Mathematics Level 5

Chapter 7 — Statistics

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Contents

Acquiring, validating and representing data

> **Code `VC2M5ST01`** (Victorian Curriculum F–10 Version 2.0, Mathematics, Level 5; authority file `maths_5.json`): "acquire, validate and represent data for nominal and ordinal categorical and discrete numerical variables to address a question of interest or purpose using software including spreadsheets; discuss and report on data distributions in terms of highest frequency (mode) and shape, in the context of the data". This section draws on `VC2M5ST01.E01`, `.E02`, `.E03`, `.E04` and `.E05`.

From the Level 5 achievement standard: *Students plan and conduct statistical investigations that collect nominal and ordinal categorical and discrete numerical data with and without digital tools.*

Theory

The path of a statistical investigation

In this section we collect data, check it, and display it so it can be reported. Every statistical investigation follows the same path:

1. **Ask** a question of interest — a question that needs data to answer it.
2. **Acquire** (collect) the data — by asking everyone, or by running chance experiments, on paper or with digital tools.
3. **Validate** the data — check it for mistakes before trusting it.
4. **Represent** the data — choose a display that fits the type of data.
5. **Report** — describe the distribution using its mode and its shape, in the context of the data.

All the data in this section was collected by a fictional Year 5 class of 25 students, so you can see every step of the path without leaving your desk.

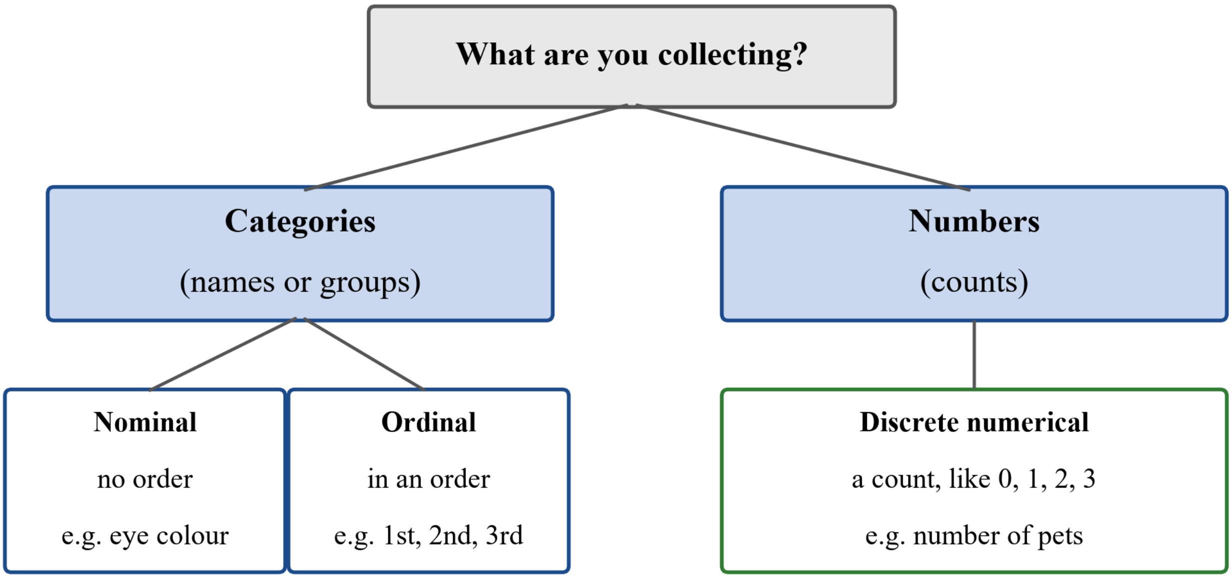
Questions of interest — questions that need data

A **question of interest** is a question you can only answer by collecting data. "What is the most popular sandwich filling in our class?" is a question of interest: nobody knows the answer until every student has answered. "What sandwich did I eat yesterday?" is not — one person's memory settles it.

The thing the question asks about is called a **variable**, because its value varies from person to person. Favourite sandwich filling is a variable: the value is Vegemite for one student and Jam for another. Before you collect anything, you need to know what *kind* of values your variable gives. There are exactly three kinds at this level.

The three types of data

The three types of data you can collect



These three types are the data we work with in Year 5.

A tree diagram splitting the question 'What are you collecting?' into categories (names or groups), with nominal and ordinal boxes, and numbers (counts), with a discrete numerical box.

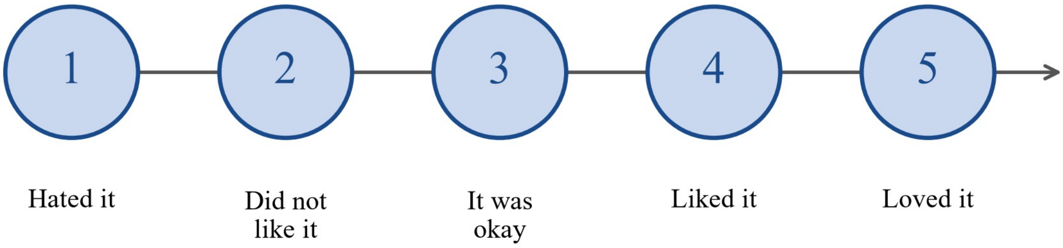
- **Nominal categorical data** — values are names or groups with no order. Eye colour, favourite pet, sandwich filling. No value comes "before" another; the names just sort people into groups.
- **Ordinal categorical data** — values are categories that *do* come in an order. Finishing places in a race (1st, 2nd, 3rd) and rating scales (Hated it → Loved it). The order means something, but the gaps between categories do not.
- **Discrete numerical data** — values are counts: whole numbers you get by counting, like 0, 1, 2, 3. Number of pets, number of brothers and sisters.

These three types are the data we work with in Year 5.

Ordinal data — numbers that are really labels

Ordinal data can trick you, because it is often written with numbers. Suppose the class rates the new film out of 5:

‘How much did you enjoy the film? Rate it out of 5.’



The numbers 1 to 5 are just labels for the categories.

They are in order, but you cannot add them. So this is categorical data, not numerical data.

A rating scale from 1 to 5 for a film, with the words Hated it, Did not like it, It was okay, Liked it and Loved it under the numbers 1 to 5, and a note that the numbers are just labels for the categories.

The numbers 1 to 5 stand for the categories, in order: 5 means “Loved it” and 1 means “Hated it”. But the numbers are still just labels. A rating of 4 is better than a rating of 2, yet it is not *twice as good* — adding and doubling labels makes no sense. So ordinal data is a form of **categorical** data, even when it is written with numbers. Treat it like ordered names, not like counts.

Acquiring data — ask everyone and keep a tally

To acquire data by asking, put the question to everyone and record each answer as it comes, with a **tally**: one line per answer, and every fifth line drawn across the previous four to make a group of five.

Filling	Tally	Number
Vegemite	卌 |||	8
Cheese	卌 |	6
Ham	卌	5
Jam	||||	4
Egg	||	2

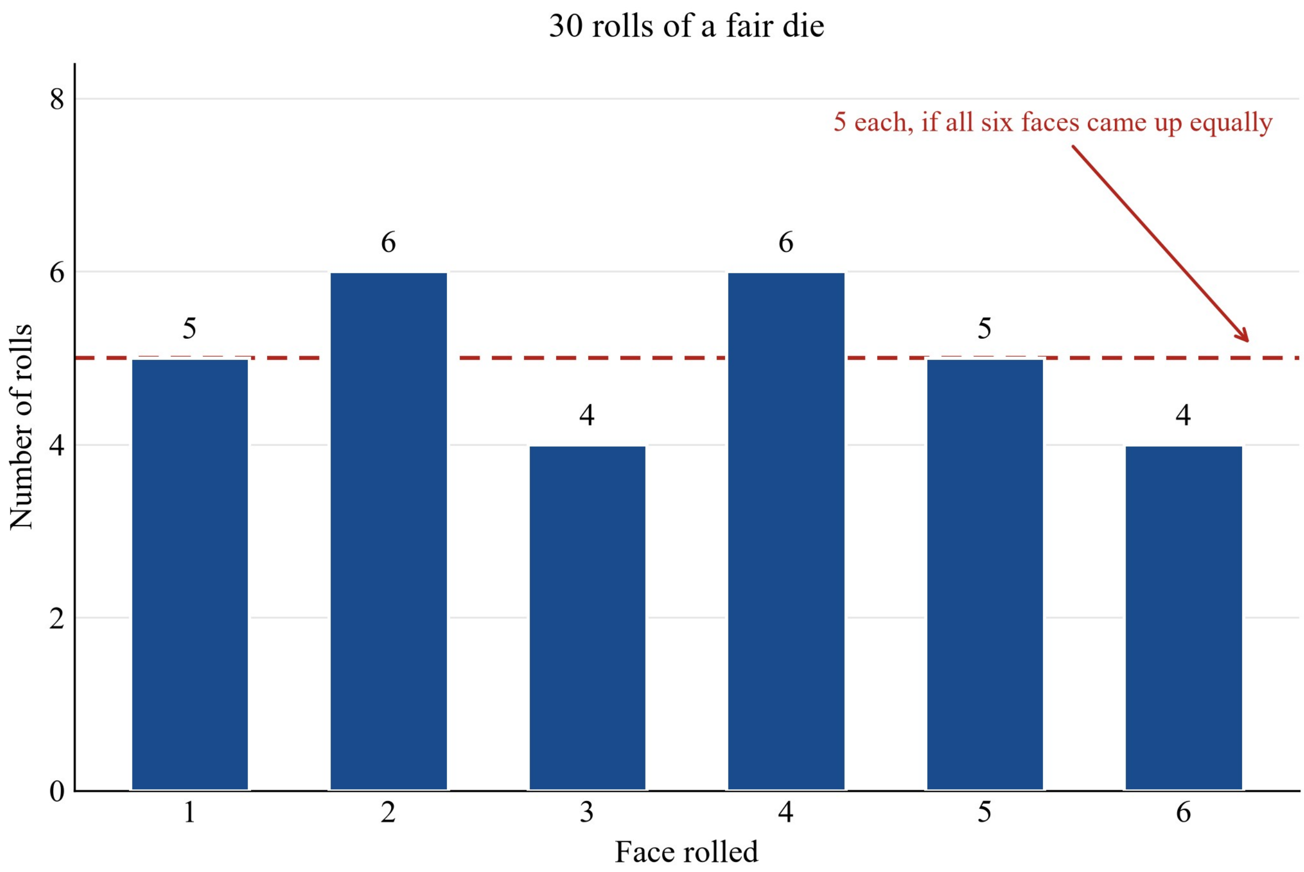
Each \ mark across four lines stands for 5. 25 students answered the question.

A tally chart of favourite sandwich filling: Vegemite 8, Cheese 6, Ham 5, Jam 4, Egg 2, with the tallies drawn in groups of five and the counts in a number column.

Tallies are hard to miscount, because the marks arrive in fives: Vegemite is one group of five and three marks, 5 + 3 = 8. The tallies give us the count for each category, ready to report.

Acquiring data — chance experiments

Not every question is about people. Some data is acquired through **chance experiments** — repeat a chance setup, like rolling a die, and record the outcome each time. Our class rolled a fair die (each face just as likely as any other) 30 times:



A column graph of 30 rolls of a fair die: face 1 came up 5 times, 2 came up 6 times, 3 came up 4 times, 4 came up 6 times, 5 came up 5 times and 6 came up 4 times, with a red dashed line at 5 labelled '5 each, if all six faces came up equally'.

The outcomes vary by chance, so the counts come out uneven: faces 2 and 4 came up six times, faces 3 and 6 only four. With equal outcomes we would get 30 ÷ 6 = 5 each — the dashed line. Our counts sit close to that line but not on it, which is exactly what chance does in a short run of 30 rolls. If the outcomes were *not* equal — say one face came up far more often than the others — the bars would not sit near the line at all. Reporting how the outcomes spread around the line is reporting the **distribution**.

Validating data — check it before you trust it

Data straight off the page can hold mistakes: a skipped answer, a double count, a value that makes no sense. **Validating** the data means checking for these mistakes before the data is displayed or reported. Two quick checks work on any survey:

- **The total check.** The counts must add up to the number of people asked. In the tally chart, 8 + 6 + 5 + 4 + 2 = 25, and 25 students were asked — so nobody was missed and nobody counted twice.
- **The sense check.** Every value must be possible. A sandwich filling with −3 votes is not possible; nor is a rating of 9 on a 1-to-5 scale.

Spreadsheets can run the sense check for you. In a spreadsheet, each column is set to a data **type** — text, number or date — and the spreadsheet validates every entry against its column's type:

A spreadsheet checks each column against its data type

	A	B	C
1	**Name** *(text)*	**Favourite number** *(number)*	**Birthday** *(date)*
2	Ava	7	12/03/2016
3	Ben	twelve	05/07/2016
4	Chloe	3	31/02/2016
5	Dan	9	18/11/2016

a word, not a number

there is no 31 February

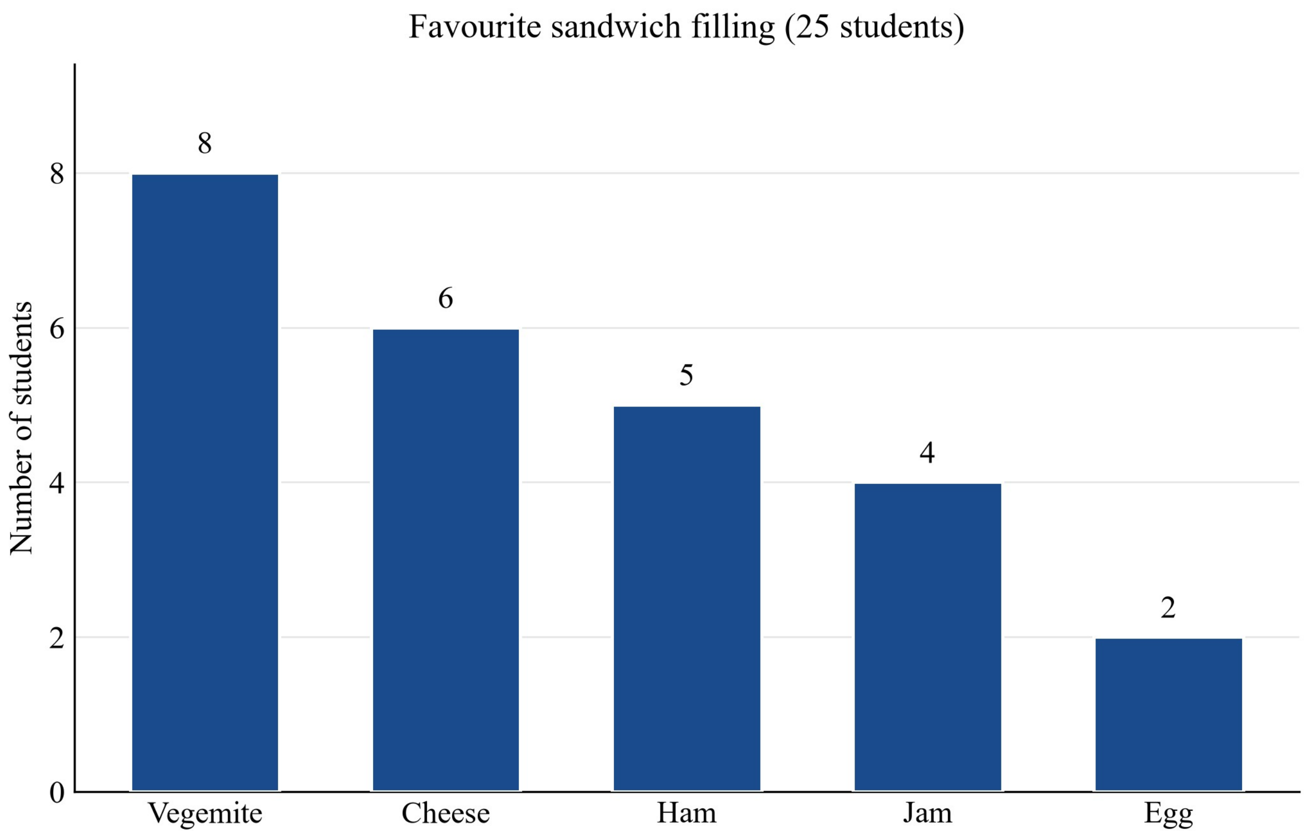
A spreadsheet with columns Name (text), Favourite number (number) and Birthday (date); the word 'twelve' in the number column and the impossible date 31/02/2016 are marked in red as mistakes.

Two entries fail. Ben's favourite number is entered as the word "twelve" — a word, not a number, so the number column rejects it. Chloe's birthday is entered as 31/02/2016 — there is no 31 February in any year, so the date column rejects it. Setting the data types is what makes the spreadsheet catch both; this is the step that validates the data. Ava's and Dan's rows pass every check, so those rows are safe to use.

Representing data — choose a display that fits

The display must fit the *type* of data. Three displays do most of the work at this level.

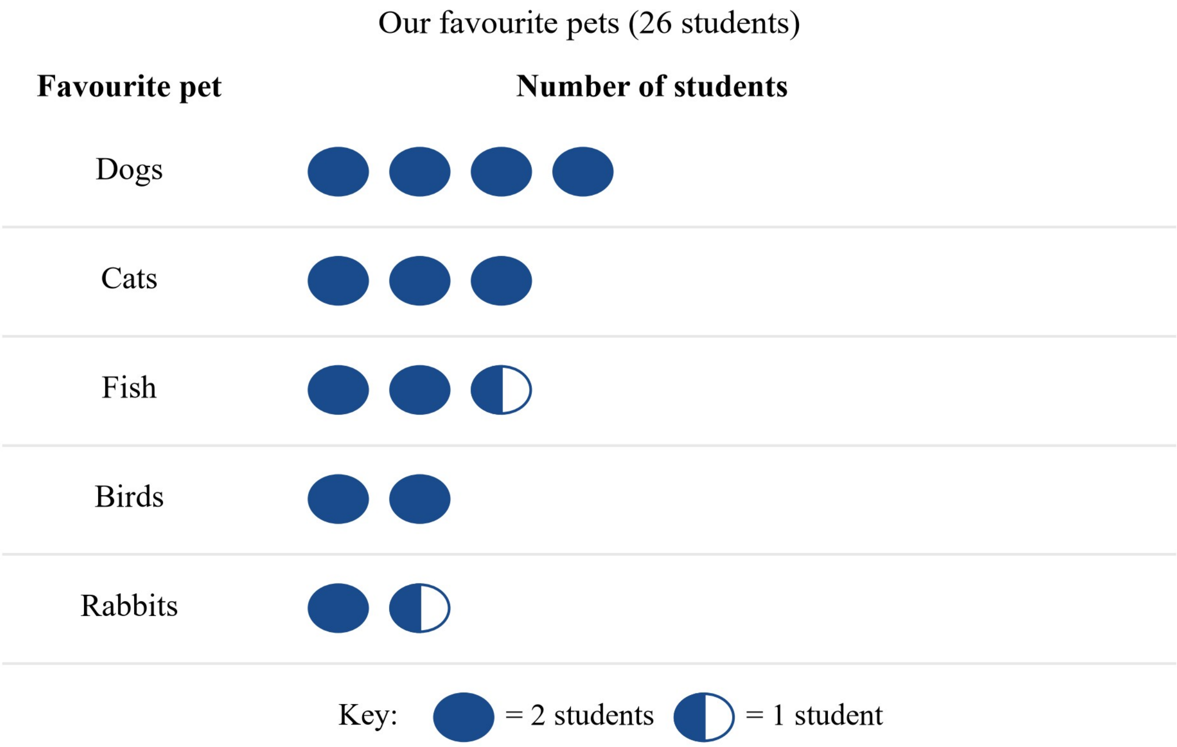
Column graphs suit nominal and ordinal data: one column per category, height equal to the count. Here is the sandwich survey as a column graph:



A column graph of the sandwich survey: Vegemite 8, Cheese 6, Ham 5, Jam 4, Egg 2, with the counts written above the columns.

For ordinal data, keep the categories in their order on the page (1 to 5, or 1st to 5th), so the order you are claiming is the order the reader sees.

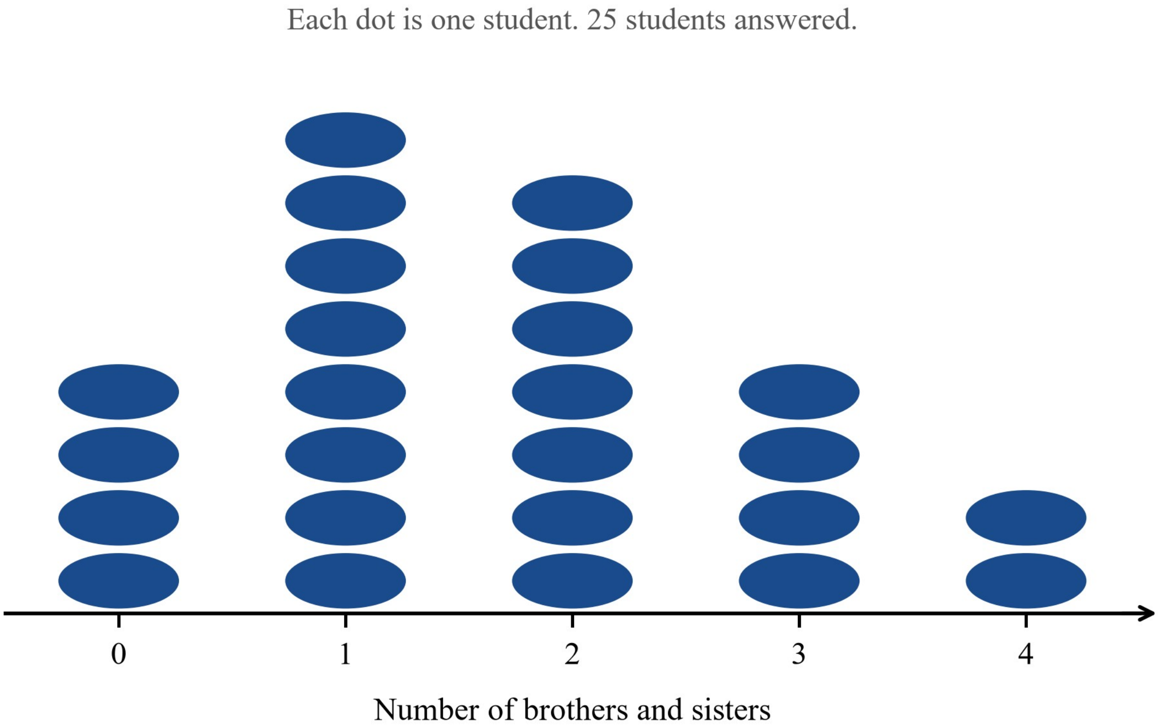
Pictographs suit small counts: pictures stand for a fixed number of answers, stated in a key. Half a picture stands for half the key number.



A pictograph of favourite pets for 26 students: Dogs 8, Cats 6, Fish 5, Birds 4, Rabbits 3, with a key showing one picture equals 2 students and a half picture equals 1 student.

Fish has 5 votes: two whole pictures and one half picture, 2 + 2 + 1 = 5. The key is what makes a pictograph honest — without it, the pictures prove nothing.

Dot plots suit discrete numerical data: a number line of the values, with one dot per answer stacked above its value.



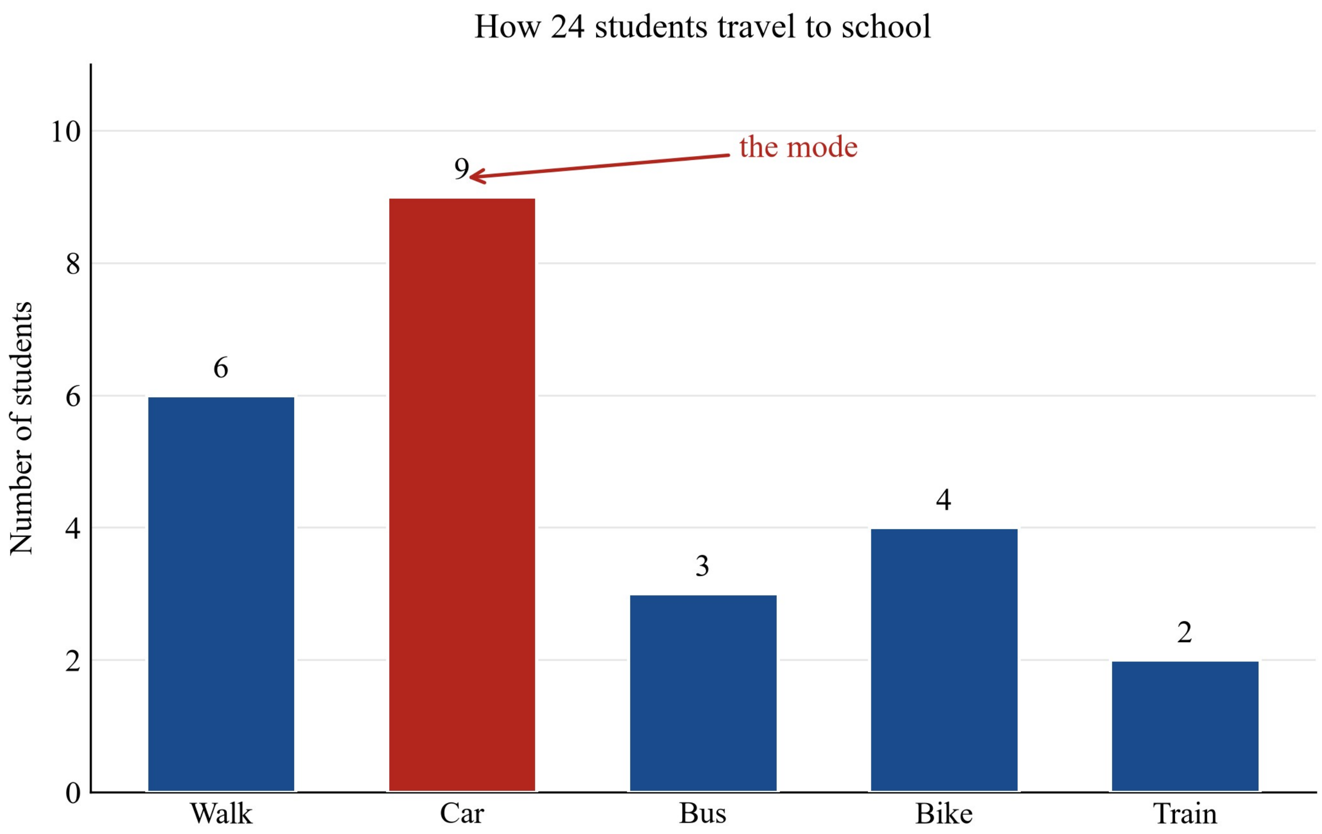
A dot plot of the number of brothers and sisters in the class: 0 has 4 dots, 1 has 8 dots, 2 has 7 dots, 3 has 4 dots and 4 has 2 dots, one dot per student.

A dot plot keeps every single answer visible, which is why it is the display of choice for counts. Spreadsheets and other software will draw all three displays straight from a table of data — the same data, represented three ways.

No matter which display you choose, you must be able to say why it fits: name the type of the data, and say why the display suits it.

The mode — the value with the highest frequency

The **frequency** of a value is the number of times it comes up in the data. The **mode** is the value with the highest frequency — the most common value.



A column graph of how 24 students travel to school: Walk 6, Car 9, Bus 3, Bike 4, Train 2, with the tallest column, Car, in red and labelled 'the mode'.

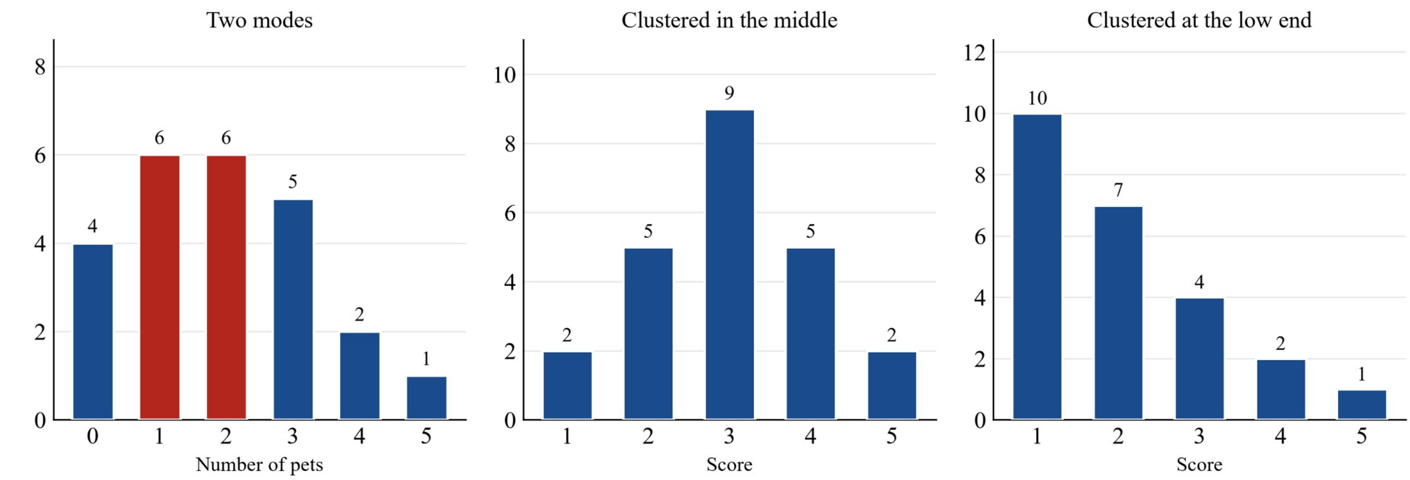
Nine students travel by car, more than any other way, so **Car is the mode** of this data. Watch the trap: the mode is the *value* (Car), not its frequency (9). On a column graph the mode is simply the tallest column.

Data does not always have one mode. If two values share the highest frequency, the data has **two modes** — the die data above has two modes, faces 2 and 4, and panel 1 below has two modes as well. And if every value comes up the same number of times, no value is most common, so there is no mode at all.

Shape — what the whole distribution looks like

The **distribution** is the whole picture: every value together with its frequency. To report a distribution in context, give its mode(s) and then describe its **shape** in plain words — where the data clusters, and where it thins out.

Reading a distribution: its mode(s) and its shape



Three small column graphs side by side: one with two modes at 1 and 2 pets, one with scores clustered in the middle around 3, and one with scores clustered at the low end at 1 and 2.

- **Panel 1, two modes:** the number of pets in 24 families. The modes are 1 and 2 pets (six families each).
- **Panel 2, clustered in the middle:** most scores sit at 3, and the frequencies fall away on both sides.
- **Panel 3, clustered at the low end:** most scores sit at 1 and 2, and the frequencies fall away towards 5.

Shape sentences always live in the context of the data: “Most families have 1 or 2 pets” says more than “the bars go down”. That is the report we are after — mode and shape, in context.

Worked examples

Example 1 — with help: classify the variable

Name the type of data each question of interest would collect.

Working	Comment
a. What is your eye colour? Colours are names with no order.	Nominal categorical.
b. Rate the canteen pies from 1 to 5. Numbers stand for ordered categories.	Ordinal categorical.
c. How many sisters do you have? A count: 0, 1, 2, …	Discrete numerical.
d. What is your favourite day of the week? Days are names; no day is “higher”.	Nominal categorical.
e. What place did you finish in the race? 1st, 2nd, 3rd — ordered categories.	Ordinal categorical.

∴ Names with no order are nominal, ordered categories are ordinal, and counts are discrete numerical — even when ordinal data borrows numbers.

Example 2 — with help: validate and report the sandwich survey

Validate the tally chart, then report the distribution in context.

Working	Comment
Total check: 8 + 6 + 5 + 4 + 2 = 25.	25 students were asked, so every answer is counted once.

Working	Comment
Sense check: every count is a whole number from 0 to 25.	All values are possible. The data is validated.
Highest frequency: 8, for Vegemite.	The mode is Vegemite.
Shape: counts fall from 8 down to 2.	One tall category, thinning out after.

∴ The data passes both checks, and in context: *Vegemite is the most popular filling (the mode, with 8 of the 25 students), and support falls away for the other fillings.*

Example 3 — with help: read a dot plot

Use the dot plot of brothers and sisters. How many students answered? What is the mode? Describe the shape.

Working	Comment
Count the dots: 4 + 8 + 7 + 4 + 2 = 25.	One dot per student, so 25 students answered.
Tallest stack: 8 dots above 1.	The mode is 1 — the value, not the 8.
Most dots sit above 0, 1 and 2; few above 3 and 4.	The data clusters at the low end.

∴ 25 students answered, the mode is 1 brother or sister, and the distribution clusters at the low end: most students in the class have few or no brothers and sisters.

Example 4 — on your own: validate a spreadsheet

Find the two entries the spreadsheet on the previous page rejects, and say why.

Ben's cell holds "twelve" in the number column: **a word is not a number, so the number column rejects it**. Chloe's cell holds 31/02/2016 in the date column: **February never has 31 days, so the date column rejects it**. Ava's and Dan's rows hold a word, a number and a possible date, so both rows pass every check.

Example 5 — on your own: report the die data

Report the 30-roll die data: compare the counts with the equal-outcomes line, and find the mode(s).

Equal outcomes would give 30 ÷ 6 = 5 rolls per face. The counts (5, 6, 4, 6, 5, 4) all sit within one roll of the line — close to equal, as a fair die should be in a short run. The highest frequency is 6, shared by faces 2 and 4, so this data has two modes.

∴ In context: *the six faces came up close to equally often, with 2 and 4 as the two modes.*

Example 6 — on your own: choose a display

Choose a display for each set of data, and say why it fits.

a. The eye colours of the students in your class.

b. The number of brothers and sisters of each student in your class.

c. Eye colour is nominal categorical data — names with no order. **A column graph** fits: one column per colour, and the tallest column shows the most common colour. b. Brothers and sisters is discrete numerical data — a count. **A dot plot** fits: one dot per student, stacked above each value on a number line, so every answer stays visible.

Practice questions

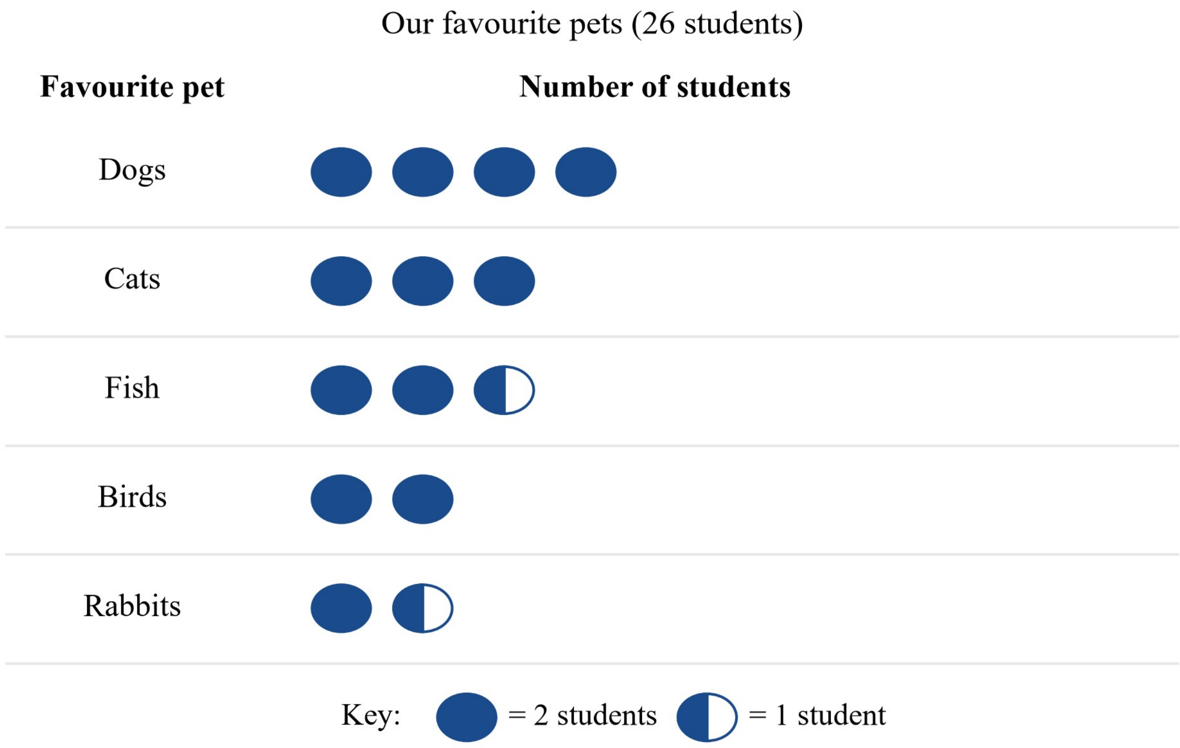
With help

Q1. Name the type of data each question of interest would collect.

a. What is your hair colour?
b. How many pets do you have?

c. What place did you finish in the swimming race?
d. What is your favourite fruit?
e. How many goals did you kick this term?

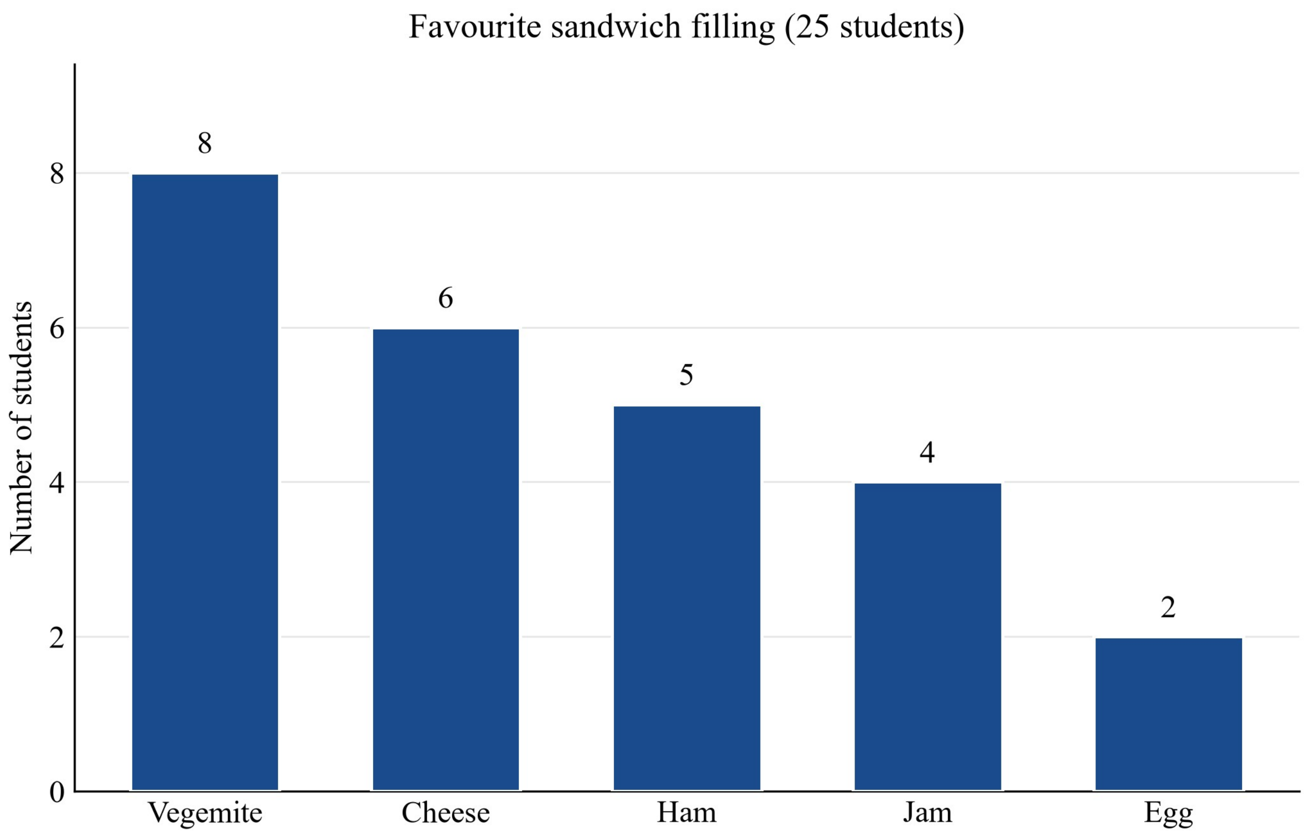
Q2. Use the pictograph of favourite pets.



A pictograph of favourite pets for 26 students: Dogs 8, Cats 6, Fish 5, Birds 4, Rabbits 3, with a key showing one picture equals 2 students and a half picture equals 1 student.

a. How many students chose Dogs?
b. Which pet is the mode?
c. Why does the Fish row end in a half picture?
d. Check the total: do the counts add up to 26 students?

Q3. Use the column graph of the sandwich survey.



A column graph of the sandwich survey: Vegemite 8, Cheese 6, Ham 5, Jam 4, Egg 2, with the counts written above the columns.

a. How many students answered the survey?
b. What is the mode?
c. How many more students chose Cheese than Egg?

Q4. The class rates the school concert from 1 to 5.

a. What type of data is a rating out of 5?
b. Zara says a rating of 4 is twice as good as a rating of 2. Is Zara right? Explain.

Q5. Each entry below sits in a spreadsheet column. Which entries would the column reject, and why?

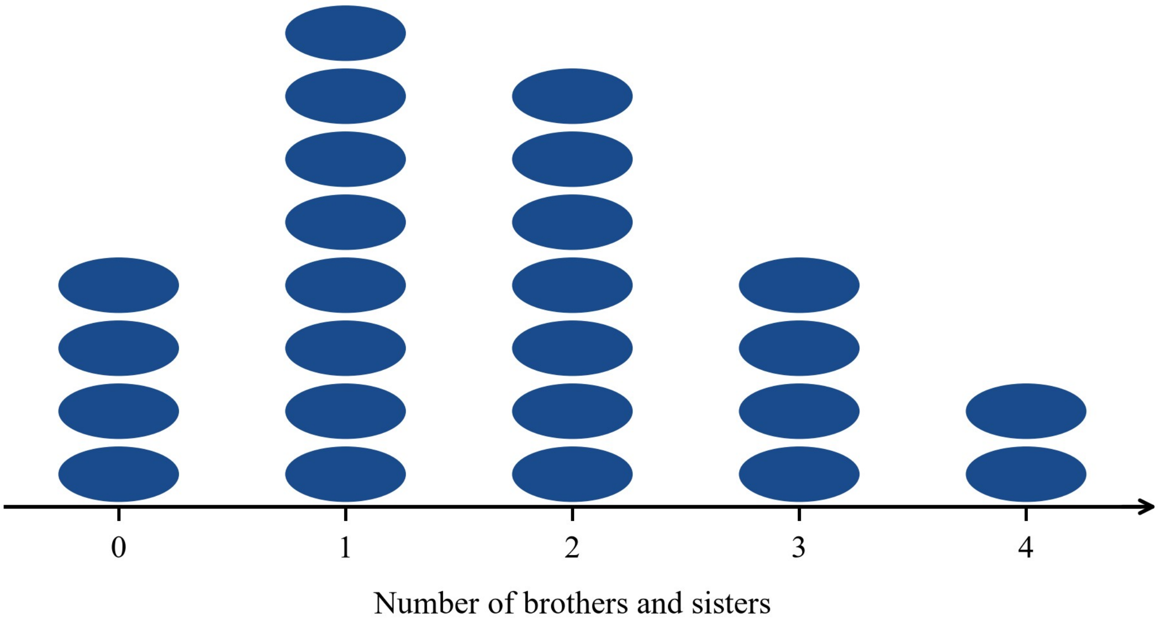
a. A date column holding 29/02/2026.
b. A number column holding 7.
c. A number column holding “seven”.
d. A text column holding “Ava”.

Q6. Find the mode(s).

a. Red, Blue, Red, Green, Red, Blue, Green
b. 2, 2, 3, 3, 5, 5, 1
c. 4, 4, 4, 7, 7, 7, 2

Q7. The dot plot of brothers and sisters is shown again here.

Each dot is one student. 25 students answered.



A dot plot of the number of brothers and sisters in the class: 0 has 4 dots, 1 has 8 dots, 2 has 7 dots, 3 has 4 dots and 4 has 2 dots, one dot per student.

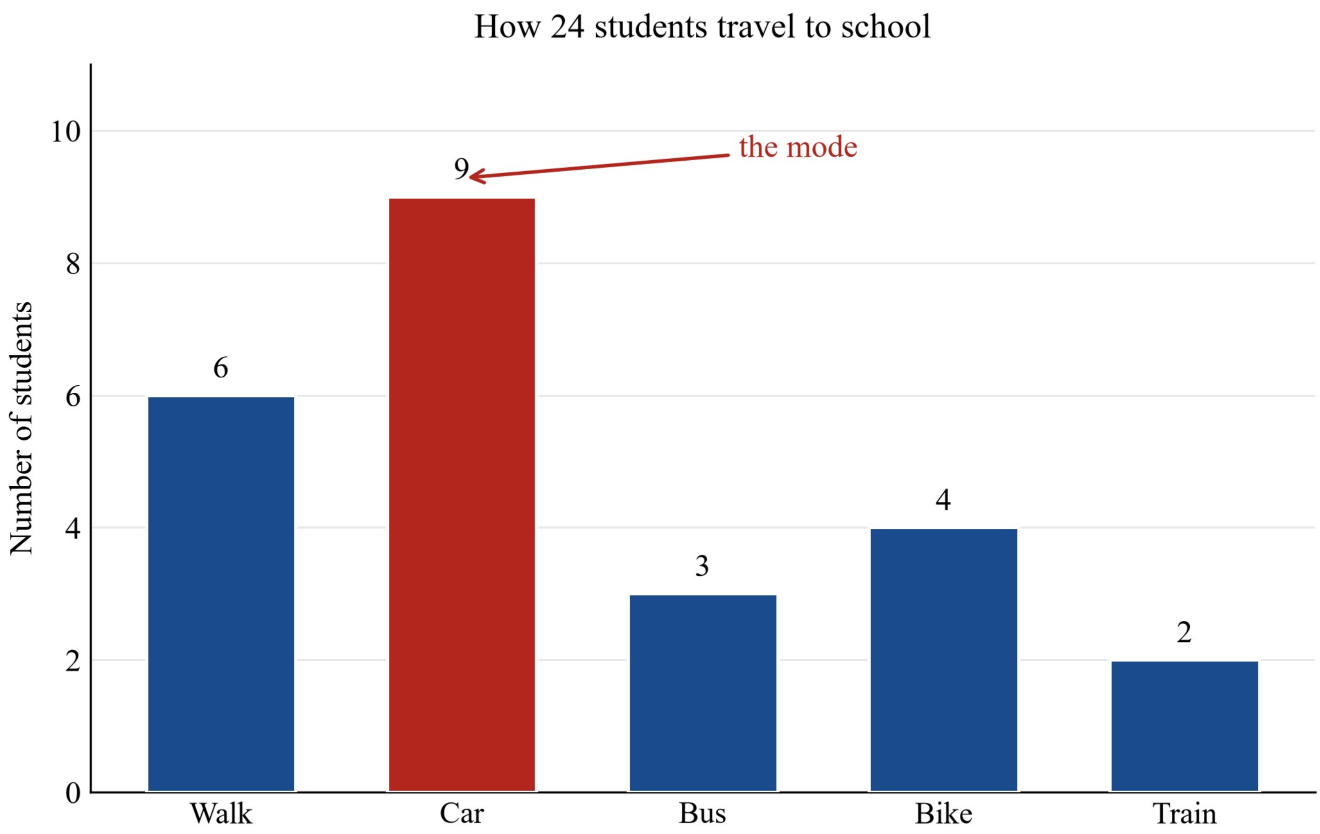
a. How many students have exactly 2 brothers and sisters?
b. How many students have no brothers and sisters?
c. True or false: more students have 1 than have 3 and 4 together.

Q8. True or false? If false, say why.

a. The mode is always the biggest value in the data.
b. A set of data can have two modes.
c. Ordinal data is numerical, because it is written with numbers.
d. Checking that the counts add up to the number of people asked is a way to validate data.

On your own

Q9. Use the column graph of how 24 students travel to school.



A column graph of how 24 students travel to school: Walk 6, Car 9, Bus 3, Bike 4, Train 2, with the tallest column, Car, in red and labelled 'the mode'.

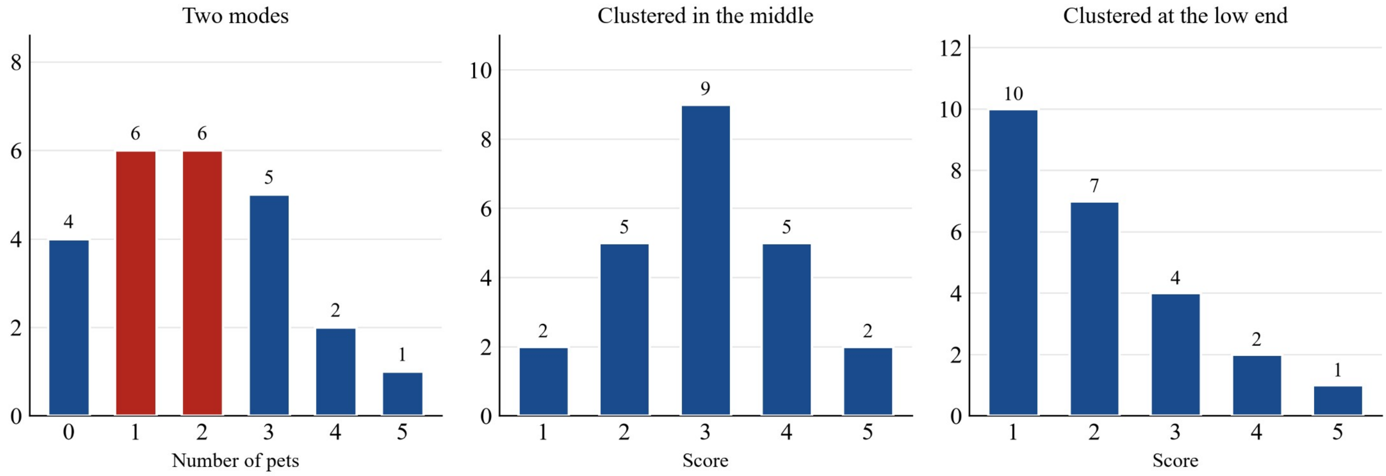
a. What is the mode?
b. Write one sentence reporting the distribution in context.

Q10. These are the numbers of people in 20 students' families:

3, 4, 5, 4, 3, 6, 4, 5, 3, 4, 2, 4, 5, 3, 4, 6, 3, 4, 5, 4

a. Make a tally of the data.
b. Draw a column graph of it.
c. What is the mode?

Q11. Describe the shape of each distribution in panel 2 and panel 3, in the context of the data.



Three small column graphs side by side: one with two modes at 1 and 2 pets, one with scores clustered in the middle around 3, and one with scores clustered at the low end at 1 and 2.

Q12. A fair coin is tossed 20 times: it lands heads 12 times and tails 8 times.

a. How many of each would equal outcomes give?
b. Does this result prove the coin is unfair? Explain.
c. What is the mode of the data?

Q13. Choose a display and say why it fits.

a. The favourite colour of 25 students (nominal data).
b. The number of books each student borrowed from the library this month, from 0 to 6 (discrete numerical data).

Q14. A spreadsheet holds three columns: student names, birthdays, and the number of books read this term. What data type should each column be set to?

Q15. The sandwich survey asked 25 students, but a careless recorder wrote the total as 24 before checking.

a. Which check catches the mistake?
b. What should the total be?

Q16. Ten students rate a new game from 1 to 5. Their ratings are:

3, 4, 5, 4, 2, 4, 5, 4, 3, 4

a. What is the mode?
b. Is this data discrete numerical or ordinal categorical? Explain.

Maths in real life

Q17. A board game club rolls a die 60 times to check the die. The counts are:

1 came up 9 times, 2 came up 11 times, 3 came up 10 times, 4 came up 8 times, 5 came up 12 times, 6 came up 10 times.

a. If all six faces were equally likely, how many times would each face come up?
b. Do the counts look close to equal? Is the die likely to be fair?
c. What is the mode of the data?

Q18. Mia types two entries into the date column of her family spreadsheet: 30/02/2015 and “next Tuesday”. Will the date column accept them? Explain each one.

Q19. The class asks 30 families: “On how many nights each week does your family eat dinner together?” The counts are:

Nights	0	1	2	3	4	5	6
Families	2	3	5	8	7	3	2

a. What type of data is this?

b. What is the mode?

c. Describe the shape, and write one findings sentence in the context of the families.

Answers

Q1. a. Nominal categorical. b. Discrete numerical. c. Ordinal categorical. d. Nominal categorical. e. Discrete numerical. **Q2.** a. 8. b. Dogs. c. 5 is odd: two whole pictures (4) plus a half picture (1). d. Yes: 8 + 6 + 5 + 4 + 3 = 26. **Q3.** a. 25. b. Vegemite. c. 2. **Q4.** a. Ordinal categorical. b. No — the numbers are labels, not counts. **Q5.** a. Rejected — no 29 February 2026. b. Accepted. c. Rejected — a word, not a number. d. Accepted. **Q6.** a. Red. b. No mode. c. Two modes: 4 and 7. **Q7.** a. 7. b. 4. c. True. **Q8.** a. False. b. True. c. False. d. True. **Q9.** a. Car. b. Answers vary. **Q10.** a. 2: 1, 3: 5, 4: 8, 5: 4, 6: 2. b. Columns of heights 1, 5, 8, 4, 2. c. 4. **Q11.** Answers vary (middle; low end). **Q12.** a. 10 and 10. b. No. c. Heads. **Q13.** a. Column graph (or pictograph). b. Dot plot. **Q14.** Names: text; birthdays: date; books read: number. **Q15.** a. The total check. b. 25. **Q16.** a. 4. b. Ordinal categorical. **Q17.** a. 10. b. Yes, close to equal; likely fair. c. 5. **Q18.** Both rejected. **Q19.** a. Discrete numerical. b. 3 nights. c. Answers vary.

Worked answers

Q1. Ask what the values are. a. Hair colours are names with no order — nominal categorical. b. Pets are counted — discrete numerical. c. Race places are ordered categories — ordinal categorical. d. Fruits are names with no order — nominal categorical. e. Goals are counted — discrete numerical. ∴ a and d nominal, b and e discrete numerical, c ordinal.

Q2. a. Dogs shows 4 whole pictures: 4 × 2 = 8 students. b. Dogs has the most votes, so Dogs is the mode. c. Fish has 5 votes: 5 = 2 + 2 + 1, so two whole pictures and one half picture. d. 8 + 6 + 5 + 4 + 3 = 26 — yes, the total matches the 26 students asked.

Q3. a. 8 + 6 + 5 + 4 + 2 = 25 students. b. Vegemite has the tallest column (8), so the mode is Vegemite. c. Cheese 6, Egg 4: 6 − 4 = 2. ∴ 2 more students chose Cheese than Egg.

Q4. a. The ratings 1 to 5 are labels for ordered categories — ordinal categorical data. b. No. A 4 is a better rating than a 2, but the numbers label categories; they are not counts, so “twice as good” has no meaning.

Q5. a. A date column checks that the date exists: 2026 is not a leap year, so 29/02/2026 is rejected. b. 7 is a number — accepted. c. “seven” is a word — a number column rejects it. d. A text column accepts names — accepted.

Q6. a. Red 3, Blue 2, Green 2 — the mode is Red. b. 2, 3 and 5 each occur twice and 1 occurs once; no value beats the others, so there is no mode. c. 4 occurs three times and 7 occurs three times, more than 2 — two modes, 4 and 7.

Q7. a. The stack above 2 has 7 dots. b. The stack above 0 has 4 dots. c. 8 students have 1; 3 and 4 together have 4 + 2 = 6; 8 is more than 6, so true.

Q8. a. False — in the dot plot the mode is 1, but 4 is the biggest value; the mode is the most common value, not the biggest. b. True — the die data has two modes, 2 and 4. c. False — the numbers are labels for ordered categories, so ordinal data is categorical. d. True — the total check validates the data.

Q9. a. Car has the tallest column (9), so Car is the mode. b. Example: *Most students travel by car — the mode — while walking is next and the train is the least common way.* Any sentence giving the mode in the context of travel is fine.

Q10. a. Tally each value in fives: 2 gives 1; 3 gives 5; 4 gives 8 (a five-group and three); 5 gives 4; 6 gives 2. b. One column per value, heights 1, 5, 8, 4, 2 above 2, 3, 4, 5, 6. c. The tallest column is 4 (8 families), so the mode is 4.

Q11. Panel 2: the tallest column is 3, with frequencies falling away the same way on both sides — the scores cluster in the middle. Panel 3: the tallest columns are 1 and 2, and the frequencies fall away towards 5 — the scores cluster at the low end. Any true shape sentence in the context of the scores is fine.

Q12. a. Equal outcomes: 20 ÷ 2 = 10 each. b. No. In a short run, chance gives uneven counts; 12 and 8 are close to 10 and 10, so the coin may well be fair. c. Heads came up more often (12), so the mode is heads.

Q13. a. The values are names (nominal), so one column per category — a column graph, or a pictograph with a key. b. The values are counts, so a dot plot shows every answer on a number line. The reason is the point: name the type, then match the display to it.

Q14. Names are words — text. Birthdays are dates — date, so impossible dates get rejected. Books read is a count — number, so words like “twelve” get rejected.

Q15. a. The total check: the counts must add up to the number of students asked. b. 8 + 6 + 5 + 4 + 2 = 25, so the total should be 25, and the written 24 shows a recording mistake.

Q16. a. The counts are: 2 once, 3 twice, 4 five times, 5 twice. The mode is **4** (five students). b. Ordinal categorical: the numbers 1 to 5 are labels for ordered categories, not counts, even though they are written with numbers.

Q17. a. Equal outcomes: 60 ÷ 6 = 10 each. b. The counts (9, 11, 10, 8, 12, 10) all sit within two rolls of 10 — close to equal, so the die is likely to be fair. c. Face 5 came up most often (12 times), so the mode is **5**.

Q18. No — the date column rejects both. 30/02/2015 is not a possible date: February never has 30 days, in any year. “next Tuesday” is a group of words, not a date, so the date column rejects it too.

Q19. a. The values are counts (0 to 6 nights) — discrete numerical data. b. The highest frequency is 8 families, at 3 nights: the mode is **3 nights**. c. The counts rise to 3 and 4 nights and fall away on both sides, so most families eat dinner together 3 or 4 nights a week. Example findings sentence: *In our survey of 30 families, the most common number of family dinners together was 3 nights a week, and most families managed 3 or 4 nights.*

Line graphs and change over time

> **Code `VC2M5ST02`** (Victorian Curriculum F–10 Version 2.0, Mathematics, Level 5; authority file `maths_5.json`): "interpret line graphs representing change over time; discuss the relationships that are represented and conclusions that can be made". This section draws on `VC2M5ST02.E01`, `.E02`, `.E03` and `.E04`.

From the Level 5 achievement standard: *They interpret and compare data represented in line graphs.*

Theory

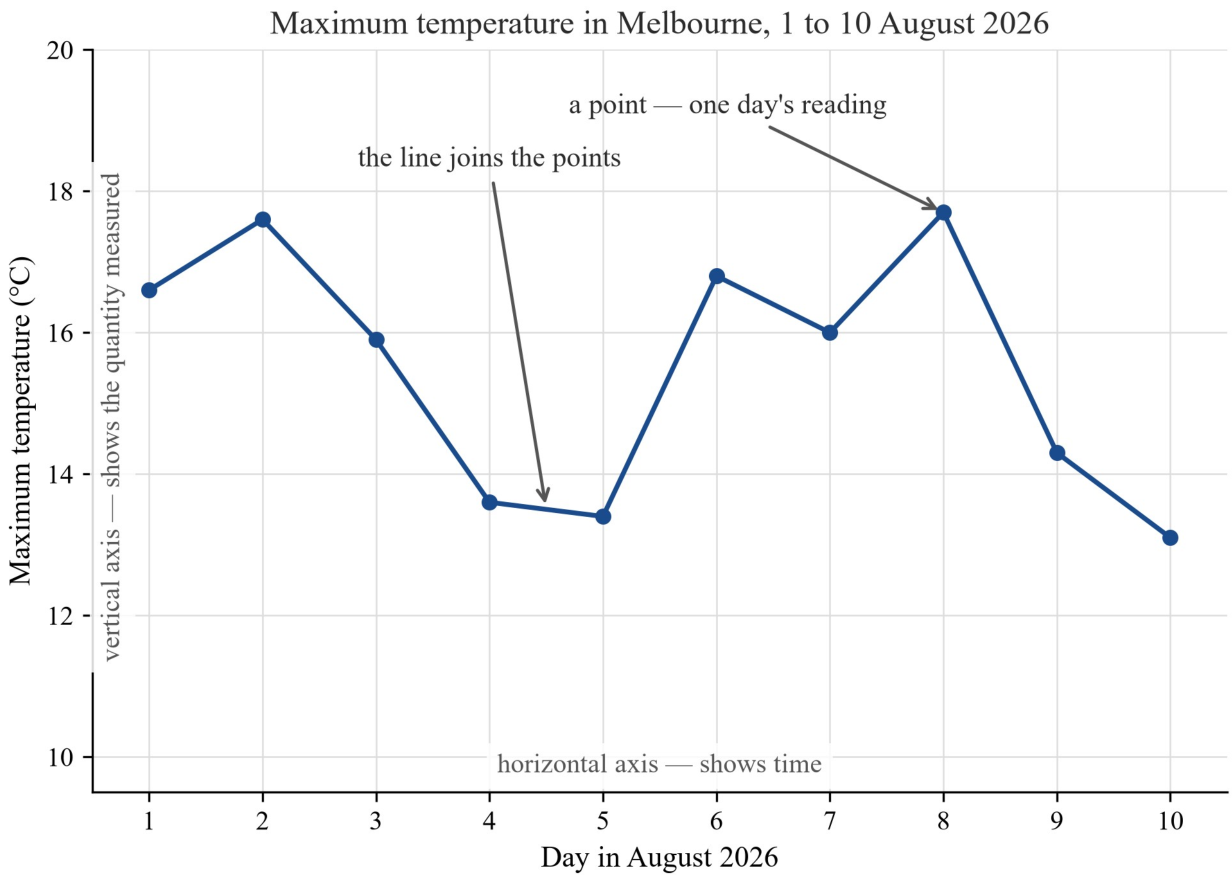
A picture that shows change

In 7A you displayed data that a class collected. This section is about a different job: showing how one thing **changes as time passes**. Every day, the Bureau of Meteorology records the hottest and coldest temperatures at weather stations all over Victoria. Every few minutes, ARPANSA measures the strength of the sun's UV rays. One day's number tells you very little — but line up the numbers day after day, and a story appears.

The display for this job is the **line graph**. In this section all the data is real: Melbourne and Ballarat temperatures and Melbourne UV readings, each one with its date.

The parts of a line graph

Here are the daily maximum temperatures in Melbourne for the first ten days of August 2026, drawn as a line graph.



A line graph of Melbourne maximum temperatures for 1 to 10 August 2026, with notes showing the horizontal axis (shows time), the vertical axis (shows the quantity measured), one point (one day's reading) and the line joining the points.

Source: Bureau of Meteorology, Daily Weather Observations for Melbourne (Olympic Park), Victoria, retrieved 20 August 2026.

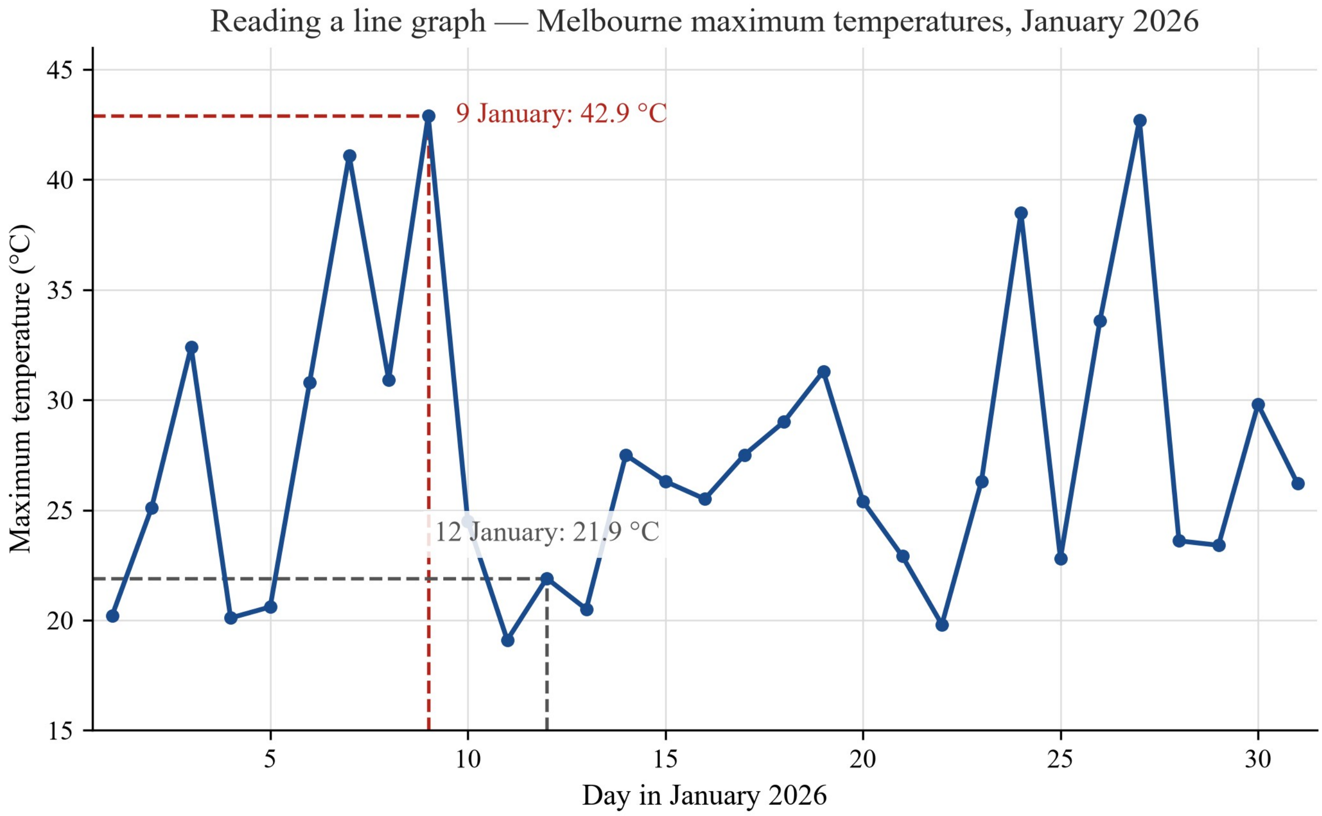
Every line graph has the same parts:

- the **horizontal axis** shows **time** — here, the days from 1 to 10 August 2026;
- the **vertical axis** shows **what is being measured** — here, the maximum temperature in degrees Celsius (°C);
- each **point** is one reading — one day's maximum temperature;
- the **line joins the points**, so your eye can follow the change from day to day.

This is the rule for line graphs at this level: **time always goes on the horizontal axis**, and the thing you are measuring goes on the vertical axis.

Reading a value from a line graph

To read one value, use two steps: find the time on the horizontal axis, go **up** to the point, then go **across** to the vertical axis and read the number.



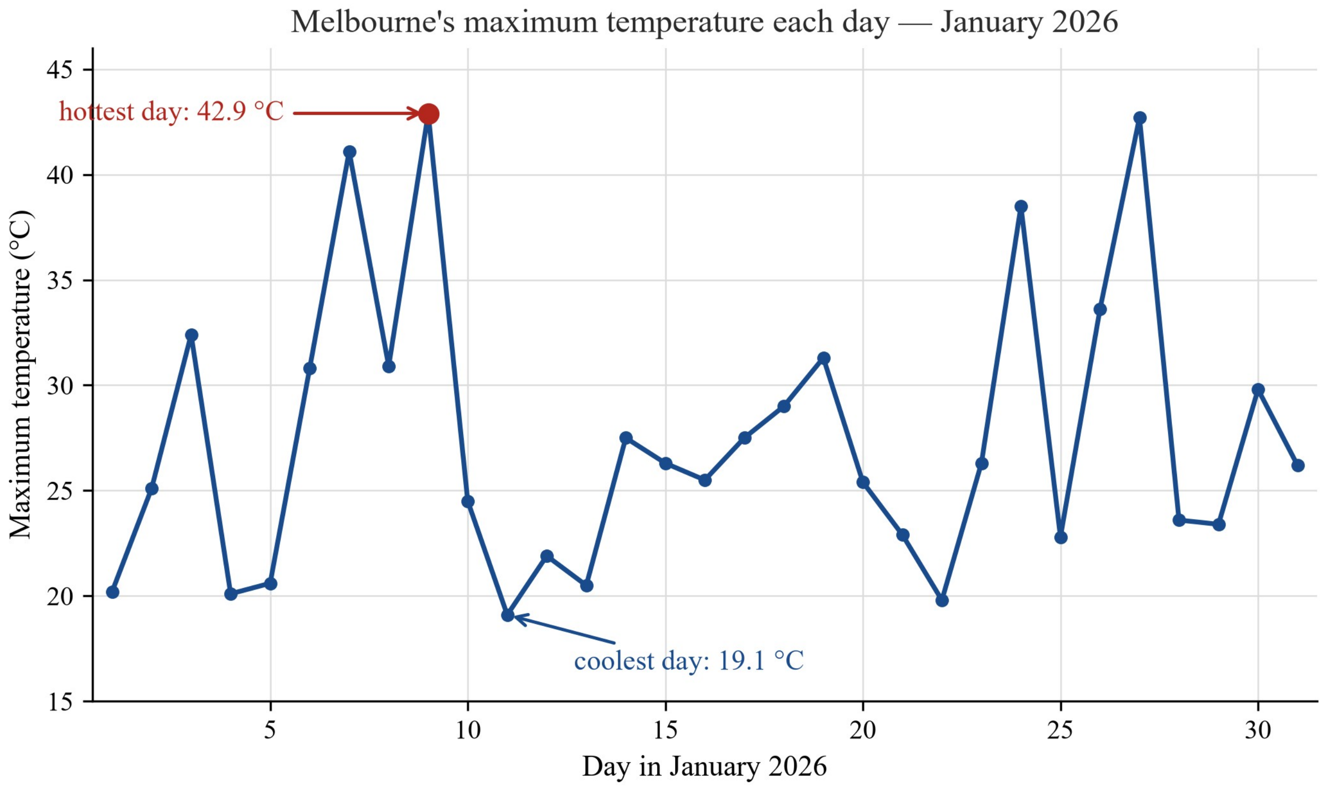
A line graph of Melbourne maximum temperatures in January 2026, with dashed guides reading 9 January as 42.9 degrees Celsius and 12 January as 21.9 degrees Celsius.

- **9 January:** go up from 9 on the horizontal axis to the point, then across — the maximum temperature was **42.9 °C**.
- **12 January:** the same two steps give **21.9 °C**.

Read against the marks on the vertical axis, and count the grid lines carefully — 42.9 °C sits just under the 43 mark, and 21.9 °C just under the 22 mark.

Describing change over time

The point of a line graph is the **change**. Read the line from left to right and say what it does: it rises, it falls, it stays steady, or it does these in turns.



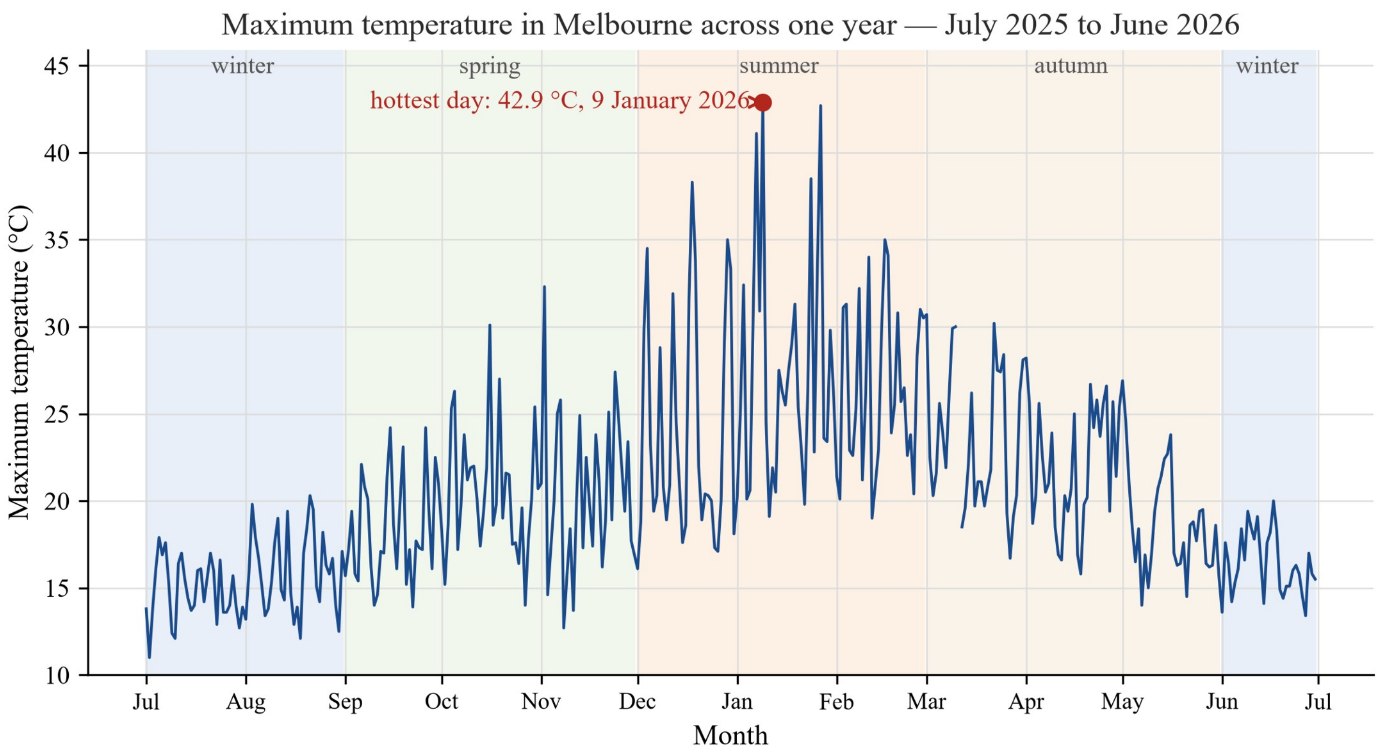
A line graph of Melbourne's maximum temperature each day in January 2026, with the hottest day marked at 42.9 degrees Celsius on 9 January and the coolest day marked at 19.1 degrees Celsius on 11 January.

Melbourne's daily maximum temperatures in January 2026 jump around a lot. The hottest day was **9 January at 42.9 °C** and the coolest day was **11 January at 19.1 °C** — and between 9 January and 11 January the maximum temperature dropped 42.9 − 19.1 = **23.8 °C in just two days**.

A good change sentence always names the dates and the numbers: *"The maximum temperature rose to 42.9 °C on 9 January, then dropped fast to 19.1 °C by 11 January"* says far more than *"it went down"*.

A whole year of change

Now zoom out to a full year of Melbourne daily maximum temperatures, from 1 July 2025 to 30 June 2026 — 365 readings on one graph.



A line graph of Melbourne maximum temperatures across one year, July 2025 to June 2026, with coloured season bands and the hottest day marked at 42.9 degrees Celsius on 9 January 2026.

The line is bumpy day to day, but the big shape is clear:

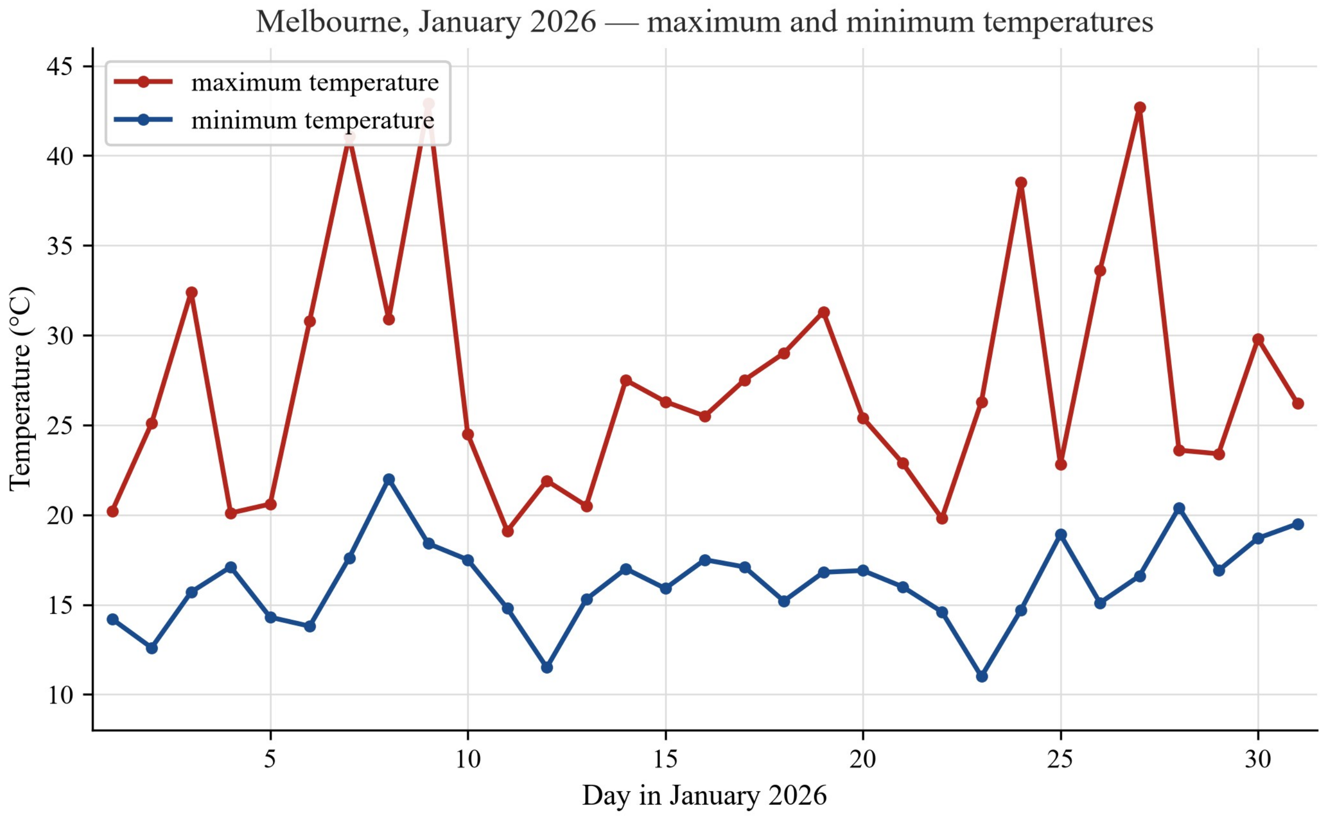
- the highest temperatures sit in the **summer** band (December to February), and the hottest day of the year was **9 January 2026 at 42.9 °C**;
- the lowest temperatures sit in the **winter** bands (June to August), and the coolest maximum temperature of the year was **11.0 °C on 2 July 2025**;
- six months of the year never reached 30 °C at all: July, August and September 2025, and April, May and June 2026.

This is the pattern of **seasons in Australia**: summer is in December, January and February, so Melbourne's hottest time is around January — not July.

There is one more thing to find: a small break in the line in March. The reading for **11 March 2026 is missing** — the station recorded no maximum temperature that day. A gap like that is data worth talking about, not a mistake to hide.

Two lines on one graph

One graph can carry more than one line, as long as both lines are measured against the same time axis. Here are Melbourne's **maximum** temperatures (the day's hottest temperature) and **minimum** temperatures (the coldest temperature at night) for January 2026, on one graph.



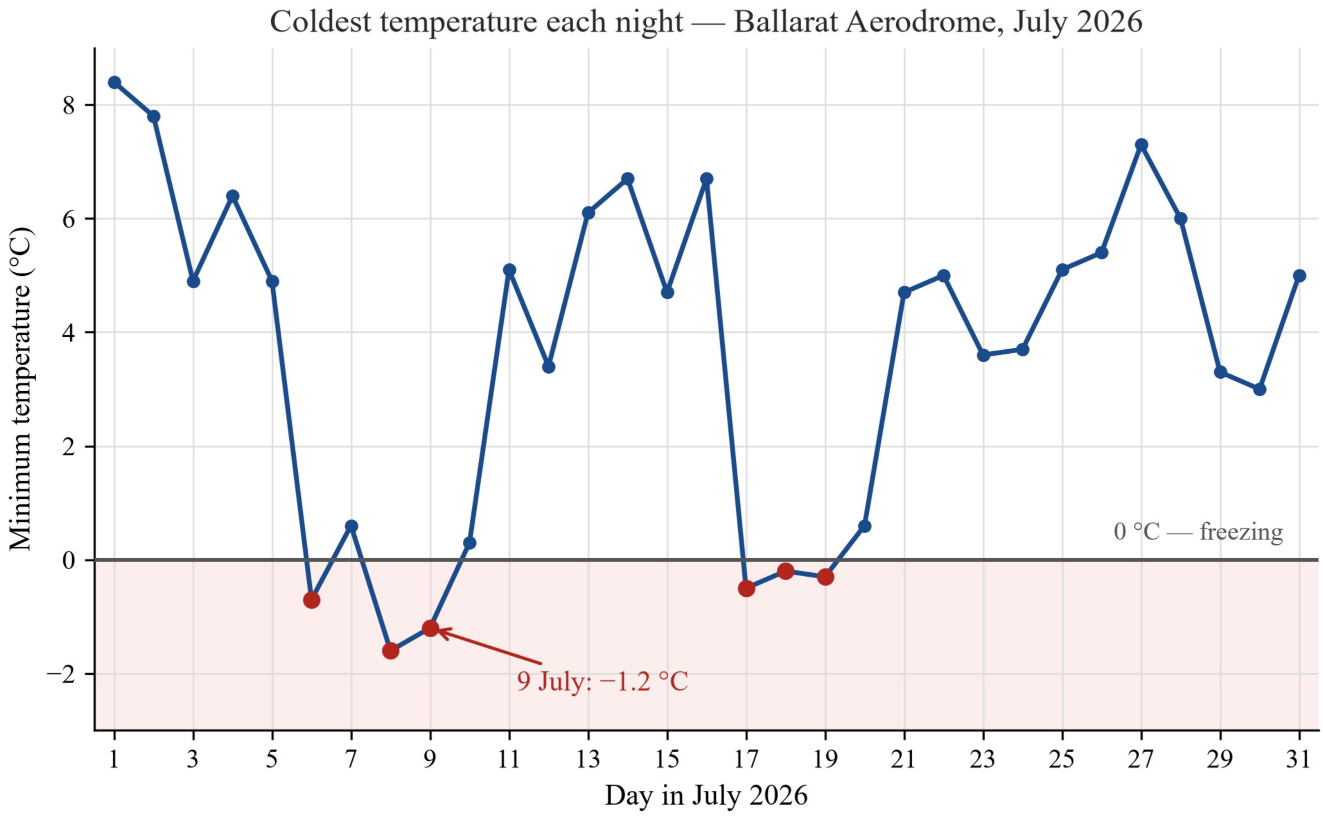
A line graph with two lines for Melbourne in January 2026: the maximum temperature in red and the minimum temperature in blue, with a key in the top-left corner.

The **key** tells you which line is which — never guess. On this graph:

- the red line (maximum temperature) is always above the blue line (minimum temperature) — a day's hottest temperature is never lower than the coldest temperature recorded in the same 24 hours;
- the **gap between the two lines** shows how much the temperature changed between the coldest part of the night and the hottest part of the day;
- the warmest night of the month was **8 January, when the minimum temperature was 22.0 °C** — a night that never cooled down much at all.

Below zero

The vertical axis can go below zero. In winter, cold nights in Victoria often drop below 0 °C — freezing — and a line graph shows that directly.



A line graph of the coldest temperature each night at Ballarat Aerodrome in July 2026, with a line marked 0 degrees Celsius freezing, the band below zero shaded, six below-zero nights marked in red, and 9 July labelled at −1.2 degrees Celsius.

Source: Bureau of Meteorology, Daily Weather Observations for Ballarat Aerodrome, Victoria, retrieved 20 August 2026.

The grey line at **0 °C — freezing** splits the graph. Points below it are below-zero nights, and the shaded band helps you find them. In July 2026, Ballarat Aerodrome had **six nights below zero**: 6 July (−0.7 °C), 8 July (−1.6 °C), 9 July (−1.2 °C), 17 July (−0.5 °C), 18 July (−0.2 °C) and 19 July (−0.3 °C). The night marked on the graph, **9 July, was −1.2 °C**, and the coldest night of the month was **8 July at −1.6 °C**.

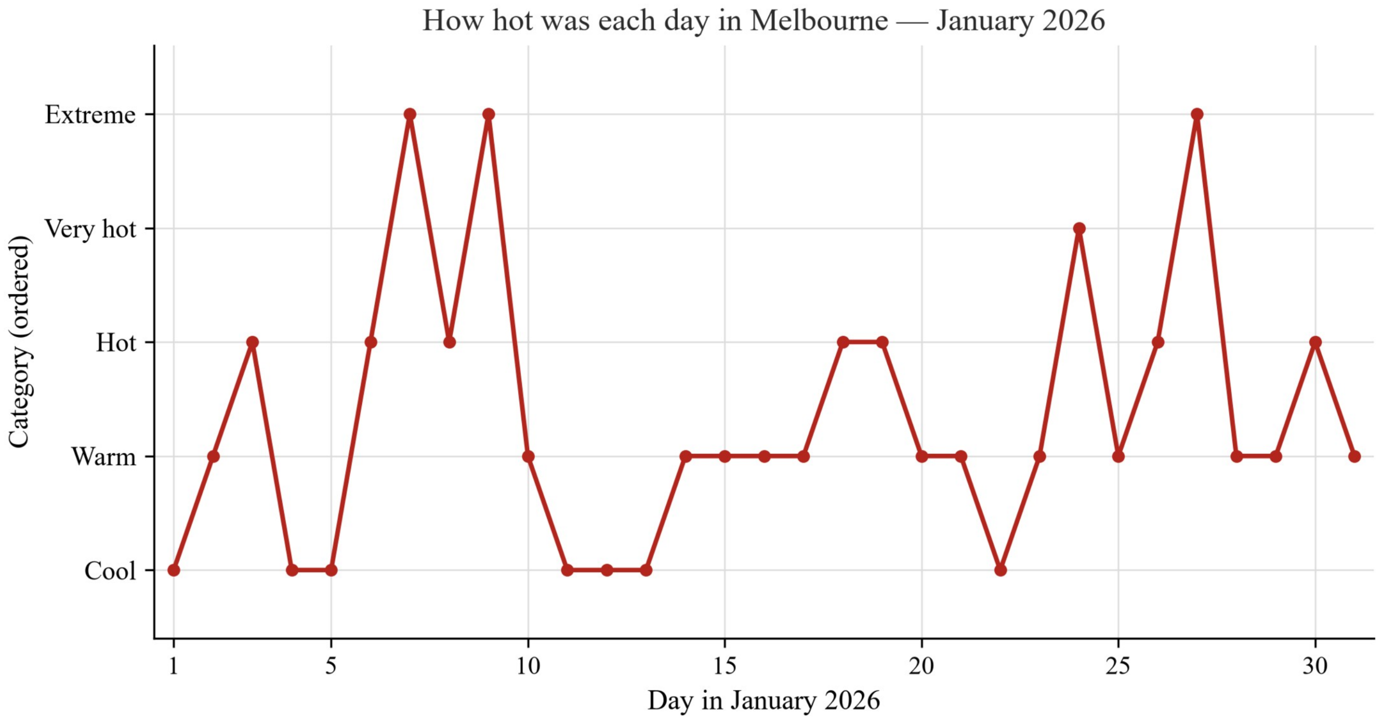
Temperatures below zero carry the − sign: −1.2 °C means 1.2 degrees colder than freezing.

Ordered categories on the vertical axis

The vertical axis does not have to be numbered with measurements. It can carry **ordered categories** — an ordinal scale, like the ratings you met in 7A. The Bureau of Meteorology sorts days by how hot they are, and we can do the same:

Category	Maximum temperature
Cool	below 22 °C
Warm	22 °C to below 28 °C
Hot	28 °C to below 35 °C
Very hot	35 °C to below 40 °C
Extreme	40 °C and above

Now plot each January 2026 day as its hotness category instead of its temperature:

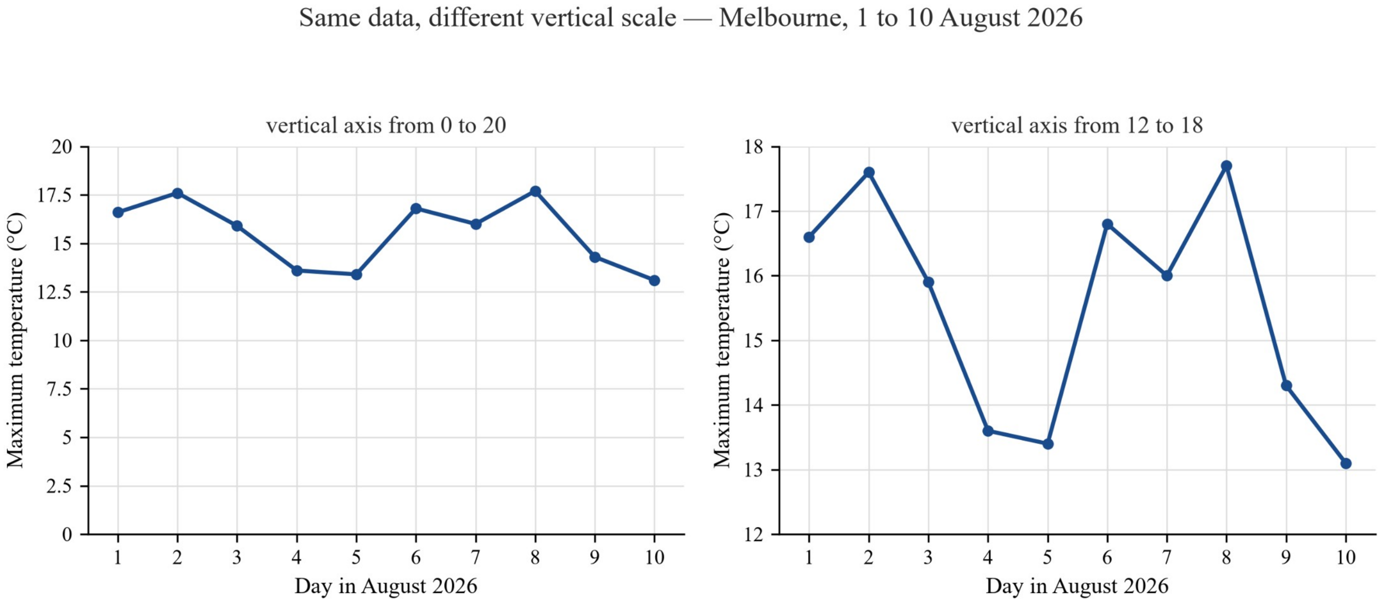


A line graph of how hot each day in Melbourne was in January 2026, with an ordered vertical axis of categories: Cool, Warm, Hot, Very hot, Extreme.

The vertical axis still goes in order from low to high — Cool at the bottom, Extreme at the top — but the steps are categories, not measured numbers. Counting the days in each category: **Cool 7, Warm 13, Hot 7, Very hot 1, Extreme 3**. Most of January was Warm or cooler, even though four days reached 35 °C or more.

Choosing the vertical scale

The same data can look very different under different vertical scales. Here are the 1 to 10 August maximum temperatures drawn twice.



Two line graphs side by side of the same Melbourne maximum temperatures for 1 to 10 August 2026, one with a vertical axis from 0 to 20 and one with a vertical axis from 12 to 18.

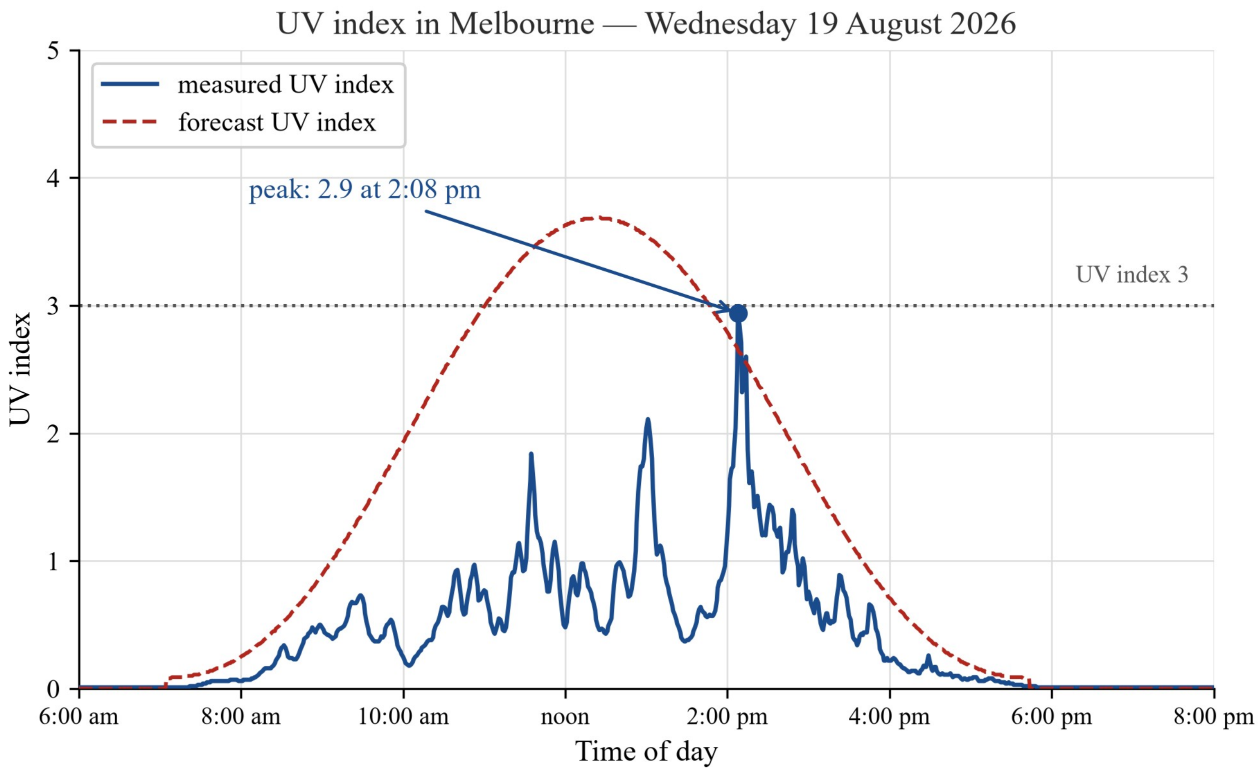
Both graphs hold exactly the same ten readings. In the left panel the vertical axis runs from 0 to 20, and the changes look small. In the right panel the vertical axis runs from 12 to 18, and the same changes look big. **The data did not change — only the scale did.**

Always read the numbers on the vertical axis before you describe a change as “big” or “small”. A graph that starts its vertical axis well above zero can make a small change look dramatic — and the scale choice is something the graph maker made, not something the data did.

UV across one day — when is it safest outside?

Line graphs can use the time of day on the horizontal axis, not just dates. ARPANSA measures the **UV index** in Melbourne every few minutes. The UV index measures the strength of the sun’s UV rays: **when it is 3 or above, sun protection is needed**.

Here is a winter day:

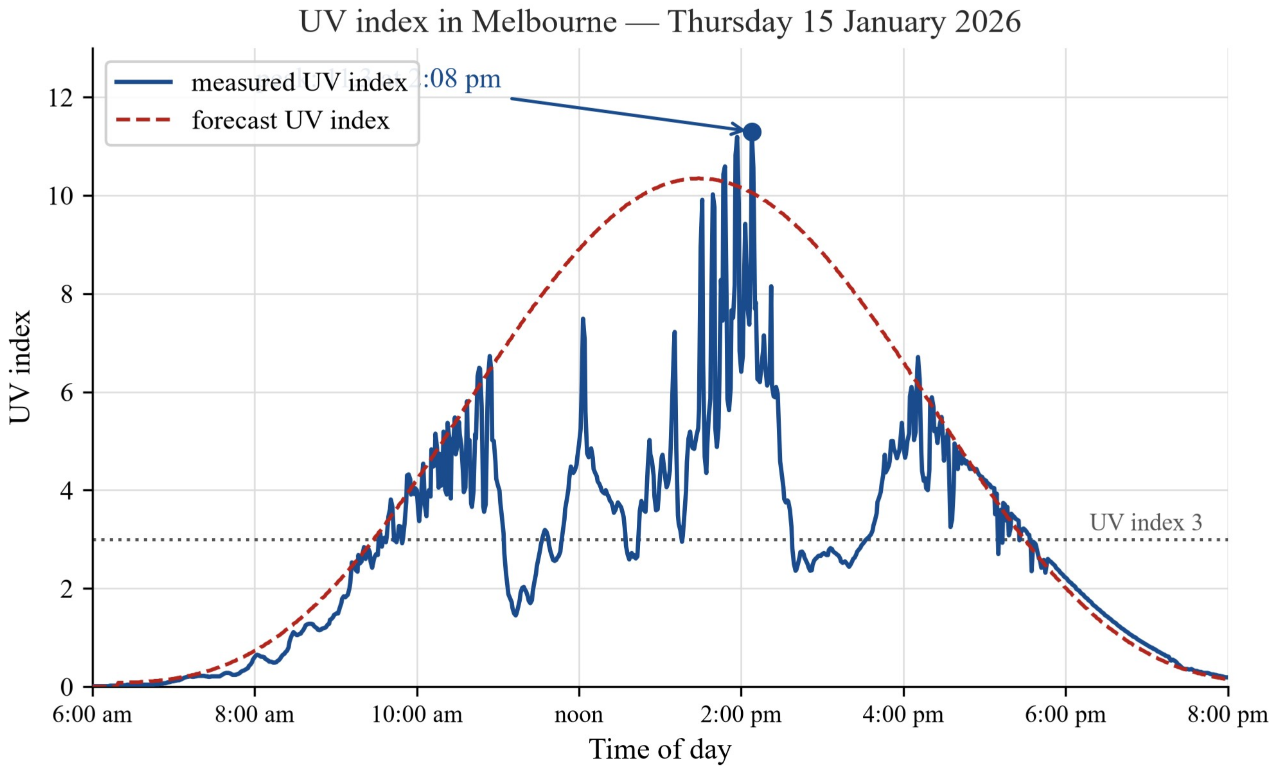


A line graph of the UV index in Melbourne on Wednesday 19 August 2026, with a solid blue measured line, a dashed red forecast line, and a dotted guide line at UV index 3.

Source: ARPANSA, UV index for Melbourne, retrieved 20 August 2026. UV observations courtesy of ARPANSA.

- The solid blue line is what was **measured**; the dashed red line is the **forecast** — what was expected to happen.
- The measured UV index peaked at **2.9 at 2:08 pm** and **never reached 3** — so on this winter day, no sun protection was needed at any time.
- The forecast expected the UV index to be 3 or above in the middle of the day, but the measured line stayed under it. Checking both lines shows the difference between what was expected and what actually happened.

And here is a summer day:



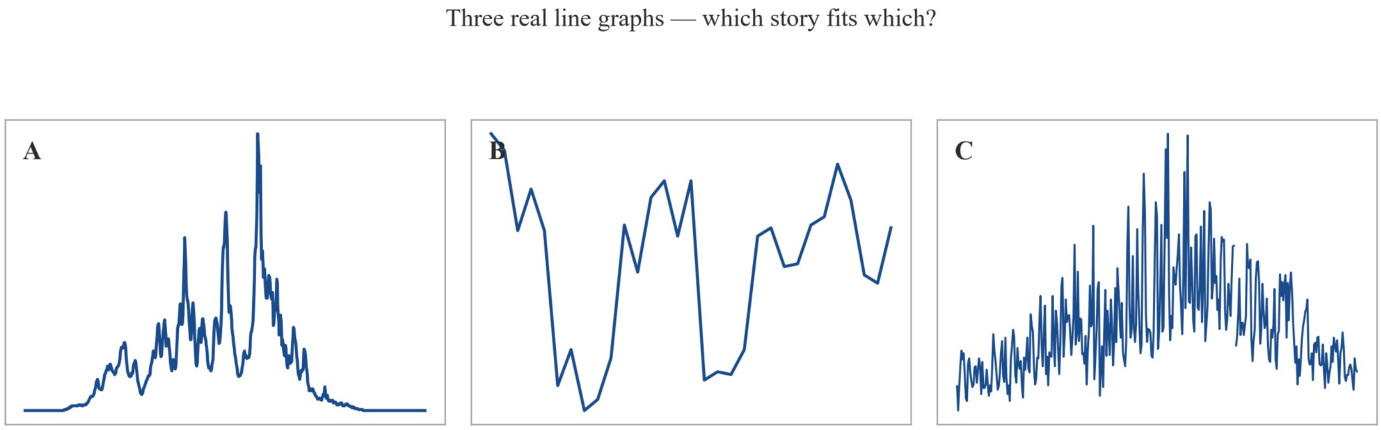
A line graph of the UV index in Melbourne on Thursday 15 January 2026, with a solid blue measured line, a dashed red forecast line, and a dotted guide line at UV index 3.

- The measured UV index peaked at **11.3 at 2:08 pm** — extreme sun strength.
- The measured UV index was **3 or above from 9:33 am to 5:33 pm**.

So when should a school hold an outdoor assembly on a day like this? Any time **before 9:33 am or after 5:33 pm** keeps everyone under UV index 3 — a morning assembly is the safe choice. This is how a line graph supports a decision: read the graph, name the time, and say why.

Matching a graph to its story

A line graph still tells you a lot even when its numbers and labels are hidden. Look at the three graphs below. Each one is real Victorian data — but which story goes with which graph?



Three unlabelled line graphs marked A, B and C, for matching to their stories.

Match by shape. Ask:

- **how many points** does the line seem to have — a few, a month's worth, or a year's worth?
- is the line **smooth, or jagged** with sharp ups and downs?
- are the changes **wide or narrow**, and is there one big peak?

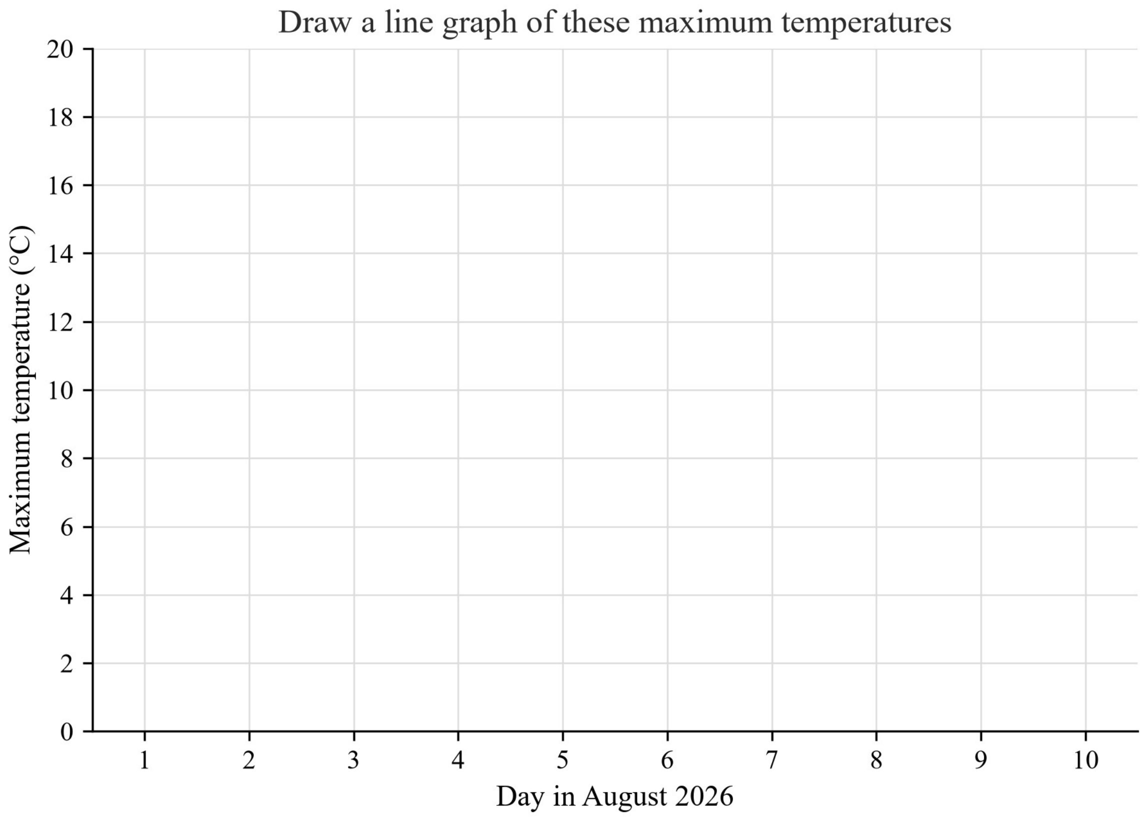
A smooth line with one rounded peak suggests a single day. A jagged line with about 31 sharp dips suggests one month of daily readings. A very dense line with one wide peak in the middle suggests a whole year. You will match these three graphs to their stories in Example 6 and Q12.

Drawing your own line graph

You may be asked to draw a line graph, and drawing one is a good way to learn how they work — but remember that in this topic **marks go to reading and interpreting**, not to the drawing itself. The steps are always the same:

1. Put **time on the horizontal axis** and the thing being measured on the vertical axis.
2. Choose a vertical scale that fits every value — start low enough and go high enough, and use even steps.
3. **Label the horizontal axis and the vertical axis**, including the unit (for example, "Maximum temperature (°C)").
4. Plot **one point per reading**.
5. **Join the points** with straight line segments.

Spreadsheets and other software can draw line graphs for you in seconds — which is another reason the valuable skill is reading the graph, not drawing it. The grid below is ready for the worked examples and practice questions.



A blank grid with the days 1 to 10 of August 2026 on the horizontal axis and 0 to 20 on the vertical axis, for drawing a line graph of maximum temperatures.

Worked examples

Example 1 — with help: read values from a line graph

Use the line graph of Melbourne's maximum temperatures in January 2026.

Working	Comment
a. 9 January: up from 9 on the horizontal axis to the point, across to the vertical axis: 42.9 °C.	Up first, then across.
b. 12 January: the same two steps give 21.9 °C.	The grey guides show the read.
c. 9 January: 42.9 °C; 11 January: 19.1 °C. Fall: 42.9 −	Change = compare two readings, with dates.

Working	Comment
19.1 = 23.8 °C.	
d. 10 January: 24.5 °C; 13 January: 20.5 °C. 24.5 > 20.5.	The higher point is the hotter day.

∴ Reading a line graph is two steps — up, then across — and describing change takes two readings and the dates between them.

Example 2 — with help: describe change across a year

Use the line graph of Melbourne's maximum temperatures from July 2025 to June 2026.

Working	Comment
a. The red point marks the hottest day: 9 January 2026, 42.9 °C.	The peak of the year.
b. The line sits highest inside the summer band (December to February).	Summer holds the hottest days.
c. There is a break in the line in March: no reading for 11 March 2026.	A gap is a missing reading, not a mistake.
d. The lowest maximum temperatures sit in winter: the lowest is 11.0 °C on 2 July 2025.	Winter days warm up very little.

∴ Melbourne's year follows Australia's seasons: hot summers peaking around January, cool winters, and one missing day in March.

Example 3 — with help: read temperatures below zero

Use the line graph of Ballarat Aerodrome's coldest temperatures each night in July 2026.

Working	Comment
a. 9 July: the point sits below the 0 °C line at −1.2 °C.	Below zero means colder than freezing.
b. Count the red points below 0 °C: 6, 8, 9, 17, 18 and 19 July — six nights.	Every red point is a below-zero night.
c. The lowest point is 8 July: −1.6 °C.	The coldest night of the month.
d. 6 July was −0.7 °C: 0.7 degrees below zero.	The number after the − sign counts the degrees below zero.

∴ Ballarat had six below-zero nights in July 2026, the coldest at −1.6 °C on 8 July — frost country.

Example 4 — on your own: read two lines on one graph

Use the two-line graph of Melbourne's maximum and minimum temperatures in January 2026.

a. On 9 January the maximum temperature was 42.9 °C and the minimum temperature was 18.4 °C. The difference between the day's hottest and coldest temperatures was 42.9 − 18.4 = **24.5 °C**.

b. The highest point on the blue (minimum temperature) line is **8 January at 22.0 °C** — the warmest night of the month.

c. Nights with a minimum temperature below 15 °C: 1, 2, 5, 6, 11, 12, 22, 23 and 24 January — **9 nights** in all.

Example 5 — on your own: use a UV graph to choose a time

Use the line graph of the UV index in Melbourne on Thursday 15 January 2026.

a. The measured UV index peaked at **11.3, at 2:08 pm**.

b. The measured line is at or above the "UV index 3" guide from **9:33 am to 5:33 pm** — sun protection was needed through those hours.

c. An outdoor assembly should happen when the UV index is below 3: **before 9:33 am or after 5:33 pm**. A morning assembly, say at 9:00 am, keeps everyone in safe sun. The inference comes straight off the graph: name the time, and quote the UV index that supports it.

Example 6 — on your own: match a graph to its story

Match the three unlabelled graphs (A, B and C) to the three stories:

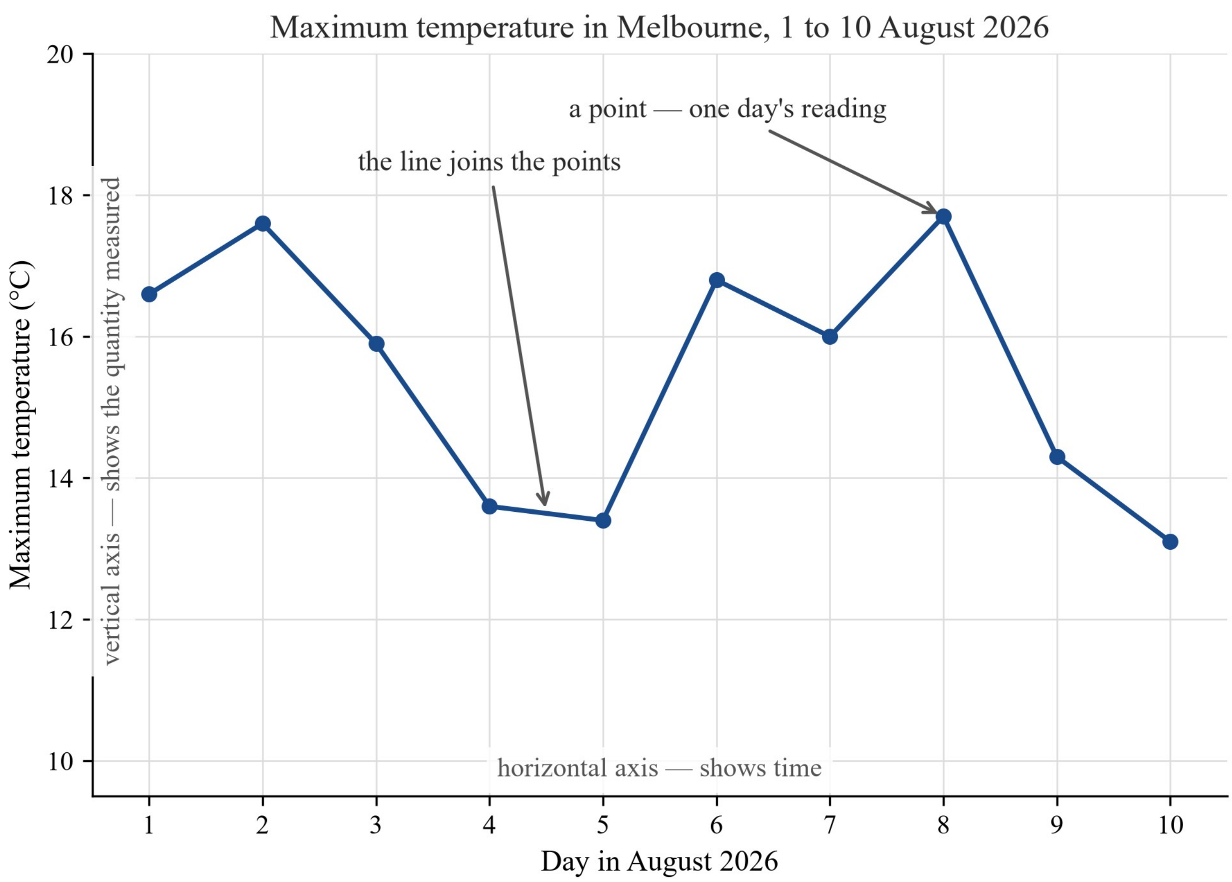
1. The strength of the sun's UV over one short winter day in Melbourne.
2. The coldest temperature each night for one winter month in Ballarat.
3. The maximum temperature each day for a whole year in Melbourne.

A matches story 1 — one smooth line with a single rounded peak: one day, rising to a peak and falling again. **B matches story 2** — a jagged line with about 31 points and sharp dips: one month of nightly readings. **C matches story 3** — a very dense line with one wide summer peak: a whole year of daily maximum temperatures. The clues are the number of points, the smoothness of the line, and the size of the swings.

Practice questions

With help

Q1. Look at the line graph of Melbourne's maximum temperatures for 1 to 10 August 2026.



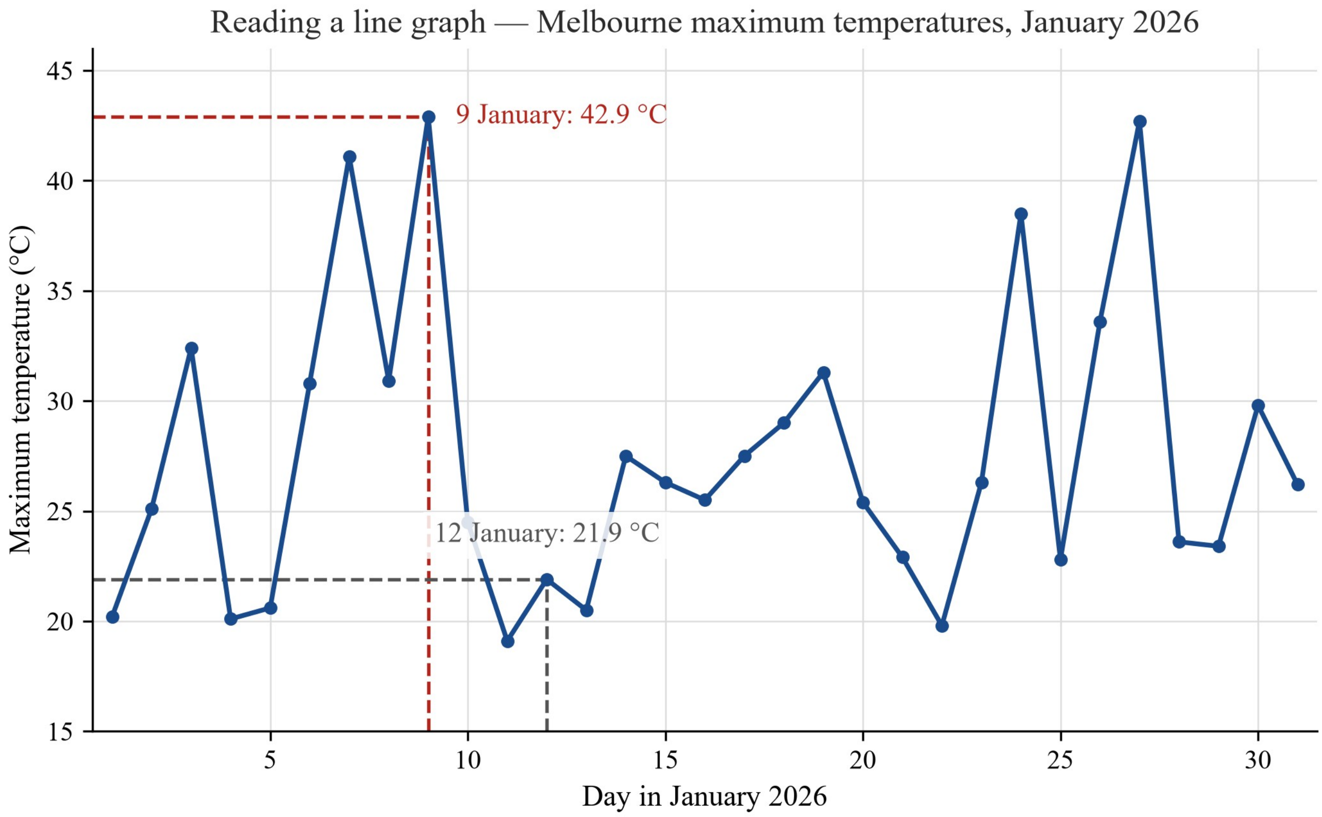
A line graph of Melbourne maximum temperatures for 1 to 10 August 2026, with notes showing the horizontal axis (shows time), the vertical axis (shows the quantity measured), one point (one day's reading) and the line joining the points.

a. Which axis shows time?
b. What is being measured on the other axis?
c. What does each point stand for?
d. What does the line joining the points help you see?

Q2. Use the same graph of 1 to 10 August maximum temperatures.

a. What was the maximum temperature on 2 August?
b. On which day was the maximum temperature 13.4 °C?
c. Which day had the highest maximum temperature, and what was it?
d. How much did the maximum temperature fall from 8 August to 10 August?

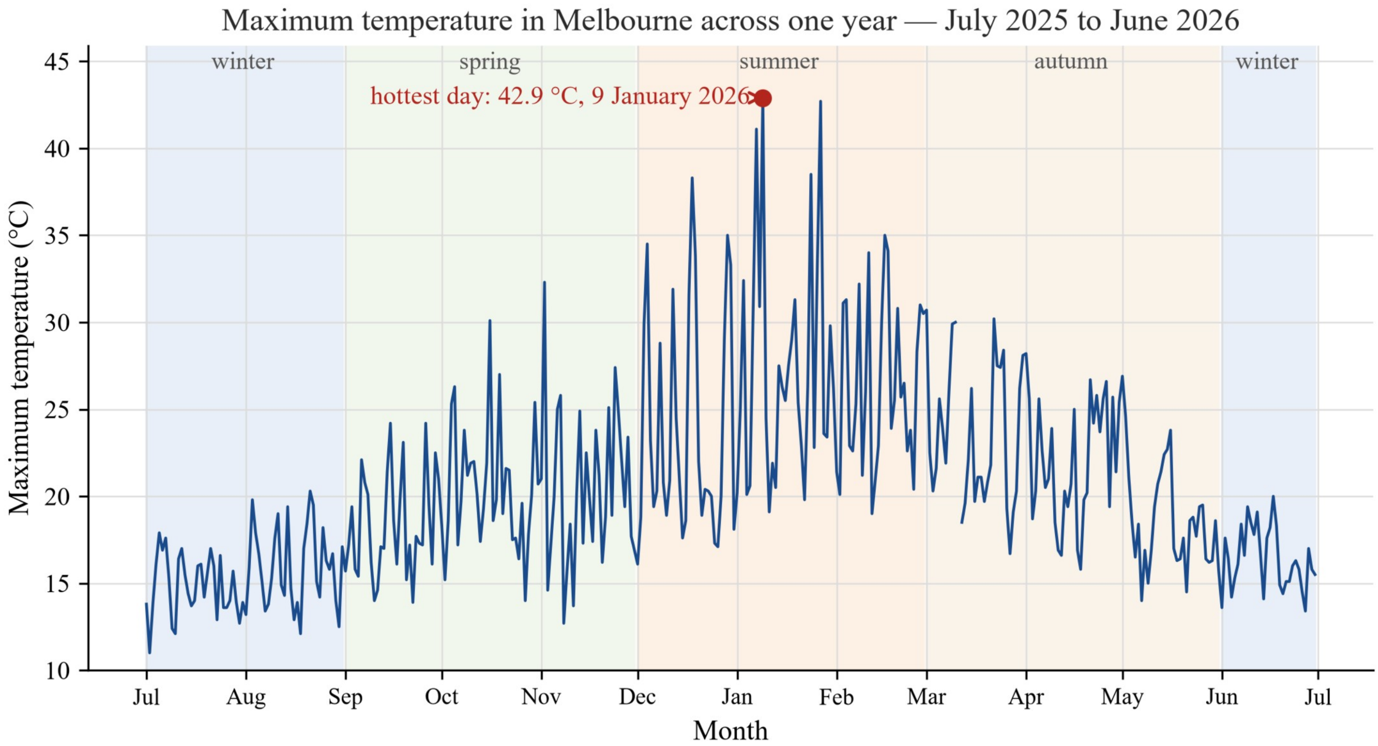
Q3. Use the line graph of Melbourne's maximum temperatures in January 2026.



A line graph of Melbourne maximum temperatures in January 2026, with dashed guides reading 9 January as 42.9 degrees Celsius and 12 January as 21.9 degrees Celsius.

a. What was the maximum temperature on 9 January?
b. What was the maximum temperature on 12 January?
c. The maximum temperature on 11 January was 19.1 °C. How much did it fall from 9 January to 11 January?
d. True or false: every day in January had a maximum temperature above 20 °C.

Q4. Use the line graph of Melbourne's maximum temperatures across one year.



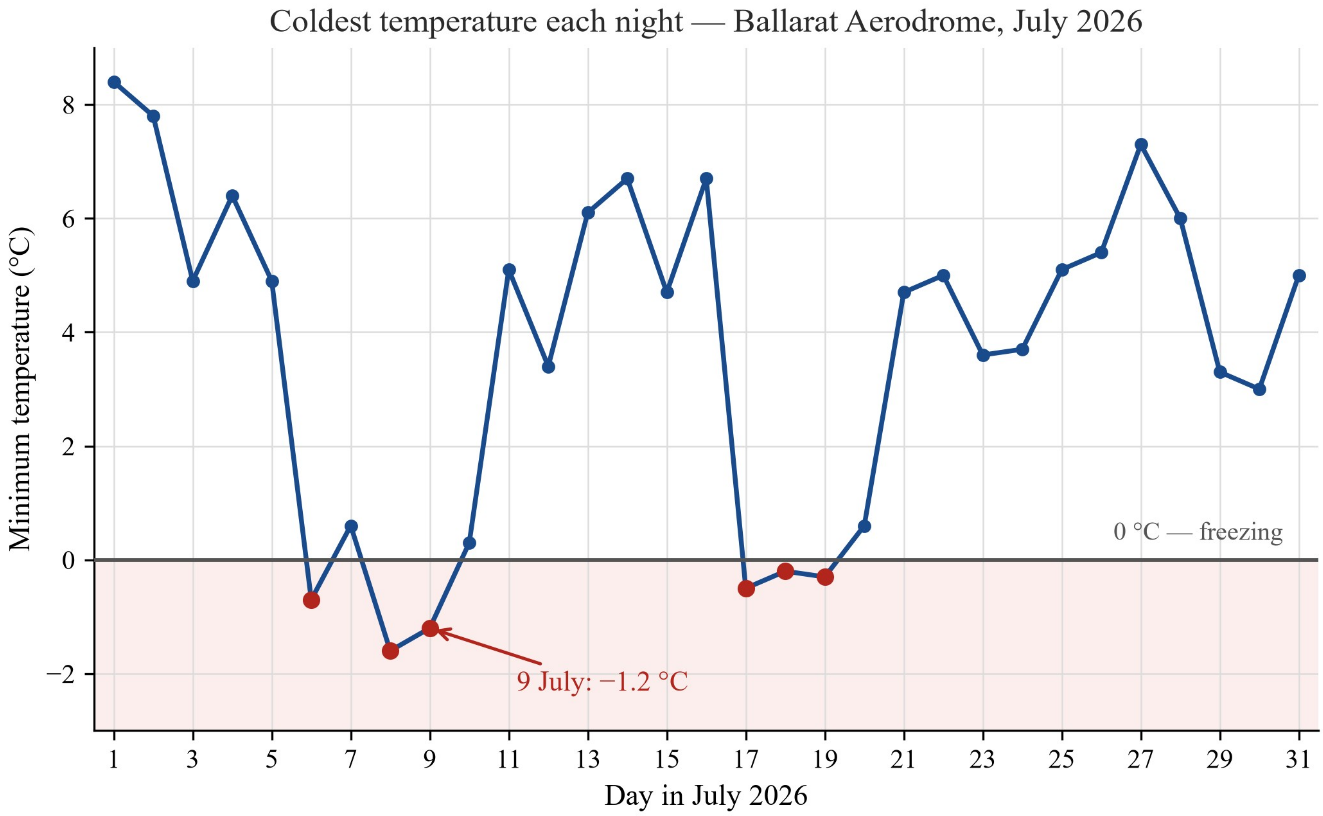
A line graph of Melbourne maximum temperatures across one year, July 2025 to June 2026, with coloured season bands and the hottest day marked at 42.9 degrees Celsius on 9 January 2026.

a. In which season was the hottest day, and in which month did it fall?
b. What was the coolest maximum temperature of the year, and on which date?
c. There is a small break in the line in March 2026. Explain it.
d. True or false: Melbourne's hottest time of year is around July.

Q5. Days are sorted into hotness categories: Cool (below 22 °C), Warm (22 °C to below 28 °C), Hot (28 °C to below 35 °C), Very hot (35 °C to below 40 °C) and Extreme (40 °C and above).

a. Put each maximum temperature into its category: 21.4 °C, 27.9 °C, 34.0 °C, 38.5 °C, 42.9 °C.
b. In January 2026, how many days were Warm?
c. Which category had the fewest days in January 2026?

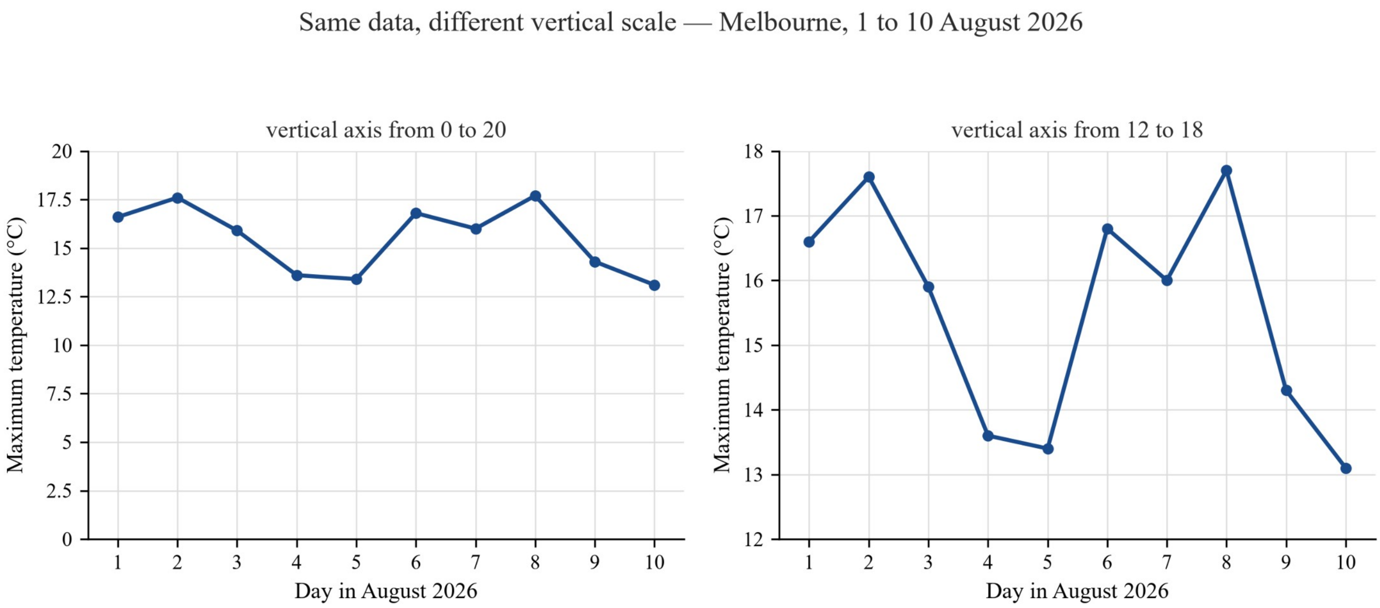
Q6. Use the line graph of Ballarat Aerodrome's coldest temperatures each night in July 2026.



A line graph of the coldest temperature each night at Ballarat Aerodrome in July 2026, with a line marked 0 degrees Celsius freezing, the band below zero shaded, six below-zero nights marked in red, and 9 July labelled at −1.2 degrees Celsius.

a. What was the coldest temperature on the night of 9 July?
b. How many nights dropped below 0 °C?
c. Which night was the coldest of the month, and what was its temperature?

Q7. Use the figure showing the same ten days of maximum temperatures drawn with two different vertical scales.



Two line graphs side by side of the same Melbourne maximum temperatures for 1 to 10 August 2026, one with a vertical axis from 0 to 20 and one with a vertical axis from 12 to 18.

a. Which panel makes the changes look greatest?
b. Is the actual change in the data different between the two panels? Explain.
c. Give one reason a graph maker might choose the vertical scale from 12 to 18.

Q8. True or false? If false, say why.

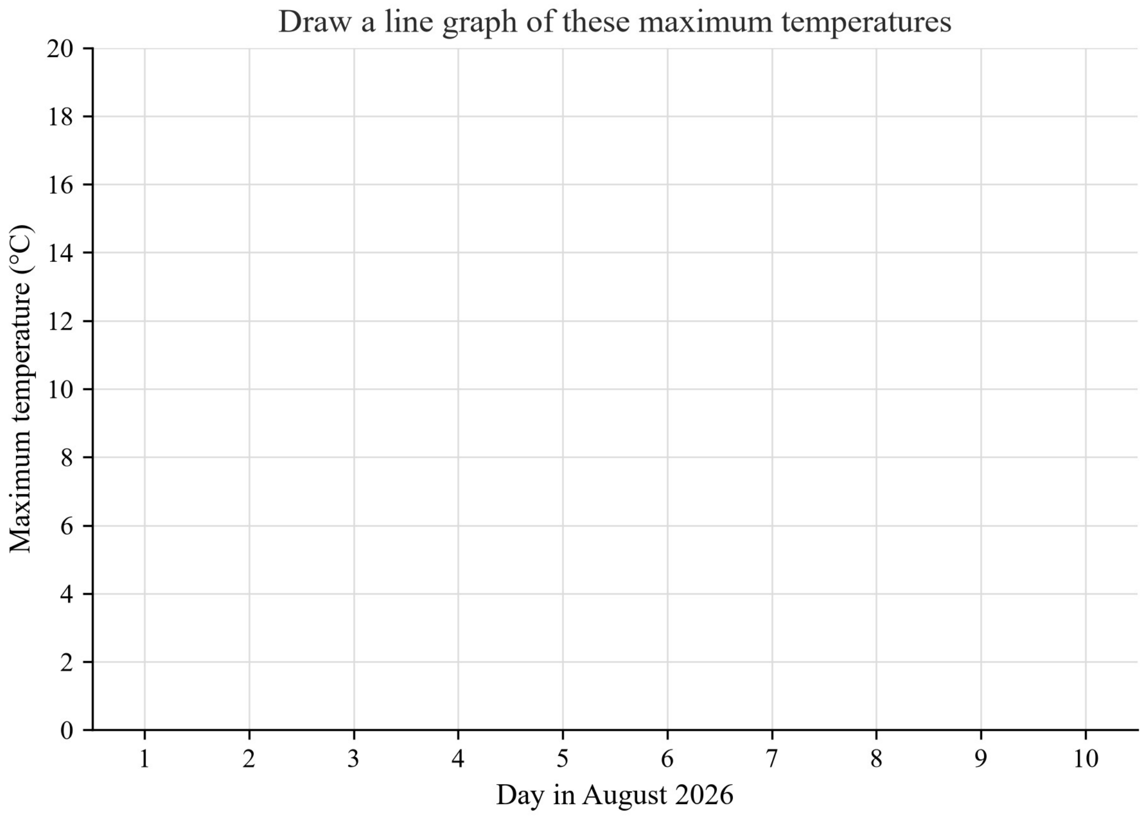
a. On a line graph, the horizontal axis shows time.
b. A line graph can only ever have one line.
c. The line between two points stands for readings that were measured.
d. The vertical axis of a line graph must always start at 0.

On your own

Q9. Melbourne's maximum temperatures for 1 to 10 August 2026 are given in the table. Draw a line graph of the data on the grid, then answer the questions.

Day in August 2026	1	2	3	4	5	6	7	8	9	10
Maximum temperature (°C)	16.6	17.6	15.9	13.6	13.4	16.8	16.0	17.7	14.3	13.1

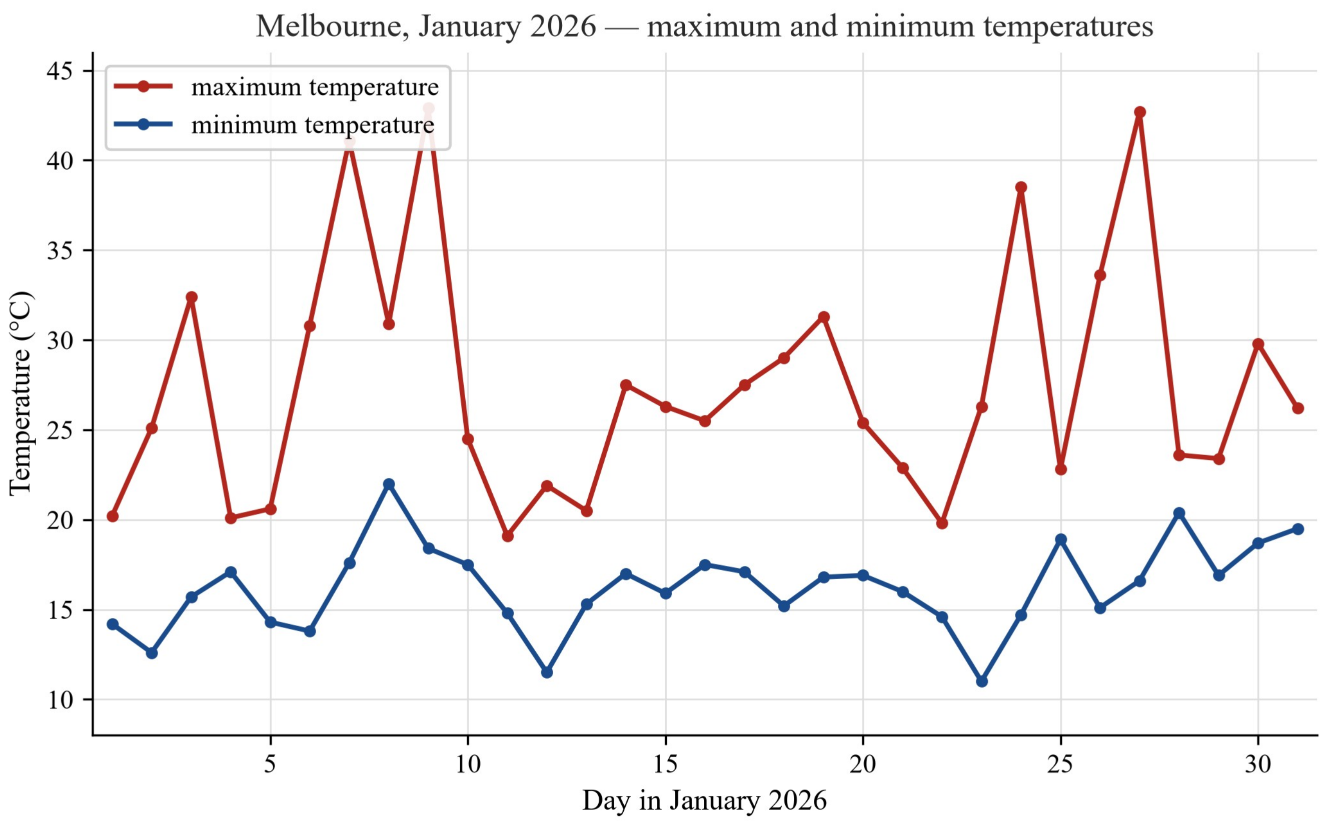
Source: Bureau of Meteorology, Daily Weather Observations for Melbourne (Olympic Park), Victoria, retrieved 20 August 2026.



A blank grid with the days 1 to 10 of August 2026 on the horizontal axis and 0 to 20 on the vertical axis, for drawing a line graph of maximum temperatures.

a. Plot the ten points and join them with line segments.
b. Which day had the highest maximum temperature?
c. Describe how the maximum temperature changed from 1 August to 10 August.

Q10. Use the two-line graph of Melbourne's maximum and minimum temperatures in January 2026.



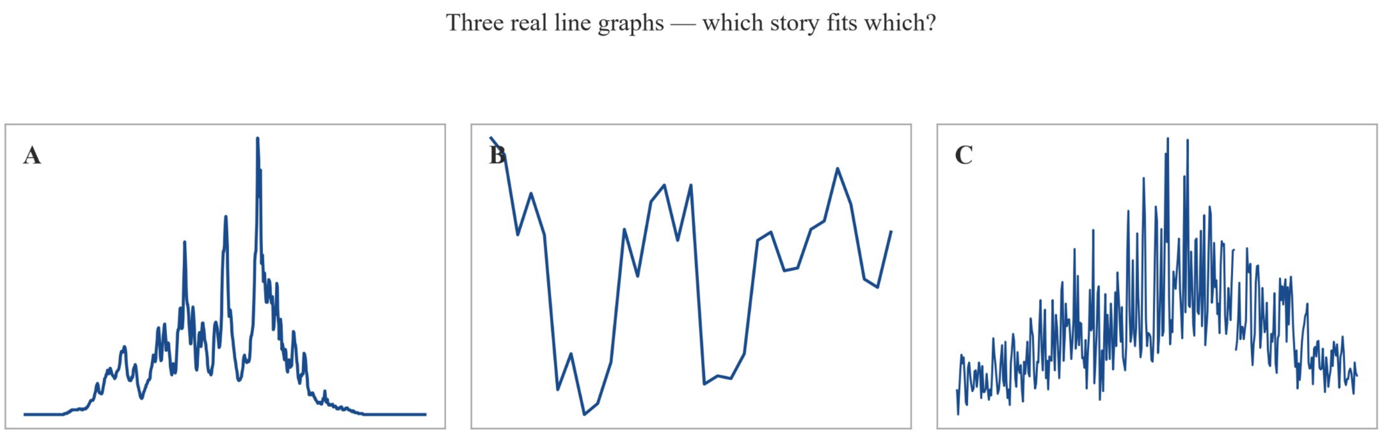
A line graph with two lines for Melbourne in January 2026: the maximum temperature in red and the minimum temperature in blue, with a key in the top-left corner.

a. Find two days that had the same maximum temperature.
b. On which day was the difference between the maximum and minimum temperatures the largest? What was the difference?
c. On which day was that difference the smallest? What was the difference?
d. On the very hot days (7, 9 and 27 January), what do you notice about the gap between the two lines?

Q11. Use the line graph of Melbourne's maximum temperatures across one year.

a. How many months of the year had no day reaching 30 °C?
b. How many days across the year reached 35 °C or more?
c. Which season held the hottest days? Which held the coolest?
d. Write one finding about Melbourne's temperatures over the year, in context.

Q12. Here are the three unlabelled graphs again.

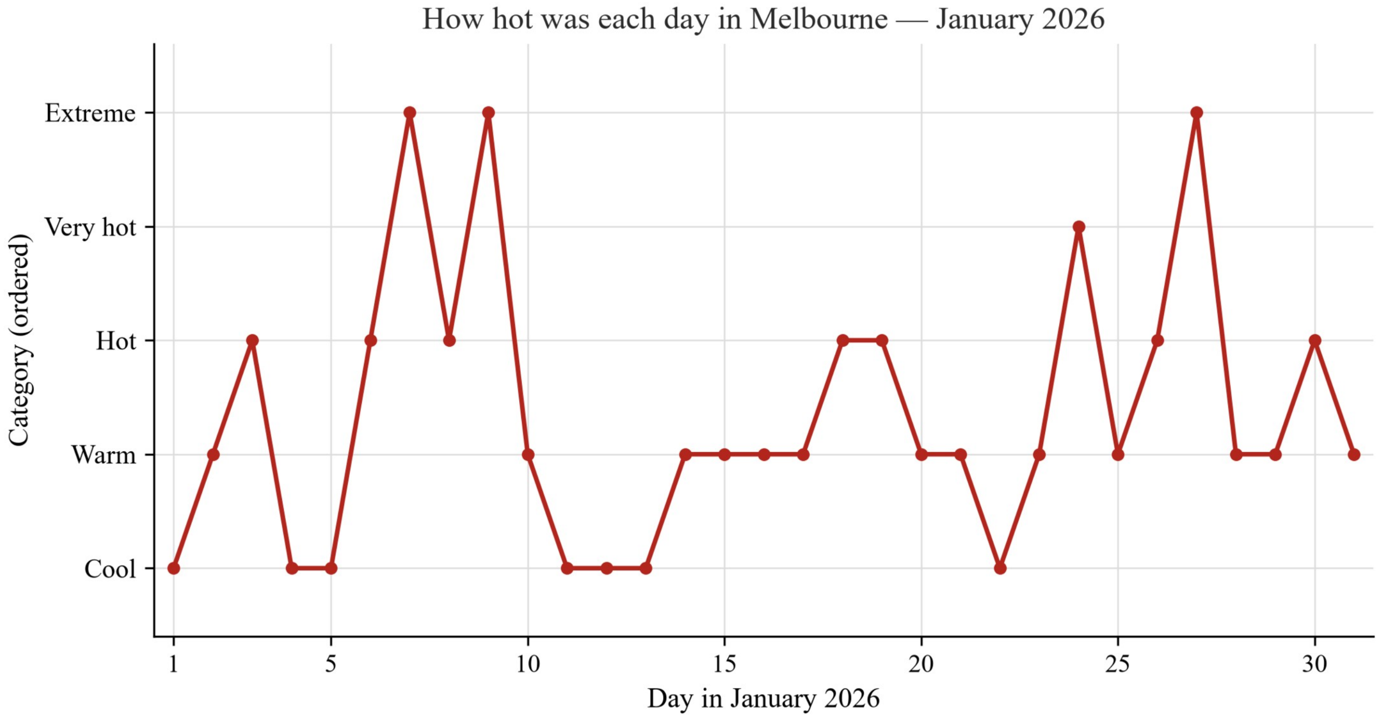


Three unlabelled line graphs marked A, B and C, for matching to their stories.

Match each graph to its story, and for each one say what the shape told you.

1. The strength of the sun’s UV over one short winter day in Melbourne.
2. The coldest temperature each night for one winter month in Ballarat.
3. The maximum temperature each day for a whole year in Melbourne.

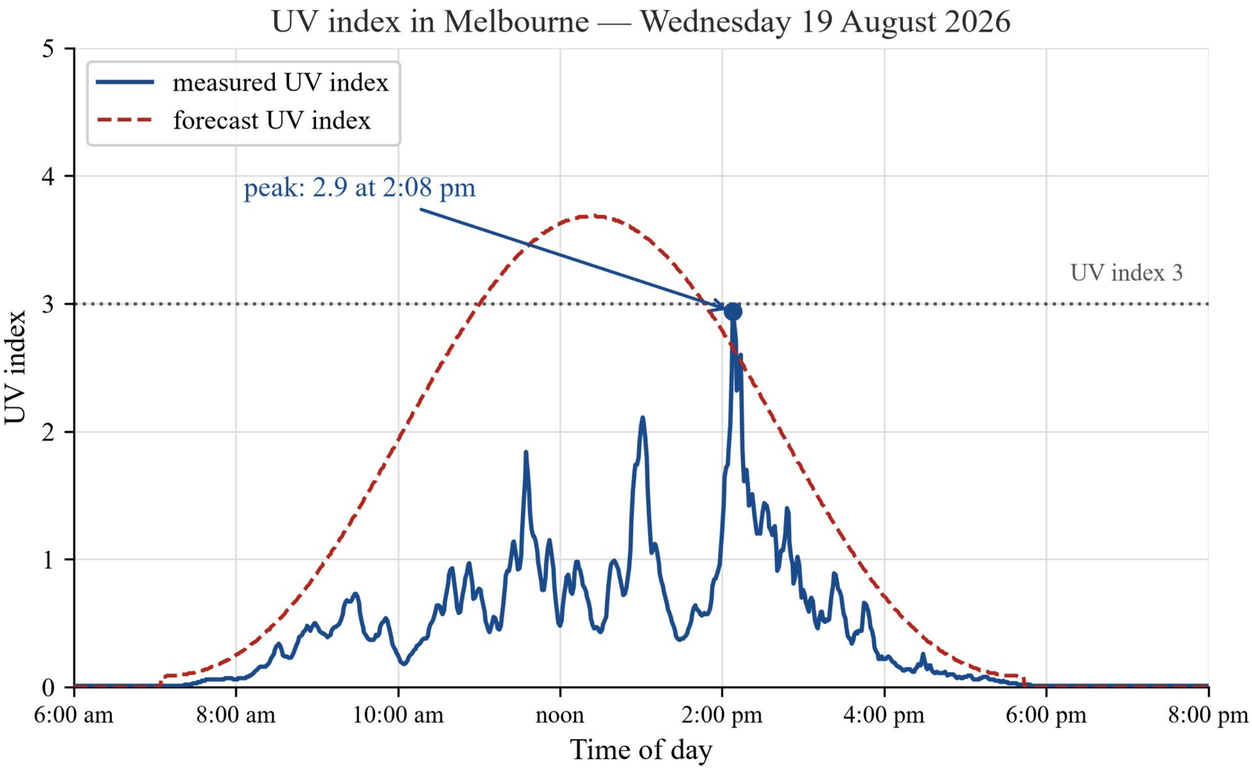
Q13. Use the line graph of hotness categories for January 2026.



A line graph of how hot each day in Melbourne was in January 2026, with an ordered vertical axis of categories: Cool, Warm, Hot, Very hot, Extreme.

a. How many days were Cool?
b. How many days were Cool or Warm?
c. How many days had a maximum temperature of 28 °C or more?
d. A news report says “Melbourne had a mild January, with most days Cool or Warm”. Does the graph support this claim? Explain.

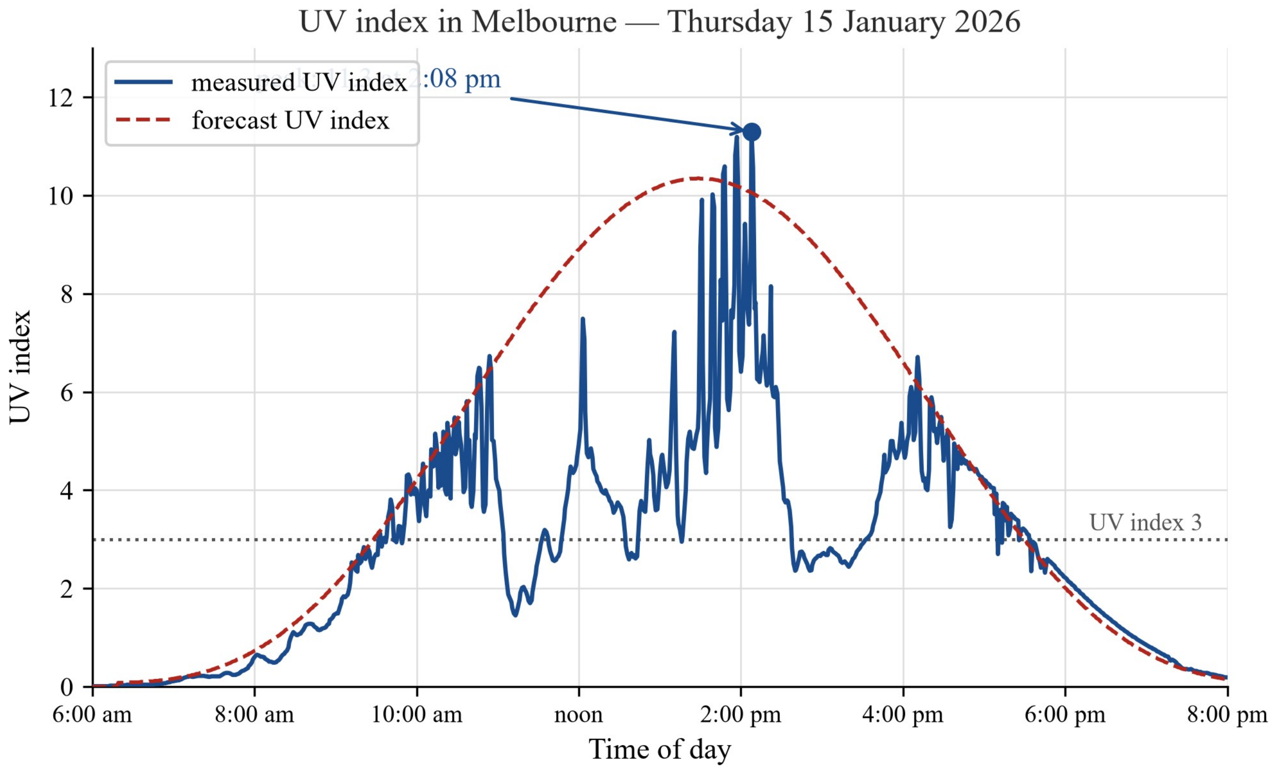
Q14. Use the line graph of the UV index in Melbourne on Wednesday 19 August 2026.



A line graph of the UV index in Melbourne on Wednesday 19 August 2026, with a solid blue measured line, a dashed red forecast line, and a dotted guide line at UV index 3.

a. What was the highest measured UV index, and at what time was it measured?
b. Did the measured UV index reach 3 on this day?
c. Sun protection is needed when the UV index is 3 or above. Was sun protection needed on this day? Explain.
d. The dashed forecast line rose above 3 in the middle of the day. What is the value of checking the measured line as well?

Q15. Use the line graph of the UV index in Melbourne on Thursday 15 January 2026.



A line graph of the UV index in Melbourne on Thursday 15 January 2026, with a solid blue measured line, a dashed red forecast line, and a dotted guide line at UV index 3.

a. What was the highest measured UV index, and at what time was it measured?

b. At what time did the measured UV index first reach 3? When did it fall below 3 again?

c. Your school wants to hold an outdoor assembly on a day like this. Use the graph to say which time of day is best, and why.

Q16. You want to draw a line graph of the coldest temperature each night at Ballarat Aerodrome in July 2026. The values go from −1.6 °C to 8.4 °C.

a. Would a vertical axis from 0 to 10 °C be a good choice? Explain.

b. Would a vertical axis from −2 to 9 °C be a good choice? Explain.

c. What labels belong on the horizontal axis and the vertical axis?

Maths in real life

Q17. The table shows Melbourne's maximum temperature on every day of July 2025.

Day in July 2025	1	2	3	4	5	6	7	8	9	10	11
Maximum temperature (°C)	13.8	11.0	13.8	16.1	17.9	16.9	17.6	15.3	12.4	12.1	16.4

Day in July 2025	12	13	14	15	16	17	18	19	20	21	22
Maximum temper	17.0	15.5	14.4	13.7	14.0	16.0	16.1	14.2	15.6	17.0	16.0

Day in July 2025	12	13	14	15	16	17	18	19	20	21	22
ature (°C)											

Day in July 2025	23	24	25	26	27	28	29	30	31
Maximum temperature (°C)	12.9	16.6	13.6	13.6	14.0	15.7	13.9	12.7	13.9

Source: Bureau of Meteorology, Daily Weather Observations for Melbourne (Olympic Park), Victoria, retrieved 20 August 2026.

a. Which was the hottest day of the month, and what was its maximum temperature?
b. Which was the coolest day of the month?
c. How many days had a maximum temperature of 15 °C or more?
d. Describe how the maximum temperature changed across July 2025.

Q18. Compare the two UV days from this section: Wednesday 19 August 2026 and Thursday 15 January 2026.

a. On which day was the measured peak UV index higher? How much higher was it?
b. On which day was sun protection needed for most of the daylight hours? Explain.
c. Suggest a reason the two days are so different.
d. It is sports day at your school in August. Use the winter graph to say whether sun protection is needed, and why.

Q19. Use the hotness categories from this section and the line graph of Melbourne's maximum temperatures across one year.

a. Across the whole year, how many days reached Extreme (40 °C or above)? In which month were they?
b. How many days across the year reached 35 °C or more?
c. In which season would you expect a Very hot or Extreme day? Why?
d. The school council is picking a term for the athletics carnival. Use the year graph to say which time of year you would choose, and why.

Answers

Q1. a. The horizontal axis. b. The maximum temperature (°C). c. One day's maximum temperature. d. How the temperature changed from day to day. **Q2.** a. 17.6 °C. b. 5 August. c. 8 August, 17.7 °C. d. 4.6 °C. **Q3.** a. 42.9 °C. b. 21.9 °C. c. 23.8 °C. d. False — 11 January was 19.1 °C. **Q4.** a. Summer; January. b. 11.0 °C on 2 July 2025. c. The reading for 11 March 2026 is missing. d. False — around January. **Q5.** a. Cool, Warm, Hot, Very hot, Extreme. b. 13. c. Very hot (1 day). **Q6.** a. −1.2 °C. b. 6. c. 8 July, −1.6 °C. **Q7.** a. The right panel. b. No — same data. c. Answers vary. **Q8.** a. True. b. False. c. False. d. False. **Q9.** a. Points plotted and joined. b. 8 August. c. Answers vary. **Q10.** a. 14 and 17 January (27.5 °C), or 15 and 23 January (26.3 °C). b. 27 January, 26.1 °C. c. 4 January, 3.0 °C. d. The gap is very wide. **Q11.** a. 6. b. 7. c. Summer; winter. d. Answers vary. **Q12.** A–1, B–2, C–3; reasons vary. **Q13.** a. 7. b. 20. c. 11. d. Answers vary. **Q14.** a. 2.9 at 2:08 pm. b. No. c. No. d. Answers vary. **Q15.** a. 11.3 at 2:08 pm. b. 9:33 am; after 5:33 pm. c. Before 9:33 am or after 5:33 pm. **Q16.** a. No — nights down to −1.6 °C would sit below the axis. b. Yes. c. Day in July 2026; minimum temperature (°C). **Q17.** a. 5 July, 17.9 °C. b. 2 July. c. 15. d. Answers vary. **Q18.** a. 15 January; 8.4 higher. b. 15 January. c. Answers vary (season). d. No. **Q19.** a. 3; January. b. 7. c. Summer. d. Answers vary.

Worked answers

Q1. a. The horizontal axis carries the days 1 to 10 August 2026 — time always goes on the horizontal axis. b. The vertical axis shows the maximum temperature, measured in degrees Celsius (°C). c. Each point is one reading: that day's maximum temperature at the Melbourne Olympic Park station. d. Joining the points lets your eye follow the change — rises, falls, and steady stretches — across the ten days.

Q2. a. Go up from 2 on the horizontal axis to the point, then across: 17.6 °C. b. Find 13.4 °C on the vertical axis and go across to the line: the point sits above day 5 — 5 August. c. The highest point sits above day 8: 17.7 °C on 8 August. d. 8 August: 17.7 °C; 10 August: 13.1 °C. The fall is 17.7 − 13.1 = 4.6 °C.

Q3. a. Up from 9, then across: 42.9 °C. b. Up from 12, then across: 21.9 °C. c. 42.9 − 19.1 = 23.8 °C — a huge fall in two days. d. False: 11 January's maximum temperature was 19.1 °C, which is below 20 °C.

Q4. a. The red point marking the hottest day sits inside the summer band, in January: 9 January 2026. b. The lowest part of the line sits in the first winter band: 11.0 °C on 2 July 2025. c. A break in the line means no reading was recorded — 11 March 2026 is missing from the data. d. False: in Australia, summer (and the hottest weather) is in December, January and February — around January, not July.

Q5. a. 21.4 °C is below 22 → Cool; 27.9 °C is between 22 and 28 → Warm; 34.0 °C is between 28 and 35 → Hot; 38.5 °C is between 35 and 40 → Very hot; 42.9 °C is 40 or more → Extreme. b. Counting the points on the second row of the categories graph gives 13 Warm days. c. Very hot had just 1 day (24 January, 38.5 °C) — the fewest of the five categories.

Q6. a. The point above 9 July is marked: −1.2 °C. b. Count the red points below the 0 °C line: 6, 8, 9, 17, 18 and 19 July — 6 nights. c. The lowest point on the graph sits above 8 July: −1.6 °C, the coldest night of the month.

Q7. a. The right panel (vertical axis from 12 to 18) makes the ups and downs look greatest. b. No — both panels draw the same ten readings, so the change in the data is identical; only the scale changed. c. Example: to show small changes clearly. The August days stay between 13.1 and 17.7 °C, so a 0-to-20 axis squashes the story; starting at 12 spreads it out. The cost is that the change can look large even when it is small, so the reader must check the numbers on the vertical axis.

Q8. a. True — time goes on the horizontal axis. b. False — one graph can carry more than one line against the same time axis, like the maximum and minimum temperatures in January 2026; a key says which line is which. c. False — only the points are readings; the line segments join the readings so your eye can follow the change. d. False — the vertical axis can start above zero (as in the scale figure), and it can even go below zero (as in the Ballarat graph); the scale must simply be labelled clearly.

Q9. a. Plot one point above each day at its maximum temperature (16.6, 17.6, 15.9, 13.6, 13.4, 16.8, 16.0, 17.7, 14.3, 13.1), then join the points with straight line segments. b. The highest point sits above 8 August: 17.7 °C. c. Example: *The maximum temperature started at 16.6 °C, rose to 17.6 °C on 2 August, dropped to 13.4 °C by 5 August, rose* *again to 17.7 °C on 8 August, then dropped to 13.1 °C on 10 August.* Any true description naming the rises, falls and dates is fine.

Q10. a. Reading the red line: 14 and 17 January both reached 27.5 °C (15 and 23 January both reached 26.3 °C, which also fits). b. The widest gap between the two lines is on 27 January: 42.7 − 16.6 = 26.1 °C. c. The narrowest gap is on 4 January: 20.1 − 17.1 = 3.0 °C. d. On 7, 9 and 27 January the red line leaps high while the blue line stays near its usual spot, so the gap between the lines is very wide — the hottest days still had cool nights, and the day-to-night change was large.

Q11. a. Six months never reached 30 °C: July, August and September 2025, and April, May and June 2026. b. Reading the graph against 35 °C, seven days reached 35 °C or more: 18 December 2025 (38.3 °C), 29 December 2025 (35.0 °C), 7 January 2026 (41.1 °C), 9 January 2026 (42.9 °C), 24 January 2026 (38.5 °C), 27 January 2026 (42.7 °C) and 16 February 2026 (35.0 °C). c. The summer band (December to February) holds the hottest days; the winter bands hold the coolest. d. Example: *Melbourne's maximum temperatures swung from 11.0 °C on a July winter day to 42.9 °C on a January summer day — most of the year's very hot days were in January.* Any true finding in context is fine.

Q12. A matches story 1: one smooth line with a single rounded peak — the UV index over one day, rising to a peak in the middle of the day and falling again. B matches story 2: a jagged line with about 31 points and sharp dips — the nightly coldest temperatures for one month, including dips below zero. C matches story 3: a very dense line with one wide peak — a whole year of daily maximum temperatures, peaking in summer. In each case the number of points and the shape of the line give the story away before any number is read.

Q13. a. 7 days were Cool. b. Cool 7 + Warm 13 = 20 days. c. Days of 28 °C or more sit in Hot, Very hot or Extreme: 7 + 1 + 3 = 11 days. d. Example: *Yes — 20 of the 31 days were Cool or Warm, so "most days" is fair; but the claim hides that 3 days reached Extreme (40 °C or more), which the graph also shows.* Any answer that uses the category counts is fine.

Q14. a. The peak of the measured line is marked: 2.9 at 2:08 pm. b. No — the measured line stayed below the "UV index 3" guide all day. c. No: sun protection is needed from UV index 3 up, and the measured UV index never reached 3. d. Example: *The forecast expected the UV index to be 3 or above in the middle of the day, but the measurements stayed below 3 — checking the measured line shows what actually happened, not just what was expected.*

Q15. a. The peak of the measured line is marked: 11.3 at 2:08 pm. b. The measured line crosses the "UV index 3" guide going up at 9:33 am and falls back below it after 5:33 pm. c. The UV index is below 3 before 9:33 am and after 5:33 pm, so an early-morning assembly — say 9:00 am — keeps everyone under UV index 3. The graph supports the choice: name the time and the UV index.

Q16. a. No: six nights dropped below 0 °C, down to −1.6 °C, so a vertical axis starting at 0 would leave those points off the graph. b. Yes: every value from −1.6 °C to 8.4 °C fits, and the scale spreads the changes out so they are easy to see. c. Horizontal axis: Day in July 2026; vertical axis: Minimum temperature (°C).

Q17. a. Reading across the table, the highest maximum temperature is 17.9 °C on 5 July. b. The lowest is 11.0 °C on 2 July. c. Counting the days of 15 °C or more: 4, 5, 6, 7, 8, 11, 12, 13, 17, 18, 20, 21, 22, 24 and 28 July — 15 days. d. Example: *July 2025 rose and dropped in waves: a warm spell peaked at 17.9 °C on 5 July, dropped to 12.1 °C by 10 July, rose again to about 17 °C around 11–13 July and 21 July, and ended the month near 14 °C.* Any true description of the rises and falls, with dates, is fine.

Q18. a. Thursday 15 January: 11.3, against 2.9 on 19 August — 11.3 − 2.9 = 8.4 higher. b. 15 January: the measured UV index was 3 or above from 9:33 am to 5:33 pm, most of the daylight hours. On 19 August it never reached 3. c. Example: the two days fall in different seasons — 15 January is a summer day and 19 August a winter day, and the sun's UV rays are far stronger in summer in Australia. d. No: on the winter day the measured UV index stayed below 3 all day, so sun protection was not needed — though a hat and jacket may matter more than sunscreen on a cold August day.

Q19. a. Three days reached Extreme (40 °C or above): 7 January (41.1 °C), 9 January (42.9 °C) and 27 January 2026 (42.7 °C) — all in January 2026. b. Seven days reached 35 °C or more: 18 and 29 December 2025; 7, 9, 24 and 27 January 2026; and 16 February 2026. c. Summer — every 35 °C-or-more day on the graph sits inside the summer band (December to February), when the sun's rays are strongest in Australia. d. Example: *Avoid summer: December to February holds every very hot and Extreme day, so a carnival then risks Extreme heat. Autumn (March to May) or* *spring (September to November) stay well below 35 °C most of the time, and winter days top out near 18 °C — comfortable for sport.* Any answer that uses the graph to avoid the summer peak is fine.

Planning and conducting a statistical investigation

> **Code `VC2M5ST03`** (Victorian Curriculum F–10 Version 2.0, Mathematics, Level 5; authority file `maths_5.json`): "plan and conduct statistical investigations by posing questions or identifying a problem and collecting relevant data; choose appropriate displays and interpret the data; communicate findings within the context of the investigation". This section draws on `VC2M5ST03.E01`, `.E02` and `.E03`.

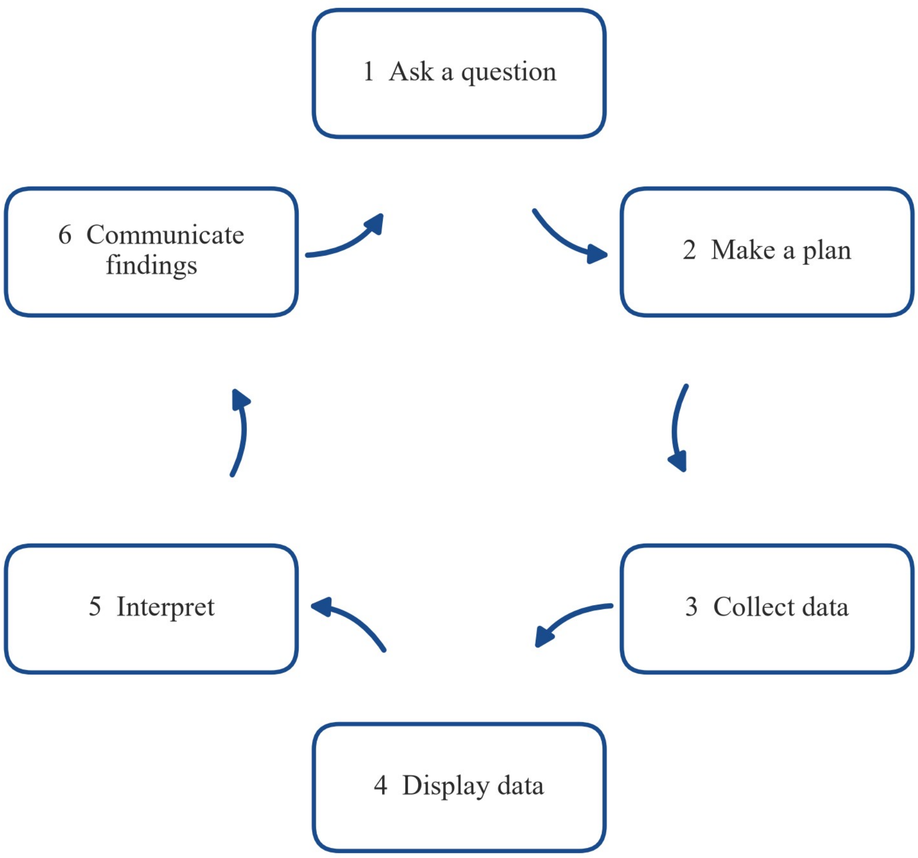
From the Level 5 achievement standard: *Students plan and conduct statistical investigations that collect nominal and ordinal categorical and discrete numerical data with and without digital tools.*

Theory

The investigation cycle

When you want to find something out about your class, your school or your playground, you run a **statistical investigation**. You follow six steps, and each step leads to the next.

The statistical investigation cycle



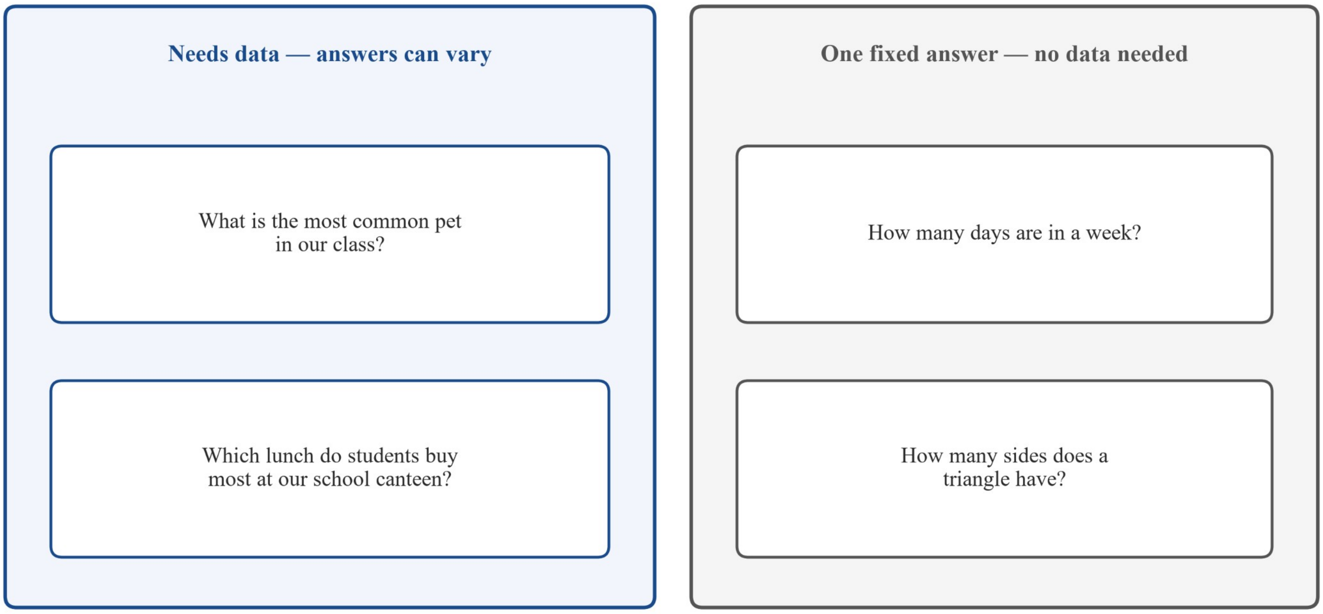
A circle of six boxes joined by arrows: 1 Ask a question, 2 Make a plan, 3 Collect data, 4 Display data, 5 Interpret, 6 Communicate findings.

Data is the information we collect. One answer from one person, or one count, is one piece of data.

Step 1 — Ask a question

A **statistical question** is a question you answer by collecting data, and the answers can vary.

- “What is the most common pet in our class?” is a statistical question. Different students have different pets, so we must collect data to answer it.
- “How many days are in a week?” is **not** a statistical question. It has one fixed answer, and we need no data.



Two panels. Left, in blue: Needs data — answers can vary, holding “What is the most common pet in our class?” and “Which lunch do students buy most at our school canteen?”. Right, in grey: One fixed answer — no data needed, holding “How many days are in a week?” and “How many sides does a triangle have?”.

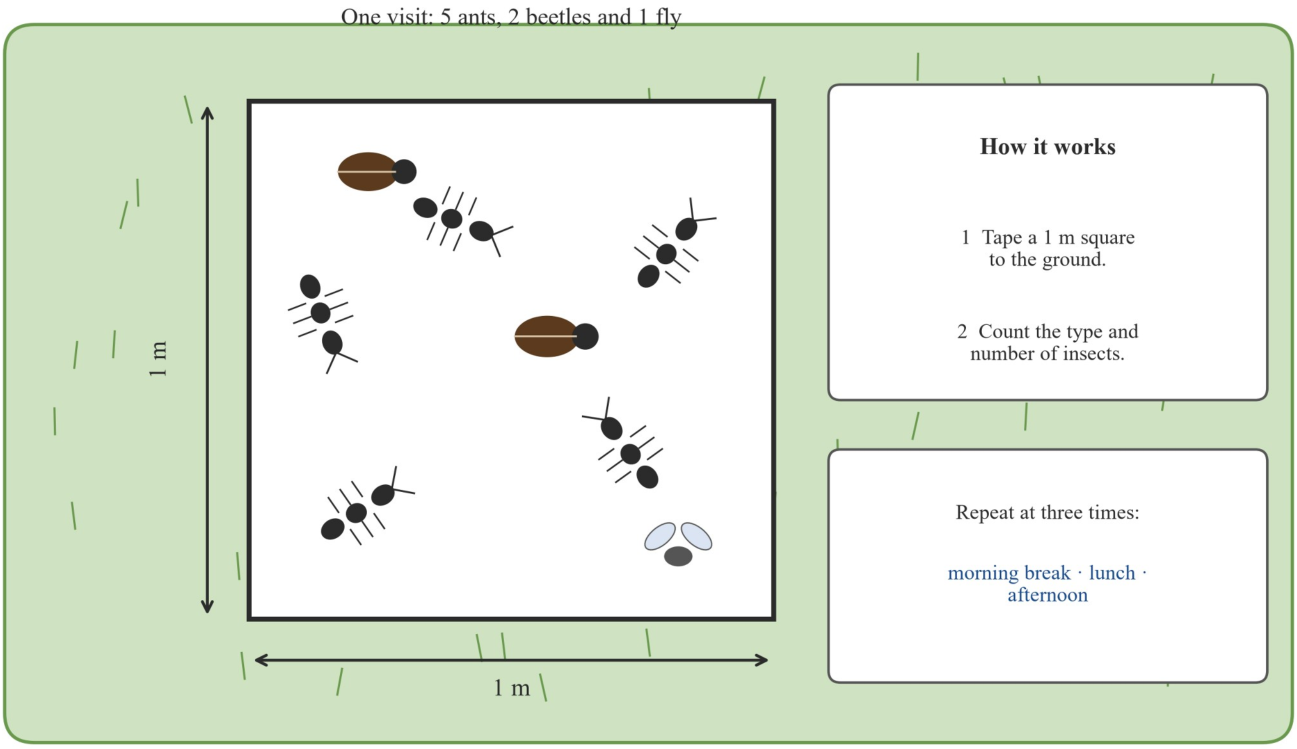
A good question also says **who** we ask and **what** we count: “What is the most common pet **in our class**?” is better than just “What is the most common pet?”

Step 2 — Make a plan: ask, or observe?

There are two main ways to collect data.

- **Survey** — ask people. A survey fits “How do you usually travel to school?”
- **Observe** — watch and count. Observing fits things people cannot tell you, like the insects living in the grass.

One way to observe insects is with a **quadrat**: a square frame that marks the piece of ground you count.



A 1 m square taped on green playground grass with 5 ants, 2 beetles and 1 fly inside. Side boxes read: How it works — 1 Tape a 1 m square to the ground, 2 Count the type and number of insects; Repeat at three times: morning break, lunch, afternoon.

Here the quadrat is a 1 m square taped to the playground. We count the type and number of insects inside it. To see how the counts change over time, we visit the same square at three times: morning break, lunch and afternoon.

The plan must also say **how** we will write the data down as it comes in. A tally chart (Step 3) is a quick way.

Step 3 — Collect the data

In a **tally chart**, each answer is one line, and every fifth line crosses the group of four before it. A crossed group of five is quick to count: 5, 10, 15, …

Travel to school — a survey of 24 students

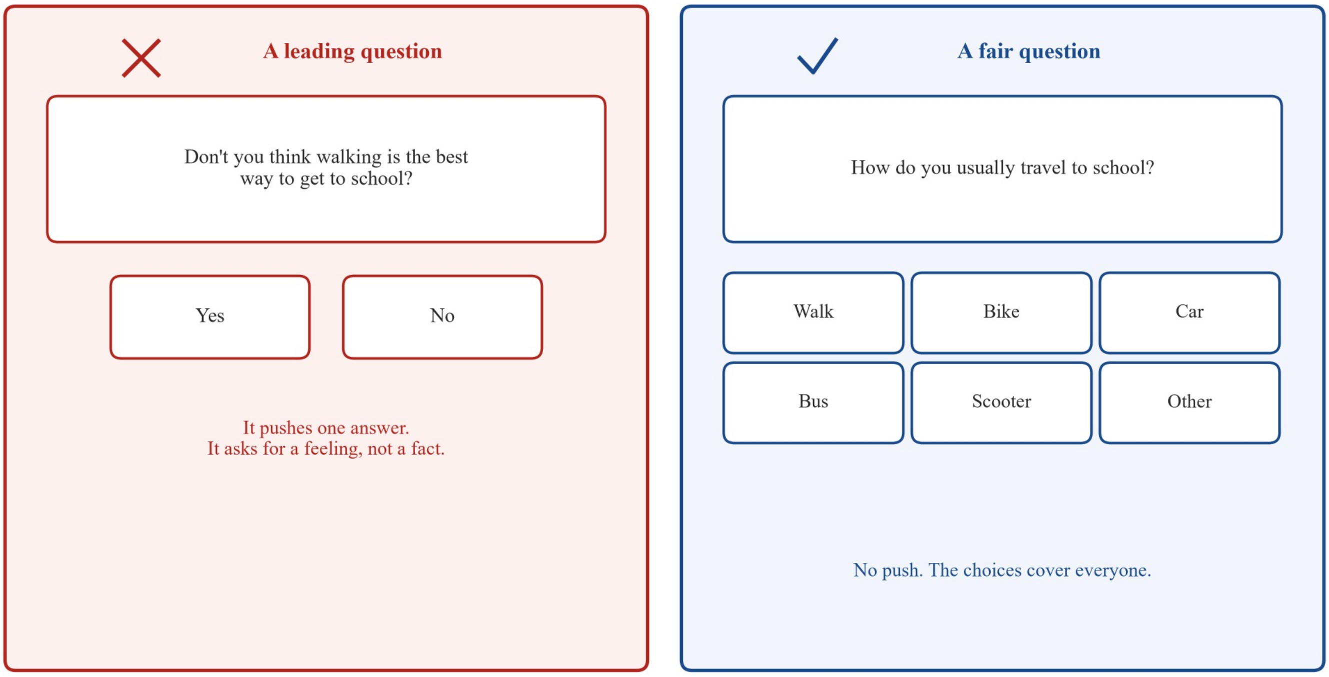
Way to travel	Tally	Number
Walk		7
Bike		4
Car		9
Bus		3
Scooter		1
Total		**24**

A tally chart of "How do you usually travel to school?" with rows Walk 7, Bike 4, Car 9, Bus 3 and Scooter 1, lines in crossed groups of five, and Total 24 in red.

The class asked every student, "How do you usually travel to school?" Each line is one student. Walk is a group of five and 2 more, so 7 students walk. The counts are: Walk 7, Bike 4, Car 9, Bus 3, Scooter 1 — 24 students altogether.

Good survey questions are fair. A fair question does not push one answer, and it does not tell you anybody's feelings about the topic.

Two survey questions about the same topic

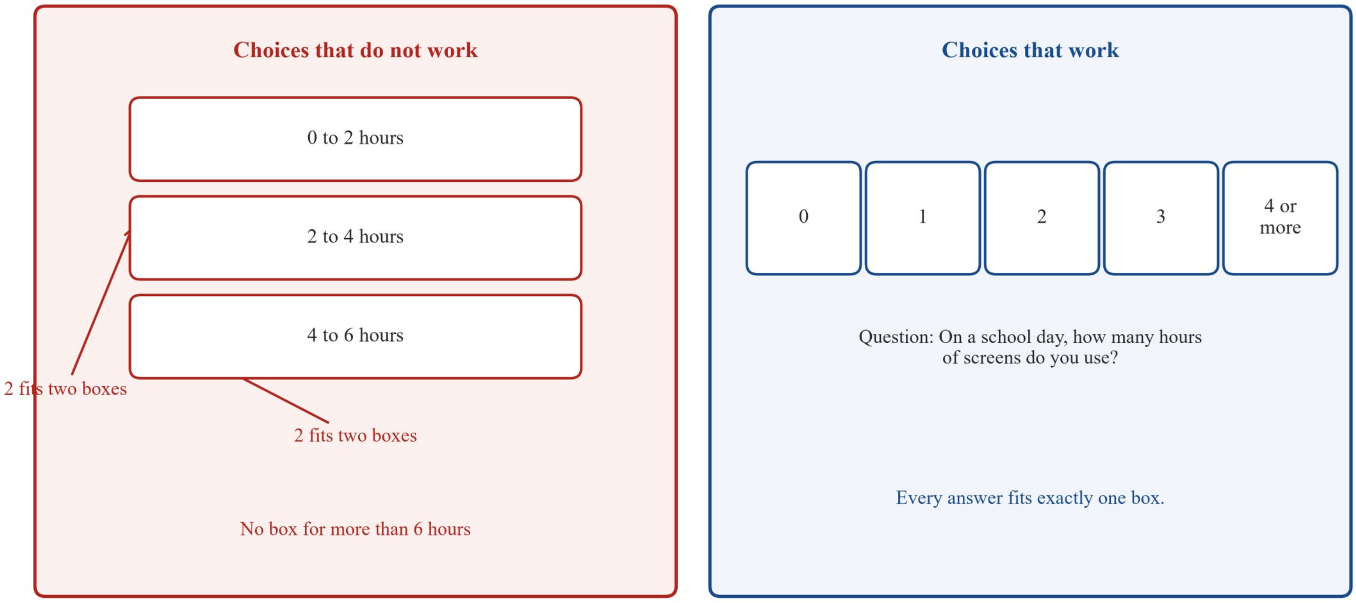


Two panels about the same topic. Left, in red with a cross: A leading question — "Don't you think walking is the best way to get to school?" with only Yes and No as choices; it pushes one answer and asks for a feeling, not a fact. Right, in blue with a tick: A fair question — "How do you usually travel to school?" with choices Walk, Bike, Car, Bus, Scooter, Other; no push, and the choices cover everyone.

The red question is a **leading** question: it pushes you towards "Yes". A question that pushes one answer is **biased**. The blue question just asks, and gives nobody's feelings.

The answer choices must cover everyone, with no overlap.

Answer choices must not overlap, and must cover everyone

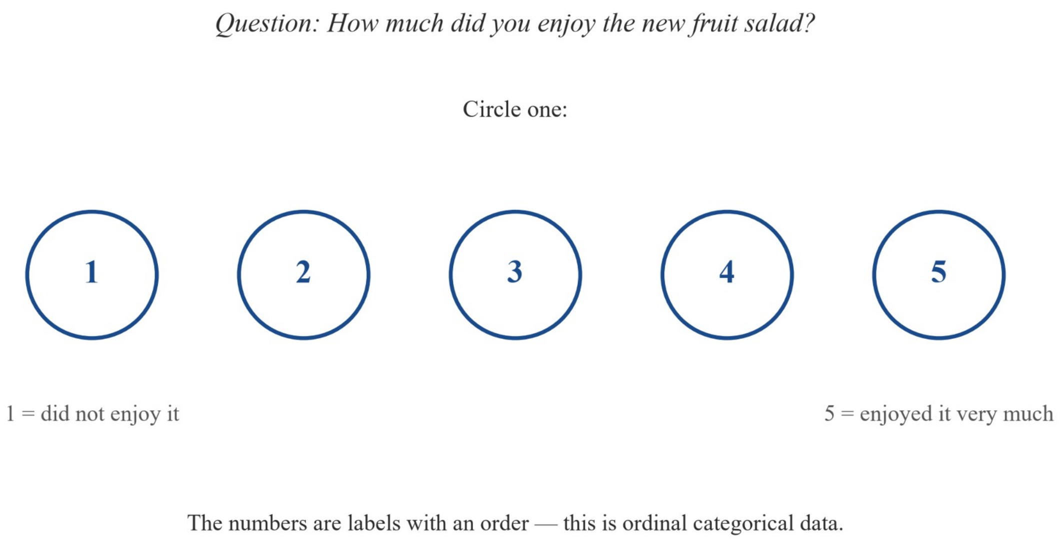


Two panels. Left, in red: Choices that do not work — boxes "0 to 2 hours", "2 to 4 hours", "4 to 6 hours"; 2 fits two boxes, and there is no box for more than 6 hours. Right, in blue: Choices that work — boxes 0, 1, 2, 3, "4 or more" for the question "On a school day, how many hours of screens do you use?"; every answer fits exactly one box.

On the red side, a student who uses screens for 2 hours fits **two** boxes, and a student who uses them for 7 hours fits **no box**. On the blue side, every answer fits exactly one box. And ask **one thing at a time**: “Do you like fruit and sport?” is really two questions.

Three types of data. The data we collect at Level 5 is one of three types.

- **Nominal categorical** data — labels with no order. Favourite fruit (apple, banana, …) is nominal categorical: the labels are only names.
- **Ordinal categorical** data — labels that **do** have an order.
- **Discrete numerical** data — counts: whole numbers we get by counting, like the number of pets.



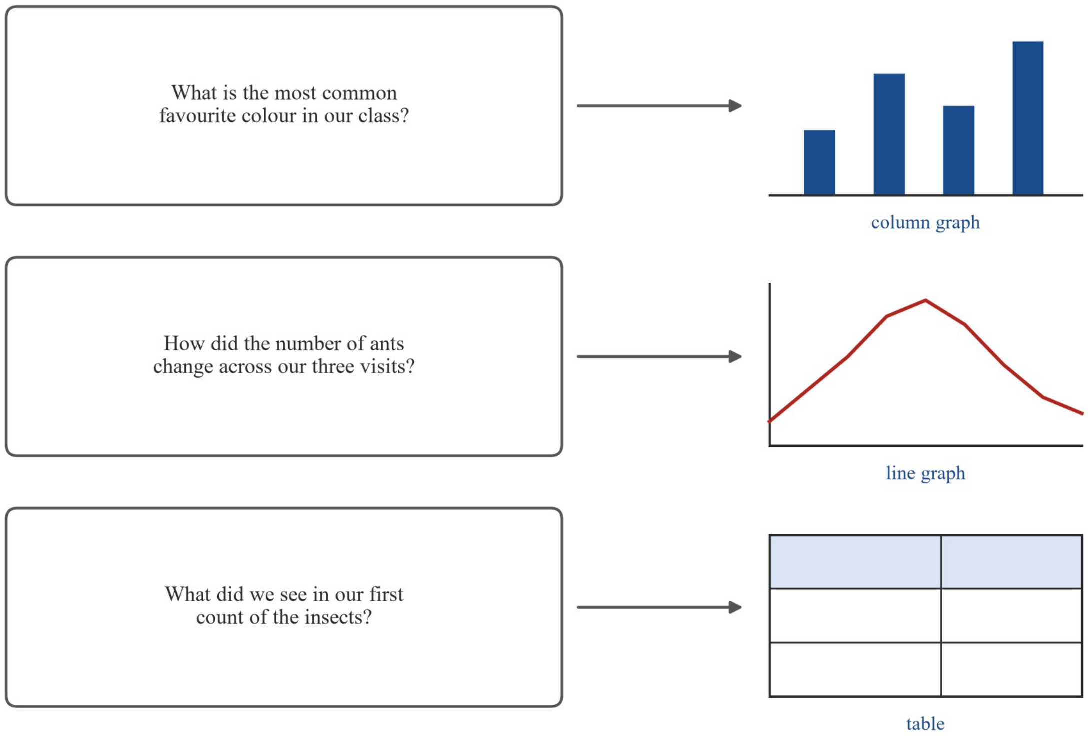
A survey question “How much did you enjoy the new fruit salad?” with five circles to circle, numbered 1 to 5. Under the ends: 1 = did not enjoy it, 5 = enjoyed it very much. Below: The numbers are labels with an order — this is ordinal categorical data.

On this scale, the numbers 1 to 5 are labels with an order: 5 means “enjoyed it more” than 4. The numbers are labels, not counts — we would not add them up. This is ordinal categorical data.

Step 4 — Choose a display and build it

Match the display to the question.

Match the question to the display



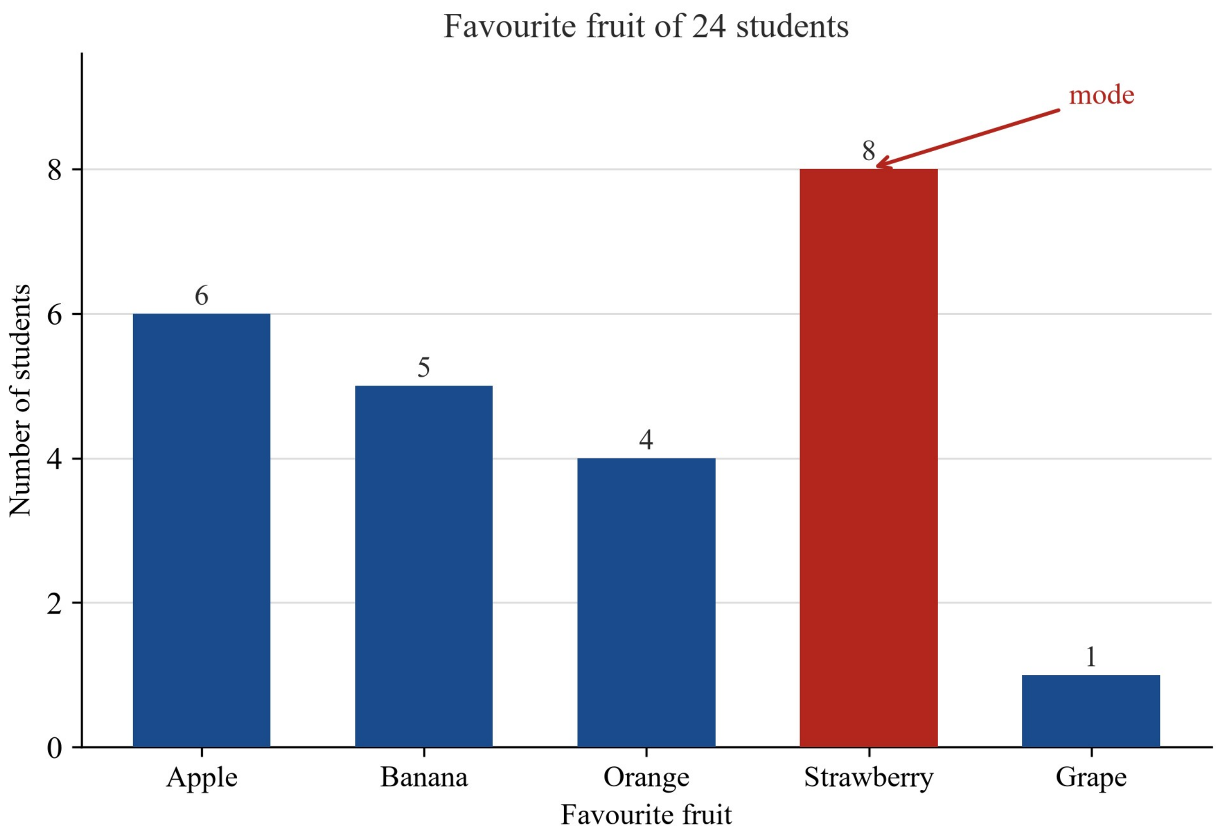
Three questions matched by arrows to displays: "What is the most common favourite colour in our class?" to a small column graph; "How did the number of ants change across our three visits?" to a small line graph; "What did we see in our first count of the insects?" to a small table.

- A **column graph** compares the categories: which one is the most common.
- A **line graph** shows change over time.
- A **table** keeps the counts as first collected, neat and exact.

Every column graph needs:

- a **title** that says what was asked and who was asked;
- labelled **axes** — an *axis* is the scale along the bottom or up the side;
- a scale that starts at **0**;
- columns the same width, with a gap between columns.

You can draw a graph by hand on grid paper, or build it with spreadsheet or graphing software. Here is the fruit survey as a column graph.



A column graph titled "Favourite fruit of 24 students": Apple 6, Banana 5, Orange 4, Strawberry 8 in red, Grape 1. The scale up the side is Number of students; the scale along the bottom is Favourite fruit. An arrow labelled "mode" points to the top of the Strawberry column, which has 8 written above it.

Step 5 — Interpret: the mode and the shape

The **mode** is the value that comes up most often — the tallest column. In the fruit graph the mode is strawberry: 8 students.

The **shape** of the data is what the graph looks like as a whole: where it is tall, where it is short, and where there are gaps. In the fruit graph the tallest column is strawberry and the shortest is grape.

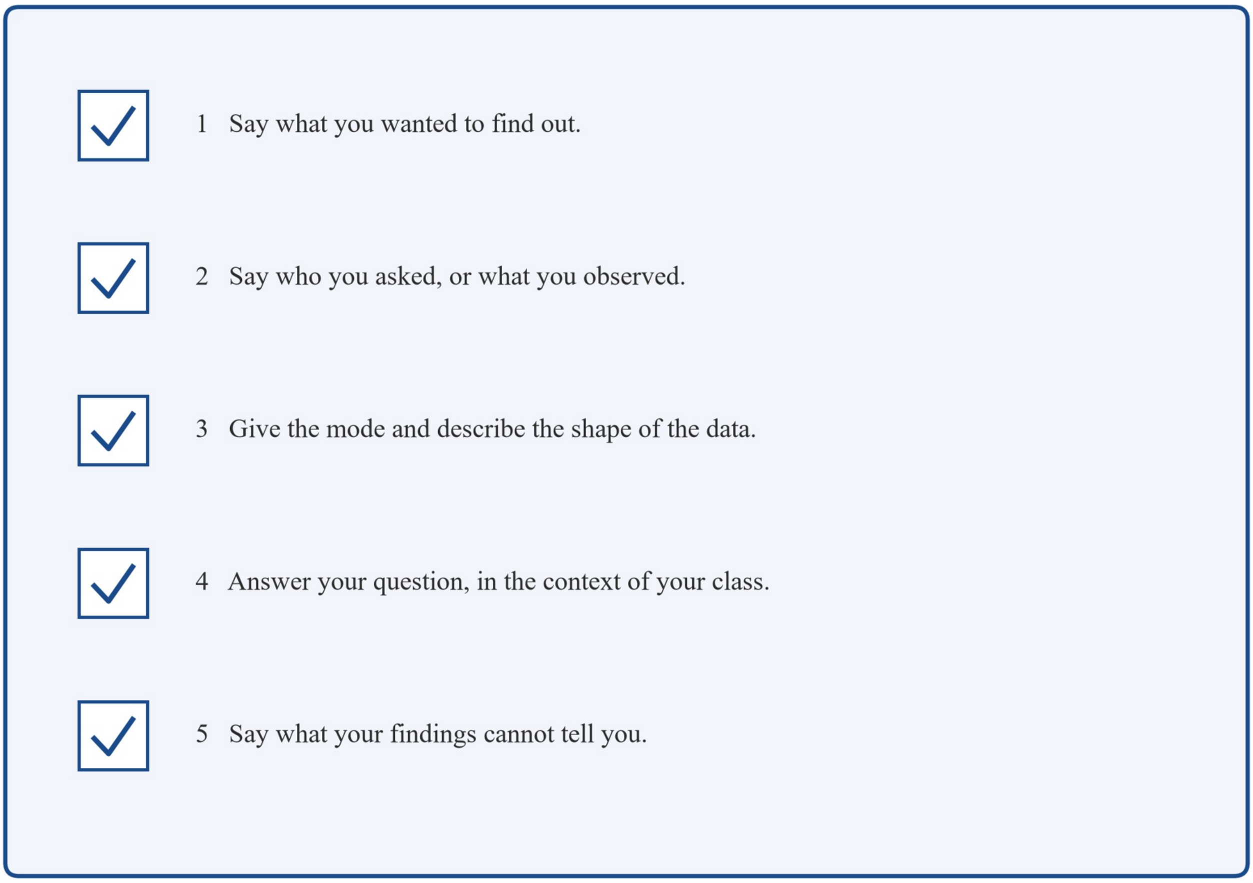
The count in each column is its **frequency**. A frequency can be given as a count (8 students), as "8 out of 24", or as a fraction:

$\frac{8}{24} = \frac{1}{3}$ of the class chose strawberry.

Step 6 — Communicate your findings

Your **findings** are what the data tells you. A good findings statement answers the question you first asked, in the context of your investigation.

Sharing your findings



A checklist titled "Sharing your findings": 1 Say what you wanted to find out. 2 Say who you asked, or what you observed. 3 Give the mode and describe the shape of the data. 4 Answer your question, in the context of your class. 5 Say what your findings cannot tell you.

Always stay inside what your data can say. We asked **our class** only — so we say "in our class", not "all students".

Worked examples

Example 1 — with help: read the tally chart

The tally chart above shows how the 24 students in our class usually travel to school. Find: a. the total number of students; b. the mode; c. the fraction of the class who walk.

Working	Comment
Count each row: Walk 7, Bike 4, Car 9, Bus 3, Scooter 1.	A crossed group is 5
$7 + 4 + 9 + 3 + 1 = 24$	Check: the class has 24 students
Car has the most lines (9), so the mode is car.	Mode = most often
Walk: 7 out of 24, $\frac{7}{24}$.	A frequency as a fraction

So 24 students answered, the mode is car, and $\frac{7}{24}$ of the class walk.

Example 2 — with help: interpret the fruit graph

Use the fruit column graph above. a. What is the mode? b. How many more students chose strawberry than grape? c. What fraction of the class chose apple? d. Write a findings sentence.

Working	Comment
The tallest column is strawberry (8): the mode is strawberry.	Mode = tallest column
$8 - 1 = 7$	Strawberry 8, grape 1
Apple: 6 out of 24, $\frac{6}{24} = \frac{1}{4}$.	Rename to quarters
"In our class, the most common favourite fruit is strawberry: 8 out of 24 students, or $\frac{1}{3}$, chose it."	Answer in context

Example 3 — with help: the quadrat counts

Our quadrat visits gave these counts.

Insect	Morning break	Lunch	Afternoon
Ants	5	7	4
Beetles	2	1	3
Flies	1	3	1
Butterflies	0	1	2

a. How many insects were in the square at each visit? b. Which visit had the most insects? c. Which insect is the mode for the whole day, and how many were there?
b. Say what the data **cannot** tell us.

Working	Comment
Morning: $5 + 2 + 1 + 0 = 8$; lunch: $7 + 1 + 3 + 1 = 12$; afternoon: $4 + 3 + 1 + 2 = 10$.	Add down each column
Lunch had the most insects (12).	Compare the three totals
Ants: $5 + 7 + 4 = 16$ — more than any other insect. The mode is ants.	Add across the ants row
It cannot tell us about the rest of the playground, or about other days.	One square, one day

Example 4 — on your own: ordinal scale data

Ten students circled a number on the fruit-salad scale (1 = did not enjoy it, 5 = enjoyed it very much): 3, 4, 5, 4, 2, 4, 5, 4, 3, 4. What is the mode, and what fraction of the students circled 4 or 5?

The mode is **4** (five students circled it). Four or five: $5 + 2 = 7$ students, so $\frac{7}{10}$ **of the students enjoyed the salad** (they circled 4 or 5).

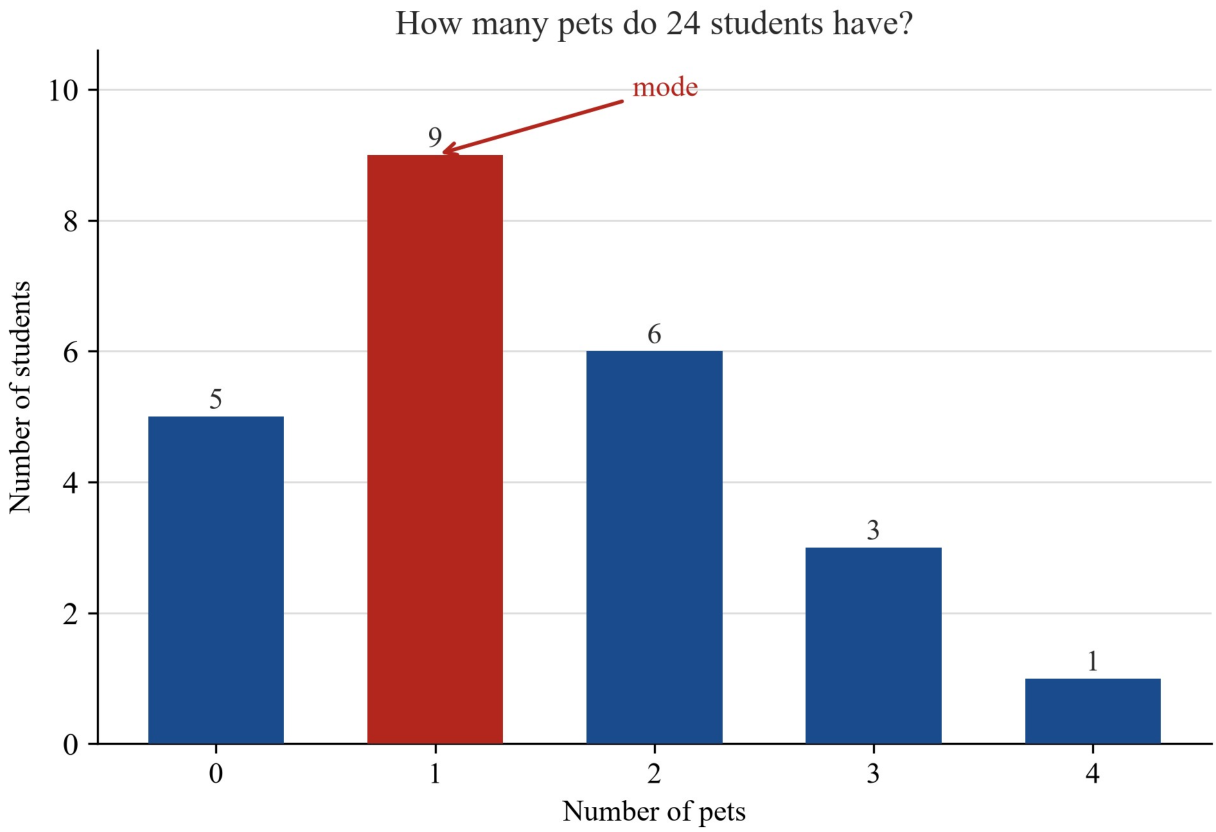
Example 5 — on your own: fix a biased question

"Don't you agree that homework should be shorter?" Why is this question biased, and how would you rewrite it?

It pushes one answer ("don't you agree…?"). A fair rewrite: **"Do you think homework should be shorter, longer, or is it about the right length?"** with the three choices *shorter / longer / about right*. Nobody's feelings are in the question, and the choices are balanced.

Example 6 — on your own: read the pets graph

Use the pets column graph below. a. What is the mode? b. What fraction of the class has no pets? c. How many students have 3 or more pets, as a fraction?



A column graph titled "How many pets do 24 students have?": 0 pets 5, 1 pet 9 in red, 2 pets 6, 3 pets 3, 4 pets 1. The scale up the side is Number of students; the scale along the bottom is Number of pets. An arrow labelled "mode" points to the top of the 1-pet column, which has 9 written above it.

a. The tallest column is 1 pet (9 students): **the mode is 1 pet**. b. No pets: 5 students, $\frac{5}{24}$. c. 3 + 1 = 4 students: \$ = \$ $\frac{1}{6}$.

Practice questions

With help

Q1. Which of these is a statistical question? a. How many legs does a spider have? b. What is the most common favourite colour in our class?

Q2. Use the travel tally chart. How many more students travel by car than by bus?

Q3. Use the travel tally chart. What fraction of the class travels by car?

Q4. Use the fruit column graph. How many students answered the survey?

Q5. Use the fruit column graph. What is the mode?

Q6. The fruit-salad scale (1 to 5) collects which type of data: nominal categorical, ordinal categorical or discrete numerical?

Q7. Which display fits "What is the most common favourite colour in our class?" — a column graph, a line graph or a table?

Q8. How many insects were in the quadrat at the morning-break visit?

On your own

Q9. Write your own statistical question about your class. Say whether you would collect the data by survey or by observing, and why.

Q10. “Which is better, swimming or boring running?” Why is this question biased? Rewrite it as a fair question with balanced choices.

Q11. A survey asks “How do you usually travel to school?” with choices Walk / Car / Bus. What is wrong with the choices, and how do you fix them?

Q12. Use the pets column graph. What fraction of the class has exactly 2 pets?

Q13. Use the pets column graph. Describe the shape of the data in one sentence.

Q14. Use the quadrat table in Example 3. How many insects were counted altogether across the three visits, and which insect is the mode?

Maths in real life

Q15. Here are the six steps of the fruit survey, mixed up. Number them 1 to 6 in the order of the investigation cycle. a. We draw a column graph of the counts. b. We ask: “What is the most common favourite fruit in our class?” c. We tell the class: “$\frac{1}{3}$ of us chose strawberry.” d. We decide to ask every student, and to record the answers in a tally chart. e. We ask every student and count the ticks for each fruit. f. We see that strawberry is the tallest column, so it is the mode.

Q16. You want to find out the most common favourite sport in your class. Write a fair survey question with four balanced choices.

Q17. Our class voted for the game to play on Friday sport: soccer 10, basketball 6, dodgeball 5, tag 3. a. What is the mode? b. What fraction of the class voted for soccer? c. Write a findings sentence for this vote.

Q18. Why do we visit the quadrat at three times, not just once?

Answers

Q1. b. **Q2.** 6. **Q3.** $\frac{9}{24}=\frac{3}{8}$. **Q4.** 24. **Q5.** Strawberry. **Q6.** Ordinal categorical. **Q7.** A column graph. **Q8.** 8. **Q9.** Answers vary. **Q10.** It calls running "boring" and says "better", pushing one answer; rewrite given in solutions. **Q11.** A student who bikes or takes the scooter fits no box; add an "Other" box. **Q12.** $\frac{6}{24}=\frac{1}{4}$. **Q13.** Answers vary (tallest at 1 pet, shorter on either side). **Q14.** 30 insects; the mode is ants. **Q15.** b = 1, d = 2, e = 3, a = 4, f = 5, c = 6. **Q16.** Answers vary. **Q17.** a. Soccer. b. $\frac{10}{24}=\frac{5}{12}$. c. Answers vary. **Q18.** One visit might be an unusual day; three visits show how the counts change over time.

Fully-worked solutions

Q1. A spider's legs have one fixed answer (8) — no data needed. Favourite colours vary from student to student, so we must collect data. ∴ **b** is the statistical question.

Q2. Car 9, bus 3: 9 − 3 = 6. ∴ **6 more students** travel by car than by bus.

Q3. Car is 9 of the 24 students: $\frac{9}{24}$. Renaming, $\frac{9}{24}=\frac{3}{8}$. ∴ $\frac{9}{24}=\frac{3}{8}$ **of the class** travels by car.

Q4. 6 + 5 + 4 + 8 + 1 = 24. ∴ **24 students** answered.

Q5. The tallest column is strawberry, with 8. ∴ the mode is **strawberry**.

Q6. The numbers 1 to 5 are labels with an order, not counts. ∴ the data is **ordinal categorical**.

Q7. The question compares categories (colours) to find the most common. ∴ a **column graph** fits.

Q8. 5 ants + 2 beetles + 1 fly = 8. ∴ **8 insects**.

Q9. Example: "How many pets does each student in our class have?" — a survey, because students know their own pets and we only need to ask. (Any statistical question with a matching method is fine.)

Q10. Calling running "boring" and asking "which is better" pushes one answer, so the question is biased. A fair rewrite: "Which do you enjoy more: swimming, running, or both the same?" with the choices *swimming / running / both the same*.

Q11. A student who travels by bike or by scooter has no box to tick, so the data would miss them. Fix: add an **Other** box (or add Bike and Scooter boxes) so every answer fits exactly one box.

Q12. Exactly 2 pets: 6 of the 24 students: $\frac{6}{24}=\frac{1}{4}$. ∴ $\frac{1}{4}$ **of the class** has exactly 2 pets.

Q13. Example: the graph is tallest at 1 pet and gets shorter on both sides, so most students have 0, 1 or 2 pets. (Any true sentence about where the graph is tall and short is fine.)

Q14. Totals: 8 + 12 + 10 = 30 insects. Ants 16, beetles 6, flies 5, butterflies 3 — ants came up most often. ∴ **30 insects; the mode is ants**.

Q15. Ask (b) → plan (d) → collect (e) → display (a) → interpret (f) → communicate (c). ∴ **b = 1, d = 2, e = 3, a = 4, f = 5, c = 6**.

Q16. Example: "Which of these is your favourite sport?" with the choices *soccer / basketball / swimming / other*. The question gives nobody's feelings, no choice is pushed, and "other" means every answer fits a box.

Q17. a. Soccer has the most votes (10): the mode is **soccer**. b. Soccer is 10 of the 24 votes: $\frac{10}{24} = \frac{5}{12}$. c. Example: "In our class, soccer is the most common choice for Friday sport: 10 out of 24 students, or $\frac{5}{12}$, voted for it." ∴ a. soccer; b. $\frac{5}{12}$; c. as written.

Q18. One count might land on an unusual day — a rainy morning may have few insects about. Three visits show how the counts change over time and give a fuller picture of the square. ∴ repeat the count to see change over time.

Test

Chapter test T7 — Statistics

Mathematics Level 5 · Chapter 7 · 7A Acquiring, validating and representing data · 7B Line graphs and change over time · 7C Planning and conducting a statistical investigation

This is a classroom check, not an exam. Answer all questions, and show your working where a question asks for it.

Marks	15 (Section A: 5 · Section B: 5 · Section C: 5)
Guidance time	20 minutes
Equipment	Ruler; printed graphs and tables provided

Section A — Acquiring, validating and representing data (5 marks)

Q1. A class surveys every student with two questions. Name the type of data each question collects — nominal categorical, ordinal categorical or discrete numerical.

a. "Rate the new school garden from 1 to 5." (1 mark)
b. "How many times did you visit the school garden this term?" (1 mark)

Q2. The 25 students in a class each answer question b of Q1. The answers are counts from 0 to 6 — discrete numerical data. Which display fits this data best?

A. A line graph B. A dot plot C. A pictograph D. A column graph

(1 mark)

Q3. Another class asks its 24 students, "What is your favourite season?" The recorded counts are:

Season	Spring	Summer	Autumn	Winter
Votes	7	9	5	4

a. Which check — the total check or the sense check — catches the mistake in this table? (1 mark)
b. Carry out the check, and say what it tells you about the data. (1 mark)

Section B — Line graphs and change over time (5 marks)

Questions 4 to 7 use this table of real Melbourne data — the daily maximum temperatures for the first ten days of August 2026.

Day in August 2026	1	2	3	4	5	6	7	8	9	10
Maximum temperature (°C)	16.6	17.6	15.9	13.6	13.4	16.8	16.0	17.7	14.3	13.1

Source: Bureau of Meteorology, Daily Weather Observations for Melbourne (Olympic Park), Victoria, retrieved 20 August 2026.

Q4. Use the table.

a. What was the maximum temperature on 5 August? (1 mark)
b. Which day had the highest maximum temperature, and what was it? (1 mark)

Q5. How much did the maximum temperature fall from 8 August to 10 August? Show your working. (1 mark)

Q6. The class draws a line graph of this data. Do the days go on the horizontal axis or the vertical axis? Give the reason. (1 mark)

Q7. In one sentence, describe how Melbourne's maximum temperature changed across these ten days. Use at least two dates and temperatures in your sentence. (1 mark)

Section C — Planning and conducting a statistical investigation (5 marks)

Q8. A student writes this survey question: *"Everyone agrees that our class should have a longer lunch, right?"*

a. Why is this question biased? (1 mark)
b. Rewrite it as a fair question. (1 mark)

Q9. The class counts the birds in the school yard at three times of day: morning break, lunch and afternoon. They want to show how the number of birds changed across the three visits. Which display fits best — a column graph, a line graph or a table? Give the reason for your choice. (1 mark)

Q10. A Year 5 class of 20 students wants to know: *"Which game should we play at Friday lunch sport?"* Every student votes, and the counts are recorded in the table.

Choice	Handball	Four square	Soccer	Basketball
Votes	7	6	4	3

a. What is the mode of the data? (1 mark)
b. Write a findings sentence that answers the class's question, in the context of the class. (1 mark)

End of test — total 15 marks.

Solutions

Answer key

Q	Answer	Marks
1a	Ordinal categorical	1
1b	Discrete numerical	1
2	B — a dot plot	1
3a	The total check	1
3b	7 + 9 + 5 + 4 = 25, not 24	1
4a	13.4 °C	1
4b	8 August, 17.7 °C	1
5	4.6 °C	1
6	The horizontal axis — time goes on the horizontal axis	1
7	Any true sentence with at least two dates and temperatures	1
8a	It pushes one answer	1
8b	Any fair rewrite with balanced choices	1
9	A line graph — it shows change over time	1
10a	Handball	1
10b	Any findings sentence answering the question in context	1
	Total	**15**

Worked solutions

Q1. Ask what the values are. a. The ratings 1 to 5 are labels in an order — 5 is a better rating than 1 — but they are not counts, so ordinal data stays categorical even though it is written with numbers: ordinal categorical. b. The answers come from counting — 0, 1, 2, 3, … — so the data is discrete numerical. ∴ a ordinal categorical; b discrete numerical.

Q2. The values are counts — discrete numerical data. A dot plot puts one dot per answer above its value on a number line, so every answer stays visible: it is the display that fits counts. A line graph shows change over time, a pictograph suits small counts with a key, and a column graph is paired with nominal and ordinal categories. ∴ **B, a dot plot.**

Q3. a. The total check: the counts must add up to the number of students asked. (Every value here is a possible count, so the sense check passes.) b. 7 + 9 + 5 + 4 = 25, but only 24 students were asked. The counts do not match the number asked, so one answer was counted twice — or a total was written down wrongly — and the data is not yet validated. ∴ a the total check; b the counts add to 25, not 24.

Q4. a. Read across the row to 5 August: 13.4 °C. b. The highest value in the table is 17.7 °C, and it sits above 8 August. ∴ a 13.4 °C; b 8 August, 17.7 °C.

Q5. 8 August: 17.7 °C. 10 August: 13.1 °C. The fall is 17.7 − 13.1 = 4.6. ∴ The maximum temperature fell **4.6 °C**.

Q6. The horizontal axis. Time always goes on the horizontal axis of a line graph, and the days are the time; the quantity being measured — the maximum temperature in °C — goes on the vertical axis. ∴ horizontal axis, because the days are the time.

Q7. Example: *The maximum temperature started at 16.6 °C on 1 August, rose to 17.7 °C on 8 August — the warmest of the ten days — and fell over the last two days to 13.1 °C on 10 August.* Any true sentence that names at least two dates with their temperatures earns the mark.

Q8. a. "Everyone agrees … right?" pushes the answer towards "yes" and puts a feeling into the question before anyone answers, so the question is biased. b. Example rewrite: *"Do you think lunch should be longer, shorter, or about the right length as it is?"* with the choices *longer / shorter / about the right length*. Nobody's feelings are in the question, and the choices are balanced. Any fair rewrite with balanced choices earns the mark.

Q9. A line graph. The data is a count changing over time across three visits, and a line graph is the display that shows change over time. A column graph compares categories, and a table keeps the counts as first collected — neither shows the change as clearly. ∴ line graph, because it shows change over time.

Q10. a. Handball has the most votes (7), so the mode is **handball** — the value, not the 7. b. Example: *In our class, handball is the most popular game for Friday lunch sport: 7 out of 20 students voted for it.* Any sentence that answers the question in the context of the class earns the mark. ∴ a handball; b as written.