

VCE VM Numeracy Units 3 & 4

Chapter 1 — The problem-solving cycle and mathematical toolkit

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Chapter 1 The problem-solving cycle and mathematical toolkit — 1A The four-stage problem-solving cycle

Theory

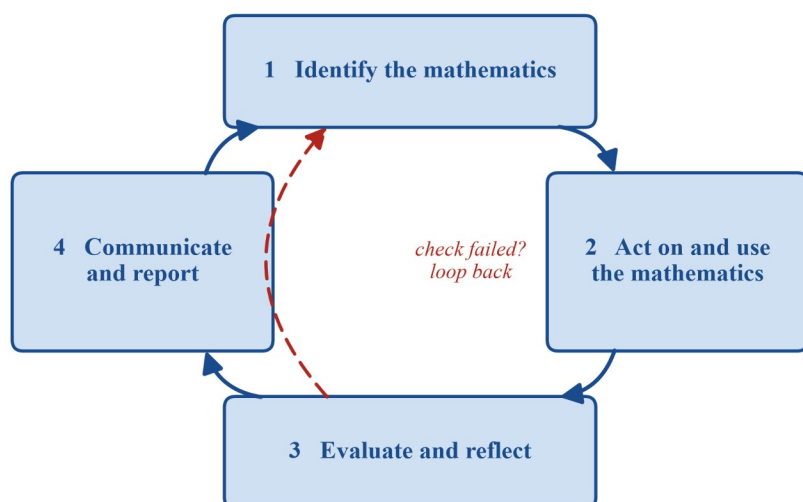
A **numeracy task** is a real-world job that needs mathematics — working out the bill for a group order, deciding which phone plan is cheaper, or checking whether a piece of timber is long enough. Tasks like this never arrive labelled “use division”. You have to find the mathematics yourself, do it, check it, and then tell someone the answer.

The VCE VM Numeracy study design asks you to handle every task with one reliable routine: the **four-stage problem-solving cycle**. The whole course is built on this cycle (see the study design’s Units 3 and 4, Outcome 2). It has four separate stages, taken in this order: identify the mathematics; act on and use mathematics; evaluate and reflect; communicate and report.

Source: VCAA, VCE Vocational Major Numeracy Study Design, retrieved 2026-10-07.

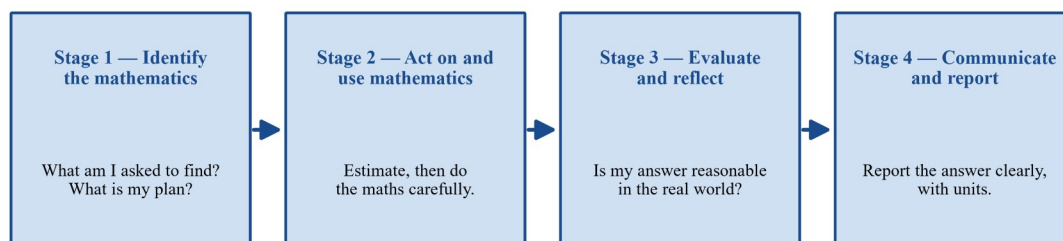
The four stages.

The stages always run in the same order. Stage 3 can send you back to fix things up — that is why the routine is called a *cycle*.



The four stages run in order — and stage 3 can send you back.

Stage	What you do	Key question
1 Identify the mathematics	Read the task. Pick out the numbers that matter. Decide what you are asked to find, and choose the operations (add, subtract, multiply, divide) that will answer it. Make a plan.	What am I asked to find, and what is my plan?
2 Act on and use mathematics	Carry out the plan. First make an estimate — a rough answer that is close enough to check against. Then do the exact mathematics carefully, by hand, with a calculator, or with a measuring tool.	Have I estimated first, and is my working careful?
3 Evaluate and reflect	Compare your answer with your estimate. Ask whether it is reasonable (sensible) in the real world: the right size, the right units, and it fits the story. If the check fails, loop back and try again.	Is my answer reasonable in the real world?
4 Communicate and report	State the answer clearly, in a sentence, with units. Use a table, diagram or short report if the task asks for one. Your reader should never have to guess what you mean.	Can someone else understand my answer?



Looping back.

The cycle is not a one-way track. When the stage 3 check fails — the answer is nothing like the estimate, or it does not make sense in the real world — you go back. You might return to stage 2 (redo the calculation more carefully) or to stage 1 (rethink what the task is really asking). Going back is not a failure; it is the cycle working the way it should. Examples 2 and 4 below both show a loop-back.

Worked model: the cycle on a small task.

Tina needs 5 exercise books for class. They cost \$2.40 each. How much does Tina spend?

Stage	Working
1 Identify the mathematics	Find the total cost of 5 books at \$2.40 each. Plan: multiply — total = 5×2.40 .
2 Act on and use mathematics	Estimate: round \$2.40 up to \$2.50, so about $5 \times 2.50 = \$12.50$. Exact: $5 \times 2.40 = \$12.00$.
3 Evaluate and reflect	\$12.00 is close to the estimate \$12.50, and 5 books at a little over \$2 each should cost a little over \$10. The answer is reasonable.
4 Communicate and report	“The five exercise books cost \$12.00 altogether.”

The symbol $\therefore$.

Answer lines in this book often start with $\therefore$, which means *therefore* — it flags the final answer. For example: $\therefore$ the total cost is \$12.00.

Where the cycle leads in this book.

Section 1B takes stage 1 further (turning a real-world task into a mathematics plan). Section 1C takes stage 3 further (estimating, checking and reflecting). Section 1D takes stage 4 further (reporting results clearly). The tools you use in stage 2 — tape measures, scales, calculators, spreadsheets and phone apps — are the **mathematical toolkit** of sections 1E and 1F. Section 1G explains words such as *familiar*, *routine* and *specialised*. After Chapter 1, every chapter practises the cycle on tasks from the six areas of everyday life: personal, civic, financial, health, work and recreation.

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

Worked examples

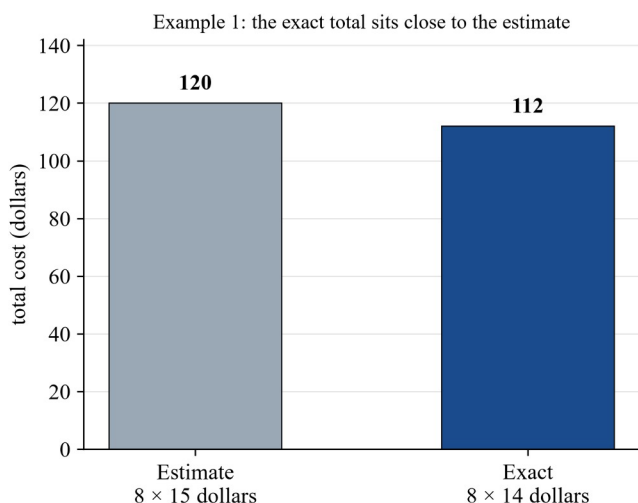
Example 1 — scaffolded

A sports club is holding an end-of-season lunch for 24 people. Each pizza feeds 3 people, and pizzas cost \$14 each. How many pizzas does the club need, and what is the total cost?

Working	Comment
Stage 1 — Identify: find the number of pizzas for 24 people, then the total cost. Plan: pizzas = $24 \div 3$, then cost = pizzas $\times$ 14.	Read the task, pick out the numbers that matter, choose the operations, and make a plan.
Stage 2 — Act: pizzas: $24 \div 3 = 8$. Estimate the cost first: $8 \times 15 = \$120$. Exact cost: $8 \times 14 = \$112$.	Estimate before calculating exactly — the estimate is the safety net for stage 3.
Stage 3 — Evaluate: \$112 is close to the estimate \$120, and 8 pizzas feeding 3 people each covers $8 \times 3 = 24$ people ✓. The answer is reasonable.	Compare with the estimate and check the answer fits the real world.

Stage 4 — Report: “The club needs 8 pizzas, and the total cost is \$112.”

A full sentence, with units, so the reader gets the answer clearly.



Example 2 — scaffolded

Naz is making 3 shelves for his garage. Each shelf is 120 cm long. The timber store sells lengths of 250 cm. How many lengths does Naz need to buy?

Stage 1 — Identify: find the total timber needed, then how many 250 cm lengths that takes. Plan: total $= 3 \times 120$, then lengths $= \text{total} \div 250$.

What is asked? The number of lengths to *buy* — whole lengths only.

Stage 2 — Act: total timber: $3 \times 120 = 360$ cm.
Lengths: $360 \div 250 = 1.44$.

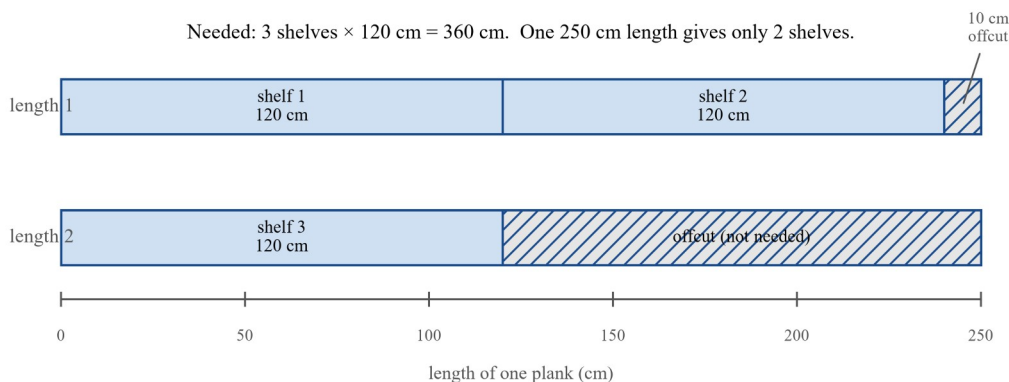
Do the mathematics carefully, one step at a time.

Stage 3 — Evaluate: Naz cannot buy 1.44 lengths — the store sells whole lengths. Test 1 length: it gives only 2 shelves ($2 \times 120 = 240$ cm, leaving a 10 cm offcut). Not enough, so loop back: 2 lengths give $2 \times 250 = 500$ cm, which covers 360 cm ✓.

The check fails, so the cycle loops back. Real-world rules (whole lengths, real cuts) decide how to round — not the usual rounding rules.

Stage 4 — Report: “Naz needs to buy 2 lengths of timber.”

Report the answer with units, in a full sentence.



Example 3 — unscaffolded

Grace is comparing two phone plans for one month. Plan A costs a flat \$25 per month. Plan B costs \$15 per month plus \$0.10 for each call. Grace makes about 120 calls in a month. Which plan is cheaper for Grace, and how much does she save?

Stage 1 — Identify. The task asks for the monthly cost of each plan at 120 calls, and which is cheaper. Plan A is a flat amount. Plan B needs a multiply and an add: $\text{cost} = 15 + 0.10 \times (\text{number of calls})$.

Stage 2 — Act.

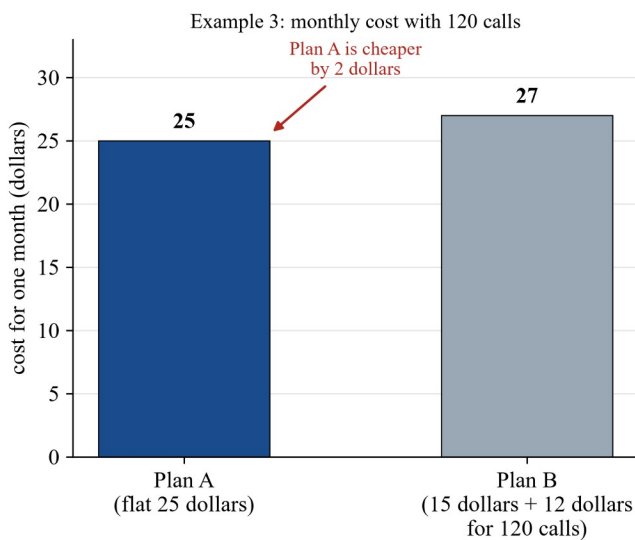
Plan A: \$25 for the month.

Plan B: calls cost $0.10 \times 120 = \$12$, so the total is $\$15 + \$12 = \$27$.

Stage 3 — Evaluate. Both amounts are believable monthly phone costs, and the two plans are close — a difference of \$2 is reasonable. Plan A is cheaper. Reflecting further: Plan B costs \$15 + \$0.10 per call, which reaches \$25 at 100 calls — so Plan B would be the cheaper choice only if Grace made fewer than 100 calls a month. At 120 calls, Plan A wins.

Stage 4 — Report.

$\therefore$ Plan A is cheaper for Grace, saving her $\$27 - \$25 = \$2$ per month.



Example 4 — unscaffolded

Jo is buying 6 meat pies for a work lunch. Each pie costs \$8.75. Jo's calculator display shows $6 \times 8.75 = 46.50$. Should Jo trust this display? Find the correct total cost.

Stage 1 — Identify. The operation is multiplication: $\text{total} = 6 \times 8.75$. The task also asks whether the display can be trusted — that is a stage 3 job.

Stage 2 — Act. Estimate first: round \$8.75 up to \$9, giving an estimate of $6 \times 9 = \$54$.

Stage 3 — Evaluate. The display shows \$46.50, which is $\$54 - \$46.50 = \$7.50$ below the estimate — too far away to believe. So the display is wrong (Jo probably keyed 7.75 instead of 8.75, since $6 \times 7.75 = 46.50$). Loop back to stage 2 and re-key carefully: $6 \times 8.75 = \$52.50$. This sits just below the estimate of \$54, which is reasonable because \$8.75 is a little less than \$9.

Stage 4 — Report.

∴ Jo should not trust the display; the 6 pies cost \$52.50.



estimate: $6 \times 9 = 54$ dollars —
46.50 is 7.50 dollars too low.
Do not trust this display.

Stage 2 again, keyed carefully: $6 \times 8.75 = 52.50$ (just below the estimate of 54, as expected)

Practice questions

Scaffolded

Q1. This question is about the cycle itself. (a) Write the four stages of the problem-solving cycle in the correct order. (b) Match each key question to its stage: (i) “Is my answer reasonable in the real world?” (ii) “What am I asked to find, and what is my plan?” (iii) “Can someone else understand my answer?” (iv) “Have I estimated first?” (c) Your stage 3 check fails. Name two stages you could loop back to.

Q2. A market stall sells hats for \$12 each. Sam buys 5 hats for his team. (a) Stage 1: write down the operation (calculation) that finds the total cost. (b) Stage 2: work out the total cost exactly. (c) Stage 4: write one sentence reporting the answer.

Q3. A football club sells 78 raffle tickets at \$4.95 each. (a) Estimate the total takings by rounding 78 to 80 and \$4.95 to \$5. (b) Work out the exact total. (c) Stage 3: is the exact total reasonable? Compare it with your estimate in one sentence.

Q4. A school camp has 108 students going. Each bus seats 45 students. (a) Work out $108 \div 45$. (b) Explain why 2 buses are not enough. (c) How many buses does the school need to book?

Q5. A calculator shows $145 \times 62 = 89\,990$. (a) Estimate the answer using 150×60 . (b) Explain why the calculator display must be wrong. (c) Work out the correct answer.

Q6. Mia’s ride-on mower uses 11.6 L of petrol to mow the whole oval. Mia buys petrol in whole litres and needs enough for the job. (a) Between which two whole litres does 11.6 L lie? (b) Round 11.6 L to the nearest whole litre. (c) How many litres should Mia buy? Explain why rounding up is the right choice here.

Un scaffolded

Q7. A painter buys 3 tins of paint at \$28.60 each and pays with a \$100 note. Find the total cost and the change the painter receives. Check your total with an estimate (round each tin to \$29).

Q8. A delivery van uses 8 L of fuel per 100 km. Fuel costs \$1.95 per litre. Find the cost of the fuel for a 250 km trip.

Q9. A carpenter is assembling 4 frames, and each frame needs 12 bolts. Bolts are sold in packs of 25, and each pack costs \$18.50. How many packs must the carpenter buy, and what do they cost in total? (Packs cannot be split.)

Q10. A neighbourhood house is printing 450 flyers. Printing costs \$0.12 per flyer. The house has a budget of \$60 for the job. Will the printing fit within the budget? How much money is left over?

- Q11.** The walking track around a park is 275 m per lap. Ada’s goal for the week is to walk at least 3 000 m. This week she walks 12 laps. Show, with a calculation, whether Ada meets her goal.
- Q12.** Two gyms are advertising. Gym A: \$ 150 joining fee, then \$ 12 per week. Gym B: no joining fee, \$ 25 per week. Ben will use the gym for 12 weeks. Which gym is cheaper for Ben, and how much does he save?
- Q13.** A student is asked how much ribbon is needed for 6 banners if each banner needs 2.4 m of ribbon. The student answers $6 \times 2.4 = 12.4$ m. Use an estimate to explain why this answer is wrong, then work out the correct length of ribbon needed.
- Q14.** A work crew of 9 people orders lunch, at \$ 13.20 per person. Find the total cost and report the answer in a full sentence.
- Q15.** The 40 members of a club share a \$ 154 equipment bill equally. How much does each member pay?
- Q16.** At a bakery, the till display shows \$ 70.40 for 12 trays of eggs at \$ 6.45 per tray. Use an estimate to show that the display is wrong, then find the correct total.
- Q17.** A youth group has \$ 40 to spend on tickets to a show. Tickets cost \$ 6.50 each. (a) Work out $40 \div 6.50$, correct to 2 decimal places. (b) How many tickets can the group buy? Explain why you round *down*, not up.
- Q18.** A class of 15 students goes to the movies. Tickets are \$ 9.50 each, and the class also buys \$ 28 worth of snacks to share. (a) Find the total cost of the tickets and the snacks. (b) The total cost is shared equally between the 15 students. How much does each student pay, to the nearest cent? (c) Check that 15 payments of your answer to (b) cover the bill. What happens to the extra few cents?
-

Answers

Q1. (a) Identify the mathematics; act on and use mathematics; evaluate and reflect; communicate and report. (b) (i) stage 3 (ii) stage 1 (iii) stage 4 (iv) stage 2. (c) Stage 1 or stage 2. **Q2.** (a) Multiply: 5×12 . (b) \$60. (c) e.g. “The five hats cost \$60 altogether.” **Q3.** (a) \$400. (b) \$386.10. (c) Yes — \$386.10 is close to the estimate \$400. **Q4.** (a) 2.4. (b) Two buses seat only $2 \times 45 = 90$ students, leaving 18 without a seat. (c) 3 buses. **Q5.** (a) 9000. (b) 89990 is about ten times the estimate — far too big. (c) 8990. **Q6.** (a) Between 11 L and 12 L. (b) 12 L. (c) 12 L — 11 L would not finish the job. **Q7.** Total \$85.80; change \$14.20 (estimate $3 \times \$29 = \$87$ ✓ close). **Q8.** 20 L of fuel; \$39.00. **Q9.** 2 packs; \$37.00 (one pack of 25 is not enough for 48 bolts). **Q10.** Cost \$54.00 — fits the budget; \$6.00 left over. **Q11.** $12 \times 275 = 3300$ m; yes, $3300 \geq 3000$. **Q12.** Gym A \$294; Gym B \$300; Gym A is cheaper by \$6. **Q13.** Estimate $6 \times 2.5 = 15$ m, so 12.4 m is too low; correct: 14.4 m. **Q14.** \$118.80. **Q15.** \$3.85 each. **Q16.** Estimate $12 \times \$6.50 = \$78$; the display is \$7.60 below it; correct total \$77.40. **Q17.** (a) 6.15. (b) 6 tickets — 7 would cost \$45.50, over the \$40 budget. **Q18.** (a) \$170.50. (b) \$11.37. (c) $15 \times \$11.37 = \$170.55$ — covers the bill, with 5 cents spare.

Fully-worked solutions

Q1. (a) In order: **identify the mathematics; act on and use mathematics; evaluate and reflect; communicate and report.** (b) (i) Stage 3 — evaluating and reflecting. (ii) Stage 1 — identifying the mathematics. (iii) Stage 4 — communicating and reporting. (iv) Stage 2 — acting on and using mathematics (estimating happens here, before the exact calculation). (c) Stage 1 (rethink the plan) or stage 2 (redo the calculation more carefully).

Q2. (a) The total cost is found by multiplying: 5×12 . (b) $5 \times 12 = 60$, so the total is \$60. (c) e.g. “The five hats cost \$60 altogether.” (Stage 4: a full sentence with the units.)

Q3. (a) Estimate: $80 \times 5 = 400$, so about \$400. (b) Exact: $78 \times 4.95 = 386.10$, so the takings are \$386.10. (c) Yes — \$386.10 is close to the estimate of \$400 (rounding both numbers up made the estimate a little high, as expected), so the answer is reasonable.

Q4. (a) $108 \div 45 = 2.4$. (b) Two buses seat only $2 \times 45 = 90$ students, so $108 - 90 = 18$ students would have no seat. (c) The school needs 3 buses ($3 \times 45 = 135$ seats, which covers 108 students). The real world rounds *up* here — you cannot book 0.4 of a bus, and 2.4 buses cannot carry everyone.

Q5. (a) Estimate: $150 \times 60 = 9000$. (b) The display shows 89990, which is about ten times the estimate of 9000 — far too big to be right, so the display must be wrong. (c) $145 \times 62 = 8990$. This is close to the estimate, so it is reasonable. (The display 89990 has an extra 9 — a keying slip.)

Q6. (a) 11.6 lies between 11 L and 12 L. (b) To the nearest whole litre, 11.6 L rounds to 12 L. (c) Mia should buy 12 L. Rounding up is the right choice because 11 L would leave the mower short of fuel and the job unfinished.

Q7. Total cost: $3 \times 28.60 = \$85.80$. Estimate check: $3 \times 29 = \$87$, and \$85.80 is close to \$87 ✓ (rounding the price up made the estimate slightly high, as expected). Change: $\$100 - \$85.80 = \$14.20$. $\therefore$ the paint costs \$85.80 and the painter receives \$14.20 change.

Q8. A 250 km trip is $250 \div 100 = 2.5$ lots of 100 km. Fuel needed: $2.5 \times 8 = 20$ L. Cost: $20 \times 1.95 = \$39.00$. Estimate check: $20 \times 2 = \$40$, and \$39.00 is close ✓. $\therefore$ the fuel for the trip costs \$39.00.

Q9. Bolts needed: $4 \times 12 = 48$. One pack holds 25 bolts, and $25 < 48$, so one pack is not enough. $48 \div 25 = 1.92$, so the carpenter must round *up* to 2 whole packs (packs cannot be split). Cost: $2 \times 18.50 = \$37.00$. $\therefore$ the carpenter buys 2 packs, costing \$37.00 in total.

Q10. Cost of printing: $450 \times 0.12 = \$54.00$. Estimate check: $450 \times 0.10 = \$45.00$, and \$54.00 is the same size ✓ (the estimate used a lower price, so it sits below the exact cost, as expected). Budget: \$60. Since $\$54.00 < \$60$, the printing fits within the budget. Money left over: $\$60 - \$54.00 = \$6.00$. $\therefore$ yes, the job fits the budget, with \$6.00 to spare.

Q11. Distance walked: $12 \times 275 = 3\,300$ m. Compare with the goal: $3\,300 \geq 3\,000$. $\therefore$ yes — Ada walks 3 300 m, which meets her goal of at least 3 000 m.

Q12. Gym A over 12 weeks: $\$150 + 12 \times \$12 = \$150 + \$144 = \$294$. Gym B over 12 weeks: $12 \times \$25 = \$300$. Both totals are believable for 12 weeks of gym, and they are close. Difference: $\$300 - \$294 = \$6$. $\therefore$ Gym A is cheaper for Ben, saving him \$6 over the 12 weeks.

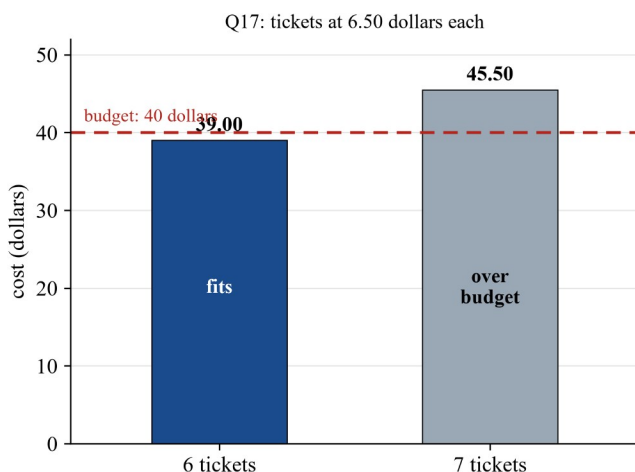
Q13. Estimate: round 2.4 up to 2.5, giving $6 \times 2.5 = 15$ m. The student's answer of 12.4 m is well below the estimate, so it cannot be right — it fails the stage 3 check. Exact: $6 \times 2.4 = 14.4$ m, which sits just below the estimate of 15 m ✓ (because 2.4 is a little less than 2.5). $\therefore$ the correct length of ribbon needed is 14.4 m.

Q14. Total cost: $9 \times 13.20 = 118.80$. Report (stage 4): “The lunch for the nine-person crew costs \$118.80 in total.” $\therefore$ the total cost is \$118.80.

Q15. Each member pays $\$154 \div 40 = \$3.85$. The division comes out exactly, so no rounding is needed. Check (stage 3): $40 \times 3.85 = \$154$ ✓ — the shares add back to the bill. $\therefore$ each member pays \$3.85.

Q16. Estimate: round \$6.45 up to \$6.50, giving $12 \times 6.50 = \$78$. The display shows \$70.40, which is $\$78 - \$70.40 = \$7.60$ below the estimate — too far away to trust, so the display fails the stage 3 check. Loop back to stage 2 and re-key carefully: $12 \times 6.45 = \$77.40$. This sits just below the estimate of \$78 ✓, so it is reasonable. (The display was exactly \$7.00 under the correct total — a keying slip.) $\therefore$ the display is wrong; the correct total is \$77.40.

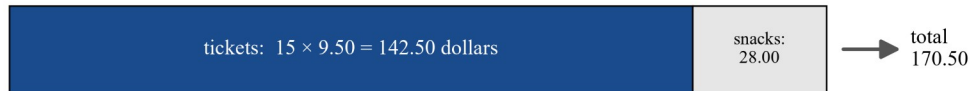
Q17. (a) $40 \div 6.50 = 6.1538\dots$, which is 6.15 correct to 2 decimal places. (b) The group can buy 6 tickets. Tickets are sold whole, so the answer must be a whole number — and rounding *up* would break the budget: 7 tickets cost $7 \times 6.50 = \$45.50$, which is more than the \$40 available, while 6 tickets cost $6 \times 6.50 = \$39.00$, which fits.



$\therefore$ the group can buy 6 tickets, with \$1.00 of the budget left over.

Q18. (a) Tickets: $15 \times 9.50 = \$142.50$. Total with snacks: $\$142.50 + \$28 = \$170.50$. Estimate check: $170 \div 15 \approx \$11.33$, so each share should be a little over \$11. (b) Share: $\$170.50 \div 15 = 11.3666\dots$, which is \$11.37 to the nearest cent. (c) $15 \times \$11.37 = \$170.55$, which is more than the \$170.50 bill, so the shares cover it. The extra 5 cents appears because every one of the 15 shares was rounded *up* to the nearest cent — each $11.3666\dots$ becomes 11.37, about a third of a cent more, and 15 of those thirds make 5 cents, which can go back into the class fund.

Q18: sharing the movie-night bill



Split 15 ways: $170.50 \div 15 = 11.3666\dots \rightarrow 11.37$ dollars each (to the nearest cent)

$\therefore$ the total cost is \$170.50, and each student pays \$11.37 (to the nearest cent).

Chapter 1 The problem-solving cycle and mathematical toolkit — 1B Identify the mathematics: from real-world context to maths plan

Theory

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

Section 1A set out the four stages of the **problem-solving cycle**: identify the mathematics; act on and use mathematics; evaluate and reflect; communicate and report. This section goes deep into **stage 1**.

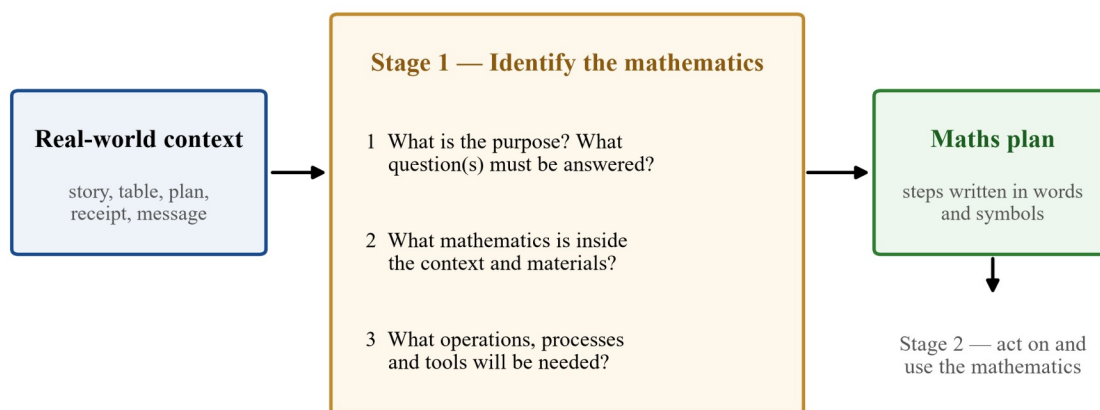
Real-world tasks do not arrive labelled “use this formula”. They arrive as a story, a price sign, a floor plan, a roster, a text message. The mathematics is **embedded** in the context — that means it is hidden inside the words and the materials, and your first job is to find it. In the study design (Units 3 and 4, Outcome 2), this first stage means spotting the maths hidden in a real-life situation, picking out the information that matters, working out what it means, and then deciding which mathematics to use.

Source: VCAA, VCE Vocational Major Numeracy Study Design, retrieved 2026-10-07.

Three things to find.

Every time you meet a real-world task, stage 1 asks you to find three things.

1. **The purpose and the question(s).** What is this task really about? What exact question (or questions) must be answered? Sometimes the question is given to you. Sometimes you must write it yourself.
2. **The mathematics in the context.** Which numbers, sizes, times, prices and shapes are in the story or the materials — and which of them do you actually need? Contexts often carry extra facts you will never use.
3. **The operations, processes and tools.** Which maths will do the job — adding, taking a percentage, finding an area, working out a time? And which tools will help: a calculator, a tape measure, a ruler, a spreadsheet, a planner?



Words that point to mathematics.

The words in a task are signposts. This table translates everyday words into the maths they usually point to.

Words in the task	The maths they point to
total, in all, altogether	addition (+)
how much is left, change, difference, how much cheaper	subtraction (−)
each, per, every, a rate like “per hour”	multiplication (×) or a rate
share equally, split into equal groups, how many groups	division (÷)
% off, discount, percentage increase	percentage

around the edge, fencing, a border	perimeter
covers a floor, a wall, a bed	area
fills a box, how much it holds	volume or capacity
how long, time between, duration	time
scale up a recipe, a map scale	ratio and proportion
which is cheaper, the best deal	find each one, then compare
how many tins, rolls, buses to buy	divide, then round up

Familiar or unfamiliar, routine or non-routine.

A **familiar** context is one you have met before; an **unfamiliar** one is new to you. A **routine** task is a job people do often (like pricing an order); a **non-routine** task is one you have not practised in that shape before. Section 1G looks at these words in full. Here is the point that matters for stage 1: an unfamiliar context does not mean unfamiliar mathematics. The story may be new, but the maths inside it is maths you know. Read slowly, find the three things, and the new context becomes an old problem.

Choosing a strategy.

Once you can see the mathematics, pick a **strategy** — a way of attacking the task. A small set of strategies covers most real-world tasks.

Strategy	Use it when
Draw a diagram	the task is about shapes, rooms, routes or anything you can picture
Make a table	numbers change step by step, or you must compare options
Look for a pattern	the same thing keeps happening over and over
Break it into smaller parts	the task holds several smaller jobs inside it
Work backwards	you know the end result but not the start
Guess, check and improve	you can test a number and see how close it is
Simplify the problem	the real numbers are awkward — try small numbers first

Writing the maths plan.

Stage 1 ends with a **plan**: your steps written down before you calculate anything. A good plan is detailed and explicit — someone else could pick it up and follow it. Write it in a mix of everyday words and mathematical symbols. Use this template.

Part of the plan	What you write in it
Purpose	why the task exists, in one sentence
Question(s)	exactly what you must find
Information given	the facts and numbers you will use; cross out the extras
Mathematics	the operations and processes (from the signpost table)
Tools	calculator, tape measure, ruler, spreadsheet, planner
Steps	numbered, one job per step, words and symbols together
Estimate	a quick in-your-head answer to check against later (stage 3)

A worked plan.

Jo tiles a rectangular bathroom floor measuring 2.4 m by 1.8 m. Floor tiles come in boxes; one box covers 1.5 m². How many whole boxes of tiles must Jo buy? Here is the plan, filled in.

Part of the plan	Jo's plan
Purpose	Work out how many whole boxes of tiles to buy for the bathroom floor.
Question(s)	How many whole boxes of tiles cover the floor?
Information given	floor 2.4 m by 1.8 m; one box covers 1.5 m ²
Mathematics	area (multiply), then divide, then round up
Tools	calculator, pen and paper
Steps	1. area = $2.4 \times 1.8 = 4.32$ m ² 2. boxes = $4.32 \div 1.5 = 2.88$ 3. round up: buy 3 boxes
Estimate	floor is about $2.5 \times 2 = 5$ m ² , so about 3 to 4 boxes

The estimate sits in the plan on purpose. Stage 3 (section 1C) checks the finished answer against it.

Buying whole things: round up.

You cannot buy 2.88 boxes of tiles, 6.7 lengths of edging or 2.14 buses. When the answer counts things that are sold whole, divide first and then **round up** to the next whole number — even when the decimal part is small. Write “round up” in your plan so the reason is on the page.

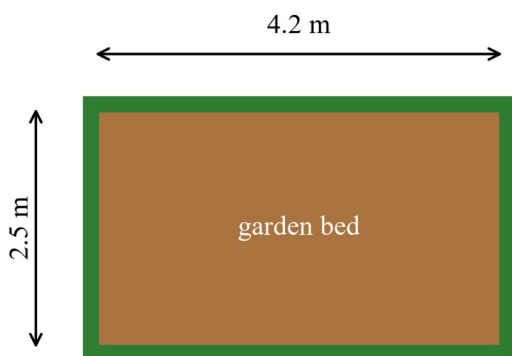
Three traps to check for.

- **Extra information.** Real contexts carry facts you do not need (the weather, the opening hours). Cross them out in your plan so they cannot wander into the working.
- **Two questions hiding in one.** “Is it enough, and how much is left over?” is two questions. List both, or you will answer only half the task.
- **Mixed units.** A plan in centimetres next to a price in metres is a trap. Convert to one unit before you calculate.

Worked examples

Example 1 — scaffolded

A community garden group is rebuilding a rectangular garden bed. Edging goes all the way around the edge, and mulch covers the bed. Edging is sold in 2 m lengths. One bag of mulch covers 2 m². How many whole lengths of edging and how many whole bags of mulch must the group buy?



edging goes all the way around the edge;
mulch covers the bed

Made-up data: the garden bed and its measurements are made up for this section.

Working	Comment
Purpose and question(s): buy the right amount of edging and mulch for the bed. Questions: how many whole 2 m lengths of edging? How many whole bags of mulch?	Name the purpose and both questions before touching a number.
Mathematics in the context: rectangle 4.2 m by 2.5 m; edging in 2 m lengths; 1 bag of mulch covers 2 m ² .	Sort the given facts and note what each one is for.
Operations and tools: perimeter for the edging; area for the mulch; divide; round up. Tools: calculator, pen and paper.	Edging follows the edge (perimeter); mulch covers the top (area).
Step 1 — edging: perimeter $= 2 \times (4.2 + 2.5) = 2 \times 6.7 = 13.4$ m. Lengths $= 13.4 \div 2 = 6.7$, so buy 7 lengths (round up).	6.7 lengths cannot be bought; take one extra.
Step 2 — mulch: area $= 4.2 \times 2.5 = 10.5$ m ² . Bags $= 10.5 \div 2 = 5.25$, so buy 6 bags (round up).	The same round-up rule.
Check with an estimate: the bed is about $4 \times 2.5 = 10$ m ² , so about 5 bags; 6 is close and sensible.	The estimate goes in the plan; stage 3 will use it again.

The group must buy 7 lengths of edging and 6 bags of mulch.

Example 2 — scaffolded

The Year 11 crew is planning an excursion. Their coordinator sends this message.

“Bus hire is \$320 return. Museum tickets are \$14.50 per student and 26 students are going. The three teachers go free. Forecast is 24 °C and sunny. The museum opens at 9:30 am. Our bus leaves school at 8:45 am and the drive takes 45 minutes. Every student needs to bring a packed lunch.”

Made-up data: the coordinator’s message and every number in it are made up for this section.

The crew must find the total cost of the excursion, and the cost per student correct to the nearest cent.

Working	Comment
Purpose and question(s): work out what the excursion costs. Questions: what is the total cost? What is the cost per student, correct to the nearest cent?	The task hides two questions — list both.
Mathematics in the context: needed — \$320 bus, \$14.50 per student, 26 students, teachers free. Not needed — 24 °C, opens 9:30 am, leaves 8:45 am, 45-minute drive, packed lunch.	Cross out the extras so they cannot sneak into the working.
Operations and tools: multiply (26×14.50), add ($+ 320$), divide ($\div 26$). Tool: calculator.	Three operations, in order, in the plan.
Step 1: tickets $= 26 \times \$14.50 = \$377.00$.	The teachers are free, so they add nothing.
Step 2: total $= \$377.00 + \$320.00 = \$697.00$.	Bus plus tickets.
Step 3: per student $= \$697.00 \div 26 = \$26.8076\dots$, so \$26.81 correct to the nearest cent.	Round only at the step the question asks for.
Check with an estimate: $26 \times \$15 = \$390$, and $\$390 + \$320 = \$710$ — close to \$697.00, so the answer is sensible.	A quick estimate catches big slips.

The excursion costs \$697.00 in total, which is \$26.81 per student correct to the nearest cent.

Example 3 — unscaffolded

Renee is painting one side of her shed. The side is a rectangle 6.5 m long and 1.8 m high. The flyer below is the only paint information she has. How many litres of paint does the job need (to 2 decimal places), how many whole tins must she buy, and what do they cost?

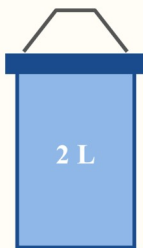
RIVERBEND PAINT
exterior timber paint

Coverage: 10 m² per litre (each coat)

Coats needed: 2

Tin size: 2 L

Price: \$38 per tin



Made-up data: Riverbend Paint and every figure on the flyer are made up for this section.

Identify first. The purpose is to buy enough paint for the shed side; the questions are the litres needed, the whole tins to buy, and the cost. The mathematics is area, then the coverage rate, then division with a round-up. The wall area is $6.5 \times 1.8 = 11.7$ m², and two coats must cover it, so the paint must cover $2 \times 11.7 = 23.4$ m². At 10 m² per litre, the paint needed is $23.4 \div 10 = 2.34$ L. Tins hold 2 L, and $2.34 \div 2 = 1.17$, so Renee must buy 2 tins (round up). The cost is $2 \times \$38 = \$76$.

$\therefore$ the job needs 2.34 L of paint, so Renee buys 2 tins, costing \$76.

Example 4 — unscaffolded

Priya uses about 10 GB of data each month and is choosing between two phone plans.

Plan	Monthly cost	Data included	Extra data
A	\$30	12 GB	not needed
B	\$20	6 GB	\$3 per GB over 6 GB

Made-up data: the two plans and their prices are made up for this section.

Which plan costs less for Priya in a month, and by how much?

Identify first: the purpose is to pick the cheaper plan for 10 GB of use, the mathematics is subtraction, multiplication, addition and a comparison, and a table is the right strategy because two options must be compared. Plan A costs \$30 for the month. Plan B covers only 6 GB, so Priya goes over by $10 - 6 = 4$ GB, which costs $4 \times \$3 = \$12$; Plan B therefore costs $\$20 + \$12 = \$32$ for the month. Comparing, $\$30 < \$32$, and the difference is $\$32 - \$30 = \$2$.

$\therefore$ Plan A costs less for Priya, by \$2 a month.

Practice questions

Scaffolded

Q1. Say which one operation each question needs: addition, subtraction, multiplication or division. (a) “How much change do I get from \$50?” (b) “Share \$240 equally between 6 clubs.” (c) “What does \$12.50 per hour for 8 hours come to?”

Q2. The Lunch Stop price list is shown below.

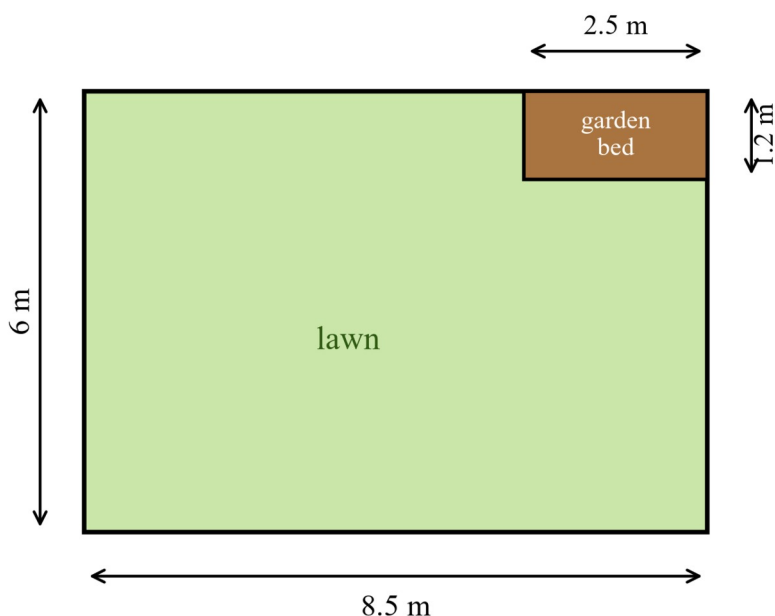
THE LUNCH STOP prices	
Sausage roll	\$4.20
Meat pie	\$5.50
Juice	\$3.10
Water	\$2.00
Doughnut	\$3.40
eat in or take away	

Made-up data: The Lunch Stop and every price on the sign are made up for this section.

- (a) Write two maths questions that this price list can answer.
- (b) Find the cost of 3 sausage rolls and 2 juices.
- (c) Mai buys 1 meat pie and 1 doughnut and pays with a \$20 note. How much change does she get?

Q3. A friend sends this message about movie night: “Tickets are \$16.50 each. Four of us are going. A large popcorn is \$8. The cinema is 3 km from the station. The session starts at 7:10 pm.” (a) State the purpose and the maths question, if you want the cost of the night. (b) Name the two facts in the message that you do not need. (c) Find the cost of four tickets and one large popcorn.

Q4. Dev’s backyard is a rectangle 8.5 m by 6 m with a rectangular garden bed 2.5 m by 1.2 m in one corner, as shown below. Turf is sold in rolls and one roll covers 5 m². Turf goes on the lawn only, not on the garden bed.



Made-up data: the backyard plan and every measurement on it are made up for this section.

- (a) What must you find first?
- (b) Name the operations you will use, in order.
- (c) How many whole rolls of turf must Dev buy?

Q5. Choose a strategy for each task from *draw a diagram*, *make a table* or *work backwards*, and say why it fits in one sentence. (a) A seat pattern: the front row has 8 seats and each row behind it has 2 more. How many seats are in row

10? (b) A driver wants the shortest way to visit four stops and come home. (c) Tom spent half his money, then \$15 more, and had \$20 left. How much did he start with?

Q6. The Lunch Stop pays \$24.50 per hour. The weekly roster is shown below.

Weekly roster — The Lunch Stop

Day	Start	Finish
Monday	07:00	13:00
Tuesday	07:00	13:00
Wednesday	11:00	17:00
Thursday	07:00	15:00
Friday	08:00	12:00

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

- Use the roster to find the hours worked on each day, and the total hours for the week.
- Find the pay for the week.
- Estimate the pay first (think 30 hours at \$25 per hour) and say whether your answer to
- is sensible.

Unscaffolded

Q7. The receipt below is from Grove Street Grocer.

GROVE STREET GROCER	
<i>cnr Grove and Elm streets</i>	

Milk 2 L	3.40
Bread	2.85
Eggs (12)	6.50
Cheese	7.25
Apples 1.5 kg @ 4.00	6.00

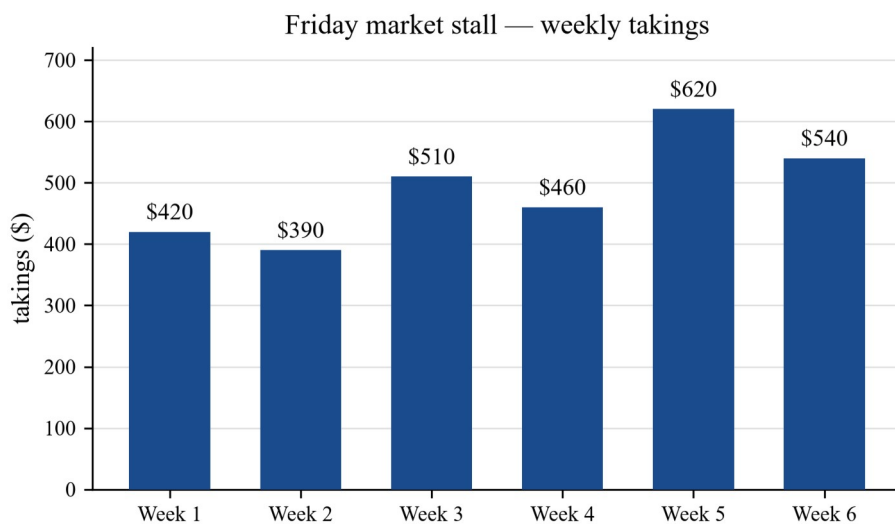
Paid (cash)	50.00
<i>Thanks for shopping with us!</i>	

Made-up data: Grove Street Grocer and every line on the receipt are made up for this section.

- Find the total of the five lines on the receipt.
- The shopper paid \$50 in cash. What change is due?
- Write one more maths question this receipt can answer, and name the operation(s) it needs.

Q8. Ana wants to work out how much paint she needs for the four walls of her bedroom. Name three pieces of information she must collect before she can start, and say in one sentence why each one matters.

Q9. The bar chart below shows six weeks of takings at a Friday market stall.



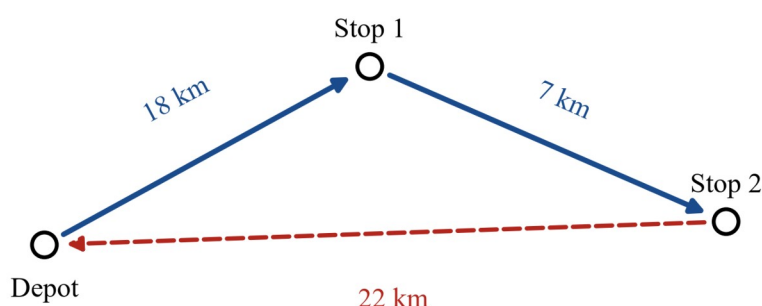
Made-up data: the stall and every takings figure in the chart are made up for this section.

- Which week took the most money, and how much was it?
- How much more did week 5 take than week 2?
- Find the mean takings per week over the six weeks.

Q10. A choir of 47 people is going on tour. Each bus holds 22 people, and buses are hired whole. (a) How many buses must be hired? (b) Explain why “2.14 buses” is not an answer. (c) How many empty seats are there on the buses used?

Q11. A picture frame is 45 cm by 30 cm. Ribbon is glued around the edge of the frame. Ribbon is sold in 2 m strips. (a) Find the perimeter of one frame, in cm. (b) Write this perimeter in m. (c) How many whole 2 m strips are needed for 3 frames?

Q12. A delivery driver follows the run shown on the map below. The van uses 8 L of fuel per 100 km, and fuel costs \$1.89 per litre.



delivery run (not to scale)

Made-up data: the route and its distances are made up for this section.

- Find the total distance of the run.
- How many litres of fuel does the run use? Give your answer to 2 decimal places.
- Find the fuel cost for the run, correct to the nearest cent.

Q13. A recipe for 6 people uses 400 g of flour, 3 eggs and 250 mL of milk. The cafe needs the same recipe for 15 people. (a) Name the mathematical process this task uses. (b) Find the scale factor. (c) Find the flour, the eggs (as whole eggs) and the milk needed for 15 people.

Q14. Kai's shift starts at 9:30 pm and finishes at 6:15 am the next morning. He takes a 30-minute unpaid break. (a) How many hours is Kai paid for? (b) Kai is paid \$28.40 per hour. Find the pay for this shift, correct to the nearest cent. (c) Estimate the pay first and say whether your answer to (b) is sensible.

Q15. Jo must check whether 3 tins of paint are enough for a wall 5 m long and 2 m high. The tin says one tin covers 8 m², and the job needs 2 coats. Jo's plan says: "3 tins times 4 L each is 12 L. That should be enough." Name three things missing from Jo's plan.

Q16. A jacket is marked \$120. A sale takes 25% off the marked price. At the register, an extra 10% comes off the sale price. (a) Find the price after the 25% discount. (b) Find the final price after the extra 10%. (c) Explain in one sentence why the final price is not 35% off \$120 (that is, not \$78).

Q17. Milk is sold as a 6 L pack for \$9.30 and as a 2 L pack for \$3.50. (a) Find the price per litre of each pack. (b) Which pack is cheaper per litre? (c) Find the cost of 12 L bought at the cheaper price per litre.

Q18. An old fridge uses 1.6 kWh of electricity each day. A new fridge uses 0.9 kWh each day. Electricity costs \$0.34 per kWh. (a) How many kWh are saved each day with the new fridge? (b) How many kWh are saved over 30 days? (c) Find the money saved over the 30 days.

Answers

Q1. (a) subtraction. (b) division. (c) multiplication. **Q2.** (a) any two, e.g. “What does a meat pie and a juice cost together?” and “How much change from \$10 after 2 doughnuts?” (b) \$18.80. (c) \$11.10. **Q3.** (a) purpose: the cost of the night out; question: what do 4 tickets and 1 popcorn cost altogether? (b) the cinema being 3 km from the station, and the 7:10 pm start. (c) \$74.00. **Q4.** (a) the area of the lawn (whole backyard minus garden bed). (b) multiply, subtract, divide, round up. (c) 10 rolls. **Q5.** (a) make a table — the rows grow by the same 2 each time. (b) draw a diagram — the routes are easy to compare as a picture. (c) work backwards — the end is known, not the start. **Q6.** (a) Mon 6 h, Tue 6 h, Wed 6 h, Thu 8 h, Fri 4 h; total 30 h. (b) \$735.00. (c) $30 \times \$25 = \$750$; \$735.00 is close to the estimate, so it is sensible. **Q7.** (a) \$26.00. (b) \$24.00. (c) any one, e.g. “What did the apples cost per kg?” — division ($\$6.00 \div 1.5$). **Q8.** any three of: the length and height of each wall (to find the area to paint); the areas of doors and windows (they are not painted, so they come off); the coverage rate on the tin (it turns area into litres); the number of coats (two coats doubles the area). **Q9.** (a) week 5, \$620. (b) \$230. (c) \$490. **Q10.** (a) 3 buses. (b) buses are sold whole; 2 buses would leave 3 people with no seat. (c) 19 empty seats. **Q11.** (a) 150 cm. (b) 1.5 m. (c) 3 strips. **Q12.** (a) 47 km. (b) 3.76 L. (c) \$7.11. **Q13.** (a) ratio and proportion (scaling every amount by the same factor). (b) 2.5. (c) 1 000 g of flour, 8 eggs, 625 mL of milk. **Q14.** (a) 8.25 h (8 h 15 min). (b) \$234.30. (c) about $8 \times \$28 = \$224$; \$234.30 is close, so it is sensible. **Q15.** any three of: the wall area ($5 \times 2 = 10 \text{ m}^2$); the 2-coats step (20 m^2 to cover); the coverage rate ($20 \div 8 = 2.5$ tins); the round-up and compare step (2.5 tins needed rounds up to 3, which matches the 3 tins on hand). **Q16.** (a) \$90.00. (b) \$81.00. (c) the extra 10% is taken off \$90 (giving \$9 off), not off \$120 (which would give \$12 off). **Q17.** (a) \$1.55 and \$1.75. (b) the 6 L pack. (c) \$18.60. **Q18.** (a) 0.7 kWh. (b) 21 kWh. (c) \$7.14.

Fully-worked solutions

Q1. (a) Change is money handed over minus the cost, so **subtraction**. (b) Sharing equally means one division, so **division**. (c) A rate of \$12.50 per hour for 8 hours is 12.50×8 , so **multiplication**.

Q2. (a) Any two questions the sign can answer, for example: “What does a meat pie and a juice cost together?” (addition) and “How much change from \$10 after 2 doughnuts?” (multiplication then subtraction). (b) Sausage rolls: $3 \times \$4.20 = \$12.60$. Juices: $2 \times \$3.10 = \$6.20$. Total: $\$12.60 + \$6.20 = \$18.80$. (c) Pie and doughnut: $\$5.50 + \$3.40 = \$8.90$. Change: $\$20.00 - \$8.90 = \$11.10$.

Q3. (a) Purpose: work out what the night out costs. Question: what do 4 tickets and 1 large popcorn cost altogether? (b) The cinema being 3 km from the station, and the 7:10 pm start time. Neither changes the cost. (c) Tickets: $4 \times \$16.50 = \$66.00$. With the popcorn: $\$66.00 + \$8.00 = \$74.00$.

Q4. (a) The area of the lawn — the whole backyard minus the garden bed — because turf goes on the lawn only. (b) Multiply (twice, for the two areas), subtract (bed from yard), divide (by 5 m^2 per roll), then round up to whole rolls. (c) Yard: $8.5 \times 6 = 51 \text{ m}^2$. Bed: $2.5 \times 1.2 = 3 \text{ m}^2$. Lawn: $51 - 3 = 48 \text{ m}^2$. Rolls: $48 \div 5 = 9.6$, so Dev buys **10 whole rolls** (round up).

Q5. (a) **Make a table** — each row adds the same 2 seats, so a table of rows 1, 2, 3, ... reaches row 10 quickly. (Looking for a pattern works for the same reason.) (b) **Draw a diagram** — a sketch of the four stops and the roads between them makes the possible routes easy to see and compare. (c) **Work backwards** — the end (\$20 left) is known and the start is not, so undo the steps: add the \$15 back, then double.

Q6. (a) Monday, 07:00 to 13:00, is 6 h; Tuesday is 6 h; Wednesday, 11:00 to 17:00, is 6 h; Thursday, 07:00 to 15:00, is 8 h; Friday, 08:00 to 12:00, is 4 h. Total: $6 + 6 + 6 + 8 + 4 = 30 \text{ h}$. (b) $30 \times \$24.50 = \$735.00$. (c) Estimate: $30 \times \$25 = \$750$. The exact \$735.00 is close to \$750, so it is sensible.

Q7. (a) $\$3.40 + \$2.85 = \$6.25$; $+\$6.50 = \$12.75$; $+\$7.25 = \$20.00$; $+\$6.00 = \$26.00$. (b) $\$50.00 - \$26.00 = \$24.00$. (c) Any question the receipt supports, for example: “What did the apples cost per kg?” This needs division: $\$6.00 \div 1.5 = \$4.00$ per kg, which matches the printed rate.

Q8. Any three of these, each with its reason: the length and height of each wall, because walls are rectangles and their areas come from length times height; the areas of the doors and windows, because they are not painted and must be taken off the total; the coverage rate on the tin (m^2 per litre), because it turns the area to be painted into litres of paint; the number of coats, because two coats double the area the paint must cover.

Q9. (a) The tallest bar is week 5, at \$620. (b) $\$620 - \$390 = \$230$. (c) Total:
 $420 + 390 + 510 + 460 + 620 + 540 = \$2940$. Mean: $\$2940 \div 6 = \$490$ per week.

Q10. (a) $47 \div 22 = 2.136\dots$, and people cannot be left behind, so round up: **3 buses**. (b) Buses are hired whole. Two buses seat only 44 people and 3 would have no seat, and “0.14 of a bus” is not a thing anyone can hire. (c) Seats on 3 buses: $3 \times 22 = 66$. Empty seats: $66 - 47 = 19$.

Q11. (a) Perimeter $= 2 \times (45 + 30) = 150$ cm. (b) $150 \text{ cm} = 1.5 \text{ m}$ (divide by 100). (c) Three frames: $3 \times 1.5 = 4.5$ m of ribbon. Strips: $4.5 \div 2 = 2.25$, so **3 whole strips** (round up).

Q12. (a) $18 + 7 + 22 = 47$ km. (b) Fuel: $47 \times 8 \div 100 = 3.76$ L (to 2 decimal places, 3.76 L). (c) Cost: $3.76 \times \$1.89 = \$7.1064$, which is **\$7.11** correct to the nearest cent. Estimate check: about 50 km uses about 4 L, near $4 \times \$1.89 = \$7.56$ — close to \$7.11, so sensible.

Q13. (a) Ratio and proportion — every amount is scaled up by the same factor. (b) Scale factor $= 15 \div 6 = 2.5$. (c) Flour: $400 \times 2.5 = 1000$ g. Eggs: $3 \times 2.5 = 7.5$, and eggs are whole, so use **8 eggs**. Milk: $250 \times 2.5 = 625$ mL.

Q14. (a) From 9:30 pm to 6:15 am is 8 h 45 min, which is 8.75 h. Taking off the 30-minute (0.5 h) unpaid break: $8.75 - 0.5 = 8.25$ h paid (8 h 15 min). (b) $8.25 \times \$28.40 = \$234.30$, so the pay is **\$234.30** correct to the nearest cent. (c) Estimate: $8 \times \$28 = \$224$. The exact \$234.30 is close to \$224, so it is sensible.

Q15. Any three of these: the wall area, $5 \times 2 = 10 \text{ m}^2$; the 2-coats step, which doubles the area to cover to $2 \times 10 = 20 \text{ m}^2$; the coverage rate on the tin, which turns area into tins ($20 \div 8 = 2.5$ tins); and the round-up and compare step (2.5 tins rounds up to 3, which is then compared with the 3 tins Jo has). Jo’s plan also leans on the 4 L tin size, which says nothing about coverage.

Q16. (a) 25% of \$120 is \$30, so the sale price is $\$120 - \$30 = \$90.00$. (b) 10% of \$90 is \$9, so the final price is $\$90 - \$9 = \$81.00$. (c) Because the extra 10% is taken off the sale price of \$90 (which is \$9 off), not off the marked \$120 (which would be \$12 off) — the two discounts together take \$39 off, not \$42.

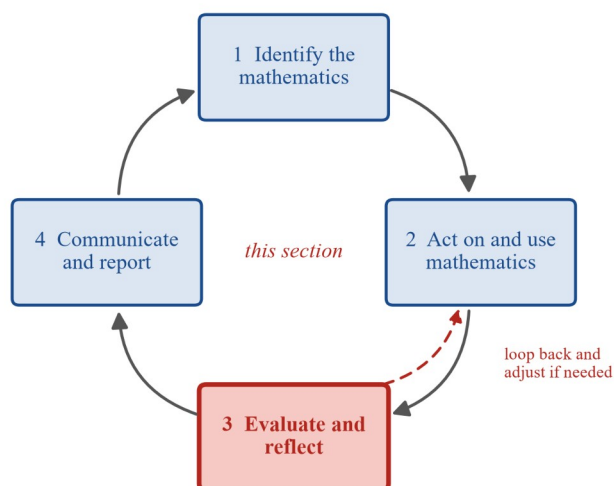
Q17. (a) 6 L pack: $\$9.30 \div 6 = \$1.55$ per litre. 2 L pack: $\$3.50 \div 2 = \$1.75$ per litre. (b) The 6 L pack, at \$1.55 per litre against \$1.75 per litre. (c) $12 \times \$1.55 = \$18.60$.

Q18. (a) $1.6 - 0.9 = 0.7$ kWh saved each day. (b) $0.7 \times 30 = 21$ kWh saved over 30 days. (c) $21 \times \$0.34 = \$7.14$ saved over the 30 days.

Chapter 1 The problem-solving cycle and mathematical toolkit — 1C Estimate, check and reflect: is the answer reasonable?

Theory

In §1A you met the four-stage problem-solving cycle: identify the mathematics, act on and use mathematics, evaluate and reflect, then communicate and report. This section is **stage 3 — evaluate and reflect**. It asks one simple but powerful question: **is my answer reasonable?**



Why check at all.

A wrong answer can cost real money or real time. You might order too much material, pay a wrong invoice, or leave people without a seat. Most wrong answers come from small slips: pressing a wrong key, putting the decimal point in the wrong place, or choosing the wrong operation. A short check catches these before they cause trouble. Good problem-solvers check every answer before they act on it.

Estimate first.

An **estimate** is a quick, rough calculation that gives an answer near the true one. Make it *before* the exact calculation. Then, when the exact answer arrives, you already know roughly what it should be.

Three handy ways to estimate:

- **Round to friendly numbers.** Swap each number for a nearby easy one: $12 \times \$3.85 \approx 12 \times \$4 = \$48$.
- **Use a benchmark.** A **benchmark** is a value you already know from everyday life. A loaf of bread costs about \$4. A city bus holds about 50 people. Most hourly wages sit between \$20 and \$40. Compare your answer with a benchmark like these.
- **Think about direction.** Ask whether the answer should be bigger or smaller than what you started with. A sale price goes *down*. More hours worked means more pay. If your answer moves the wrong way, stop and look again.

Six checks after you calculate.

Check	Question to ask
1 — against the estimate	Is the exact answer close to my estimate?
2 — size and units	Is it the right size, in the right units? (A door is about 2 m high, not 20 m.)
3 — direction	Did the answer move the way it should have?
4 — type of number	Does the type of number suit the situation? (You cannot

Check	Question to ask
5 — real-world knowledge	hire 2.95 buses. Money is counted in whole cents.) Would this be believable in real life? (A wage of \$240 an hour is not.)
6 — another way	Does it still work checked backwards, or by a different method? (If you multiplied, divide back.)

If an answer passes the checks, accept it. If a check fails, find the slip, **adjust** (fix the working and calculate again), then check again.

When a problem cannot be solved.

Sometimes the honest outcome is *this problem cannot be solved*. There are two common reasons:

- **Missing information.** A number you need was never given. Say exactly what is missing.
- **Impossible conditions.** The facts given cannot all be true at once. Say why.

“Cannot be solved, because ...” is a complete and correct answer. Explaining *why* a problem could not be solved is part of this stage of the cycle, not a failure to solve it.

Contextual judgement: what the number means in real life.

The pure maths answer is not always the answer you use. The study design names this step **contextual judgement** (Units 3 and 4, Outcome 2, the evaluate-and-reflect stage). When you make a decision about a solution, you may also need to think about things beyond the maths — for example, the effect on people, or the effect on money and costs.

Source: VCAA, VCE Vocational Major Numeracy Study Design, retrieved 2026-10-07.

In practice, contextual judgement usually means **rounding to fit the situation**:

- **Round up** when leaving people or jobs out is not an option. 2.95 buses becomes 3 buses. 17-and-a-bit weeks of saving becomes 18 weeks.
- **Round down** when only complete units count. 18.2 full boxes means 18 full boxes.
- **Round to the nearest** when a small over- or under-shoot does not matter, such as fabric cut to the nearest centimetre.

It also means thinking about **consequences**: the extra cost of a third bus, the people who would be left behind without it, or the money left over (or missing) in a budget.

The reasonableness checklist.

1. Estimate before you calculate.
2. Compare the exact answer with your estimate.
3. Check the size, the units and the direction.
4. Check the type of number suits the situation.
5. Check against what you know about real life.
6. Check a second way if you can.
7. If a check fails, find the slip, adjust, and check again.
8. If the problem truly cannot be solved, explain why.
9. Make the contextual judgement: round to fit the situation, and think about the consequences.

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

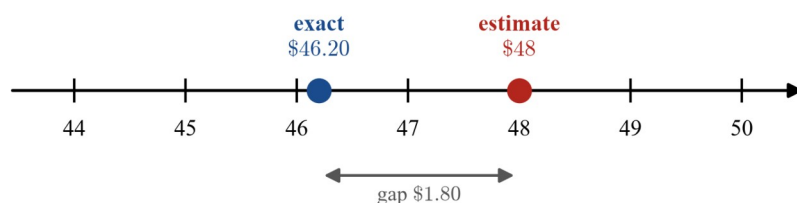
Worked examples

Example 1 — scaffolded

Tanesha buys 12 diaries at \$3.85 each. Estimate the cost, find the exact cost, and check that the exact cost is reasonable.

Working	Comment
Estimate: $\$3.85 \approx \$4$, so $12 \times \$4 = \$48$.	Round the price to a friendly number before calculating.
Exact: $12 \times \$3.85 = \$46.20$.	Now calculate carefully, by hand or calculator.
Check 1 — estimate: \$46.20 is close to the estimate of \$48. The gap is only \$1.80.	Same size, so no big slip.
Check 3 — direction: the price was rounded <i>up</i> , so the estimate should sit a little above the exact answer — and it does.	The direction check agrees too.
Conclusion: \$46.20 is reasonable. Tanesha should expect a total near \$46, not near \$460 or \$4.62.	Accept the answer and move on.

close to the estimate $\Rightarrow$ the exact answer passes the check



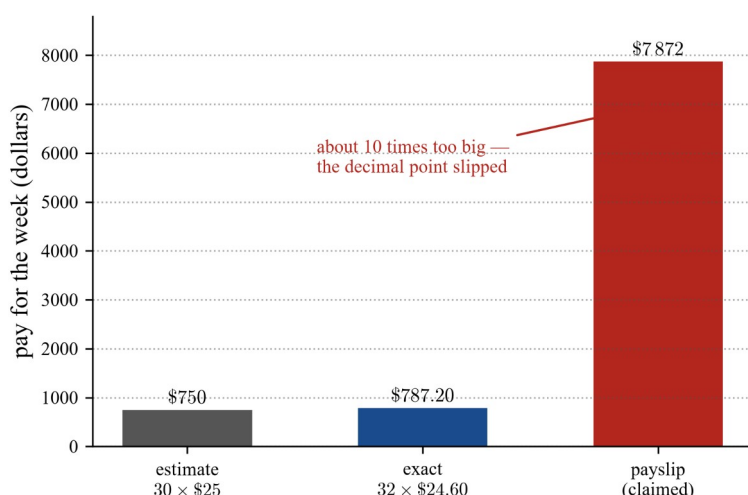
Example 2 — scaffolded

Ben worked 32 hours last week at \$24.60 an hour. His payslip shows \$7 872 for the week. Use estimation to check the payslip, find the exact pay, and explain the mistake.

Working	Comment
Understand: 32 hours at \$24.60 an hour; the payslip claims \$7 872.	Write down what is given and what looks wrong.
Estimate: $30 \times \$25 = \$750$, so the pay should be near \$750.	Friendly numbers first.
Check the claim: \$7 872 is about ten times \$750. The claim is nowhere near the estimate, so it fails check 1.	Compare the claim with the estimate.
Exact: $32 \times \$24.60 = \$787.20$.	Calculate exactly.
Find the slip: $\$7\,872 = 10 \times \$787.20$. If \$7 872 were right, Ben's hourly rate would be $\$7\,872 \div 32 = \$246$ — not believable. The decimal point has slipped one place.	A gap of exactly ten times nearly always means the decimal point slipped one place.

Adjust: report the slip; the correct pay for the week is \$787.20.

Fix it, then check once more.



Example 3 — unscaffolded

Riverview College is taking 118 people on an excursion. Each bus holds 40 people. How many buses must the college hire?

Dividing gives $118 \div 40 = 2.95$. But 2.95 buses cannot be hired — check 4 says the type of number must suit the situation. Test the whole numbers nearby: 2 buses hold $2 \times 40 = 80$ people, which leaves $118 - 80 = 38$ people with no seat. That is not an option, so 2 buses fail. 3 buses hold $3 \times 40 = 120$ people, which is enough for 118, with 2 spare seats. This is a contextual judgement: the maths says 2.95, the situation says round **up**, because the consequence of rounding down is 38 people left behind.

$$118 \div 40 = 2.95 \Rightarrow 3 \text{ buses are needed}$$



With only 2 buses: $2 \times 40 = 80$ seats — $118 - 80 = 38$ people left behind.

So the whole-number answer must be rounded UP: $2.95 \rightarrow 3$.

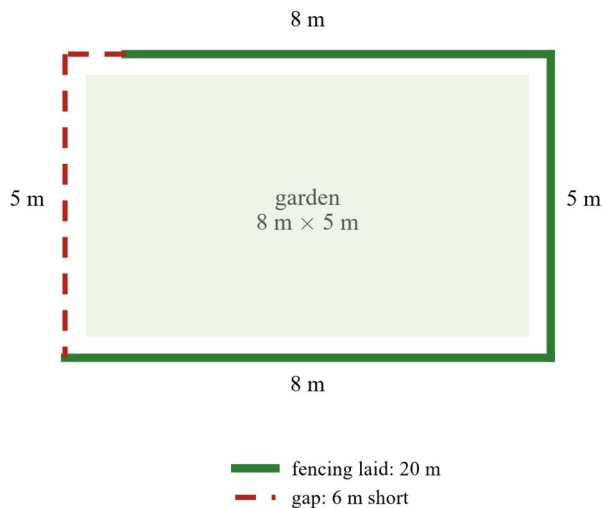
$\therefore$ the college must hire 3 buses.

Example 4 — unscaffolded

Mei has 20 m of leftover fencing. She wants to fence all four sides of a rectangular garden bed measuring 8 m by 5 m. Can she do it?

The fencing needed is the perimeter of the rectangle: $8 + 5 + 8 + 5 = 26$ m, that is $2 \times (8 + 5) = 26$ m. Check this against what Mei has: 26 m of fencing is needed but only 20 m exists, so she is 6 m short. Laying the fencing a different way will not help, because the perimeter is fixed by the chosen size. This is a problem that **cannot be solved** as stated, and the reason is the answer: the conditions are impossible. (Mei's options are to make the garden bed smaller or to buy 6 m more fencing.)

perimeter = $2(8 + 5) = 26$ m, but only 20 m of fencing



∴ the garden bed cannot be fenced with 20 m of fencing: the perimeter is 26 m, so the fencing is 6 m short.

Practice questions

Scaffolded

Q1. A café orders 9 cartons of milk at \$4.75 each. (a) Estimate the total cost by rounding \$4.75 to the nearest dollar. (b) Find the exact total cost. (c) Is your estimate above or below the exact cost? Explain how you could have predicted this without calculating.

Q2. A builder's invoice shows 25 bags of cement at \$13.40 per bag, with a total of \$3 350. (a) Estimate the total by rounding the bag price to the nearest dollar. (b) Find the exact total. (c) What mistake was most likely made on the invoice?

Q3. Choose the reasonable value in each case, and say what you compared it with. (a) The height of a classroom door: 2 m, 20 m or 200 m. (b) The water in a backyard swimming pool: 40 L, 4 000 L or 40 000 L. (c) The time to boil a full jug: 4 minutes, 40 minutes or 4 hours.

Q4. A party has 47 guests, and each table seats 6 people. (a) Estimate the number of tables by rounding 47 to 48. (b) Divide exactly: how many full tables of 6, and how many guests left over? (c) How many tables must be set up? Explain why the leftover guests matter.

Q5. Six friends share a bill of \$756 equally, so each pays \$126. (a) Estimate one share by rounding \$756 to \$750. (b) Check the exact share by working backwards with the opposite operation. (c) A friend claims each share is \$116. Use your estimate and your backwards check to explain why this is wrong.

Q6. A sports club buys 22 trophies at \$18.50 each, plus a one-off engraving fee of \$40. (a) Estimate the total cost by rounding \$18.50 to \$20 and 22 to 20. (b) Find the exact total cost. (c) The club has \$500 set aside. Is it enough? Use your estimate and your exact answer to justify, and state the change or shortfall.

Un scaffolded

Q7. A news item claims a part-time shop assistant earned \$4 800 for a 20-hour week. Use a benchmark hourly wage to decide whether this figure is reasonable. If it is not, suggest a likely correct figure and the mistake that could have caused the claim.

Q8. Dev wants to know how many litres of fuel his van used on a 240 km trip. He knows the distance and that fuel costs \$1.85 a litre at his station. Can he work out the litres used from these facts alone? Explain your answer, name the missing information, and show what the calculation would look like if the van used 12 L per 100 km.

Q9. A food bank packs 218 cans of soup into boxes that each hold 12 cans. How many full boxes are there, and how many cans are left over? Explain why you rounded down here instead of to the nearest whole number.

Q10. A jacket marked \$90 is in a sale. At the checkout, Trang is charged \$135 for it. Without working out any discount, explain how Trang knows immediately that the charge is wrong, and say how a sale price must compare with \$90.

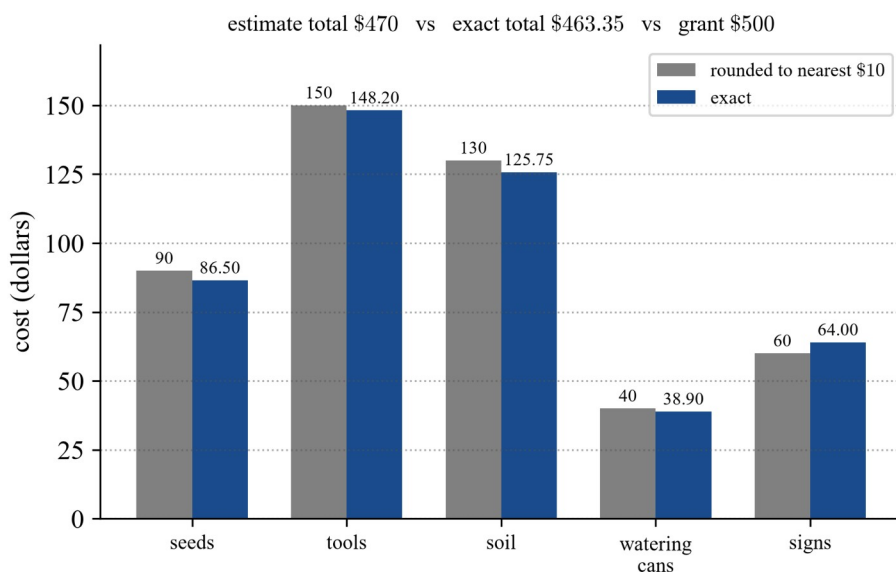
Q11. Priya's shopping trolley holds: bread \$3.90, milk \$2.85, eggs \$6.50, chicken \$12.40, vegetables \$7.60 and fruit \$5.25. Estimate the total by rounding each price to the nearest dollar, then find the exact total. How close was the estimate?

Q12. A community garden group has a \$500 grant to spend on the items below.

Item	Cost
Seeds	\$86.50
Tools	\$148.20
Potting soil	\$125.75
Watering cans	\$38.90
Signs	\$64.00

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

- Estimate the total by rounding each cost to the nearest \$10.
- Find the exact total.
- Does the grant cover the bill? State the amount left over or the shortfall, and say what the group could do with any money left over.



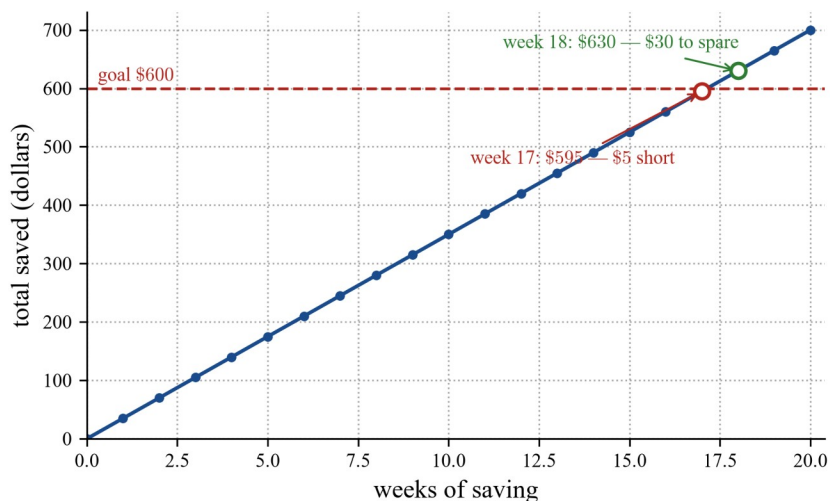
Q13. Two of these statements are reasonable and two are not. Identify each and explain your reasoning with a quick calculation or a benchmark. (i) "I walked the 5 km to school in 10 minutes." (ii) "A teaspoon holds about 5 mL." (iii) "My suitcase weighed 200 kg at the airport check-in." (iv) "The film ran for 2 hours."

Q14. A coach company invoices a school camp for 45 students at \$37.90 each, with a total of \$1 605.50. Check the invoice with an estimate, find the exact total, and describe the likely error. What should the school do?

Q15. In a competition game every goal scores 2 points. A team's final score is recorded as 45 points. Could this score be correct? Explain.

Q16. A family leaves home at 8:20 am and arrives at their destination at 11:05 am. (a) Estimate the travel time. (b) Find the exact travel time. (c) The family must now arrive by 11:00 am for a booking. If the trip takes the same time, is leaving at 8:20 am still all right? State the latest leaving time, to the nearest 5 minutes.

Q17. Jos saves \$35 of her wage every week towards a \$600 laptop. (a) Estimate how many weeks of saving she needs. (b) Find exactly how many weeks she must save, and explain the rounding you used. (c) State how much Jos has saved when she can finally buy the laptop, and the money left over after the purchase.



Q18. A caterer quotes a club \$466.50 for 9 sandwich trays at \$48.50 each plus a \$60 delivery fee. Check the quote with an estimate, find the exact total, and decide whether the quote is right. If it is wrong, identify a likely cause of the gap and state the correct quote.

Answers

Q1. (a) about \$45. (b) \$42.75. (c) above — the price was rounded up, so the estimate had to land above the exact cost.
Q2. (a) about \$325. (b) \$335.00. (c) a decimal-point slip: \$3 350 is 10 times the correct \$335.00. **Q3.** (a) 2 m. (b) 40 000 L. (c) 4 minutes. **Q4.** (a) about 8 tables. (b) 7 full tables, 5 guests left over. (c) 8 tables — 7 tables seat only 42 of the 47 guests. **Q5.** (a) about \$125. (b) $\$126 \times 6 = \$756$ ✓. (c) $\$116 \times 6 = \$696$, not \$756, and \$116 is far below the estimate of about \$125. **Q6.** (a) about \$440. (b) \$447.00. (c) yes — \$447.00 is under \$500; change \$53.00. **Q7.** Not reasonable: it implies \$240 an hour. About \$600 is typical for 20 hours; \$4 800 is about 8 times too big. A likely true figure is \$480 (\$24 an hour), with a zero wrongly added in the report. **Q8.** No — the van's fuel use (for example L per 100 km) or the litres put back in is missing. At 12 L per 100 km the trip uses 28.8 L. **Q9.** 18 full boxes, 2 cans left over; a box only counts as full with 12 cans, so the leftover cans cannot make a 19th full box. **Q10.** A sale price must be **less** than \$90; \$135 is \$45 *more* than \$90, so the charge has gone the wrong way. **Q11.** Estimate \$39; exact \$38.50; the estimate is out by only \$0.50. **Q12.** (a) about \$470. (b) \$463.35. (c) yes, with \$36.65 left over. **Q13.** Reasonable: (ii) and (iv). Not reasonable: (i) — 5 km in 10 minutes is 30 km/h, faster than any runner; (iii) — 200 kg is almost 9 times the usual 23 kg airline bag limit. **Q14.** The estimate (about \$1 800) shows \$1 605.50 is too low; exact total \$1 705.50; the invoice is \$100 short, as if the hundreds digit slipped. Query the invoice and pay \$1 705.50.
Q15. No — every total of 2-point goals is an even number, and 45 is odd. **Q16.** (a) about $2\frac{1}{2}$ to 3 hours. (b) 2 h 45 min. (c) no; leave by 8:15 am at the latest (5 minutes earlier). **Q17.** (a) about 17–18 weeks. (b) 18 weeks — 17 weeks gives \$595, \$5 short. (c) \$630 saved, so \$30 left over after buying the laptop. **Q18.** Estimate about \$510; exact total \$496.50; the quote is \$30 short — only \$30 of the \$60 delivery appears to have been added. The correct quote is \$496.50.

Fully-worked solutions

Q1. (a) Rounding \$4.75 up to \$5 gives $9 \times \$5 = \$45$. (b) Exact: $9 \times \$4.75 = \$42.75$. (c) The estimate is above the exact cost. This could be predicted: rounding the price *up* makes every carton cost more in the estimate, so the estimate must land above the exact total (by $9 \times \$0.25 = \$2.25$).
Q2. (a) Rounding \$13.40 down to \$13 gives $25 \times \$13 = \$325$. (b) Exact: $25 \times \$13.40 = \$335.00$. (c) The invoice total of \$3 350 is exactly 10 times \$335.00, and far above the estimate of about \$325. A gap of ten times means the decimal point slipped one place (or a zero was added). The correct total is \$335.00.
Q3. (a) 2 m — compare with your own height, a little over 1.5 m; a door is a bit taller than a person. 20 m would be a six-storey building. (b) 40 000 L — a pool about 8 m by 4 m and 1.25 m deep holds $8 \times 4 \times 1.25 = 40 \text{ m}^3$, and 1 m^3 is 1 000 L. 40 L is a large bucket; 4 000 L is a small plunge pool, not a swimming pool. (c) 4 minutes — a jug boils in a few minutes; 40 minutes or 4 hours would be an oven, not a jug.
Q4. (a) $48 \div 6 = 8$, so about 8 tables. (b) $47 \div 6 = 7$ remainder 5: seven full tables of 6, with 5 guests left over. (c) 8 tables. The 5 leftover guests still need seats, and 7 tables seat only $7 \times 6 = 42$ guests. So round up: 8 tables, with 1 spare seat. (Here the estimate in (a) already matched the answer.)
Q5. (a) $\$750 \div 6 = \$125$, so about \$125 each. (b) Backwards check: $\$126 \times 6 = \$756$ ✓, so \$126 per person is right. (c) If each paid \$116, the total collected would be $\$116 \times 6 = \$696$, which is not the \$756 bill. The estimate (about \$125) also shows \$116 is far too low. So the claim fails both the backwards check and the estimate.
Q6. (a) $20 \times \$20 = \$400$, plus the \$40 fee, gives about \$440. (b) Trophies: $22 \times \$18.50 = \$407.00$. Total: $\$407.00 + \$40 = \$447.00$. (c) Yes. The exact total \$447.00 is under \$500, and the estimate of about \$440 already suggested it would fit. Change: $\$500 - \$447.00 = \$53.00$.
Q7. A typical part-time wage is about \$30 an hour, so 20 hours should pay about $20 \times \$30 = \$600$. The claimed \$4 800 implies $\$4\,800 \div 20 = \$240$ an hour — about 8 times the benchmark, and not believable for a shop job (check 5). A likely correct figure is \$480 for the week (that is \$24 an hour), with a zero wrongly added in the report. So the figure is **not** reasonable.

Q8. No, he cannot. The distance and the fuel *price* do not say how much fuel was burnt: the missing information is the van's fuel use (for example litres per 100 km), or the litres (or dollars) put back in at the next fill-up. With that fact the calculation works; for example at 12 L per 100 km the trip uses $240 \div 100 \times 12 = 28.8$ L. Without it, the problem cannot be solved — and saying so, with the reason, is the correct outcome.

Q9. $218 \div 12 = 18$ remainder 2, so there are 18 full boxes and 2 cans left over. Round **down** because a “full box” needs all 12 cans: the 2 spare cans cannot fill a 19th box (19 full boxes would need $19 \times 12 = 228$ cans). This is the contextual judgement — the situation, not the nearest-number rule, decides the rounding.

Q10. A sale price must be **less** than the marked price, so the checkout total must be below \$90. The charge of \$135 is $\$135 - \$90 = \$45$ *above* the marked price — the wrong direction (check 3). Trang knows at once that the charge is wrong and should ask for it to be re-scanned.

Q11. Rounded to the nearest dollar: \$4, \$3, \$7, \$12, \$8 and \$5, which add to \$39. Exact: $\$3.90 + \$2.85 + \$6.50 + \$12.40 + \$7.60 + \$5.25 = \$38.50$. The estimate is out by only $\$39 - \$38.50 = \$0.50$ — a very good check.

Q12. (a) Rounded to the nearest \$10: \$90, \$150, \$130, \$40 and \$60, giving about \$470 (see figure 1c_budget.png). (b) Exact: $\$86.50 + \$148.20 + \$125.75 + \$38.90 + \$64.00 = \$463.35$. (c) Yes, the \$500 grant covers it: $\$500 - \$463.35 = \$36.65$ left over. The group could put the spare \$36.65 towards next season's seeds, or keep it as a buffer in case a price rises.

Q13. (i) Not reasonable: 5 km in 10 minutes means $6 \times 5 = 30$ km in $6 \times 10 = 60$ minutes, that is 30 km/h — faster than the world's best runners, not a walk to school. (ii) Reasonable: a teaspoon holds about 5 mL, a standard cooking measure. (iii) Not reasonable: airline checked bags are limited to about 23 kg, and 200 kg is almost 9 times that — heavier than two adult people. (iv) Reasonable: films commonly run about 2 hours.

Q14. Estimate: $45 \times \$40 = \$1800$, so the total should be a little *under* \$1 800. The invoiced \$1 605.50 is about \$200 below the estimate — check 1 fails. Exact: $45 \times \$37.90 = \$1705.50$. The invoice is exactly \$100 short of this, as if the hundreds digit slipped, turning 1 705.50 into 1 605.50. The school should query the invoice and pay the correct total of \$1 705.50.

Q15. No. Every goal adds 2 points, so any score is $2 + 2 + \dots + 2$, which is always an even number. 45 is odd, so no whole number of 2-point goals can give it. The recorded score cannot be correct — a counting or recording error has happened.

Q16. (a) 8:20 am to 11:05 am is a little under 3 hours; estimate about $2\frac{1}{2}$ to 3 hours. (b) Exact: 8:20 am to 11:20 am would be 3 h, and 11:05 am is 15 minutes before that, so the trip took 2 h 45 min (that is 165 minutes). (c) No. Leaving at 8:20 am arrives at 11:05 am, which is 5 minutes late for an 11:00 am booking. The latest leaving time is 8:15 am (5 minutes earlier), which arrives exactly at 11:00 am — earlier still is safer.

Q17. (a) A benchmark: 20 weeks of \$35 is \$700, which is more than \$600, so the answer is a little under 20 weeks — about 17 or 18 (see figure 1c_savings.png). (b) $\$600 \div \$35 = 17$ remainder 5: after 17 weeks Jos has $17 \times \$35 = \$595$, which is \$5 short of \$600. She must save one more week, so round **up** to 18 weeks — the consequence of stopping at 17 is not being able to buy the laptop. (c) After 18 weeks Jos has $18 \times \$35 = \$630$. Buying the \$600 laptop leaves $\$630 - \$600 = \$30$ over.

Q18. Estimate: $9 \times \$50 = \$450$, plus the \$60 delivery, gives about \$510; the quote should sit a little under \$510. The quoted \$466.50 is about \$45 below the estimate — check 1 fails. Exact: $9 \times \$48.50 = \$436.50$, and $\$436.50 + \$60 = \$496.50$. The quote is $\$496.50 - \$466.50 = \$30$ short; the gap is exactly half the delivery fee, as if only \$30 of the \$60 delivery was added. The club should ask for a corrected quote of \$496.50.

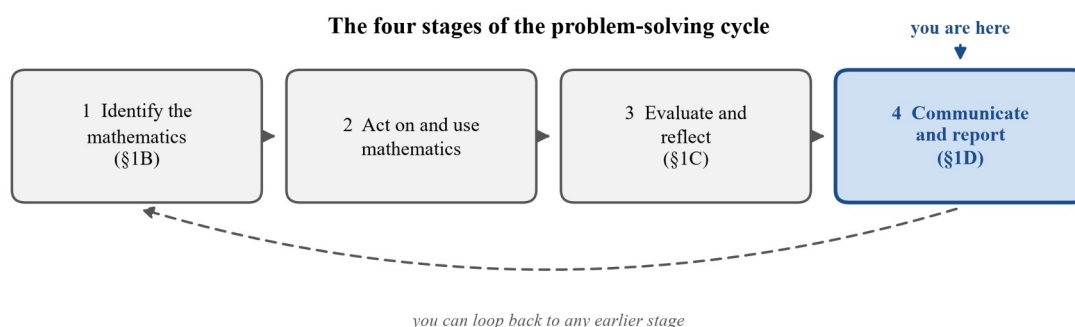
Chapter 1 The problem-solving cycle and mathematical toolkit — 1D Communicate and report results

About the data in this section. The pay rates, harvests, ticket sales, budgets and plans here are **made up** (not real): pretend businesses and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

Theory

Where this section sits.

Section 1A set out the four stages of the problem-solving cycle. Sections 1B and 1C took you through the first three: identifying the mathematics, acting on it, and checking whether the answer is reasonable. This section is the fourth stage — **communicate and report results**. A result that stays in your head, or on a calculator screen, is not finished: someone usually has to receive it, and understand it, without you standing next to them explaining.



Good problem-solvers also **loop back**: writing a report often shows up a gap (“wait — I never checked Tuesday”), and that sends you back to an earlier stage. That is normal, not a mistake.

Written and oral reports.

You will report results in two broad ways:

- **Written** — a short report, an email, a table on a page, a poster, a graph, a sign. The reader gets it later, so it must stand alone.
- **Oral** — a talk to your class or work team, a handover to a co-worker, a phone call to a customer. The listener hears it once, so it must be short and clearly ordered.

Each way can be **formal** or **informal**:

- **Formal written** uses full sentences, correct units, labelled tables and graphs — a report to a manager, a quote for a customer.
- **Informal written** is quick and short — a note to a co-worker (“tkts sold: 150, check the tin”), a reminder to yourself. Fine for its purpose; wrong for a customer.
- **Formal oral** is a planned talk: question, method, result, check, in that order.
- **Informal oral** is the two-sentence handover at the end of a shift.

The rule behind all four: **match the report to the audience**. The test is whether the person receiving it understands what you found and how sure you are of it, without asking.

Symbols and shorthand.

Mathematical shorthand is part of reporting: it says a lot in a small space, and every reader of your report needs to read it the same way you wrote it.

Symbol	Name	Reads as	Example
=	equals	“is equal to”	$3.5 \times 4 = 14$

Symbol	Name	Reads as	Example
$\approx$	approximately equal to	“is about equal to”	$\frac{22}{7} \approx 3.14$ (to 2 d.p.)
$\times$ and $\div$	times, divided by	“multiplied by”, “shared between”	$150 \div 4 = 37.5$
%	per cent	“out of 100”	rent is 45 % of income
$\therefore$	therefore (from §1A)	“so the result is”	$\therefore$ each person pays \$45.49

Two cautions. Use $\approx$ (not $=$) whenever a number has been rounded, and say how it was rounded. And end a piece of working with a $\therefore$ line: it tells the reader “this next sentence is the answer”.

Units and number conventions.

Conventions are the agreed habits that keep reports readable. The ones used in this book:

- **A space between the number and the unit:** 35 km, 7.5 m, 22.3 kg — never “35km”.
- **Money** keeps the dollar sign tight to the number: \$45.49, with cents as decimals.
- **Thousands** are grouped with a space: a 2 400 L tank, an income of \$1 525.
- **Round only at the end.** Carry the full calculator value through the working, and round once, in the result sentence.
- **Say how you rounded:** “to the nearest cent”, “to 1 decimal place”, “to the nearest whole number”. A rounded number with no stated precision is a number the reader cannot trust.

The result sentence.

A calculator display is not a report. The display 45.488333 answers no question, carries no units and hides its rounding. The result sentence does all three jobs at once:

✗ 45.488333 a calculator display is not a report — no units, no rounding, no words

✓ $\therefore$ Each person pays \$45.49, correct to the nearest cent.

Every result sentence passes this four-part check:

- | | |
|---|--------------------------------|
| ✓ it answers the question that was asked | ✓ it has units (here, dollars) |
| ✓ it is a full sentence — it stands alone | ✓ it states the rounding used |

Every result sentence in this book passes a four-part check:

1. it **answers the question that was asked**;
2. it **has units** (dollars, kg, m, hours, days);
3. it is a **full sentence** — it stands alone;
4. it **states the rounding used**, or says the value is exact.

Working someone can read.

Reports usually show some working, so a reader can follow — and check — what you did. Readable working has one step per line, keeps the units, and labels what each line is for. Compare:

$272.93/6=45.488333 \quad \times 6=272.94 \quad \text{ok}$

with:

bill total: $\$216.45 + \$56.48 = \$272.93$

share: $\$272.93 \div 6 = \$45.4883\dots$

$\therefore$ each person pays \$45.49, to the nearest cent.

The second version can be checked by anyone, months later, without you in the room.

Tables, diagrams and graphs.

A representation is any way of setting out results — table, diagram, graph, plan. The same numbers can communicate well or badly depending on how they are presented:

✗ **hard to read**

1	2	3	4
22	18	25	20

no title · no headings · no units

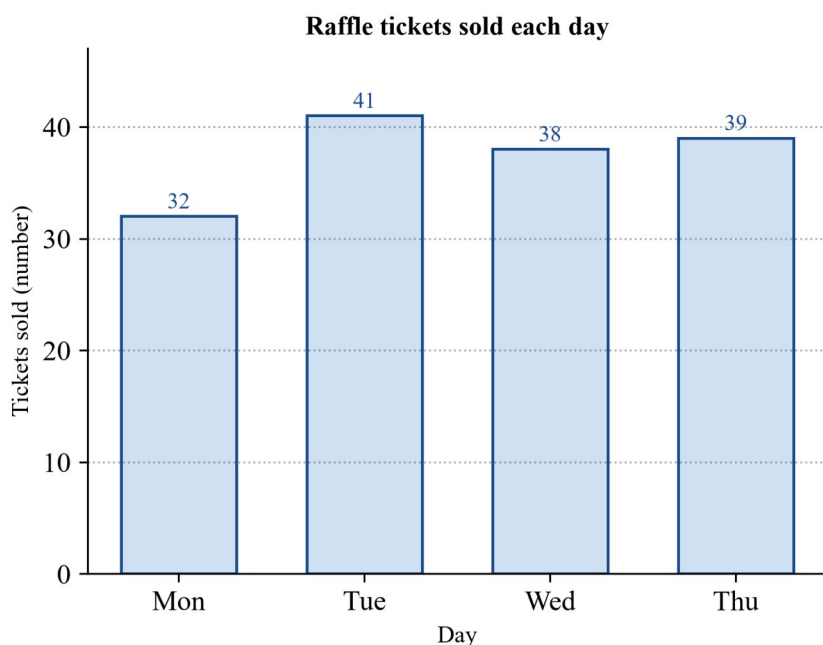
✓ **easy to read**

Deliveries completed each day

Day	Deliveries (number)
Monday	22
Tuesday	18
Wednesday	25
Thursday	20

title · column headings · units

The two tables hold exactly the same numbers. Only one of them tells you what the numbers are. A graph has the same rule — title, labelled axes with units, and values or a key:



Choosing the right representation depends on what you are reporting:

- **Table** — exact values the reader may reuse (a price list, a roster, readings).
- **Line graph** — a change over time (a harvest, a savings balance, a temperature).
- **Bar chart** — a comparison between categories (days, candidates, products).
- **Pie chart** — shares of one whole (a budget, a survey).
- **Diagram or plan** — sizes and layout (a room, a hall, a site).

Drawing these graphs step by step is practised in later chapters; here the skill is **using** them to report, and reading what they say.

Formats and devices.

The **format** is the shape of the report (sentence, table, graph, poster, slides). The **device** is what carries it (paper, whiteboard, spreadsheet or app — see §1F, phone, your voice). Match both to the audience:

Who you report to	A good format	A good device
manager or boss	short written report with a table	email or printed page
work team or class	poster or slides with one graph	whiteboard or projector
customer or client	one plain sentence with a rounded number	speech, phone call or sign
yourself	notes with a check line	notebook or phone notes

A short written report.

Six parts cover almost every written report you will need at work or in life: **Question** (one line), **Method** (what you did and why), **Working** (one step per line), **Result** (the $\therefore$ sentence with units and rounding), **Check** (your reasonableness check from §1C), **Conclusion** (what it means in the real situation).

Short report — Saturday deliveries

Question. How much is Nik's delivery pay for Saturday's 6 deliveries?

Method. Pay is \$18.50 per delivery, plus a \$25 weekend bonus. Multiply, then add.

Working. $6 \times \$18.50 = \$111.00$
 $\$111.00 + \$25 = \$136.00$

Result. $\therefore$ Nik's pay for Saturday is \$136.00 (exact — no rounding needed).

Check. $\$136.00 - \$25 = \$111.00$, and $6 \times \$18.50 = \$111.00$ ✓

Conclusion. Nik should be paid \$136.00 for Saturday's 6 deliveries.

Anyone can read this report and see what was asked, what was done, what the answer is, and why it can be trusted.

A short written report:

..... the task, in one line

..... what you did, and why

..... one step per line

..... the $\therefore$ line: answer + units + rounding

..... your reasonableness check (§1C)

..... what it means in the real situation

Reporting out loud.

An oral report follows the same shape, kept short:

1. Say the **question**, in one sentence.
2. Say the **method**, in one sentence.
3. Show **one** table or graph — and point at the parts you mention.
4. Say the **result sentence** slowly, with units and rounding.
5. Give the **check**, then invite questions.

Report the check too.

The check from §1C belongs inside the report, not just in your head — it is what makes your number believable. For example: 30 boxes sold at \$19.50 gives $30 \times \$19.50 = \$585.00$; your estimate was $30 \times \$20 = \$600$; the exact total sits \$15 below the estimate, which is close, so the answer is sensible. One line like that earns a reader's trust.

Worked examples

Example 1 — scaffolded

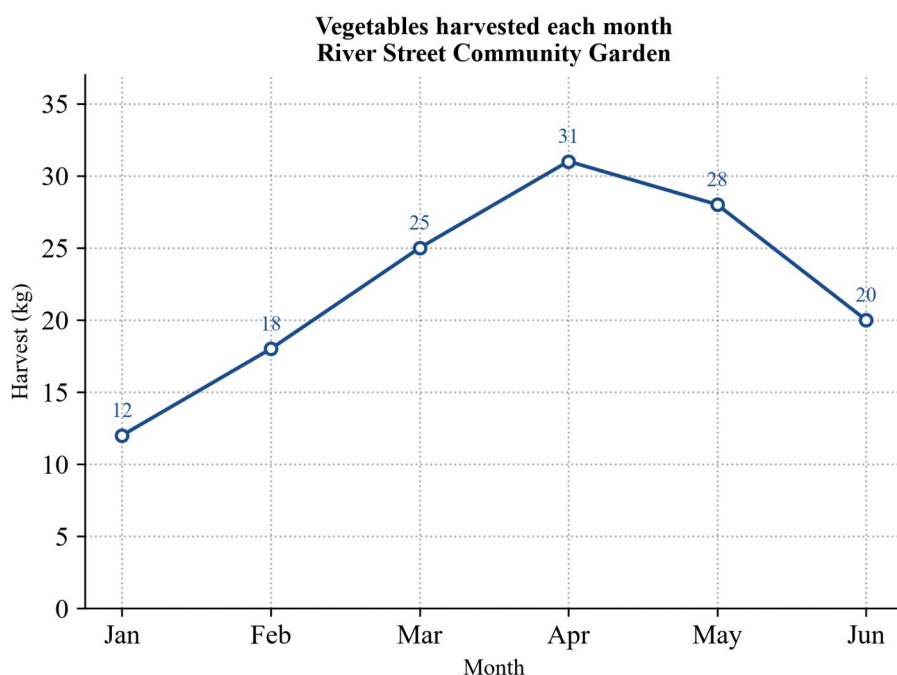
Six friends share a dinner bill equally. The food came to \$216.45 and the drinks to \$56.48. Report, **to the nearest cent**, what each person pays, and say what happens to the total when everyone rounds their share.

Working	Comment
bill total: $\$216.45 + \$56.48 = \$272.93$	Add the two parts of the bill first.
share: $\$272.93 \div 6 = \$45.4883\dots$	The exact share does not terminate — keep the full value for now.
$\therefore$ each person pays \$45.49, to the nearest cent.	Result sentence: units (dollars) and rounding (nearest cent) both stated.
check: $\$45.49 \times 6 = \$272.94$	Collecting the rounded share gives 1 cent more than the bill — each person rounded up.
if rounded down: $\$45.48 \times 6 = \$272.88$	Rounding down instead would leave the bill \$0.05 short — the reason the rounding must be stated.

Reporting the 1-cent overshoot is part of communicating: the friends can see exactly why the money collected is not exactly the bill.

Example 2 — scaffolded

The line graph shows the vegetables harvested each month at a community garden, from January to June.



- (a) Read off the biggest month and its harvest. (b) Find the total harvest over the six months. (c) Find the mean harvest per month, **to 1 decimal place**. (d) Write a two-sentence report of the results.

Working	Comment
(a) biggest month: April, 31 kg	Read straight off the labelled point.
(b) total: $12 + 18 + 25 + 31 + 28 + 20 = 134$ kg	Add the six labelled values.
(c) mean: $134 \div 6 = 22.333... \rightarrow 22.3$ kg, to 1 d.p.	The mean is the total divided by how many; round only at the end.
(d) “The garden produced 134 kg of vegetables over the six months to June. The mean harvest was 22.3 kg per month, to 1 decimal place, with April the strongest month at 31 kg.”	Two full sentences, units throughout, rounding stated — and it answers what was asked.

Example 3 — unscaffolded

A crate of 30 oranges costs \$46.00. Hana’s café needs 120 oranges for the week. Report what Hana should budget, and explain why multiplying 120 by a rounded price per orange is a trap.

Work with crates, not with a rounded per-orange price. Hana needs $120 \div 30 = 4$ crates, and $4 \times \$46.00 = \$184.00$. That value is exact, so no rounding is needed at all.

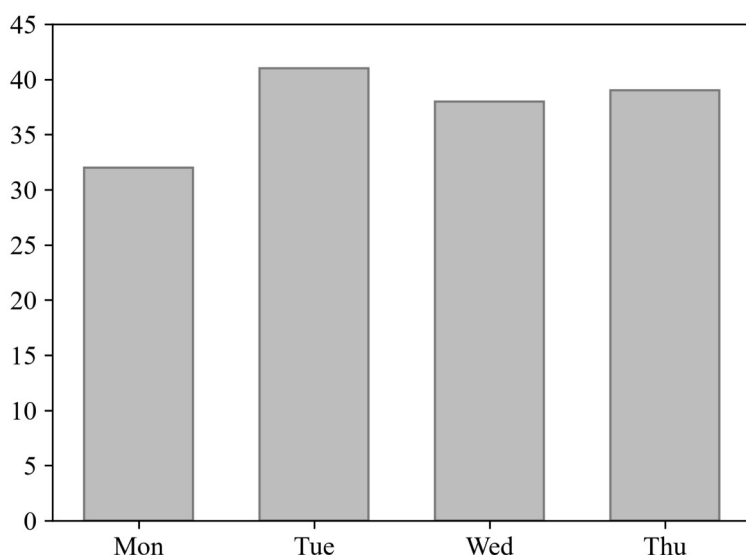
The trap: the price per orange is $\$46.00 \div 30 = \$1.5333...$, which rounds to \$1.53 to the nearest cent. Multiplying the rounded price by 120 gives $120 \times \$1.53 = \$183.60$ — \$0.40 **short** of what Hana actually pays, because the tiny rounding was multiplied 120 times. This is why working keeps full precision and only the result sentence rounds.

Check: $\$184.00 \div 120 = \$1.5333... \approx \$1.53$ per orange to the nearest cent, which matches the crate price. ✓

∴ Hana should budget \$184.00 for 120 oranges (exact — no rounding needed); using a rounded per-orange price would have under-budgeted by \$0.40.

Example 4 — unscaffolded

Marco’s team ran a four-day raffle. His poster for the team meeting shows only this graph:



Marco says “the graph has the numbers, so the poster is finished”. Critique the poster as a piece of communication, and report what the results actually say. (The corrected graph is the bar chart in the Theory notes above.)

As communication, the poster fails in three ways. It has **no title**, so a reader cannot say what is being counted; the **axes carry no labels or units**, so “40” could be tickets, dollars or boxes; and there is **no result sentence**, so the reader must work out the point of the graph unaided. A reader at the back of the room learns nothing.

The fixes are the conventions from Theory: a title (“Raffle tickets sold each day”), axis labels with units (Day; Tickets sold (number)), and value labels or a key — exactly the corrected bar chart shown earlier.

With the graph readable, the results can be reported: total tickets $32 + 41 + 38 + 39 = 150$, and the mean per day is $150 \div 4 = 37.5$ tickets (exact — one decimal place, no rounding needed).

∴ the poster needs a title, labelled axes with units and a result sentence; with them it reports 150 tickets sold over the four days, a mean of 37.5 per day.

Practice questions

Scaffolded

Q1. (a) Match each symbol to its name: $\therefore$, $\%$, $\approx$, $=$ — names: *per cent*, *therefore*, *equals*, *approximately equal to*. (b) Write these sentences in mathematical symbols: (i) “five point two times three is equal to fifteen point six”; (ii) “twenty-two sevenths is approximately three point one four, to 2 decimal places”.

Q2. Jordan’s pay for four shifts was \$96.50, \$104.20, \$88.75 and \$110.05. (a) Find the total pay for the four shifts. (b) Find the mean pay per shift, **to the nearest cent**. (c) Write part (b) as a result sentence.

Q3. Each of these calculator displays needs to become a result sentence. Write one for each, stating the rounding you use. (a) 45.488333 — dollars per person, six people sharing a \$272.93 bill equally. (b) 22.333333 — kg per month, the mean of six monthly harvests. (c) 12.307692 — days a water tank lasts.

Q4. A water bill lists usage of 38, 41, 52 and 44 kL for quarters 1, 2, 3 and 4 of one year. (a) Name the representation you would use to report the change across the year, and say why. (b) Find the total water used in the year. (c) State the highest quarter and its usage. (d) Write one sentence reporting the total and the highest quarter.

Q5. Match each audience to the better report: (a) your manager, who must approve next week’s roster; (b) your class, at the end of a group task; (c) a customer asking the price of one item. Choices: *a poster with one bar chart*; *a short written report with a table*; *one plain sentence with a rounded dollar amount*.

Q6. Rewrite each line using the house conventions (space before units, tight dollar sign, stated rounding, space in thousands). (a) 35km (b) \$ 45.49 (c) 8.333333 metres, the value of $25 \div 3$, reported to **1 decimal place** (d) \$1525

Un scaffolded

Q7. A fuel receipt shows 42.7 L at \$1.949 per litre. (a) Calculate the cost and report it **to the nearest cent**. (b) Write the result sentence the receipt is really making. (c) Explain why the receipt does not print \$83.2223.

Q8. A pay slip uses the formula $W = 24h$, where W is the week’s pay in dollars and h is the hours worked. (a) Say in words what the 24 means. (b) Find W when $h = 35$, and write it as a result sentence. (c) Explain why the report writes \$840.00 rather than just “840”.

Q9. Match each situation to the best representation: *table*, *line graph*, *bar chart*, *pie chart*. (a) the share of a monthly budget going to rent, food, savings, transport and phone (b) a savings balance recorded at the end of each week for eight weeks (c) the exact price of each of twelve items on a menu (d) the number of votes for each of five candidates

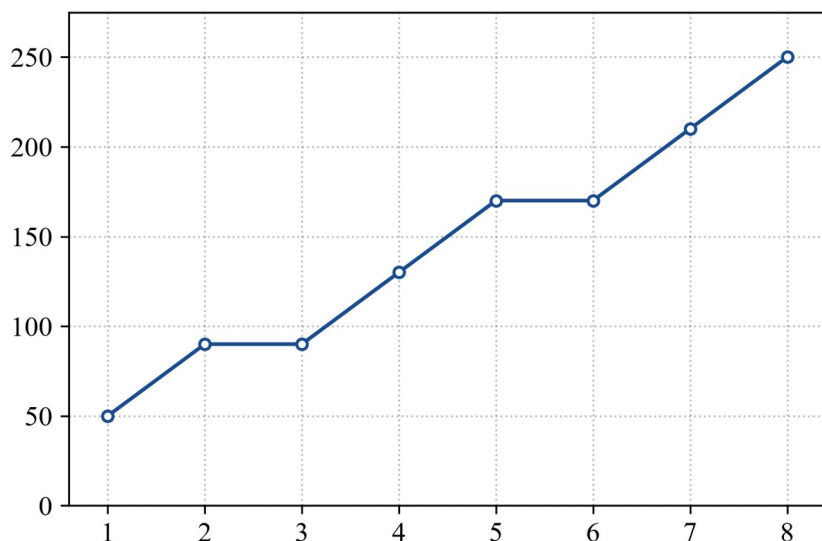
Q10. A supervisor's note shows only this table of hours worked:

1	2	3	4
12.5	16	14.5	18

Made-up data: the week labels and every number in this table are made up for this section.

- (a) Redraw it as a table a stranger could read (title, column headings, units).
- (b) Find the total hours over the four weeks.
- (c) Find the mean hours per week, **to 1 decimal place**.

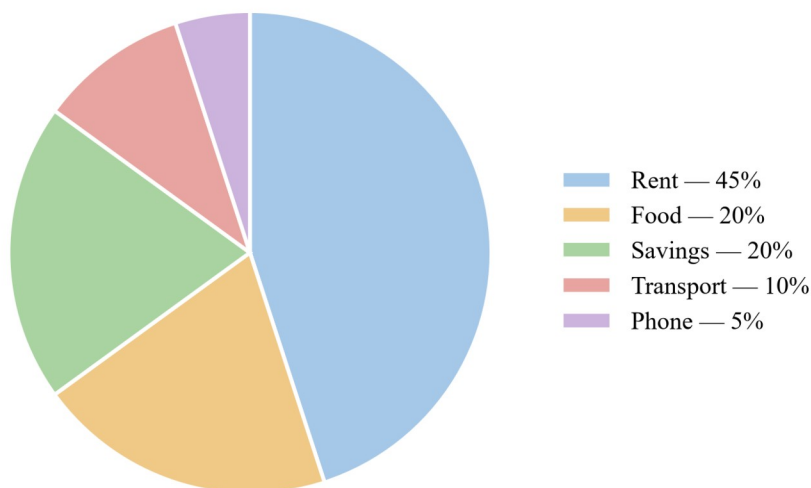
Q11. This line graph shows a savings balance at the end of each week.



- (a) Name two things missing from the graph that a reader needs.
- (b) Read off the balance at the end of week 5.
- (c) Between which pairs of weeks did the balance not change?
- (d) Find the increase in the balance from week 1 to week 8.

Q12. The pie chart shows where a monthly income goes, as per cent of income.

Where the monthly income goes (per cent of income)



The monthly income is \$1 525. (a) Show that the five percentages add to 100 %. (b) Calculate the rent in dollars, **to the nearest dollar**. (c) Calculate the amount put into savings each month. (d) Write one sentence reporting the largest share of the budget.

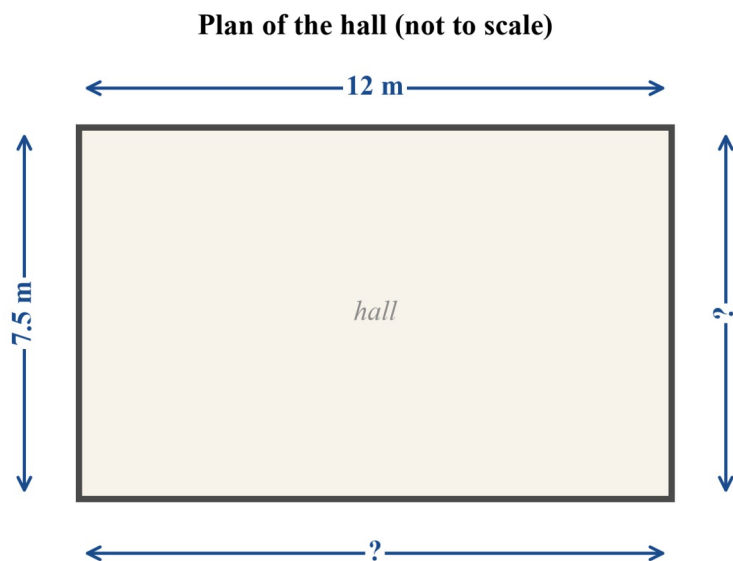
Q13. These six sentences are an oral report in the wrong order. Rewrite them in the order a good oral report uses.

- A. “So the car wash earned \$ 64.90 towards the grade trip — enough for the bus deposit.”
- B. “We subtracted the costs from the money taken: \$ 113.50 – \$ 48.60.”
- C. “Our question was: how much profit did Saturday’s car wash make?”
- D. “The profit is \$ 64.90.”
- E. “We counted the money taken at the end of the day and kept every receipt for costs.”
- F. “Check: \$ 64.90 + \$ 48.60 = \$ 113.50, which is the money we took. ✓”

Q14. A water tank holds 2 400 L. A household uses 195 L per day. (a) Show that $2\,400 \div 195 = 12.307692\dots$ days. (b) Report the number of **whole** days the tank will last, to the nearest whole day. (c) Explain why the answer is not 13 days.

Q15. (a) Match each audience to a format: *a whiteboard sketch for the team during a job*; *a printed quote for a customer*; *a slide with one graph for a meeting*. Audiences: a meeting of the whole work group; a customer comparing prices; co-workers mid-job. (b) Name two devices you could use to give an oral report with a graph. (c) Explain why a pie chart is the wrong choice for reporting a savings balance over eight weeks. (d) A sign reads 2 6L. Rewrite it using the house convention.

Q16. A committee is planning bunting around the edges of a rectangular hall. The plan shows two of the four side lengths.



- (a) State the two missing side lengths, and say how you know them.
- (b) Find the total distance around the hall.
- (c) Write the result sentence for the committee's minutes.

Q17. The canteen orders 24 rolls at \$ 1.75 each and 24 drinks at \$ 1.45 each, and pays with a \$ 100 note. Write a four-line report — Working, Result, Check, Conclusion — giving the total cost and the change.

Q18. An excursion costs \$ 18.60 per student and 45 students are going. (a) Calculate the exact total cost. (b) Before calculating, a teacher estimated $45 \times \$ 20 = \$ 900$. Is the exact total above or below the estimate, and by how much? (c) Write a result sentence that includes the check against the estimate.

Answers

Q1. (a) $\therefore$ therefore; % per cent; $\approx$ approximately equal to; = equals. (b) (i) $5.2 \times 3 = 15.6$. (ii) $\frac{22}{7} \approx 3.14$ (to 2 d.p.).

Q2. (a) \$399.50. (b) \$99.88, to the nearest cent. (c) e.g. “Jordan’s mean pay per shift over the four shifts is \$99.88, to the nearest cent.”

Q3. (a) $\therefore$ each person pays \$45.49, to the nearest cent. (b) $\therefore$ the mean harvest is 22.3 kg per month, to 1 decimal place. (c) $\therefore$ the tank lasts 12 days, to the nearest whole day.

Q4. (a) a line graph — it shows change over time (a table of the four values is also acceptable). (b) 175 kL. (c) quarter 3, 52 kL. (d) e.g. “The household used 175 kL in the year, with the highest quarter 52 kL in quarter 3.”

Q5. (a) short written report with a table. (b) poster with one bar chart. (c) one plain sentence with a rounded dollar amount.

Q6. (a) 35 km. (b) \$45.49. (c) 8.3 m, to 1 d.p. (d) \$1525.

Q7. (a) \$83.22, to the nearest cent. (b) e.g. “The fuel cost \$83.22, to the nearest cent.” (c) money is paid to the cent, so the receipt rounds to 2 decimal places.

Q8. (a) the pay rate: \$24 per hour. (b) \$840.00 (exact). (c) money is written with two decimal places so the cents place is visible.

Q9. (a) pie chart. (b) line graph. (c) table. (d) bar chart.

Q10. (a) e.g. title “Hours worked each week”; headings “Week” and “Hours worked (hours)”; values 12.5, 16, 14.5, 18. (b) 61 hours. (c) 15.3 hours, to 1 decimal place.

Q11. (a) any two of: no title; no axis labels; no units. (b) \$170. (c) weeks 2–3 and weeks 5–6. (d) \$200.

Q12. (a) $45 + 20 + 20 + 10 + 5 = 100$. (b) \$686, to the nearest dollar. (c) \$305.00 (exact). (d) e.g. “Rent is the largest share of the budget, about \$686 of the \$1525 monthly income, to the nearest dollar.”

Q13. C, E, B, D, F, A.

Q14. (a) $2400 \div 195 = 12.307692\dots$ (b) 12 days, to the nearest whole day. (c) 13 days would need $195 \times 13 = 2535$ L, more than the 2400 L the tank holds.

Q15. (a) meeting of the whole work group — slide with one graph; customer comparing prices — printed quote; co-workers mid-job — whiteboard sketch. (b) any two of: whiteboard, projector or screen, poster, spreadsheet on a laptop. (c) a pie chart shows shares of one whole, not a change over time. (d) 26 L.

Q16. (a) 12 m and 7.5 m — opposite sides of a rectangle are equal. (b) 39 m. (c) e.g. “The distance around the hall is 39 m, so 39 m of bunting is needed.”

Q17. Working: $24 \times \$1.75 = \$42.00$; $24 \times \$1.45 = \$34.80$; total \$76.80. Result: the change from \$100 is \$23.20. Check: $\$76.80 + \$23.20 = \$100.00$ ✓. Conclusion: the canteen order costs \$76.80 and the \$100 note covers it with \$23.20 change.

Q18. (a) \$837.00 (exact). (b) below the estimate, by \$63.00. (c) e.g. “The excursion costs \$837.00 in total; the estimate was \$900, and the exact total is \$63.00 under it, so the answer is sensible.”

Fully-worked solutions

Q1. (a) $\therefore$ means *therefore*, % means *per cent*, $\approx$ means *approximately equal to*, = means *equals*. (b) (i) $5.2 \times 3 = 15.6$. (ii) $\frac{22}{7} \approx 3.14$, with the precision stated: to 2 decimal places. ($\approx$, not =, because $\frac{22}{7}$ is not exactly 3.14.)

Q2. (a) $\$96.50 + \$104.20 + \$88.75 + \$110.05 = \$399.50$. (b) The mean is the total divided by how many: $\$399.50 \div 4 = \$99.875$, which rounds to \$99.88 to the nearest cent. (c) A result sentence needs units, a full sentence and the rounding: “Jordan’s mean pay per shift over the four shifts is \$99.88, to the nearest cent.”

Q3. (a) Money is paid to the cent: $\$45.488333 \rightarrow \$45.49$, so “ $\therefore$ each person pays \$45.49, to the nearest cent.” (b) The harvest is measured in kg and 1 d.p. is plenty: “ $\therefore$ the mean harvest is 22.3 kg per month, to 1 decimal place.” (c) Days are counted in whole days here: “ $\therefore$ the tank lasts 12 days, to the nearest whole day.”

Q4. (a) A **line graph** suits a change over time; the four points joined show the rise into quarter 3 and the fall after. (A table is acceptable if the reader needs the exact values.) (b) $38 + 41 + 52 + 44 = 175$ kL. (c) Quarter 3, at 52 kL. (d) e.g. “The household used 175 kL of water in the year, with the highest quarter 52 kL in quarter 3.” Units and both results in one standing sentence.

Q5. (a) A manager approving a roster needs exact values to reuse — a **short written report with a table**. (b) A class at the end of a task sees it once, from a distance — a **poster with one bar chart**. (c) A customer asking one price needs no table at all — **one plain sentence with a rounded dollar amount**.

Q6. (a) 35 km — space between number and unit. (b) \$45.49 — dollar sign tight to the number. (c) 8.3 m, to 1 d.p. — rounded once, precision stated, unit spaced. (d) \$1525 — space as the thousands separator.

Q7. (a) $42.7 \times \$1.949 = \$83.2223$, which reports as \$83.22 to the nearest cent. (b) e.g. “The fuel cost \$83.22, to the nearest cent.” (c) No one can pay a fraction of a cent: money changes hands to 2 decimal places, so the receipt rounds the exact product once, at the end.

Q8. (a) The 24 is the hourly rate: each hour worked pays \$24. (b) $W = 24 \times 35 = 840$, so the result sentence is “The week’s pay is \$840.00” (exact — no rounding needed). (c) Writing \$840.00 shows the cents place is zero, so a reader sees the amount is exact to the cent rather than roughly eight hundred and forty.

Q9. (a) Shares of one whole (the income) — **pie chart**. (b) A balance changing over time — **line graph**. (c) Exact values a reader may reuse — **table**. (d) Comparing categories — **bar chart**.

Q10. (a) e.g.

Week	Hours worked (hours)
1	12.5
2	16
3	14.5
4	18

with a title above it: “Hours worked each week”. Title, headings and units are what turn four bare numbers into a report. (b) $12.5 + 16 + 14.5 + 18 = 61$ hours. (c) $61 \div 4 = 15.25$, which rounds to 15.3 hours to 1 decimal place.

Q11. (a) The graph has **no title** and **no axis labels or units** — a reader cannot say what is counted (dollars? number of weeks?) or over what period. (b) The point above week 5 is at \$170. (c) The line is flat between weeks 2 and 3, and again between weeks 5 and 6 — the balance did not change in those two pairs of weeks. (d) $\$250 - \$50 = \$200$.

Q12. (a) $45 + 20 + 20 + 10 + 5 = 100$, so the five shares use up the whole income. ✓ (b) Rent is 45 %:
 $0.45 \times \$1\,525 = \$686.25$, which rounds to \$686 to the nearest dollar. (c) Savings is 20 %:
 $0.20 \times \$1\,525 = \$305.00$ — exact, no rounding needed. (d) e.g. “Rent is the largest share of the budget, about \$686 of the \$1525 monthly income, to the nearest dollar.”

Q13. A good oral report runs question → method → working → result → check → conclusion: **C** (the question), **E** (the method), **B** (the working), **D** (the result sentence), **F** (the check), **A** (the conclusion — what the money means for the trip).

Q14. (a) $2\,400 \div 195 = 12.307692\dots$ (the division does not terminate). (b) To the nearest whole day this is 12 days. (c) A thirteenth full day would need $195 \times 13 = 2\,535$ L, and the tank holds only 2 400 L; after 12 days ($195 \times 12 = 2\,340$ L) only 60 L remains — not a full day’s water. So the tank lasts 12 whole days.

Q15. (a) Meeting of the whole work group — a slide with one graph; customer comparing prices — a printed quote; co-workers mid-job — a whiteboard sketch. (b) Any two of: whiteboard, projector or screen, poster, a spreadsheet or slides on a laptop (§1F). (c) A pie chart shows how one whole is shared at one moment; a savings balance over eight weeks is a **change over time**, which a line graph shows and a pie chart cannot. (d) 26 L — space between the number and the unit.

Q16. (a) Opposite sides of a rectangle are equal, so the missing sides are 12 m (the side opposite the 12 m side) and 7.5 m (opposite the 7.5 m side). (b) Distance around: $12 + 7.5 + 12 + 7.5 = 39$ m. (c) e.g. “The distance around the hall is 39 m, so the committee should buy 39 m of bunting.” Exact — no rounding needed.

Q17. Working: $24 \times \$1.75 = \$42.00$ for the rolls; $24 \times \$1.45 = \$34.80$ for the drinks; total
 $\$42.00 + \$34.80 = \$76.80$. Result: the change from a \$100 note is $\$100 - \$76.80 = \$23.20$. Check:
 $\$76.80 + \$23.20 = \$100.00$ ✓ — the total and the change return the note. Conclusion: the canteen order costs \$76.80, and the \$100 note covers it with \$23.20 change.

Q18. (a) $45 \times \$18.60 = \$837.00$ — exact, no rounding needed. (b) The exact total is **below** the estimate: $\$900 - \$837.00 = \$63.00$ below it, because \$20 overstates the \$18.60 price. (c) e.g. “The excursion costs \$837.00 in total; my estimate was \$900, and the exact total sits \$63.00 under the estimate, so the answer is sensible.”

Chapter 1 The problem-solving cycle and mathematical toolkit — 1E The analogue toolkit: measuring and everyday tools

Theory

Your mathematical toolkit is the set of tools you reach for when a job needs measuring, calculating or checking. Some of those tools are digital — calculators, spreadsheets and phone apps (section 1F). This section is about the other half of the toolkit: the **analogue** tools, the ones you hold in your hands and read with your eyes.

An **analogue tool** shows a quantity as a **position**: a needle on a dial, a liquid level in a jug, a hand on a clock face, or a mark lined up with a scale. You read the position against the numbers marked on the tool. A **digital tool** instead shows digits on a screen. Analogue tools are everywhere — in kitchens, workshops, clinics, warehouses and on building sites — so reading them confidently is a core toolkit skill.

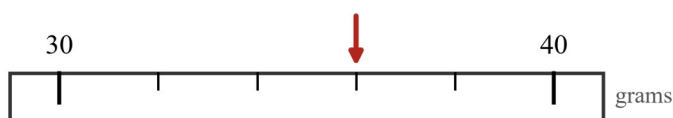
About the tools and readings in this section. Every tool reading, person, job and workplace in this section is **made up** (not real). They are built for this book so you can practise reading tools and using the numbers. Nothing here is real data about a real person, business or place.

Familiar and unfamiliar tools.

A **familiar** tool is one you have used before, such as a school ruler or a kitchen jug. An **unfamiliar** tool is new to you — the dial on a machine at a new job, say, or a hanging scale at a market. The good news is that reading any scale uses the same four steps below, so the skill you build on a ruler works just as well on a tool you have never seen.

How to read any scale.

1. Find what the tool measures, and its unit (g, kg, mL, °C, cm, minutes).
2. Find two labelled marks, and count the small spaces between them.
3. Divide: value of one small space = (gap between the labels) ÷ (number of spaces).
4. Count spaces from a labelled mark to the needle, level or end mark, and add them on.



The scale above is marked in grams. Between the labels 30 and 40 there are five small spaces, so one small space is $(40 - 30) \div 5 = 2$ grams. The needle sits three spaces past 30, so the reading is $30 + 3 \times 2 = 36$ grams.

The everyday analogue tools.

What is measured	Usual units	Common analogue tools
Length and distance	mm, cm, m	ruler, tape measure, trundle wheel
Time	hours and minutes	analogue clock, wind-up timer
Mass	g, kg	kitchen scale, bathroom scale, spring balance, platform scale
Volume and capacity	mL, L	measuring jug, measuring cup
Temperature	°C	thermometer

Length: rulers and tape measures.

A school ruler is marked in centimetres, with a small mark every millimetre — ten small spaces in each centimetre, so one small space is 1 mm. Read a length to the nearest millimetre. A tape measure does the same job over longer distances: keep the tape straight and pulled tight, and read where the object ends. If the zero end of a tape is worn, or

cannot reach the start of the job, hold a clear mark (say the 10 cm or 50 cm mark) at the start instead. The length is then the **difference** of the two readings: length = end reading – start reading.

Time: analogue clocks.

An analogue clock has a short **hour hand** and a long **minute hand**. Each number on the face stands for 5 minutes, so a minute hand pointing at 8 means $8 \times 5 = 40$ minutes. The hour hand moves too: at 5:40 it sits well past the 5, close to the 6, yet the hour is still 5 — reading the hour as 6 is a common mistake. A 12-hour clock face also shows every time twice a day, so it cannot tell 7 am from 7 pm on its own (24-hour time is section 4D). To find how long something took, read the clock at the start and at the end, then count on.

Mass, volume and temperature.

A dial scale (kitchen, bathroom or platform) shows mass with a needle: read it with the four steps, standing directly in front of the dial so you are not looking at the needle from an angle. A measuring jug shows volume as a liquid level: stand the jug on a flat bench, bring your eyes down to the level of the liquid, and read the mark at the surface. A thermometer shows temperature as a liquid column (or a needle on a dial) against a scale in °C. Below zero the numbers count downwards, so a column ending two marks below 0 reads -2°C .

Tools of the trade.

Every trade keeps its own measuring tools — its **tools of trade**. A carpenter’s van holds tape measures and a **spirit level**: a small tube of liquid with a bubble in it, fixed on a straight frame. When the bubble sits between the two centre lines, the surface is level. A groundskeeper measures long distances with a **trundle wheel**, a wheel on a handle that clicks once per metre and carries a counter. A fish market weighs bags with a **spring balance**, a hanging scale whose spring stretches and moves a pointer down a scale. You do not need to have met a tool before to read it — the four steps work on all of them.

Trade or job	Analogue tool	What it measures
Carpenter or builder	tape measure, spirit level	lengths; whether a surface is level
Cook or baker	kitchen scale, measuring jug, oven thermometer	mass, volume, temperature
Groundskeeper	trundle wheel	long distances
Nurse	thermometer, height tape, bathroom scale	temperature, height, mass

Choosing the right tool.

Two questions choose the tool. First, does it measure the **quantity** you need — a scale measures mass, not volume, so it cannot measure 250 mL of milk. Second, are its marks **fine enough** — a bathroom scale marked every 1 kg cannot weigh a 300 g letter, and a 30 cm ruler cannot measure a hallway. Make a quick estimate first (section 1C), then measure; if the reading is very different from your estimate, read the tool again before trusting it.

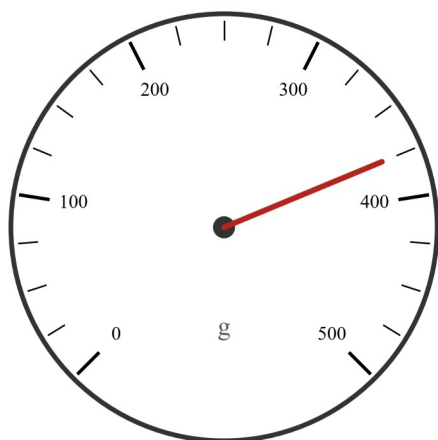
Where formulas fit in.

Tools give you numbers; formulas turn those numbers into results. A tape measure gives the length and width of a bench top, and the formula $\text{area} = \text{length} \times \text{width}$ turns them into an area. You are not expected to carry every formula in your head: the formulas used in this book, with the meaning of every letter, are listed on the formula sheet at the back. The toolkit skill is knowing **where** a formula lives, what each letter stands for, and substituting your own measurements into it. Whatever the tool, write each reading with its unit and with how finely it was read — “86.5 cm, to the nearest millimetre” — so you can always tell how finely each number was read.

Worked examples

Example 1 — scaffolded

A kitchen scale is marked from 0 to 500 g, with a label every 100 g and four small spaces between labels. Read the mass of flour on the scale below.



Working

The labels 300 and 400 have four small spaces between them.

One small space = $(400 - 300) \div 4 = 25$ g.

The needle is three spaces past 300: $300 + 3 \times 25 = 375$ g.

The scale shows 375 g of flour.

Comment

Step 2: count the spaces between two labels.

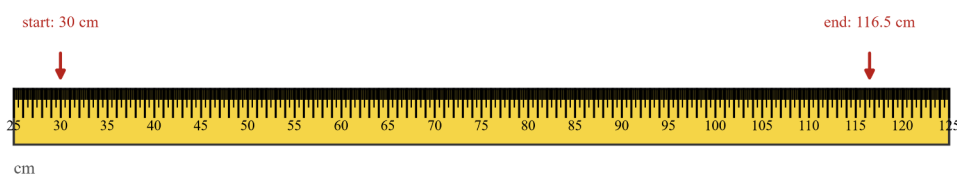
Step 3: divide the gap between labels by the number of spaces.

Step 4: count on from a labelled mark.

Always record the unit with the number.

Example 2 — scaffolded

A carpenter measures a window frame for a new screen. The zero end of her tape is damaged, so she holds the 30 cm mark at one end of the frame; the other end lines up with 116.5 cm on the tape, as shown below. Find the length of the frame.



Working

Start reading = 30 cm; end reading = 116.5 cm.

Length = $116.5 - 30 = 86.5$ cm.

The frame is 86.5 cm long, to the nearest millimetre.

Comment

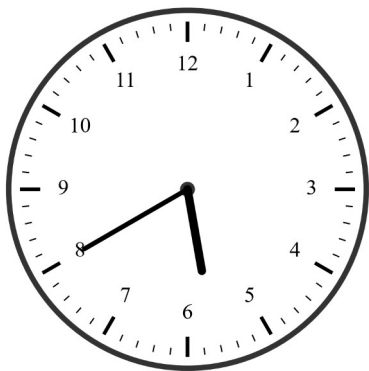
Read **both** marks, not just the end.

Only the tape between the two marks lies along the frame, so subtract the start.

The end was read to the nearest millimetre, so the answer carries the same fineness.

Example 3 — unscaffolded

The clock on the wall of Mia's workplace shows the time below when she finishes her shift. Her train leaves at 6:15 pm. How many minutes does she have to reach the station?



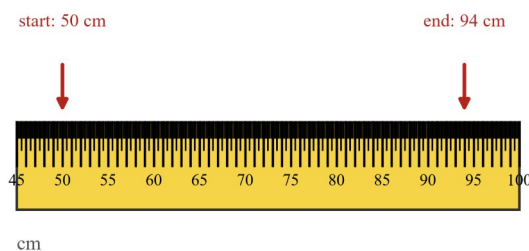
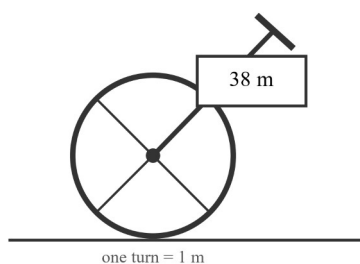
The minute hand points at 8, which means $8 \times 5 = 40$ minutes, and the hour hand sits between 5 and 6 — so the clock shows 5:40 pm, not 6:40. From 5:40 to 6:00 is 20 minutes, and from 6:00 to 6:15 is a further 15 minutes, so the time left is

$$20 + 15 = 35 \text{ minutes.}$$

$\therefore$ Mia has 35 minutes to reach the station.

Example 4 — unscaffolded

A council worker measures a footpath before it is repaired. Her trundle wheel clicks once per metre, and its counter reads 38 m where the wheel stops. She measures the last short piece with a tape, from the 50 cm mark to the 94 cm mark, as shown below. Find the total length of the footpath in metres, and to the nearest metre.



The tape piece is the difference of its two readings:

$$94 - 50 = 44 \text{ cm} = 0.44 \text{ m.}$$

Adding this to the wheel's count gives

$$38 + 0.44 = 38.44 \text{ m,}$$

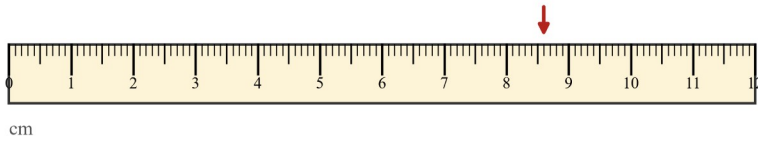
and 38.44 m rounded to the nearest metre is 38 m.

$\therefore$ the footpath is 38.44 m long, or 38 m to the nearest metre.

Practice questions

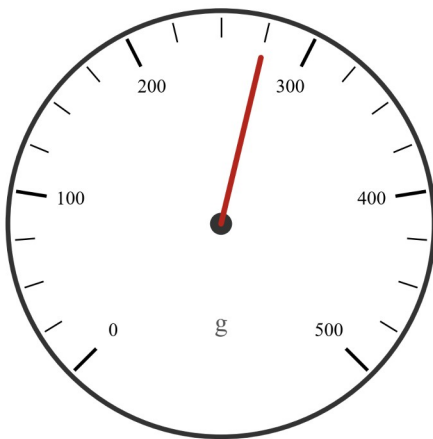
Scaffolded

Q1. The ruler below shows the length of a pencil; the arrow marks the pencil's end.



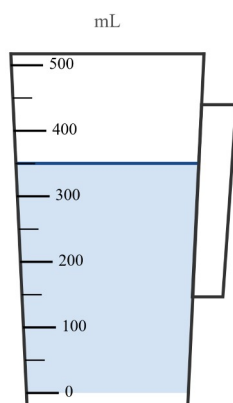
- (a) What is the value of the smallest mark on the ruler?
- (b) Read the length of the pencil to the nearest millimetre.
- (c) Write the same length in centimetres.

Q2. The kitchen scale below is marked like the one in Example 1: a label every 100 g, with four small spaces between labels.



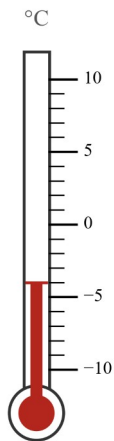
- (a) What is the value of one small space?
- (b) Read the mass shown on the scale.
- (c) A recipe needs twice this mass of flour. How many grams is that?

Q3. The measuring jug below holds the milk for a smoothie.



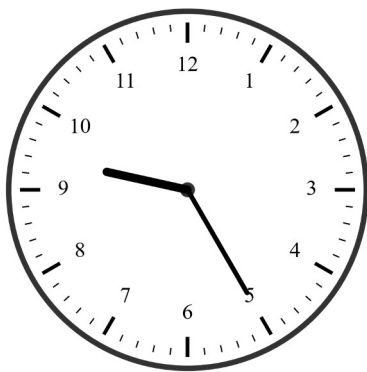
- (a) What is the value of one small mark on the jug?
- (b) Read the volume of milk shown.
- (c) The smoothie needs 500 mL in total. How much more milk must be added?

Q4. The thermometer below shows the outside temperature on a frosty morning.



- (a) What quantity does the thermometer measure, and in what unit?
- (b) What is the value of one small mark?
- (c) Read the temperature shown.

Q5. The clock below shows the time Priya arrives at her bus stop.

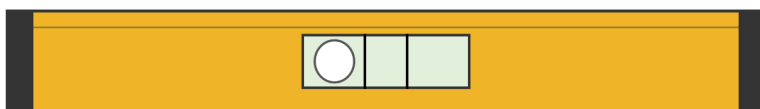


- (a) Write down the time shown.
- (b) Explain why a minute hand pointing at 5 means 25 minutes.
- (c) Her bus arrives at 9:40. How many minutes does she wait?

Q6. A tabletop is longer than the good part of a tape measure, so a worker holds the 50 cm mark at one end of the table; the other end reads 137 cm. (a) Explain why starting at the 50 cm mark can still give a correct length. (b) Find the length of the tabletop in centimetres. (c) Write this length in metres, to 2 decimal places.

Unscaffolded

Q7. A shelf-fitter rests a spirit level on a new shelf; the bubble in its tube looks like the one below.



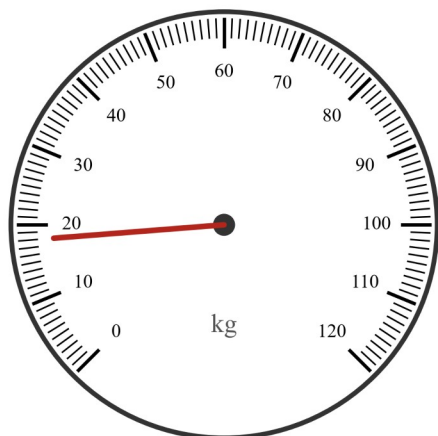
- (a) Is the shelf level?
- (b) Which end of the shelf is higher — the left or the right?
- (c) What must the fitter do before fixing the shelf in place?

Q8. A groundskeeper checks a cricket pitch with a trundle wheel that clicks once per metre. The counter shows 20 turns, and the last piece measures 12 cm on his tape. (a) Find the total length of the pitch in metres. (b) A cricket pitch should be 20.12 m long. Does his measurement match?

Q9. Ben starts painting a fence at 11:15 am and stops when the clock shows 2:45 pm. How long did he paint, in hours and minutes?

Q10. Choose the better analogue tool for each job, and say why. (a) Measuring a 4.5 m hallway: a 30 cm ruler or a 5 m tape measure. (b) Measuring 250 mL of milk for a recipe: a bathroom scale or a measuring jug. (c) Checking that a picture frame hangs straight: a trundle wheel or a spirit level.

Q11. A platform scale used for sending parcels is marked from 0 to 120 kg, with a label every 10 kg and a small mark every 1 kg.



(a) Read the mass of the parcel on the scale.

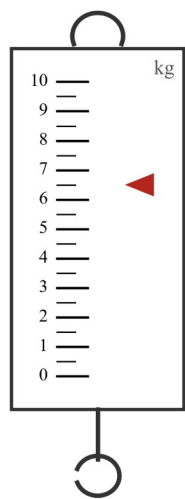
(b) A driver wants to check a 300 g letter on the same scale. Explain why this scale cannot do that job.

Q12. The zero end of a carpenter's ruler is worn away, so she measures a drawer from the 2 cm mark; the far end lines up with 47.5 cm. Find the length of the drawer, and explain why starting at 2 cm does not spoil the answer.

Q13. A recipe needs exactly 250 mL of stock. The only jug in the kitchen has labels every 100 mL and no marks in between. (a) Explain why this jug cannot measure 250 mL accurately. (b) Name one analogue tool that could measure 250 mL accurately.

Q14. A nurse reads a patient's thermometer. The scale runs from 35 °C to 42 °C with a small mark every 0.1 °C, and the liquid ends four marks past 38. (a) Read the patient's temperature. (b) Normal body temperature is about 37 °C. What does the reading suggest?

Q15. A fish market weighs bags of mussels on a spring balance — a hanging scale many students have never seen. Its scale runs from 0 to 10 kg with a small mark every 0.5 kg, and the pointer rests one mark past 6.



- (a) Read the mass of the bag.

(b) Explain how the four steps for reading any scale let you read a tool you have never seen before.
- Q16.** A factory roster says “shift starts at 7:00”. The wall clock is a 12-hour analogue clock. Explain why the clock alone cannot tell a new starter whether the shift starts at 7 am or 7 pm, and name one thing that would show which is meant.
- Q17.** Copy the table and complete it: for each job, name one analogue tool a worker uses, what it measures, and the unit.

Job	Analogue tool	What it measures	Unit
Baker			
Carpenter			
Nurse			

Q18. A handyman fits a shelf into a space between two walls. (a) He holds the 10 cm mark of his tape at one side of the space; the other side reads 91.5 cm. Find the width of the space. (b) His shelf board is 90 cm long. How much must he cut off, in millimetres, so the board fits the space exactly? (c) After fixing the shelf he rests a spirit level on it, and the bubble sits between the two centre lines. What does this tell him?

Answers

Q1. (a) 1 mm (0.1 cm). (b) 86 mm. (c) 8.6 cm. **Q2.** (a) 25 g. (b) 275 g. (c) 550 g. **Q3.** (a) 50 mL. (b) 350 mL. (c) 150 mL. **Q4.** (a) temperature, in degrees Celsius ($^{\circ}\text{C}$). (b) 1°C . (c) -4°C . **Q5.** (a) 9:25. (b) each number on the face stands for 5 minutes, and $5 \times 5 = 25$. (c) 15 minutes. **Q6.** (a) the length is the difference of the two readings, so any clear starting mark works. (b) 87 cm. (c) 0.87 m. **Q7.** (a) no. (b) the left end — the bubble moves to the higher side. (c) adjust the shelf until the bubble sits between the two centre lines. **Q8.** (a) 20.12 m. (b) yes — it matches exactly. **Q9.** 3 hours 30 minutes. **Q10.** (a) the 5 m tape — the hallway is far longer than the ruler. (b) the measuring jug — a scale measures mass, not volume. (c) the spirit level — it shows level, while a trundle wheel measures distance. **Q11.** (a) 18 kg. (b) its smallest mark is 1 kg, and 300 g moves the needle less than one mark, so there is nothing to read. **Q12.** 45.5 cm; subtracting the start reading takes care of the worn end. **Q13.** (a) 250 mL falls between the 200 and 300 labels with no mark to read. (b) any jug or cup with finer marks (say every 25 or 50 mL), or a 250 mL measuring cup. **Q14.** (a) 38.4°C . (b) it is above normal — the patient has a temperature. **Q15.** (a) 6.5 kg. (b) the steps use only what the scale shows — its unit, its labels and the spaces between them — not memory of the tool. **Q16.** the same face appears twice a day, so 7 am and 7 pm look identical; the roster's am/pm (or a 24-hour clock showing 07:00 or 19:00) shows which is meant. **Q17.** e.g. baker — kitchen scale — mass — g or kg; carpenter — tape measure — length — mm, cm or m; nurse — thermometer — temperature — $^{\circ}\text{C}$. **Q18.** (a) 81.5 cm. (b) 85 mm. (c) the shelf is level (horizontal).

Fully-worked solutions

Q1. (a) Each centimetre holds ten small spaces, so the smallest mark is 1 mm. (b) The arrow sits six small marks past 8 cm, so the pencil is 86 mm long, to the nearest millimetre. (c) $86 \text{ mm} = 8.6 \text{ cm}$.

Q2. (a) Between the labels 200 and 300 there are four spaces, so one space is $(300 - 200) \div 4 = 25 \text{ g}$. (b) The needle is three spaces past 200: $200 + 3 \times 25 = 275 \text{ g}$. (c) Twice 275 g is $2 \times 275 = 550 \text{ g}$.

Q3. (a) The labels sit every 100 mL with one small mark between, so a small mark is 50 mL. (b) The liquid surface is on the small mark between 300 and 400, so the jug holds 350 mL. (c) $500 - 350 = 150 \text{ mL}$ more milk is needed.

Q4. (a) It measures temperature, in degrees Celsius ($^{\circ}\text{C}$). (b) The labels sit every 5°C with five spaces between, so one small mark is 1°C . (c) The column ends one mark above -5°C , so the temperature is -4°C .

Q5. (a) The minute hand is on 5 and the hour hand is just past 9: the time is 9:25. (b) Each number on the face stands for 5 minutes, so a minute hand at 5 means $5 \times 5 = 25$ minutes past the hour. (c) From 9:25 to 9:40 is $40 - 25 = 15$ minutes of waiting.

Q6. (a) The length covered is the difference between the end reading and the start reading, so holding any clear mark at the start still gives a correct length once the start is subtracted. (b) $137 - 50 = 87 \text{ cm}$. (c) $87 \text{ cm} = 0.87 \text{ m}$, to 2 decimal places.

Q7. (a) No — the bubble is not between the two centre lines, so the shelf is not level. (b) The bubble moves towards the higher end; here it sits left of centre, so the left end is higher. (c) He must raise the right end (or lower the left) until the bubble sits between the two centre lines, then fix the shelf.

Q8. (a) Twenty turns of a one-metre wheel is 20 m, and the tape adds $12 \text{ cm} = 0.12 \text{ m}$, so the pitch is $20 + 0.12 = 20.12 \text{ m}$. (b) Yes: 20.12 m is exactly the length a cricket pitch should be, so his measurement matches.

Q9. From 11:15 am to 12:15 pm is 1 hour, to 1:15 pm is 2 hours and to 2:15 pm is 3 hours; from 2:15 pm to 2:45 pm is a further 30 minutes. So Ben painted for 3 hours 30 minutes.

Q10. (a) The 5 m tape measure: the hallway is 4.5 m long, far beyond a 30 cm ruler, and a tape measures it in one go. (b) The measuring jug: volume is what the recipe needs, and a jug's mL marks read volume directly, while a bathroom scale measures mass. (c) The spirit level: it shows directly whether the frame is straight (level), while a trundle wheel only measures distance.

Q11. (a) The needle is eight small marks past the label 10, and each small mark is 1 kg, so the parcel is $10 + 8 = 18$ kg. (b) The smallest mark on the scale is 1 kg. A 300 g letter is less than one small mark, so the needle barely moves and there is no mark to read — the scale is not fine enough for the job (a kitchen or letter scale is).

Q12. The length is the difference of the two readings: $47.5 - 2 = 45.5$ cm. Starting at 2 cm does not spoil the answer because the subtraction removes the effect of the start: the part of the ruler from 2 cm to 47.5 cm is exactly the drawer's length, whatever number the start happens to carry.

Q13. (a) 250 mL lies halfway between the 200 and 300 labels, and with no mark between them there is nothing to read against — any pour is a guess, so the jug cannot measure 250 mL accurately. (b) A jug or measuring cup with finer marks (every 25 or 50 mL), or a 250 mL measuring cup filled to its 250 mL mark, would do the job.

Q14. (a) Each small mark is 0.1°C , so four marks past 38 is $38 + 4 \times 0.1 = 38.4^{\circ}\text{C}$. (b) 38.4°C is above the normal 37°C , so the reading suggests the patient has a temperature (a fever).

Q15. (a) Step 2 and 3: between the labels 6 and 7 there are two spaces, so one space is 0.5 kg. Step 4: the pointer is one space past 6, so the bag is $6 + 0.5 = 6.5$ kg. (b) The four steps need only what the scale itself shows — the quantity and unit, two labels, the spaces between them, and the pointer's position. None of that depends on having seen the tool before, which is why the same steps read a ruler, a dial, a jug or a spring balance alike.

Q16. A 12-hour clock face shows each time twice a day: the hands look exactly the same at 7 am and at 7 pm, so the clock alone cannot say which one the roster means. The roster's own am/pm label shows which is meant, as would a 24-hour digital clock (showing 07:00 or 19:00) or asking the supervisor.

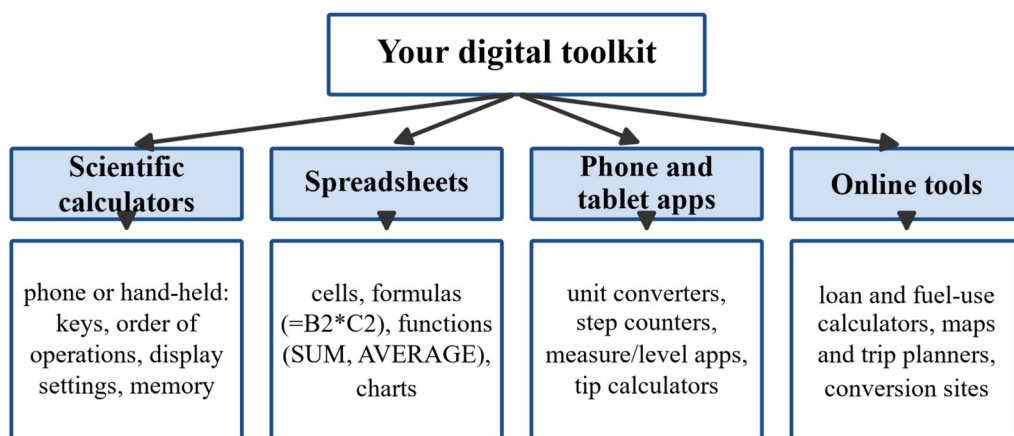
Q17. Any sensible row scores. For example: a baker reads a **kitchen scale**, which measures **mass** in **g or kg** (and a measuring jug for volume in mL); a carpenter reads a **tape measure**, which measures **length** in **mm, cm or m**; a nurse reads a **thermometer**, which measures **temperature** in $^{\circ}\text{C}$.

Q18. (a) The width is the difference of the two readings: $91.5 - 10 = 81.5$ cm. (b) The board must lose $90 - 81.5 = 8.5$ cm, and $8.5 \text{ cm} = 85 \text{ mm}$, so he cuts off 85 mm. (c) A bubble between the two centre lines means the shelf is level (horizontal), so it is fixed straight and things will not roll off it.

Chapter 1 The problem-solving cycle and mathematical toolkit — 1F The digital toolkit: calculators, spreadsheets, apps and online safety

Theory

A **digital tool** is any device or program that does part of the maths for you: a scientific calculator, a spreadsheet, an app on a phone, or a calculator on a website. Section 1E covers analogue tools (tape measures, scales, clocks); this section covers the digital half of your toolkit. Every digital tool works the same way: you supply **inputs** (the numbers and settings you enter), the tool does the working, and it hands back an **output** (the answer it displays). Your job is to choose the right tool, feed it sensible inputs, and judge whether the output is believable.

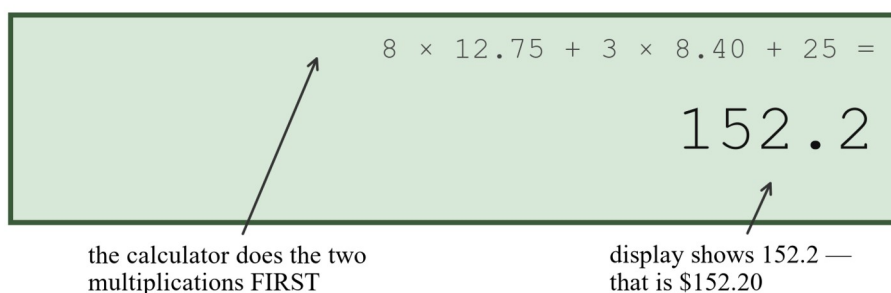


All four must give answers you can CHECK: estimate first, then compare.

The four families of digital tools

Scientific calculators: keys and order of operations.

A scientific calculator follows the **order of operations** by itself: brackets first, then multiplication and division, then addition and subtraction, working left to right inside each group. So you can type a whole job-cost sum in one line, exactly as you would write it, and press = once. Useful keys include the bracket keys, the square-root key, the % key, the π key and the memory keys (M+, MR), which store a number so you can reuse it without writing it down.



A calculator display working out a job cost in one line

Calculator settings that change your answer.

Two settings matter most. The **display setting** chooses how many decimal places the screen shows: set to 2 decimal places (often called FIX 2), every answer is shown rounded to the cent — sensible for money. The screen only *shows* the rounded value; the calculator still *stores* the full value, so if you copy the rounded display into the next step you can drift away from the true answer (Example 3). The **angle setting** (DEG for degrees) matters whenever angles appear (Chapter 7). When a result looks strange, the first things to check are these settings and the clear key (AC clears everything ready for a new sum).

Spreadsheets: cells, formulas and functions.

A **spreadsheet** is a grid of boxes called **cells**. Each cell has a name made of its column letter and row number, so B2 is the cell in column B, row 2. A **formula** is an instruction typed into a cell that tells it what to calculate; every formula starts with = so the spreadsheet knows it is maths and not text. =B2*C2 means “multiply whatever is in B2 by whatever is in C2”. A **function** is a built-in formula word: =SUM(D2:D6) adds a block of cells, =AVERAGE(B2:B6) finds their mean, and =MAX(. . .) and =MIN(. . .) pick out the largest and smallest. The great strength of a spreadsheet is that outputs follow inputs: change one number and every cell whose formula uses it recalculates at once. Spreadsheets also **visualise** — they turn a table into a column chart or line chart in a couple of clicks.

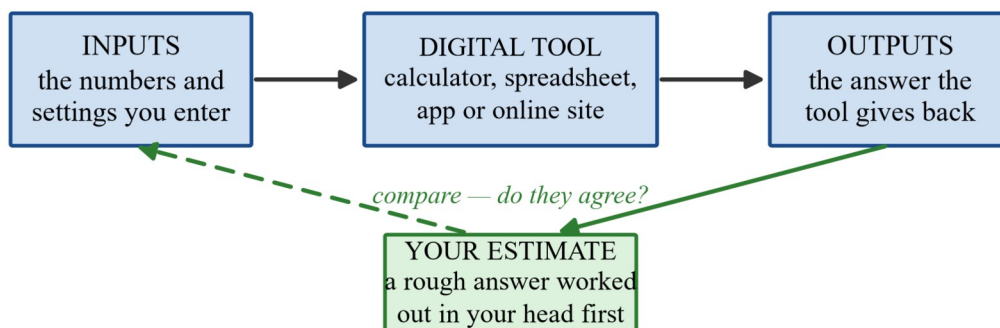
Apps and online tools, and choosing a valid one.

Phones and websites add tools a calculator cannot be: unit **converters** (cm to inches, kg to pounds), measure and level apps that use the phone’s camera and sensors, step counters, map and trip planners, and online calculators for fuel use, loan repayments and hundreds of other jobs. New (**emerging**) tools keep arriving — tradespeople now quote jobs with drone measurements and phone apps — so the skill is not knowing one app but knowing how to judge any tool. A tool is **valid** for a task if it is the right kind of tool for that task and gives answers accurate enough for the purpose: a tip calculator is not valid for loan repayments, and a kitchen scale is not valid for weighing a truck.

Accuracy, error and checking outputs.

The **accuracy** of an output is how close it is to the true value; the **error** is the gap between the output and the truth. Errors creep in through wrong inputs (type 43 instead of 34 and the tool happily computes the wrong sum — “wrong input, wrong output”), through rounding (a display set to 2 decimal places, or an app that uses $\pi \approx 3.14$), and through wrong units or settings (kilometres entered where the tool expects miles). Three habits catch most errors: **estimate first** in your head and compare (Section 1C), **check the units and settings** before trusting a number, and **carry full precision through the working**, rounding once at the end to the precision the question states.

Wrong input → wrong output. The tool cannot know your numbers are wrong.



Inputs, tool, outputs — and your estimate as the check

Inputs, outputs and decisions.

Using technology well is a chain of decisions: which tool, which numbers, which settings, which precision — then reading the output critically. Ask of every output: is it the right **order of magnitude** (tens, hundreds, thousands)? Are the **units** what I expect? Does it agree with my estimate? What would change if I changed one input? A spreadsheet makes that last question easy to explore, because changing an input shows you the new output instantly.

Online safety.

A digital tool is often connected to the internet, and the internet has traps. Five habits keep you safe. (1) Look for **https** and the padlock symbol in the address bar: they mean the connection is **secure** — the information travelling between you and the site is scrambled so strangers cannot read it. (2) Read the site’s name carefully: scam sites copy a real name but glue on extra words or use odd endings. (3) Never type personal or bank details into a site that has no need of them — a calculator needs numbers, not your BSB. (4) Treat urgent messages asking for payment through a link as scams until proven otherwise; go to the official site or app yourself instead of tapping the link. (5) Give an app

only the **permissions** (access to contacts, location, camera and so on) that its job genuinely needs, and use different passwords for banking and for games.

Same bank, two web addresses — only one is the real bank



`https://www.southernbank.com.au/login`

SAFE: https + padlock, and the name before .com.au is the bank's real name

`http://southernbank-secure-login.xyz/verify`

SCAM: no https, odd ending (.xyz), extra words glued around the bank's name

Two web addresses for the same bank — only one is real

About the data in this section. The cafe sales, market-stall sales, screen-time hours, step counts, lawn-mowing takings, grocery prices and loan offers in this section are **made up** (not real): pretend businesses and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business or person.

Worked examples

Example 1 — scaffolded

Desh orders materials for a decking job: 8 lengths of timber at \$12.75 each, 3 boxes of screws at \$8.40 a box, and a \$25 delivery fee on the whole order. He types the sum into his calculator in one line, as in the figure above. Check what the calculator does and what it should display.

Working	Comment
Type $8 \times 12.75 + 3 \times 8.40 + 25 =$ left to right, pressing = once.	A scientific calculator follows the order of operations by itself — no need to split the sum up.
Multiplications first: $8 \times 12.75 = \$102.00$ and $3 \times 8.40 = \$25.20$.	$\times$ and $\div$ are done before $+$ and $-$.
Then left to right: $102.00 + 25.20 + 25 = \$152.20$.	The display reads 152.2; for money that is \$152.20.
Estimate: about $8 \times 13 = 104$, about $3 \times 8 = 24$, plus 25 gives about \$153.	The estimate sits right beside \$152.20, so the output is believable.

Example 2 — scaffolded

The Corner Cup cafe records one week's sales in a spreadsheet (below). Show how the Total column and the grand total are built with formulas, and what happens when one input changes.

The Corner Cup cafe — week 9 sales (made-up data)

	A	B	C	D
1	Item	Qty sold	Price each	Total
2	Flat white	140	\$4.80	=B2*C2
3	Toastie	85	\$8.50	\$722.50
4	Smoothie	60	\$7.20	\$432.00
5	Muffin	95	\$4.50	\$427.50
6	Bottled water	120	\$2.50	\$300.00
7	Total			=SUM(D2:D6)

The Corner Cup cafe spreadsheet

Made-up data: the cafe's name and every number in the spreadsheet are made up for this section.

Working	Comment
Cell names come from column letter + row number: the toastie price sits in cell C3.	Names let a formula point at the numbers it needs.
Type =B2*C2 into D2: it shows $140 \times 4.80 = \$672.00$.	Every formula starts with = so the spreadsheet reads it as maths, not text.
Copy that formula down to D6; D3 shows $85 \times 8.50 = \$722.50$, and so on.	Copying saves retyping — in D3 the formula becomes =B3*C3 by itself.
Type =SUM(D2:D6) into D7: it shows \$2 554.00.	SUM is a function — a built-in formula word that adds a block of cells.
Change B3 from 85 to 90: D3 becomes \$765.00 and D7 becomes \$2 596.50, with no retyping.	Outputs follow inputs: every cell that uses B3 updates at once.

Example 3 — unscaffolded

Rach's calculator is set to show 2 decimal places. She works out $156 \div 7$, writes down the number on the screen, clears the calculator, then multiplies her written number by 7. She expects 156 and gets 156.03. Explain what happened, and say what she should do instead.

The true value of $156 \div 7$ is 22.285714... A 2-decimal-place display **rounds** this to 22.29 for showing only — inside the calculator the full value is still stored. Rach wrote the rounded display down, so her second sum was

$$22.29 \times 7 = 156.03,$$

which is $156.03 - 156 = \$0.03$ above the truth: an error created by rounding in the middle of the working. If instead she keeps the full stored value (press = then $\times 7$, or recall the answer from memory), she gets exactly 156.

$\therefore$ the extra 3 cents is a display-rounding error; carry full precision through the middle steps and round only once, at the end, to the precision the question asks for.

Example 4 — unscaffolded

Bas searches online for a loan repayment calculator. The first site asks for his full name, his address, and his bank BSB and account number “to personalise your results”. Bas only wants to see the repayments on a \$4 000 loan over 2 years. Should he type his details in? Give two reasons, and name one thing he should check before trusting any money site.

No. A repayment calculator needs only the inputs the calculation uses — the amount borrowed, the interest rate and the time — and bank details change nothing about that arithmetic, so asking for them is a sign the site wants his details rather than wanting to help. Typing a BSB and account number into an unknown site could hand strangers access to his money. Before using any money site he should check the address bar for `https` and the padlock, and for the lender's real name spelled correctly before `.com.au`.

∴ Bas should leave the site without typing anything personal: enter only the numbers the calculation needs, and check `https`, the padlock and the site name first.

Practice questions

Scaffolded

Q1. (a) Use the order of operations to evaluate $6 + 4 \times 5$. (b) Evaluate $(6 + 4) \times 5$. (c) In one sentence, explain why (a) and (b) give different answers.

Q2. A calculator is set to show every answer to 2 decimal places (FIX 2). (a) Work out $75 \div 8$ and state what the FIX 2 display shows, to 2 decimal places. (b) Write the exact value of $75 \div 8$. (c) Explain why FIX 2 is a sensible display setting for money calculations.

Q3. Look at the cafe spreadsheet in Example 2. (a) Write the formula that is typed into cell D2. (b) In words, what does `=SUM(D2:D6)` in cell D7 do? (c) The cafe sells 90 toasties instead of 85. Write the new values of D3 and of D7.

Q4. Tama logs his phone screen time for five days: Monday 3.5 h, Tuesday 2 h, Wednesday 4.25 h, Thursday 1.75 h, Friday 3.5 h. The hours sit in cells B2 to B6. (a) Write the spreadsheet function that returns the mean of the five hours. (b) Work out the mean screen time, in hours. (c) List the days on which Tama's screen time was above the mean.

Q5. (a) A converter app changes 165 cm to inches using $1 \text{ inch} = 2.54 \text{ cm}$. Work out the output, to 1 decimal place. (b) Which digital tool would you choose to split a \$246 restaurant bill evenly between 6 people, and why? (c) Which digital tool would you choose to keep a weekly record of income and spending with running totals, and why?

Q6. (a) Name the two things in a browser's address bar that tell you the connection to a site is secure (scrambled so strangers cannot read it). (b) Give two warning signs that a message or website is a scam. (c) Explain why your banking password and your game-account password should be different.

Unscaffolded

Q7. A landscaper quotes a job: 6.5 hours of labour at \$48 an hour, 4 plants at \$32.50 each, 2 bags of mulch at \$8.90 a bag, and \$45 of edging. GST (the Goods and Services Tax, 10% of the price) is then added. (a) Work out the subtotal before GST. (b) Work out the GST, correct to the nearest cent. (c) Work out the total of the quote.

Q8. A calculator shows 0.142857142... for $1 \div 7$. (a) Write $1 \div 7$ correct to 4 decimal places. (b) Multiply your 4-decimal-place value by 7, and state how far the result is from 1. (c) In one sentence, explain why keeping more decimal places makes that gap smaller.

Q9. Jai types his last fill into a fuel-use app: 412 km driven and 34 L of fuel used. The app answers 10.44 L/100 km, but Jai's car usually uses about 8 to 9 L/100 km. (a) Estimate the fuel use per 100 km by using 400 km instead of 412 km. (b) Work out the true fuel use per 100 km, to 2 decimal places. (c) The app's 10.44 came from one mistyped input. Which input looks wrong, and what was most likely typed instead?

Q10. Sam records a Saturday at his market stall in a spreadsheet (below). (a) Write the formula in cell D2. (b) Write the value that cell D6, holding =SUM(D2:D5) , shows. (c) Sam changes the honey price in C5 to \$13.00. What do D5 and D6 show now?

Riverside market stall — Saturday sales (made-up data)

	A	B	C	D
1	Item	Qty sold	Price each	Total
2	Candle	12	\$9.50	=B2*C2
3	Soap	18	\$4.00	\$72.00
4	Jam	25	\$6.50	\$162.50
5	Honey	9	\$12.00	\$108.00
6	Total			=SUM(D2:D5)

Sam's market stall spreadsheet

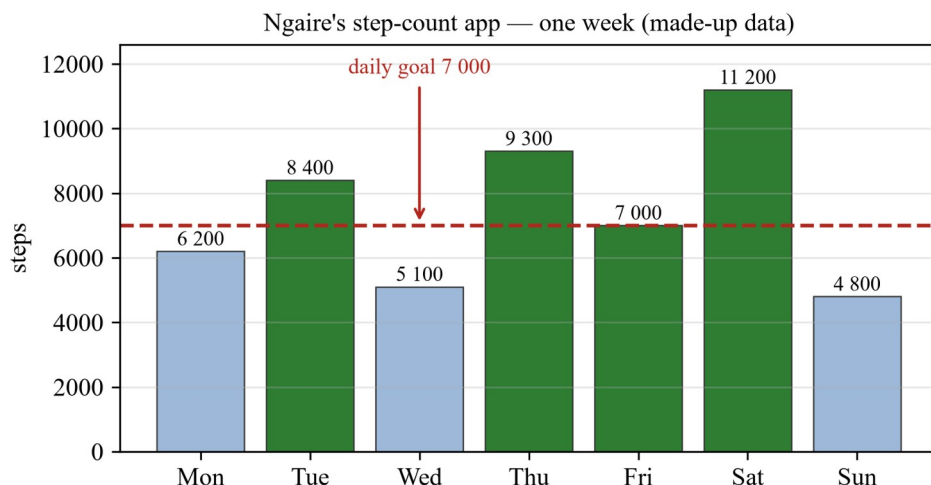
Made-up data: the stall's name and every number in the spreadsheet are made up for this section.

Q11. A gardening app works out the area of a circular garden bed of diameter 3.4 m using $\pi \approx 3.14$. A scientific calculator uses its π key for the same job. (a) Work out the area each tool gives, to 2 decimal places. (b) Which output is closer to the true area, and why? (c) Work out the difference between the two areas, to 4 decimal places.

Q12. Maree receives a text message: "AUSTRALIA POST: Your parcel is on hold. Pay a \$3.99 delivery fee within 2 hours or it is returned: auspost-delivery-fee.xyz". (a) Give two warning signs in the message. (b) Say what Maree should do instead of tapping the link. (c) The fee is only \$3.99. Explain why criminals still send messages like this one.

Q13. (a) A converter app says 78 kg is 172 pounds, to the nearest pound. Check this output using $1 \text{ kg} \approx 2.2046$ pounds, and say whether the app is right. (b) The same app converts 2.6 miles to kilometres using $1 \text{ mile} \approx 1.60934$ km. Work out the output, to 1 decimal place. (c) Give one quick way to sanity-check a converter app's output without using another app.

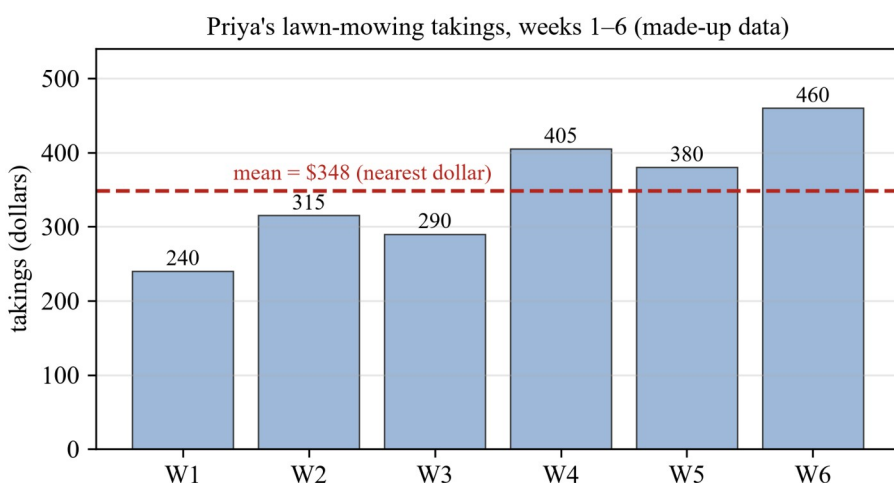
Q14. Ngaire's step-count app draws the column chart below for one week. (a) Read off the day with the most steps, and how many steps it shows. (b) Work out Ngaire's total steps for the week. (c) Her goal is at least 7 000 steps a day. On how many days did she meet her goal?



Ngaire's weekly step counts

Made-up data: Ngaire's name and every step count in the chart are made up for this section.

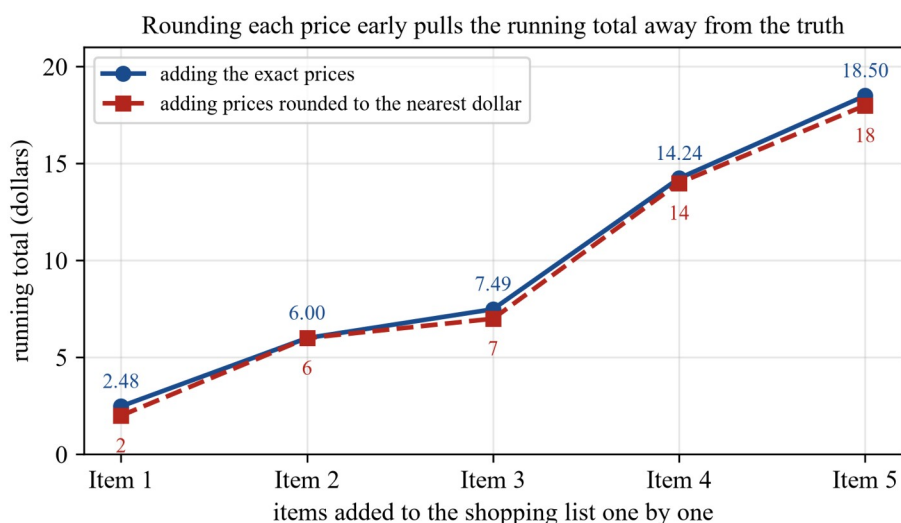
Q15. Priya's spreadsheet charts her lawn-mowing takings for weeks 1 to 6 (below). (a) Read off the week with the highest takings, and the amount. (b) Work out Priya's mean weekly takings over the 6 weeks, to the nearest dollar. (c) Describe the trend across the 6 weeks in one sentence.



Priya's weekly takings

Made-up data: Priya's business and every amount in the chart are made up for this section.

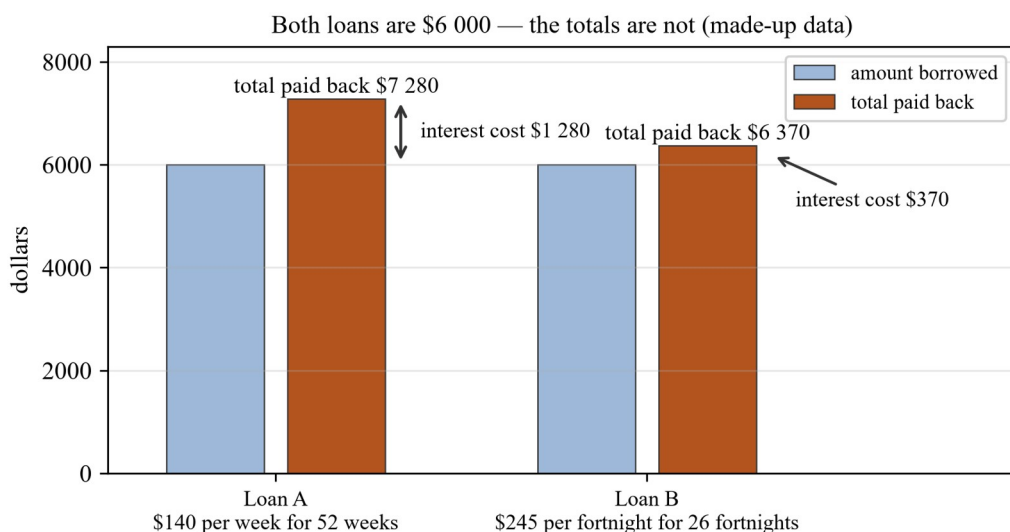
Q16. A grocery app offers to round every price to the nearest dollar “to keep the total simple”. The prices in one basket are \$2.48, \$3.52, \$1.49, \$6.75 and \$4.26. (a) Work out the exact total of the five prices. (b) Round each price to the nearest dollar first, then add. Write that total. (c) Use the chart below to explain, in one sentence, why rounding once at the end is the safer habit.



Running totals: exact prices versus prices rounded early

Made-up data: the five grocery prices and every total in the chart are made up for this section.

Q17. An online loan calculator shows two offers for borrowing \$6 000 (below). Loan A repays \$140 per week for 52 weeks. Loan B repays \$245 per fortnight for 26 fortnights. (a) Work out Loan A’s total repaid, and its interest cost (the amount repaid above \$6 000). (b) Work out Loan B’s total repaid, and its interest cost. (c) How much less does Loan B cost in total? What does this say about judging a loan by its repayment size alone?



Two loan offers for the same \$6 000

Made-up data: both loan offers and every amount in the chart are made up for this section.

Q18. A free tip-calculator app asks, the first time it opens, for permission to read Tessa’s contacts and to track her location. (a) Does working out a tip need either permission? Explain. (b) Give one risk of tapping “allow” anyway. (c) What is the safer choice, and what could Tessa use instead if the app refuses to work without those permissions?

Answers

Q1. (a) 26. (b) 50. (c) in (b) the brackets force the addition first; in (a) the multiplication is done first. **Q2.** (a) 9.38. (b) 9.375. (c) money is counted in cents, i.e. 2 decimal places. **Q3.** (a) $=B2 * C2$. (b) it adds the five totals in cells D2 to D6. (c) $D3 = \$765.00$, $D7 = \$2\,596.50$. **Q4.** (a) $=AVERAGE(B2 : B6)$. (b) 3 hours. (c) Monday, Wednesday, Friday. **Q5.** (a) 65.0 inches. (b) a calculator — one division, no table needed. (c) a spreadsheet — it stores rows of numbers and keeps running totals by itself. **Q6.** (a) `https` at the start of the address and the padlock symbol. (b) any two of: urgent threats or deadlines; a link with an odd or misspelled site name; requests for personal or bank details; prices or prizes too good to be true. (c) if one site is broken into, the stolen password does not unlock the other account. **Q7.** (a) \$504.80. (b) \$50.48. (c) \$555.28. **Q8.** (a) 0.1429. (b) 1.0003, which is 0.0003 above 1. (c) each digit dropped is a tiny error, and fewer dropped digits means a smaller error when multiplied back up. **Q9.** (a) about 8.5 L/100 km. (b) 8.25 L/100 km. (c) the fuel: 43 L was most likely typed instead of 34 L. **Q10.** (a) $=B2 * C2$. (b) \$456.50. (c) $D5 = \$117.00$ and $D6 = \$465.50$. **Q11.** (a) app: 9.07 m^2 ; calculator: 9.08 m^2 . (b) the calculator — its π key stores many more digits than 3.14. (c) 0.0046 m^2 . **Q12.** (a) any two of: a web address that is not `auspost.com.au`; urgency (“within 2 hours”); a payment demanded through a link in a text. (b) delete the message and check the parcel on the official Aus Post app or website herself. (c) the card details entered for \$3.99 are worth far more than \$3.99. **Q13.** (a) $78 \times 2.2046 = 171.9588 \approx 172$ pounds — the app is right. (b) 4.2 km. (c) compare with a known fact (1 kg is a bit over 2 pounds, 1 mile is a bit over 1.5 km) and check the size is sensible. **Q14.** (a) Saturday, 11 200 steps. (b) 52 000 steps. (c) 4 days (Tue, Thu, Fri, Sat). **Q15.** (a) week 6, \$460. (b) \$348. (c) takings rise overall, with a small dip in week 3. **Q16.** (a) \$18.50. (b) \$18. (c) each early rounding adds a small error to the running total, so the rounded total drifts 50c away from the truth. **Q17.** (a) \$7 280 repaid; interest \$1 280. (b) \$6 370 repaid; interest \$370. (c) \$910 less; a small-looking repayment can hide a much dearer loan, so compare totals. **Q18.** (a) no — a tip needs only the bill amount and the percentage. (b) her contacts or movements could be collected and sold, or used to target her with scams. (c) refuse the permissions (or delete the app) and work the tip out with a calculator or a different app that asks for nothing.

Fully-worked solutions

Q1. (a) Multiply first: $4 \times 5 = 20$, then $6 + 20 = 26$. (b) Brackets first: $6 + 4 = 10$, then $10 \times 5 = 50$. (c) The brackets in (b) force the addition to happen before the multiplication, while in (a) the order of operations puts the multiplication first.

Q2. (a) $75 \div 8 = 9.375$; a FIX 2 display rounds this to 9.38 (2 decimal places). (b) The exact value is 9.375 — the display hides the third decimal place but the calculator still stores it. (c) Australian money is counted in cents, which is 2 decimal places of a dollar, so FIX 2 shows money the way it is actually paid.

Q3. (a) $=B2 * C2$ (quantity times price each). (b) It adds the block of cells D2, D3, D4, D5 and D6 — the five item totals — and shows their sum in D7. (c) With 90 toasties, $D3 = 90 \times 8.50 = \$765.00$; the total becomes $2554.00 - 722.50 + 765.00 = \$2\,596.50$.

Q4. (a) $=AVERAGE(B2 : B6)$. (b) The hours add to $3.5 + 2 + 4.25 + 1.75 + 3.5 = 15$; the mean is $15 \div 5 = 3$ hours. (c) Above 3 hours: Monday (3.5), Wednesday (4.25) and Friday (3.5) — three days.

Q5. (a) $165 \div 2.54 = 64.9606\dots$, which is 65.0 inches to 1 decimal place. (b) A calculator (phone or hand-held): the job is one division, $246 \div 6 = \$41$, so no table or chart is needed. (c) A spreadsheet: it holds a row per week, adds running totals with $=SUM$ by itself, and updates them when a number is corrected.

Q6. (a) The address beginning with `https` and the padlock symbol beside it. (b) Any two of: pressure to act quickly (“within 2 hours”); a web address with extra words or an odd ending; a request for personal, card or bank details; an offer too good to be true. (c) Sites are sometimes broken into and passwords stolen; if the two accounts share one password, one break-in opens both, and different passwords contain the damage to the less important account.

Q7. (a) Labour = $6.5 \times 48 = \$312.00$; plants = $4 \times 32.50 = \$130.00$; mulch = $2 \times 8.90 = \$17.80$; edging = $\$45.00$. Subtotal = $312.00 + 130.00 + 17.80 + 45.00 = \$504.80$. (b) GST = 10 % of 504.80 = $504.80 \times 0.10 = \$50.48$ (exact to the cent). (c) Total = $504.80 + 50.48 = \$555.28$.

Q8. (a) $1 \div 7 = 0.142857\dots$, which is 0.1429 to 4 decimal places. (b) $0.1429 \times 7 = 1.0003$; that is $1.0003 - 1 = 0.0003$ above 1. (c) Rounding throws away digits, and each thrown-away digit is a tiny error; keeping more digits throws away less, so the error left after multiplying back is smaller.

Q9. (a) $34 \div 400 \times 100 = 8.5$, so about 8.5 L/100 km — matching his usual 8 to 9. (b) $34 \div 412 \times 100 = 8.2524\dots$, i.e. 8.25 L/100 km to 2 decimal places. (c) The estimate says the true answer is near 8.5, so 10.44 must come from a wrong input; typing 43 L instead of 34 L gives $43 \div 412 \times 100 = 10.44$, so the fuel figure was mistyped (digits swapped).

Q10. (a) $=B2 \times C2$. (b) D6 adds the four item totals: $114.00 + 72.00 + 162.50 + 108.00 = \$456.50$. (c) With the honey price at \$13.00, $D5 = 9 \times 13.00 = \$117.00$, and D6 recalculates to $456.50 - 108.00 + 117.00 = \$465.50$ — no formula retyped, because outputs follow inputs.

Q11. (a) Radius $= 3.4 \div 2 = 1.7$ m. App: $3.14 \times 1.7^2 = 3.14 \times 2.89 = 9.0746$, i.e. 9.07 m² to 2 decimal places. Calculator: $\pi \times 2.89 = 9.0792\dots$, i.e. 9.08 m² to 2 decimal places. (b) The calculator's, because its π key stores π to many more digits while the app replaces it with 3.14, an approximation. (c) The difference is $9.0792 - 9.0746 = 0.0046$ m² (4 decimal places) — small here, but it grows with bigger areas.

Q12. (a) Any two of: the address `auspost-delivery-fee.xyz` is not Aus Post's real website; the message threatens a 2-hour deadline to rush her; payment is demanded by tapping a link in an unsolicited text. (b) She should not tap the link: delete or report the message, and check any parcel herself through the official Aus Post app or by typing the real website address. (c) The \$3.99 is bait — what the criminals want is the card number, expiry and CVV typed at their fake site, which they can reuse for far larger purchases or sell on.

Q13. (a) $78 \times 2.2046 = 171.9588$ pounds, which rounds to 172 pounds to the nearest pound — the app's output checks out. (b) $2.6 \times 1.60934 = 4.184284$, i.e. 4.2 km to 1 decimal place. (c) Compare with a fact you know (1 kg is a little over 2 pounds; 1 mile is a little over 1.5 km) and ask whether the size of the answer is sensible — a conversion that fails that check means a wrong input or a bad app.

Q14. (a) The tallest column is Saturday, at 11 200 steps. (b) Total $= 6\,200 + 8\,400 + 5\,100 + 9\,300 + 7\,000 + 11\,200 + 4\,800 = 52\,000$ steps. (c) The days at or above the 7 000 goal line are Tuesday (8 400), Thursday (9 300), Friday (7 000) and Saturday (11 200) — 4 days.

Q15. (a) Week 6, at \$460. (b) The six weeks add to $240 + 315 + 290 + 405 + 380 + 460 = \$2\,090$; the mean is $2\,090 \div 6 = 348.33\dots$, i.e. \$348 to the nearest dollar. (c) Takings rise overall from week 1 to week 6, with a small dip in week 3 — an upward trend.

Q16. (a) Exact total $= 2.48 + 3.52 + 1.49 + 6.75 + 4.26 = \$18.50$. (b) Rounded prices: $2 + 4 + 1 + 7 + 4 = \$18$. (c) The chart shows the rounded running total falling further below the exact running total as items are added — five small rounding errors stack up to a 50c difference — so round once, at the end, to the stated precision.

Q17. (a) Loan A repays $140 \times 52 = \$7\,280$; interest cost $= 7\,280 - 6\,000 = \$1\,280$. (b) Loan B repays $245 \times 26 = \$6\,370$; interest cost $= 6\,370 - 6\,000 = \$370$. (c) Loan B costs $7\,280 - 6\,370 = \$910$ less in total. Loan A's repayment *looks* smaller (\$140 against \$245), but it runs for twice as many payments — so judge loans by the total repaid, not by the size of one repayment.

Q18. (a) No. A tip is a percentage of the bill, so the only input the calculation needs is the bill amount (and the chosen percentage); contacts and location play no part in it. (b) The app's maker could collect and sell her contact list or her movements, or use them to target her with scams — data given away once cannot be taken back. (c) The safer choice is to deny those permissions (and uninstall if the app then refuses to work); she can work the tip out with any calculator, or with a different tip app that asks only for the bill amount.

Chapter 1 The problem-solving cycle and mathematical toolkit — 1G Numeracy words: familiar, unfamiliar, routine, non-routine, specialised

Theory

About the data in this section. The shops, workplaces, prices, rosters, pay slips and charts in this section are **made up** (not real). They were built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

Why these words matter. This subject describes its tasks with five words: **familiar**, **unfamiliar**, **routine**, **non-routine** and **specialised**. The study design's statement for Outcome 1 (Units 3 and 4) uses four of them: students apply mathematics in a mix of contexts — routine ones, non-routine ones, unfamiliar ones and some specialised ones.

Source: VCAA, VCE Vocational Major Numeracy Study Design, retrieved 2026-10-07.

You will meet these words in your course, in assessment tasks and in this book. Once you know what they mean, you can:

- see what kind of task is coming;
- choose a sensible way to start it;
- watch yourself improve — a task that is unfamiliar today becomes familiar with practice.

The words describe the task. They do not describe you or your ability. A non-routine task is not a test of how smart you are; it is a task with no procedure you do regularly.

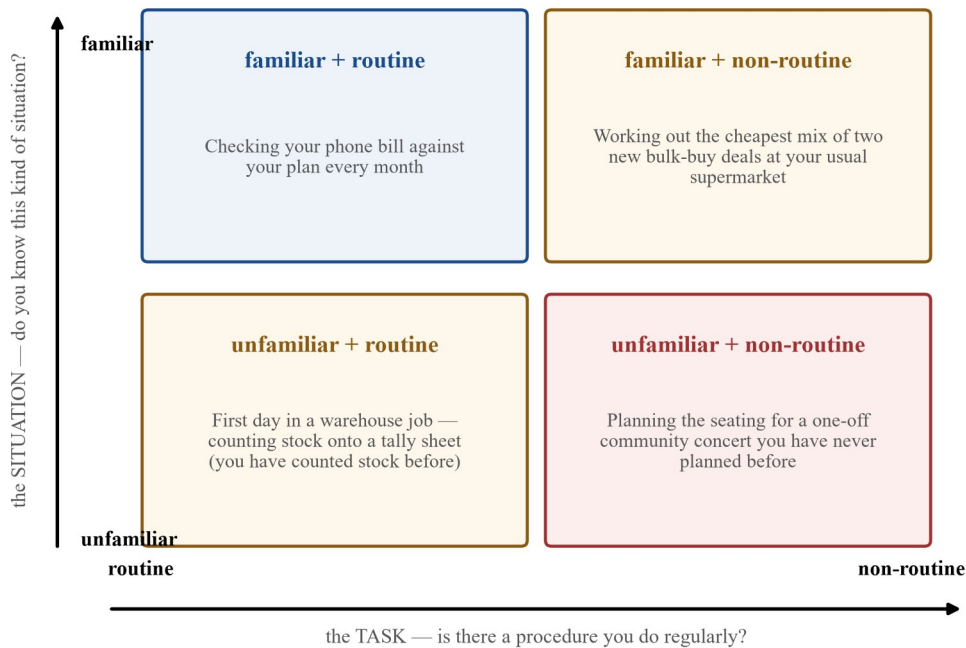
Two words you need first: context and task. A **context** is the real-life situation a problem sits in — a shop, a workplace, a sports club, a home. A **task** is what you are actually asked to do — total, compare, plan, measure. The five words sort both of these.

Two different questions. The five words answer two different questions, plus one extra:

1. *Do you know this kind of situation?* → **familiar** or **unfamiliar**. This is about the **context**.
2. *Is there a procedure for this task that you do regularly?* → **routine** or **non-routine**. This is about the **task**.
3. *Does the task need the particular words and steps of one area of work or knowledge?* → **specialised**.

One task can carry several labels at once. Totalling the docket at a shop you use every week is **familiar** (you know the shop) and **routine** (you do it every week). The grid below shows the four combinations.

Two questions, four combinations



Familiar and unfamiliar. A situation is **familiar** when you know it well — you have met it before, inside or outside school. Doing maths in a familiar situation helps you connect the maths to the real world. A situation is **unfamiliar** when you have not met it before. Unfamiliar tasks stretch you: the goal is to spot the maths in a new setting and carry across skills you already have.

Two things to remember:

- **Familiar is personal.** A roster is familiar to a classmate who works weekends. It may be unfamiliar to you. Neither of you is wrong.
- **Unfamiliar does not mean impossible.** It means new to you.

Routine and non-routine. A task is **routine** when people meet it often in life or work — a procedure done regularly or at set times, and practised often. Entering your hours on a timesheet the same way every Friday is routine. A task is **non-routine** when it is not done regularly. There is no practised procedure you can just follow, so you build the steps yourself, often by joining methods in a new way.

The study design uses the word *non-routine* in its outcome statement but does not give it its own definition. This book treats a **non-routine** task as one that is **not done regularly** — **there is no practised procedure you can just follow**. Every task in this book works with that meaning.

Non-routine tasks are where the problem-solving cycle earns its keep: identify the mathematics (Section 1B), write a plan, then estimate and check (Section 1C).

Specialised. A task is **specialised** when it belongs to a particular area of work or knowledge and needs that area's own words and steps before the maths makes sense. A forklift driver reading a load chart, a hairdresser mixing colour to a ratio, a nurse timing doses from a medicine chart — these tasks are specialised. The **terminology** (the particular words of an area) is the gate: learn the words first, and the maths after it is often routine.

Specialised does not mean non-routine. A kennel hand who prepares a flea treatment every day is doing a task that is **specialised** (chart, dose, per kilogram of body weight) and **routine** (she does it at set times, with frequent practice). Specialised tells you which area a task belongs to. Routine tells you how often the person does it.

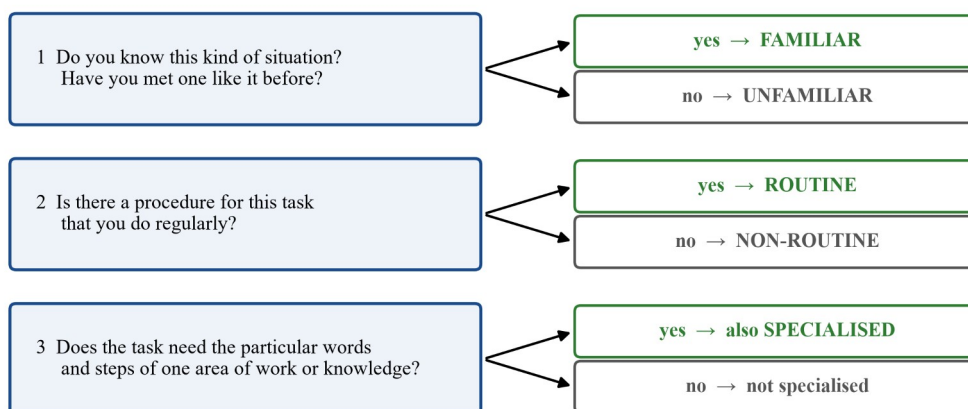
Labels change as you gain experience. What is unfamiliar and non-routine in week 1 of a job can be familiar and routine by week 10. That change is what learning in this subject looks like.

Labels change as you gain experience



A sorting guide. Ask three questions about any task.

A sorting guide: ask three questions about any task



One task can carry several labels — answer all three questions.

The five words across the six numeracies. Outcome 1 applies mathematics across six kinds of real-life context, called **numeracies**. Your school chooses three numeracies per unit; this book covers all six (Chapters 6 and 11 work through them). Here is a taste of how the five words appear across them.

Numeracy	Example situation	Words that can fit
Personal	Reading the hours on your own weekly roster	familiar, routine
Civic	Reading a council rates notice for the first time and working out the year's four equal payments	unfamiliar; the division itself can still be routine
Financial	Comparing two loan repayment tables to decide which loan costs less overall	non-routine, specialised (lending terminology)
Health	Reading a medicine label to time three doses across a day	specialised
Vocational	Checking a machine part against a workplace tolerance (how far a measurement is allowed to be out) chart	specialised; routine if it is your daily check
Recreational	Costing a one-off trip for your club	unfamiliar, non-routine

Why the labels matter — choosing your approach. The labels suggest how to start:

- **Routine** → follow the practised procedure. Check each step as you go; the risk here is a slip, not a new idea.

- **Unfamiliar** → slow down at the start. Identify the mathematics in the new setting (Section 1B). Ask: what do I already know that works here?
- **Non-routine** → write your plan before you calculate. Estimate the answer first so you can check it at the end (Section 1C).
- **Specialised** → learn the area's words first. Write down what each word on the chart or label means, then do the maths.

Worked model — sorting four tasks.

Task	Words	Why
Entering the meter reading on the power company's online form every second Wednesday	familiar, routine	Done regularly, at set times, on a known form.
Comparing "40% off, then \$10 off" with "half price" on a \$90 jacket — never done before	unfamiliar, non-routine	A new kind of decision. No practised procedure, so the steps must be built.
Following the workplace safety data sheet to mix a cleaning product	specialised	The safety data sheet belongs to one area of work, with its own words and steps.
Splitting a \$56 dinner bill four ways	familiar, routine	An everyday split that friends do often.

The jacket comparison has maths in it: 40% off \$90 leaves \$54, then \$10 off gives \$44. Half price is \$45. So the first deal is \$1 cheaper. The dinner split: $\$56 \div 4 = \$14$ each.

Worked examples

Example 1 — scaffolded

May has four tasks this week (cards below). For each one, say whether it is familiar or unfamiliar and whether it is routine or non-routine, and do the small calculation inside it.

May's week — four tasks

Task A — Sunday night at home Add up the week's shopping docket and write the total in the budget book. Dockets: \$63.40 \$28.15 \$41.45	Task B — working bee (May's first one) Pack seedling trays into the car boot, flat, all facing the same way. Boot space: 90 cm × 60 cm Each tray: 30 cm × 20 cm
Task C — new job at the pet shop Use the aquarium heater guide: 5 watts per litre of water. Tank: 40 L What heater rating does the tank need?	Task D — getting to the working bee Two buses, 25 minutes each, with a 15-minute wait between. May must arrive by 8:50 am. What time does she leave home?

Made-up data: May, her four tasks and every number on the cards are made up for this section.

Working	Comment
Task A — total: $\$63.40 + \$28.15 + \$41.45 = \$133.00$. Labels: familiar, routine.	May does this every Sunday in her own budget book: a practised procedure in a setting she knows.
Task B — trays along the boot: $90 \div 30 = 3$; across: $60 \div 20 = 3$; trays: $3 \times 3 = 9$. Labels: unfamiliar, non-routine.	A first working bee is a new situation for May. Loading a boot has no procedure she does regularly, so she builds steps: fit the length, fit the width, multiply.
Task C — heater: $5 \times 40 = 200$ watts. Labels: specialised (and unfamiliar to May, in her first week).	The guide belongs to one area (aquarium keeping) with its own words: watts per litre, heater rating. Once May reads the words, the maths is one multiplication.
Task D — travel time: $25 + 15 + 25 = 65$ minutes. Leave home: 8:50 am – 65 minutes = 7:45 am. Labels: familiar context, non-routine task.	May catches buses all the time, but joining two legs and a wait into an arrival time is not something she does regularly — she has to plan it.

Example 2 — scaffolded

Dev works at Starlight Cinema. Every week he checks his paid hours against the roster — same roster, same steps. This week his manager also offers him a Saturday choice (card below). Classify Dev's weekly check and the Saturday choice, then work out which Saturday option pays more, and by how much.

STARLIGHT CINEMA
Saturday special opening — Dev's choice

Dev's rate: \$23.80 per hour

Option 1: 4 hours on Saturday at time-and-a-half

Option 2: flat \$135.00 call-out for the shift

*Every week Dev checks his paid hours against the roster —
same roster, same steps.*

Made-up data: Starlight Cinema, Dev's rate and both offers are made up for this section.

Working	Comment
Weekly roster check: familiar, routine.	The same task, every week, at set times — frequent practice in a setting Dev knows.
Saturday choice: non-routine.	Dev has never had to choose between pay options. No practised procedure, so he plans it: work out both options, then compare.
Time-and-a-half rate: $\$23.80 \times 1.5 = \$35.70$ per hour.	Time-and-a-half means 1.5 times the normal hourly rate (a penalty rate).
Option 1: $\$35.70 \times 4 = \$142.80$.	Four hours at the penalty rate.
Option 2: \$135.00 flat.	The call-out pays one amount whatever the hours.
Difference: $\$142.80 - \$135.00 = \$7.80$.	Compare to answer the question.
Option 1 pays \$7.80 more.	The arithmetic (multiply, subtract) is routine. The <i>decision</i> is the non-routine part. Labels describe the task, not the arithmetic.

Example 3 — unscaffolded

Bella the dog is boarding at Paws and Claws Boarding Kennels. The kennel's flea treatment chart says: **Dose: 0.5 mL per 4 kg of body weight**. Bella weighs 27 kg. Classify this task, and find Bella's dose, correct to one decimal place.

This task is **specialised**: it belongs to animal care and needs that area's terminology — *dose* (how much treatment to give) and *body weight* — before the maths makes sense. For a kennel hand who gives treatments every day it is also **routine**.

Dose per kilogram: $0.5 \div 4 = 0.125$ mL per kg.

Bella's dose: $0.125 \times 27 = 3.375$ mL.

Rounded to one decimal place: 3.4 mL.

$\therefore$ Bella's dose is 3.4 mL, correct to one decimal place. The task is specialised, and routine for staff who give it regularly.

Example 4 — unscaffolded

The Kookaburra Football Netball Club has never hired a coach before. Two quotes for the away final are below. The trip is 65 km each way.

BELLBIRD COACHES — two quotes for the away final

QUOTE A	QUOTE B
\$300 booking fee	\$100 booking fee
+ \$1.25 per kilometre	+ \$2.50 per kilometre

Trip: 65 km each way (130 km in total)

Made-up data: Bellbird Coaches and both quotes are made up for this section.

- (a) Classify this task for the club treasurer. (b) Which quote is cheaper for this trip, and by how much? (c) At what total trip distance would the two quotes cost the same?
- (b) For a treasurer who has never hired a coach, the context is **unfamiliar** and the task is **non-routine**: there is no procedure he does regularly, so he builds a plan — find the total kilometres, cost each quote, compare.
- (c) Total distance: $65 \times 2 = 130$ km.

Quote A: $\$300 + \$1.25 \times 130 = \$300 + \$162.50 = \$462.50$.

Quote B: $\$100 + \$2.50 \times 130 = \$100 + \$325.00 = \$425.00$.

Difference: $\$462.50 - \$425.00 = \$37.50$.

- (c) Let k be the total trip distance in km. The quotes cost the same when $300 + 1.25k = 100 + 2.5k$, so $200 = 1.25k$ and $k = 160$.

$\therefore$ Quote B is \$37.50 cheaper for this 130 km trip, and the two quotes cost the same at 160 km.

Practice questions

Scaffolded

Q1. Say whether each situation is **familiar** or **unfamiliar**, and give a reason. (a) Following a recipe you have cooked every week for years. (b) Reading the train timetable of a city you have never visited. (c) Buying your usual items at the corner shop you use every day; the total is \$32.75 and you pay with \$50 — also find your change.

Q2. Say whether each task is **routine** or **non-routine**, and give a reason. (a) Taking the Monday cash deposit to the bank and filling in the same deposit slip each week. (b) Working out the best way to combine a \$40 gift card with a “buy 3, pay for 2” offer — a decision you have never made before. (c) Checking your bus timetable each morning to find your departure time.

Q3. Here are three tasks: (i) following a workshop’s torque (turning force) settings table to tighten a car’s wheel nuts; (ii) totalling your own till docket at the end of a shift; (iii) following a cake recipe you make every week. (a) Which task is **specialised**? (b) Name two words from the area that task (i) needs. (c) Explain why tasks (ii) and (iii) are not specialised.

Q4. Copy the grid from the theory and place each task in a cell. (i) Totalling your own hours on the timesheet every Friday. (ii) You always travel the same bus route to TAFE; today track repairs (trackwork) mean you must combine a bus and a tram in a new way to arrive by 8:15 am. (iii) First day at a childcare centre — recording attendance the same way you did at previous jobs. (iv) You have never catered an event; sandwich trays serve 12 people each, and 45 people are coming. (a) Place tasks (i)–(iv) in cells of the grid. (b) Give a reason for your cell for task (ii). (c) Give a reason for your cell for task (iv), and find how many trays to order as a whole number of trays.

Q5. Nadia puts 38.7 litres of petrol in her car each week. The price is \$1.92 per litre. (a) Estimate the cost first, rounding 38.7 L to 40 L and \$1.92 to \$2. (b) Calculate the exact cost, correct to the nearest cent. (c) Classify this task for Nadia (familiar or unfamiliar, routine or non-routine) and explain.

Q6. A gym charges \$12.50 per casual visit or \$45.00 for a week pass with unlimited visits. Tanesha plans four visits in one week. (a) Find the cost of four casual visits. (b) Find how much the week pass saves her. (c) Classify the task “decide which price is better for me” for Tanesha, and explain.

Un scaffolded

Q7. Here are five tasks from a week at a landscape supplies yard. 1. Running the start-of-shift equipment checklist every morning. 2. Reading a new timesheet template for the first time and totalling your hours on it. 3. Splitting a 3.5 kg bag of grass seed into 250 g sample packets. 4. Planning how to cut a 4.8 m length of timber into the pieces on a one-off job list with the least leftover timber. 5. Reading a forklift’s load chart to check a pallet is within its rated capacity. (a) Label each task with the words from this section (familiar or unfamiliar, routine or non-routine, specialised where it fits), and give a reason for one of your labels. (b) Calculate how many sample packets task 3 makes. (c) After a month on the job, which label has changed for task 2? Explain.

Q8. Sam has worked in a bakery for two years. Jack is on his first shift. Both are given the same task: use the recipe scaling chart to find the flour needed for tomorrow’s batch. Each batch uses 750 g of flour, and tomorrow needs 45 batches. (a) Give the labels for Sam and explain. (b) Give the labels for Jack and explain. (c) Calculate the flour needed, in kg.

Q9. Amira started at The Book Nook six months ago. In week 1 her manager showed her how to check her pay slip against her hours; she found it slow and confusing. Now she checks it every fortnight without thinking. Her pay slip for this fortnight is below.

PAY SLIP – THE BOOK NOOK	
<i>Amira N. · Fortnight 12</i>	
Hours worked	24.0
Hourly rate	\$22.40
Gross pay	\$537.60
Tax withheld	\$64.50
NET PAY	\$473.10
<i>check: gross = hours × rate; net = gross – tax</i>	

Made-up data: The Book Nook, Amira and every number on the slip are made up for this section.

- (a) Give the labels for the pay slip check in week 1 and explain. (b) Give the labels for the check now, and say what changed. (c) Check the slip: calculate the gross pay and the net pay and compare them with the slip. (d) What does Amira’s story tell you about these labels?

Q10. Glow Salon’s colour mix card is below.

GLOW SALON	
<i>colour mix card</i>	
Mix:	1 part colour to 1.5 parts developer
Today's client:	40 mL of colour

<i>Record the developer amount and the total mix in the client's notes.</i>	

Made-up data: Glow Salon and every number on the card are made up for this section.

- (a) Classify this task and explain. (b) A client’s mix uses 40 mL of colour. Calculate the developer needed. (c) Calculate the total mix (colour plus developer).

Q11. The club needs 400 flyers for the finals fete. Two print shops quote as below.

Two print shops quote the club for flyers

PRINT HUT	COPY CORNER
\$60 set-up fee	no set-up fee
+ \$0.15 per flyer	\$0.55 per flyer

The club needs 400 flyers.

Made-up data: both print shops and both quotes are made up for this section.

- (a) Find the cost of 400 flyers at Print Hut. (b) Find the cost of 400 flyers at Copy Corner. (c) The club can spend \$150 on flyers. Find how many whole flyers Copy Corner could print for \$150. Give your answer as a whole number of flyers and explain your rounding.

Q12. Jordan has four tasks. (i) Counting the coins in the donation tin at the end of the fete he helps run every year. (ii) His phone plan now offers two add-on data packs — Pack X: \$12 for 3 GB; Pack Y: \$15 for 5 GB. He uses his phone shop weekly but has never compared packs; find the cost per GB of each pack and say which is cheaper. (iii) First day at a plant nursery — reading the watering timer schedule and totalling the run time (Zone A: 25 minutes morning and 25 minutes evening; Zone B: 15 minutes morning and 15 minutes evening). (iv) He has never been to an auction. The house adds a 15% buyer's fee on top of the winning bid, and Jordan's total budget is \$2 000; find the highest bid he can make and stay within budget. (a) Place tasks (i)–(iv) in cells of the grid from the theory, and give a reason for one of your placements. (b) Do the calculation in task (ii). (c) Do the calculation in task (iv), correct to the nearest cent.

Q13. Taha's coach uses this rule for training: maximum heart rate is $220 - a$ beats per minute, where a is age in years. The training zone is 60%–75% of the maximum heart rate. Taha is 16. (a) Calculate Taha's maximum heart rate. (b) Calculate Taha's training zone, to the nearest whole number of beats per minute. (c) Classify this task and explain. (Hint: think about the words *maximum heart rate* and *training zone*.)

Q14. Banksia Neighbourhood House receives a \$3 750 community grant to run a repairs day. Materials cost \$1 475. The rest of the grant pays labour at \$25 per hour. (a) Find how much of the grant is left after materials. (b) Find how many hours of labour the grant pays for. (c) A student who has never run a grant does these calculations. Give the labels for this task for the student, and explain whether “unfamiliar” means the calculations are hard.

Q15. A farmer at Marra Vale mixes herbicide in a spray tank. The label says: **Mix 25 mL of concentrate per 2 L of water.** (a) Find the concentrate needed for one full 9 L tank. (b) The farmer sprays three full tanks in one day. Find the concentrate used that day. (c) Classify this task, and name two words from the area.

Q16. Write your own examples. (a) Write one task for each cell of the grid from the theory (four tasks), from your own life, work or course. (b) Write one **specialised** task. (c) For each task you wrote, give one reason for each label you chose. (d) Compare your list with a classmate's. Explain why your examples can differ even when you both follow the same definitions.

Q17. The Kookaburra Football Netball Club ran a fete stall last Saturday: a guess-the-jar competition and raffle tickets. (a) At close of day the tin holds $3 \times \$50$ notes, $4 \times \$20$ notes and $6 \times \$10$ notes. Find the total. (b) The club counts the tin the same way at every fete, and then the manager works out the raffle plan below. Label each of these two tasks (routine or non-routine) and explain. (c) The club wants at least \$600 profit from the fete in total. Printing the raffle tickets cost \$85 and tickets sell for \$3 each. Counting the jar takings from (a), find how many tickets must sell, as a whole number of tickets, and explain your rounding.

Q18. Jess says: “A specialised task is always non-routine.” (a) Do you agree? Support your answer with one example from this section. (b) Explain what each of the two words actually tells you about a task.

Answers

Q1. (a) Familiar — cooked many times before. (b) Unfamiliar — never been to that city's network. (c) Familiar — same shop, same items; change \$17.25.

Q2. (a) Routine — same steps every week. (b) Non-routine — a one-off decision with no practised procedure. (c) Routine — done every morning.

Q3. (a) Task (i). (b) Any two of: torque, newton metres (Nm), torque settings table. (c) They need no particular terminology or procedures of one area of work — they use everyday words and practised steps.

Q4. (a) (i) Familiar + routine; (ii) familiar + non-routine; (iii) unfamiliar + routine; (iv) unfamiliar + non-routine. (b) The route is known (familiar) but the new combination must be planned — no regular procedure (non-routine). (c) First event catered (unfamiliar) and no regular procedure for it (non-routine); 4 trays.

Q5. (a) About \$80. (b) \$74.30. (c) Familiar and routine — the same weekly fill-up with practised steps.

Q6. (a) \$50.00. (b) \$5.00. (c) The gym is a familiar context; the decision task is non-routine (no regular procedure for comparing the two prices).

Q7. (a) 1: routine (and familiar once the yard is known). 2: unfamiliar + routine. 3: routine. 4: unfamiliar + non-routine. 5: specialised. Reasons will vary. (b) 14 packets. (c) Unfamiliar changes to familiar — the template is now known; the totalling was routine all along.

Q8. (a) Sam: familiar + routine — same chart, same batches, two years of practice. (b) Jack: unfamiliar + non-routine — new setting and no practised procedure yet, so he must build steps. (c) 33.75 kg.

Q9. (a) Unfamiliar + non-routine — new slip, no regular practice yet. (b) Familiar + routine — done every fortnight now, with practice. (c) Gross $24 \times \$22.40 = \$537.60$ and net $\$537.60 - \$64.50 = \$473.10$ — both match the slip, so the slip is correct. (d) Labels describe the person's experience of a task, and they change as experience grows.

Q10. (a) Specialised — salon terminology (colour, developer, parts in a ratio); the arithmetic itself is routine. (b) 60 mL. (c) 100 mL.

Q11. (a) \$120.00. (b) \$220.00. (c) 272 whole flyers — $150 \div 0.55 = 272.72\dots$ and 273 flyers would cost \$150.15, over budget, so round down.

Q12. (a) (i) Familiar + routine; (ii) familiar + non-routine; (iii) unfamiliar + routine; (iv) unfamiliar + non-routine. Reasons will vary. (b) Pack X \$4.00 per GB; Pack Y \$3.00 per GB; Pack Y is \$1.00 per GB cheaper. (c) \$1 739.13.

Q13. (a) 204 beats per minute. (b) 122–153 beats per minute. (c) Specialised — it uses sports-science terminology (maximum heart rate, training zone, beats per minute); the calculations are routine.

Q14. (a) \$2 275. (b) 91 hours. (c) Unfamiliar (never run a grant); the calculations inside it (subtract, divide) are still routine — “unfamiliar” describes the situation, not how hard the maths is.

Q15. (a) 112.5 mL. (b) 337.5 mL. (c) Specialised — any two of: concentrate, mixing rate, spray tank, label rate.

Q16. Answers will vary. Model set — (a) familiar + routine: checking your own phone balance each Sunday night; unfamiliar + routine: totalling till dockets on your first day in a job where you have totalled dockets before; familiar + non-routine: at your local pool, working out the cheapest mix of entry passes for you and three cousins, a decision you have never made; unfamiliar + non-routine: costing ingredients for a one-off birthday cake across two different shops. (b) Specialised: reading a grain depot's moisture test chart to price a farmer's load. (c) Reasons must quote the definitions (known situation or not; regular procedure or not; area words needed or not). (d) Labels are personal — they depend on each person's own experience, so different examples can all be correct.

Q17. (a) \$290. (b) Counting the tin: routine (same steps every fete). The raffle plan: non-routine (a one-off plan with no regular procedure). (c) 132 tickets — 131 tickets give only \$598, so round up.

Q18. (a) Disagree — Example 3: the kennel's dose task is specialised and, for the kennel hand who gives it daily, routine. (b) Specialised tells you which area of work or knowledge a task belongs to (its words and steps); routine or non-routine tells you how regularly the person does it.

Fully-worked solutions

Q1. (a) Familiar: the recipe has been cooked every week for years, so the situation is well known. (b) Unfamiliar: the city's network has never been met before, so nothing about it is known yet. (c) Familiar: the same shop and the same items every day. Change: $\$50.00 - \$32.75 = \$17.25$.

Q2. (a) Routine: the same deposit slip is filled in the same way every week — a procedure done regularly. (b) Non-routine: combining a gift card with a “buy 3, pay for 2” offer is a one-off decision with no practised procedure, so the steps must be built. (c) Routine: the timetable is checked every morning, at a set time, the same way.

Q3. (a) Task (i): the torque settings table belongs to vehicle mechanics and must be read before any maths happens. (b) Any two of: torque (the turning force to apply), newton metres (Nm, the unit torque is measured in), torque settings table. (c) Tasks (ii) and (iii) use everyday words and practised steps; no particular area of work has to be learned first, so neither is specialised.

Q4. (a) (i) Familiar + routine: own timesheet, every Friday. (ii) Familiar + non-routine: the route is well known, but the replacement combination is a one-off plan. (iii) Unfamiliar + routine: a first day in a new centre, but recording attendance is a practised procedure from previous jobs. (iv) Unfamiliar + non-routine: a first catering job and a one-off plan. (b) Task (ii) sits in familiar + non-routine because the context (the usual route, the usual arrival time) is known, while the task — joining a bus and a tram in a new way — has no regular procedure. (c) Task (iv) sits in unfamiliar + non-routine because the situation has never been met and no practised procedure applies. Trays: $45 \div 12 = 3.75$; three trays serve only $3 \times 12 = 36$ people, fewer than 45, so round up to **4 trays** (four trays serve 48).

Q5. (a) Estimate: $40 \times \$2 = \$80$, so the cost should be near \$80. (b) Exact: $38.7 \times \$1.92 = \$74.304$; correct to the nearest cent this is **\$74.30** (the third decimal place, 4, rounds down). The estimate \$80 confirms it. (c) Familiar + routine: the same fill-up at the same pump every week with practised steps.

Q6. (a) $4 \times \$12.50 = \$50.00$. (b) $\$50.00 - \$45.00 = \$5.00$ saved. (c) The gym is a familiar context for Tanesha, but the task “decide which price is better for me” is non-routine: it is not a decision she makes regularly, so she builds it — cost each option for her own number of visits, then compare.

Q7. (a) 1: routine — the same checklist every morning at a set time (familiar too, once the yard is known). 2: unfamiliar + routine — the template is new, but totalling hours is a practised procedure. 3: routine — splitting into set packet sizes is a regular job with a known procedure. 4: unfamiliar + non-routine — a one-off job list; the cutting plan must be built, with no regular procedure. 5: specialised — the load chart and rated capacity are forklift terminology and must be understood first. One reason, as an example: task 5 is specialised because its words (load chart, rated capacity) belong to one area of work. (b) 3.5 kg is 3 500 g, and $3\,500 \div 250 = 14$ sample packets. (c) After a month the template is known, so **unfamiliar becomes familiar**; the task was routine from the start because totalling hours is a practised procedure.

Q8. (a) Sam: familiar + routine. The bakery, the chart and the batches are all well known to Sam after two years, and scaling a recipe is done regularly. (b) Jack: unfamiliar + non-routine. The bakery and the chart are new to Jack, and he has no practised procedure yet, so he must build the steps. (c) $45 \text{ batches} \times 750 \text{ g each} = 33\,750 \text{ g}$, and $33\,750 \div 1000 = 33.75 \text{ kg}$. Note the labels say nothing about the maths itself: both workers do the same multiplication.

Q9. (a) Week 1: unfamiliar + non-routine. The slip was new to Amira and checking it was not yet something she did regularly, so each step had to be worked out. (b) Now: familiar + routine. The same slip is checked every fortnight, with frequent practice — the situation is known and the procedure is regular. (c) Gross: $24 \times \$22.40 = \$537.60$, which matches the slip. Net: $\$537.60 - \$64.50 = \$473.10$, which also matches. The slip is correct. (d) The same task carried different labels at different times, so the labels describe a person's experience of a task, not the task alone — and they change as experience grows.

Q10. (a) Specialised: the card uses salon terminology — colour, developer, and a ratio in parts — and those words must be understood before the maths. For a stylist the arithmetic is routine. (b) Developer is 1.5 times the colour: $40 \times 1.5 = 60$ mL. (c) Total mix: $40 + 60 = 100$ mL.

Q11. (a) Print Hut: $\$60 + \$0.15 \times 400 = \$60 + \$60.00 = \$120.00$. (b) Copy Corner: $\$0.55 \times 400 = \$220.00$. (c) $\$150 \div \$0.55 = 272.72\dots$ flyers. A part flyer cannot be printed, and 273 flyers would cost $273 \times \$0.55 = \$150.15$, over the \$150 budget, so round **down: 272 whole flyers** (cost $272 \times \$0.55 = \$149.60$).

Q12. (a) (i) Familiar + routine — his own fete, counted the same way every year. (ii) Familiar + non-routine — his own phone shop and plan, but comparing packs is a new kind of decision. (iii) Unfamiliar + routine — first day at the nursery, but reading a schedule and totalling minutes is a practised procedure. (iv) Unfamiliar + non-routine — a first auction and a one-off plan under a budget. (b) Pack X: $\$12 \div 3 = \$4.00$ per GB. Pack Y: $\$15 \div 5 = \$3.00$ per GB. Pack Y is cheaper by \$1.00 per GB. (c) With a 15% buyer's fee, a bid of b costs $b \times 1.15$ in total, so $b = 2000 \div 1.15 = 1739.1304\dots$; correct to the nearest cent the highest bid is **\$1 739.13**. Check: the fee on \$1 739.13 is \$260.87 (to the nearest cent), and $\$1\,739.13 + \$260.87 = \$2\,000.00$, exactly the budget; one more cent on the bid goes over.

Q13. (a) $220 - 16 = 204$ beats per minute. (b) Lower end: $0.60 \times 204 = 122.4$; upper end: $0.75 \times 204 = 153$. To the nearest whole number of beats per minute the zone is **122–153** (122.4 rounds down to 122; 153 is already whole). (c) Specialised: the rule uses sports-science terminology — maximum heart rate, training zone, beats per minute — that must be learned before the percentages mean anything. Once the words are known, the calculations are routine.

Q14. (a) $\$3\,750 - \$1\,475$ leaves \$2 275 after materials. (b) $\$2\,275 \div \$25$ per hour gives 91 hours of labour. (c) For the student the task is unfamiliar — grants have never been run before — yet the calculations inside it (one subtraction, one division) are routine procedures. So “unfamiliar” describes the situation being new; it does not mean the maths is hard.

Q15. (a) A 9 L tank is $9 \div 2 = 4.5$ times the 2 L mixing rate, so $4.5 \times 25 = 112.5$ mL of concentrate. (b) Three full tanks: $3 \times 112.5 = 337.5$ mL. (c) Specialised: the label rate belongs to farm spraying, with its own words — any two of concentrate (the strong chemical before mixing), mixing rate (how much concentrate per volume of water), spray tank. For a farmer who mixes every season the calculation is also routine.

Q16. Answers will vary; the model set from the answers section shows the standard. Check each example against the definitions: familiar or unfamiliar asks whether *you* know the situation; routine or non-routine asks whether *you* do a procedure for it regularly; specialised asks whether one area's words and steps must be learned first. In (d), expect different lists: the labels are personal, so two students with different jobs, sports and families will (correctly) give different examples for the same cells.

Q17. (a) $3 \times \$50 + 4 \times \$20 + 6 \times \$10 = \$150 + \$80 + \$60 = \$290$. (b) Counting the tin is routine: the same steps at every fete, at a set time. The raffle plan is non-routine: a one-off plan with no regular procedure, so it must be built. (c) Let t be the tickets sold. Profit is takings minus costs: $290 + 3t - 85$. This must be at least 600: $290 + 3t - 85 \geq 600$, so $3t \geq 395$ and $t \geq 131.66\dots$. Check: 131 tickets give $290 + 393 - 85 = \$598$ (short of \$600) and 132 tickets give $290 + 396 - 85 = \$601$ (enough), so round **up: 132 tickets**.

Q18. (a) Disagree. Example 3 is a counter-example: the kennel's flea treatment task is specialised (chart, dose, per kilogram of body weight are animal-care terminology) and, for the kennel hand who gives it at set times every day, it is also routine. Any task can be specialised and routine at once. (b) *Specialised* tells you which area of work or knowledge a task belongs to — its particular words and steps must be learned first. *Routine* or *non-routine* tells you how regularly the person does the task — whether a practised procedure can simply be followed. The two words answer different questions, so one cannot force the other.

Chapter 1 — Test A (multiple choice)

Chapter 1: The problem-solving cycle and mathematical toolkit (Sections 1A to 1G). Answer all 12 questions. Each question is worth 1 mark, so Section A is worth 12 marks. Suggested time: 20 minutes.

Materials: pen, paper and a basic scientific calculator. No other technology is needed.

Choose the one best answer for each question and write its letter on the question paper.

About the data in this test. Every name, price, time and measurement here is **made up** (not real). The situations are invented to give you practice; they do not report facts about any real person, business or place.

Section A — Multiple-choice questions

Question 1

Which list gives the four stages of the problem-solving cycle in the correct order?

- A. act on and use mathematics; identify the mathematics; evaluate and reflect; communicate and report
- B. identify the mathematics; evaluate and reflect; act on and use mathematics; communicate and report
- C. communicate and report; identify the mathematics; act on and use mathematics; evaluate and reflect
- D. identify the mathematics; act on and use mathematics; evaluate and reflect; communicate and report

Question 2

A school's photo-day notice reads:

Photo packages are \$16.50 each. 22 students are ordering a package. The photographer charges the school \$240 for the day. Photos start at 9:00 am and each sitting takes 4 minutes. Wear your full school uniform.

Which information is **not** needed to work out the total the school pays for photo day?

- A. the \$240 for the day and the number of students ordering
- B. the \$16.50 package price and the number of students ordering
- C. the 9:00 am start and the 4-minute sittings
- D. the \$16.50 package price and the reminder about the uniform

Question 3

A plant nursery packs 74 seedlings into trays that hold 12 seedlings each. A tray cannot be split.

How many trays are needed for all 74 seedlings?

- A. 6
- B. 7
- C. 8
- D. 6.17

Question 4

A casual warehouse worker's pay slip shows 38 hours at \$23.50 an hour. Her calculator display reads $38 \times 23.50 = 8\,930$.

Which statement is correct?

- A. The display is right: the estimate $40 \times 25 = 1\,000$ shows that \$8 930 is in the right range.
- B. The display is right: pay is given in whole dollars, and 8 930 is a whole number of dollars.
- C. The display is right: $8\,930 \div 38 = 235$, and \$235 an hour is a believable rate for warehouse work.
- D. The display is wrong: $40 \times 25 = 1\,000$, so the total should be near \$1 000, but \$8 930 is about nine times that — the decimal point has slipped one place.

Question 5

A bakery has 340 muffins to pack. Each box holds 15 muffins.

How many **full** boxes can be packed?

- A. 21
- B. 22
- C. 23
- D. 22.67

Question 6

A council ranger records the height of a river at the same time each day for one month. She wants to show how the height changed across the month.

Which representation is the best choice?

- A. a line graph
- B. a pie chart
- C. a bar chart
- D. a table of the 30 readings

Question 7

A printer prints 3 600 pages in 275 minutes. A calculator shows $3\,600 \div 275 = 13.090909$.

Which sentence reports the printer's speed, correct to the nearest whole page per minute?

- A. The printer prints 13.090909 pages per minute.
- B. 13.090909
- C. The printer prints about 13.1 pages per minute.
- D. The printer prints 13 pages per minute, to the nearest whole page.

Question 8

A rain gauge is marked from 0 mm to 50 mm. There is a label every 10 mm and five small spaces between labels. After a storm, the water sits three spaces past the 20 mm label.

How much rain fell?

- A. 20.6 mm
- B. 23 mm
- C. 26 mm
- D. 30 mm

Question 9

A school orders 5 boxes of 12 markers and 3 boxes of 8 markers. Typed as one line, the calculation is $5 \times 12 + 3 \times 8$.

How many markers does the school order?

- A. 84
- B. 63
- C. 504
- D. 600

Question 10

A free torch app — an app that turns the phone screen into a light — asks Deniz for access to his contacts, his location and his camera before it will open.

What should Deniz do?

- A. Allow all three: the app is free, so it must earn money from something
- B. Close the app and choose one that asks only for what its job needs; a torch needs none of these
- C. Allow contacts and location, but not the camera
- D. Allow all three, then use a different password for banking than for games

Question 11

Every Friday afternoon, a store supervisor fills in the same stock sheet for the same six lines of goods — opening stock, deliveries, sales and closing stock — exactly as she has done for three years.

For the supervisor, this task is

- A. familiar and routine
- B. unfamiliar and routine
- C. familiar and non-routine
- D. unfamiliar and non-routine

Question 12

Every shift, a dry cleaner reads the garment care chart for each item and sets the machine for that fabric. The chart's words — fabric type, cycle, temperature — belong to dry cleaning. She has cleaned this way every shift for four years.

Which statement about this task is correct?

- A. It is specialised, so it must also be non-routine
- B. It is routine, so it cannot be specialised
- C. It is specialised, because it needs the area's own words, and routine, because she does it every shift
- D. It is neither specialised nor routine, because she has done it for four years

End of Section A

Test A — Answers

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

Test A — Fully-worked solutions

Q1. D. The cycle runs in this order: identify the mathematics, act on and use mathematics, evaluate and reflect, communicate and report (§1A). A does the mathematics before finding out what the mathematics is, B reflects on an answer that has not been found yet, and C reports before anything is worked out. The cycle also loops back: if the check in stage 3 fails, you return to stage 2 and do the mathematics again.

Q2. C. The total the school pays is the tickets plus the photographer's day fee: $22 \times \$16.50 = \$363.00$, and $\$363.00 + \$240 = \$603.00$. Every number in that working appears in A, B and D — the \$240 day fee, the \$16.50 price and the 22 students. The 9:00 am start and the 4-minute sittings say when things happen, not what they cost, so they are the extra information (§1B). The uniform reminder in D is not needed either, but D pairs it with the \$16.50 price, which is needed, so D is not the answer.

Q3. B. $74 \div 12 = 6.1666\dots$ trays. A tray cannot be split, and 6 trays hold only $6 \times 12 = 72$ seedlings — two short of 74. Seven trays hold $7 \times 12 = 84$, which covers all 74, so round **up**: $\therefore$ 7 trays are needed (§1B, §1C). A leaves seedlings unplanted, C buys a tray more than the job needs, and D is not a whole number of trays.

Q4. D. Estimate first with friendly numbers: $40 \times 25 = 1\,000$, so the true total sits near \$1 000 (§1C). The display reads \$8 930, which is about nine times the estimate because $8\,930 \div 1\,000 = 8.93$. That cannot be right, so the decimal point has slipped one place: $38 \times 23.50 = \$893.00$. A calls \$8 930 “in the right range” when it is nine times too big, B mistakes whole dollars for a correct answer, and C's backwards check returns \$235 an hour — a check only helps if you judge the answer it gives, and no casual warehouse job pays that.

Q5. B. $340 \div 15 = 22.666\dots$ Only **full** boxes count: $22 \times 15 = 330$ muffins are boxed and $340 - 330 = 10$ muffins are left over, so $\therefore$ 22 full boxes can be packed (§1C). Rounding down is the right judgement because a 23rd box would not be full: $23 \times 15 = 345$, which needs more muffins than the bakery has. A boxes 21 lots of 15 and leaves 25 muffins out when 15 more would fit, C needs muffins that do not exist, and D is not a whole number of boxes.

Q6. A. The ranger records one quantity (river height) at regular times, and she wants to show how it changed — a line graph is the representation for a change over time (§1D). A pie chart shows shares of one whole, and there is no whole being shared here (B). A bar chart compares separate categories, while these readings are a sequence of days (C). A table gives the exact readings but does not show the rise and fall at a glance (D).

Q7. D. $3\,600 \div 275 = 13.090909\dots$, and the question asks for the answer correct to the nearest whole page per minute: the first dropped digit is 0, which is less than 5, so the answer rounds to 13. A result sentence must carry the units and state the rounding, so $\therefore$ “The printer prints 13 pages per minute, to the nearest whole page” (§1D). Check: $13 \times 275 = 3\,575$ pages, inside the 3 600 printed, while $14 \times 275 = 3\,850$ is more. A copies the calculator's string of decimals, B is a bare number with no units and no sentence, and C rounds to a different precision from the one asked for.

Q8. C. Use the four steps for any scale (§1E). Find two labelled values, 20 mm and 30 mm; count the small spaces between them, five; so one space = $(30 - 20) \div 5 = 2$ mm. Read from the label and add the spaces: $20 + 3 \times 2 = 26$, so $\therefore$ 26 mm of rain fell. A counts a space as 0.2 mm, B counts a space as 1 mm, and D reads the next label up instead of adding the spaces.

Q9. A. Multiplication is done before addition, so the calculator finds $5 \times 12 = 60$ and $3 \times 8 = 24$ first and then adds them: $60 + 24 = 84$ markers (§1F). B stops after $60 + 3$, C works strictly left to right as $(60 + 3) \times 8 = 504$, and D puts brackets where none belong and finds $5 \times (12 + 3) \times 8 = 600$.

Q10. B. Give an app only the permissions its job genuinely needs (§1F). A torch uses the screen, so contacts, location and camera are all unnecessary; the right move is to close it and choose an app that asks for less. A and D hand over all three permissions — a separate password for banking is a good habit, but it does not take back access already given — and C still gives away two permissions the app has no use for.

Q11. A. *Familiar* asks whether you know the situation, and the supervisor has done this for three years, so the task is familiar. *Routine* asks whether there is a practised procedure done regularly, and the same sheet with the same six lines is filled in every Friday, so the task is routine (§1G). Both labels describe the person's experience rather than the arithmetic, so B, C and D each get one of the two labels wrong.

Q12. C. *Specialised* tells you the task belongs to one area of work and needs that area's own words first: fabric type, cycle and temperature are dry-cleaning terminology. *Routine* tells you how regularly the person does it: every shift for four years. The two words answer different questions, so a task can be both, and $\therefore$ C is correct (§1G). A and B each let one label force the other, and D mistakes “done often” for “not specialised”.

Chapter 1 — Test B (written response)

Chapter 1: The problem-solving cycle and mathematical toolkit (Sections 1A to 1G). Answer all eight questions in the spaces provided. Section B is worth 39 marks. Suggested time: 45 minutes.

Materials: pen, paper and a basic scientific calculator. No other technology is needed.

Show your working. Where a question asks you to round, use the precision the question states, and say what you rounded to.

About the data in this test. Every name, price, time and measurement here is **made up** (not real). The situations are invented to give you practice; they do not report facts about any real person, business or place.

Section B

Question 1 (5 marks)

A junior hockey club buys 8 water bottles for its under-14 team. Each bottle costs \$12.75. Use the four stages of the problem-solving cycle to answer the parts below.

a. Stage 1, *identify the mathematics*: write the calculation that finds the total cost. 1 mark

b. Stage 2, *act on and use mathematics*: estimate the total cost by rounding \$12.75 to \$13. 1 mark

c. Stage 2, *act on and use mathematics*: find the exact total cost. 1 mark

d. Stage 3, *evaluate and reflect*: use your estimate to say whether your exact total is reasonable, and explain. 2 marks

Question 2 (5 marks)

A reception centre is setting up for a wedding. Round tables seat 8 guests each, and 62 guests are coming. A table cannot be shared with another booking.

a. Write the **Purpose** line for a plan of this task. 1 mark

b. Write the **Mathematics** line for the plan: the calculation that must be done. 1 mark

c. Find how many tables the centre needs. 1 mark

d. Explain why the answer to (c) is not 7.75 tables. Use a calculation in your explanation. 2 marks

Question 3 (6 marks)

In each part, decide whether to round **up**, round **down** or round to the **nearest**, and say which you used.

- a. A school prints 1 250 newsletters. Paper comes in reams of 500 sheets, and reams are sold whole. How many reams must the school buy? 2 marks

- b. A 47 m roll of irrigation pipe is cut into lengths of 3.5 m. How many full lengths can be cut? 2 marks

- c. A postal scale reads 4.62 kg for a parcel. The postage table gives prices to the nearest 0.1 kg. What mass should be used from the table? 2 marks

Question 4 (4 marks)

Each task below cannot be solved. Explain why not.

- a. Nadia wants the total cost of four pairs of shoes from an online store. The site tells her the delivery fee is \$3.50, but the price of one pair will not load. 2 marks

- b. A builder's ute has a load limit of 900 kg. A delivery note asks for 14 crates of tiles, each crate 75 kg, to be carried in one trip. 2 marks

Question 5 (5 marks)

A craft group buys 14 balls of wool at \$3.85 each. The treasurer pays with a \$60 note.

- a. Find the total cost of the wool. 1 mark

- b. Find the change from the \$60 note. 1 mark

- c. Write a **result sentence** reporting the change. It must include the units and say whether the value is exact or rounded. 1 mark

- d. Write the **Check** line for this report: one estimate and one backwards check. 2 marks

Question 6 (5 marks)

Jo is a florist. She uses analogue tools every day.

a. Jo wraps a bouquet with 2.5 m of twine. Write this length in centimetres.

1 mark

b. Jo's cool-room thermometer is marked from 0 °C to 10 °C, with a label every 2 °C and four small spaces between labels. The pointer sits three spaces past the 4 °C label. Read the temperature, and say whether the cool room is inside the 2 °C to 6 °C range that flowers need.

2 marks

c. Jo needs to measure a 3 mm gap under the cool-room door. Which is the better tool: a 30 cm ruler marked in millimetres, or a trundle wheel that clicks once per metre? Give a reason using the word **fineness**.

2 marks

Question 7 (5 marks)

A childcare centre keeps its equipment order in a spreadsheet. Column B holds the quantity, column C the price each and column D the total. Every cell in column D holds a formula like =B2*C2, and cell D7 holds =SUM(D2:D6). The supplier's price list says jugs cost \$5.50 each, but \$5.10 was typed into C4.

Row	Item	Quantity (B)	Price each (C)	Total (D)
2	Tablecloths	7	\$12.40	\$86.80
3	Mugs	20	\$2.00	\$40.00
4	Jugs	5	\$5.10	\$25.50
5	Lamps	6	\$10.50	\$63.00
6	Clocks	4	\$4.55	\$18.20
7				\$233.50

Made-up data: the centre's order and every number in this spreadsheet are made up for this test.

a. Explain why D4 and D7 both change as soon as C4 is corrected, without anybody retyping them.

1 mark

b. Check the five totals in column D against columns B and C. Name the row whose input is wrong, and write the value that C4 should hold.

2 marks

c. Write the corrected values of D4 and D7.

2 marks

Question 8 (4 marks)

- (i) On her first shift at a bookshop, Mei packs returned paperbacks into boxes of 24, following the same packing steps she used at her last job.
- (ii) Tessa has shopped at the same supermarket for years. This week she must plan and cost a catering order for a graduation party — something she has never done — using the store's bulk prices.

a. Classify each task as **familiar** or **unfamiliar**, and as **routine** or **non-routine**.

2 marks

b. Tessa's order comes to \$240 and she has a voucher for 10% off. Find the price she pays with the voucher.

1 mark

c. Explain what the word **specialised** tells you about a task, and why a specialised task can still be routine.

1 mark

End of Section B

Test B — Answers

Q1. (a) $8 \times \$12.75$. (b) \$104. (c) \$102.00. (d) reasonable — the exact total is \$2.00 below the estimate.

Q2. (a) e.g. “Work out how many round tables are needed so that all 62 guests have a seat.” (b) tables = $62 \div 8$. (c) 8 tables. (d) $7 \times 8 = 56$ seats, six guests short; $8 \times 8 = 64$ seats, enough.

Q3. (a) 3 reams, rounded up. (b) 13 full lengths, rounded down. (c) 4.6 kg, rounded to the nearest 0.1 kg.

Q4. (a) No — the price of one pair of shoes is missing. (b) $14 \times 75 = 1\,050$ kg, which is 150 kg over the 900 kg limit; at most 12 crates fit.

Q5. (a) \$53.90. (b) \$6.10. (c) e.g. “The change from the \$60 note is \$6.10, exact to the cent.” (d) estimate $14 \times \$4 = \$56$; backwards $\$53.90 + \$6.10 = \$60.00$.

Q6. (a) 250 cm. (b) $5.5\text{ }^{\circ}\text{C}$ — inside the $2\text{ }^{\circ}\text{C}$ to $6\text{ }^{\circ}\text{C}$ range. (c) the 30 cm ruler; its 1 mm marks are fine enough for a 3 mm gap.

Q7. (a) Column D holds formulas that refer to other cells, so outputs follow inputs. (b) Row 4 (jugs); C4 should hold \$5.50. (c) $D4 = \$27.50$; $D7 = \$235.50$.

Q8. (a) (i) unfamiliar and routine; (ii) familiar and non-routine. (b) \$216.00. (c) specialised = the area’s own words and steps must be learned first; a specialised task done every shift is also routine.

Test B — Fully-worked solutions

Q1. (a) Stage 1 finds the mathematics: the total is 8 lots of \$12.75, so the calculation is $8 \times \$12.75$. (b) Rounding \$12.75 up to \$13 gives the estimate $8 \times 13 = \$104$. (c) The exact working is $8 \times \$12.75 = \$102.00$. (d) Stage 3 compares the two: \$102.00 is \$2.00 below the estimate of \$104.00, and the estimate should sit a little higher because the price was rounded up, so the exact total is reasonable. $\therefore$ The 8 water bottles cost \$102.00.

Q2. (a) Purpose — e.g. “Work out how many round tables the reception centre needs so that all 62 guests have a seat.” (b) Mathematics — tables = $62 \div 8$. (c) $62 \div 8 = 7.75$, and a table cannot be part-bought, so round **up**: $\therefore$ 8 tables are needed. (d) Seven tables would seat $7 \times 8 = 56$ guests, which is $62 - 56 = 6$ guests short, and eight tables seat $8 \times 8 = 64$ guests, which covers all 62 with two seats spare. Rounding down would leave six guests standing, so 7.75 cannot be the answer (§1B).

Q3. (a) $1250 \div 500 = 2.5$. Two reams give $2 \times 500 = 1000$ sheets, which is 250 short, so round **up**: $\therefore$ the school must buy 3 reams. (b) $47 \div 3.5 = 13.4285\dots$ Thirteen lengths use $13 \times 3.5 = 45.5$ m and leave 1.5 m over, while 14 lengths would need $14 \times 3.5 = 49$ m, more than the roll holds, so round **down**: $\therefore$ 13 full lengths can be cut. (c) The table only gives prices to the nearest 0.1 kg, so round **to the nearest 0.1 kg**: the second decimal digit of 4.62 is 2, which is less than 5, so $\therefore$ use 4.6 kg. In each part the rounding follows the consequence — buying short, cutting short, reading a table — not the arithmetic alone (§1C).

Q4. (a) No, it cannot be solved. The total is $4 \times (\text{price of one pair}) + \$3.50$, and the price of one pair never loads, so a needed number is missing (§1C). Nadia must find that price — on the site, from the store, or on a printed receipt — before any working can start. (b) The conditions are impossible: 14 crates at 75 kg each weigh $14 \times 75 = 1050$ kg, which is $1050 - 900 = 150$ kg over the ute’s 900 kg limit. The most the ute can carry is $900 \div 75 = 12$ crates, and $12 \times 75 = 900$ kg exactly, so $\therefore$ one trip cannot do the job: it needs two trips, or a lighter load.

Q5. (a) $14 \times \$3.85 = \$53.90$. (b) $\$60.00 - \$53.90 = \$6.10$. (c) A result sentence carries the units and says whether the value is exact or rounded, e.g. “The change from the \$60 note is \$6.10, exact to the cent.” (d) Check — estimate: $14 \times \$4 = \$56$, so the total should be near \$56 and the change near \$4, and \$53.90 and \$6.10 are the right size; backwards: $\$53.90 + \$6.10 = \$60.00$, which returns the note paid. Both checks pass, so $\therefore$ the wool costs \$53.90 and the change is \$6.10 (§1D).

Q6. (a) $2.5 \times 100 = 250$, so $\therefore$ 2.5 m is 250 cm. (b) Two labelled values are 4 °C and 6 °C, with four small spaces between them, so one space = $2 \div 4 = 0.5$ °C. The pointer is three spaces past 4 °C: $4 + 3 \times 0.5 = 5.5$, so $\therefore$ the cool room is 5.5 °C. Flowers need 2 °C to 6 °C and 5.5 °C is inside that range, so the cool room is safe — but it is near the top of the range, so Jo would be sensible to check again later. (c) The 30 cm ruler. Fineness is the smallest change a tool can show: the ruler’s marks are 1 mm apart, so a 3 mm gap spans three marks and is easy to read, while the trundle wheel clicks once per metre — a fineness of 1 000 mm — and cannot show a gap far smaller than one metre (§1E).

Q7. (a) Column D holds formulas rather than typed numbers: D4 holds $=B4 * C4$ and D7 holds $=SUM (D2 : D6)$. A formula refers to cells, so correcting C4 recalculates D4, and the new D4 flows straight into D7 — outputs follow inputs, and nothing is retyped (§1F). (b) Check each row by multiplying B by C: $7 \times \$12.40 = \$86.80 \checkmark$, $20 \times \$2.00 = \$40.00 \checkmark$, $5 \times \$5.10 = \$25.50 \checkmark$, $6 \times \$10.50 = \$63.00 \checkmark$ and $4 \times \$4.55 = \$18.20 \checkmark$. Every formula agrees with its own inputs, so the error must be an input: row 4 (jugs) holds \$5.10 in C4 while the price list says \$5.50, so $\therefore$ C4 should hold \$5.50 — it was typed \$0.40 low. (c) Corrected D4 = $5 \times \$5.50 = \$27.50$, and corrected D7 = $\$86.80 + \$40.00 + \$27.50 + \$63.00 + \$18.20 = \$235.50$. Check: the old total of \$233.50 rises by \$2.00, which is $5 \times \$0.40$, the five jugs at \$0.40 more each. $\therefore$ D4 = \$27.50 and D7 = \$235.50.

Q8. (a) (i) Mei’s bookshop is an **unfamiliar** context — a new workplace on her first shift — but packing into boxes of 24 is **routine** for her, because she has a practised procedure from her last job: unfamiliar and routine. (ii) Tessa’s supermarket is **familiar** — she has shopped there for years — while planning and costing a graduation catering order is something she has never done and has no procedure for, so it is **non-routine**: familiar and non-routine (§1G). (b) 10 % of \$240 is $\$240 \div 10 = \$24.00$, so $\$240 - \$24.00 = \$216.00$. $\therefore$ Tessa pays \$216.00 with the voucher. (c) *Specialised* tells you that a task belongs to a particular area of work or knowledge, and that the area’s own words and steps must be learned before the mathematics makes sense. It says nothing about how often the task is done — that is

what *routine* and *non-routine* tell you. So a specialised task done every shift, such as reading the same chart and following the same steps, is specialised and routine at once: the two labels answer different questions.