# Mathematics Level 10

## End-of-book review



**Aboriginal and Torres Strait Islander content** has been excluded as accuracy cannot be guaranteed, and it is better to be respectful than cover the entire curriculum inaccurately.

Significant effort has been made to ensure this content is legal. Please send any areas of concern to admin@vwx.au with appropriate document/legal references so errors can be verified and changes be made.

## End-of-year review

*Mathematics 10 · Level 10 · End-of-year review · all 30 content descriptions · 80 marks*

> This is a school-designed paper. It is not a VCAA instrument. Achievement in the Victorian Curriculum is reported against the Level 10 achievement standard, not against a mark on this paper.

**Codes:** all 30 content descriptions of Mathematics Level 10, each scored separately · **Total: 80 marks** — Part A 30, Part B 50

**The End-of-year review** is the exit paper of Mathematics Level 10. It is cumulative: one paper assessing all 30 content descriptions the book owns (TOC §4), weighted to the chapters carrying the heaviest VCE load (TOC §5, §7.2). Part A is **technology-free** — worked without calculators or digital tools — and carries 15 questions worth 30 marks. Part B is **technology-active** — the tool your teacher nominates is permitted — and carries 15 questions worth 50 marks. Part A is sat and collected before Part B is issued (TOC §7.2). The paper carries answers and fully-worked solutions, and a mark scheme written in the language of the achievement-standard extracts, so a teacher's judgement maps to the VCAA wording without translation (TOC §7).

**This is a classroom instrument. It is not a VCE examination, is not modelled on one, and may not be described as practice for one (TOC §7.2).**

| Part | Questions | Technology | Marks |
|---|---|---|---|
| Part A | A1–A15 | Technology-free — no calculator, no digital tool of any kind | 30 |
| Part B | B1–B15 | Technology-active — the nominated tool class; No CAS | 50 |
| | | **Total — all 30 content descriptions, each scored separately** | **80** |

### What the paper covers

| Question | CD | What it scores | Marks |
|---|---|---|---|
| A1 | `VC2M10N01` | Approximations in repeated calculations — rounding early and late | 3 |
| A2 | `VC2M10A01` | Factorising by taking out a common algebraic factor | 1 |
| A3 | `VC2M10A02` | Simplifying products and quotients with exponent laws | 2 |
| A4 | `VC2M10A03` | Adding simple algebraic fractions | 1 |
| A5 | `VC2M10A04` | Expanding a binomial product; factorising a monic quadratic | 2 |
| A6 | `VC2M10A05` | Rearranging a formula; substituting into a formula | 2 |
| A7 | `VC2M10A07` | A linear equation from a situation | 2 |
| A8 | `VC2M10A08` | A linear inequality and its graph on a number line | 2 |
| A9 | `VC2M10A10` | Gradients of perpendicular | 2 |

| Question | CD | What it scores | Marks |
|---|---|---|---|
| | | lines | |
| A10 | VC2M10A12 | Linear equations involving algebraic fractions | 2 |
| A11 | VC2M10A13 | Quadratic equations — null factor law; exact surd form | 2 |
| A12 | VC2M10A14 | A simple exponential equation | 1 |
| A13 | VC2M10A16 | Reading solutions from a graph; deciding whether all are found | 2 |
| A14 | VC2M10SP01 | A proof by deductive reasoning — diagonals of a rhombus | 3 |
| A15 | VC2M10ST01 | Reading a boxplot — median, IQR, outliers, judging a claim | 3 |
| B1 | VC2M10A06 | Tracing an algorithm in pseudocode | 2 |
| B2 | VC2M10A09 | Simultaneous linear equations, algebraically and graphically | 4 |
| B3 | VC2M10A11 | Reading features of circle, reciprocal and exponential graphs | 3 |
| B4 | VC2M10A15 | Compound interest as repeated simple interest; an exponential model; evaluate and modify | 5 |
| B5 | VC2M10M01 | Volume of a composite object | 3 |
| B6 | VC2M10M02 | Reading and using a logarithmic scale — the Richter scale | 2 |
| B7 | VC2M10M03 | Angles of elevation; Pythagoras' theorem and bearings | 4 |
| B8 | VC2M10M04 | Scaling — area and volume factors; the impact of measurement errors | 4 |
| B9 | VC2M10SP02 | A network — degrees, connectedness, Euler's walk test | 3 |
| B10 | VC2M10ST02 | A scatterplot — association, line of good fit, judging a claim | 4 |
| B11 | VC2M10ST03 | A two-way table; association between categorical variables | 2 |
| B12 | VC2M10ST04 | Critiquing a misleading | 3 |

| Question | CD | What it scores | Marks |
|---|---|---|---|
| | | display | |
| B13 | `VC2M10ST05` | A time-series investigation — trend, prediction, limitations | 4 |
| B14 | `VC2M10P01` | Conditional probability — ‘given’ and ‘of’ | 3 |
| B15 | `VC2M10P02` | A two-step chance experiment without replacement; independence | 4 |
| | | **Total** | **80** |

### How to run the review

- **Format** — a written paper in two parts. Part A is sat and collected before Part B is issued (TOC §7.2): run it as two sessions, or as one 90-minute sitting with Part A collected in between.
- **Timing** — 90 minutes in total (TOC §7.2). Suggested allocation: 35 minutes for Part A and 55 minutes for Part B.
- **Equipment** — pens or pencils and a ruler; grid paper for any hand-drawn graphs in Part B.
- **Calculator and tools** — Part A: none — no calculator and no digital tool of any kind. Part B: the tool you nominate — scientific calculator, spreadsheet, graphing tool, dynamic geometry software or a general purpose programming language (TOC §7). **No CAS.** Tools are named by class only, never by product (D13). Where a Part B question carries a DIGITAL TOOL banner, the tool-free path stated there is still a complete response (R8).
- **Multiple choice** — used sparingly: one item on this paper (A2), four options A–D (TOC §7.1).
- **What this paper is** — a classroom instrument (D19). It is not a VCAA instrument, not a VCE examination, and may not be described as practice for one (TOC §7.2). It is the instrument a school uses to advise on a VCE mathematics pathway (TOC §7.2).

---

## Part A — Technology-free · Questions A1–A15 · 30 marks

*No calculator and no digital tool of any kind in this part. Give exact values unless a question asks for a decimal. Show your working — marks are awarded for the reasoning, not only the answer.*

**A1. (3 marks)** · `VC2M10N01`

A cylinder has radius $r=\sqrt{8}$ cm and height $h=5$ cm.

(a) Show that the exact volume is $40\pi$ cm³.

(b) One student rounds $\sqrt{8}\approx 2.8$ and $\pi\approx 3.14$ **before** substituting. Calculate the volume this student obtains, to 1 decimal place.

(c) A second student keeps $r^2=8$ exact and rounds only at the end: $V\approx 3.14\times 8\times 5$. Calculate this value, and decide which student's answer is closer to the exact value $40\pi\approx 125.66$. What does this say about rounding early in a repeated calculation?

**A2. (1 mark)** · `VC2M10A01`

Which of the following is the **fully factorised** form of $18x^3y-12x^2y^2$?

A $6x^2y(3x-2y)$

B $6xy(3x^2-2xy)$

C $3x^2y(6x-4y)$

D $2x^2y(9x-6y)$

**A3. (2 marks)** · `VC2M10A02`

Simplify, leaving only positive exponents:

(a) $(2a^3b^2)^2 \div a^4b$

(b) $5m^2n \times m^{-4}n^3$

**A4. (1 mark)** · `VC2M10A03`

Write $\frac{2}{x}+\frac{3}{x^2}$ as a single fraction in simplest form.

**A5. (2 marks)** · `VC2M10A04`

(a) Expand $(2x-3)(x+4)$.

(b) Factorise $x^2+10x+24$.

**A6. (2 marks)** · `VC2M10A05`

(a) Make $t$ the subject of $v=u+at$.

(b) The area of a trapezium is $A=\frac{(a+b)h}{2}$. Find $h$ when $A=54$, $a=7$ and $b=11$.

**A7. (2 marks)** · `VC2M10A07`

`SCENARIO` A rectangular courtyard is $3$ m longer than it is wide, and its perimeter is $54$ m. Form an equation and solve it to find the width and the length of the courtyard.

**A8. (2 marks)** · `VC2M10A08`

Solve the inequality $7-2x\geq 15$, and graph its solutions on a number line.

**A9. (2 marks)** · `VC2M10A10`

(a) Find the gradient of a line perpendicular to $y=4x-9$.

(b) Find the equation of the line through $(8,3)$ that is perpendicular to $y=-2x+5$.

**A10. (2 marks)** · `VC2M10A12`

Solve:

(a) $\frac{5}{x}+3=\frac{8}{x}$

(b) $\frac{x+3}{4}=\frac{x-2}{3}$

**A11. (2 marks)** · `VC2M10A13`

(a) Solve $x^2-9x+20=0$ using the null factor law.

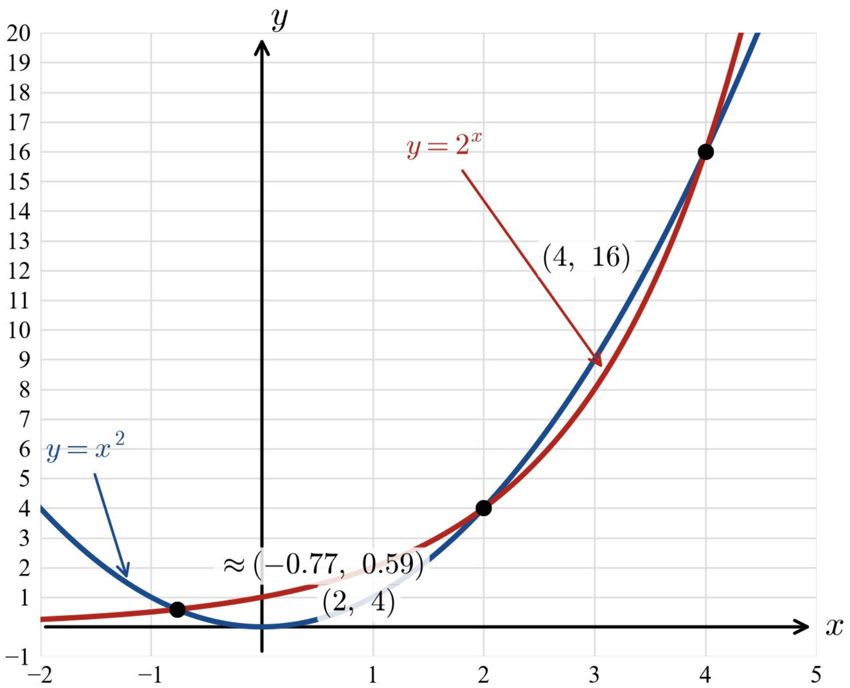
(b) Solve $(x-3)^2=27$, leaving your answers in exact surd form.

**A12. (1 mark)** · `VC2M10A14`

Solve $4^x=8$, giving an exact answer.

**A13. (2 marks)** · `VC2M10A16`

The figure shows the graphs of $y=x^2$ and $y=2^x$.




*The graphs y equals x squared and y equals 2 to the power of x, for x from negative 2 to 5 and y from negative 1 to 20, meeting three times: near (negative 0.77, 0.59), at (2, 4) and at (4, 16).*

(a) Use the graph to write down all solutions of $x^2=2^x$, to 1 decimal place where the solution is not a whole number.

(b) Explain how you can be confident you have found **all** the solutions. (Consider what each graph does for $x>4$, and for $x\le -1$.)

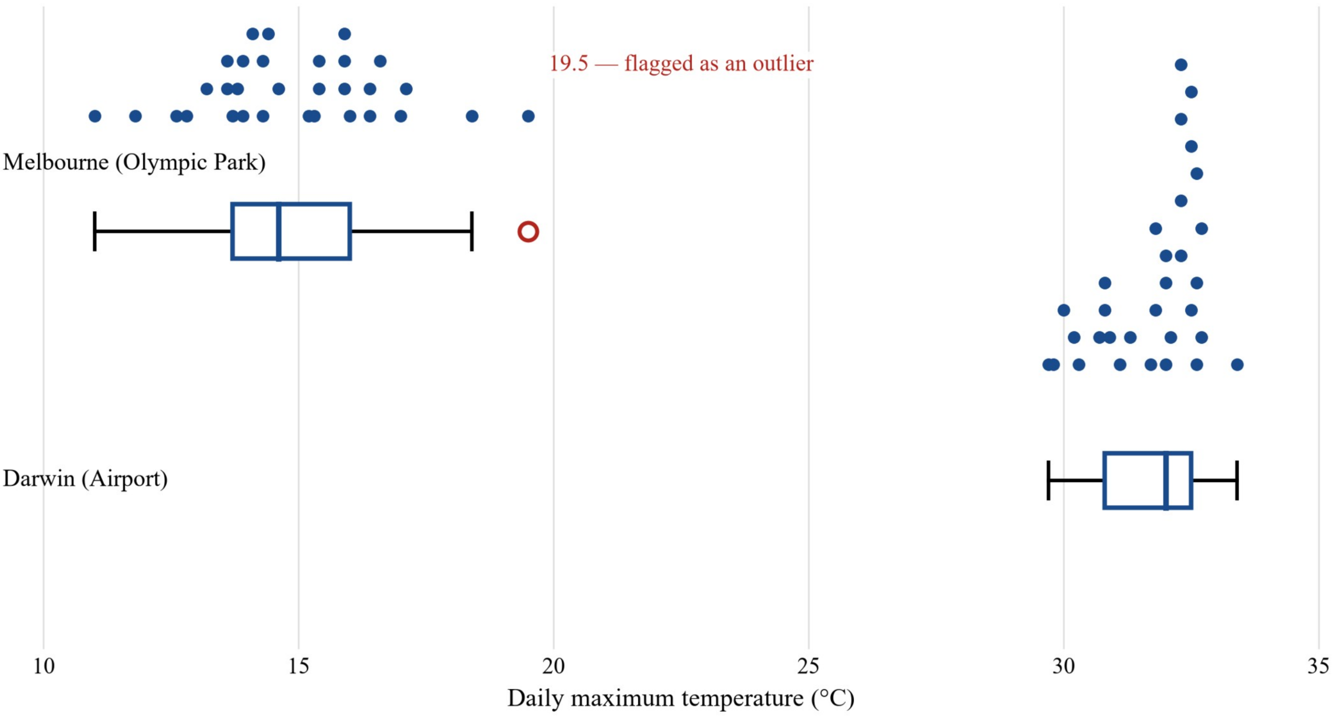
**A14. (3 marks)** · `VC2M10SP01`

Draw a rhombus $ABCD$ with diagonals $AC$ and $BD$ meeting at $M$. Prove that the diagonals of a rhombus meet at right angles — that is, prove $\angle AMB=90°$.

You may quote without proof: all sides of a rhombus are equal, and the diagonals of a parallelogram bisect each other (Theorem 3 of 5A). Give a reason for every step.

**A15. (3 marks)** · `VC2M10ST01`

The figure shows parallel boxplots of the daily maximum temperatures recorded in July 2026 at Melbourne (Olympic Park) and Darwin (Airport).




*Parallel boxplots with dot strips on one number line from 10 to 35 degrees Celsius. Melbourne (Olympic Park): whiskers from 11.0 to 18.4, box from 13.7 to 16.0 with median 14.6, and one red circled outlier point at 19.5. Darwin (Airport): whiskers from 29.7 to 33.4, narrow box from 30.8 to 32.5 with median 32.0, no outliers. The dot strips above each boxplot show Melbourne's values spread widely and Darwin's piled tightly near 32.*

Source: Bureau of Meteorology, Daily Weather Observations, Melbourne (station 086338, Melbourne Olympic Park), daily maximum temperature, July 2026 table (IDCJDW3050.202607), 2026. Retrieved 20 August 2026.

Source: Bureau of Meteorology, Daily Weather Observations, Darwin (station 014015, Darwin Airport), daily maximum temperature, July 2026 table (IDCJDW8014.202607), 2026. Retrieved 20 August 2026.

(a) Read from the Melbourne boxplot: the median daily maximum temperature, and the interquartile range.

(b) The plot marks one point at 19.5 °C. Use the $1.5 \times \text{IQR}$ rule to show by calculation whether it is an outlier.

(c) A travel website claims that Melbourne's daily maximum temperature in July is *typically* 15 *°C or warmer*. Is the claim supported by the data? Justify your answer with a summary statistic.

---

## Part B — Technology-active · Questions B1–B15 · 50 marks

*The tool your teacher nominates is permitted in this part — scientific calculator, spreadsheet, graphing tool, dynamic geometry software or a general purpose programming language.* ***No CAS.*** *Where a question can be completed equally well by hand, a fully hand-worked response is a complete response.*

**B1. (2 marks)** · `VC2M10A06`

The algorithm below works on $G$, a two-dimensional array whose three rows are the coordinates of three points. Positions are counted from 0, row first, column second.

```
G ← [[1, 2], [3, 4], [5, 6]]
p ← 1
FOR r ← 0 TO 2
    G[r][p] ← 2 × G[r][p]
NEXT r
OUTPUT G
```

(a) Trace the algorithm and write down what it outputs.

(b) In words, describe what the algorithm does to the three points, and say what role $p$ plays. (You may implement the algorithm in your nominated programming language instead of tracing it; a correct trace scores full marks.)

**B2. (4 marks)** · `VC2M10A09`

`SCENARIO` At a school fete, two adult tickets and three child tickets cost $\$52$, and five adult tickets and one child ticket cost $\$78$.

(a) Form a pair of simultaneous linear equations and solve them algebraically to find the cost of one adult ticket and one child ticket. Show your method.

(b) When the two equations are graphed as straight lines, they meet at one point. Write down the coordinates of that point and explain what they mean in this situation. (You may check your intersection with a graphing tool; an algebraic reading scores full marks.)

(c) Name the method you used in part (a) — substitution or elimination — and give one reason it was an efficient choice for this pair of equations.

**B3. (3 marks)** · `VC2M10A11`

**DIGITAL TOOL — you may check each part of this question with a graphing tool. Your teacher will nominate the tool. No CAS. Every part can also be completed by hand, reading the equation alone — the tool-free response is a complete response.**

(a) The circle has equation $x^2+y^2=49$. State its centre and its radius.

(b) The reciprocal function has equation $y=\dfrac{24}{x}$. Find $y$ when $x=6$, and explain why there is no point on the graph with $x=0$.

(c) The exponential curve has equation $y=3\times 2^x$. Solve $3\times 2^x=24$, showing your steps.

**B4. (5 marks)** · `VC2M10A15`

The Reserve Bank of Australia's one-year term deposit rate for deposits of $\$10\,000$ was $5.00\,\%$ p.a. as at July 2026. Suppose $\$12\,000$ is invested at that rate, compounded yearly.

(a) Build the first three years as **repeated simple interest**: each year, add $5.00\,\%$ of the balance at the start of that year. Show the balance at the end of year 1, year 2 and year 3.

(b) Write an exponential rule $V=12\,000\times a^n$ for the balance after $n$ years at the constant rate, and use it to find the first whole year in which the balance exceeds $\$15\,000$. (You may use your calculator for the powers; a trap-and-refine table scores full marks.)

(c) **Evaluate.** The RBA's HISTORICAL one-year term deposit rates — trend and comparison only — were $4.50\,\%$ p.a. in July 2024, $4.20\,\%$ p.a. in December 2024, $3.60\,\%$ p.a. in July 2025 and $5.00\,\%$ p.a. in July 2026. Comment on the assumption that the rate stays at $5.00\,\%$ for the whole period, and describe how the model would be modified to use each year's own rate.

Source: Reserve Bank of Australia, *Statistical Table F4 — Retail Deposit and Investment Rates* (one-year term deposit rate for $\$10\,000$, as at July 2026; historical rates 2024–2025), 2026, published 10 August 2026. Retrieved 20 August 2026.

**B5. (3 marks)** · `VC2M10M01`

`SCENARIO` A grain silo is a cylinder of radius $2$ m and height $5$ m, with a hemisphere of radius $2$ m on top.

(a) Show that the exact volume of the silo is $\dfrac{76\pi}{3}$ m³.

(b) Hence write the volume to 1 decimal place.

**B6. (2 marks)** · `VC2M10M02`

The Mansfield earthquake of 22 September 2021 had magnitude $5.9$ — the largest recorded in Victoria. On the Richter scale, each step of 1 multiplies the shaking of the ground by $10$ and the energy released by about $32$.

Source: Geoscience Australia, *Earthquakes@GA*, 2021. Retrieved 20 August 2026.

(a) How many times more shaking did the Mansfield earthquake produce than an earthquake of magnitude $4.9$ at the same distance?

(b) About how many magnitude steps is an earthquake that releases roughly $1000$ times the energy of the Mansfield earthquake, and what magnitude would it be? (Hint: $32 \times 32 \approx 1000$.)

**B7. (4 marks)** · `VC2M10M03`

The wall of Thomson Reservoir is $165$ m high. A surveyor stands on level ground and measures the angle of elevation of the top of the wall.

Source: Melbourne Water, *Thomson Reservoir*, 2026. Retrieved 19 August 2026.

(a) From her first position the angle of elevation is $10°$. How far is she from the base of the wall, to 1 decimal place? Draw the right-angled triangle you use.

(b) She walks $200$ m closer to the wall along level ground. Find the new angle of elevation, to 1 decimal place.

(c) From the second position she then walks $300$ m due east, on a bearing of `090°T`. Her original approach to the wall was due north, on a bearing of `000°T`. How far is she now from her starting position, to 1 decimal place, and what is the bearing of her final position from the start, to the nearest degree?

**B8. (4 marks)** · `VC2M10M04`

`SCENARIO` An architectural model of a building is made at scale $1:50$ — every length on the model is $\frac{1}{50}$ of the real length.

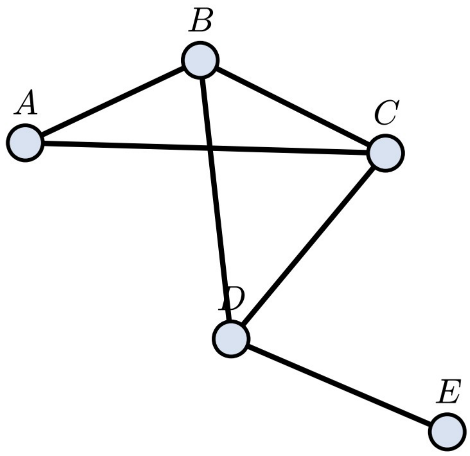
(a) A window on the model has area $6$ cm². Find the area of the real window, in m².

(b) A water tank on the model holds $400$ mL. How many litres does the real tank hold?

(c) The real courtyard is measured as $6.2$ m by $4.8$ m, each to 1 decimal place. Find the nominal area, and the largest area consistent with those measurements. Hence find how much the true area could exceed the nominal area.

**B9. (3 marks)** · `VC2M10SP02`

The figure shows a network on vertices A to E.




*A network on five vertices: edges A–B, A–C, B–C, B–D, C–D and D–E.*

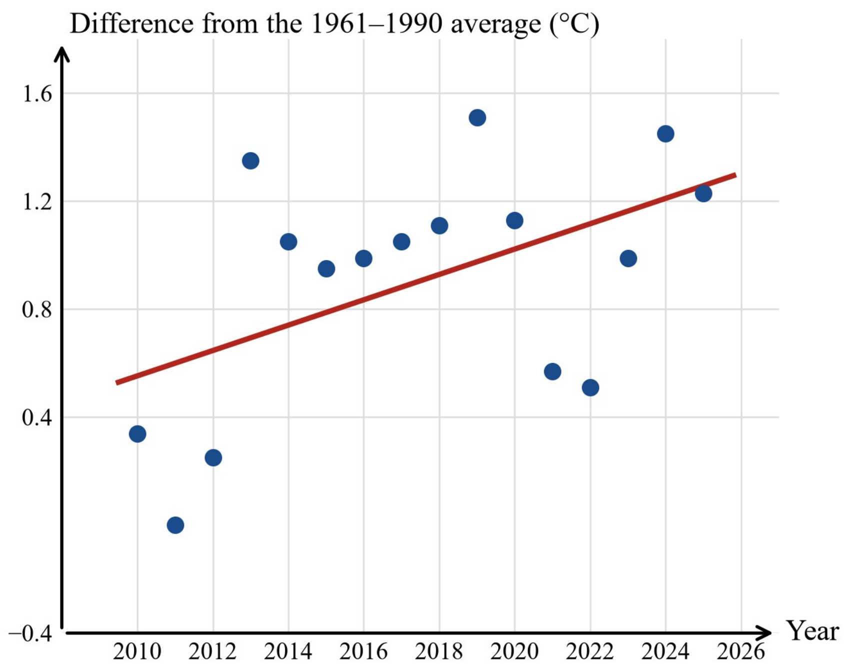
(a) State the number of vertices, the number of edges, and whether the network is connected.

(b) Find the degree of each vertex, and count the vertices of odd degree.

(c) Can a walk use every edge exactly once? Use the Euler walk test (Result 4 of 5B) to justify your answer.

**B10. (4 marks)** · `VC2M10ST02`

The figure shows the Australian annual mean temperature for 2010–2025, as the difference from the 1961–1990 average, with a line of good fit.




*Scatterplot of the Australian annual mean temperature difference from the 1961–1990 average for 2010 to 2025, with a rising red line of good fit through the scattered points.*

Source: Bureau of Meteorology, *Annual Climate Statement 2025* (Australian annual mean temperature, as the difference from the 1961–1990 average), 2025. Retrieved 20 August 2026.

(a) Describe the association between year and temperature difference, giving its direction and whether it is roughly linear.

(b) Comment on the strength of the association.

(c) Use the line of good fit to estimate the temperature difference for 2028. (You may extend the line with a graphing tool; a hand-read estimate scores full marks.)

(d) Someone reading the graph says it *proves exactly how warm 2028 will be*. Refute this claim.

**B11. (2 marks)** · `VC2M10ST03`

`SCENARIO` Eighty students at a school are surveyed about how they travel to school, by year level. The partial results are:

| | Walk | Ride | Total |
|---|---|---|---|
| Year 7 | 24 | 16 | |
| Year 10 | 12 | 28 | |
| **Total** | | | |

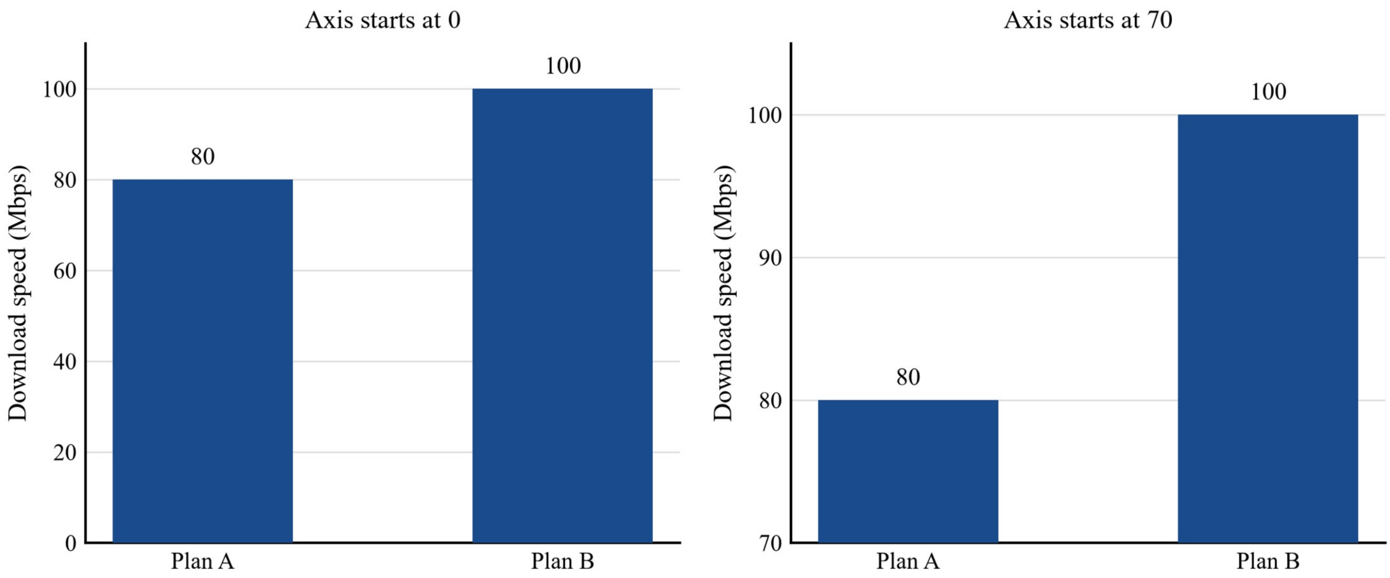
(a) Copy and complete the two-way table, adding the row totals, the column totals and the grand total.

(b) Calculate the percentage of each year level that walks, and say whether the table shows an association between year level and travel mode.

**B12. (3 marks)** · `VC2M10ST04`

`SCENARIO` An internet company's advertisement compares the download speeds of two of its plans, and presents the comparison in the figure on the right.

| Plan | Download speed (Mbps) |
|---|---|
| A | 80 |
| B | 100 |




*Two bar charts of the same two download speeds, 80 and 100 megabits per second: on the left the vertical axis starts at zero and the two bars look much the same height; on the right the axis starts at 70 with no break shown and the second bar towers over the first.*

(a) Identify the feature of the advertisement's display (the right-hand chart) that makes the comparison misleading.

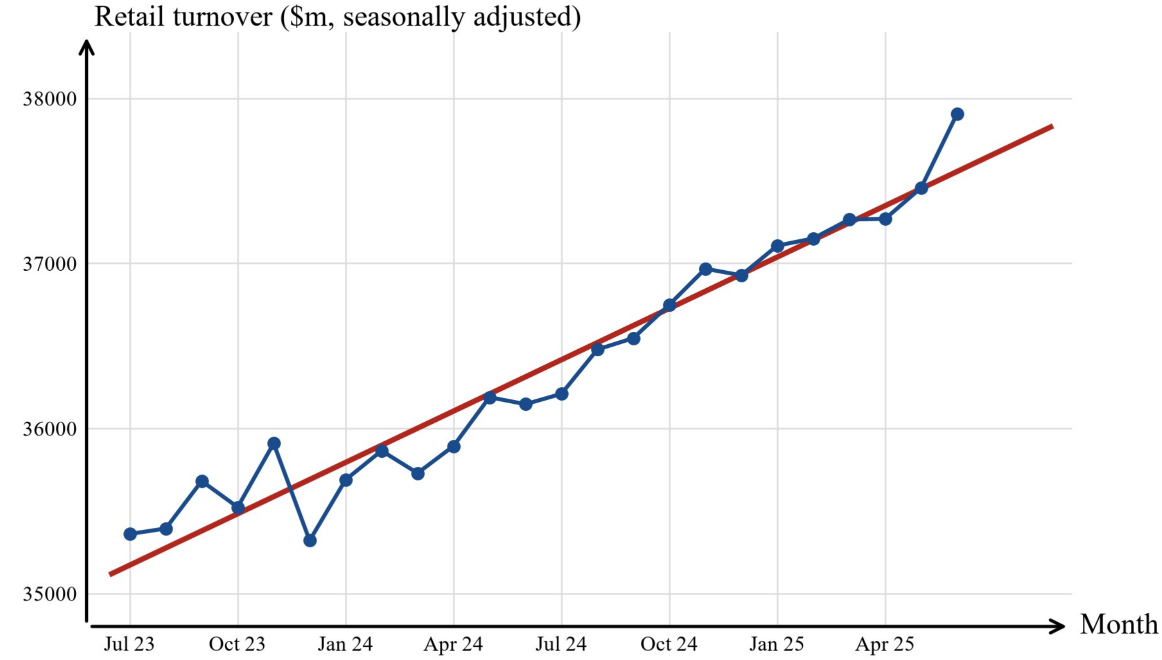
(b) By what factor is Plan B's speed actually greater than Plan A's, and roughly what factor do the visible bar lengths suggest? Show the calculation for the actual factor.

(c) State one change to the display that would make the comparison fair.

**B13. (4 marks)** · `VC2M10ST05`

Australia's monthly retail turnover, in current-price millions of dollars, is shown for the 2024–25 year, seasonally adjusted, as at June 2025. The figure shows the series for the two years to June 2025 with a line of good fit.

| Month | 2024–25 (million dollars) |
|---|---|
| Jul | 36 209.4 |
| Aug | 36 478.2 |
| Sep | 36 547.0 |
| Oct | 36 749.7 |
| Nov | 36 967.4 |
| Dec | 36 927.5 |
| Jan | 37 107.1 |
| Feb | 37 150.7 |
| Mar | 37 265.7 |
| Apr | 37 269.7 |
| May | 37 457.6 |
| Jun | 37 906.6 |




*A time-series graph of Australian monthly retail turnover from July 2023 to June 2025, in millions of dollars. The points rise gradually from about 35,400 to about 37,900, and a straight red line of good fit rises through them.*

Source: Australian Bureau of Statistics, *Retail Trade, Australia* (cat. 8501.0, seasonally adjusted total for all industries, current prices), reference month June 2025, released 31 July 2025. Retrieved 20 August 2026.

(a) Describe the trend in retail turnover over the 2024–25 year.

(b) Find the mean monthly increase in turnover from July 2024 to June 2025, to 1 decimal place. (The change over the whole period divided by the number of one-month steps.)

(c) Extend the trend by your mean monthly increase to predict the turnover for September 2025, to 1 decimal place. (You may check with a spreadsheet; the hand calculation scores full marks.)

(d) Give two limitations of the prediction in part (c).

**B14. (3 marks)** · `VC2M10P01`

`SCENARIO` One hundred households in a street are surveyed about their dwelling type and whether they have a dog. The results are:

| | Dog | No dog | Total |
|---|---|---|---|
| House | 30 | 20 | 50 |
| Unit | 10 | 40 | 50 |
| **Total** | 40 | 60 | 100 |

A household is selected at random.

(a) Find $P(\text{dog} / \text{house})$ — the probability the household has a dog, given that it is a house.

(b) Find $P(\text{house} / \text{dog})$ — the probability the dwelling is a house, given that the household has a dog.

(c) The answers to (a) and (b) are different. Explain why, and name the common mistake this pair of questions exposes.

**B15. (4 marks)** · `VC2M10P02`

`SCENARIO` A bag contains $4$ red marbles and $6$ blue marbles. Two marbles are drawn at random, one after the other, **without replacement**.

(a) Draw a tree diagram for the two draws, and find the probability that both marbles are red. Give your answer as a fraction in simplest form.

(b) Find the probability that the second marble is red, given that the first marble is blue.

(c) Are the events *the first marble is blue* and *the second marble is red* independent? Justify your answer with a calculation.

---

### Teacher note

*Teacher-facing. Nothing in this section is read to students.*

- **Place in the book.** The review is the fifth of the book's seven assessment instruments: four topic tests (150 marks), this review (80 marks), and two extended tasks (40 rubric marks, not counted with the tests). The book's total is 270 marks (TOC §7.4), deliberately matching the 9–10 band plan's Level 10 total — do not "normalise" it (TOC §7.4).
- **Coverage join (D8).** Every item carries exactly one CD tag, and the mark scheme scores each CD on its own rows: 30 CDs, 80 marks, no joint scoring. A coverage audit reads delivery straight off the scheme. Shared achievement-standard wording (six of the eighteen extracts are shared) is not permission to score those CDs jointly (TOC §7).
- **Full-cycle CDs.** `VC2M10A15`, `VC2M10M04` and `VC2M10ST05` require a full cycle that a timed paper cannot assess (TOC §7.3); tasks X1 and X2 score the cycles. Items B4, B8 and B13 score those CDs here as timed skills — evaluate-and-modify reasoning on supplied data — not as a student-run cycle.
- **Weighting (TOC §5).** Marks are weighted to the chapters carrying the heaviest VCE load: Chapters 2–3 carry 27 marks, Chapters 6–7 carry 23, Chapters 4–5 carry 19, Chapter 1 carries
  11. The weighting is at the chapter-group level; every CD is still separately scored.
- **A16 in a technology-free part.** `VC2M10A16` names digital tools; item A13 supplies the graph in place of the tool, and scores the clause the extract exists for — making and testing a conjecture about whether all solutions have been found. The reasoning is assessed, not the tool-use (R8: the tool-free path is assessed).
- **Boundaries held.** No Level 9 outcome as a Level 10 outcome (D3); nothing on the D6 prohibited list — no $f(x)$ notation, no domain or range, no derivation of the quadratic formula, no discriminant classifier, no log laws, no sine or cosine rules, no least-squares regression or correlation coefficient, no standard deviation, no calculus, no three-dimensional distance formula; and no VCE content (TOC §1, §7). B13 scores a hand-read trend extension, not a fitted regression; B10 scores a by-eye line of good fit.
- **Dated data (R3).** Current values carry their as-at stamps and sit inside the two-year window: the RBA rate as at July 2026 (B4, from 3C); the BOM July 2026 daily maxima (A15, from 6A); the BOM Annual Climate Statement 2025 (B10, from 6B); the ABS retail turnover as at June 2025 (B13, from 6E). The 2024–2025

RBA rates are labelled HISTORICAL and used for trend and comparison only, as in 3C. The Mansfield earthquake (B6) and the Thomson Reservoir wall height (B7) are facts, not current statistics.

- **Real content (R1, R2).** Five real, named, sourced data sets are reused from the subtopics with their source lines re-stated; the eight `SCENARIO` items are constructs on real parameters and are labelled, with no invented organisations or places presented as real.
- **Vocabulary.** Student-facing text sits at or below the Year 10 ceiling (WORD_LEVEL_POLICY Rule 2); curriculum words and defined subject terms are exempt. This note, the Marking guide and the Solutions are teacher-facing text (Rule 3).

## Marking guide

*Teacher-facing. The scheme is written in the language of the achievement-standard extracts carried in the authority file (`maths_10.json`, VCAA export retrieved 29 July 2026); each scored item quotes its extract verbatim, so your judgement maps to the VCAA wording without translation (TOC §7).*

**End-of-year review — total: 80 marks.** Part A 30, Part B 50; 30 items covering all 30 CDs, each CD separately scored (TOC §7.2, D8). Whole marks only: each row scores 1 or 0.

**Marking rules.**

- Whole marks only; each row scores 1 or 0.
- Award marks for correct working shown, not only for final answers; an answer with no working scores the answer rows only where the row says so.
- Follow-through: where a later row depends on an earlier answer, award the later row if the method is correct on the student's own earlier value, even if that value was wrong — unless the row says otherwise.
- Accept equivalent forms: $\frac{3}{5}$ and $0.6$, $3 \pm 3\sqrt{3}$ and $3+3\sqrt{3}, 3-3\sqrt{3}$, $y=\frac{1}{2}x-1$ and $2y=x-2$.
- Exact values are required unless the question asks for a decimal.
- Part A is technology-free: a response showing tool output (a printed graph, a CAS printout) is not a Part A response — score the working that is shown.

### A1 — `VC2M10N01` — 3 marks

> *"students recognise the effect of approximations of real numbers in repeated calculations"* — VC2M10N01, achievement-standard extract

| Mark | Look for |
|---|---|
| 1 | The exact volume: $V=\pi r^2 h=\pi \times (\sqrt{8})^2 \times 5=\pi \times 8 \times 5=40\pi$ cm³, with $(\sqrt{8})^2=8$ kept exact. |
| 1 | The early-rounded value: $3.14 \times 2.8^2 \times 5=3.14 \times 7.84 \times 5=123.088 \approx 123.1$ cm³ (accept 123.088 unrounded). |
| 1 | The late-rounded value $3.14 \times 8 \times 5=125.6$ cm³, identified as the closer one, with the recognition stated: rounding early carries the error into every later step, so the early value drifts further from $40\pi \approx 125.66$ — early rounding compounds the error in a repeated calculation. |

### A2 — `VC2M10A01` — 1 mark

> *"Students substitute into formulas, find unknown values, manipulate linear and quadratic algebraic expressions, expand binomial expressions and factorise monic and simple non-monic quadratic expressions, with and without the use of digital tools."* — VC2M10A01, achievement-standard extract (shared with `VC2M10A02`–`VC2M10A05`; A2 scores the factorise clause, with a common algebraic factor)

| Mark | Look for |
|---|---|
| 1 | **A.** $6x^2y(3x-2y)$ is the fully factorised form: the common factor $6x^2y$ is the largest one, and nothing further comes out of $(3x-2y)$. Options B, C and D expand back to the original but each leaves a common factor still inside. |

### A3 — `VC2M10A02` — 2 marks

*"Students substitute into formulas, find unknown values, manipulate linear and quadratic algebraic expressions, expand binomial expressions and factorise monic and simple non-monic quadratic expressions, with and without the use of digital tools."* — VC2M10A02, achievement-standard extract (shared with `VC2M10A01`, `VC2M10A03`–`VC2M10A05`; A3 scores the manipulate clause, with exponent laws)

| Mark | Look for |
|---|---|
| 1 | (a) $(2a^3b^2)^2 \div a^4b = 4a^6b^4 \div a^4b = 4a^2b^3$. |
| 1 | (b) $5m^2n \times m^{-4}n^3 = 5m^{-2}n^4 = \frac{5n^4}{m^2}$, with only positive exponents in the final form. |

### A4 — `VC2M10A03` — 1 mark

*"Students substitute into formulas, find unknown values, manipulate linear and quadratic algebraic expressions, expand binomial expressions and factorise monic and simple non-monic quadratic expressions, with and without the use of digital tools."* — VC2M10A03, achievement-standard extract (shared with `VC2M10A01`, `VC2M10A02`, `VC2M10A04`, `VC2M10A05`; A4 scores the manipulate clause, with simple algebraic fractions)

| Mark | Look for |
|---|---|
| 1 | $\frac{2}{x} + \frac{3}{x^2} = \frac{2x}{x^2} + \frac{3}{x^2} = \frac{2x+3}{x^2}$, as a single fraction. |

### A5 — `VC2M10A04` — 2 marks

*"Students substitute into formulas, find unknown values, manipulate linear and quadratic algebraic expressions, expand binomial expressions and factorise monic and simple non-monic quadratic expressions, with and without the use of digital tools."* — VC2M10A04, achievement-standard extract (shared with `VC2M10A01`–`VC2M10A03`, `VC2M10A05`; A5 scores the expand and factorise clauses)

| Mark | Look for |
|---|---|
| 1 | (a) $(2x-3)(x+4) = 2x^2 + 8x - 3x - 12 = 2x^2 + 5x - 12$. |
| 1 | (b) $x^2 + 10x + 24 = (x+4)(x+6)$ — a pair that multiplies to $24$ and adds to $10$. |

### A6 — `VC2M10A05` — 2 marks

*"Students substitute into formulas, find unknown values, manipulate linear and quadratic algebraic expressions, expand binomial expressions and factorise monic and simple non-monic quadratic expressions, with and without the use of digital tools."* — VC2M10A05, achievement-standard extract (shared with `VC2M10A01`–`VC2M10A04`; A6 scores the substitute-and-find-unknown clause, with formulas)

| Mark | Look for |
|---|---|
| 1 | (a) $v = u + at$ rearranged to $t = \frac{v-u}{a}$, with the steps shown (subtract $u$, divide by $a$). |
| 1 | (b) $54 = \frac{(7+11)h}{2} = \frac{18h}{2} = 9h$, so $h = 6$. |

### A7 — `VC2M10A07` — 2 marks

*"They solve problems involving linear equations and inequalities, quadratic equations and pairs of simultaneous linear equations and related graphs, algebraically and graphically, with and without the use of digital tools, and justify solutions."* — VC2M10A07, achievement-standard extract (shared with `VC2M10A08`, `VC2M10A09`, `VC2M10A10`, `VC2M10A12`, `VC2M10A13`; A7 scores the linear-equations clause, with an equation from a situation)

| Mark | Look for |
|---|---|
| 1 | The equation formed and solved: let the width be $w$ m, so the length is $(w+3)$ m; $2w+2(w+3)=54$ (or $w+(w+3)=27$), giving $4w=48$, $w=12$. |
| 1 | Both dimensions stated with units: width 12 m, length 15 m. |

### A8 — `VC2M10A08` — 2 marks

*"They solve problems involving linear equations and inequalities, quadratic equations and pairs of simultaneous linear equations and related graphs, algebraically and graphically, with and without the use of digital tools, and justify solutions."* — VC2M10A08, achievement-standard extract (shared with `VC2M10A07`, `VC2M10A09`, `VC2M10A10`, `VC2M10A12`, `VC2M10A13`; A8 scores the inequalities clause, with the number-line graph)

| Mark | Look for |
|---|---|
| 1 | $7-2x\geq 15$ solved correctly: $-2x\geq 8$, so $x\leq -4$ — the inequality sign turned when dividing by $-2$. |
| 1 | The number-line graph: a closed dot at $-4$ and shading or an arrow to the left. |

### A9 — `VC2M10A10` — 2 marks

*"They solve problems involving linear equations and inequalities, quadratic equations and pairs of simultaneous linear equations and related graphs, algebraically and graphically, with and without the use of digital tools, and justify solutions."* — VC2M10A10, achievement-standard extract (shared with `VC2M10A07`, `VC2M10A08`, `VC2M10A12`, `VC2M10A13`; A9 scores the linear-equations clause, with perpendicular gradients)

| Mark | Look for |
|---|---|
| 1 | (a) Gradient of the given line is $4$, so a perpendicular gradient is $-\frac{1}{4}$ (negative reciprocal). |
| 1 | (b) Perpendicular to $y=-2x+5$ means gradient $\frac{1}{2}$; $y=\frac{1}{2}x+c$ through $(8,3)$: $3=4+c$, $c=-1$, so $y=\frac{1}{2}x-1$. Accept an equivalent form. |

### A10 — `VC2M10A12` — 2 marks

*"They solve problems involving linear equations and inequalities, quadratic equations and pairs of simultaneous linear equations and related graphs, algebraically and graphically, with and without the use of digital tools, and justify solutions."* — VC2M10A12, achievement-standard extract (shared with `VC2M10A07`–`VC2M10A10`, `VC2M10A13`; A10 scores the linear-equations clause, with algebraic fractions)

| Mark | Look for |
|---|---|
| 1 | (a) $\frac{5}{x}+3=\frac{8}{x}$: $3=\frac{3}{x}$, so $x=1$. Working shown, not the answer alone. |
| 1 | (b) $\frac{x+3}{4}=\frac{x-2}{3}$: $3(x+3)=4(x-2)$, $3x+9=4x-8$, so $x=17$. |

### A11 — `VC2M10A13` — 2 marks

*"They solve problems involving linear equations and inequalities, quadratic equations and pairs of simultaneous linear equations and related graphs, algebraically and graphically, with and without the use of digital tools, and justify solutions."* — VC2M10A13, achievement-standard extract (shared with `VC2M10A07`–`VC2M10A10`, `VC2M10A12`; A11 scores the quadratic-equations clause, by null factor law and by square roots)

| Mark | Look for |
|---|---|
| 1 | (a) $x^2-9x+20=(x-4)(x-5)=0$, so $x=4$ or $x=5$, with the null factor law named or used. |
| 1 | (b) $(x-3)^2=27$: $x-3=\pm\sqrt{27}=\pm3\sqrt{3}$, so $x=3\pm3\sqrt{3}$, exact — not a decimal. |

### A12 — `VC2M10A14` — 1 mark

*"They represent linear, quadratic and exponential functions numerically, graphically and algebraically, and use them to model situations and solve practical problems."* — VC2M10A14, achievement-standard extract (shared with `VC2M10A11`; A12 scores the solve clause, with an exponential equation)

| Mark | Look for |
|---|---|
| 1 | $4^x=8$ written with a common base: $2^{2x}=2^3$, so $2x=3$ and $x=\frac{3}{2}$. Accept a correct trap-and-refine arriving at $x=1.5$ with the check $4^{1.5}=8$. |

### A13 — `VC2M10A16` — 2 marks

*"They make and test conjectures involving functions and relations using digital tools."* — VC2M10A16, achievement-standard extract. *The graph is supplied in place of the tool (Part A is technology-free); what is scored is the conjecture and its test — the consideration of whether all solutions have been found.*

| Mark | Look for |
|---|---|
| 1 | (a) All three solutions read from the supplied graph: $x\approx-0.8$ (accept $-0.7$ to $-0.8$), $x=2$ and $x=4$. |
| 1 | (b) A sufficiency argument covering both sides: for $x>4$, $2^x$ is already above $x^2$ at $x=4$ they are equal and $2^x$ pulls away — check $x=6$: $2^6=64$ against $6^2=36$ — and exponential growth keeps it above, so no further crossing; for $x\le-1$, $x^2\ge1$ while $2^x\le0.5$, so the graphs cannot meet there. |

### A14 — `VC2M10SP01` — 3 marks

*"Students use deductive reasoning, theorems and algorithms to solve spatial problems."* — VC2M10SP01, achievement-standard extract

| Mark | Look for |
|---|---|
| 1 | A correct diagram — rhombus $ABCD$, diagonals meeting at $M$ — with the given (rhombus $ABCD$) and the to-prove ($\angle AMB = 90°$) stated. |
| 1 | The congruence established with reasons: $AB = CB$ (sides of a rhombus), $AM = CM$ (diagonals of a parallelogram bisect each other), $BM$ common, so $\triangle ABM \cong \triangle CBM$ by SSS. |
| 1 | The angle conclusion completed: $\angle AMB = \angle CMB$ (corresponding angles of congruent triangles); $\angle AMB + \angle CMB = 180°$ (angles on the straight line $AC$); so $2\angle AMB = 180°$ and $\angle AMB = 90°$ — the diagonals meet at right angles. |

*A proof that asserts the result, or quotes "diagonals of a rhombus are perpendicular" as a reason, scores at most the diagram mark — the extract names deductive reasoning, and the reasoning is what is scored.*

### A15 — `VC2M10ST01` — 3 marks

> *"Students compare univariate data sets by referring to summary statistics and the shape of their displays."* — VC2M10ST01, achievement-standard extract

| Mark | Look for |
|---|---|
| 1 | (a) Median $14.6$ °C read from the box, and $\text{IQR} = 16.0 - 13.7 = 2.3$ °C from the quartiles. |
| 1 | (b) The fence calculated and applied: upper fence $= 16.0 + 1.5 \times 2.3 = 16.0 + 3.45 = 19.45$; $19.5 > 19.45$, so the point is an outlier. (The lower fence $13.7 - 3.45 = 10.25$ may be shown; the minimum 11.0 sits above it.) |
| 1 | (c) The claim judged against a summary statistic: the median is $14.6$ °C — half the July days were below $14.6$ °C — so *typically* $15$ *°C or warmer* is not supported. |

### B1 — `VC2M10A06` — 2 marks

> *"Students can design and implement simple algorithms using pseudocode or other general purpose programming language."* — VC2M10A06, achievement-standard extract

| Mark | Look for |
|---|---|
| 1 | (a) The correct output: `[[1, 4], [3, 8], [5, 12]]` — the second entry of each row doubled. A trace table showing the three passes of the loop earns the mark even without the final OUTPUT line written out. |
| 1 | (b) The effect described in words: the algorithm doubles the second coordinate (the $y$-coordinate) of each point and leaves the first coordinate (the $x$-coordinate) unchanged; $p$ names the column the loop changes — a pointer to column $1$. |

### B2 — `VC2M10A09` — 4 marks

> *"They solve problems involving linear equations and inequalities, quadratic equations and pairs of simultaneous linear equations and related graphs, algebraically and graphically, with and without the use of digital tools, and justify solutions."* — VC2M10A09, achievement-standard extract (shared with

`VC2M10A07`, `VC2M10A08`, `VC2M10A10`, `VC2M10A12`, `VC2M10A13`; B2 scores the simultaneous-equations clause, algebraically and graphically, with a method justification)

| Mark | Look for |
|---|---|
| 1 | The pair formed: $2A+3C=52$ and $5A+C=78$, with $A$ and $C$ defined as the adult and child ticket prices. |
| 1 | The pair solved algebraically with method shown: from $C=78-5A$, $2A+3(78-5A)=52$, $2A+234-15A=52$, $-13A=-182$, $A=14$; $C=78-70=8$. (Elimination scores the same: $15A+3C=234$ minus $2A+3C=52$ gives $13A=182$ .) |
| 1 | (b) The intersection point $(14,8)$, read as the one pair of prices that satisfies both statements at once — the adult ticket is $\$14$ and the child ticket $\$8$. |
| 1 | (c) The method named and a reason given that fits this pair — e.g. *elimination, because multiplying the second equation by 3 lines up the $C$ terms and removes a variable in one step*, or *substitution, because the second equation gives $C$ directly in terms of $A$*. A bare name with no reason does not score. |

### B3 — `VC2M10A11` — 3 marks

*"They represent linear, quadratic and exponential functions numerically, graphically and algebraically, and use them to model situations and solve practical problems."* — VC2M10A11, achievement-standard extract (shared with `VC2M10A14`; B3 scores the represent clause, reading features from the algebraic forms; the circle is named in the CD's own text — *relations such as simple quadratic, reciprocal, circle and exponential*)

| Mark | Look for |
|---|---|
| 1 | (a) Centre $(0,0)$ and radius 7 read from $x^2+y^2=49=7^2$. |
| 1 | (b) $y=24\div6=4$; and the reason there is no point at $x=0$: $\frac{24}{0}$ is undefined — division by zero has no value, so the graph has no point on the $y$-axis. |
| 1 | (c) $3\times2^x=24$: $2^x=8=2^3$, so $x=3$, with the same-base step shown. |

### B4 — `VC2M10A15` — 5 marks

*"Students use mathematical modelling to solve problems involving growth and decay in financial and other applied situations, applying linear, quadratic and exponential functions as appropriate, and solve related equations, numerically and graphically."* — VC2M10A15, achievement-standard extract. *The full modelling cycle of this CD is assessed by task X1 (TOC §7.3); B4 scores the timed skills — build, model, solve, evaluate and modify — on supplied data.*

| Mark | Look for |
|---|---|
| 1 | (a) Year 1 built as simple interest: $12\,000\times0.05=600$, balance $\$12\,600$. |
| 1 | (a) Year 2: $12\,600\times0.05=630$, balance $\$13\,230$. Follow-through on the student's year-1 balance. |
| 1 | (a) Year 3: $13\,230\times0.05=661.50$, balance |

| Mark | Look for |
|---|---|
| | $\$13\,891.50$. Follow-through on the student's year-2 balance. |
| 1 | (b) The exponential rule $V = 12\,000 \times 1.05^n$, and the first whole year over $\$15\,000$ found: $V(4) = 12\,000 \times 1.05^4 \approx 14\,586.08$ and $V(5) = 12\,000 \times 1.05^5 \approx 15\,315.38$, so $n = 5$ — during the fifth year. Accept a trap-and-refine table in place of direct evaluation. |
| 1 | (c) The evaluation and the modification: the historical rates ($4.50\,\%$, $4.20\,\%$, $3.60\,\%$, then $5.00\,\%$) moved by more than a percentage point over 2024–2026, so holding $5.00\,\%$ fixed is an assumption, not a fact; modify by applying each year's own published rate to that year's balance instead of one constant rate. |

### B5 — `VC2M10M01` — 3 marks

> *"Students solve measurement problems involving surface area and volume of composite objects."* — VC2M10M01, achievement-standard extract

| Mark | Look for |
|---|---|
| 1 | (a) The cylinder part: $\pi r^2 h = \pi \times 2^2 \times 5 = 20\pi$ m³. |
| 1 | (a) The hemisphere added: $\frac{1}{2} \times \frac{4}{3}\pi r^3 = \frac{2}{3}\pi \times 8 = \frac{16\pi}{3}$ m³, giving $20\pi + \frac{16\pi}{3} = \frac{60\pi + 16\pi}{3} = \frac{76\pi}{3}$ m³ exact. |
| 1 | (b) $\frac{76\pi}{3} \approx 79.6$ m³ to 1 decimal place. Follow-through on the student's exact value if it was wrong but their decimal follows from it. |

### B6 — `VC2M10M02` — 2 marks

> *"They interpret and use logarithmic scales representing small or large quantities or change in applied contexts."* — VC2M10M02, achievement-standard extract

| Mark | Look for |
|---|---|
| 1 | (a) One magnitude step: $5.9 - 4.9 = 1$, so the shaking is 10 times greater. |
| 1 | (b) $32 \times 32 = 1024 \approx 1000$, so about 2 magnitude steps; $5.9 + 2 = 7.9$ — about magnitude 7.9. |

### B7 — `VC2M10M03` — 4 marks

> *"Students apply Pythagoras' theorem and trigonometry to solve practical problems involving right-angled triangles."* — VC2M10M03, achievement-standard extract

| Mark | Look for |
|---|---|
| 1 | (a) The right-angled triangle drawn or described: height 165 m opposite the $10\,°$ angle, distance $d$ adjacent; $\tan 10\,° = \frac{165}{d}$. |
| 1 | (a) $d = \frac{165}{\tan 10\,°} \approx 935.8$ m to 1 decimal place. |

| Mark | Look for |
|---|---|
| 1 | (b) New distance $935.76\ldots - 200 = 735.76\ldots$ m; new angle $\tan^{-1}\left(\frac{165}{735.76\ldots}\right) \approx 12.6°$ to 1 decimal place. Follow-through on the student's part (a) value. |
| 1 | (c) The two legs are perpendicular (north then east): distance $\sqrt{200^2+300^2}=\sqrt{130\,000}\approx 360.6$ m; bearing $\tan^{-1}\left(\frac{300}{200}\right)\approx 56°$ east of north — `056°T`, written as three figures. |

### B8 — `VC2M10M04` — 4 marks

*"They identify the impact of measurement errors on the accuracy of results. Students use mathematical modelling to solve practical problems involving direct and inverse proportion and scaling, evaluating and modifying models, and reporting assumptions, methods and findings."* — VC2M10M04, achievement-standard extract. *The full modelling cycle of this CD is assessed by task X1 (TOC §7.3); B8 scores the timed skills — scaling and the impact of measurement errors — on supplied values.*

| Mark | Look for |
|---|---|
| 1 | (a) Areas scale by the square of the scale factor: $6 \times 50^2 = 6 \times 2500 = 15\,000$ cm² $= 1.5$ m². |
| 1 | (b) Volumes scale by the cube: $400 \times 50^3 = 400 \times 125\,000 = 50\,000\,000$ mL $= 50\,000$ L. |
| 1 | (c) The nominal area and the bounds: $6.2 \times 4.8 = 29.76$ m²; the measurements to 1 d.p. give upper bounds $6.25$ m and $4.85$ m, so the largest consistent area is $6.25 \times 4.85 = 30.3125$ m². |
| 1 | (c) The excess found: $30.3125 - 29.76 = 0.5525 \approx 0.55$ m² — the true area could exceed the nominal area by about $0.55$ m². |

### B9 — `VC2M10SP02` — 3 marks

*"They interpret networks used to represent practical situations and describe connectedness."* — VC2M10SP02, achievement-standard extract

| Mark | Look for |
|---|---|
| 1 | (a) 5 vertices, 6 edges, and the network is connected — there is a path between every pair of vertices. |
| 1 | (b) Degrees: A 2, B 3, C 3, D 3, E 1 — four vertices of odd degree. |
| 1 | (c) No walk can use every edge exactly once: by the Euler walk test (Result 4), such a walk exists only with 0 or 2 odd vertices, and this network has 4. |

### B10 — `VC2M10ST02` — 4 marks

*"They represent the distribution of data involving 2 variables, using tables and scatterplots, and comment on possible association."* — VC2M10ST02, achievement-standard extract (shared with `VC2M10ST03`; B10 scores the scatterplot clause — direction, linearity, strength, prediction)

| Mark | Look for |
| --- | --- |
| 1 | (a) Direction and linearity: as the years increase, the temperature difference tends to increase — a positive association — and the pattern is roughly linear. |
| 1 | (b) Strength: weak (accept weak-to-moderate with justification) — the points sit widely spread about the line, year to year. |
| 1 | (c) An estimate for 2028 read from the line of good fit: about 1.4 °C above the 1961–1990 average (accept 1.1–1.6 °C, consistent with the student's own line). |
| 1 | (d) The claim refuted: the line is an estimate of a trend, not a proof — 2028 is outside the data, the year-to-year spread is large (the points wander about the line), so the graph supports a warming tendency, not an exact value. |

### B11 — `VC2M10ST03` — 2 marks

> *"They represent the distribution of data involving 2 variables, using tables and scatterplots, and comment on possible association."* — VC2M10ST03, achievement-standard extract (shared with `VC2M10ST02`; B11 scores the two-way-table clause, with categorical variables)

| Mark | Look for |
| --- | --- |
| 1 | (a) The completed table: row totals 40 and 40; column totals walk 36, ride 44; grand total 80. |
| 1 | (b) Row percentages: Year 7 walks $24 \div 40 = 60\,\%$, Year 10 walks $12 \div 40 = 30\,\%$; the percentages differ markedly between the two year levels, so there is an association between year level and travel mode. |

### B12 — `VC2M10ST04` — 3 marks

> *"They analyse inferences and conclusions in the media, noting potential sources of bias. Students compare the distribution of continuous numerical data, using various displays, and discuss distributions in terms of centre, spread, shape and outliers."* — VC2M10ST04, achievement-standard extract. *B12 scores the media-analysis clause: linking the claim to the display and naming the bias.*

| Mark | Look for |
| --- | --- |
| 1 | (a) The misleading feature named: the vertical axis starts at 70, not 0, with no break shown — bar lengths no longer compare the values they represent. |
| 1 | (b) The actual factor calculated: $100 \div 80 = 1.25$ — Plan B is 1.25 times as fast; the visible bar lengths rise 10 and 30 from the axis start, suggesting roughly a 3-fold difference. |
| 1 | (c) One fair fix: start the axis at 0, or show a clear break in the axis where it jumps. |

### B13 — `VC2M10ST05` — 4 marks

> *"They plan and conduct statistical investigations involving bivariate data, including where the independent variable is time."* — VC2M10ST05, achievement-standard extract. *The full investigation cycle — plan, collect, report with limitations — is assessed by task X2 (TOC §7.3); B13 scores the timed skills on a supplied series: describing the trend, extending it, and naming limitations.*

| Mark | Look for |
| --- | --- |
| 1 | (a) The trend described: turnover rises over the year — a |

| Mark | Look for |
|---|---|
| | positive, near-linear trend (accept reference to the small December dip without losing the mark). |
| 1 | (b) The mean monthly increase: $\frac{37\,906.6-36\,209.4}{11}=\frac{1697.2}{11}\approx 154.3$ million dollars per month. |
| 1 | (c) September 2025 is three months beyond June 2025: $37\,906.6+3\times 154.29\ldots\approx 38\,369.5$ million dollars. Follow-through on the student's part (b) value. |
| 1 | (d) Two limitations: the extension assumes the trend keeps going — September 2025 is outside the data range; and real turnover carries seasonal swings and events the straight-line trend cannot know about (the data here are seasonally adjusted, which removes the repeating swing but not one-off shifts). Any two sensible limitations score. |

### B14 — `VC2M10P01` — 3 marks

> *"Students apply conditional probability to solve problems involving compound events."* — VC2M10P01, achievement-standard extract (shared with `VC2M10P02`; B14 scores the conditional language — 'given', 'of' — and the common mistake of reversing the condition)

| Mark | Look for |
|---|---|
| 1 | (a) $P(\text{dog} / \text{house})=\frac{30}{50}=\frac{3}{5}$ — the denominator restricted to the $50$ houses. |
| 1 | (b) $P(\text{house} / \text{dog})=\frac{30}{40}=\frac{3}{4}$ — the denominator restricted to the $40$ households with a dog. |
| 1 | (c) The difference explained: the condition changes the sample — *given house* looks only at the $50$ houses, *given dog* only at the $40$ dog-owning households — and the common mistake named: reversing the condition, reading *of* as *given* (or $P(A/B)$ as $P(B/A)$). |

### B15 — `VC2M10P02` — 4 marks

> *"Students apply conditional probability to solve problems involving compound events."* — VC2M10P02, achievement-standard extract (shared with `VC2M10P01`; B15 scores the two-step experiment without replacement, with independence)

| Mark | Look for |
|---|---|
| 1 | (a) The tree diagram: first draw $\frac{4}{10}$ red, $\frac{6}{10}$ blue; second-draw branches conditional on the first — after a red, $\frac{3}{9}$ red and $\frac{6}{9}$ blue; after a blue, $\frac{4}{9}$ red and $\frac{5}{9}$ blue. |
| 1 | (a) $P(\text{both red})=\frac{4}{10}\times\frac{3}{9}=\frac{12}{90}=\frac{2}{15}$, simplest form. |
| 1 | (b) $P(\text{second red} / \text{first blue})=\frac{4}{9}$ — after a blue is drawn, $4$ red remain of $9$. |

| Mark | Look for |
|---|---|
| 1 | (c) Not independent, justified by calculation: $P\left(\text{second red}\right)=\frac{6}{10}\times\frac{4}{9}+\frac{4}{10}\times\frac{3}{9}=\frac{24+12}{90}=\frac{36}{90}=\frac{2}{5}$, and $\frac{2}{5}\neq\frac{4}{9}$ — knowing the first was blue changes the probability, so the events are dependent. |

### Coverage — all 30 content descriptions

| CD | Question | Marks | CD | Question | Marks |
|---|---|---|---|---|---|
| VC2M10N01 | A1 | 3 | VC2M10M01 | B5 | 3 |
| VC2M10A01 | A2 | 1 | VC2M10M02 | B6 | 2 |
| VC2M10A02 | A3 | 2 | VC2M10M03 | B7 | 4 |
| VC2M10A03 | A4 | 1 | VC2M10M04 | B8 | 4 |
| VC2M10A04 | A5 | 2 | VC2M10SP01 | A14 | 3 |
| VC2M10A05 | A6 | 2 | VC2M10SP02 | B9 | 3 |
| VC2M10A06 | B1 | 2 | VC2M10ST01 | A15 | 3 |
| VC2M10A07 | A7 | 2 | VC2M10ST02 | B10 | 4 |
| VC2M10A08 | A8 | 2 | VC2M10ST03 | B11 | 2 |
| VC2M10A09 | B2 | 4 | VC2M10ST04 | B12 | 3 |
| VC2M10A10 | A9 | 2 | VC2M10ST05 | B13 | 4 |
| VC2M10A11 | B3 | 3 | VC2M10P01 | B14 | 3 |
| VC2M10A12 | A10 | 2 | VC2M10P02 | B15 | 4 |
| VC2M10A13 | A11 | 2 | | | |
| VC2M10A14 | A12 | 1 | | | |
| VC2M10A15 | B4 | 5 | | | |
| VC2M10A16 | A13 | 2 | **Total** | **30 CDs** | **80** |

### Recording sheet

| Question | CD | Marks | Question | CD | Marks |
|---|---|---|---|---|---|
| A1 | VC2M10N01 | ____ /3 | | B1 | VC2M10A06 |
| A2 | VC2M10A0 | ____ /1 | | B2 | VC2M10A0 |

| Question | CD | Marks | Question | CD | Marks |
|---|---|---|---|---|---|
| | 1 | | | | 9 |
| A3 | VC2M10A02 | ____ /2 | | B3 | VC2M10A11 |
| A4 | VC2M10A03 | ____ /1 | | B4 | VC2M10A15 |
| A5 | VC2M10A04 | ____ /2 | | B5 | VC2M10M01 |
| A6 | VC2M10A05 | ____ /2 | | B6 | VC2M10M02 |
| A7 | VC2M10A07 | ____ /2 | | B7 | VC2M10M03 |
| A8 | VC2M10A08 | ____ /2 | | B8 | VC2M10M04 |
| A9 | VC2M10A10 | ____ /2 | | B9 | VC2M10SP02 |
| A10 | VC2M10A12 | ____ /2 | | B10 | VC2M10ST02 |
| A11 | VC2M10A13 | ____ /2 | | B11 | VC2M10ST03 |
| A12 | VC2M10A14 | ____ /1 | | B12 | VC2M10ST04 |
| A13 | VC2M10A16 | ____ /2 | | B13 | VC2M10ST05 |
| A14 | VC2M10SP01 | ____ /3 | | B14 | VC2M10P01 |
| A15 | VC2M10ST01 | ____ /3 | | B15 | VC2M10P02 |
| | **Part A** | **____ /30** | | | **Part B** |
| | | | | | **Total** |

### What the marks say

A student who scores across all 30 items has shown the Level 10 achievement standard end to end, in the words of the authority file. The eighteen distinct extracts, quoted verbatim:

- *"students recognise the effect of approximations of real numbers in repeated calculations"* — `VC2M10N01`
- *"Students substitute into formulas, find unknown values, manipulate linear and quadratic algebraic expressions, expand binomial expressions and factorise monic and simple non-monic quadratic expressions, with and without the use of digital tools."* — `VC2M10A01`, `VC2M10A02`, `VC2M10A03`, `VC2M10A04`, `VC2M10A05`
- *"Students can design and implement simple algorithms using pseudocode or other general purpose programming language."* — `VC2M10A06`
- *"They solve problems involving linear equations and inequalities, quadratic equations and pairs of simultaneous linear equations and related graphs, algebraically and graphically, with and without the use of digital tools, and justify solutions."* — `VC2M10A07`, `VC2M10A08`, `VC2M10A09`, `VC2M10A10`, `VC2M10A12`, `VC2M10A13`
- *"They represent linear, quadratic and exponential functions numerically, graphically and algebraically, and use them to model situations and solve practical problems."* — `VC2M10A11`, `VC2M10A14`

- *"Students use mathematical modelling to solve problems involving growth and decay in financial and other applied situations, applying linear, quadratic and exponential functions as appropriate, and solve related equations, numerically and graphically."* — `VC2M10A15`
- *"They make and test conjectures involving functions and relations using digital tools."* — `VC2M10A16`
- *"Students solve measurement problems involving surface area and volume of composite objects."* — `VC2M10M01`
- *"They interpret and use logarithmic scales representing small or large quantities or change in applied contexts."* — `VC2M10M02`
- *"Students apply Pythagoras' theorem and trigonometry to solve practical problems involving right-angled triangles."* — `VC2M10M03`
- *"They identify the impact of measurement errors on the accuracy of results. Students use mathematical modelling to solve practical problems involving direct and inverse proportion and scaling, evaluating and modifying models, and reporting assumptions, methods and findings."* — `VC2M10M04`
- *"Students use deductive reasoning, theorems and algorithms to solve spatial problems."* — `VC2M10SP01`
- *"They interpret networks used to represent practical situations and describe connectedness."* — `VC2M10SP02`
- *"Students compare univariate data sets by referring to summary statistics and the shape of their displays."* — `VC2M10ST01`
- *"They represent the distribution of data involving 2 variables, using tables and scatterplots, and comment on possible association."* — `VC2M10ST02`, `VC2M10ST03`
- *"They analyse inferences and conclusions in the media, noting potential sources of bias. Students compare the distribution of continuous numerical data, using various displays, and discuss distributions in terms of centre, spread, shape and outliers."* — `VC2M10ST04`
- *"They plan and conduct statistical investigations involving bivariate data, including where the independent variable is time."* — `VC2M10ST05`
- *"Students apply conditional probability to solve problems involving compound events."* — `VC2M10P01`, `VC2M10P02`

A mark not scored here is a gap to teach next. The review is the instrument a school uses to advise on a VCE mathematics pathway (TOC §7.2): read the pattern of the marks — which strands are firm, which are thin — alongside the four topic tests and the two extended tasks. It reports against the Level 10 achievement standard; it is not a VCAA instrument and carries no VCAA weight.

## Solutions

*Teacher-facing. Answers first — final values only — then fully-worked solutions for every item, one step per line.*

## Answers

**A1.** (a) $40\pi$ cm³; (b) 123.1 cm³; (c) 125.6 cm³ — the late-rounded value is closer; early rounding compounds the error. **A2.** **A**. **A3.** (a) $4a^2b^3$; (b) $\frac{5n^4}{m^2}$. **A4.** $\frac{2x+3}{x^2}$. **A5.** (a) $2x^2+5x-12$; (b) $(x+4)(x+6)$. **A6.** (a) $t=\frac{v-u}{a}$; (b) $h=6$. **A7.** width 12 m, length 15 m. **A8.** $x\le-4$ — closed dot at $-4$, arrow left. **A9.** (a) $-\frac{1}{4}$; (b) $y=\frac{1}{2}x-1$. **A10.** (a) $x=1$; (b) $x=17$. **A11.** (a) $x=4$ or $x=5$; (b) $x=3\pm3\sqrt{3}$. **A12.** $x=\frac{3}{2}$. **A13.** (a) $x\approx-0.8$, $x=2$, $x=4$; (b) see worked solution. **A14.** see worked solution. **A15.** (a) median 14.6 °C, IQR 2.3 °C; (b) fence 19.45, so 19.5 is an outlier; (c) not supported — median $14.6<15$.

**B1.** (a) `[[1, 4], [3, 8], [5, 12]]`; (b) doubles each point's second coordinate; $p$ points to the column changed. **B2.** (a) adult $\$14$, child $\$8$; (b) $(14,8)$; (c) see worked solution. **B3.** (a) centre $(0,0)$, radius 7; (b) $y=4$; no point at $x=0$ — division by zero is undefined; (c) $x=3$. **B4.** (a) $\$12\,600$, $\$13\,230$, $\$13\,891.50$; (b) $V=12\,000\times1.05^n$, first year over $\$15\,000$ is $n=5$; (c) see worked solution. **B5.** (a) $\frac{76\pi}{3}$ m³; (b) 79.6 m³. **B6.** (a) 10 times; (b) about 2 steps — about M7.9. **B7.** (a) 935.8 m; (b) $12.6°$; (c) 360.6 m, bearing `056°T`. **B8.** (a) 1.5 m²; (b) 50 000 L; (c) nominal 29.76 m², largest 30.3125 m², excess about 0.55 m². **B9.** (a) 5 vertices, 6 edges, connected; (b) A 2, B 3, C 3, D 3, E 1 — four odd; (c) no. **B10.** (a) positive, roughly linear; (b) weak; (c) about 1.4 °C (accept 1.1–1.6); (d) see worked solution. **B11.** (a) totals 40, 40, 36, 44, 80; (b) 60 % and 30 % — association present. **B12.** (a) axis starts at 70 with no break; (b) actual 1.25 times, visible lengths suggest about 3 times; (c) start at 0 or show a break. **B13.** (a) positive, near-linear trend; (b) about 154.3 million dollars per month; (c) about 38 369.5 million dollars; (d) see worked solution. **B14.** (a) $\frac{3}{5}$; (b) $\frac{3}{4}$; (c) see worked solution. **B15.** (a) $\frac{2}{15}$; (b) $\frac{4}{9}$; (c) not independent — $\frac{2}{5}\ne\frac{4}{9}$.

## Fully-worked solutions

**A1 (`VC2M10N01`, 3 marks).**

(a) $V=\pi r^2h$ $V=\pi\times(\sqrt{8})^2\times5$ $V=\pi\times8\times5$ — the square undoes the square root, exactly $\therefore V=40\pi$ cm³, exact.

(b) Early rounding: $r\approx2.8$, $\pi\approx3.14$ $V\approx3.14\times2.8^2\times5$ $V\approx3.14\times7.84\times5$ $V\approx3.14\times39.2$ $\therefore V\approx123.088\approx123.1$ cm³.

(c) Late rounding: keep $r^2=8$ exact $V\approx3.14\times8\times5$ $V\approx3.14\times40$ $\therefore V\approx125.6$ cm³. The exact value is $40\pi\approx125.66$ cm³: 125.6 is about 0.06 away, while 123.1 is about 2.6 away. $\therefore$ the late-rounded value is closer — rounding early carries the error into every later step of a repeated calculation, and the error compounds.

**A2 (`VC2M10A01`, 1 mark).**

The highest common factor of $18x^3y$ and $12x^2y^2$ is $6x^2y$: $18x^3y-12x^2y^2=6x^2y(3x-2y)$ $\therefore$ **A** — the only fully factorised form. B, C and D each expand back to the original, but each leaves a further common factor: $x$ inside B's bracket, 2 inside C's, 3 inside D's.

**A3 (`VC2M10A02`, 2 marks).**

(a) $(2a^3b^2)^2\div a^4b=2^2a^6b^4\div a^4b$ — power of a product: apply the square to every factor $=4a^{6-4}b^{4-1}$ — quotient law: subtract the exponents $\therefore=4a^2b^3$.

(b) $5m^2n \times m^{-4}n^3 = 5m^{2+(-4)}n^{1+3}$ — product law: add the exponents $= 5m^{-2}n^4 \therefore = \frac{5n^4}{m^2}$ — a negative exponent means a reciprocal.

**A4 (VC2M10A03, 1 mark).**

$\frac{2}{x} + \frac{3}{x^2} = \frac{2x}{x^2} + \frac{3}{x^2}$ — write both fractions over the common denominator $x^2 \therefore = \frac{2x+3}{x^2}$.

**A5 (VC2M10A04, 2 marks).**

(a) $(2x-3)(x+4) = 2x^2 + 8x - 3x - 12$ — every term in the first bracket times every term in the second $\therefore = 2x^2 + 5x - 12$.

(b) Need a pair that multiplies to 24 and adds to 10: 4 and 6 $\therefore x^2 + 10x + 24 = (x+4)(x+6)$. Check: $(x+4)(x+6) = x^2 + 6x + 4x + 24 = x^2 + 10x + 24$. ✓

**A6 (VC2M10A05, 2 marks).**

(a) $v = u + at$ $v - u = at$ — subtract $u$ from both sides $\therefore t = \frac{v-u}{a}$ — divide both sides by $a$.

(b) $A = \frac{(a+b)h}{2}$ with $A = 54$, $a = 7$, $b = 11$ $54 = \frac{(7+11)h}{2}$ $54 = \frac{18h}{2}$ $54 = 9h$ $\therefore h = 6$.

**A7 (VC2M10A07, 2 marks).**

Let the width be $w$ m, so the length is $(w+3)$ m. Perimeter: $2w + 2(w+3) = 54$ $2w + 2w + 6 = 54$ $4w = 48$ $w = 12$ $\therefore$ width 12 m, length $12 + 3 = 15$ m. Check: $2(12) + 2(15) = 24 + 30 = 54$. ✓

**A8 (VC2M10A08, 2 marks).**

$7 - 2x \geq 15$ $-2x \geq 8$ — subtract 7 from both sides $x \leq -4$ — divide by $-2$ and turn the inequality sign Graph: a closed dot at $-4$ (the value is included), shading to the left — all values less than $-4$. Check: at $x = -4$, $7 - 2(-4) = 15$ ✓; at $x = -5$, $7 - 2(-5) = 17 \geq 15$ ✓.

**A9 (VC2M10A10, 2 marks).**

(a) $y = 4x - 9$ has gradient 4. Perpendicular gradients multiply to $-1$: $4 \times \left(-\frac{1}{4}\right) = -1$ $\therefore$ the perpendicular gradient is $-\frac{1}{4}$.

(b) $y = -2x + 5$ has gradient $-2$, so the perpendicular gradient is $\frac{1}{2}$. $y = \frac{1}{2}x + c$ through $(8, 3)$: $3 = \frac{1}{2}(8) + c$ $3 = 4 + c$ $c = -1$ $\therefore y = \frac{1}{2}x - 1$.

**A10 (VC2M10A12, 2 marks).**

(a) $\frac{5}{x} + 3 = \frac{8}{x}$ $3 = \frac{8}{x} - \frac{5}{x}$ — move the fraction terms to one side $3 = \frac{3}{x}$ $3x = 3$ — multiply both sides by $x$ ($x \neq 0$) $\therefore x = 1$. Check: $\frac{5}{1} + 3 = 8 = \frac{8}{1}$. ✓

(b) $\frac{x+3}{4}=\frac{x-2}{3}$ $3(x+3)=4(x-2)$ — cross-multiply $3x+9=4x-8$ $9+8=4x-3x$ $\therefore x=17$. Check: $\frac{20}{4}=5=\frac{15}{3}$. ✓

**A11 (`VC2M10A13`, 2 marks).**

(a) $x^2-9x+20=0$ $(x-4)(x-5)=0$ — a pair that multiplies to 20 and adds to $-9$: $-4$ and $-5$ $x-4=0$ or $x-5=0$ — null factor law: a product is zero only when a factor is zero $\therefore x=4$ or $x=5$.

(b) $(x-3)^2=27$ $x-3=\pm\sqrt{27}$ — square roots, both signs $\sqrt{27}=\sqrt{9\times 3}=3\sqrt{3}$ $\therefore x=3\pm 3\sqrt{3}$ — exact surd form.

**A12 (`VC2M10A14`, 1 mark).**

$4^x=8$ $2^{2x}=2^3$ — write both sides as powers of 2 $2x=3$ — equal bases, so the exponents are equal $\therefore x=\frac{3}{2}$. Check: $4^{3/2}=(\sqrt{4})^3=2^3=8$. ✓

**A13 (`VC2M10A16`, 2 marks).**

(a) The solutions of $x^2=2^x$ are the $x$-values where the two graphs meet: $x\approx -0.8$ (the crossing just left of the $y$-axis), $x=2$ and $x=4$ — the two whole-number meetings are exact: $2^2=4=2^2$ and $4^2=16=2^4$.

(b) For $x>4$: at $x=4$ the values are equal, and beyond that $2^x$ pulls away — at $x=6$, $2^6=64$ while $6^2=36$ — and an exponential keeps growing faster than a quadratic, so the graphs never meet again to the right. For $x\le -1$: $x^2\ge 1$ while $2^x\le 2^{-1}=0.5$, so $x^2$ stays above $2^x$ and the graphs cannot meet there. $\therefore$ the three solutions read from the graph are all of them.

**A14 (`VC2M10SP01`, 3 marks).**

Given: rhombus $ABCD$, diagonals $AC$ and $BD$ meeting at $M$. To prove: $\angle AMB=90°$.

| Statement | Reason |
|---|---|
| Draw rhombus $ABCD$ with diagonals meeting at $M$. | Given. |
| $AB=CB$ | All sides of a rhombus are equal. |
| $AM=CM$ | Diagonals of a parallelogram bisect each other (Theorem 3 of 5A); a rhombus is a parallelogram. |
| $BM=BM$ | Common side. |
| $\triangle ABM\cong\triangle CBM$ | SSS — three pairs of equal sides. |
| $\angle AMB=\angle CMB$ | Corresponding angles of congruent triangles. |
| $\angle AMB+\angle CMB=180°$ | Angles on the straight line $AC$. |
| $2\angle AMB=180°$, so $\angle AMB=90°$ | Substitute the equal angles. |

$\therefore$ the diagonals of a rhombus meet at right angles. ■

**A15 (`VC2M10ST01`, 3 marks).**

(a) From the Melbourne boxplot: median $=14.6$ °C; $Q1=13.7$ °C, $Q3=16.0$ °C IQR $=16.0-13.7=2.3$ °C.

(b) Upper fence $=Q3+1.5\times$ IQR $=16.0+1.5\times 2.3=16.0+3.45=19.45$ °C $19.5>19.45$ $\therefore$ the 19.5 °C point is an outlier. (Lower fence $=13.7-3.45=10.25$ °C; the minimum 11.0 °C sits above it, so there is no low outlier.)

(c) The median — the typical value — is 14.6 °C: half of Melbourne's July days were cooler than 14.6 °C. $\therefore$ the claim *typically* 15 *°C or warmer* is not supported: $14.6<15$.

**B1 (`VC2M10A06`, 2 marks).**

(a) Trace, one pass of the loop per row — $p=1$ throughout, so column 1 is the entry changed:

| Pass | $r$ | Entry changed | New value | $G$ after |
|---|---|---|---|---|
| 1 | 0 | $G[0][1]=2$ | $2\times2=4$ | `[[1, 4], [3, 4], [5, 6]]` |
| 2 | 1 | $G[1][1]=4$ | $2\times4=8$ | `[[1, 4], [3, 8], [5, 6]]` |
| 3 | 2 | $G[2][1]=6$ | $2\times6=12$ | `[[1, 4], [3, 8], [5, 12]]` |

∴ the output is `[[1, 4], [3, 8], [5, 12]]`.

(b) Each row of $G$ is a point $(x, y)$. The algorithm doubles the second coordinate — the $y$-coordinate — of every point and leaves the first coordinate — the $x$-coordinate — unchanged. $p$ holds the column number the loop works on: it points to column 1, so changing $p$ to 0 would double the $x$-coordinates instead.

**B2 (`VC2M10A09`, 4 marks).**

Let $A$ be the adult ticket price in dollars and $C$ the child ticket price.

(a) $2A+3C=52$ and $5A+C=78$. From the second equation, $C=78-5A$. Substitute into the first: $2A+3(78-5A)=52$ $2A+234-15A=52$ $-13A=-182$ $A=14$ $C=78-5(14)=78-70=8$ ∴ adult $\$14$, child $\$8$. Check: $2(14)+3(8)=28+24=52$ ✓ and $5(14)+8=78$ ✓.

(b) The lines meet at $(A, C)=(14, 8)$ — the one pair of prices that makes both statements true at once.

(c) Substitution was efficient here because the second equation gives $C$ directly in terms of $A$ — no equation needed multiplying first. (Elimination by tripling the second equation and subtracting scores equally with a matching reason.)

**B3 (`VC2M10A11`, 3 marks).**

(a) $x^2+y^2=49=7^2$ matches $x^2+y^2=r^2$ ∴ centre $(0, 0)$, radius 7.

(b) At $x=6$: $y=\dfrac{24}{6}=4$. At $x=0$: $\dfrac{24}{0}$ is undefined — division by zero has no value ∴ there is no point on the graph with $x=0$; the $y$-axis is a guide line the graph never touches.

(c) $3\times2^x=24$ $2^x=8$ — divide both sides by 3 $2^x=2^3$ ∴ $x=3$.

**B4 (`VC2M10A15`, 5 marks).**

(a) Repeated simple interest — each year, add $5.00\,\%$ of that year's starting balance: Year 1: $12\,000\times0.05=600$; balance $12\,000+600=\$12\,600$ Year 2: $12\,600\times0.05=630$; balance $12\,600+630=\$13\,230$ Year 3: $13\,230\times0.05=661.50$; balance $13\,230+661.50=\$13\,891.50$ Each year's interest is a little larger — the interest itself starts earning interest.

(b) Each year multiplies the balance by 1.05, so $V=12\,000\times1.05^n$. $V(4)=12\,000\times1.05^4\approx14\,586.08$ — still under $\$15\,000$ $V(5)=12\,000\times1.05^5\approx15\,315.38$ — over $\$15\,000$ ∴ the first whole year over $\$15\,000$ is year 5.

(c) The HISTORICAL rates — $4.50\,\%$ (July 2024), $4.20\,\%$ (December 2024), $3.60\,\%$ (July 2025), $5.00\,\%$ (July 2026) — moved by more than a percentage point over two years, so the assumption of a constant $5.00\,\%$ is not supported by the recent record; it is useful for comparison, not a forecast. ∴ modify the model by applying each year's own published rate to that year's balance — year 1 at $4.50\,\%$, year 2 at $4.20\,\%$, and so on — instead of one constant rate.

**B5 (`VC2M10M01`, 3 marks).**

(a) Cylinder: $V = \pi r^2 h = \pi \times 2^2 \times 5 = 20\pi$ m³ Hemisphere: $V = \frac{1}{2} \times \frac{4}{3} \pi r^3 = \frac{2}{3} \pi \times 2^3 = \frac{16\pi}{3}$ m³ Total: $20\pi + \frac{16\pi}{3} = \frac{60\pi}{3} + \frac{16\pi}{3}$ $\therefore V = \frac{76\pi}{3}$ m³ exact.

(b) $\frac{76\pi}{3} = 79.587\ldots$ $\therefore V \approx 79.6$ m³ to 1 decimal place.

**B6 (`VC2M10M02`, 2 marks).**

(a) $5.9 - 4.9 = 1$ step on the scale; each step multiplies shaking by $10$ ∴ $10$ times more shaking.

(b) Energy multiplies by about 32 per step: $32 \times 32 = 1024 \approx 1000$ ∴ about 2 magnitude steps; $5.9 + 2 = 7.9$ — about magnitude 7.9.

**B7 (`VC2M10M03`, 4 marks).**

(a) Triangle: wall height $165$ m vertical, distance $d$ along the ground, angle of elevation $10°$ at the surveyor. $\tan 10° = \frac{165}{d}$ — opposite over adjacent $d = \frac{165}{\tan 10°}$ $d \approx 935.7615$ $\therefore d \approx 935.8$ m.

(b) New distance: $935.7615 - 200 = 735.7615$ m $\tan\theta = \frac{165}{735.7615}$ $\theta = \tan^{-1}(0.22426\ldots) \approx 12.6399°$ ∴ the new angle of elevation is $12.6°$ — closer in, the wall looks higher.

(c) The second leg is due east (`090°T`) and the approach was due north (`000°T`), so the two legs meet at right angles. Distance from the start: $\sqrt{200^2 + 300^2} = \sqrt{40\,000 + 90\,000} = \sqrt{130\,000} \approx 360.555$ $\therefore \approx 360.6$ m. Bearing: $\tan\alpha = \frac{300}{200} = 1.5$, so $\alpha \approx 56.3°$ east of north ∴ bearing `056°T` to the nearest degree.

**B8 (`VC2M10M04`, 4 marks).**

(a) Lengths scale by $50$, so areas scale by $50^2 = 2500$: $6 \times 2500 = 15\,000$ cm² $15\,000 \div 10\,000 = 1.5$ — one square metre is $10\,000$ cm² ∴ the real window is 1.5 m².

(b) Volumes scale by $50^3 = 125\,000$: $400 \times 125\,000 = 50\,000\,000$ mL $50\,000\,000 \div 1000 = 50\,000$ ∴ the real tank holds $50\,000$ L.

(c) Nominal area: $6.2 \times 4.8 = 29.76$ m². Each measurement to 1 d.p. has upper bound $0.05$ m above the stated value: $6.25$ m and $4.85$ m. Largest consistent area: $6.25 \times 4.85 = 30.3125$ m² Excess: $30.3125 - 29.76 = 0.5525$ ∴ the true area could exceed the nominal area by about $0.55$ m² — rounding the measurements alone can shift the area by more than half a square metre.

**B9 (`VC2M10SP02`, 3 marks).**

(a) Vertices: A, B, C, D, E — $5$ of them. Edges: A–B, A–C, B–C, B–D, C–D, D–E — $6$ of them. Every vertex can be reached from every other — through the triangle A–B–C and the edges to D and E — so the network is connected.

(b) Degrees: A $2$ (AB, AC); B $3$ (AB, BC, BD); C $3$ (AC, BC, CD); D $3$ (BD, CD, DE); E $1$ (DE). Check: $2 + 3 + 3 + 3 + 1 = 12 = 2 \times 6$ — twice the edge count ✓. Odd degrees: B, C, D, E — four vertices.

(c) By the Euler walk test (Result 4 of 5B), a walk using every edge exactly once exists only when the number of odd vertices is 0 or 2. ∴ with four odd vertices, no such walk exists.

**B10 (`VC2M10ST02`, 4 marks).**

(a) As the years increase, the temperature difference tends to increase: a **positive** association, and the cloud follows its line of good fit closely enough in shape to call it **roughly linear**.

(b) The points sit widely spread about the line — 2011 sits near 0.00 while 2019 reaches 1.51 — so the association is **weak** (a judgement of weak-to-moderate with this reasoning also scores).

(c) The line rises about 0.05 °C per year; extending it two years past 2026 reads about 1.4 °C. ∴ estimate for 2028: about 1.4 °C above the 1961–1990 average (accept 1.1–1.6, consistent with the student's own line).

(d) The line of good fit summarises a tendency — it is drawn by eye through scattered points, and 2028 lies outside the data range, where the line is an extrapolation. The year-to-year spread (from 0.00 to 1.51 within the data itself) is larger than the change the line shows in any one year. ∴ the graph supports a warming trend, not a proof of exactly how warm 2028 will be.

**B11 (`VC2M10ST03`, 2 marks).**

(a) Completed table:

| | Walk | Ride | Total |
|---|---|---|---|
| Year 7 | 24 | 16 | 40 |
| Year 10 | 12 | 28 | 40 |
| **Total** | 36 | 44 | 80 |

(b) Year 7 walk: $24 \div 40 = 60\,\%$; Year 10 walk: $12 \div 40 = 30\,\%$. ∴ the walking rate halves between Year 7 and Year 10 — the percentages differ markedly, so there is an association between year level and travel mode.

**B12 (`VC2M10ST04`, 3 marks).**

(a) The advertisement's chart starts its vertical axis at 70 — not at 0 — and shows no break. Bar lengths compare values only when the axis starts at zero, so the visible lengths misrepresent the numbers.

(b) Actual factor: $100 \div 80 = 1.25$ — Plan B is 1.25 times as fast as Plan A. Visible lengths, measured from the axis start at 70: Plan B's bar rises 30 and Plan A's rises 10 — the bars suggest Plan B is roughly 3 times as fast. ∴ the display overstates a 1.25-times difference as a roughly 3-times difference.

(c) Start the axis at 0 — the left-hand chart is the fair version — or show a clear break in the axis at the jump from 0 to 70.

**B13 (`VC2M10ST05`, 4 marks).**

(a) Turnover rises through the year — a positive, near-linear trend (December dips slightly below November; the trendline rises through it).

(b) Change over the period: $37\,906.6 - 36\,209.4 = 1697.2$ million dollars Steps: 11 one-month steps from July to June Mean monthly increase: $1697.2 \div 11 \approx 154.29$ ∴ about 154.3 million dollars per month.

(c) September 2025 is three months after June 2025: $37\,906.6 + 3 \times 154.29\ldots = 37\,906.6 + 462.87\ldots \approx 38\,369.5$ ∴ predicted turnover about 38 369.5 million dollars.

(d) Two limitations:

- September 2025 is outside the data range — the extension assumes the trend keeps going unchanged, which nothing in the data guarantees.
- The straight trend cannot know about events that move turnover — a rate change, a poor retail season, or shifts the seasonal adjustment has not removed.

**B14 (`VC2M10P01`, 3 marks).**

(a) Given the dwelling is a house, the sample is the 50 houses; 30 of them have a dog. $P(\text{dog} / \text{house}) = \frac{30}{50} = \frac{3}{5}$

.

(b) Given the household has a dog, the sample is the 40 dog-owning households; 30 of them are houses. $P(\text{house} / \text{dog}) = \frac{30}{40} = \frac{3}{4}$.

(c) The condition after *given* decides the denominator: *given house* restricts to 50 households, *given dog* restricts to 40 — different samples, different probabilities. $\therefore$ the common mistake is reversing the condition — reading *the probability of a dog, given a house* as *the probability of a house, given a dog*, or *of* where the question says *given*. The words *given*, *of* and *knowing that* each fix which group is the sample.

**B15 (`VC2M10P02`, 4 marks).**

(a) Tree diagram — first draw from 10 marbles; without replacement, the second draw is from 9:

```
                          ┌─ red    3/9
          ┌─ red 4/10 ─┤
          │               └─ blue   6/9
start ────┤
          │               ┌─ red    4/9
          └─ blue 6/10─┤
                          └─ blue   5/9
```

$P(\text{both red}) = \frac{4}{10} \times \frac{3}{9}$ — multiply along the branch $= \frac{12}{90} = \frac{2}{15}$.

(b) Given the first marble is blue, the bag holds 9 marbles, still 4 of them red. $\therefore P(\text{second red} / \text{first blue}) = \frac{4}{9}$.

(c) $P(\text{second red}) = P(\text{red, red}) + P(\text{blue, red}) = \frac{4}{10} \times \frac{3}{9} + \frac{6}{10} \times \frac{4}{9} = \frac{12}{90} + \frac{24}{90} = \frac{36}{90} = \frac{2}{5}\ \frac{2}{5} \neq \frac{4}{9}$, so $P(\text{second red}) \neq P(\text{second red} / \text{first blue})$ $\therefore$ the events are not independent — drawing a blue first changes the chance of a red second.