn = 360°

Refresher — clockwise and anticlockwise. **Clockwise** means turning the way the hands of a clock move: top, then right, then bottom, then left. **Anticlockwise** is the opposite way: top, then left, then bottom, then right. The curved arrows in this section's diagrams show which way each turn goes. A quarter turn is 90° whichever way you turn — the way you turn only changes where you end up facing.

Turns on a compass.

Refresher — compass points. On a map or a compass, **N** (north) is towards the top of the page, **E** (east) is to the right, **S** (south) is towards the bottom and **W** (west) is to the left. **NE** (north-east) is halfway between north and east, and **SE** (south-east) is halfway between south and east. This book uses these six points only.

Turns on a compass



Starting from north: a one-eighth turn (45°) leaves you facing NE, a quarter turn (90°) leaves you facing E, a half turn (180°) leaves you facing S, and a full turn (360°) leaves you facing N again.

Refresher — turn facts worth knowing. These adding, multiplying and dividing facts cover most of the work in this section:

Fact	What it means
$45 + 45 = 90$	two 45° turns make a right angle
$90 + 90 = 180$	two quarter turns make a half turn
$180 + 180 = 360$	two half turns make a full turn
$90 \times 4 = 360$	four quarter turns make a full turn

Fact	What it means
$45 \times 8 = 360$	eight 45° turns make a full turn
$360 \div 45 = 8$	eight 45° turns fit in a full turn
$360 \div 90 = 4$	four quarter turns fit in a full turn
$180 \div 90 = 2$	two right angles fit in a half turn
$90 \div 45 = 2$	two 45° turns fit in a quarter turn

Angles make turns exact.

Section 2C practised giving and following walking instructions with left and right turns. Adding degrees makes those turns exact: “turn 90° to the right” is a quarter turn to the right; “make a half turn” (180°) leaves you facing the opposite way; “turn all the way around” (360°) leaves you facing the way you started.

Spotting the four angles without measuring.

You do not need a measuring tool for the four angles in this section — compare the opening with a right angle you already know. The corner of a page or an index card is 90° . Hold it against the opening: the same opening is 90° ; an opening half as wide is 45° ; two arms making one straight line is 180° ; and all the way around is 360° .

A phone app or a website can show turns and angles on a screen, and a spreadsheet will do the dividing for you, but nothing in this section needs more than pen, paper and a basic calculator.

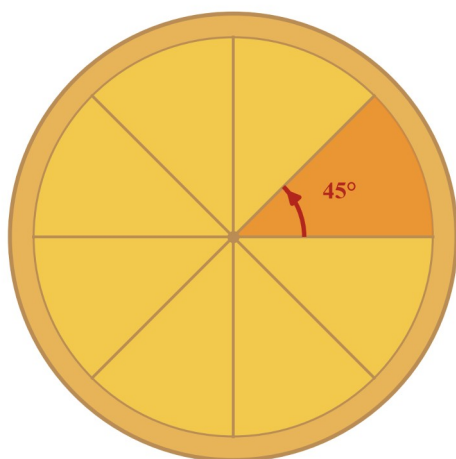
Units 3 & 4 preview. In Units 3 and 4 you will measure angles of any size with a protractor and use angle facts in triangles and quadrilaterals; this book stops at the four everyday angles above.

Worked examples

Example 1 — scaffolded

Gemma cuts a round cake into 8 equal slices for the cake stall. What is the angle at the centre of one slice?

A round cake cut into 8 equal slices



8 equal slices — one slice is highlighted

Made-up cake, drawn for this book.

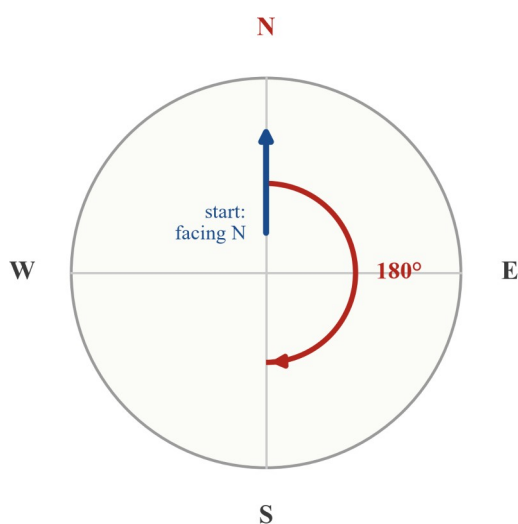
Working	Comment
A full turn around the centre is 360° .	The slices fill the whole circle.

Working	Comment
8 equal slices, so one slice is $\frac{1}{8}$ of the turn.	Equal slices share the turn equally.
$360 \div 8 = 45$	Divide the full turn by the number of slices.
Check: $45 \times 8 = 360$, and $45 + 45 = 90$.	Eight slices fill the turn; two slices make a right angle.
The angle at the centre of one slice is 45° .	

Example 2 — scaffolded

Bram stands at the park gate facing north. He turns clockwise until he faces south. (a) What fraction of a full turn is that? (b) How many degrees is it? (c) How many more degrees would finish the full turn?

Bram turns from north to south



A half turn clockwise takes north to south.

Made-up turn at a made-up park gate.

Working	Comment
South sits directly opposite north on the compass.	N and S are the two ends of one straight line.
Opposite is half of the full turn: $\frac{1}{2}$.	(a) a half turn
$360 \div 2 = 180$	(b) 180°
$360 - 180 = 180$	(c) another 180° gets back to north

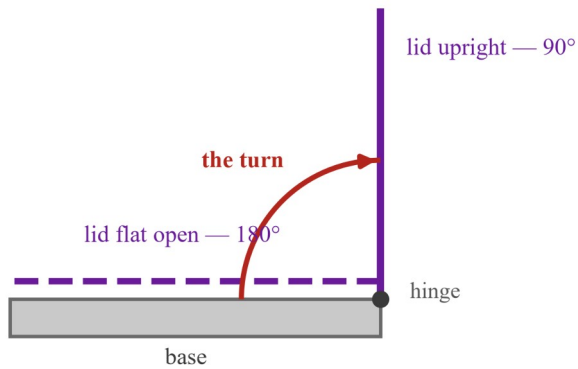
Bram's turn is a half turn, 180° , and another 180° would bring him back to facing north.

Example 3 — unscaffolded

Perrie's laptop lid is lying flat open, making a 180° angle with the base. She lifts the lid until it stands upright, making a 90° angle with the base. How many degrees did the lid turn through?

Perrie lifts her laptop lid

From flat (180°) to upright (90°): $180 - 90 = 90$.



Made-up laptop, drawn for this book.

Flat open is 180° from the base and upright is 90° from the base, so the lid turned through the difference:

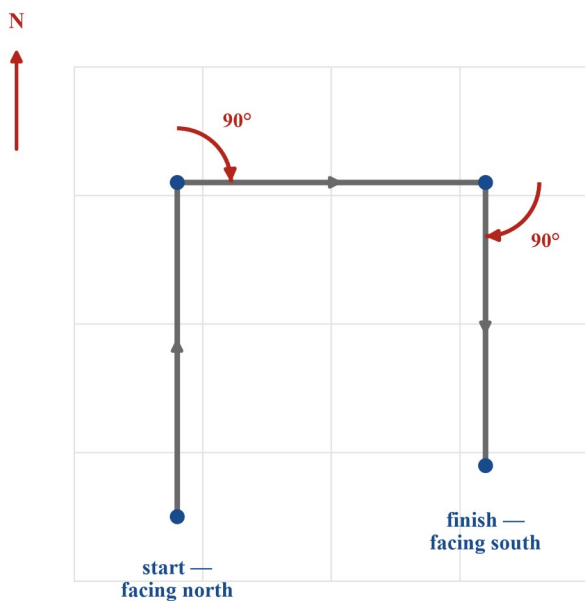
$$180 - 90 = 90$$

$\therefore$ The lid turned through 90° — a quarter turn.

Example 4 — unscaffolded

Hollis walks north along a path. He makes a 90° turn to the right, walks on, then makes another 90° turn to the right. What is his total turn, and which way is he facing at the end?

Hollis's walk — two right turns



Two right turns of 90° — altogether 180° , a half turn.

Made-up walk, drawn for this book.

The first 90° right turn takes north to east, and the second 90° right turn takes east to south. The total turn is the two turns added:

$$90 + 90 = 180$$

$\therefore$ Hollis turned 180° altogether — a half turn — and he ends facing south, the opposite way to his start.

Practice questions

Scaffolded

Q1. Four angles are drawn below.

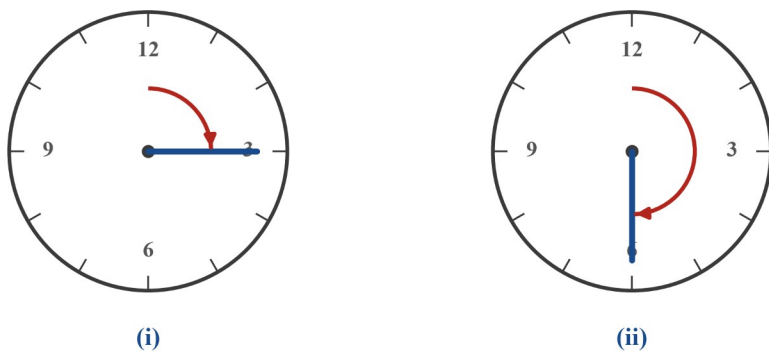
Four angles — which is which?



- Which letter shows 45° ?
- Which letter shows a right angle?
- Which letter shows a half turn?

Q2. The minute hand of each clock has moved from the 12.

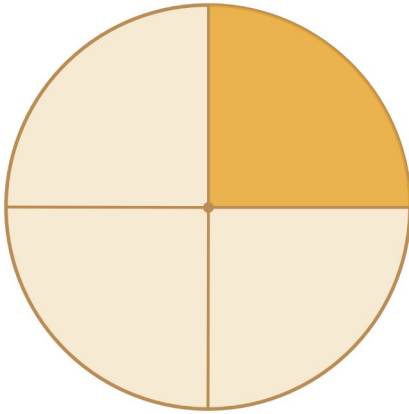
The minute hand moves from 12



- In clock (i), what fraction of a full turn has the minute hand moved?
- How many degrees is that turn?
- In clock (ii), give the turn as a fraction and in degrees.

Q3. A round cheese is cut into 4 equal wedges.

A round cheese cut into 4 equal wedges



4 equal wedges — one wedge is highlighted

- (a) What fraction of a full turn is one wedge at the centre?
- (b) How many degrees is that?
- (c) Two wedges side by side make what angle at the centre?

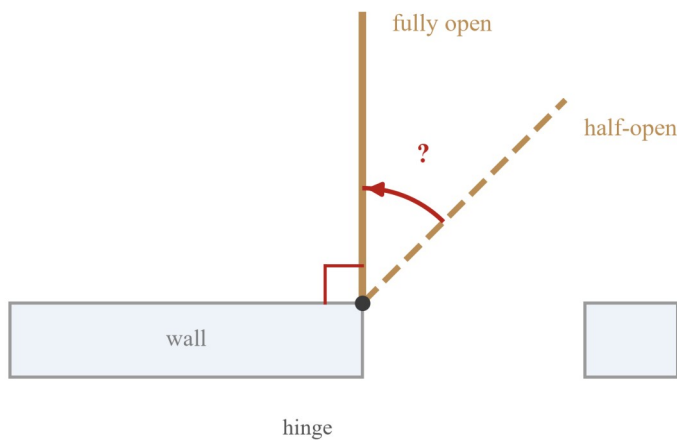
Q4. Use the six compass points N, NE, E, SE, S and W.

- (a) How many degrees is a clockwise turn from east to south?
- (b) How many degrees is a turn from north to NE?
- (c) You face west, then turn all the way around until you face west again. How many degrees did you turn?

Q5. The door of the Cobble Creek tool shed opens fully to a right angle with the wall.

A door, seen from above

Seen from above: the door swings from the wall.



Made-up door, drawn for this book.

- (a) What is the angle between the fully open door and the wall?
- (b) The half-open door sits halfway between shut and fully open. What is its angle with the wall?
- (c) How many more degrees does the half-open door need to turn to be fully open?

Q6. The roundabout at the Cobble Creek playground spins all the way around when the kids push it.

- (a) One full spin of the roundabout is how many degrees?
- (b) Gemma pushes it half a spin. How many degrees is that?
- (c) Name the turn in (b): a quarter turn, a half turn or a full turn?

Unscaffolded

Q7. A clock shows 12 o'clock exactly. Half an hour later:

- (a) what fraction of a full turn has the minute hand moved?
- (b) how many degrees is that turn?
- (c) which number is the minute hand pointing at?

Q8. Gemma stands at the park gate facing north.

- (a) She turns 90° anticlockwise. Which way is she facing now?
- (b) From there she turns 180° . Which way is she facing now?
- (c) Starting from north again, which way would she face after a 180° turn clockwise?

Q9. Cass is framing a new tool shed and must turn a piece of timber a quarter turn (90°) to slot it in place. She has already turned it 45° .

- (a) How many degrees are in the quarter turn she needs?
- (b) How many more degrees must the timber turn?
- (c) The 45° she has already turned is what fraction of the quarter turn?

Q10. The turnstile at Cobble Creek station — the gate with turning arms that lets one person through at a time — spins 90° for each push.

- (a) What fraction of a full turn is one push?
- (b) How many pushes spin the turnstile a full turn?
- (c) After two pushes, how many degrees has it turned, and what is that turn called?

Q11. For the cake stall, Gemma cuts a large round cake into 4 equal slices and a small round cake into 8 equal slices.

- (a) What is the angle at the centre of one large slice?
- (b) What is the angle at the centre of one small slice?
- (c) How many small slices match the centre angle of one large slice?

Q12. Hollis is facing north.

- (a) He turns clockwise until he faces east. Describe that turn as a fraction of a full turn.
- (b) How many degrees did he turn?
- (c) From east he turns 180° . Which way is he facing now?

Q13. Write each angle as 45° , 90° , 180° or 360° .

- (a) The angle between the clock hands at 6 o'clock.
- (b) The angle at the centre of one slice of a round cake cut into 8 equal slices.
- (c) The corner of a square floor tile.
- (d) The minute hand going once around the face.

Q14. The carousel at the Cobble Creek show turns in a circle all day.

- (a) One full spin of the carousel is how many degrees?
- (b) After half a spin, a seat faces the opposite way. How many degrees is that?
- (c) How many 45° turns fit into one full spin?

Q15. Bram is laying square floor tiles in the tool shed.

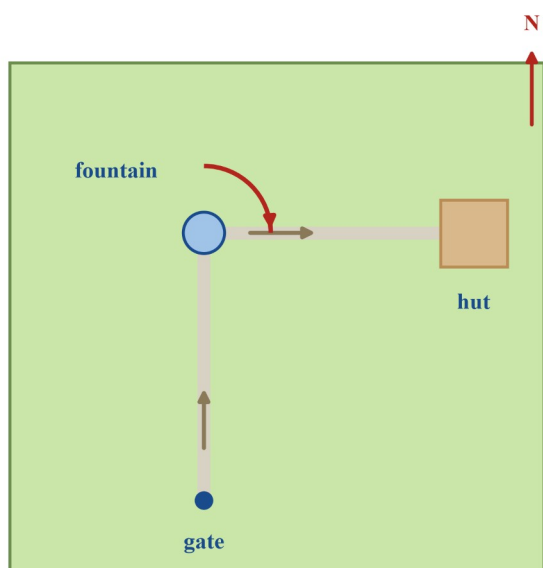
- (a) What is the angle at each corner of a square tile?
- (b) He turns a tile a quarter turn before setting it down. How many degrees is that?
- (c) After the quarter turn, does the tile still fit the same square gap? Give one reason for your answer.

Q16. Give the angle between the clock hands:

- (a) at 3 o'clock
- (b) at 6 o'clock
- (c) at 9 o'clock

Q17. Use the map of Cobble Creek Park. You walk in through the gate and follow the path north to the fountain, then turn and follow the path east to the hut.

Cobble Creek Park



Walk north from the gate to the fountain, then turn and walk east to the hut.

Made-up park map, drawn for this book.

- (a) At the fountain, do you turn left or right?
- (b) How many degrees is that turn?
- (c) Rewrite the instruction “At the fountain, turn and walk east to the hut” using a fraction of a turn for the turn instead of a compass direction.

Q18. Hollis follows a walking map at Cobble Creek Park, starting at the gate facing north.

- (a) He makes a quarter turn clockwise. Which way is he facing?
- (b) From there he makes a half turn. Which way is he facing now?
- (c) He then turns 90° clockwise. Which way is he facing, and how many degrees has he turned altogether across the three turns?

Answers

Q1. (a) A. (b) B. (c) C. (D is a full turn, 360° .)

Q2. (a) $\frac{1}{4}$ — a quarter turn. (b) 90° . (c) $\frac{1}{2}$ of a turn, 180° .

Q3. (a) $\frac{1}{4}$. (b) 90° . (c) 180° — a half turn.

Q4. (a) 90° . (b) 45° . (c) 360° .

Q5. (a) 90° . (b) 45° . (c) 45° .

Q6. (a) 360° . (b) 180° . (c) a half turn.

Q7. (a) $\frac{1}{2}$. (b) 180° . (c) 6.

Q8. (a) west. (b) east. (c) south.

Q9. (a) 90° . (b) 45° . (c) $\frac{1}{2}$.

Q10. (a) $\frac{1}{4}$ — a quarter turn. (b) 4 pushes. (c) 180° — a half turn.

Q11. (a) 90° . (b) 45° . (c) 2 slices.

Q12. (a) $\frac{1}{4}$ — a quarter turn clockwise. (b) 90° . (c) west.

Q13. (a) 180° . (b) 45° . (c) 90° . (d) 360° .

Q14. (a) 360° . (b) 180° . (c) 8.

Q15. (a) 90° . (b) 90° . (c) yes — a quarter-turned square still fills the same square gap, because all four of its corners are right angles.

Q16. (a) 90° . (b) 180° . (c) 90° .

Q17. (a) right. (b) 90° . (c) “At the fountain, make a quarter turn to the right and walk to the hut.”

Q18. (a) east. (b) west. (c) north — the way he started; total turn $90 + 180 + 90 = 360^\circ$, a full turn.

Fully-worked solutions

Q1. (a) A is the opening smaller than a right angle: 45° . (b) B carries the small square corner mark: a right angle, 90° . (c) C’s two arms make one straight line: a half turn, 180° . (D’s arrow goes all the way around: a full turn, 360° .)

Q2. (a) From 12 to 3 is one quarter of the face: $\frac{1}{4}$ of a turn. (b) $360 \div 4 = 90^\circ$. (c) From 12 to 6 is half the face: $\frac{1}{2}$ of a turn, and $360 \div 2 = 180^\circ$.

Q3. (a) 4 equal wedges share the full turn, so one wedge is $\frac{1}{4}$ of a turn. (b) $360 \div 4 = 90^\circ$. (c) Two wedges: $90 + 90 = 180^\circ$, a half turn.

Q4. (a) East to south is a quarter turn clockwise: $360 \div 4 = 90^\circ$. (b) NE sits halfway between N and E, so north to NE is half of a quarter turn: $90 \div 2 = 45^\circ$. (c) All the way around is a full turn: 360° .

Q5. (a) Fully open is a right angle with the wall: 90° . (b) Halfway to fully open: $90 \div 2 = 45^\circ$. (c) $90 - 45 = 45^\circ$ more.

Q6. (a) One full spin is a full turn: 360° . (b) Half a spin: $360 \div 2 = 180^\circ$. (c) 180° is $\frac{180}{360} = \frac{1}{2}$ of a turn: a **half turn**.

Q7. (a) Half an hour is half of the hour, so the minute hand moves $\frac{1}{2}$ of a turn. (b) $360 \div 2 = 180^\circ$. (c) Halfway around the face from the 12 is the number 6.

Q8. (a) A 90° turn anticlockwise from north goes to **west**. (b) A 180° turn from west faces the opposite way: **east**. (c) A 180° turn clockwise from north faces **south**.

Q9. (a) A quarter turn is $360 \div 4 = 90^\circ$. (b) $90 - 45 = 45^\circ$ more. (c) 45 is half of 90 (since $90 \div 45 = 2$): $\frac{1}{2}$ of the quarter turn.

Q10. (a) 90° is $\frac{90}{360} = \frac{1}{4}$ of a turn: a **quarter turn**. (b) $360 \div 90 = 4$ pushes. (c) $90 + 90 = 180^\circ$, which is a **half turn**.

Q11. (a) $360 \div 4 = 90^\circ$. (b) $360 \div 8 = 45^\circ$. (c) $90 \div 45 = 2$ small slices match one large slice.

Q12. (a) North to east is one quarter of the way around: $\frac{1}{4}$ of a turn, a quarter turn clockwise. (b) $360 \div 4 = 90^\circ$. (c) A 180° turn from east faces the opposite way: **west**.

Q13. (a) At 6 o'clock the hands make one straight line: 180° . (b) 8 equal slices share the full turn: $360 \div 8 = 45^\circ$. (c) A square corner is a right angle: 90° . (d) Once around the face is a full turn: 360° .

Q14. (a) One full spin is a full turn: 360° . (b) Half a spin: $360 \div 2 = 180^\circ$. (c) $360 \div 45 = 8$ turns of 45° .

Q15. (a) Every corner of a square tile is a right angle: 90° . (b) A quarter turn is $360 \div 4 = 90^\circ$. (c) **Yes**. A square looks the same after a quarter turn — all four of its corners are right angles — so the turned tile still fills the same square gap.

Q16. (a) At 3 o'clock the hands are a quarter turn apart: 90° . (b) At 6 o'clock the hands make one straight line: 180° . (c) At 9 o'clock the hands are a quarter turn apart again: 90° .

Q17. (a) You were walking north and now walk east, so the turn is to the **right**. (b) North to east is a quarter turn: 90° . (c) "At the fountain, make a **quarter turn to the right** (90°) and walk to the hut."

Q18. (a) A quarter turn clockwise from north faces **east**. (b) A half turn from east faces the opposite way: **west**. (c) A 90° turn clockwise from west faces **north**, the way he started. Altogether: $90 + 180 + 90 = 360^\circ$, a full turn.

Chapter 02 — Test A (multiple choice)

Chapter 2 (Dimension and direction), sections 2A to 2D. Materials: pen, paper; a basic calculator may be used. Test A: 12 multiple-choice questions (12 marks). Approximate time: 20 minutes.

About the data in this test. The streets, shops, maps, shows, shelves and measurements here are **made up** (not real): pretend places and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

Choose the response that is correct for the question.

Question 1

A bike is parked with a tree on one side and a gate on the other side. Which position word says where the bike is?

- A. above
- B. between
- C. opposite
- D. behind

Question 2

In a theatre, the seats are set out in columns A to E from the left and rows 1 to 4 from the front. Row 1 is nearest the stage. Which seat is directly behind seat C2?

- A. C1
- B. D2
- C. C3
- D. 3C

Question 3

A plank of wood is measured on a tape measure. One end of the plank sits at the 25 cm mark and the other end sits at the 60 cm mark. The length of the plank is

- A. 35 cm
- B. 25 cm
- C. 60 cm
- D. 85 cm

Question 4

On a town map, a hall is drawn 3 blocks south and 3 blocks east of the milk bar. The direction of the hall from the milk bar is

- A. north
- B. north-east
- C. south
- D. south-east

Question 5

A map grid has columns labelled A to F from left to right and rows numbered 1 to 6 from top to bottom. A landmark sits in the 3rd column and the 5th row. Its grid reference is

- A. 5C
- B. C5
- C. E3
- D. C3

Question 6

On a track map with scale 1 cm = 250 m, a section of the track measures 6 cm on the map. The real length of this section is

- A. 600 m
- B. 1 250 m
- C. 1 500 m
- D. 256 m

Question 7

Which of these gives the clearest directions to the hall?

- A. “The hall is not far — just head down the road and you will see it.”
- B. “Go out the gate and turn left somewhere near the big tree.”
- C. “Walk a while and the hall will be in front of you.”
- D. “From the front gate, walk 200 m south along Walnut Street. The hall is on your left.”

Question 8

A delivery driver is travelling south along Foundry Road. At a junction she turns right. The direction she is now travelling in is

- A. west
- B. east
- C. north
- D. south

Question 9

Ellie walks 450 m at a steady speed of 50 m per minute. The time the walk takes is

- A. 7.5 minutes
- B. 8 minutes
- C. 9 minutes
- D. 45 minutes

Question 10

On a clock face, the minute hand moves from the 3 to the 6. The angle the minute hand turns through is

- A. 45°
- B. 90°
- C. 180°
- D. 360°

Question 11

A round cake is cut into 8 equal slices. The number of slices that together make 180° at the centre of the cake is

- A. 2
- B. 3
- C. 8
- D. 4

Question 12

A person is facing east and turns 45° anticlockwise. The direction the person now faces is

- A. north-east
- B. north
- C. south-east
- D. east

End of Test A

Test A — Answers

Question	1	2	3	4	5	6	7	8	9	10	11	12
Answer	B	C	A	D	B	C	D	A	C	B	D	A

Test A — Fully-worked solutions

Question	Answer	Working
1	B	With a tree on one side and a gate on the other side, the bike has one thing on each side of it, and the position word for this is between . Option A (above) talks about height, option C (opposite) means facing from across something like a road, and option D (behind) means at the back of one thing — none of these says “one on each side”.
2	C	“Directly behind” on a seat grid means the same column, one row further back. Seat C2 is column C, row 2, so the seat behind it is column C, row $2 + 1 = 3$: seat C3 . Option A (C1) is directly in front, option B (D2) is one column across, and option D (3C) is written row-first instead of letter-first.
3	A	The length between two marks on a tape is the bigger mark minus the smaller mark: $60 - 25 = 35$, so the plank is 35 cm long. Option B is the starting mark, option C is the end mark, and option D adds the two marks ($60 + 25 = 85$) — none of those is the length in between.
4	D	South and east together point halfway between the two, which is south-east . Option C follows the south part only and forgets the east; options A and B point north, the wrong way for a south-and-east move.
5	B	Grid references are written letter first, number second. The 3rd column is C ($A = 1, B = 2, C = 3$) and the 5th row is 5, so the reference is C5 . Option A reverses the order; option C is the 5th column, 3rd row; option D is the 3rd column, 3rd row.
6	C	Multiply the map length by the scale: $6 \times 250 = 1\,500$, so the section is 1 500 m long. Option A multiplies by the block scale of 100 m instead of 250 m; option B measures 5 cm instead of 6 cm; option D adds instead of multiplying ($250 + 6 = 256$).
7	D	Check each set of directions against the good-directions checklist: a

Question	Answer	Working
		starting point, a distance, a compass direction, a street name and a landmark finish. Only option D has all five — “From the front gate” (start), “200 m” (distance), “south” (direction), “Walnut Street” (street name), “on your left” (landmark finish). Options A, B and C each miss several of these, which leaves the walker guessing.
8	A	Turning right is a quarter turn clockwise. Going clockwise from south: south → west . Option B (east) is what a left turn from south gives; option C (north) would need a half turn; option D means no turn at all.
9	C	Time = distance ÷ speed: $450 \div 50 = 9$, so the walk takes 9 minutes . Option A divides by 60 instead of the 50 m per minute given in the question; option B rounds 7.5 up to 8; option D divides by the wrong number.
10	B	From the 3 to the 6 the minute hand travels one quarter of the way around the clock face, and a quarter turn is $360 \div 4 = 90$. The angle is 90° — a right angle. Option A (45°) is half of this turn, option C (180°) is a half turn and option D (360°) is a full turn.
11	D	Each slice makes $360 \div 8 = 45^\circ$ at the centre. The number of slices needed to reach 180° is $180 \div 45 = 4$, so 4 slices . Options A and B are too few slices to reach 180° , and option C is the whole cake, a full turn of 360° .
12	A	A 45° turn is one step around the compass, and turning anticlockwise from east moves towards north. One 45° step anticlockwise from east lands halfway between north and east: north-east . Option B (north) would need a 90° anticlockwise turn; option C (south-east) is a clockwise turn from east; option D is no turn at all.

Chapter 02 — Test B (written response)

Chapter 2 (Dimension and direction), sections 2A to 2D. Materials: pen, paper; a basic calculator may be used. Test B: 7 questions (34 marks). Approximate time: 45 minutes. Answer all questions in the spaces provided. In all questions where a numerical answer is required, you should only round when instructed to do so, and then to the precision stated. Where more than one mark is available, appropriate working must be shown.

About the data in this test. The streets, shops, maps, shows, shelves and measurements here are **made up** (not real): pretend places and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

Question 1 (5 marks)

At the Cobble Creek Market, 18 crates are stacked in a single row. The crates are numbered 1 to 18 from the left end, and the apples are in crate 6.

- a. State the position of the apple crate counted from the right end of the row. 1 mark

- b. Crate 14 holds the oranges. How many crates sit between crate 6 and crate 14? 1 mark

- c. Which crate is exactly halfway between crate 6 and crate 14? 1 mark

- d. A second row holds 12 crates, numbered 1 to 12 from the left end. Show that the 5th crate from the left is the 8th crate from the right. 2 marks

Question 2 (5 marks)

The Cobble Creek depot stores tool kits on a shelf. The shelf has 5 spaces across and 4 levels, and level 1 is at the bottom.

- a. How many spaces are on the shelf in total? 1 mark

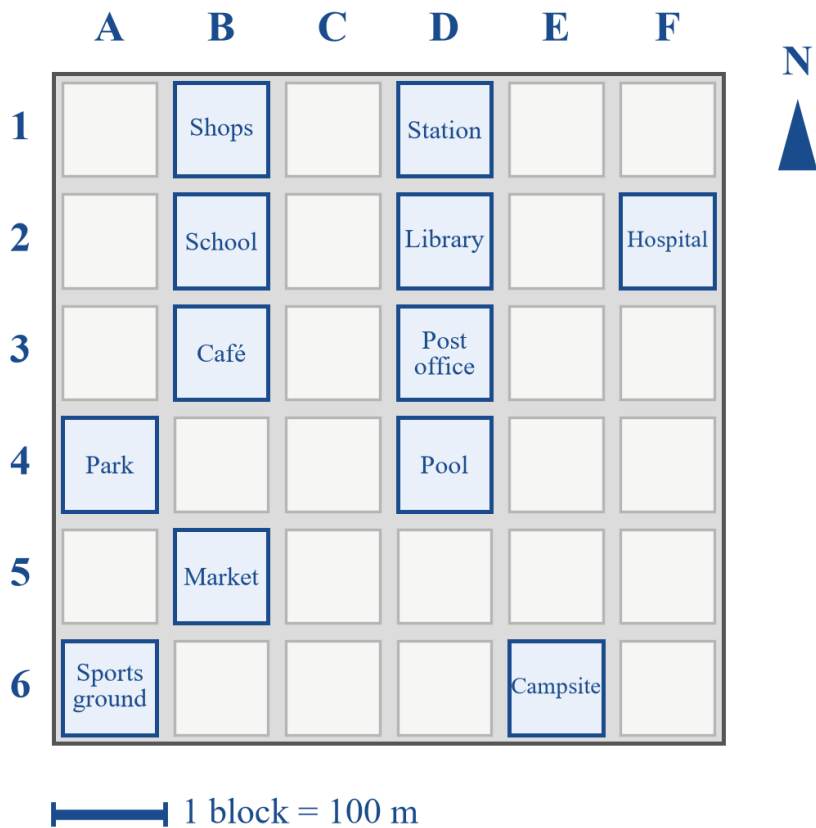
- b. Archie puts the crate of rope in the 3rd space from the left on the top level. Describe this position using the column and the level. 1 mark

- c. Every space holds 2 tool kits. How many tool kits are on the shelf when it is full? 1 mark

- d. A plank at the depot is measured on a tape. One end sits at the 30 cm mark and the other end sits at the 95 cm mark. Find the length of the plank in centimetres, and then write this length in metres. 2 marks

Question 3 (5 marks)

The map below shows Emu Crossing. Each block is 100 m and north is at the top of the map.



Made-up data: Emu Crossing, its streets and every place on this map are made up for this book.

a. State the grid reference of the library. 1 mark

b. State the compass direction of the park from the sports ground. 1 mark

c. Nellie walks from the sports ground to the park, along the streets. Find the distance of this walk in metres. 1 mark

d. Write this distance in kilometres, and find how many minutes the walk takes Nellie at a steady 50 m per minute. 2 marks

Question 4 (5 marks)

Ellie walks from the library in Bellhaven to the community hall. She walks 340 m east along Rose Street to the corner of Chapel Street, turns left and walks 270 m along Chapel Street, then turns right onto Park Lane and walks 180 m to the hall.

a. Find the total distance Ellie walks, in metres. 1 mark

b. Write this distance in kilometres. 1 mark

c. Ellie walks at a steady 60 m per minute. Find the time the walk takes, to the nearest minute. 1 mark

d. State the compass direction Ellie faces as she walks along Chapel Street, and the direction she faces as she walks along Park Lane. 2 marks

Question 5 (4 marks)

Gina is planning a walk using a track map with scale 1 cm = 150 m. One section of the track measures 7 cm on the map.

a. Find the real length of this section of track, in metres. 1 mark

b. Write this length in kilometres. 1 mark

c. On the walk, Gina uses the navigation app on her phone. The screen shows a blue dot and a red pin. State what the red pin shows, and name the satellite system the phone uses to fix her position. 2 marks

Question 6 (5 marks)

This question is about the Cobble Creek show. The show clock has a minute hand, the carousel turns in full circles, and Cass and Hollis are waiting at the show gate.

- a.** The minute hand of the show clock points at the 12. The hand makes a quarter turn clockwise. Which number does the minute hand point at now? 1 mark

- b.** A seat on the carousel turns 90° . Write this turn as a fraction of one full spin. 1 mark

- c.** Cass stands at the show gate facing east. He turns until he faces south-east. State the number of degrees Cass turns, and say whether the turn is clockwise or anticlockwise. 2 marks

- d.** Hollis faces south and makes a quarter turn anticlockwise. State the direction Hollis now faces. 1 mark

Question 7 (5 marks)

Darcy is making a delivery at the Cobble Creek Market. From the gate, his route goes 150 m west along the main path to the fountain, then 100 m south to his stall.

- a.** Find the distance Darcy walks from the gate to his stall. 1 mark

- b.** Write directions for Darcy's route from the gate to his stall. Use one landmark and the correct turn word (left or right). 2 marks

- c.** State the compass direction Darcy faces when he arrives at his stall. 1 mark

- d.** Darcy walks back to the gate the same way he came. Find the total distance he walks for the whole trip, there and back. 1 mark

End of Test B

Test B — Answers

- Q1.** **a.** the 13th crate from the right end **b.** 7 crates **c.** crate 10 **d.** $12 - 5 + 1 = 8$, so the 5th crate from the left is the 8th crate from the right
- Q2.** **a.** 20 spaces **b.** column 3, level 4 **c.** 40 tool kits **d.** 65 cm; 0.65 m
- Q3.** **a.** D2 **b.** north **c.** 200 m **d.** 0.2 km; 4 minutes
- Q4.** **a.** 790 m **b.** 0.79 km **c.** 13 minutes (to the nearest minute) **d.** north along Chapel Street; east along Park Lane
- Q5.** **a.** 1 050 m **b.** 1.05 km **c.** the red pin shows the destination; GPS
- Q6.** **a.** 3 **b.** $\frac{1}{4}$ of a full spin (a quarter turn) **c.** 45° ; clockwise **d.** east
- Q7.** **a.** 250 m **b.** “From the gate, walk west 150 m along the main path to the fountain. Turn left and walk south 100 m. The stall is straight ahead.” **c.** south **d.** 500 m

Test B — Fully-worked solutions

Question 1.

- a. To count from the other end: position from the right = total minus position from the left, plus 1. So $18 - 6 + 1 = 13$: the apple crate is the **13th crate** from the right end.
- b. The number in between = bigger number minus smaller number minus 1: $14 - 6 - 1 = 7$. There are **7 crates** between crate 6 and crate 14.
- c. Halfway = the two positions added and halved: $(6 + 14) \div 2 = 20 \div 2 = 10$. **Crate 10** is exactly halfway between crate 6 and crate 14.
- d. Position from the right = total minus position from the left, plus 1. For the row of 12 crates: $12 - 5 + 1 = 8$. So the 5th crate from the left is the **8th crate from the right**, as required.

Question 2.

- a. Total spaces = spaces across $\times$ levels: $5 \times 4 = 20$. The shelf has **20 spaces** in total.
- b. The top level is level 4, and the 3rd space from the left is column 3, so the crate of rope sits at **column 3, level 4**.
- c. Full shelf = total spaces $\times$ kits per space: $20 \times 2 = 40$. A full shelf holds **40 tool kits**.
- d. The length between two marks = bigger mark minus smaller mark: $95 - 30 = 65$ cm. In metres: $65 \div 100 = 0.65$ m. The plank is **65 cm** long, which is **0.65 m**.

Question 3.

- a. Find the library's column, then its row: column D, row 2. Written letter-first, the grid reference is **D2**.
- b. The park is in A4 and the sports ground is in A6 — the same column, with the park higher up the map. North is at the top of the map, so the park is **north** of the sports ground.
- c. The walk follows the streets for 2 blocks: $2 \times 100 = 200$. The distance is **200 m**.
- d. Metres to kilometres: divide by 1000, so $200 \div 1\,000 = 0.2$ km. Time = distance $\div$ speed: $200 \div 50 = 4$. The walk is **0.2 km** and takes Nellie **4 minutes**.

Question 4.

- a. Add the three legs: $340 + 270 + 180 = 790$. The total distance is **790 m**.
- b. Metres to kilometres: divide by 1000, so $790 \div 1\,000 = 0.79$. The distance is **0.79 km**.
- c. Time = distance $\div$ speed: $790 \div 60 = 13.1666\dots$ Rounding to the nearest minute as instructed, the deciding digit is the 1 in the tenths column, and 1 is less than 5, so round down: **13 minutes** (to the nearest minute).
- d. Ellie starts facing east. Turning left is a quarter turn anticlockwise, and east $\rightarrow$ north, so along Chapel Street she faces **north**. Turning right is a quarter turn clockwise, and north $\rightarrow$ east, so along Park Lane she faces **east**.

Question 5.

- a. Multiply the map length by the scale: $7 \times 150 = 1\,050$. The section is **1 050 m** long.
- b. Metres to kilometres: divide by 1000, so $1\,050 \div 1\,000 = 1.05$. The section is **1.05 km** long.
- c. On a navigation app, the blue dot shows where you are and the red pin shows **the destination** — the place you want to reach. The satellite system the phone uses to fix her position is **GPS**.

Question 6.

- a. A quarter turn on a clock face moves the minute hand 3 numbers, so from the 12, a quarter turn clockwise lands on **3**.
- b. A full spin is 360° , and $360 \div 90 = 4$, so 90° is $\frac{1}{4}$ **of a full spin** — a quarter turn.
- c. South-east sits one compass step clockwise from east (east $\rightarrow$ south-east $\rightarrow$ south), so Cass turns 45° and the turn is **clockwise**.
- d. A quarter turn anticlockwise from south goes towards the east side: south $\rightarrow$ east. Hollis now faces **east**.

Question 7.

- a. Add the two legs: $150 + 100 = 250$. Darcy walks **250 m** from the gate to his stall.
- b. Walking west, south is on the left, so the turn word is “left”: **“From the gate, walk west 150 m along the main path to the fountain. Turn left and walk south 100 m. The stall is straight ahead.”**
- c. The last leg of the route goes south, so Darcy arrives facing **south**.
- d. The walk back is the same 250 m again: $2 \times 250 = 500$. The whole trip is **500 m**.