

# VCE VM Numeracy Units 3 & 4

## Chapter 6 — Unit 3 numeracy in context

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### Theory

**Personal numeracy** is the mathematics of running your own life: the numbers you meet when you shop, cook, plan an event, tend a garden, play sport or travel. The study design (Unit 3, Outcome 1) describes it as working with the numbers and maths that come in many formats and media. You understand them, use them and make sense of them, so you can carry out activities that matter in your own life. Those activities can be routine, non-routine or unfamiliar, and some can be specialised.

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

Personal numbers arrive in many formats — a shelf tag, a receipt, a recipe card, a timetable, a fuel gauge, an ad on your phone. The skill is reading the format, pulling out the numbers that matter, and using them to make a sensible decision.

**Where you meet personal numeracy.** The study design's examples for this numeracy (Unit 3, Outcome 1) cover everyday situations like these:

- reading numbers in print and on screens, including amounts of money
- planning a BBQ, a family event or a class excursion, and working out its costs and arrangements
- everyday jobs for you and your family, such as cooking, gardening, sport and travel
- saving money: comparing prices when the discounts or the ways to pay are different
- finding unit prices, and comparing how much fuel cars use and what that fuel costs

Every one of these uses mathematics you already have from Chapters 2 to 5: percentages and ratio (Chapter 2), time and measures (Chapter 4), and rates (Chapter 5). This section puts those tools to work on your own life.

### The problem-solving cycle, at home.

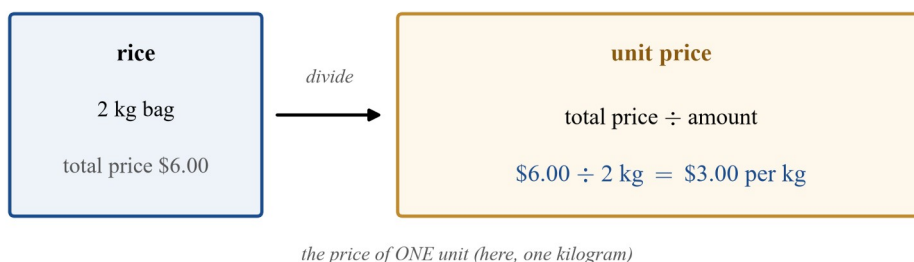
Personal tasks never arrive labelled “use division”. You run each one through the four-stage cycle from §1A: **identify** the mathematics, **act** on it, **evaluate** and reflect, then **communicate** the result. Here it is on a small job.

| Stage             | Working                                                                                            |
|-------------------|----------------------------------------------------------------------------------------------------|
| <b>1 Identify</b> | Two friends share a \$14 pizza bill equally. Find each share: divide.                              |
| <b>2 Act</b>      | Estimate: \$14 is close to \$15, and $15 \div 2 \approx \$7.50$ .<br>Exact: $14 \div 2 = \$7.00$ . |
| <b>3 Evaluate</b> | \$7.00 is near the estimate and two shares of \$7 add back to \$14 ✓. Reasonable.                  |
| <b>4 Report</b>   | “Each friend pays \$7.00.”                                                                         |

From here on, every example and question in this section is worked the same way.

### Unit prices — the best buy.

A **unit price** is the price of one unit: one kilogram, one litre, one item, one hundred grams. It is a **rate** (§5B) — a price *per* something. To find it, divide the total price by the amount.



Unit prices let you compare packs of different sizes fairly. The pack with the *lower* unit price is the **better buy**, even if its total price looks bigger. Supermarket shelf tags often print the unit price for you; when they do not, work it out.

### Discounts and percentage off.

A **discount** is an amount taken *off* the marked price, usually given as a percentage (§2F). Find the percentage of the price, then subtract. The **multiplier** shortcut multiplies by what is left: 25 % off keeps 75 %, so multiply by 0.75.

Worked model: a jacket marked \$80 is 25 % off. Discount:  $0.25 \times \$80 = \$20$ . Sale price:  $\$80 - \$20 = \$60$ .  
Multiplier check:  $0.75 \times \$80 = \$60$  ✓.

### Payment deals and instalments.

Shops offer deals to move stock: “3 for \$12”, “buy two get one half price”, or “pay in 4 interest-free instalments”. A deal is only good if it beats the price you would actually pay. Work out the cost per item under the deal and compare it with the single price. With **instalments**, divide the total by the number of payments — and notice whether interest or fees are added, because that changes the true cost.

### Ratio and proportion in the kitchen.

Recipes are written for a set number of serves. To cook for more (or fewer) people you **scale** every ingredient by the same **ratio** (§2G). The scale factor is new serves  $\div$  old serves. Multiply each amount by that factor and the recipe still works.

Worked model: a recipe serves 4; you need 6. Scale factor =  $6 \div 4 = 1.5$ . An ingredient of 200 g becomes  $200 \times 1.5 = 300$  g.

### Fuel economy and the cost of a trip.

Cars state **fuel economy** in litres per 100 km (L/100 km) — a rate. To find the fuel a trip uses, count how many 100 km lots the trip is, then multiply by the rate. Multiply the litres by the fuel price per litre for the cost.

Worked model: a car uses 7 L per 100 km. A 250 km trip is 2.5 lots of 100 km, so it uses  $2.5 \times 7 = 17.5$  L. At \$1.90 per litre the fuel costs  $17.5 \times \$1.90 = \$33.25$ . A lower L/100 km figure means a more economical car.

### Time and durations for planning.

Events run on the clock. Reading **24-hour time** and adding **durations** (§4D) tells you when you arrive, when you finish, and whether a plan actually fits the day. Add the hours and minutes separately, and carry 60 minutes over into an extra hour.

### Estimate, then check.

Stage 3 of the cycle is your safety net. Round the numbers to something easy, do the calculation in your head, and compare. If the exact answer is nowhere near the estimate, something went wrong — loop back and redo it (§1C).

### Tools.

A calculator, a phone app or a spreadsheet all handle these calculations (§1E, §1F). But every question here can be done with pen, paper and a basic calculator. Estimate first, calculate carefully, then check.

## Precision.

Carry full precision through your working and round only where the question tells you to — and the question always says how far (“correct to the nearest cent”, “to 2 decimal places”). Money is rounded to the nearest cent (§2C).

**About the data in this section.** The prices, plans, recipes and timetables here are **made up** (not real): pretend shops, pretend events 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.

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## Worked examples

### Example 1 — scaffolded

Two brands of pasta sauce sit side by side on the shelf. Which is the better buy?

| Brand A       | Brand B       |
|---------------|---------------|
| pasta sauce   | pasta sauce   |
| 750 g         | 500 g         |
| <b>\$4.50</b> | <b>\$3.20</b> |

*which is the better buy? work out the price per 100 g*

#### Working

#### Comment

**Stage 1 — Identify:** compare the price per 100 g for each brand. Plan: unit price = total price ÷ number of 100 g lots.

Different pack sizes cannot be compared by total price alone.

**Stage 2 — Act:** Brand A: 750 g is 7.5 lots of 100 g, so  $\$4.50 \div 7.5 = \$0.60$  per 100 g.

“Per 100 g” makes the two packs comparable.

Brand B: 500 g is 5 lots of 100 g, so  $\$3.20 \div 5 = \$0.64$  per 100 g.

Same method, second pack.

**Stage 3 — Evaluate:** both sit around 60 cents per 100 g, and A is the smaller number, so A is cheaper per unit. The gap (\$0.04) is small but real.

The check confirms the comparison is close, not a miskey.

**Stage 4 — Report:** “Brand A is the better buy at \$0.60 per 100 g; it saves \$0.04 per 100 g.”

Per-kg check: A = \$6.00/kg, B = \$6.40/kg — same conclusion.

### Example 2 — scaffolded

A family is hosting a BBQ for 12 people. They buy the catering below: 3 packs of sausages, 2 packs of bread rolls, the drinks and the salad. The shop takes 10 % off the total for buying in bulk. Find the total cost and the cost per person.

| FAMILY BBQ<br>catering prices          |                 |
|----------------------------------------|-----------------|
| Sausages                               | \$6.50 per pack |
| Bread rolls                            | \$3.20 per pack |
| Drinks                                 | \$18.00         |
| Salad                                  | \$12.50         |
| 10% off the total when you buy in bulk |                 |
| 12 people are coming                   |                 |

## Working

## Comment

**Stage 1 — Identify:** find the subtotal (all four items), remove the 10 % discount, then share over 12 people.

Three steps: add, discount, divide.

**Stage 2 — Act:** sausages:  $3 \times \$6.50 = \$19.50$ ; rolls:  $2 \times \$3.20 = \$6.40$ .

Multiply each “per pack” price by the packs bought.

Subtotal:  $\$19.50 + \$6.40 + \$18.00 + \$12.50 = \$56.40$

Add the four line costs.

Discount: 10 % of  $\$56.40 = \$5.64$ . Total:  $\$56.40 - \$5.64 = \$50.76$ .

A discount comes *off*, so subtract.

Per person:  $\$50.76 \div 12 = \$4.23$ .

Share the discounted total over 12.

**Stage 3 — Evaluate:** estimate subtotal  $\approx \$20 + \$6 + \$18 + \$12 = \$56$ ; 10 % off  $\approx \$50.40$ ; per person  $\approx \$4.20$ . The exact figures sit right beside these.

The estimate and the exact working agree.

**Stage 4 — Report:** “The BBQ costs \$50.76 after the discount, which is \$4.23 per person.”

Multiplier check:  $0.90 \times \$56.40 = \$50.76 \checkmark$ .

## Example 3 — unscaffolded

Priya’s car uses 8.4 L of fuel per 100 km. She drives 350 km to a coastal town and back, so the return trip is 700 km in total. Fuel costs \$1.86 per litre. Find the fuel used and the fuel cost for the whole return trip, correct to the nearest cent.

| Priya's trip                                                                        |                  |
|-------------------------------------------------------------------------------------|------------------|
| Fuel use:                                                                           | 8.4 L per 100 km |
| Distance:                                                                           | 350 km           |
| Fuel price:                                                                         | \$1.86 per litre |
|  |                  |

**Stage 1 — Identify.** The return trip is 700 km. Count the 100 km lots, multiply by the fuel rate to get litres, then multiply by the price per litre.

**Stage 2 — Act.** 700 km is  $700 \div 100 = 7$  lots of 100 km. Fuel used:  $7 \times 8.4 = 58.8$  L. Fuel cost:  $58.8 \times \$1.86 = \$109.368$ .

**Stage 3 — Evaluate.** Estimate: 58.8 L is close to 60 L, and  $60 \times \$1.90 = \$114$ , so a cost a little under \$114 is reasonable — \$109.368 fits. Carrying full precision matters here: rounding the litres first would shift the cents. (For reference, the one-way 350 km leg uses  $3.5 \times 8.4 = 29.4$  L, costing  $29.4 \times \$1.86 = \$54.684$ , or \$54.68 to the nearest cent.)

**Stage 4 — Report.**

$\therefore$  the return trip uses 58.8 L of fuel and costs **\$109.37**, correct to the nearest cent.

#### Example 4 — unscaffolded

The pancake card below serves 4. Kai wants to serve 6. Find the amount of each ingredient he needs.

**PANCAKES**  
*serves 4*

- 200 g flour
- 2 eggs
- 300 mL milk
- 1 tablespoon sugar

*Kai wants to serve 6 — scale every amount up*

**Stage 1 — Identify.** Scaling a recipe means multiplying every amount by the same scale factor: new serves  $\div$  old serves =  $6 \div 4 = 1.5$ .

**Stage 2 — Act.**

- flour:  $200 \times 1.5 = 300$  g
- eggs:  $2 \times 1.5 = 3$  eggs
- milk:  $300 \times 1.5 = 450$  mL
- sugar:  $1 \times 1.5 = 1.5$  tablespoons

**Stage 3 — Evaluate.** The factor is bigger than 1, so every amount must grow — and each has ( $300 > 200$ ,  $3 > 2$ ,  $450 > 300$ ,  $1.5 > 1$ ) ✓. Three eggs for six people is half an egg each, the same as two eggs for four — the ratio is preserved.

**Stage 4 — Report.**

$\therefore$  for 6 serves Kai needs 300 g flour, 3 eggs, 450 mL milk and 1.5 tablespoons of sugar.

---

## Practice questions

### Scaffolded

**Q1.** Find the unit price in each case. (a) A 3 kg bag of potatoes costs \$7.50. Find the price per kg. (b) A 4 L carton of juice costs \$9.60. Find the price per litre. (c) A 6-pack of eggs costs \$4.20. Find the price per egg.

**Q2.** A jacket is marked \$120 and is discounted by 15 %. (a) Find the discount in dollars. (b) Find the sale price. (c) Check your answer to (b) using the multiplier.

**Q3.** A stir-fry recipe serves 2 and uses 1 cup of rice, 300 g of chicken and 1 capsicum. You need to serve 6. (a) Find the scale factor. (b) How much rice do you need? (c) How much chicken and how many capsicums do you need?

**Q4.** A school excursion bus leaves at 08:45 and the drive takes 1 h 50 min. (a) What time does the bus arrive? Give your answer in 24-hour time. (b) The activities run for 3 h 20 min from arrival. What time do they finish? (c) The bus leaves for home at 14:10 and the drive takes 1 h 45 min. What time does it get back?

**Q5.** A car uses 9 L of fuel per 100 km. It makes a 400 km trip, and fuel costs \$1.75 per litre. (a) How many litres of fuel does the trip use? (b) Find the fuel cost for the trip. (c) Six people share the fuel cost equally. How much does each person pay?

**Q6.** A club needs 28 trophies. Trophies are sold in boxes of 12 for \$45 a box, and boxes cannot be split. (a) Work out  $28 \div 12$  to 2 decimal places, then state how many boxes the club must buy. Explain your rounding. (b) Find the total cost of the boxes. (c) Find the cost per trophy (using the 28 trophies), correct to the nearest cent.

### **Unscaffolded**

**Q7.** Two packs of rice sit on the same shelf. Pack A holds 5 kg and costs \$12.00. Pack B holds 3 kg and costs \$7.80. (a) Find the price per kg for each pack. (b) Which pack is the better buy? (c) How much do you save by choosing the better pack instead of buying 5 kg at the other pack's per-kg price?

**Q8.** A cereal is priced at \$4.50 each, or “3 for \$12”.

**BREAKFAST AISLE**

Cereal

\$4.50 each

**or 3 for \$12**

- (a) Find the price per box under the “3 for \$12” deal.
- (b) How much do you save per box by using the deal?
- (c) You need 6 boxes. Compare the cost of 6 boxes on the deal with 6 boxes at the single price, and state the saving.

**Q9.** A household's electricity bill rises from \$180 to \$207 in one quarter. (a) Find the increase in dollars. (b) Find the percentage increase. (c) The bill rises by another 15 % the next quarter. Find the new bill.

**Q10.** A class of 24 students goes on an excursion. The costs are shown.

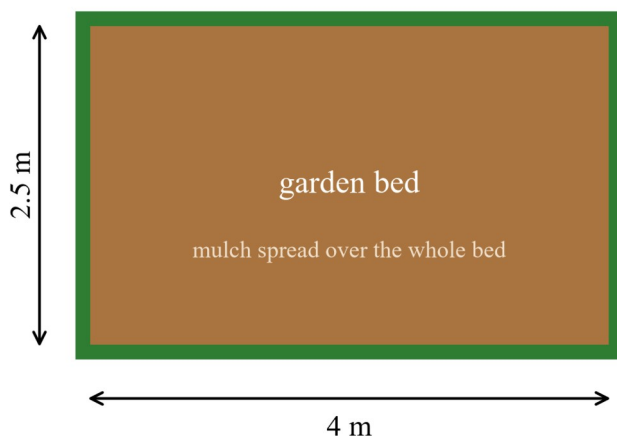
| CLASS EXCURSION                                      |              |
|------------------------------------------------------|--------------|
| <i>costs for 24 students</i>                         |              |
| Bus hire                                             | \$180 (flat) |
| Entry ticket                                         | \$13.50 each |
| Lunch                                                | \$7.25 each  |
| <i>work out the total, then the cost per student</i> |              |

- (a) Find the total cost of the entry tickets for the 24 students.
- (b) Find the total cost of the excursion (bus hire, entry and lunch).
- (c) Find the cost per student.

**Q11.** A lentil soup recipe serves 6 and uses 300 g lentils, 2 carrots, 1.5 L of stock and 3 cloves of garlic. A community kitchen needs to serve 15. Find the amount of each ingredient needed.

**Q12.** A rectangular garden bed measures 4 m by 2.5 m. Mulch is spread over the whole bed to a depth of 0.1 m.

**mulch depth: 0.1 m (10 cm)**



- (a) Find the area of the garden bed in  $\text{m}^2$ .
- (b) Find the volume of mulch needed in  $\text{m}^3$ .
- (c) Mulch is sold in  $0.5 \text{ m}^3$  bags for \$18 a bag. How many bags are needed, and what do they cost?

**Q13.** A runner covers 5 km in 25 minutes at a steady pace. (a) Find the runner's average speed in km/h. (b) At this pace, how many minutes does an 8 km run take? (c) How far does the runner travel in 1 h 15 min?

**Q14.** Two cars are compared for a 600 km trip. Car X uses 7.5 L per 100 km; Car Y uses 5.8 L per 100 km. Fuel costs \$1.80 per litre. (a) Find the fuel used by each car for the trip. (b) Find the fuel cost for each car. (c) How much does Car Y save over the trip?

**Q15.** A commuter's train departs at 07:52 and arrives at 09:17. (a) How long is the trip? Give your answer in hours and minutes. (b) One morning the train is delayed by 18 minutes. What time does it now arrive? (c) The return train arrives at 18:20, and the walk home takes 15 minutes. What time does the commuter get home? Give your answer in 24-hour time.

**Q16.** A streaming service advertises two plans.

**STREAMTIME — choose a plan**

|                                                                     |                                                                        |
|---------------------------------------------------------------------|------------------------------------------------------------------------|
| <b>Individual</b><br><br><b>\$4.50</b><br>per month<br><br>1 person | <b>Family</b><br><br><b>\$16.20</b><br>per month<br><br>up to 6 people |
|---------------------------------------------------------------------|------------------------------------------------------------------------|

- (a) Find the cost of the Family plan for 12 months.
- (b) Six people share one Family plan and split the monthly cost equally. How much does each person pay per month?
- (c) Six people on separate Individual plans would pay  $6 \times \$4.50$  a month. How much does the shared Family plan save per month?

**Q17.** A coat costs \$240. The shop offers “4 interest-free instalments”, or a 50 deposit followed by 4 equal instalments on the remainder, or a 5 % discount for paying cash up front. (a) Find each instalment under the “4 interest-free instalments” option. (b) Find each instalment under the deposit option. (c) Find the cash price and the saving compared with \$240.

**Q18.** A family is planning a birthday party for 30 guests. The costs are: venue hire \$150 (flat), catering \$9.50 per guest, cake \$45, decorations \$60. (a) Find the total catering cost for 30 guests. (b) Find the total cost of the party. (c) Find the cost per guest. (d) Four family organisers split the total cost equally. How much does each pay?

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## Answers

**Q1.** (a) \$2.50 per kg. (b) \$2.40 per L. (c) \$0.70 per egg. **Q2.** (a) \$18. (b) \$102. (c)  $0.85 \times \$120 = \$102$  ✓. **Q3.** (a) 3. (b) 3 cups. (c) 900 g chicken; 3 capsicums. **Q4.** (a) 10:35. (b) 13:55. (c) 15:55. **Q5.** (a) 36 L. (b) \$63.00. (c) \$10.50 each. **Q6.** (a) 2.33 to 2 d.p.; 3 boxes (round up — 2 boxes hold only 24). (b) \$135. (c) \$4.82 (to the nearest cent). **Q7.** (a) A \$2.40/kg; B \$2.60/kg. (b) Pack A. (c) \$1.00. **Q8.** (a) \$4.00. (b) \$0.50. (c) deal \$24.00, single \$27.00; saving \$3.00. **Q9.** (a) \$27. (b) 15 %. (c) \$238.05. **Q10.** (a) \$324. (b) \$678. (c) \$28.25. **Q11.** lentils 750 g; carrots 5; stock 3.75 L; garlic 7.5 cloves. **Q12.** (a)  $10 \text{ m}^2$ . (b)  $1 \text{ m}^3$ . (c) 2 bags; \$36. **Q13.** (a) 12 km/h. (b) 40 min. (c) 15 km. **Q14.** (a) X 45 L; Y 34.8 L. (b) X \$81.00; Y \$62.64. (c) \$18.36. **Q15.** (a) 1 h 25 min. (b) 09:35. (c) 18:35. **Q16.** (a) \$194.40. (b) \$2.70. (c) \$10.80 per month. **Q17.** (a) \$60. (b) \$47.50. (c) \$228; saving \$12. **Q18.** (a) \$285. (b) \$540. (c) \$18.00. (d) \$135.00.

---

## Fully-worked solutions

**Q1.** (a) Price per kg =  $\$7.50 \div 3 = \$2.50$  per kg. (b) Price per litre =  $\$9.60 \div 4 = \$2.40$  per L. (c) Price per egg =  $\$4.20 \div 6 = \$0.70$  per egg. Check (stage 3):  $3 \times \$2.50 = \$7.50$  ✓,  $4 \times \$2.40 = \$9.60$  ✓,  $6 \times \$0.70 = \$4.20$  ✓ — the unit prices rebuild the totals.

**Q2.** (a) Discount = 15 % of  $\$120 = 0.15 \times \$120 = \$18$ . (b) Sale price =  $\$120 - \$18 = \$102$ . (c) A 15 % discount keeps 85 %:  $0.85 \times \$120 = \$102$  ✓ — same as (b).

**Q3.** (a) Scale factor =  $6 \div 2 = 3$ . (b) Rice:  $1 \times 3 = 3$  cups. (c) Chicken:  $300 \times 3 = 900$  g; capsicum:  $1 \times 3 = 3$  capsicums. Evaluate: serving three times as many people needs three times each ingredient ✓.

**Q4.** (a) 08:45 + 1 h 50 min:  $45 + 50 = 95$  min = 1 h 35 min, so  $8 + 1 = 9$  h plus the carried hour gives 10 h 35 min → **10:35**. (b) 10:35 + 3 h 20 min = 13 h 55 min → **13:55**. (c) 14:10 + 1 h 45 min = 15 h 55 min → **15:55**.

**Q5.** (a) 400 km is 4 lots of 100 km, so fuel =  $4 \times 9 = 36$  L. (b) Cost =  $36 \times \$1.75 = \$63.00$ . (c) Share =  $\$63.00 \div 6 = \$10.50$  each. Evaluate: 36 L at about \$2/L is near \$72, and \$63 sits below that as expected ✓.

**Q6.** (a)  $28 \div 12 = 2.3333\dots = 2.33$  to 2 decimal places. Boxes are whole, and 2 boxes hold only  $2 \times 12 = 24$  trophies — not enough for 28 — so round **up** to 3 boxes. (b) Cost =  $3 \times \$45 = \$135$ . (c) Cost per trophy =  $\$135 \div 28 = \$4.8214\dots$ , which is **\$4.82** correct to the nearest cent. Evaluate:  $28 \times \$4.82 \approx \$134.96$ , close to \$135 (the tiny gap is the rounding) ✓.

**Q7.** (a) Pack A:  $\$12.00 \div 5 = \$2.40$  per kg. Pack B:  $\$7.80 \div 3 = \$2.60$  per kg. (b)  $\$2.40 < \$2.60$ , so **Pack A** is the better buy. (c) 5 kg at B's per-kg price =  $5 \times \$2.60 = \$13.00$ . Pack A costs \$12.00, so the saving is  $\$13.00 - \$12.00 = \$1.00$ .

**Q8.** (a) Price per box on the deal =  $\$12 \div 3 = \$4.00$ . (b) Saving per box =  $\$4.50 - \$4.00 = \$0.50$ . (c) 6 boxes on the deal is 2 lots of “3 for \$12”:  $2 \times \$12 = \$24.00$ . At the single price:  $6 \times \$4.50 = \$27.00$ . Saving =  $\$27.00 - \$24.00 = \$3.00$ .

**Q9.** (a) Increase =  $\$207 - \$180 = \$27$ . (b) Percentage increase =  $\frac{27}{180} \times 100 = 15\%$ . (c) A further 15 % rise keeps 115 %:  $\$207 \times 1.15 = \$238.05$ . Evaluate: 15 % of \$207 is about \$31, and  $\$207 + \$31 = \$238$  ✓.

**Q10.** (a) Entry:  $24 \times \$13.50 = \$324$ . (b) Lunch:  $24 \times \$7.25 = \$174$ . Total =  $\$180 + \$324 + \$174 = \$678$ . (c) Per student =  $\$678 \div 24 = \$28.25$ . Evaluate: about \$28 each times 24 is near \$672, close to \$678 ✓.

**Q11.** Scale factor =  $15 \div 6 = 2.5$ . Multiply every amount by 2.5: lentils  $300 \times 2.5 = 750$  g; carrots  $2 \times 2.5 = 5$ ; stock  $1.5 \times 2.5 = 3.75$  L; garlic  $3 \times 2.5 = 7.5$  cloves. Evaluate: each amount grew by the same factor, so the recipe keeps its balance ✓.

**Q12.** (a) Area =  $4 \times 2.5 = 10 \text{ m}^2$ . (b) Volume = area  $\times$  depth =  $10 \times 0.1 = 1 \text{ m}^3$ . (c) Bags =  $1 \div 0.5 = 2$  bags. Cost =  $2 \times \$18 = \$36$ . Evaluate: two half-cubic-metre bags make exactly  $1 \text{ m}^3$  ✓, so nothing is wasted.

**Q13.** (a)  $25 \text{ min} = \frac{25}{60} \text{ h}$ . Speed  $= 5 \div \frac{25}{60} = 5 \times \frac{60}{25} = 12 \text{ km/h}$ . (b) Time for 8 km  $= 8 \div 12 = \frac{2}{3} \text{ h} = 40 \text{ min}$ . (c) 1 h 15 min  $= 1.25 \text{ h}$ . Distance  $= 12 \times 1.25 = 15 \text{ km}$ . Evaluate: 12 km/h means 1 km every 5 min, and 8 km at 5 min each is 40 min ✓.

**Q14.** (a) Car X:  $600 \div 100 = 6$  lots,  $6 \times 7.5 = 45 \text{ L}$ . Car Y:  $6 \times 5.8 = 34.8 \text{ L}$ . (b) Car X:  $45 \times \$1.80 = \$81.00$ . Car Y:  $34.8 \times \$1.80 = \$62.64$ . (c) Saving  $= \$81.00 - \$62.64 = \$18.36$ . Evaluate: Y uses about 10 L less, and  $10 \times \$1.80 = \$18$ , close to \$18.36 ✓.

**Q15.** (a) From 07:52 to 09:17: 07:52  $\rightarrow$  08:52 is 1 h, then 08:52  $\rightarrow$  09:17 is 25 min, so 1 h 25 min. (b) 09:17 + 18 min  $= 09:35 \rightarrow$  **09:35**. (c) 18:20 + 15 min  $= 18:35 \rightarrow$  **18:35**.

**Q16.** (a) 12 months of the Family plan:  $\$16.20 \times 12 = \$194.40$ . (b) Per person per month:  $\$16.20 \div 6 = \$2.70$ . (c) Six Individual plans:  $6 \times \$4.50 = \$27.00$  a month. Saving  $= \$27.00 - \$16.20 = \$10.80$  per month. Evaluate: \$2.70 each times 6 rebuilds \$16.20 ✓.

**Q17.** (a) Instalment  $= \$240 \div 4 = \$60$ . (b) Remainder after the deposit:  $\$240 - \$50 = \$190$ . Instalment  $= \$190 \div 4 = \$47.50$ . (c) Cash price  $= 95\% \text{ of } \$240 = 0.95 \times \$240 = \$228$ . Saving  $= \$240 - \$228 = \$12$ . Evaluate:  $4 \times \$60 = \$240$  ✓ and  $\$50 + 4 \times \$47.50 = \$240$  ✓ — both payment paths total the full price, while cash is cheaper.

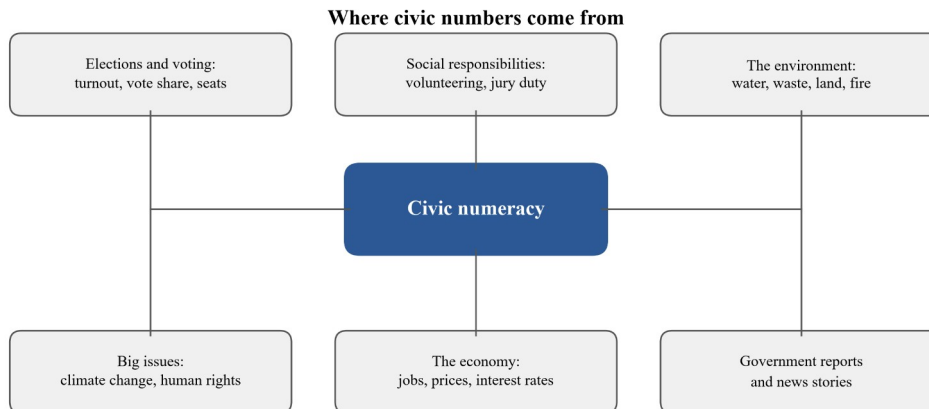
**Q18.** (a) Catering:  $30 \times \$9.50 = \$285$ . (b) Total  $= \$150 + \$285 + \$45 + \$60 = \$540$ . (c) Per guest  $= \$540 \div 30 = \$18.00$ . (d) Each organiser pays  $\$540 \div 4 = \$135.00$ . Evaluate:  $30 \times \$18 = \$540$  ✓ and  $4 \times \$135 = \$540$  ✓ — the shares add back to the bill.

### Theory

**What civic numeracy is.** Civic numbers are the numbers in public life: the ones in news stories, council reports, election results and government budgets. The study design (Unit 3, Outcome 1) describes civic numeracy as the maths you need to take part in public life: knowing how to keep yourself informed, and making sense of the data, facts and processes of government, politics and society.

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

Civic numeracy turns up in five big places, and this section visits all of them.



- **Elections and voting** — how many people are enrolled, how many voted, and how votes turn into seats.
- **Social responsibilities** — the numbers behind volunteering, jury duty and other obligations.
- **The environment** — water storage, waste, land management and fire management.
- **State, national and global issues** — climate change, human rights and access to things like safe water.
- **The economy** — unemployment, underemployment, participation, inflation and official interest rates.

**Rates: a part of a whole.** Most civic numbers are rates: a part of something, compared with the whole, out of 100.

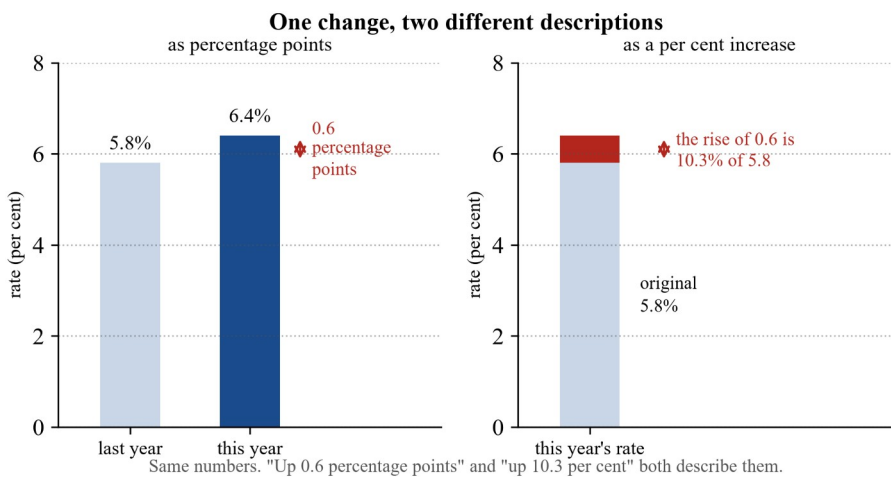
$$\text{rate} = \text{part} \div \text{whole} \times 100$$

For example, if 39 840 of the 48 000 enrolled voters in a shire cast a vote, the turnout is  $39\,840 \div 48\,000 \times 100 = 83\%$ .

When the whole is a population, reports often use a rate **per 100 000 people** so that big and small places can be compared. One town had 42 reported break-ins in a population of 12 000: that is  $42 \div 12\,000 \times 100\,000 = 350$  per 100 000 people. A smaller town had 38 in a population of 6 000:  $38 \div 6\,000 \times 100\,000 = 633.3$  per 100 000 people, correct to 1 decimal place. The smaller town had fewer break-ins but a much higher rate.

**Percentage points and per cent.** These two are different and news stories mix them up. Suppose a rate goes from 5.8% to 6.4%.

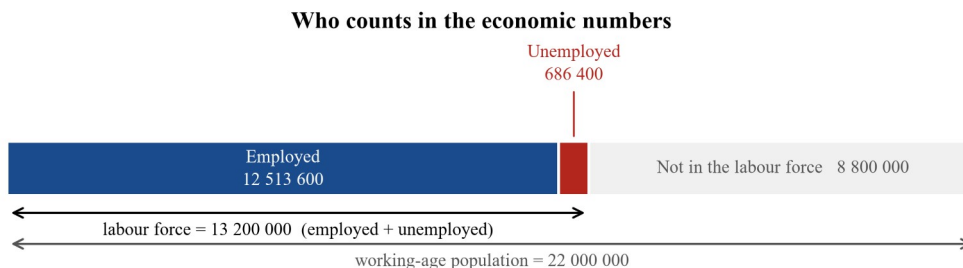
- The **percentage point** change is the simple difference:  $6.4 - 5.8 = 0.6$  percentage points.
- The **per cent** change compares the rise with where it started:  $0.6 \div 5.8 \times 100 = 10.3\%$ , correct to 1 decimal place.



Both sentences are true: “the rate rose 0.6 percentage points” and “the rate rose 10.3 per cent”. Always check which one a report means.

**Jobs, prices and interest rates.** Economic reports use a few words with exact meanings.

- **Employed:** people who did some paid work in the survey week.
- **Unemployed:** people with no paid work who are actively looking for work.
- **Labour force:** employed + unemployed. People who are not working and not looking (retired, studying full time, caring full time) are **not in the labour force**.
- **Unemployment rate:**  $\text{unemployed} \div \text{labour force} \times 100$ .
- **Participation rate:**  $\text{labour force} \div \text{working-age population} \times 100$ .
- **Underemployed:** people working part time who would like more hours. They are counted as employed, even though their hours are not enough.



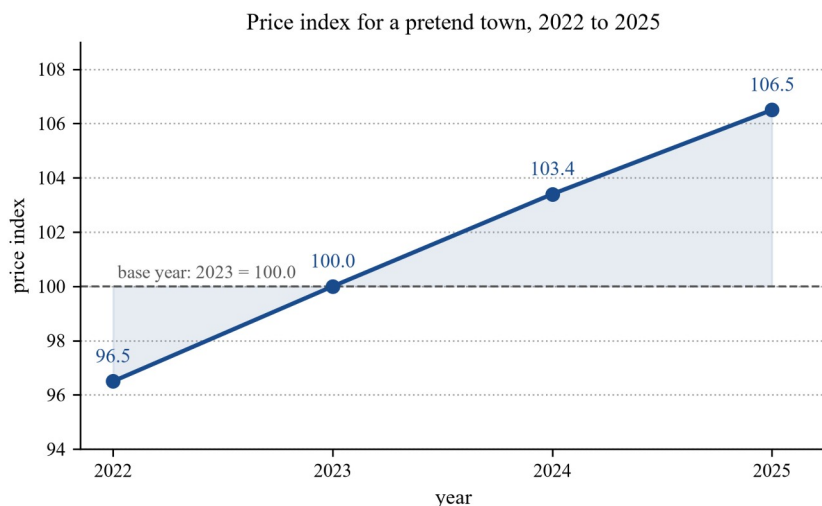
$$\text{unemployment rate} = \text{unemployed} \div \text{labour force} \times 100 = 5.2\%$$

$$\text{participation rate} = \text{labour force} \div \text{working-age population} \times 100 = 60.0\%$$

The two rates use DIFFERENT denominators — that is why they are different numbers.

In the picture above the labour force is  $12\,513\,600 + 686\,400 = 13\,200\,000$  people, so the unemployment rate is  $686\,400 \div 13\,200\,000 \times 100 = 5.2\%$  and the participation rate is  $13\,200\,000 \div 22\,000\,000 \times 100 = 60.0\%$ . The two rates look similar but they use different denominators, so they answer different questions.

**Prices and index numbers.** An **index number** compares prices with a base year, whose index is set to 100. An index of 118.4 means prices are 18.4% above the base year. The **inflation rate** for a year is the per cent rise in the index from the year before.



**Interest rates.** The official interest rate is a per cent per year. When it rises, borrowing costs rise. A rate of 6% per year on \$1 000 is  $6 \div 100 \times \$1\,000 = \$60$  in interest for one year. A rise from 3.10% to 3.35% is a rise of 0.25 percentage points, even though newspapers may call it “a quarter of a per cent”.

**Environmental and civic measures.** Civic reports mix units, so these conversions are worth knowing.

- 1 kL (kilolitre) = 1 000 L; 1 ML (megalitre) = 1 000 kL = 1 000 000 L. Dams are usually measured in ML or kL.
- 1 ha (hectare) = 10 000 m<sup>2</sup>; 1 km<sup>2</sup> = 100 ha = 1 000 000 m<sup>2</sup>. Parks, farms and fire scars are measured in ha or km<sup>2</sup>.
- 1 cm = 10 mm. Sea-level reports usually quote mm per year.
- “ppm” means parts per million. Carbon dioxide at 421 ppm is  $421 \div 1\,000\,000 = 0.0421\%$  of the air, or 4.21 parts in every 10 000.

For example, if sea level rose 84 mm over 30 years, that is  $84 \div 30 = 2.8$  mm per year, which is 8.4 cm over the 30 years.

**Reading a civic number critically.** Before you believe a number in a report, ask these questions.

- What is the **whole**? A rate is only meaningful once you know what it is a part of.
- Is it a **count or a rate**? “More thefts” can just mean “more people”.
- Is the change in **percentage points or per cent**?
- Over **what period**? A one-year jump and a ten-year trend are different facts.
- Does the graph’s **axis start at 0**? An axis that starts part-way up makes small differences look huge.
- **Who collected the data**, and is the source stated?

**The problem-solving cycle.** Civic tasks run through the same four stages as any numeracy task. Here is what they look like for the question “Our council claims youth enrolment is falling. Should we run an enrolment drive?”

| Stage              | What it looks like for this civic task                                                                                            |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Stage 1 — Identify | The claim is about a rate over time: enrolled young voters $\div$ all young people $\times 100$ , for each of the last few years. |
| Stage 2 — Act      | Read the enrolment figures from the council report, compute each year’s rate, and find the change in percentage points.           |
| Stage 3 — Evaluate | Check the size of the fall against the whole period, check whether it is a rate or a count, and decide if the claim holds.        |
| Stage 4 — Report   | Write a short answer for the council: the rate fell from                                                                          |

one value to another, so the drive is (or is not) justified.

**About the data in this section.** Every council, election, price index, dam, park and country in this section is **made up** (not real). The numbers are chosen to look like the reports you see in the news so that the practice is realistic, but no real place, person or election is described.

### Worked examples

#### *Example 1 — scaffolded*

The table shows the result of a made-up council election.

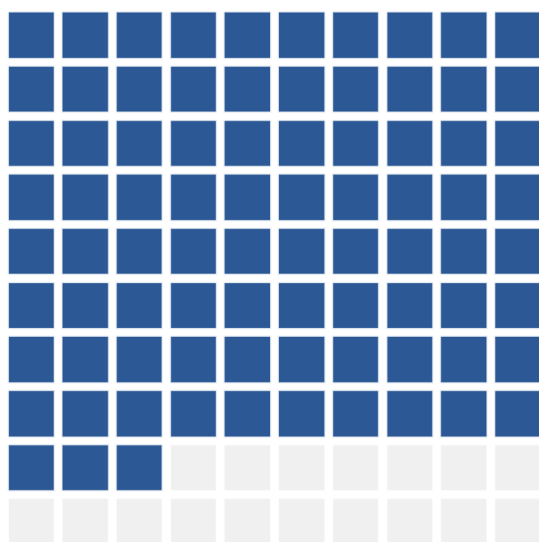
| Council election, Bayview Shire                                                 | Number |
|---------------------------------------------------------------------------------|--------|
| Enrolled voters                                                                 | 48 000 |
| Votes cast                                                                      | 39 840 |
| Informal votes (ballots not counted, because they were not filled in correctly) | 1 152  |
| Votes for candidate A                                                           | 14 508 |

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

- Find the turnout: the votes cast as a percentage of enrolled voters.
- Find the number of enrolled voters who did not cast a vote, and write it as a percentage of enrolled voters.
- Find the informal votes as a percentage of the votes cast, correct to 1 decimal place.
- Find candidate A's votes as a percentage of the **formal** votes (the votes cast, minus the informal votes).
- Half of the formal votes is enough to win outright. Find how many more votes candidate A would have needed to reach half of the formal votes.

| Working                                            | Comment                                               |
|----------------------------------------------------|-------------------------------------------------------|
| (a) $39\,840 \div 48\,000 \times 100 = 83$         | The whole is the enrolled voters. The turnout is 83%. |
| (b) $48\,000 - 39\,840 = 8\,160$                   | These enrolled voters did not cast a vote.            |
| $8\,160 \div 48\,000 \times 100 = 17$              | So 17% of enrolled voters did not cast a vote.        |
| (c) $1\,152 \div 39\,840 \times 100 = 2.8915\dots$ | The whole here is the votes cast, not the enrolment.  |
| 2.9%, correct to 1 decimal place                   | Rounded as the question asks.                         |
| (d) $39\,840 - 1\,152 = 38\,688$                   | Formal votes = votes cast – informal votes.           |
| $14\,508 \div 38\,688 \times 100 = 37.5$           | Candidate A's share of the formal vote is 37.5%.      |
| (e) $38\,688 \div 2 = 19\,344$                     | Half of the formal votes.                             |
| $19\,344 - 14\,508 = 4\,836$                       | Candidate A needed 4 836 more votes.                  |

Turnout: 83 of every 100 enrolled voters voted



83 squares shaded = 83% voted    17 squares left blank = 17% did not vote

The picture checks part (a): 83 squares in every 100 are shaded, one for each 1% of enrolled voters who cast a vote.

### Example 2 — scaffolded

In a made-up region the labour force was 13 200 000 people in both of the last two years. The number of unemployed people rose from 686 400 last year to 858 000 this year.

- Write the labour force, 13 200 000, in words.
- Find the unemployment rate for last year and for this year.
- Find the change in the unemployment rate in percentage points, and then as a percentage increase, correct to the nearest whole number.
- Find the number of employed people this year.

| Working                                                      | Comment                                                 |
|--------------------------------------------------------------|---------------------------------------------------------|
| (a) thirteen million two hundred thousand                    | Read the number in groups of three digits.              |
| (b) last year: $686\,400 \div 13\,200\,000 \times 100 = 5.2$ | The whole for an unemployment rate is the labour force. |
| this year: $858\,000 \div 13\,200\,000 \times 100 = 6.5$     | Same denominator, bigger part.                          |
| (c) $6.5 - 5.2 = 1.3$                                        | The rate rose 1.3 percentage points.                    |
| $1.3 \div 5.2 \times 100 = 25$                               | As a percentage increase, the rate rose 25%.            |
| (d) $13\,200\,000 - 858\,000 = 12\,342\,000$                 | Employed = labour force – unemployed.                   |

Notice how different (c)'s two answers are: 1.3 percentage points sounds small, while 25% sounds large. They are the same change described against different wholes.

### Example 3 — unscaffolded

A made-up town publishes a price index with 2023 as the base year.

| Year        | 2023  | 2024  | 2025  |
|-------------|-------|-------|-------|
| Price index | 100.0 | 103.4 | 106.5 |

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

- Find the inflation rate for 2024 and for 2025, correct to 1 decimal place.
- A grocery basket cost \$182.50 in 2023, the base year. Find what the same basket would cost in 2025 if its price rose exactly with the index. Give your answer correct to the nearest cent.
- A part-time worker's weekly payment was \$470.00 in 2023 and \$484.10 in 2025. Find the payment's rise as a percentage, and decide whether it kept pace with prices over those two years.
- Write the 2025 payment of \$484.10 in 2023 dollars, correct to the nearest cent, and find how much buying power the worker lost against the 2023 payment.

For (a), the inflation rate for a year is the rise in the index from the year before, as a percentage of the earlier index. For 2024:  $(103.4 - 100.0) \div 100.0 \times 100 = 3.4\%$ . For 2025:  $(106.5 - 103.4) \div 103.4 \times 100 = 2.998\ldots\%$ , which is 3.0% correct to 1 decimal place.

For (b), the 2025 index is 106.5 against the base year's 100.0, so 2025 prices are  $106.5 \div 100.0 = 1.065$  times base-year prices:  $\$182.50 \times 1.065 = \$194.3625$ , which is \$194.36 correct to the nearest cent.

For (c), the payment rose  $\$484.10 - \$470.00 = \$14.10$ , and  $\$14.10 \div \$470.00 \times 100 = 3\%$ . Prices over the same two years rose  $(106.5 - 100.0) \div 100.0 \times 100 = 6.5\%$ . Because 3% is less than 6.5%, the payment did **not** keep pace with prices.

For (d), to write a 2025 amount in 2023 dollars, divide by the price rise:  $\$484.10 \div 1.065 = \$454.5539\ldots$ , which is \$454.55 correct to the nearest cent. Against the \$470.00 the worker earned in 2023, that is  $\$470.00 - \$454.55 = \$15.45$  of lost buying power.

$\therefore$  inflation was 3.4% then 3.0%; the basket would cost \$194.36; the payment rose only 3% against prices of 6.5%, so in 2023 dollars it was worth \$454.55 — a shortfall of \$15.45.

### Example 4 — unscaffolded

A made-up town draws its water from one dam. The table is from the water authority's summer report.

| Dam report                   | Value    |
|------------------------------|----------|
| Capacity of the dam          | 8 400 ML |
| Storage on 1 December        | 6 090 ML |
| Storage at the end of summer | 5 320 ML |
| Households in the town       | 5 000    |

| Dam report                                 | Value    |
|--------------------------------------------|----------|
| Water used by those households in one year | 1 095 ML |

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

- Find the storage on 1 December as a percentage of capacity.
- Find the storage at the end of summer as a percentage of capacity, correct to 1 decimal place.
- Find the fall over summer as a percentage of the 1 December storage, correct to 1 decimal place.
- Find the water used per household in one year in kL, and then in litres per day. Use 365 days in a year.
- The authority asks every household to cut use by 15%. Find the new daily use per household in litres, and the saving per household over one year in kL.

The whole for (a) and (b) is the capacity:  $6\,090 \div 8\,400 \times 100 = 72.5\%$ , and  $5\,320 \div 8\,400 \times 100 = 63.333\ldots\%$ , which is 63.3% correct to 1 decimal place. For (c) the whole is the starting storage: the fall is  $6\,090 - 5\,320 = 770$  ML, and  $770 \div 6\,090 \times 100 = 12.643\ldots\%$ , which is 12.6% correct to 1 decimal place.

For (d), convert first: 1 095 ML = 1 095 000 kL. Shared over 5 000 households that is  $1\,095\,000 \div 5\,000 = 219$  kL per household per year. In litres that is 219 000 L, and per day  $219\,000 \div 365 = 600$  L exactly.

For (e), a 15% cut leaves 85% of the use:  $600 \times 0.85 = 510$  L per day. The saving is  $600 - 510 = 90$  L per day, so over a year  $90 \times 365 = 32\,850$  L, which is 32.85 kL per household.

$\therefore$  the dam went from 72.5% to 63.3% full (a fall of 12.6% of the December storage), households use 600 L per day, and a 15% cut takes that to 510 L per day, saving 32.85 kL per household per year.

## Practice questions

### Scaffolded

**Q1.** A made-up state electoral commission reports 3 480 620 enrolled voters.

- Write 3 480 620 in words.
- Round 3 480 620 to the nearest 100 000.
- The commission says 4.37% of votes were informal. Write 4.37% as a decimal, then round that decimal to 3 decimal places and to 2 decimal places.

**Q2.** A made-up survey asked 2 500 enrolled voters whether they voted in the last election, and 1 675 said yes.

- Write the fraction of people who said they voted in simplest form, and as a percentage.
- Write the percentage of people who did **not** say they voted.
- Find the number of people in the survey who did not say they voted.

**Q3.** In a made-up city, 4 800 of the 62 400 enrolled citizens were summoned for jury duty in one year.

- Find the summoned citizens as a percentage of enrolled citizens, correct to 1 decimal place.
- Write the same rate in the form “1 in n”, where n is a whole number.
- A second made-up city has 156 000 enrolled citizens and summons jurors at the same rate. Find how many are summoned.

**Q4.** A made-up central bank raised its official interest rate from 5.75% per year to 6.05% per year.

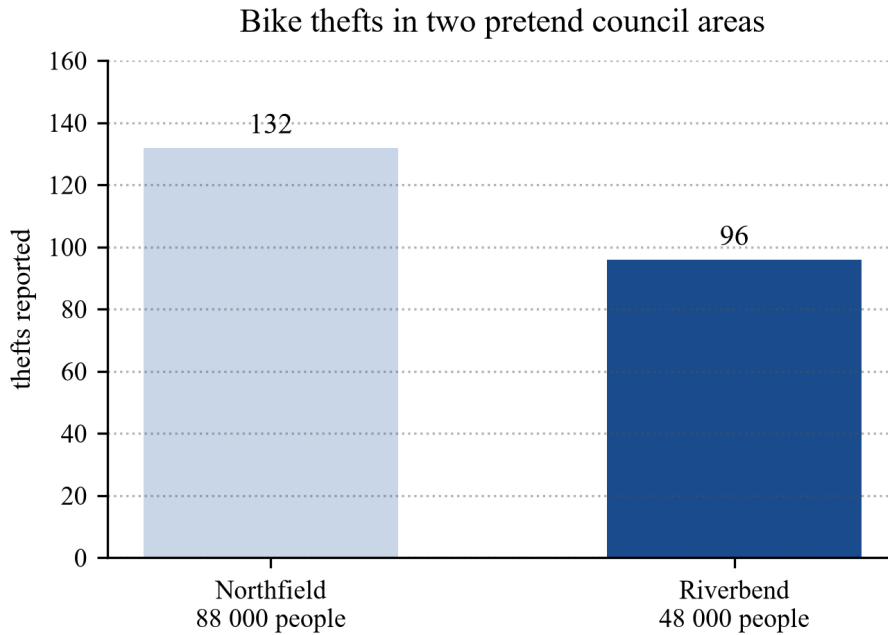
- Find the rise in percentage points.
- Find the rise as a percentage increase, correct to 1 decimal place.
- A headline writer rounds your answer to (b) and writes “rates up 5%”. Show that raising 5.75% by 5% gives a rise of only 0.288 percentage points, correct to 3 decimal places, so the headline understates the rise.

**Q5.** Convert these civic and environmental measures.

- (a) A made-up town uses 2 400 kL of water in a day. Write this in litres.
- (b) A made-up wildlife reserve covers 3.5 km<sup>2</sup>. Write this in hectares.
- (c) A made-up council owns 12 ha of public parkland. Write this in square metres.

**Q6.** Two made-up council areas report bike thefts for one year. Northfield reported 132 thefts and has 88 000 people. Riverbend reported 96 thefts and has 48 000 people.

- (a) Find the rate of reported thefts per 100 000 people for each area.
- (b) Which area had more reported thefts, and which area had the higher rate?
- (c) Find the difference between the two rates, per 100 000 people.



## Unscaffolded

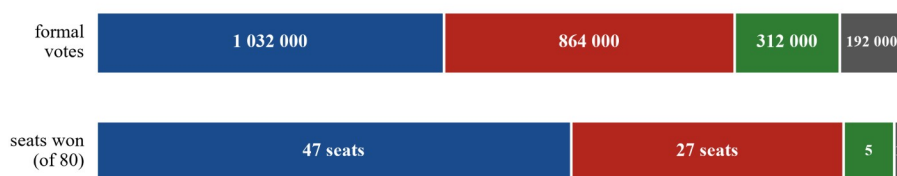
**Q7.** The table shows a made-up state election with 80 seats in parliament.

| Party   | Formal votes | Seats won |
|---------|--------------|-----------|
| Party A | 1 032 000    | 47        |
| Party B | 864 000      | 27        |
| Party C | 312 000      | 5         |
| Others  | 192 000      | 1         |
| Total   | 2 400 000    | 80        |

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

- Find each group's share of the formal vote as a percentage.
- Find Party A's share of the seats as a percentage, correct to 1 decimal place.
- A majority in an 80-seat parliament means more than half the seats. Find the smallest number of seats that is a majority, and how many seats Party A has above that number.
- Find Party B's share of the seats as a percentage, correct to 1 decimal place.

The same election, counted two ways



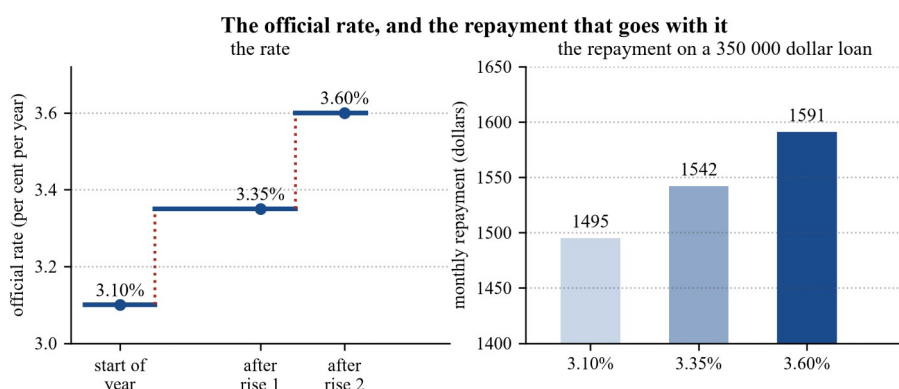
■ Party A ■ Party B ■ Party C ■ Others

**Q8.** A made-up central bank raised the official interest rate twice in one year: from 3.10% to 3.35%, then from 3.35% to 3.60%. The table shows the monthly repayment on a made-up \$350 000 home loan over 30 years at each rate; the repayments are correct to the nearest dollar.

| Official rate     | 3.10%   | 3.35%   | 3.60%   |
|-------------------|---------|---------|---------|
| Monthly repayment | \$1 495 | \$1 542 | \$1 591 |

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

- Find the total rise in the official rate over the year, in percentage points.
- Find the rise in the monthly repayment from the start of the year to the end, and the extra paid over 12 months.
- Find the rise in the monthly repayment as a percentage of the first repayment, correct to 1 decimal place.
- Find the rise in the official rate itself as a percentage of the first rate, correct to 1 decimal place, and compare it with your answer to (c).
- Find the total of the repayments over the 30 years of the loan at the 3.60% rate.



The axis on the right does not start at 0 — read the numbers, not the picture.

**Q9.** In a made-up region there are 17 500 000 people of working age. Of these, 10 528 000 are employed and 672 000 are unemployed.

- Find the labour force.
- Find the unemployment rate.
- Find the participation rate.
- Find the number of working-age people not in the labour force, and write it as a percentage of the working-age population.

**Q10.** Use the labour force from Q9. In the same made-up region, 740 000 people are underemployed: working part time but wanting more hours.

- Find the underemployment rate: underemployed people as a percentage of the labour force, correct to 1 decimal place.
- Find the total number of unemployed and underemployed people, and write it as a percentage of the labour force, correct to 1 decimal place.
- A minister says “about 1 in 8 people in the labour force is unemployed or underemployed”. Decide whether that claim is reasonable, and justify your answer with your figure from (b).

**Q11.** A made-up country publishes this price index, with 2023 as the base year.

| Year        | 2022 | 2023  | 2024  | 2025  |
|-------------|------|-------|-------|-------|
| Price index | 96.5 | 100.0 | 103.4 | 106.5 |

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

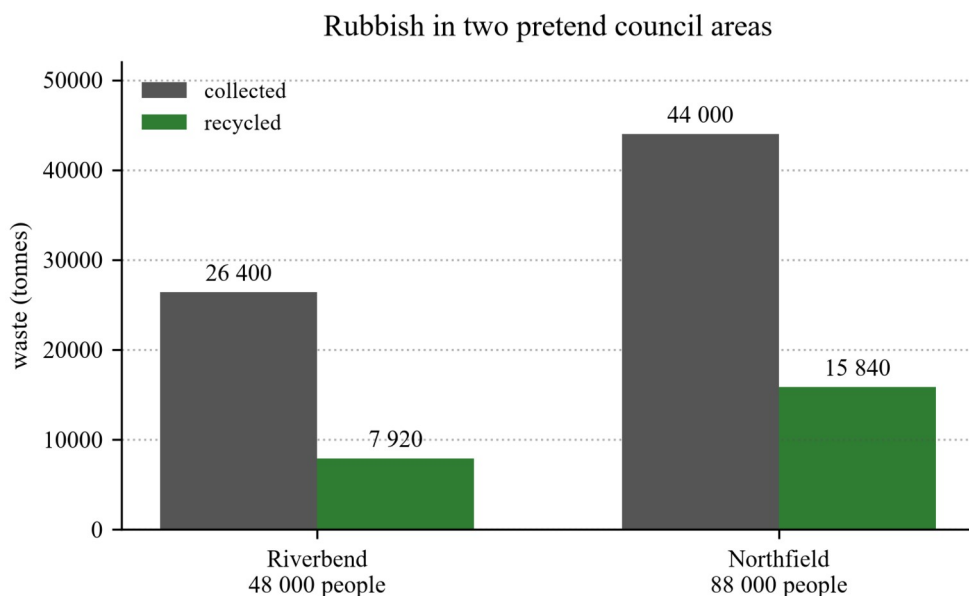
- Find how much lower prices were in 2022 than in 2023, as a percentage.
- Find the inflation rate for 2023, 2024 and 2025, each correct to 1 decimal place.
- Find the total rise in prices from 2022 to 2025 as a percentage, correct to 1 decimal place.
- A made-up pension payment was \$510.00 per week in 2023 and \$545.70 per week in 2025. Find the rise as a percentage, and decide whether the payment kept pace with prices from 2023 to 2025.
- Write the 2025 payment of \$545.70 in 2023 dollars, correct to the nearest cent, and find how far above the original \$510.00 payment it is.

**Q12.** Two made-up council areas report their household waste for one year.

| Council area | Waste collected | Waste recycled | Population |
|--------------|-----------------|----------------|------------|
| Riverbend    | 26 400 t        | 7 920 t        | 48 000     |
| Northfield   | 44 000 t        | 15 840 t       | 88 000     |

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

- Find the recycling rate ( $\text{recycled} \div \text{collected} \times 100$ ) for each area.
- Find the waste collected per person in each area, in kilograms. (1 t = 1 000 kg.)
- Find the tonnes of waste Riverbend sent to landfill (collected – recycled).
- Riverbend sets a target: cut landfill waste by 20% and recycle the difference instead. Find the new landfill tonnage, the new recycled tonnage, and the new recycling rate. How many percentage points is that above the old rate?



**Q13.** A made-up farming district records these figures.

- Average yearly rainfall: 640 mm in 1995, falling to 512 mm in 2025.
- The district dam has a capacity of 12 500 ML and currently holds 9 250 ML.
- The water authority starts restrictions when storage falls to 60% of capacity.
- In a dry summer the dam loses 25 ML per week.

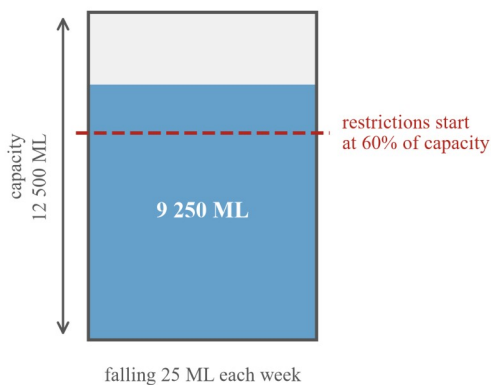
(a) Find the fall in average yearly rainfall in mm, and as a percentage.

(b) Find the dam's current storage as a percentage of capacity.

(c) Find the storage, in ML, at which restrictions start.

(d) At 25 ML per week, find how many weeks it would take the dam to fall from its current storage to the restriction level. Give your answer in weeks, in days, and in years correct to 1 decimal place (use 365 days in a year).

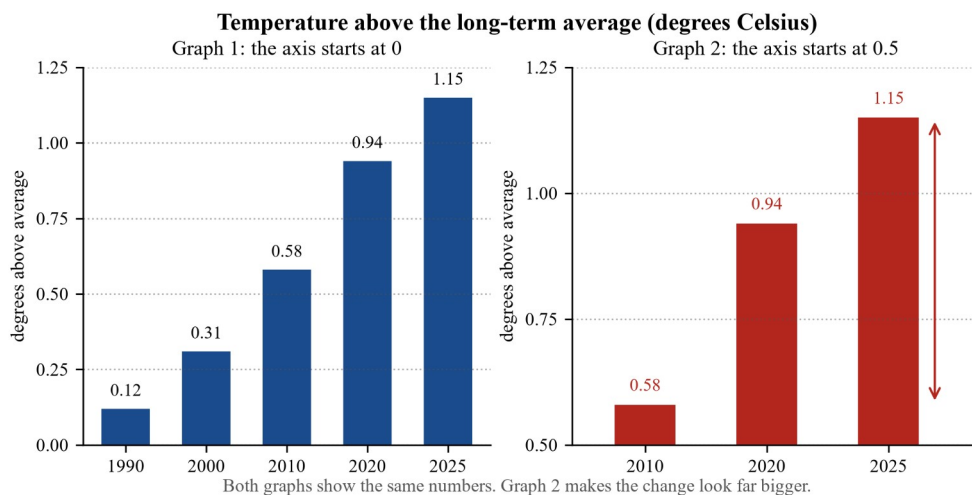
Dam storage at the start of summer



**Q14.** A made-up climate report gives the average temperature for five years, as degrees above the long-term average.

| Year                                | 1990  | 2000  | 2010  | 2020  | 2025  |
|-------------------------------------|-------|-------|-------|-------|-------|
| Degrees above the long-term average | +0.12 | +0.31 | +0.58 | +0.94 | +1.15 |

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

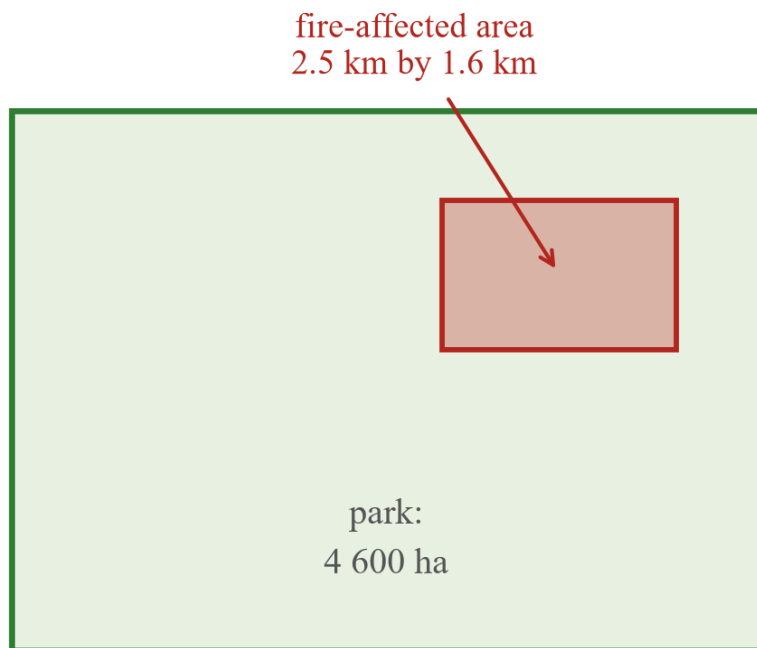


- Find the rise in temperature from 1990 to 2025, in degrees.
- Find the rise per year over 1990–2010 and over 2010–2025, each to 3 decimal places. Which period warmed faster?
- In Graph 2 the vertical axis starts at 0.5. Find the height of the 2010 bar and of the 2025 bar above that axis, and hence how many times taller the 2025 bar looks than the 2010 bar, correct to 1 decimal place.
- Find how many times the 2025 temperature figure actually is of the 2010 figure, correct to 1 decimal place. Explain in one sentence why Graph 2 makes the change look much bigger than Graph 1 does.

**Q15.** A made-up regional park covers 4 600 ha. This year the land agency plans fuel-reduction burns over 345 ha of the park.

- (a) Find this year's burn area as a percentage of the park.
- (b) Write this year's burn area in square kilometres, and write the whole park in square kilometres and in square metres.
- (c) Last year the agency burned 230 ha. Find last year's burn as a percentage of the park, then describe the change from last year to this year in percentage points and as a percentage increase.
- (d) A bushfire in the park affected a roughly rectangular area 2.5 km by 1.6 km. Find the fire-affected area in square kilometres, and then as a percentage of the park, correct to 1 decimal place.

A pretend regional park, drawn to scale



**Q16.** A made-up community report says that 240 volunteers gave 31 200 hours of service in one year, and values each hour at \$38.50.

- (a) Find the hours given per volunteer over the year, and per week (use 52 weeks in a year).
- (b) Find the total value of the volunteer hours.
- (c) The report's summary says the volunteers gave "over one and a quarter million dollars" of service. Check this claim against your answer to (b): is it right, and by how much is it out? Also write your answer to (b) as a percentage of \$1 250 000, correct to 1 decimal place.

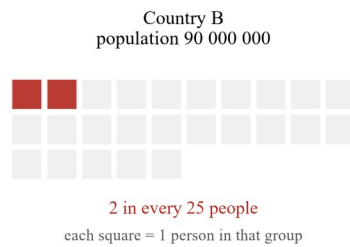
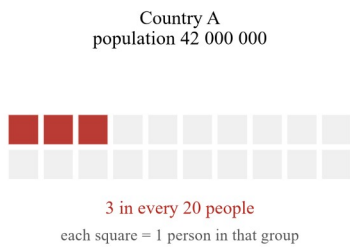
**Q17.** A made-up juror serves on a trial that sits from 9:30 am to 4:15 pm each day, with a 45-minute lunch break. The trial runs for 18 days. Jurors are paid \$45.10 per day for the first 6 days and \$105.35 per day for each day after that.

- (a) Find the hours in court per day, and the total hours over the 18 days.
- (b) Find the pay for the first 6 days, the pay for the remaining 12 days, and the total pay.
- (c) Find the juror's total pay per hour in court, correct to the nearest cent.

**Q18.** A made-up global report gives these figures about safe drinking water.

- Country A: population 42 000 000; 3 people in every 20 have no safe drinking water.
  - Country B: population 90 000 000; 2 people in every 25 have no safe drinking water.
- (a) For Country A, write the rate as a percentage and find the number of people with no safe drinking water.
- (b) For Country B, write the rate as a percentage and find the number of people with no safe drinking water.
- (c) Which country has the higher rate, and which country has more people without safe drinking water? Find the difference in the number of people.
- (d) A charity appeal raises \$4 800 000 for Country A. Each water point costs \$24 000 to build and serves 250 people. Find how many water points the appeal funds, how many people they serve, and what percentage of Country A's people without safe water that is, correct to 1 decimal place.

**People without safe drinking water (made-up countries)**



## Answers

**Example 1.** (a) 83% (b) 8 160 people, 17% (c) 2.9% (d) 37.5% (e) 4 836 votes

**Example 2.** (a) thirteen million two hundred thousand (b) 5.2%; 6.5% (c) 1.3 percentage points; 25% (d) 12 342 000 people

**Example 3.** (a) 3.4%; 3.0% (b) \$194.36 (c) 3%, which is less than the 6.5% rise in prices, so no (d) \$454.55; \$15.45

**Example 4.** (a) 72.5% (b) 63.3% (c) 12.6% (d) 219 kL; 600 L (e) 510 L; 32.85 kL

**Q1.** (a) three million four hundred and eighty thousand six hundred and twenty (b) 3 500 000 (c) 0.0437; 0.044; 0.04

**Q2.** (a) 67/100, 67% (b) 33% (c) 825 people

**Q3.** (a) 7.7% (b) 1 in 13 (c) 12 000 people

**Q4.** (a) 0.30 percentage points (b) 5.2% (c)  $5.75 \times 0.05 = 0.2875$ , which is 0.288 to 3 d.p., not 0.30

**Q5.** (a) 2 400 000 L (b) 350 ha (c) 120 000 m<sup>2</sup>

**Q6.** (a) Northfield 150; Riverbend 200 (b) Northfield more thefts; Riverbend higher rate (c) 50 per 100 000 people

**Q7.** (a) A 43%; B 36%; C 13%; Others 8% (b) 58.8% (c) 41 seats; 6 seats above (d) 33.8%

**Q8.** (a) 0.50 percentage points (b) \$96; \$1 152 (c) 6.4% (d) 16.1%, much larger than the 6.4% rise in the repayment (e) \$572 760

**Q9.** (a) 11 200 000 (b) 6% (c) 64% (d) 6 300 000, 36%

**Q10.** (a) 6.6% (b) 1 412 000 people, 12.6% (c) reasonable: 1 in 8 is 12.5%, only 0.1 percentage points below 12.6%

**Q11.** (a) 3.5% lower (b) 3.6%; 3.4%; 3.0% (c) 10.4% (d) 7.0%, so yes, it kept pace (prices rose 6.5%) (e) \$512.39; \$2.39 above

**Q12.** (a) Riverbend 30%; Northfield 36% (b) Riverbend 550 kg; Northfield 500 kg (c) 18 480 t (d) 14 784 t; 11 616 t; 44%, which is 14 percentage points higher

**Q13.** (a) 128 mm, 20% (b) 74% (c) 7 500 ML (d) 70 weeks; 490 days; 1.3 years

**Q14.** (a) 1.03 degrees (b) 0.023 per year; 0.038 per year; 2010–2025 (c) 0.08 and 0.65; 8.1 times (d) 2.0 times; the axis starts at 0.5, so the bars show only the part above 0.5

**Q15.** (a) 7.5% (b) 3.45 km<sup>2</sup>; 46 km<sup>2</sup>; 46 000 000 m<sup>2</sup> (c) 5%; up 2.5 percentage points, a 50% increase (d) 4 km<sup>2</sup>; 8.7%

**Q16.** (a) 130 hours; 2.5 hours (b) \$1 201 200 (c) wrong — it overstates the value by \$48 800; the value is 96.1% of \$1 250 000

**Q17.** (a) 6 hours; 108 hours (b) \$270.60; \$1 264.20; \$1 534.80 (c) \$14.21

**Q18.** (a) 15%; 6 300 000 people (b) 8%; 7 200 000 people (c) Country A higher rate; Country B more people; 900 000 people (d) 200 water points; 50 000 people; 0.8%

## Fully-worked solutions

**Example 1.** (a)  $39\,840 \div 48\,000 \times 100 = 83$ , so the turnout is 83%.

(b)  $48\,000 - 39\,840 = 8\,160$  people;  $8\,160 \div 48\,000 \times 100 = 17\%$ .

(c)  $1\,152 \div 39\,840 \times 100 = 2.8915\dots = 2.9\%$  to 1 d.p.

(d) Formal votes =  $39\,840 - 1\,152 = 38\,688$ ;  $14\,508 \div 38\,688 \times 100 = 37.5\%$ .

(e) Half of 38 688 is 19 344;  $19\,344 - 14\,508 = 4\,836$  votes.

**Example 2.** (a) 13 200 000 is thirteen million two hundred thousand.

(b)  $686\,400 \div 13\,200\,000 \times 100 = 5.2\%$ ;  $858\,000 \div 13\,200\,000 \times 100 = 6.5\%$ .

- (c)  $6.5 - 5.2 = 1.3$  percentage points;  $1.3 \div 5.2 \times 100 = 25\%$ .  
 (d)  $13\,200\,000 - 858\,000 = 12\,342\,000$  employed people.

**Example 3.** (a) 2024:  $(103.4 - 100.0) \div 100.0 \times 100 = 3.4\%$ . 2025:  $(106.5 - 103.4) \div 103.4 \times 100 = 2.998\dots = 3.0\%$  to 1 d.p.

- (b)  $\$182.50 \times 106.5 \div 100.0 = \$194.3625 = \$194.36$  to the nearest cent.  
 (c) Rise =  $\$484.10 - \$470.00 = \$14.10$ ;  $\$14.10 \div \$470.00 \times 100 = 3\%$ . Prices rose  $(106.5 - 100.0) \div 100.0 \times 100 = 6.5\%$ , so the payment did not keep pace.  
 (d)  $\$484.10 \div 1.065 = \$454.5539\dots = \$454.55$  to the nearest cent;  $\$470.00 - \$454.55 = \$15.45$  lost.

**Example 4.** (a)  $6\,090 \div 8\,400 \times 100 = 72.5\%$ .

- (b)  $5\,320 \div 8\,400 \times 100 = 63.333\dots = 63.3\%$  to 1 d.p.  
 (c) Fall =  $6\,090 - 5\,320 = 770$  ML;  $770 \div 6\,090 \times 100 = 12.643\dots = 12.6\%$  to 1 d.p.  
 (d)  $1\,095$  ML =  $1\,095\,000$  kL;  $1\,095\,000 \div 5\,000 = 219$  kL per household per year;  $219\,000 \div 365 = 600$  L per day.  
 (e)  $600 \times 0.85 = 510$  L per day; saving  $90$  L per day  $\times 365 = 32\,850$  L =  $32.85$  kL per year.

- Q1.** (a)  $3\,480\,620$  = three million four hundred and eighty thousand six hundred and twenty.  
 (b) The hundred-thousands digit is 4 and the next digit is 8, so round up:  $3\,500\,000$ .  
 (c)  $4.37\% = 4.37 \div 100 = 0.0437$ ; to 3 d.p. that is  $0.044$ ; to 2 d.p. that is  $0.04$ .

- Q2.** (a)  $1\,675/2\,500 = 67/100$  (divide top and bottom by 25) =  $67\%$ .  
 (b)  $100\% - 67\% = 33\%$ .  
 (c)  $2\,500 - 1\,675 = 825$  people (check:  $825 \div 2\,500 \times 100 = 33\%$ ).

- Q3.** (a)  $4\,800 \div 62\,400 \times 100 = 7.692\dots = 7.7\%$  to 1 d.p.  
 (b)  $4\,800/62\,400 = 1/13$  (divide by 4 800), so 1 in 13 enrolled citizens.  
 (c)  $156\,000 \div 13 = 12\,000$  people summoned.

- Q4.** (a)  $6.05 - 5.75 = 0.30$  percentage points.  
 (b)  $0.30 \div 5.75 \times 100 = 5.217\dots = 5.2\%$  to 1 d.p.  
 (c) A 5% rise on 5.75 is  $5.75 \times 0.05 = 0.2875$  percentage points =  $0.288$  to 3 d.p.  
 The real rise was 0.30 percentage points, so the headline's rise is smaller than what actually happened.

- Q5.** (a)  $2\,400$  kL =  $2\,400 \times 1\,000 = 2\,400\,000$  L.  
 (b)  $3.5$  km<sup>2</sup> =  $3.5 \times 100 = 350$  ha.  
 (c)  $12$  ha =  $12 \times 10\,000 = 120\,000$  m<sup>2</sup>.

- Q6.** (a) Northfield:  $132 \div 88\,000 \times 100\,000 = 150$  per 100 000. Riverbend:  $96 \div 48\,000 \times 100\,000 = 200$  per 100 000.  
 (b) Northfield reported more thefts (132 against 96), but Riverbend has the higher rate (200 against 150 per 100 000).  
 (c)  $200 - 150 = 50$  per 100 000 people.

- Q7.** (a) A:  $1\,032\,000 \div 2\,400\,000 \times 100 = 43\%$ . B:  $864\,000 \div 2\,400\,000 \times 100 = 36\%$ . C:  $312\,000 \div 2\,400\,000 \times 100 = 13\%$ . Others:  $192\,000 \div 2\,400\,000 \times 100 = 8\%$ .  
 (b)  $47 \div 80 \times 100 = 58.75 = 58.8\%$  to 1 d.p.  
 (c) Half of 80 is 40, so a majority is 41 seats;  $47 - 41 = 6$  seats above.  
 (d)  $27 \div 80 \times 100 = 33.75 = 33.8\%$  to 1 d.p. Party A won 43% of the votes but 58.8% of the seats.

- Q8.** (a)  $3.60 - 3.10 = 0.50$  percentage points (two rises of 0.25).  
 (b)  $\$1\,591 - \$1\,495 = \$96$  per month; over 12 months,  $\$96 \times 12 = \$1\,152$ .  
 (c)  $\$96 \div \$1\,495 \times 100 = 6.421\dots = 6.4\%$  to 1 d.p.  
 (d)  $0.50 \div 3.10 \times 100 = 16.129\dots = 16.1\%$  to 1 d.p. The rate rose 16.1% while the repayment rose only 6.4%, because most of the repayment is repaying the borrowed  $\$350\,000$ , not interest.  
 (e) 30 years = 360 months;  $\$1\,591 \times 360 = \$572\,760$ .

- Q9.** (a)  $10\,528\,000 + 672\,000 = 11\,200\,000$  people.  
 (b)  $672\,000 \div 11\,200\,000 \times 100 = 6\%$ .  
 (c)  $11\,200\,000 \div 17\,500\,000 \times 100 = 64\%$ .  
 (d)  $17\,500\,000 - 11\,200\,000 = 6\,300\,000$  people;  $6\,300\,000 \div 17\,500\,000 \times 100 = 36\%$ .

**Q10.** (a)  $740\,000 \div 11\,200\,000 \times 100 = 6.607\dots = 6.6\%$  to 1 d.p.

(b)  $672\,000 + 740\,000 = 1\,412\,000$  people;  $1\,412\,000 \div 11\,200\,000 \times 100 = 12.607\dots = 12.6\%$  to 1 d.p.

(c)  $1 \text{ in } 8 = 1 \div 8 \times 100 = 12.5\%$ . That is 0.1 percentage points below the true 12.6%, so the minister's claim is reasonable.

**Q11.** (a)  $(100.0 - 96.5) \div 100.0 \times 100 = 3.5\%$  lower.

(b) 2023:  $(100.0 - 96.5) \div 96.5 \times 100 = 3.626\dots = 3.6\%$ . 2024:  $(103.4 - 100.0) \div 100.0 \times 100 = 3.4\%$ . 2025:  $(106.5 - 103.4) \div 103.4 \times 100 = 2.998\dots = 3.0\%$ , each to 1 d.p.

(c)  $(106.5 - 96.5) \div 96.5 \times 100 = 10.362\dots = 10.4\%$  to 1 d.p.

(d) Rise =  $\$545.70 - \$510.00 = \$35.70$ ;  $\$35.70 \div \$510.00 \times 100 = 7.0\%$ . Prices rose  $(106.5 - 100.0) \div 100.0 \times 100 = 6.5\%$ , and  $7.0\% > 6.5\%$ , so the payment kept pace.

(e)  $\$545.70 \div 1.065 = \$512.394\dots = \$512.39$  to the nearest cent;  $\$512.39 - \$510.00 = \$2.39$  above the 2023 payment.

**Q12.** (a) Riverbend:  $7\,920 \div 26\,400 \times 100 = 30\%$ . Northfield:  $15\,840 \div 44\,000 \times 100 = 36\%$ .

(b) Riverbend:  $26\,400 \text{ t} = 26\,400\,000 \text{ kg}$ ;  $\div 48\,000$  people = 550 kg each. Northfield:  $44\,000\,000 \text{ kg} \div 88\,000 = 500$  kg each.

(c)  $26\,400 - 7\,920 = 18\,480 \text{ t}$  to landfill.

(d) 20% of 18 480 = 3 696 t cut; new landfill  $18\,480 - 3\,696 = 14\,784 \text{ t}$ ; new recycled  $7\,920 + 3\,696 = 11\,616 \text{ t}$ ; new rate  $11\,616 \div 26\,400 \times 100 = 44\%$ , which is  $44 - 30 = 14$  percentage points above the old rate.

**Q13.** (a)  $640 - 512 = 128 \text{ mm}$ ;  $128 \div 640 \times 100 = 20\%$  fall.

(b)  $9\,250 \div 12\,500 \times 100 = 74\%$  full.

(c) 60% of 12 500 =  $0.60 \times 12\,500 = 7\,500 \text{ ML}$ .

(d) Fall needed:  $9\,250 - 7\,500 = 1\,750 \text{ ML}$ ;  $1\,750 \div 25 = 70$  weeks;  $70 \times 7 = 490$  days;  $490 \div 365 = 1.342\dots = 1.3$  years to 1 d.p.

**Q14.** (a)  $1.15 - 0.12 = 1.03$  degrees.

(b) 1990–2010:  $(0.58 - 0.12) \div 20 = 0.46 \div 20 = 0.023$  degrees per year. 2010–2025:  $(1.15 - 0.58) \div 15 = 0.57 \div 15 = 0.038$  degrees per year. The later period warmed faster.

(c) Above the 0.5 axis: 2010 bar is  $0.58 - 0.5 = 0.08$  high; 2025 bar is  $1.15 - 0.5 = 0.65$  high.  $0.65 \div 0.08 = 8.125 = 8.1$  times to 1 d.p.

(d)  $1.15 \div 0.58 = 1.982\dots = 2.0$  times to 1 d.p. Graph 2 exaggerates because its axis starts at 0.5, so each bar shows only the part of the value above 0.5 and small differences look enormous.

**Q15.** (a)  $345 \div 4\,600 \times 100 = 7.5\%$  of the park.

(b)  $345 \text{ ha} = 345 \div 100 = 3.45 \text{ km}^2$ . Park:  $4\,600 \text{ ha} = 46 \text{ km}^2 = 46 \times 1\,000\,000 = 46\,000\,000 \text{ m}^2$ .

(c)  $230 \div 4\,600 \times 100 = 5\%$ . Change:  $7.5 - 5 = 2.5$  percentage points; as an increase,  $(345 - 230) \div 230 \times 100 = 115 \div 230 \times 100 = 50\%$ .

(d)  $2.5 \times 1.6 = 4 \text{ km}^2$ ;  $4 \div 46 \times 100 = 8.695\dots = 8.7\%$  of the park to 1 d.p.

**Q16.** (a)  $31\,200 \div 240 = 130$  hours per volunteer per year;  $130 \div 52 = 2.5$  hours per week.

(b)  $31\,200 \times \$38.50 = \$1\,201\,200$ .

(c) One and a quarter million dollars is  $\$1\,250\,000$ , and  $\$1\,201\,200$  is less than that, so the claim is wrong: it overstates the value by  $\$1\,250\,000 - \$1\,201\,200 = \$48\,800$ . As a percentage,  $\$1\,201\,200 \div \$1\,250\,000 \times 100 = 96.096 = 96.1\%$  to 1 d.p.

**Q17.** (a) 9:30 am to 4:15 pm is 6 h 45 min = 405 min; less the 45-min lunch = 360 min = 6 h per day. Over 18 days:  $6 \times 18 = 108 \text{ h}$ .

(b) First 6 days:  $6 \times \$45.10 = \$270.60$ . Remaining 12 days:  $12 \times \$105.35 = \$1\,264.20$ . Total:  $\$270.60 + \$1\,264.20 = \$1\,534.80$ .

(c)  $\$1\,534.80 \div 108 = \$14.2111\dots = \$14.21$  per hour to the nearest cent.

**Q18.** (a)  $3 \text{ in } 20 = 3 \div 20 \times 100 = 15\%$ ;  $15\% \text{ of } 42\,000\,000 = 6\,300\,000$  people.

(b)  $2 \text{ in } 25 = 2 \div 25 \times 100 = 8\%$ ;  $8\% \text{ of } 90\,000\,000 = 7\,200\,000$  people.

(c) Country A has the higher rate (15% against 8%); Country B has more people (7 200 000 against 6 300 000), a difference of 900 000 people.

(d)  $\$4\,800\,000 \div \$24\,000 = 200$  water points;  $200 \times 250 = 50\,000$  people served;  $50\,000 \div 6\,300\,000 \times 100 = 0.793\ldots = 0.8\%$  to 1 d.p. of Country A's people without safe water.

### Theory

Financial numeracy is the maths of your own money: the money that comes **in** (wages, allowances, gifts), the money that goes **out** (rent, bills, repayments), and the choices you make in between. This section walks through the money situations most young adults meet first — a bank account, a pay slip, a budget, bills, and borrowing — and the percentage and rate maths (AoS 1 and AoS 4) that makes each one answerable.

#### Money in and money out: your bank account.

A bank account holds money for you. The **balance** is the amount in it right now. Every movement of money is a **transaction**, and transactions come in two kinds:

- a **credit** puts money **in** — wages, a refund, a gift from family;
- a **debit** takes money **out** — a card purchase, a bill payment, a transfer out.

On a statement or in a banking app, credits are often shown as positive amounts and debits as negative amounts (with a minus sign  $-$ ). The **running balance** is the balance updated after each transaction, in date order. **Monitoring** your account means reading that list regularly, so you know what you have and can catch a mistake or an unfair charge early.

Worked model. An account starts at \$340. A credit of \$860 (wages) takes the balance to  $\$340 + \$860 = \$1\,200$ . A debit of \$420 (rent) takes it to  $\$1\,200 - \$420 = \$780$ . A debit of \$86.50 (groceries) leaves  $\$780 - \$86.50 = \$693.50$ .

Online services do the same sums for you. Mobile banking apps show transactions and balances as they happen; **MyGov** is the government's online login for services such as **Medicare** (Australia's public health system) and your tax details; and banks email or post a **statement** — the official list of a period's transactions — each month. The maths is yours either way: the app shows the numbers, you check them.

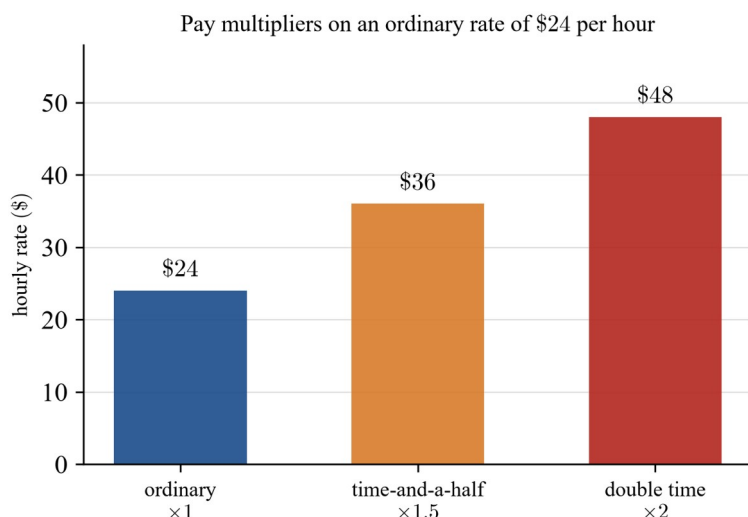
#### Pay from work.

Most jobs pay an **hourly rate** for **ordinary hours** — the agreed weekly hours at the plain rate. **Gross pay** is pay before anything is taken out; **take-home pay** is what lands in your account after tax and other amounts. For ordinary hours:

$$W = R \times H$$

where  $W$  is the pay for those hours,  $R$  is the hourly rate and  $H$  is the number of hours worked.

**Overtime** is hours beyond the ordinary hours, paid at a **multiplier** of the ordinary rate. The two common multipliers are **time-and-a-half** ( $\times 1.5$ ) and **double time** ( $\times 2$ ). A **penalty rate** is the higher rate paid for unsocial times — Saturdays, Sundays and public holidays — and it is usually one of those same multipliers.



An **allowance** is extra pay that covers a cost your work creates. Common ones are a **vehicle allowance** (a set amount per kilometre you drive for work), a **uniform allowance**, and a **meal allowance** for long shifts. Allowances are paid on top of the hourly pay.

Worked model. On an ordinary rate of \$24 an hour, time-and-a-half is  $\$24 \times 1.5 = \$36$  an hour and double time is  $\$24 \times 2 = \$48$  an hour.

### Commission.

Some jobs pay a **commission** — a percentage of the sales you make — on top of a fixed weekly amount called a **retainer** (or **base**). Others pay commission only. With a retainer, the weekly pay is:

$$P = B + c \times S$$

where  $P$  is the total weekly pay,  $B$  is the retainer,  $c$  is the commission rate written as a decimal, and  $S$  is the value of your sales that week.

Worked model. A retainer of \$400 plus 5 % commission on \$6 000 of sales pays commission  $0.05 \times \$6\,000 = \$300$ , so  $P = \$400 + \$300 = \$700$ .

When two pay plans compete — a big retainer with a small percentage against a small retainer with a big percentage — the better plan **depends on your sales**. Example 2 shows how a graph and a small table find the sales value where the plans pay the same.

### Budgets.

A **budget** is a plan of income and expenses over a period — usually a week, a fortnight or a month. List the money in, list the money out, then compare:

- if income is more than expenses, the leftover is a **surplus** — money you can save or spend on choices;
- if expenses are more than income, the gap is a **deficit** — money you must find from savings or borrowing, and a sign the budget needs changing.

A budget only works if it is honest. A week of writing down every purchase usually finds money nobody planned.

### Tax, GST, super and other government money.

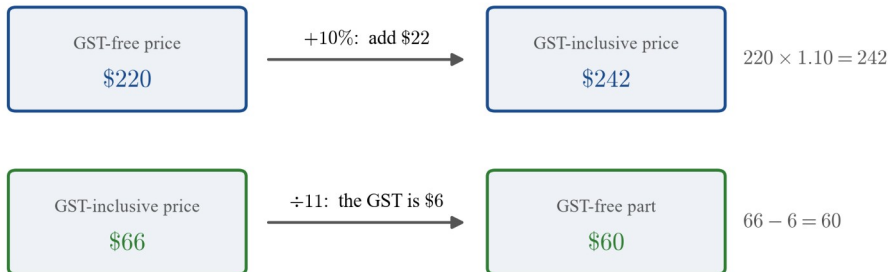
**Tax** is the share of your income the government takes to pay for public services — roads, schools, hospitals.

Employers **withhold** it (take it out) from each pay and send it on; the amount appears on your pay slip. The **Medicare levy** is an extra percentage of income that helps fund Medicare. **Superannuation** (almost always called **super**) is money your employer pays into a super fund for you, on top of your wages, for you to live on when you stop working; it is a percentage of your gross pay. A **student loan** (such as a HELP loan) lends you money for study and is repaid later through the tax system, as an extra percentage of your pay once your income passes a set level.

The **GST** (goods and services tax) is 10 % on most goods and services in Australia. Prices in shops include it; trade prices often do not. Two moves cover every GST question:

- **Adding GST:** multiply the GST-free price by 1.10 (the price keeps its 100 % and adds 10 %).
- **Taking GST out:** the GST inside a GST-inclusive price is that price  $\div 11$ , because the inclusive price is 110 % of the GST-free price and the GST is 10 of those 110 parts — one eleventh.

#### GST: adding it and taking it out



Worked models. Super at 11 % on a gross week of \$900 is  $0.11 \times \$900 = \$99$  into the super fund. A Medicare levy of 2 % on a yearly income of \$48 000 is  $0.02 \times \$48\,000 = \$960$ .

Real tax and super percentages change with government decisions. Every rate used in this section’s questions is stated in the question and is made up — the *method* is the real skill.

#### Bills and comparing providers.

Many household bills — electricity, gas, water, internet, mobile phones — are built the same way: a **fixed charge** you pay anyway (a daily **supply charge** or a monthly plan fee) plus a **usage charge** for each unit you use (per kWh of electricity, per MJ of gas, per GB of data). The total is:

$$C = F + u \times q$$

where  $C$  is the total cost,  $F$  is the fixed charge for the period,  $u$  is the usage charge per unit and  $q$  is the number of units used.

Worked model. A quarter of 90 days at a supply charge of \$0.85 a day gives  $F = \$0.85 \times 90 = \$76.50$ . Using 1 400 kWh at \$0.26 per kWh gives  $u \times q = \$0.26 \times 1\,400 = \$364$ . The bill is  $C = \$76.50 + \$364 = \$440.50$ .

To compare providers fairly, work out the **unit cost** — the cost of one unit. A \$30 plan with 10 GB included costs  $\$30 \div 10 = \$3.00$  per GB if you use it all; a \$50 plan with 25 GB costs  $\$50 \div 25 = \$2.00$  per GB. Notice there is no single “cheapest” provider: a plan with a low fixed charge and a high usage charge wins for light users and loses for heavy ones (Example 3 and Q11).

#### Borrowing money.

A **loan** is money you borrow and pay back, usually with **interest** — the price of borrowing. Interest rates are quoted as a percentage **per annum** (written **p.a.**, meaning each year). With **simple interest**, the interest on a loan is:

$$I = P \times r \times n$$

where  $I$  is the interest,  $P$  is the **principal** (the amount borrowed),  $r$  is the yearly rate written as a decimal, and  $n$  is the number of years.

Worked model. Borrowing \$3 000 at 8 % p.a. for 2 years gives  $I = \$3\,000 \times 0.08 \times 2 = \$480$ , so \$3 480 is repaid in total.

Real car loans and home loans add interest more often than yearly, and the lender sets the repayment schedule — an **online interest calculator** (or the lender’s quote) shows those exact numbers, and checking a hand calculation against one is good practice. Every question in this book, though, can be done with pen, paper and a basic calculator.

The common forms of personal credit, from cheapest to most expensive in practice:

- a **bank personal loan** or **car loan** — interest as above, repaid in equal instalments;
- a **credit card** — you borrow what you spend; if the balance is not paid off, interest is added each month, and the **minimum repayment** (the smallest payment the bank accepts) keeps the debt alive for a long time;
- **store credit** and **instalment plans** — the store lets you pay over time; the extra cost hides in fees and in the interest built into the plan;
- **buy now pay later (BNPL)** — the price is split into a few instalments, usually interest-free *if every payment is on time*; late fees are where it stings;
- a **payday loan** — a small loan until pay day, with fees that are enormous compared with a bank loan (Q14 measures how enormous).

One rule covers all of them: the longer money is borrowed, the more interest is paid.

### Short-term and long-term cost.

A price tag is the short-term cost. The **long-term cost** adds everything the purchase makes you pay later: repayments times the number of repayments, plus running costs such as fuel, data and repairs. Three habits compare long-term costs well:

- **Count the repayments.** A “\$60 a week” purchase over 18 weeks costs  $\$60 \times 18 = \$1\,080$ , not \$60.
- **Add the running cost.** A cheap car that drinks fuel can cost more per year than a dearer car that sips it (Q16).
- **Compare like with like.** A membership at \$15 a week costs  $\$15 \times 52 = \$780$  a year — set that against what it gives you.

Special deals belong here too: “30 % off”, “\$15 off” and “a quarter off” are three different maths on the same tag (Q17).

### Staying safe with money.

A **scam** is a trick that takes your money or your details. Scams lean on hurry and on deals that look too good, and they ask for payment in ways that leave you no protection. Safe transacting — in shops, online and in apps — is mostly a short list of habits.

#### Transacting safely: warning signs and safer habits

| Warning signs of a scam                                                                                                                   | Safer habits                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
|  pressure to pay today, or you 'miss out'              |  check the seller is real before you pay                           |
|  a price far below every other seller                  |  use a payment method that protects buyers                         |
|  payment by gift card or bank transfer only            |  never share a password or a one-off code                          |
|  asks for passwords, codes or card numbers             |  reach your bank by its official app, or type the address yourself |
|  you cannot find any real information about the seller |  when a deal feels too good, stop and ask                          |

Numbers are part of safety too. A discount that is far bigger than every other seller’s is a warning sign even when the arithmetic checks out — the maths can be perfect and the seller fake (Q17(c)).

### Tools and the problem-solving cycle.

Every money question in this section runs through the same four stages (§1A):

1. **Identify the mathematics** — what is being asked, what numbers are given, and which formula or rate connects them.

2. **Act on and use mathematics** — substitute into the formula and calculate; a calculator, a spreadsheet or a banking app is a legitimate tool here (§1F).
3. **Evaluate and reflect** — estimate first or check after: is the pay bigger than the all-ordinary pay? is the discounted price below the tag? are the cents right?
4. **Communicate and report** — answer in a sentence, with dollars and cents, and say how far you rounded.

Carry full precision through the working and round only where the question tells you to. Money answers are usually given **correct to the nearest cent**, and this section always says so when rounding is needed.

**About the data in this section.** The wages, prices, plans, bills and loan terms 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. The services and rules named — Medicare, MyGov, the GST at 10 % — are real Australian ones; every dollar amount attached to a person or a business is made up.

## Worked examples

### Example 1 — scaffolded

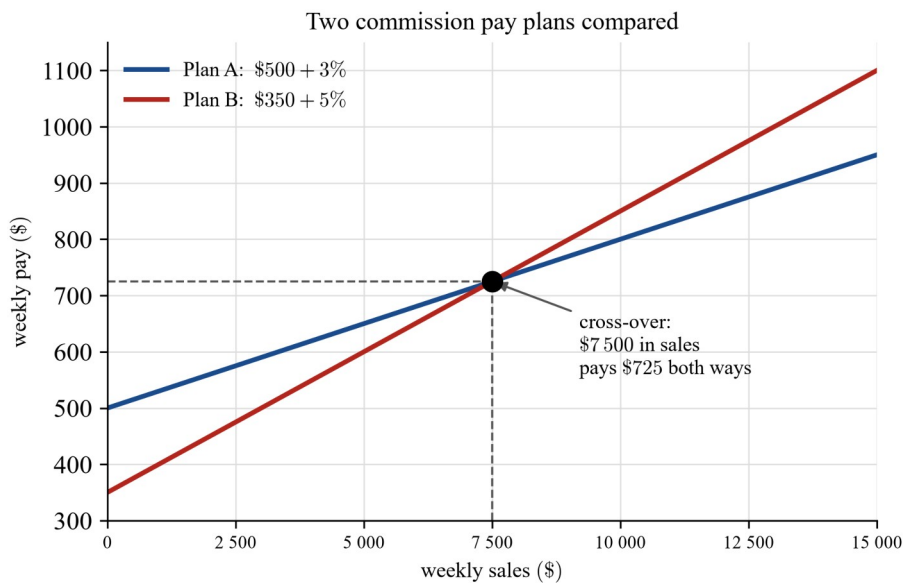
Josie's ordinary rate at the Crust & Crumb bakery café is \$27.40 an hour. She works her 38 ordinary hours plus 5 hours of Saturday overtime at time-and-a-half. Find her gross pay for the week.

| Working                                                                                                                                                              | Comment                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Ordinary pay: $\$27.40 \times 38 = \$1\,041.20$ .                                                                                                                    | $W = R \times H$ for the ordinary hours.                                         |
| Overtime rate: $\$27.40 \times 1.5 = \$41.10$ an hour.                                                                                                               | Time-and-a-half means multiply the ordinary rate by 1.5.                         |
| Overtime pay: $\$41.10 \times 5 = \$205.50$ .                                                                                                                        | Five overtime hours at the overtime rate.                                        |
| Gross pay: $\$1\,041.20 + \$205.50 = \$1\,246.70$ .                                                                                                                  | Add the two parts; keep the cents all the way through.                           |
| Check: all 43 hours at the ordinary rate would pay $\$27.40 \times 43 = \$1\,178.20$ , and all 43 at the overtime rate would pay $\$41.10 \times 43 = \$1\,767.30$ . | Evaluate stage: the true gross must sit between those two — and \$1 246.70 does. |

### Example 2 — scaffolded

Nico is offered two pay plans at a phone accessories shop. **Plan A:** a retainer of \$500 a week plus 3 % commission on sales. **Plan B:** a retainer of \$350 a week plus 5 % commission on sales. In a week with \$9 000 of sales, which plan pays more, and by how much? For what weekly sales do the plans pay the same?

| Working                                                                                               | Comment                                                     |
|-------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| Plan A: commission $0.03 \times \$9\,000 = \$270$ ; pay $\$500 + \$270 = \$770$ .                     | $P = B + c \times S$ with $B = 500$ , $c = 0.03$ .          |
| Plan B: commission $0.05 \times \$9\,000 = \$450$ ; pay $\$350 + \$450 = \$800$ .                     | Same formula with $B = 350$ , $c = 0.05$ .                  |
| Difference: $\$800 - \$770 = \$30$ in Plan B's favour.                                                | At \$9 000 of sales the bigger percentage wins.             |
| Try lower sales, \$7 000: Plan A pays $\$500 + \$210 = \$710$ ; Plan B pays $\$350 + \$350 = \$700$ . | Now the bigger retainer wins — the better plan has flipped. |
| Try \$7 500: Plan A pays $\$500 + \$225 = \$725$ ; Plan B pays $\$350 + \$375 = \$725$ .              | Equal pay — this is the cross-over.                         |
| At \$8 000: Plan A pays \$740, Plan B pays \$750 — B ahead again.                                     | So below \$7 500 choose A; above \$7 500 choose B.          |



### Example 3 — unscaffolded

Zara's household used 1 250 kWh of electricity in a 90-day quarter. Two providers quote as follows (made-up prices).

**Wattle Creek Power:** supply charge \$0.95 a day plus \$0.28 per kWh. **Ironbark Energy:** supply charge \$0.75 a day plus \$0.31 per kWh. Which provider costs less for this quarter, and by how much?

Wattle Creek Power, using  $C = F + u \times q$ :

$$F = \$0.95 \times 90 = \$85.50$$

$$u \times q = \$0.28 \times 1\,250 = \$350.00$$

$$C = \$85.50 + \$350.00 = \$435.50$$

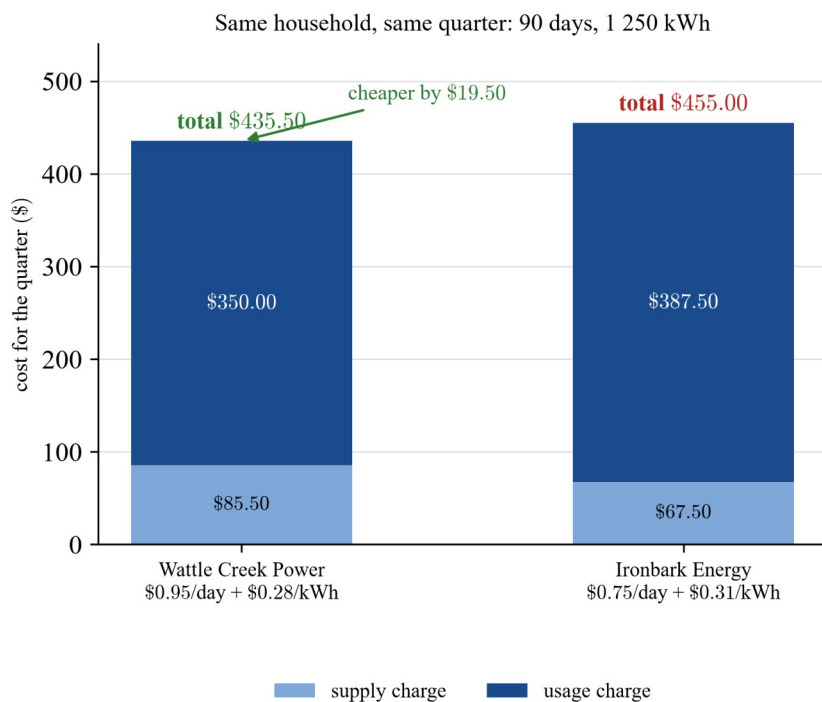
Ironbark Energy:

$$F = \$0.75 \times 90 = \$67.50$$

$$u \times q = \$0.31 \times 1\,250 = \$387.50$$

$$C = \$67.50 + \$387.50 = \$455.00$$

The difference is  $\$455.00 - \$435.50 = \$19.50$ . Check by estimate: the usage charge dominates (about \$350–\$390 against about \$70–\$85 of supply), and 1 250 kWh at about \$0.30 is about \$375 — both totals sit near that, as they should.



∴ Wattle Creek Power costs less for this quarter, by \$19.50.

#### Example 4 — unscaffolded

Owen borrows \$12 000 to buy a car. The lender charges simple interest at 9 % p.a. over 4 years, and the loan is repaid in 48 equal monthly payments. Find the interest, the total amount repaid, and the monthly repayment.

The interest uses  $I = P \times r \times n$  with  $P = 12\,000$ ,  $r = 0.09$  and  $n = 4$ :

$$I = \$12\,000 \times 0.09 \times 4 = \$4\,320$$

The total repaid is the principal plus the interest:

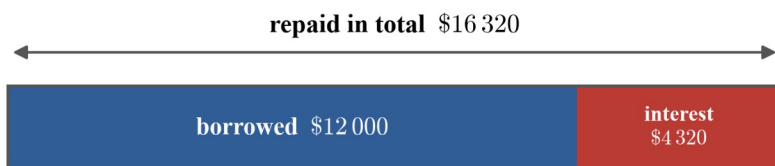
$$\$12\,000 + \$4\,320 = \$16\,320$$

Spread over 48 monthly payments, each payment is

$$\$16\,320 \div 48 = \$340$$

Check by estimate: 9 % a year for 4 years is 36 % of the principal, a little under 40 %; 40 % of \$12 000 is \$4 800, and the interest of \$4 320 sits just below it. ✓

**A \$12 000 car loan at 9% p.a. for 4 years (made-up numbers)**



monthly repayment:  $\$16\,320 \div 48 = \$340$  (48 monthly payments over 4 years)

∴ the loan costs \$4 320 in interest, \$16 320 is repaid in total, and each of the 48 monthly repayments is \$340.

## Practice questions

### Scaffolded

**Q1.** Finn's bank statement for one week is shown below.

**Finn's bank account — one week (made-up data)**

| Date  | Details                | Debit (out) | Credit (in) | Balance  |
|-------|------------------------|-------------|-------------|----------|
|       | Opening balance        |             |             | \$215.40 |
| 3 Mar | Wages                  |             | \$742.60    | \$958.00 |
| 4 Mar | Phone bill             | \$45.00     |             | \$913.00 |
| 6 Mar | Groceries              | \$96.35     |             | \$816.65 |
| 8 Mar | Rent                   | \$380.00    |             | \$436.65 |
| 9 Mar | Birthday gift from Nan |             | \$50.00     | \$486.65 |

A debit takes money OUT (red). A credit puts money IN (green). The balance is the running total.

- Say which of the five transactions are debits and which are credits.
- Find the balance after the wages credit on 3 Mar.
- Find the closing balance on 9 Mar.

**Q2.** Hugo earns \$25.60 an hour and works 35 ordinary hours a week. His ordinary pay uses  $W = R \times H$ . (a) Find  $W$ , his ordinary weekly pay. (b) Find his overtime hourly rate at time-and-a-half. (c) One week Hugo works 3 hours of overtime as well. Find his gross pay for that week.

**Q3.** (a) A bicycle is priced at \$480 before GST. Find the GST added and the price the customer pays. (b) A toaster is priced at \$93.50 including GST. Find the GST inside that price, and the GST-free part of the price. (c) Willa quotes \$1 650 for a lawn-mowing job, including GST. Find the GST inside her quote.

**Q4.** Isla writes a weekly budget.

| Weekly budget       | Amount |
|---------------------|--------|
| Income: wages       | \$900  |
| Income: weekend job | \$150  |
| Rent                | \$350  |
| Food                | \$140  |
| Transport           | \$55   |
| Phone               | \$20   |
| Entertainment       | \$60   |
| Other               | \$45   |

*Made-up data: every number in this budget is made up for this section.*

- Find Isla's total weekly income and her total weekly expenses.
- Find her surplus.
- She moves \$250 a week of the surplus into savings. How many weeks will it take her to save \$2 000 for a laptop?

**Q5.** Farah is a home-support worker who drives her own car between clients. Her vehicle allowance is 78c per km, and she gets a meal allowance of \$6.80 for each workday. Her kilometres for the week are: Mon 32, Tue 45, Wed 28, Thu 51, Fri 39. She works 5 days. (a) Find her total kilometres for the week. (b) Find her vehicle allowance for the week. (c) Find her total allowances for the week.

**Q6.** Dante sells furniture on a retainer of \$450 a week plus 4 % commission on his sales. In one week his sales are \$8 500. (a) Find his commission for that week. (b) Find his total pay for that week. (c) The next week his sales double to \$17 000. Find his total pay for that week, and how much more it is than the first week's pay.

### Unscaffolded

**Q7.** Liam's ordinary rate in hospitality is \$26.00 an hour. In one week he works 25 ordinary hours, 6 Saturday hours at time-and-a-half, 4 Sunday hours at double time, and 3 hours on a public holiday at double time. (a) Find his hourly rate for Saturday and for Sunday and the public holiday. (b) Find his gross pay for the week. (c) Liam worked 38 hours in total. Find his average hourly rate for the week, correct to the nearest cent.

**Q8.** Tahlia has two offers in furniture sales. **Job A:** a retainer of \$620 a week plus 1.5 % commission on sales. **Job B:** a retainer of \$500 a week plus 2.5 % commission on sales. She expects to sell about \$20 000 a week. (a) Find the weekly pay under each job at \$20 000 of sales. (b) Which job pays more at that sales level, and by how much? (c) Show by calculation that the two jobs pay exactly the same when weekly sales are \$12 000.

**Q9.** Nina's gross salary is \$52 000 a year. This question uses made-up rates: income tax 16 % of gross, Medicare levy 2 % of gross, and a student loan repayment of 4 % of gross. (a) Find the income tax and the Medicare levy taken from her pay each year. (b) Find her take-home pay for the year after those two amounts. (c) Find her student loan repayment for the year, and her take-home pay after it as well.

**Q10.** Kofi uses about 22 GB of data a month. **Coco Mobile:** \$35 a month with 20 GB included, then \$5 for each extra GB. **Big Talk:** \$42 a month with 35 GB included. (a) On the Coco Mobile plan, how many GB over his included data is Kofi each month? (b) Find Kofi's monthly cost on Coco Mobile. (c) Find his monthly cost on Big Talk, say which plan is cheaper for him, and find the Big Talk cost per GB he actually uses, correct to the nearest cent.

**Q11.** Billie's household used 9 500 MJ of gas in a 90-day quarter. **Eastgate Gas:** supply charge \$65 per quarter plus 3.2c per MJ. **Southvale Gas:** supply charge \$95 per quarter plus 2.8c per MJ. (a) Find the Eastgate Gas cost for the quarter. (b) Find the Southvale Gas cost for the quarter, and say which provider is cheaper for this quarter and by how much. (c) Show by calculation that the two plans cost exactly the same when a quarter's usage is 7 500 MJ.

**Q12.** Rafael borrows \$15 000 for a car at simple interest of 8 % p.a. over 5 years, repaid in 60 equal monthly payments. (a) Find the interest on the loan. (b) Find the total amount to be repaid. (c) Find the monthly repayment. (d) A second lender offers simple interest of 6 % p.a. over the same 5 years. Find the interest and the total repaid at that rate, and how much Rafael saves by choosing it.

**Q13.** Noa buys a \$900 lounge suite on the store's instalment plan: a \$50 deposit, then 8 monthly payments of \$115.

#### The instalment plan for a \$900 lounge suite



8 payments of \$115 = \$920, plus the \$50 deposit: total \$970

**cash price \$900 ⇒ the plan costs \$70 more**

- Find the total Noa pays on the instalment plan.
- Find how much more the plan costs than the cash price, and write that extra amount as a percentage of the cash price, correct to 1 decimal place.
- Noa also buys a \$400 jacket on a buy now pay later service: 4 payments of \$100. Two payments arrive late and each attracts a \$15 late fee. Find the total cost of the jacket, and write the late fees as a percentage of the jacket's cash price.

**Q14.** Oliver needs to borrow \$2 000 for 6 months. **FastFee Lending** (a payday lender) charges a \$200 set-up fee plus \$35 per month. **Riverbank Bank** charges simple interest at 9 % p.a. (a) Find FastFee's total fees, and the total Oliver

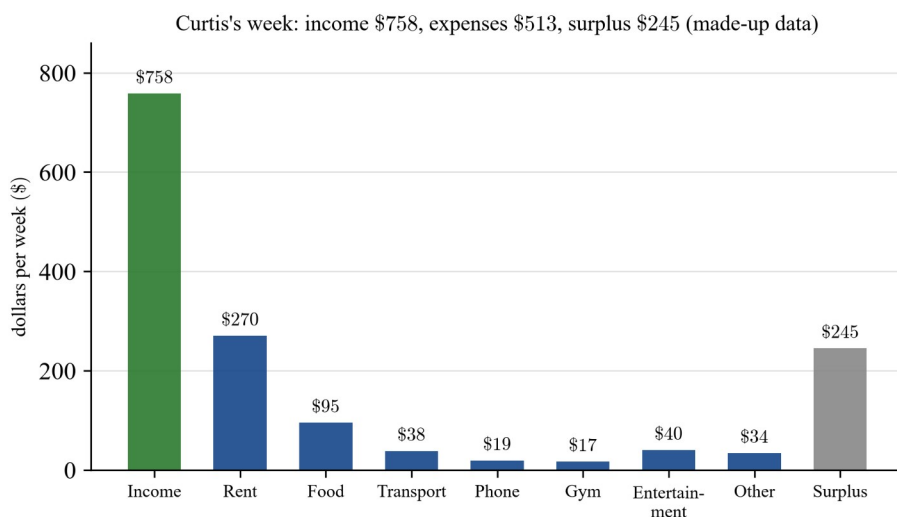
repays FastFee. (b) Find the Riverbank interest for the 6 months, and the total Oliver repays the bank. (c) Find how many times larger FastFee's fees are than the bank's interest, correct to 1 decimal place.

**Q15.** Amber owes \$1 500 on a credit card. The card adds interest each month at 1.5 % of the balance (that is, 18 % p.a.). (a) Find the interest added in the first month. (b) Amber pays only the \$50 minimum repayment. Find how much of that payment actually reduces the balance, and find her new balance. (c) Repeat part (b) with a \$200 payment instead: find how much reduces the balance, and the new balance. (d) In one sentence, say why paying only the minimum repayment keeps Amber in debt for a long time.

**Q16.** Levi is choosing between a new car priced at \$24 000 that uses 6.2 L of fuel per 100 km, and a three-year-old car priced at \$16 500 that uses 8.5 L per 100 km. Petrol costs \$1.80 a litre and Levi drives 15 000 km a year. (a) Find each car's fuel use in litres, and its fuel cost, for one year. (b) Find the difference in yearly fuel cost, and the difference in purchase price. (c) Find how many whole years of fuel savings it would take to cover the purchase-price difference, correct to the nearest whole number. Hence say which car costs less overall if Levi keeps his car for 5 years.

**Q17.** Thea wants a pair of running shoes tagged at \$85. **Shop A** takes 30 % off. **Shop B** takes \$15 off. **Shop C** takes a quarter off. (a) Find the sale price at each shop. (b) Which shop is cheapest, and how much cheaper is it than the dearest of the three? (c) An online site sells the same shoes for \$17, advertising "80% off \$85". Show by calculation that \$17 really is 80 % off \$85. Then give two warning signs that the site could be a scam, and one safer way for Thea to buy the shoes.

**Q18.** Curtis's week looks like this. **Income:** 20 ordinary hours at \$28.00 an hour; 4 Saturday hours at time-and-a-half; and 2 % commission on \$1 500 of sales. **Expenses:** rent \$270, food \$95, transport \$38, phone \$19, gym \$17, entertainment \$40, other \$34.



*Made-up data: the name and every number in this question are made up for this section.*

- Find Curtis's total weekly income.
- Find his total weekly expenses and his surplus.
- Find his rent as a percentage of his weekly income, correct to 1 decimal place.
- He saves \$200 a week from the surplus towards a \$1 200 trip. How many weeks will it take to save the trip money?

## Answers

**Q1.** (a) Debits: phone bill \$45.00, groceries \$96.35, rent \$380.00. Credits: wages \$742.60, birthday gift \$50.00. (b) \$958.00. (c) \$486.65. **Q2.** (a) \$896.00. (b) \$38.40 an hour. (c) \$1 011.20. **Q3.** (a) GST \$48.00; price \$528.00. (b) GST \$8.50; GST-free part \$85.00. (c) \$150.00. **Q4.** (a) Income \$1 050; expenses \$670. (b) \$380. (c) 8 weeks. **Q5.** (a) 195 km. (b) \$152.10. (c) \$186.10. **Q6.** (a) \$340. (b) \$790. (c) \$1 130; \$340 more. **Q7.** (a) Saturday \$39.00 an hour; Sunday and public holiday \$52.00 an hour. (b) \$1 248.00. (c) \$32.84 an hour (to the nearest cent). **Q8.** (a) Job A \$920; Job B \$1 000. (b) Job B, by \$80. (c) both pay \$800. **Q9.** (a) Tax \$8 320; Medicare levy \$1 040. (b) \$42 640. (c) Loan repayment \$2 080; take-home \$40 560. **Q10.** (a) 2 GB. (b) \$45. (c) \$42; Big Talk, by \$3; \$1.91 per GB (to the nearest cent). **Q11.** (a) \$369.00. (b) \$361.00; Southvale, by \$8.00. (c) both cost \$305.00. **Q12.** (a) \$6 000. (b) \$21 000. (c) \$350.00. (d) Interest \$4 500; total \$19 500; saving \$1 500. **Q13.** (a) \$970. (b) \$70; 7.8% (to 1 d.p.). (c) \$430; 7.5%. **Q14.** (a) Fees \$410; repays \$2 410. (b) Interest \$90; repays \$2 090. (c) 4.6 times (to 1 d.p.). **Q15.** (a) \$22.50. (b) \$27.50 reduces the balance; new balance \$1 472.50. (c) \$177.50 reduces the balance; new balance \$1 322.50. (d) any correct reason — most of each minimum payment pays interest, so the balance barely falls. **Q16.** (a) New: 930 L, \$1 674.00; second-hand: 1 275 L, \$2 295.00. (b) \$621.00 a year; \$7 500. (c) 12 years (to the nearest whole number); over 5 years the second-hand car costs less overall. **Q17.** (a) A \$59.50; B \$70.00; C \$63.75. (b) Shop A, \$10.50 cheaper than Shop B. (c) 80% of \$85 is \$68 and  $\$85 - \$68 = \$17$  ✓; warning signs and a safer method as listed in the solution. **Q18.** (a) \$758. (b) \$513; surplus \$245. (c) 35.6% (to 1 d.p.). (d) 6 weeks.

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## Fully-worked solutions

**Q1.** (a) Money out is a debit: the phone bill (\$45.00), groceries (\$96.35) and rent (\$380.00). Money in is a credit: the wages (\$742.60) and the birthday gift (\$50.00). (b)  $\$215.40 + \$742.60 = \$958.00$ . (c) Work down the statement:  $\$958.00 - \$45.00 = \$913.00$ ;  $\$913.00 - \$96.35 = \$816.65$ ;  $\$816.65 - \$380.00 = \$436.65$ ;  $\$436.65 + \$50.00 = \$486.65$ . The closing balance is \$486.65.

**Q2.** (a)  $W = R \times H = \$25.60 \times 35 = \$896.00$ . (b) Time-and-a-half:  $\$25.60 \times 1.5 = \$38.40$  an hour. (c) Overtime pay:  $\$38.40 \times 3 = \$115.20$ . Gross pay:  $\$896.00 + \$115.20 = \$1 011.20$ .

**Q3.** (a) GST:  $10\% \text{ of } \$480 = 0.10 \times \$480 = \$48.00$ . Price paid:  $\$480 + \$48.00 = \$528.00$ . (Check:  $480 \times 1.10 = 528$  ✓.) (b) GST inside a GST-inclusive price is the price  $\div 11$ :  $\$93.50 \div 11 = \$8.50$ . The GST-free part is  $\$93.50 - \$8.50 = \$85.00$ . (Check:  $85 \times 1.10 = 93.50$  ✓.) (c)  $\$1 650 \div 11 = \$150.00$  of GST is inside the quote.

**Q4.** (a) Income:  $\$900 + \$150 = \$1 050$ . Expenses:  $\$350 + \$140 + \$55 + \$20 + \$60 + \$45 = \$670$ . (b) Surplus:  $\$1 050 - \$670 = \$380$  a week. (c)  $\$2 000 \div \$250 = 8$ . It takes 8 weeks.

**Q5.** (a)  $32 + 45 + 28 + 51 + 39 = 195$  km. (b) 78c per km is \$0.78 per km:  $195 \times \$0.78 = \$152.10$ . (c) Meal allowance:  $\$6.80 \times 5 = \$34.00$ . Total allowances:  $\$152.10 + \$34.00 = \$186.10$ .

**Q6.** (a) Commission:  $0.04 \times \$8 500 = \$340$ . (b) Total pay:  $\$450 + \$340 = \$790$ . (c) Commission:  $0.04 \times \$17 000 = \$680$ ; total pay  $\$450 + \$680 = \$1 130$ . That is  $\$1 130 - \$790 = \$340$  more than the first week. Doubling the sales doubled the commission — but not the total pay, because the retainer stayed at \$450.

**Q7.** (a) Saturday (time-and-a-half):  $\$26.00 \times 1.5 = \$39.00$  an hour. Sunday and public holiday (double time):  $\$26.00 \times 2 = \$52.00$  an hour. (b) Ordinary:  $\$26.00 \times 25 = \$650.00$ . Saturday:  $\$39.00 \times 6 = \$234.00$ . Sunday:  $\$52.00 \times 4 = \$208.00$ . Public holiday:  $\$52.00 \times 3 = \$156.00$ . Gross:  $\$650.00 + \$234.00 + \$208.00 + \$156.00 = \$1 248.00$ . (c) Hours worked:  $25 + 6 + 4 + 3 = 38$ . Average rate:  $\$1 248.00 \div 38 = \$32.8421\dots$  Correct to the nearest cent: **\$32.84** an hour — above his ordinary \$26.00, which is what penalty rates are for.

**Q8.** (a) Job A: commission  $0.015 \times \$20 000 = \$300$ ; pay  $\$620 + \$300 = \$920$ . Job B: commission  $0.025 \times \$20 000 = \$500$ ; pay  $\$500 + \$500 = \$1 000$ . (b)  $\$1 000 - \$920 = \$80$ : Job B pays \$80 more at \$20 000 of sales. (c) Job A: commission  $0.015 \times \$12 000 = \$180$ ; pay  $\$620 + \$180 = \$800$ . Job B: commission  $0.025 \times \$12 000 = \$300$ ; pay  $\$500 + \$300 = \$800$ . Both jobs pay \$800 — at \$12 000 of sales they are exactly equal.

- Q9.** (a) Income tax:  $0.16 \times \$52\,000 = \$8\,320$ . Medicare levy:  $0.02 \times \$52\,000 = \$1\,040$ . (b)  $\$52\,000 - \$8\,320 - \$1\,040 = \$42\,640$ . (c) Student loan repayment:  $0.04 \times \$52\,000 = \$2\,080$ . Take-home after it:  $\$42\,640 - \$2\,080 = \$40\,560$ .
- Q10.** (a)  $22 - 20 = 2$  GB over the included data. (b) Extra data:  $2 \times \$5 = \$10$ ; monthly cost  $\$35 + \$10 = \$45$ . (c) Big Talk costs \$42 a month whatever he uses up to 35 GB, so Big Talk is cheaper by  $\$45 - \$42 = \$3$ . Cost per GB used:  $\$42 \div 22 = \$1.9090\dots$  Correct to the nearest cent: **\$1.91** per GB.
- Q11.** (a) Usage:  $0.032 \times 9\,500 = \$304.00$  ( $3.2c = \$0.032$ ). Total:  $\$65 + \$304.00 = \$369.00$ . (b) Usage:  $0.028 \times 9\,500 = \$266.00$ . Total:  $\$95 + \$266.00 = \$361.00$ . Southvale Gas is cheaper for this quarter, by  $\$369.00 - \$361.00 = \$8.00$ . (c) Eastgate at 7 500 MJ: usage  $0.032 \times 7\,500 = \$240.00$ ; total  $\$65 + \$240.00 = \$305.00$ . Southvale at 7 500 MJ: usage  $0.028 \times 7\,500 = \$210.00$ ; total  $\$95 + \$210.00 = \$305.00$ . Both plans cost \$305.00 — at 7 500 MJ they are exactly equal. Below that usage Eastgate wins (its supply charge is lower); above it, Southvale wins (its usage charge is lower).
- Q12.** (a)  $I = P \times r \times n = \$15\,000 \times 0.08 \times 5 = \$6\,000$ . (b) Total repaid:  $\$15\,000 + \$6\,000 = \$21\,000$ . (c) Monthly repayment:  $\$21\,000 \div 60 = \$350.00$ . (d)  $I = \$15\,000 \times 0.06 \times 5 = \$4\,500$ ; total repaid  $\$15\,000 + \$4\,500 = \$19\,500$ . Saving:  $\$21\,000 - \$19\,500 = \$1\,500$ .
- Q13.** (a) Payments:  $8 \times \$115 = \$920$ . Total on the plan:  $\$50 + \$920 = \$970$ . (b) Extra over the cash price:  $\$970 - \$900 = \$70$ . As a percentage of the cash price:  $\frac{70}{900} \times 100 = 7.777\dots\%$ . Correct to 1 decimal place: **7.8%**. (c) Payments:  $4 \times \$100 = \$400$ ; late fees:  $2 \times \$15 = \$30$ ; total cost:  $\$400 + \$30 = \$430$ . Late fees as a percentage of the cash price:  $\frac{30}{400} \times 100 = 7.5\%$ . BNPL itself charged nothing — the lateness did.
- Q14.** (a) FastFee fees:  $\$200 + (6 \times \$35) = \$200 + \$210 = \$410$ . Total repaid:  $\$2\,000 + \$410 = \$2\,410$ . (b) Six months is half a year, so  $n = 0.5$ :  $I = \$2\,000 \times 0.09 \times 0.5 = \$90$ . Total repaid:  $\$2\,000 + \$90 = \$2\,090$ . (c)  $\$410 \div \$90 = 4.555\dots$  Correct to 1 decimal place: **4.6 times** the bank's interest — for the same \$2 000 over the same six months. An online interest or loan calculator shows the same story for real products: check the fees, not just the advertised rate.
- Q15.** (a)  $1.5\%$  of  $\$1\,500 = 0.015 \times \$1\,500 = \$22.50$ . (b) Of the \$50 payment, \$22.50 pays the interest first, leaving  $\$50 - \$22.50 = \$27.50$  to reduce the balance. New balance:  $\$1\,500 - \$27.50 = \$1\,472.50$ . (c) Of the \$200 payment, \$22.50 pays the interest, leaving  $\$200 - \$22.50 = \$177.50$  to reduce the balance. New balance:  $\$1\,500 - \$177.50 = \$1\,322.50$ . (d) At the minimum repayment, nearly half of every payment is swallowed by interest, so the balance falls by only \$27.50 a month and the debt (and its interest) goes on and on.
- Q16.** (a) New car:  $15\,000 \div 100 = 150$  lots of 100 km, so  $150 \times 6.2 = 930$  L; cost  $930 \times \$1.80 = \$1\,674.00$  a year. Second-hand car:  $150 \times 8.5 = 1\,275$  L; cost  $1\,275 \times \$1.80 = \$2\,295.00$  a year. (b) Fuel difference:  $\$2\,295.00 - \$1\,674.00 = \$621.00$  a year in the new car's favour. Price difference:  $\$24\,000 - \$16\,500 = \$7\,500$  in the second-hand car's favour. (c)  $\$7\,500 \div \$621.00 = 12.07\dots$  Correct to the nearest whole number: **12 years** of fuel savings would be needed to wipe out the price gap. Over 5 years the totals are: new car  $\$24\,000 + 5 \times \$1\,674.00 = \$32\,370$ ; second-hand car  $\$16\,500 + 5 \times \$2\,295.00 = \$27\,975$ . So for a 5-year plan the **second-hand car costs less overall** — by  $\$32\,370 - \$27\,975 = \$4\,395$ .
- Q17.** (a) Shop A: 30% off is  $0.30 \times \$85 = \$25.50$  off; price  $\$85 - \$25.50 = \$59.50$ . Shop B:  $\$85 - \$15 = \$70.00$ . Shop C: a quarter off is  $\$85 \div 4 = \$21.25$  off; price  $\$85 - \$21.25 = \$63.75$ . (b) Shop A is cheapest at \$59.50; the dearest is Shop B at \$70.00; Shop A is  $\$70.00 - \$59.50 = \$10.50$  cheaper. (c) 80% of \$85 is  $0.80 \times \$85 = \$68$  off. The claimed price is  $\$85 - \$68 = \$17$ . The arithmetic is exactly right — and the site can still be a scam. Warning signs (any two): the price is far below every other seller; pressure to pay today before the “deal” ends; payment by bank transfer or gift card only, with no buyer protection; requests for card numbers, passwords or one-off codes; no real contact details or reviews for the seller. A safer way: buy from a seller she can verify, and pay through a method that protects buyers (or in person with the shoes in her hands).

**Q18.** (a) Ordinary pay:  $\$28.00 \times 20 = \$560.00$ . Overtime rate:  $\$28.00 \times 1.5 = \$42.00$ ; overtime pay:  $\$42.00 \times 4 = \$168.00$ . Commission:  $0.02 \times \$1500 = \$30.00$ . Total income:  $\$560.00 + \$168.00 + \$30.00 = \$758.00$ . (b) Total expenses:  $\$270 + \$95 + \$38 + \$19 + \$17 + \$40 + \$34 = \$513$ . Surplus:  $\$758 - \$513 = \$245$ . (c)  $\frac{270}{758} \times 100 = 35.620\dots\%$ . Correct to 1 decimal place: 35.6 % of his income goes to rent. (d)  $\$1200 \div \$200 = 6$ . It takes 6 weeks — comfortably inside his \$245 weekly surplus.

## Chapter 6 Unit 3 numeracy in context — 6D Health numeracy

### Theory

The Study Design (Unit 3, Outcome 1) defines the context of this section: health numeracy means using maths to look after your own health, safety and wellbeing, while also seeing these issues from the point of view of a community or a workplace.

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

Health numeracy is the maths of everyday health decisions: reading a medicine label, checking a temperature against a guideline, working out what a clinic visit really costs, comparing accident rates at work. Every task in this section runs through the four-stage problem-solving cycle from Section 1A — **Stage 1 — Identify, Stage 2 — Act, Stage 3 — Evaluate, Stage 4 — Report** — and uses a toolkit where that is natural: a calculator, a phone timer or alarm, the oral syringe that comes with a medicine, a pedometer app. Every calculation here can also be done with pen and paper.

### Body signals worth knowing.

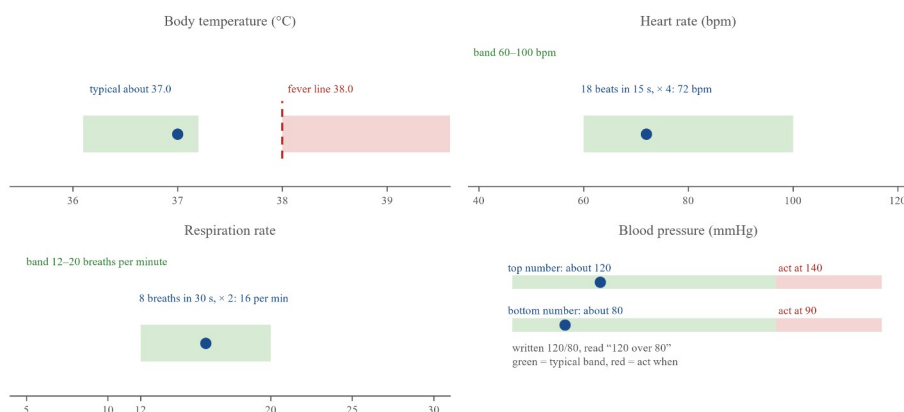
Clinics and hospitals track a few key body signals, called **vital signs** (or **vitals**). The table gives the simplified normal ranges this book uses for a resting adult. They are practice values for maths, not medical advice.

| Measure          | Unit                   | Typical for a resting adult | Act when                                   |
|------------------|------------------------|-----------------------------|--------------------------------------------|
| body temperature | degrees Celsius (°C)   | about 36.1 to 37.2          | 38.0°C or above is a <b>fever</b>          |
| heart rate       | beats per minute (bpm) | 60 to 100                   | outside the band                           |
| respiration rate | breaths per minute     | 12 to 20                    | outside the band                           |
| blood pressure   | mmHg                   | about 120 over 80           | top 140 or above, or<br>bottom 90 or above |

Blood pressure is written as two numbers, like 120 / 80, read “120 over 80”. The **top number** is the pressure while the heart squeezes; the **bottom number** is the pressure while the heart rests between beats. The unit is **millimetres of mercury** (mmHg), the unit printed on blood-pressure gauges. In this section, **high blood pressure** means a top number of 140 or above **or** a bottom number of 90 or above.

Health workers often count a pulse or a breathing rate over a short time and then scale the count up to one minute. There are 60 seconds in a minute, so a 15-second count is multiplied by 4 (because  $60 \div 15 = 4$ ) and a 30-second count is multiplied by 2. For example, 18 beats counted in 15 seconds give a heart rate of  $18 \times 4 = 72$  bpm, which sits inside the 60–100 band.

Vital signs: simplified practice bands for a resting adult



### Percentages in health information.

Public health information is full of percentages, and three types turn up again and again in this section.

*Food labels.* Food energy is measured in **kilojoules** (kJ). The daily guideline for an average adult is about 8 700 kJ. A snack bar with 870 kJ uses  $870 \div 8\,700 \times 100 = 10\%$  of a whole day's energy.

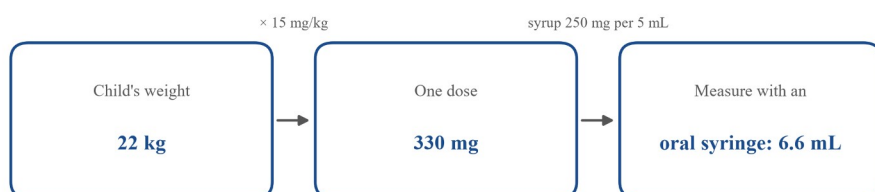
*Fitness zones.* A common **rule of thumb** (a simple estimate, not an exact law) puts a person's estimated maximum heart rate at 220 minus their age. Moderate exercise is said to sit at 50 % to 70 % of that maximum. For a person aged 50: maximum =  $220 - 50 = 170$  bpm, so the zone runs from 50 % of 170 = 85 bpm to 70 % of 170 = 119 bpm.

*Lifestyle and disease risk.* Risks are often quoted as percentages, and advice quotes how much an action cuts a risk. If a risk of 8 % falls **by** 30 %, the fall is 30 % *of* 8 %, that is  $0.3 \times 8 = 2.4$  percentage points, so the new risk is  $8 - 2.4 = 5.6\%$ . A fall *by* 30 % is not a fall *to* 30 %. Community figures work the same way: if 37 of the 50 residents of a street are vaccinated, the coverage is  $37 \div 50 \times 100 = 74\%$ .

When a result does not come out exactly, carry full precision through the working and round only at the end. Every question here says the precision it wants — “to 1 d.p.”, “to the nearest whole number”, “to the nearest cent”. When a value sits exactly halfway, this book rounds up (the school **half-up** rule): 87.5 rounds to 88.

### Medicines: doses, dilutions and schedules.

*Doses by body weight.* A medicine label often gives a dose **per kilogram** of body weight, written mg/kg. A child weighing 22 kg at 15 mg per kg needs  $22 \times 15 = 330$  mg for one dose. Liquid medicines (syrups) then state their **strength**, such as 250 mg per 5 mL. To turn the mg into mL, count the steps of strength and multiply by 5:  $330 \div 250 = 1.32$  steps, and  $1.32 \times 5 = 6.6$  mL.



*Measuring tools.* One teaspoon holds 5 mL, but the **oral syringe** (a needle-less plastic syringe marked in mL, supplied with children's medicines) measures a dose like 6.6 mL far more accurately.

*Dilutions.* Cleaning and disinfecting products are **diluted** (watered down) before use. A ratio of 1 : 50 means 1 part concentrate to 50 parts water, so 1 000 mL of water takes  $1\,000 \div 50 = 20$  mL of concentrate.

*Schedules.* “Every 8 hours” splits the day into  $24 \div 8 = 3$  doses. Starting at 07:00, the doses fall at 07:00, 15:00 and 23:00. This section uses **24-hour time**: 00:00 is midnight and 13:00 is 1 pm. Labels also set limits — a minimum number of hours between doses, and a maximum number of doses in 24 hours. A phone alarm is part of the toolkit, but the time arithmetic is yours.

### Public advice numbers.

*Activity.* Public advice suggests at least 150 minutes of moderate activity a week, and less **sitting time** (the hours spent seated each day).

*Alcohol.* In Australia, one **standard drink** contains 10 g of alcohol, and drinks are labelled with the number of standard drinks they hold. The advice for healthy adults is no more than 4 standard drinks on any one day and no more than 10 in a week; learner and **P-plate** (probationary) drivers must have zero alcohol before driving.

*Obesity screening.* The **body mass index** (BMI) screens for weight categories:

$$\text{BMI} = \frac{w}{h^2}$$

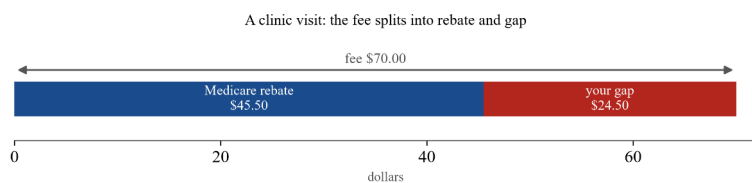
where  $w$  is weight in kg and  $h$  is height in m. Squaring is the index work from AoS 1: for  $h = 1.65$ ,  $h^2 = 1.65 \times 1.65 = 2.7225$ .

| BMI           | Category       |
|---------------|----------------|
| below 18.5    | underweight    |
| 18.5 to 24.9  | healthy weight |
| 25.0 to 29.9  | overweight     |
| 30.0 or above | obese          |

BMI is a screening number, not a diagnosis — it cannot tell muscle from fat.

### Health costs: Medicare and private insurance.

**Medicare** is Australia's public health care system. A clinic visit has a **fee** (the clinic's price). Medicare pays back part of it — the **rebate**. The **gap** (your out-of-pocket cost) is fee minus rebate: a \$ 70 fee with a \$ 45.50 rebate leaves a gap of  $70 - 45.50 = \$ 24.50$ .



A clinic that **bulk bills** sends the Medicare rebate straight to the clinic, so the patient's gap is \$ 0. **Extras cover** (private insurance for services Medicare generally does not cover, such as dental) pays back a percentage of the bill, such as 70 %.

The **Medicare levy surcharge** is extra tax that some higher-income people pay when they do not hold private hospital cover. The real surcharge uses income tiers; Q16 practises with a simplified made-up rule. A **premium** is the amount paid each month or year for insurance, and premiums change across life stages — single, coupled, family, older single. **Lifetime Health Cover** loading adds to a premium when hospital cover is first taken out later in life; Q17(d) practises with a simplified version of that rule.

### Health and safety at work.

Workplaces record accidents (injuries) by type — slips and trips, lifting, machinery, chemicals — and report a **rate** so that workplaces of different sizes can be compared. A rate **per 100 workers** is  $\text{injuries} \div \text{workers} \times 100$ : 12 injuries among 200 workers is a rate of  $12 \div 200 \times 100 = 6$  per 100 workers.

A chemical **audit** is a formal check against a list: every chemical product is counted and its hazard symbol recorded. The common symbols are **flammable** (catches fire easily), **corrosive** (burns skin or materials) and **toxic** (poisonous). Audits often compare workplace chemicals with home chemicals — many home cupboard products carry the same symbols.

**About the data in this section.** The quoted definition, the 10 g standard-drink rule, the drinking and activity advice, the 220 – age rule of thumb and the typical vitals bands are real-world rules, simplified for practice. Everything else — the clinics, health funds, warehouses, families, and every number and data set in the examples and questions — is **made up** (not real): pretend people and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real person, business or place. The surcharge rule in Q16 and the loading rule in Q17(d) are simplified versions of real rules, invented for practice.

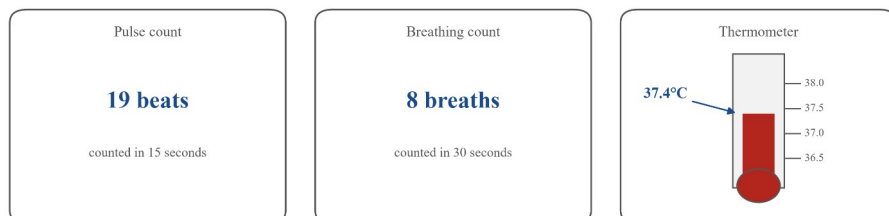
**Not medical advice.** Every band, rule and dose in this section is simplified for maths practice. Never use this section to make a real decision about medicine or health — follow the label on the medicine, and follow your doctor, pharmacist or nurse.

## Worked examples

### Example 1 — scaffolded

Nurse Kelly takes a patient's vital signs at a clinic. She counts 19 heart beats in 15 seconds, counts 8 breaths in 30 seconds, and reads a digital thermometer showing  $37.4^{\circ}\text{C}$ . Find the heart rate in bpm and the respiration rate in breaths per minute, and decide whether each of the three vitals sits inside the typical bands from the theory table.

Nurse Kelly's three observations (made-up patient)



*Made-up data: these counts and readings are invented for this book.*

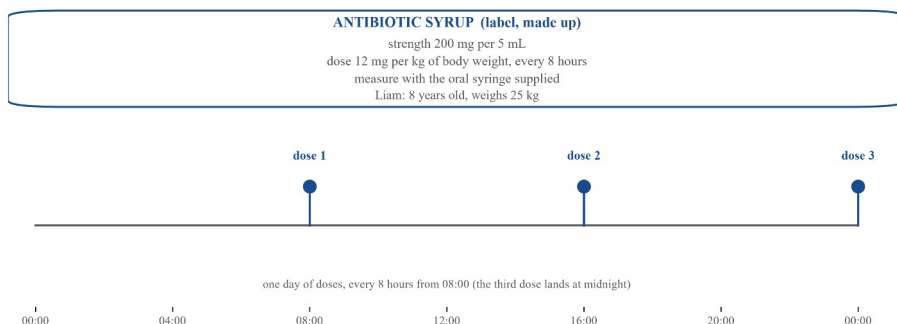
| Working                                                                                                                                                                                                                                                                                                                                                                             | Comment                                                                                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| <b>Stage 1 — Identify:</b> three vitals must each be compared with a band. Plan: scale the two short counts up to one minute, then compare all three results with the bands.                                                                                                                                                                                                        | What is asked? The two rates, and an inside-the-band decision for each vital.                    |
| <b>Stage 2 — Act:</b> heart rate = $19 \times 4 = 76$ bpm.                                                                                                                                                                                                                                                                                                                          | $60 \div 15 = 4$ , so a 15-second count is multiplied by 4.                                      |
| <b>Stage 2 — Act:</b> respiration rate = $8 \times 2 = 16$ breaths per minute.                                                                                                                                                                                                                                                                                                      | $60 \div 30 = 2$ , so a 30-second count is multiplied by 2.                                      |
| <b>Stage 3 — Evaluate:</b> heart rate: $60 \leq 76 \leq 100$ ✓.<br>Respiration: $12 \leq 16 \leq 20$ ✓. Temperature: $37.4 > 37.2$ , so it sits a little above the typical band; but $37.4 < 38.0$ , so no fever. Scale check: a wrong multiplier of 40 would give $19 \times 40 = 760$ bpm, which is impossible — no heart beats 760 times a minute — so $\times 4$ must be right. | Compare each result with its band. An answer outside any possible band points to a scaling slip. |
| <b>Stage 4 — Report:</b> $\therefore$ the heart rate is 76 bpm and the respiration rate is 16 breaths per minute. The heart rate and the respiration rate sit inside the typical bands; the temperature sits a little above its band but below the fever line.                                                                                                                      | Kelly writes the three values, with their times, on the observations chart.                      |

### Example 2 — scaffolded

Liam is 8 years old and weighs 25 kg. The antibiotic syrup he has been prescribed carries this label:

- strength: 200 mg per 5 mL
- dose: 12 mg per kg of body weight, every 8 hours
- measure the dose with the oral syringe supplied

His first dose is given at 08:00. Find one dose in mg and in mL, list the three dose times for the day, and find the total mg Liam receives in one day.



*Made-up data: Liam, the syrup and every number here are invented for this book.*

| Working                                                                                                                                                                                                                                                                                       | Comment                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| <b>Stage 1 — Identify:</b> dose in mg, then dose in mL, then the three times, then the daily total. Plan: $25 \times 12$ ; convert mg to mL through the strength; step the clock forward 8 hours at a time; multiply the dose by the number of doses.                                         | “Every 8 hours” means $24 \div 8 = 3$ doses in a day.                                                     |
| <b>Stage 2 — Act:</b> dose = $25 \times 12 = 300$ mg.                                                                                                                                                                                                                                         | mg per kg $\times$ kg.                                                                                    |
| <b>Stage 2 — Act:</b> strength steps = $300 \div 200 = 1.5$ , so volume = $1.5 \times 5 = 7.5$ mL.                                                                                                                                                                                            | Each 5 mL of syrup carries 200 mg.                                                                        |
| <b>Stage 2 — Act:</b> times: 08:00, add 8 hours to get 16:00, add 8 more to get 00:00 — midnight.                                                                                                                                                                                             | 24-hour time; the third dose wraps around to midnight.                                                    |
| <b>Stage 2 — Act:</b> daily total = $300 \times 3 = 900$ mg.                                                                                                                                                                                                                                  | Three doses of 300 mg each.                                                                               |
| <b>Stage 3 — Evaluate:</b> estimate $25 \times 12$ as $25 \times 10 = 250$ — so 300 mg is a little more, which fits. 7.5 mL is one and a half teaspoons: a sensible child’s volume, and the oral syringe (toolkit) will measure it exactly. A phone alarm covers the midnight dose (toolkit). | Estimation and real-world size catch slips; tools help with measuring and timing, not with the decisions. |
| <b>Stage 4 — Report:</b> $\therefore$ one dose is 300 mg, which is 7.5 mL of syrup; the times are 08:00, 16:00 and 00:00; the daily total is 900 mg.                                                                                                                                          | Liam’s parent writes “08:00 / 16:00 / 00:00 · 7.5 mL” on the medicine chart.                              |

### Example 3 — unscaffolded

Priya’s GP charges a fee of \$85.00 for a standard visit, and Medicare rebates \$52.40 of it. She needs 6 visits this year. One clinic in her town bulk bills, so a visit there has a gap of \$0. Separately, Priya has a dental bill of \$450.00 and her extras cover returns 70% of dental bills. Find the gap on one GP visit, her total gap across the 6 visits, what bulk billing would save her, and for the dental bill the amount returned and the gap that is left. Check the 70% calculation with an estimate.

| THE CLINIC (made up)                     |           |
|------------------------------------------|-----------|
| GP visit fee                             | \$85.00   |
| Medicare rebate                          | -\$52.40  |
| Gap you pay                              | \$32.60   |
| 6 visits $\times$ \$32.60 gap = \$195.60 |           |
| <hr/>                                    |           |
| Dental bill                              | \$450.00  |
| Extras returns 70%                       | -\$315.00 |
| Gap you pay                              | \$135.00  |
| <br>bulk-billing clinic: gap \$0.00      |           |

**Stage 1 — Identify.** The numbers are: fee \$85.00, rebate \$52.40, 6 visits, dental \$450.00 at 70%. The operations: gap = fee – rebate; total gap = gap  $\times$  6; returned = 70 % of \$450.00; dental gap = bill – returned.

**Stage 2 — Act.** Gap per visit =  $85.00 - 52.40 = 32.60$ , so \$32.60. Across 6 visits:  $32.60 \times 6 = 195.60$ , so \$195.60. With bulk billing the gap is \$0 per visit, so the saving is the whole \$195.60. Dental:  $450 \times 0.70 = 315$ , so \$315.00 returned, and the gap left is  $450 - 315 = 135$ , so \$135.00.

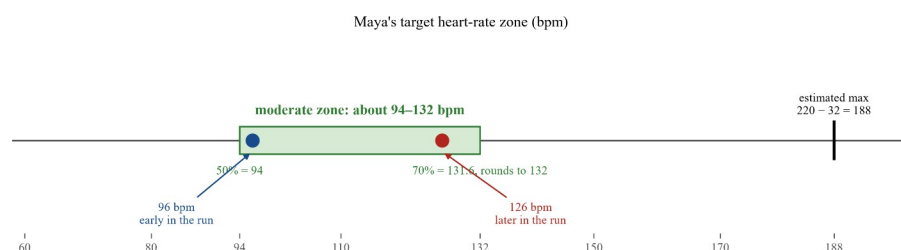
**Stage 3 — Evaluate.** Estimate the 70%: 70 % of \$400 is \$280 and 70 % of \$500 is \$350; \$450 sits between the two, so \$315 is sensible. Add back as a check: rebate + gap =  $52.40 + 32.60 = 85.00$  ✓, and returned + dental gap =  $315 + 135 = 450$  ✓.

**Stage 4 — Report.**  $\therefore$  the gap is \$32.60 per visit and \$195.60 across the 6 visits; using the bulk-billing clinic would save the whole \$195.60; on the dental bill the fund returns \$315.00, leaving a gap of \$135.00.

*Made-up data: Priya's clinics, her health fund and every number are invented for this book.*

### Example 4 — unscaffolded

Maya is 32 and jogs in the moderate zone, which is 50 % to 70 % of her estimated maximum heart rate, using the rule of thumb maximum =  $220 - \text{age}$ . Find Maya's estimated maximum heart rate and her moderate zone, giving the zone ends to the nearest whole beat. Her watch shows 96 bpm early in a run and 126 bpm later. Decide whether each reading sits inside the zone, and express 126 bpm as a percentage of her estimated maximum, to 1 d.p.



**Stage 1 — Identify.** Maximum =  $220 - 32$ . Zone ends = 50 % and 70 % of the maximum, rounded to whole beats. The percentage is reading  $\div$  maximum  $\times 100$ , to 1 d.p.

**Stage 2 — Act.** Maximum =  $220 - 32 = 188$  bpm. Low end =  $0.50 \times 188 = 94$  bpm. High end =  $0.70 \times 188 = 131.6$ , which rounds to 132 bpm (nearest whole beat). So the zone is about 94–132 bpm. Both readings sit inside it:  $94 \leq 96 \leq 132$  and  $94 \leq 126 \leq 132$ . The percentage is  $126 \div 188 \times 100 = 67.021\ldots\%$ , which is 67.0 % to 1 d.p.

**Stage 3 — Evaluate.** Half of 188 is exactly 94, so the low end needed no rounding, and 131.6 is nearer 132 than 131 ✓. As a cross-check, 67.0 % sits just below the 70 % top of the zone — which agrees with 126 being inside the zone, near its top ✓.

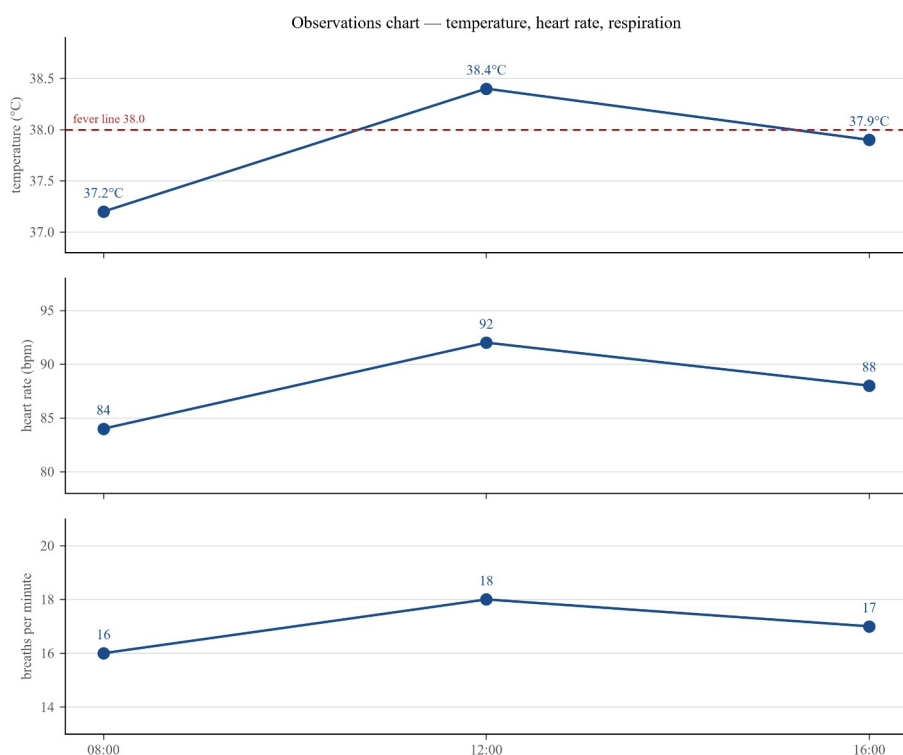
**Stage 4 — Report.** ∴ Maya’s estimated maximum heart rate is 188 bpm, her moderate zone is about 94–132 bpm, both watch readings sit inside the zone, and 126 bpm is 67.0 % of her estimated maximum (to 1 d.p.).

*Made-up data: Maya and her two readings are invented for this book.*

## Practice questions

### Scaffolded

**Q1.** A patient’s observations chart records the temperature, heart rate and respiration rate at three times in one day: 08:00, 12:00 and 16:00.



*Made-up data: these readings are invented for this book.*

- A fever is a temperature of  $38.0^{\circ}\text{C}$  or above. How many of the three temperature readings show a fever? Give the reading and its time.
- Find the range of the three heart rates.
- Find the mean of the three temperatures, to 1 d.p.

**Q2.** A nurse counts pulses (heart beats) for three patients.

- Patient 1: 16 beats counted in 15 seconds. Find the heart rate in bpm, and say whether it is inside the band 60–100.
- Patient 2: 23 beats counted in 20 seconds. Find the heart rate in bpm.
- Patient 3 is a competitive athlete with a resting heart rate of 52 bpm, which is below the band 60–100. Give one reason a very fit person’s resting heart rate can sit below the band.

**Q3.** A patient takes one tablet every 6 hours, with the first dose at 06:00, and the course runs for 5 days.

- (a) List the four dose times for one day, in 24-hour time.
- (b) How many tablets does the whole 5-day course need?
- (c) The pharmacy supplies a pack of 24 tablets. Is the pack enough for the course? How many tablets are left over?

**Q4.** A muesli bar's label and the daily guidelines for an average adult are shown below.

| Label (per bar) | Daily guideline   |
|-----------------|-------------------|
| energy 890 kJ   | about 8 700 kJ    |
| fat 7.5 g       | no more than 70 g |

*Made-up data: this product and its numbers are invented for this book.*

- (a) Express the energy in one bar as a percentage of the daily energy guideline, to 1 d.p.
- (b) Express the fat in one bar as a percentage of the daily fat guideline, to 1 d.p.
- (c) Find the total energy in a 5-bar pack, and express it as a percentage of the daily energy guideline, to 1 d.p.

**Q5.** A disinfectant's label says to dilute it at a ratio of 1:50 — that is, 1 part concentrate to 50 parts water.

- (a) How many mL of concentrate go with 2 000 mL of water?
- (b) A cleaner fills a 5 L bucket with water. How many mL of concentrate does the bucket need? (1 L = 1 000 mL.)
- (c) A 250 mL bottle of concentrate is used up completely. How many mL of water does it treat, and what is that in litres?

**Q6.** A GP charges a fee of \$76.50 for a visit, and Medicare rebates \$51.20.

- (a) Find the patient's gap for one visit.
- (b) The patient needs 3 visits. Find the total gap.
- (c) Another clinic bulk bills, so the gap there is \$0. Explain, in one sentence, what bulk billing means for the patient.

### **Unscaffolded**

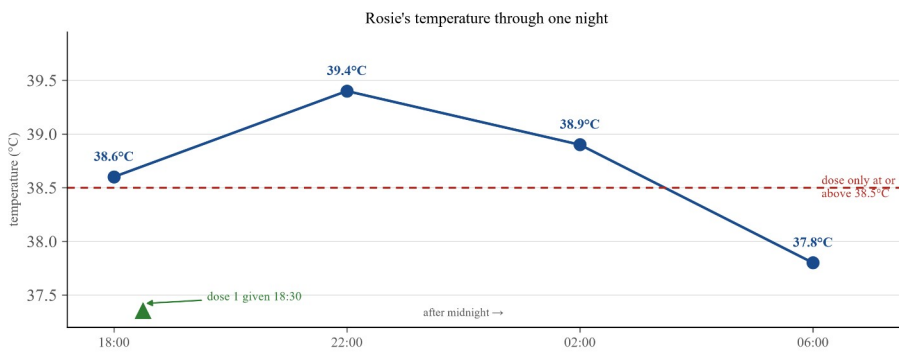
**Q7.** Four patients' blood pressures are measured in mmHg. Each reading is written top number/bottom number. In this section, high blood pressure means a top number of 140 or above **or** a bottom number of 90 or above.

| Patient | Reading  |
|---------|----------|
| Anh     | 118 / 76 |
| Bea     | 142 / 92 |
| Callum  | 134 / 86 |
| Dee     | 121 / 79 |

*Made-up data: these patients and readings are invented for this book.*

- (a) Which patient or patients have high blood pressure?
- (b) Whose top number is closest to 120?
- (c) Find the mean of the four top numbers, to 1 d.p.

**Q8.** Baby Rosie's temperature is logged through one night, as shown in the graph. The medicine label has three rules: give a dose only when the temperature is  $38.5^{\circ}\text{C}$  or above; leave at least 4 hours between doses; give no more than 4 doses in 24 hours. Dose 1 is given at 18:30.



*Made-up data: Rosie and her readings are invented for this book.*

- How many of the four logged temperatures are at or above  $38.5^{\circ}\text{C}$ ?
- At 22:15 Rosie is still unsettled and her parent wants to give dose 2. Is 22:15 too soon? What is the earliest time dose 2 may be given?
- Dose 3 is given at 02:30. At 06:00 Rosie's temperature is  $37.8^{\circ}\text{C}$ . May dose 4 be given at 06:30? Use the label rules to justify your answer.
- Find the fall in temperature from the highest reading to the 06:00 reading.

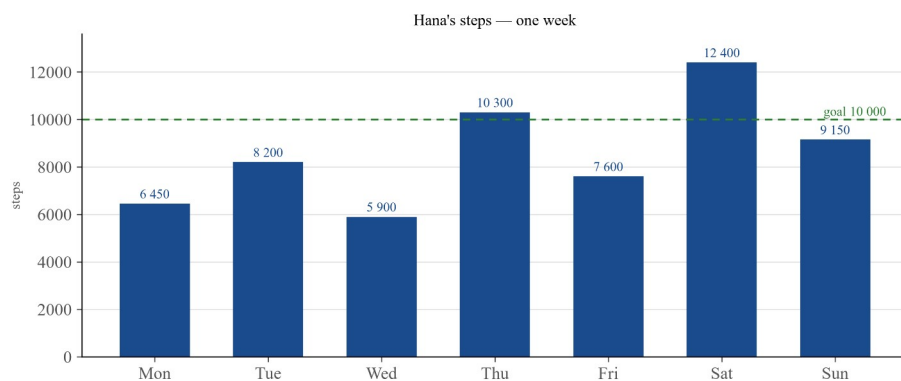
**Q9.** A child weighs 18 kg. The doctor prescribes a syrup at 10 mg per kg of body weight per dose, 3 doses a day, for 5 days. The syrup's strength is 125 mg per 5 mL. The label also warns: do not exceed 60 mg per kg of body weight in one day.

- Find the mg in one dose.
- Find the mL in one dose, to 1 d.p.
- Find the mg the child receives in one day, and say whether that is within the label's daily cap.
- Find the mL needed for the whole 5-day course. Is one 100 mL bottle enough? If not, how many mL short is it?

**Q10.** Tomas is 45 and rides his bike in the moderate zone: 50% to 70% of his estimated maximum heart rate, where maximum =  $220 - \text{age}$ .

- Find Tomas's estimated maximum heart rate.
- Find the two ends of his zone, to the nearest whole beat.
- On a flat stretch Tomas rides at 118 bpm. Is he inside his zone?
- After a steep hill his heart rate is 148 bpm. How many beats above the top of the zone is that?

**Q11.** Hana's pedometer app (a step-counting app) records her steps each day for one week, as shown in the graph. Her goal is 10 000 steps a day.



*Made-up data: these step counts are invented for this book.*

- Find Hana's total steps for the week.
- Find her mean steps per day, to the nearest whole step.
- On how many days did Hana reach her 10 000-step goal?
- For the next week Hana raises her weekly total by 10 %. Find the new weekly total and the extra steps it stands for.

**Q12.** In Australia, one standard drink (SD) contains 10 g of alcohol. The menu below lists the standard drinks in each item, and the advice card gives the limits for healthy adults. Learner and P-plate (probationary) drivers must have zero alcohol before driving.

| Drink                     | Standard drinks |
|---------------------------|-----------------|
| can of beer               | 1.3             |
| glass of wine             | 1.4             |
| shot of spirits           | 1.0             |
| bottle of pre-mixed drink | 1.8             |

Advice card: no more than 4 standard drinks on any one day, and no more than 10 in a week.

*Made-up data: these standard-drink numbers are invented for this book; the 10 g rule and the advice limits are real.*

Jai has 2 cans of beer and 1 glass of wine on Friday night, and 3 shots and 1 pre-mixed bottle on Saturday night.

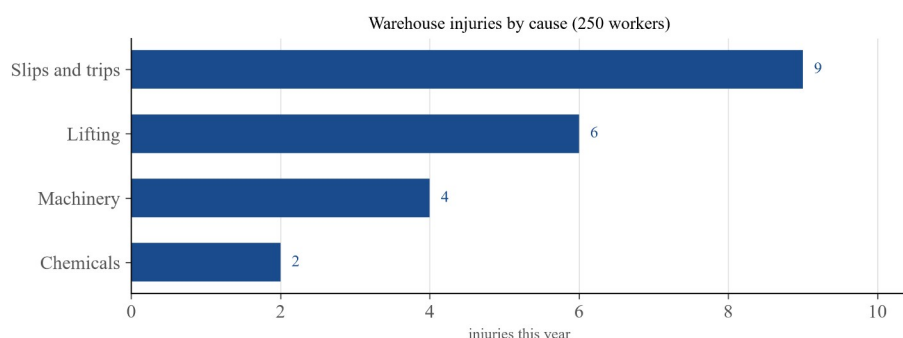
- Find Jai's standard drinks for Friday. Is he within the daily limit?
- Find Jai's standard drinks for Saturday. By how many standard drinks does he go over the daily limit?
- Find Jai's total for the weekend. Is he within the 10-a-week limit?
- On Sunday Jai drives his friends home, and he is on his P-plates. What is the maximum number of standard drinks he can have before driving?

**Q13.** BMI is calculated as weight in kg divided by the square of height in m. The categories are: below 18.5 underweight; 18.5 to 24.9 healthy weight; 25.0 to 29.9 overweight; 30.0 or above obese. Dana weighs 72 kg and is 1.65 m tall. Sam weighs 68 kg and is 1.82 m tall.

*Made-up data: Dana, Sam and their measurements are invented for this book.*

- Show that Dana's BMI is 26.4, correct to 1 d.p.
- Find Sam's BMI, to 1 d.p., and give the category for Dana and for Sam.
- Dana sets a goal of BMI 24.9, the top of the healthy band. Find the weight this stands for, to the nearest 0.1 kg, and the weight Dana needs to lose, to 1 d.p.
- BMI is a screening number, not a diagnosis. Give one reason it can misclassify a very muscular athlete.

**Q14.** A warehouse with 250 workers recorded every injury this year, sorted by cause, as shown in the graph. Last year the warehouse recorded 30 injuries in total.



*Made-up data: this warehouse and its injury counts are invented for this book.*

- Find the total number of injuries this year, and the rate per 100 workers, to 1 d.p.
- Find slips as a percentage of this year's injuries, to 1 d.p.
- Find the percentage decrease from last year to this year, to the nearest whole percent.
- The safety team sets a target: cut injuries by a further 20 % next year. Find the exact target number, then the largest whole number of injuries that meets the target. Explain why 17 injuries would fail.

**Q15.** For a safety audit, a workplace lists every chemical product by the hazard symbol on its label. One worker counts the products in their home cupboard the same way.

| Symbol                              | Work      | Home      |
|-------------------------------------|-----------|-----------|
| flammable (catches fire easily)     | 5         | 2         |
| corrosive (burns skin or materials) | 8         | 5         |
| toxic (poisonous)                   | 3         | 1         |
| no symbol                           | 8         | 7         |
| <b>total</b>                        | <b>24</b> | <b>15</b> |

*Made-up data: this audit and its counts are invented for this book.*

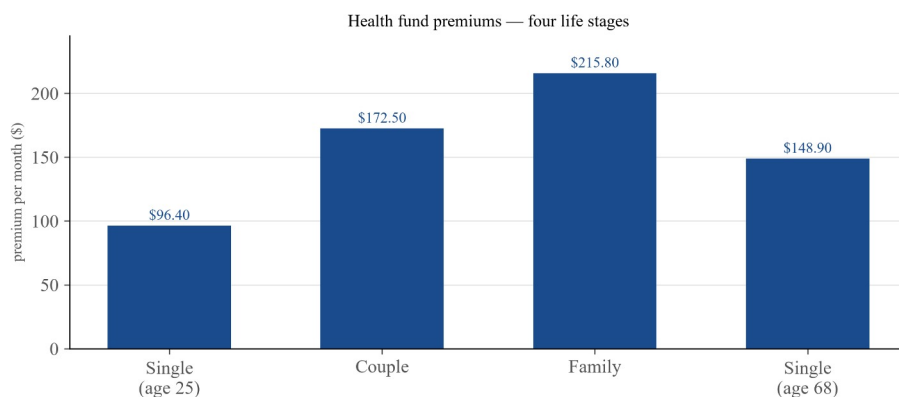
- Find the percentage of the workplace products that are corrosive, to 1 d.p.
- Write the ratio of workplace products to home products (24 : 15) in its simplest form.
- Find the percentage of products carrying **any** hazard symbol at work and at home, each to 1 d.p. Which location is higher?
- The workplace rule: every product with a hazard symbol must be stored in the locked cabinet. How many products must go in the cabinet?

**Q16.** This question uses a **simplified surcharge rule invented for this book** — the real Medicare levy surcharge uses income tiers. Rule: if your taxable income is over \$93 000 and you do not hold private hospital cover, you pay a surcharge of 1 % of your taxable income. Oscar's taxable income is \$104 000 and he has no hospital cover.

*Made-up data: Oscar, his income and this surcharge rule are invented or simplified for this book.*

- Find Oscar's surcharge for the year.
- Hospital cover would cost Oscar \$89 per month. Find its cost for a year.
- Which option is cheaper this year — paying the surcharge, or buying the cover? By how much?
- Give one reason Oscar might buy the cover even when it costs a little more than the surcharge.

**Q17.** A health fund advertises the four monthly premiums below, one for each life stage.



*Made-up data: this fund and its premiums are invented for this book.*

- Find the cost of the family cover for a year, to the nearest cent.
- A family of four considers cover: one family policy, or a single (age 25) policy for each of the four people. Find the cost of the four policies for a year, and the saving for the year from taking one family cover instead, to the nearest cent.
- Find the percentage increase from the single (age 25) premium to the single (age 68) premium, to 1 d.p.
- Lifetime Health Cover loading, **simplified for this book**: add 2% to the premium for each year of age over 30 when hospital cover is first taken out. A person aged 40 takes out the single (age 25) cover for the first time. Find the loading percentage, the loading amount, and the loaded monthly premium, to the nearest cent.

**Q18.** Public advice suggests at least 150 minutes of moderate activity a week, and less sitting time. In one week Ngaire is active for 35 minutes on Monday, 0 on Tuesday, 45 on Wednesday, 25 on Thursday, 0 on Friday, 60 on Saturday and 20 on Sunday. She also sits for about 9 hours each day.

*Made-up data: Ngaire's week is invented for this book.*

- Find Ngaire's total activity minutes for the week. Does she meet the 150-minute guideline?
- Express Ngaire's total as a percentage of the 150-minute guideline, to 1 d.p.
- Find Ngaire's sitting hours for the week.
- Ngaire cuts her sitting time by 20%. Find her new sitting hours per week, and per day, each to 1 d.p.

## Answers

**Q1.** (a) 1 reading —  $38.4^{\circ}\text{C}$  at 12:00. (b) 8 bpm. (c)  $37.8^{\circ}\text{C}$  to 1 d.p. **Q2.** (a) 64 bpm; yes, inside 60–100. (b) 69 bpm. (c) sample answer: a trained heart pumps more blood per beat, so a very fit person's resting heart rate is often below the band without being a problem. **Q3.** (a) 06:00, 12:00, 18:00, 00:00. (b) 20 tablets. (c) yes; 4 tablets left over. **Q4.** (a) 10.2%. (b) 10.7%. (c) 4 450 kJ; 51.1%. **Q5.** (a) 40 mL. (b) 100 mL. (c) 12 500 mL, that is 12.5 L. **Q6.** (a) \$25.30. (b) \$75.90. (c) sample answer: the clinic sends the Medicare rebate straight to itself, so the patient pays nothing — a gap of \$0. **Q7.** (a) Bea only. (b) Dee — 121 is 1 away from 120. (c) 128.8 to 1 d.p. **Q8.** (a) 3 readings (38.6, 39.4 and  $38.9^{\circ}\text{C}$ ). (b) yes, too soon — only 3 h 45 min after dose 1; the earliest is 22:30. (c) no — the  $37.8^{\circ}\text{C}$  reading is below the  $38.5^{\circ}\text{C}$  rule, even though the time gap and the dose count would allow it. (d) a fall of  $1.6^{\circ}\text{C}$ . **Q9.** (a) 180 mg. (b) 7.2 mL. (c) 540 mg a day; the cap is  $18 \times 60 = 1\,080$  mg, so yes, within it. (d) 108 mL; no — the bottle is 8 mL short. **Q10.** (a) 175 bpm. (b) 88 to 123 bpm. (c) yes. (d) 25 beats. **Q11.** (a) 60 000 steps. (b) 8 571 steps. (c) 2 days. (d) 66 000 steps; 6 000 extra steps. **Q12.** (a) 4.0 SD; yes — exactly at the limit. (b) 4.8 SD; over by 0.8 SD. (c) 8.8 SD; yes. (d) zero — none at all. **Q13.** (a)  $1.65^2 = 2.7225$  and  $72 \div 2.7225 = 26.4462\dots$ , which is 26.4 to 1 d.p. (b) Sam: 20.5; Dana overweight, Sam healthy weight. (c) 67.8 kg; lose 4.2 kg. (d) sample answer: BMI cannot tell muscle from fat, so a muscular athlete can land in “overweight” while carrying little body fat. **Q14.** (a) 21 injuries; 8.4 per 100 workers. (b) 42.9%. (c) 30%. (d) exact target 16.8; at most 16 injuries — 17 would cut only 19.0%, which is under 20%. **Q15.** (a) 33.3%. (b) 8:5. (c) work 66.7%, home 53.3%; work is higher. (d) 16 products. **Q16.** (a) \$1 040. (b) \$1 068. (c) the surcharge is cheaper, by \$28. (d) sample answer: the cover pays hospital costs if he ever needs hospital, while the surcharge is only extra tax that buys nothing. **Q17.** (a) \$2 589.60. (b) \$4 627.20; saving \$2 037.60. (c) 54.5%. (d) 20%; \$19.28; \$115.68. **Q18.** (a) 185 minutes; yes. (b) 123.3%. (c) 63 hours. (d) 50.4 hours a week; 7.2 hours a day.

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## Fully-worked solutions

**Q1.** (a) Fever means  $38.0^{\circ}\text{C}$  or above. The three readings are 37.2, 38.4 and  $37.9^{\circ}\text{C}$ ; only  $38.4 \geq 38.0$ . So 1 reading shows a fever:  $38.4^{\circ}\text{C}$  at 12:00. (b) Range = highest – lowest =  $92 - 84 = 8$ , so 8 bpm. (c) Sum =  $37.2 + 38.4 + 37.9 = 113.5$ ; mean =  $113.5 \div 3 = 37.8333\dots$ , which is  $37.8^{\circ}\text{C}$  to 1 d.p.

**Q2.** (a) A 15-second count is scaled by  $60 \div 15 = 4$ :  $16 \times 4 = 64$  bpm, and  $60 \leq 64 \leq 100$ , so yes, inside the band. (b) A 20-second count is scaled by  $60 \div 20 = 3$ :  $23 \times 3 = 69$  bpm. (c) Sample answer: training makes the heart stronger, so each beat pumps more blood and fewer beats are needed a minute — a low resting rate in a fit person is common and usually not a problem. The nurse still records it.

**Q3.** (a) Every 6 hours from 06:00: 06:00, 12:00, 18:00, and adding 6 hours to 18:00 gives 00:00 (midnight). Check:  $24 \div 6 = 4$  doses a day. (b) 4 tablets a day  $\times$  5 days = 20 tablets. (c)  $24 \geq 20$ , so yes, the pack is enough, with  $24 - 20 = 4$  tablets left over.

**Q4.** (a)  $890 \div 8\,700 \times 100 = 10.2298\dots\%$ , which is 10.2% to 1 d.p. (b)  $7.5 \div 70 \times 100 = 10.7142\dots\%$ , which is 10.7% to 1 d.p. (c) Pack energy =  $5 \times 890 = 4\,450$  kJ;  $4\,450 \div 8\,700 \times 100 = 51.1494\dots\%$ , which is 51.1% to 1 d.p. One pack is over half a day's energy.

**Q5.** (a)  $2\,000 \div 50 = 40$ , so 40 mL of concentrate. (b) 5 L = 5 000 mL, and  $5\,000 \div 50 = 100$ , so 100 mL. (c)  $250 \times 50 = 12\,500$  mL of water, and  $12\,500 \div 1\,000 = 12.5$  L.

**Q6.** (a) Gap = fee – rebate =  $76.50 - 51.20 = 25.30$ , so \$25.30. (b)  $25.30 \times 3 = 75.90$ , so \$75.90. (c) Sample answer: the clinic sends the Medicare rebate straight to itself, so the patient pays nothing at all — the gap is \$0.

**Q7.** (a) High means top  $\geq 140$  or bottom  $\geq 90$ . Anh 118 / 76: no. Bea 142 / 92: yes on both counts ( $142 \geq 140$  and  $92 \geq 90$ ). Callum 134 / 86: no. Dee 121 / 79: no. So Bea only. (b) Distances from 120: Anh  $|118 - 120| = 2$ ; Bea 22; Callum 14; Dee  $|121 - 120| = 1$ . Dee is closest. (c) Sum of top numbers =  $118 + 142 + 134 + 121 = 515$ ; mean =  $515 \div 4 = 128.75$  exactly. Rounded half-up to 1 d.p. that is 128.8.

**Q8.** (a) At or above  $38.5^{\circ}\text{C}$ :  $38.6$  (18:00),  $39.4$  (22:00) and  $38.9$  (02:00) — 3 readings. The 06:00 reading,  $37.8$ , is below. (b) Dose 1 was at 18:30, so dose 2 must wait until 4 hours later, that is 22:30. At 22:15 only 3 h 45 min have passed, which is less than 4 hours, so yes, 22:15 is too soon; the earliest time for dose 2 is 22:30. (c) No. By 06:30 the time gap is fine (02:30 to 06:30 is exactly 4 hours) and a 4th dose is within the 4-doses-in-24-hours cap, but the temperature rule fails: the label says dose only at  $38.5^{\circ}\text{C}$  or above, and Rosie's 06:00 reading is  $37.8^{\circ}\text{C}$ , which is below it. (d) Highest reading  $39.4^{\circ}\text{C}$ , at 06:00 it is  $37.8^{\circ}\text{C}$ :  $39.4 - 37.8 = 1.6$ , so a fall of  $1.6^{\circ}\text{C}$ .

**Q9.** (a) Dose =  $18 \times 10 = 180$  mg. (b) Strength steps =  $180 \div 125 = 1.44$ ; volume =  $1.44 \times 5 = 7.2$  mL (exact, so 7.2 mL to 1 d.p.). (c) Daily total =  $180 \times 3 = 540$  mg. The cap is  $18 \times 60 = 1\,080$  mg, and  $540 \leq 1\,080$ , so the prescription is within the cap. (d) One dose is 7.2 mL, 3 doses a day for 5 days is 15 doses, so  $7.2 \times 15 = 108$  mL. The course needs 108 mL and one bottle holds 100 mL:  $108 > 100$ , so the bottle is not enough — it is  $108 - 100 = 8$  mL short, and the pharmacy should supply a second bottle.

**Q10.** (a) Maximum =  $220 - 45 = 175$  bpm. (b) Low end =  $0.50 \times 175 = 87.5$ , which rounds half-up to 88 bpm. High end =  $0.70 \times 175 = 122.5$ , which rounds half-up to 123 bpm. Zone: 88–123 bpm. (c)  $88 \leq 118 \leq 123$ , so yes, Tomas is inside his zone. (d)  $148 - 123 = 25$ , so 148 bpm is 25 beats above the top of the zone — Tomas should ease off until his rate drops back.

**Q11.** (a) Total =  $6\,450 + 8\,200 + 5\,900 + 10\,300 + 7\,600 + 12\,400 + 9\,150 = 60\,000$  steps. (b) Mean =  $60\,000 \div 7 = 8571.4285\dots$ , which is 8571 steps to the nearest whole step. (c) At or above 10000: the 10300 and 12400 days — 2 days. (d) New total =  $60\,000 \times 1.10 = 66\,000$  steps; extra =  $66\,000 - 60\,000 = 6\,000$  steps (which is 10% of 60000, as a check).

**Q12.** (a) Friday =  $2 \times 1.3 + 1.4 = 2.6 + 1.4 = 4.0$  SD. The limit is 4, and  $4.0 \leq 4$ , so yes — exactly at the limit. (b) Saturday =  $3 \times 1.0 + 1.8 = 3.0 + 1.8 = 4.8$  SD;  $4.8 - 4 = 0.8$ , so Jai goes over by 0.8 SD. (c) Weekend =  $4.0 + 4.8 = 8.8$  SD, and  $8.8 \leq 10$ , so yes, within the weekly limit. (d) Zero. The P-plate rule allows no alcohol before driving, so the maximum is 0 standard drinks.

**Q13.** (a)  $h^2 = 1.65 \times 1.65 = 2.7225$ . BMI =  $72 \div 2.7225 = 26.4462\dots$  Rounded to 1 d.p. that is 26.4 ✓, as required. (b) Sam:  $h^2 = 1.82 \times 1.82 = 3.3124$ , so BMI =  $68 \div 3.3124 = 20.5289\dots = 20.5$  to 1 d.p. Categories: Dana's 26.4 sits in 25.0–29.9 — overweight; Sam's 20.5 sits in 18.5–24.9 — healthy weight. (c) Target weight =  $24.9 \times 2.7225 = 67.79025$ , which is 67.8 kg to the nearest 0.1 kg. Weight to lose =  $72 - 67.79025 = 4.20975$ , which is 4.2 kg to 1 d.p. Check:  $67.8 \div 2.7225 = 24.903\dots$ , a BMI of 24.9 to 1 d.p. — just inside the healthy band. (d) Sample answer: BMI uses only weight and height, so it cannot tell muscle from fat; a very muscular athlete can weigh enough to land in “overweight” even with very little body fat.

**Q14.** (a) Total =  $9 + 6 + 4 + 2 = 21$  injuries. Rate =  $21 \div 250 \times 100 = 8.4$  per 100 workers (exact, so 8.4 to 1 d.p.). (b) Slips:  $9 \div 21 \times 100 = 42.857\dots\%$ , which is 42.9% to 1 d.p. (c) Decrease =  $(30 - 21) \div 30 \times 100 = 9 \div 30 \times 100 = 30\%$  exactly, so 30% to the nearest whole percent. (d) 20% of  $21 = 0.20 \times 21 = 4.2$ , so the exact target is  $21 - 4.2 = 16.8$  injuries. Injuries come in whole numbers. With 17: the cut is  $(21 - 17) \div 21 \times 100 = 19.0\%$  to 1 d.p. — under 20%, so 17 fails. With 16: the cut is  $(21 - 16) \div 21 \times 100 = 23.8\%$  to 1 d.p. — at least 20%, so 16 meets the target. The largest whole number of injuries that meets the target is 16. Note the rounding direction: 16.8 rounded *up* to 17 would miss the goal, so the team rounds *down* — the same “round in the direction that serves the goal” thinking as buying 2 lengths when 1.44 are needed.

**Q15.** (a) Corrosive at work:  $8 \div 24 \times 100 = 33.333\dots\%$ , which is 33.3% to 1 d.p. (b) 24:15; both divide by 3, giving 8:5. (c) Products with any symbol: work =  $24 - 8 = 16$ , home =  $15 - 7 = 8$ . Work:  $16 \div 24 \times 100 = 66.666\dots\% = 66.7\%$  to 1 d.p. Home:  $8 \div 15 \times 100 = 53.333\dots\% = 53.3\%$  to 1 d.p. Work is higher. (d) Every product with a symbol goes in the cabinet:  $5 + 8 + 3 = 16$  products (the same 16 as in (c)).

**Q16.** (a) Surcharge = 1% of \$104 000 =  $0.01 \times 104\,000 = \$1\,040$ . (Oscar's income is over the \$93 000 line, so the rule applies.) (b) Cover =  $89 \times 12 = \$1\,068$  for the year. (c)  $\$1\,040 < \$1\,068$ , so paying the surcharge is cheaper this year, by  $1\,068 - 1\,040 = \$28$ . (d) Sample answer: the cover is insurance — if Oscar needs hospital, the fund pays

hospital costs, while the surcharge is only extra tax that buys him nothing. (Holding cover also avoids Lifetime Health Cover loading later.)

**Q17.** (a) Family cover =  $215.80 \times 12 = \$2\,589.60$  a year. (b) One single policy =  $96.40 \times 12 = \$1\,156.80$  a year; four of them =  $1\,156.80 \times 4 = \$4\,627.20$ . The family cover costs  $\$2\,589.60$ , so the saving is  $4\,627.20 - 2\,589.60 = \$2\,037.60$  a year (to the nearest cent; these figures are already exact to the cent). (c) Increase =  $148.90 - 96.40 = \$52.50$ ;  $52.50 \div 96.40 \times 100 = 54.4605\dots\%$ , which is  $54.5\%$  to 1 d.p. (d) Age 40 is  $40 - 30 = 10$  years over 30, so the loading is  $10 \times 2\% = 20\%$ . Loading amount =  $0.20 \times 96.40 = \$19.28$ . Loaded premium =  $96.40 + 19.28 = \$115.68$  a month, to the nearest cent.

**Q18.** (a) Total =  $35 + 0 + 45 + 25 + 0 + 60 + 20 = 185$  minutes, and  $185 \geq 150$ , so yes, Ngaire meets the guideline. (b)  $185 \div 150 \times 100 = 123.333\dots\%$ , which is  $123.3\%$  of the guideline to 1 d.p. (c)  $9 \times 7 = 63$  sitting hours for the week. (d) A  $20\%$  cut leaves  $80\%$ :  $0.80 \times 63 = 50.4$  hours a week (exact, so  $50.4$  to 1 d.p.). Per day:  $50.4 \div 7 = 7.2$  hours a day to 1 d.p. — that is  $1.8$  hours less sitting each day.

### Theory

**Vocational numeracy is the maths of doing a job.** *Vocational* means to do with work and training for work. Every workplace runs on numbers: how long a job takes, how much chemical goes in the mix, how big a part is allowed to be, which phone number to call. In this section the maths is the same maths you have already met — ratio and rates (§5B, §5C), measures and volume (§4C), percentages (§2F), tolerance (§4F) — but every number arrives the way it arrives at work: on a document, a label, a plan or a device, and every number is a rule to follow exactly, not a suggestion.

**Workplace documents and phone numbers.** A *job docket* is a sheet that travels with a job: it says which job this is, who to call, what to do, and what safety rules apply. Reading one slowly is a numeracy skill, because one misread digit can send you to the wrong site or mix the wrong chemical.

**JOB DOCKET #2214**

Date: Mon 12 Oct  
Site: Creek Street Depot

**Contact — site manager, J. Nolan**  
Phone (03) 5760 2100  
Mobile 0417 663 908

**Tasks**

1. Mix disinfectant — see label ratio
2. Clean store room floor
3. Check aisle width against site rule

**Safety note**  
Gloves + goggles. Follow the safety data sheet.

job number — which job this is

contact block — phone numbers are read and dialled digit by digit

safety note — the numbers here are rules, not tips

Phone numbers on a docket are read and dialled digit by digit. Australian numbers have a fixed shape: a landline (a phone fixed to a place) starts with an area code such as 03 or 02, then eight digits; a mobile starts with 04, then eight digits — ten digits in all. When a number is written for another country, Australia's country code +61 replaces the leading 0:

(03)5760 2100 → +61 35760 2100

The leading 0 is dropped because it is only a trunk prefix for calls made inside Australia. At work, important numbers are *read back*: you say the number back to the person who gave it to you, digit by digit, so a mistake is caught before it costs anything.

**Safety data sheets and mixing ratios.** A *safety data sheet* (SDS, on older documents an MSDS) is the document that comes with a chemical product. It lists the *hazards* (the ways the product can harm people), the *PPE* or personal protective equipment to wear (gloves, safety glasses and so on), first aid, and the mixing instructions. Chemicals usually arrive as a *concentrate* (the strong, undiluted product) and must be *diluted* (watered down) to a ratio before use.

**SAFETY DATA SHEET (SDS)**

**Product:** AquaClear chlorine concentrate

**Mixing:** mix 1 : 99 (product : water)

**Hazards:** harmful if swallowed; damages eyes;  
never mix with other chemicals

**PPE:**  safety glasses

 gloves

**Emergency:** follow the site emergency card. In a real emergency, call 000.

a pretend SDS with a pretend product — real products come with a real SDS; always follow the real one

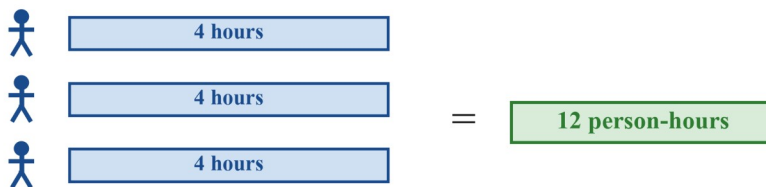
A mixing ratio such as 1 : 99 (product : water) means 1 part product for every 99 parts water. The finished mix is then  $1 + 99 = 100$  parts, so the product is 1 part in every 100:

$$\frac{1}{100} = 1\% \text{ of the finished mix is product}$$

That is why the ratio on a label is a rule. A mix that is too weak may not clean or disinfect at all; a mix that is too strong can burn skin, damage surfaces and waste product — and both are quality and safety failures, not just mistakes on paper.

**Before digital and after digital: counting person-hours.** Workplaces often compare an old paper method with a new digital one: paper timesheets against a phone app, pencil stocktake against barcode scanners. A *stocktake* is a count of everything a business holds. To compare two methods fairly, count *person-hours* — the number of workers multiplied by the hours each of them works:

$$\text{person-hours} = \text{number of workers} \times \text{hours each}$$

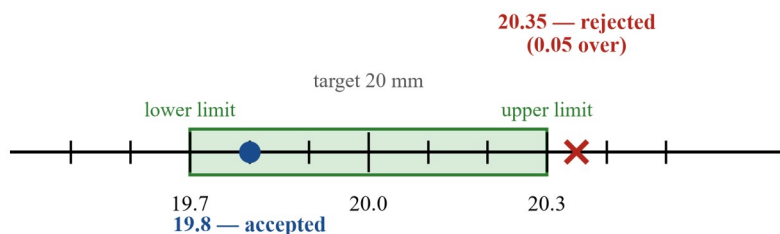


3 workers each work 4 hours

$$\text{person-hours} = \text{number of workers} \times \text{hours each: } 3 \times 4 = 12$$

Three workers each working 4 hours is  $3 \times 4 = 12$  person-hours of work, whoever does it. Person-hours let you compare a method that uses many people for a short time with a method that uses few people for a long time, on one fair scale. The difference between the two methods is then often written as a percentage decrease (§2F).

**Tolerances and quality assurance.** *Quality assurance* (QA) is the checking a business does so that every part or product leaves the door the same. QA works with a *spec* (specification): the target size plus a *tolerance*, the amount a measurement is allowed to differ from the target and still pass. A spec of  $20 \pm 0.3$  mm (read “20 plus or minus 0.3 millimetres”) accepts anything from  $20 - 0.3 = 19.7$  mm up to  $20 + 0.3 = 20.3$  mm, and the two limits themselves count as accepted (§4F).



spec  $20 \pm 0.3$  mm — accepted from 19.7 mm to 20.3 mm (the limits count as accepted)

Measurements come from devices, and devices come in two kinds. An *analogue* device (a dial, a needle gauge, a tape measure) shows a reading you judge between marks, so its *smallest division* — the gap between two marks — limits how finely you can read it. A *digital* device prints digits, usually to a stated number of decimal places. Two devices measuring the same thing can disagree a little; the one with the finer smallest division is the more precise one, and a QA check must say which device the check was made with.

**Plans, rates and formulas at work.** Workplace plans and diagrams carry a scale (§5C): on a 1:500 site plan, 1 cm on the paper is 500 cm on the ground. Jobs run at a *rate* (§5B) — jars per hour, blocks per hour, litres per minute — and rates are turned into times by dividing the job size by the rate. Formulas do the same work for measures (§5A), for example the volume of a rectangular tank,  $V = l \times w \times h$  (§4C), with  $1 \text{ m}^3 = 1000 \text{ L}$ . Times at work are written on the 24-hour clock (§4D), so a shift that starts at 08:00 and runs 7 h 30 min finishes at 15:30, and temperatures in a cool room or a fridge (§4E) are checked against a safe band rather than a single number.

**About the data in this section.** The docket, labels, safety sheets, tables, plans and charts 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, person or place. Real products come with a real SDS and a real label — at work, always follow the real one.

## Worked examples

### Example 1 — scaffolded

**DISINFECTANT  
CONCENTRATE**

**mix 1 : 19**

(product : water)

*Bright Way Cleaning*

**SDS extract — key points**

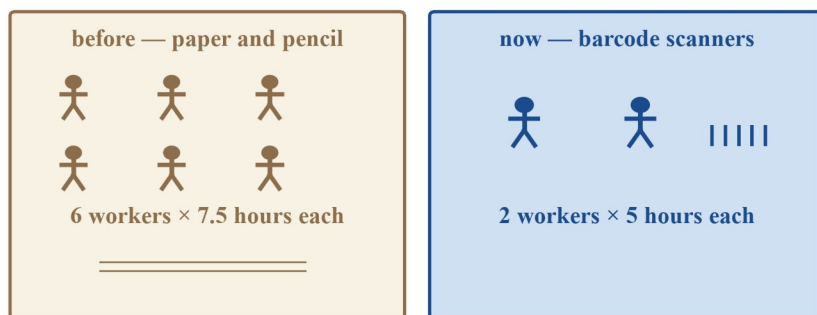
- dilute before use — see ratio on the label
- PPE: gloves and safety glasses
- use the mix within 2 hours of mixing it
- never mix with other chemicals

the label and the sheet give the numbers the job must follow exactly

Bright Way Cleaning must make 5 L of disinfectant mix for an aged-care kitchen floor. The label ratio is 1:19 (product : water), and the SDS says the mix must be used within 2 hours of mixing. The cleaner mixes it at 10:40. Find (a) how many parts the finished mix has, (b) how much concentrate is needed, in mL, (c) how much water is needed, in mL, and (d) the latest time the mix can be used.

| Working                                                                         | Comment                                                         |
|---------------------------------------------------------------------------------|-----------------------------------------------------------------|
| (a) $1 + 19 = 20$ parts                                                         | the ratio is product : water, so the full mix is 20 equal parts |
| (b) $5 \text{ L} = 5000 \text{ mL}$ ; $5000 \div 20 = 250 \text{ mL}$           | one part is the concentrate                                     |
| (c) $250 \times 19 = 4750 \text{ mL}$                                           | water is the other 19 parts                                     |
| (d) $10:40 + 2 \text{ h} = 12:40$                                               | the SDS says use within 2 hours of mixing                       |
| Check: $250 + 4750 = 5000 \text{ mL} = 5 \text{ L}$ , and $250 : 4750 = 1 : 19$ | total and ratio both agree with the label                       |

### Example 2 — scaffolded

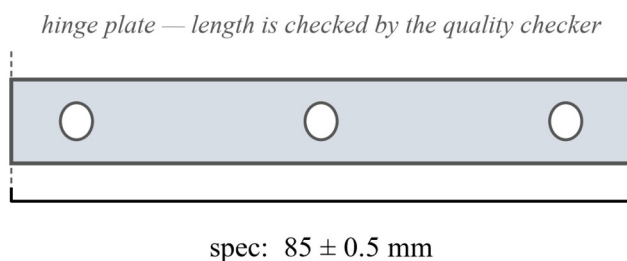


*count person-hours for each method, then compare*

Barlow Warehouse used to do its yearly stocktake with paper and pencil: 6 workers, each working 7.5 hours. Now 2 workers with barcode scanners do it, each working 5 hours. Find (a) the person-hours the paper method took, (b) the person-hours the scanner method takes, (c) the person-hours saved, and (d) the percentage decrease in person-hours, to the nearest whole percent.

| Working                                                    | Comment                                           |
|------------------------------------------------------------|---------------------------------------------------|
| (a) $6 \times 7.5 = 45$ person-hours                       | person-hours = workers $\times$ hours each        |
| (b) $2 \times 5 = 10$ person-hours                         | same formula for the new method                   |
| (c) $45 - 10 = 35$ person-hours                            | the saving                                        |
| (d) $35 \div 45 \times 100 = 77.77 \dots \% \approx 78 \%$ | percentage decrease, to the nearest whole percent |
| Check: $10 + 35 = 45$ person-hours                         | new method plus saving gives the old method back  |

### Example 3 — unscaffolded



*Hartley Metalworks cuts each plate to the spec above*

Hartley Metalworks cuts hinge plates to a spec of  $85 \pm 0.5 \text{ mm}$ . The quality checker measures five plates off the line: 84.6 mm, 85.4 mm, 84.5 mm, 85.5 mm and 85.9 mm. Decide which plates pass and which fail, and by how much any failing plate is out.

The spec gives the accepted band. The lower limit is  $85 - 0.5 = 84.5$  mm and the upper limit is  $85 + 0.5 = 85.5$  mm, and a plate measuring exactly on a limit counts as accepted.

Now test each measurement against the band 84.5 mm to 85.5 mm:

84.6 mm is inside the band — accepted.

85.4 mm is inside the band — accepted.

84.5 mm is on the lower limit — accepted.

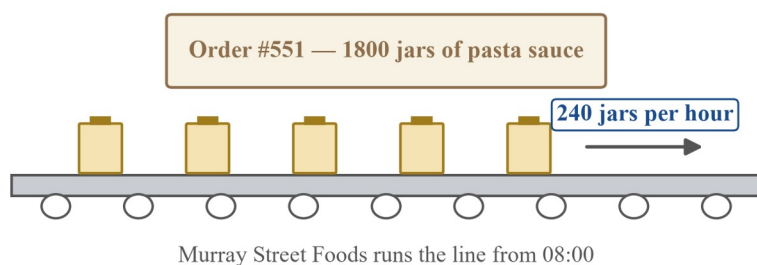
85.5 mm is on the upper limit — accepted.

85.9 mm is above the upper limit — rejected, by  $85.9 - 85.5 = 0.4$  mm.

Check: 4 accepted + 1 rejected = 5 plates, and the band is  $0.5 + 0.5 = 1$  mm wide, as the spec says.

$\therefore$  4 of the 5 plates pass; the 85.9 mm plate fails, 0.4 mm over the upper limit.

#### **Example 4 — unscaffolded**



*how long will the order take, and when does the line finish?*

The filling line at Murray Street Foods runs at a rate of 240 jars per hour. Order #551 is for 1800 jars of pasta sauce, and the line starts the order at 08:00. Find (a) how long the order takes, in hours and minutes, (b) the clock time the order finishes if the line runs straight through, and (c) the clock time it finishes if the crew also takes a 30-minute break during the order.

Time is the job size divided by the rate:

$$1800 \div 240 = 7.5 \text{ hours}$$

and 0.5 of an hour is 30 minutes, so the order takes 7 h 30 min.

Counting 7 h 30 min on from 08:00 on the 24-hour clock gives 15:30.

Adding the 30-minute break adds 30 min to the finish time:  $15:30 + 30 \text{ min} = 16:00$ .

Check:  $240 \times 7.5 = 1800$  jars, the size of the order.

$\therefore$  the order takes 7 h 30 min of running, finishing at 15:30 straight through, or at 16:00 with the 30-minute break.

## Practice questions

### Scaffolded

**Q1.** A job docket at Creek Street Depot lists these contact numbers.

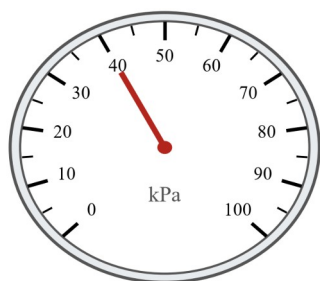
| Who                    | Number         |
|------------------------|----------------|
| Depot (landline)       | (03) 5455 8210 |
| Kai's mobile           | 0417 663 908   |
| Head office (landline) | (02) 9871 4500 |

*Made-up data: every name and number in this table is made up for this book.*

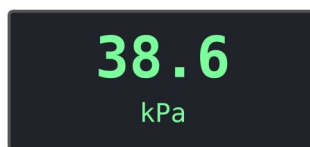
- (a) Which number is the mobile? How can you tell? (b) How many digits does the mobile have? (c) Write the mobile in international form, using Australia's country code +61.

**Q2.** A floor cleaner label says mix 1:24 (product : water). A worker must make 15 L of mix. (a) How many parts does the finished mix have? (b) How much concentrate is needed, in mL? (c) How much water is needed, in mL?

**Q3.** The figure shows the same air line measured with two devices.



analogue gauge  
smallest division: 5 kPa



digital readout  
shows 1 decimal place

*the same air line, measured with two different devices*

- (a) What does the analogue gauge read? (b) What is the difference between the two readings, in kPa? (c) Which device shows the finer reading — the analogue gauge or the digital readout? Give the smallest division of each to support your answer.

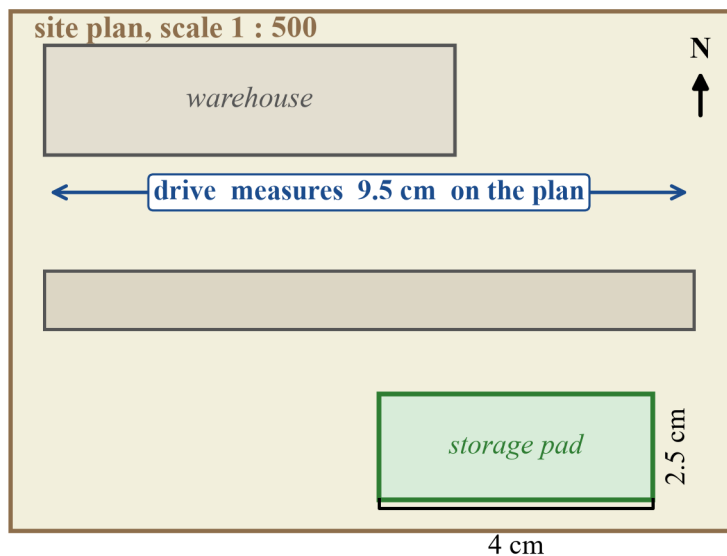
**Q4.** A pallet (a flat timber base that goods are stacked on) at the depot is rated to carry 400 kg. Bags of product weigh 25 kg each. (a) What is the maximum number of whole bags the pallet can carry? (b) A worker stacks 18 bags on the pallet. What do they weigh in total? (c) By how many kilograms is that over the pallet's limit?

**Q5.** Paper timesheets take each worker 22 minutes a week to fill in. A phone app takes each worker 4 minutes a week. The crew has 12 workers. (a) How many minutes a week do the paper timesheets take in total? (b) How many minutes a week does the app take in total? (c) Over 4 weeks, how many minutes are saved by using the app? Give your answer in minutes and in hours.

**Q6.** A drill bit is specified at  $6.0 \pm 0.1$  mm. (a) Write the lower and upper limits of the accepted band. (b) A bit measures 6.14 mm. Does it pass? If not, by how much is it out?

## Un scaffolded

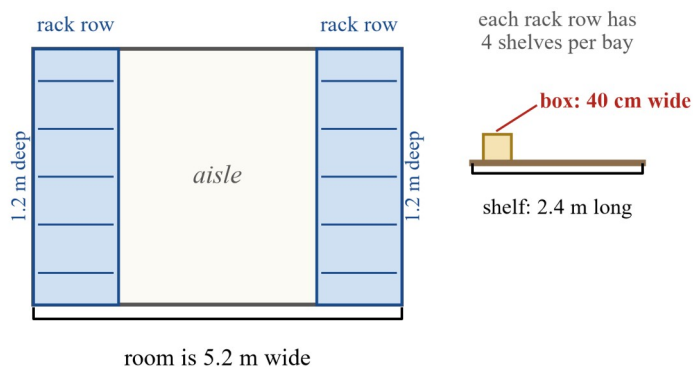
**Q7.** The site plan of the Creek Street Depot yard is drawn at a scale of 1 : 500.



*Creek Street Depot yard — dimensions are plan centimetres*

- (a) The drive measures 9.5 cm on the plan. How long is it in real life, in metres? (b) The storage pad measures 4 cm by 2.5 cm on the plan. Find its real perimeter, in metres. (c) Find the real area of the storage pad, in  $\text{m}^2$ .
- Q8.** A degreaser SDS says the working mix is 1 : 49 (product : water). A new worker misreads the sheet and mixes 1 : 4 instead. What percentage of the correct mix is product, and what percentage of the worker's mix is product? How many times stronger than the correct mix is the worker's mix? Write one sentence saying why this matters for OHS (occupational health and safety) or quality.
- Q9.** A block machine at Parker Pre-cast makes 90 concrete blocks per hour. An order is for 1440 blocks. (a) How many hours of running time does the order need? (b) The machine runs 8 hours a day. How many days does the order take? (c) A second machine, running at 150 blocks per hour, is put on the same order. How many hours does the order take with both machines running together?
- Q10.** A rectangular water tank at Fernlea Nursery measures 2.4 m long, 1.5 m wide and 1.2 m high. (a) Find the volume of the tank in  $\text{m}^3$ . (b) Write that volume in litres. (c) A pump fills the tank at 45 L per minute. How long does a full tank take to fill? Give your answer in minutes, and in hours and minutes.
- Q11.** Bottles at Rivergum Drinks Co. are filled to 600 mL with a tolerance of  $\pm 1.5\%$ . (a) Find the tolerance in mL. (b) Write the accepted band of fill volumes, in mL. (c) Six bottles off the line measure 592 mL, 608 mL, 589 mL, 601 mL, 612 mL and 595 mL. Which bottles are accepted, and which are rejected?
- Q12.** Bellbird Couriers drivers used to fill in paper delivery logs taking 3.5 hours a day across the depot. A scanning app now takes 45 minutes a day. (a) How many minutes a day are saved? (b) Over a 5-day week, how many minutes are saved? Give your answer in minutes and in hours. (c) Find the percentage decrease in daily logging time, to the nearest whole percent.

**Q13.** The store room at Creek Street Depot is 5.2 m wide, with a rack row 1.2 m deep along each side wall and an aisle down the middle.

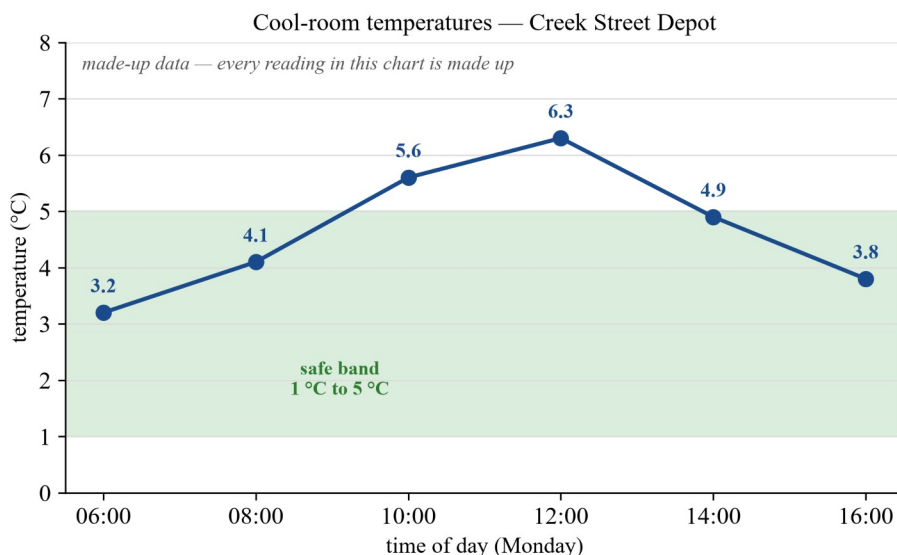


site rule: the aisle must be at least 900 mm wide for safe walking

- (a) How wide is the aisle, in metres? (b) The site rule says the aisle must be at least 900 mm wide for safe walking. Does this store room meet the rule? Show the comparison in one unit. (c) Boxes are 40 cm wide. How many boxes fit in one row along a 2.4 m shelf? (d) Each rack bay has 4 shelves. How many boxes fit in one bay?

**Q14.** A painter must put 2 coats of paint on a wall 5.4 m long and 2.7 m high. The paint tin says the paint covers 12 m<sup>2</sup> per litre. (a) Find the area of the wall in m<sup>2</sup>. (b) Find the total area to be painted for 2 coats. (c) How many litres of paint are needed? Give your answer to 2 decimal places. (d) The supplier sells 2 L and 4 L tins. Which tin should the painter buy, and why?

**Q15.** The chart shows Monday's temperatures in the depot cool room, which must stay between 1 °C and 5 °C. Every reading in the chart is made-up data.



- (a) Which readings are above the safe band, and at what times were they taken? (b) How far above the top of the safe band was the warmest reading? (c) Find the range of the six readings (highest – lowest), in °C.

**Q16.** A delivery docket shows these numbers.

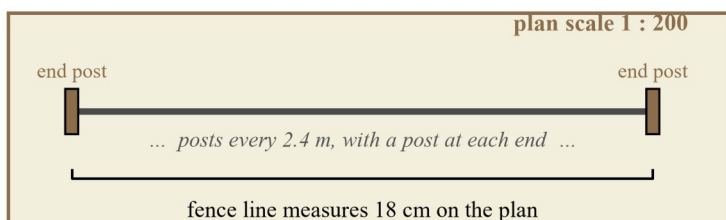
| Docket field                         | Number as written |
|--------------------------------------|-------------------|
| Supplier landline                    | (03) 5334 9280    |
| Driver mobile, handwritten           | 0438 225 167      |
| Driver mobile, printed by the system | 0438 225 176      |

*Made-up data: every number on this docket is made up for this book.*

- (a) Write the supplier landline in international form using +61. (b) The handwritten mobile and the printed mobile disagree. Describe exactly what the error is. (c) In one sentence, say why reading a number back before dialling it matters at work.

**Q17.** A cleaning supervisor checks a mix made by a new worker: 320 mL of concentrate topped up with 8 L of water. Show that the mix is in the ratio 1 : 25 (product : water).

**Q18.** Oakden Builders' fence line measures 18 cm on a 1 : 200 plan.



*Oakden Builders — each post hole is dug 600 mm deep*

- (a) How long is the fence line in real life, in metres? (b) Posts are spaced every 2.4 m along the line, with a post at each end. How many posts are needed? (c) Each post hole is dug 600 mm deep. What total depth of hole is dug for the whole fence, in metres?

## Answers

**Q1.** (a) 0417 663 908 — it starts with 04. (b) 10 digits. (c) +61 417 663 908.

**Q2.** (a) 25 parts. (b) 600 mL. (c) 14 400 mL.

**Q3.** (a) 40 kPa. (b) 1.4 kPa. (c) The digital readout: its smallest division is 0.1 kPa, against 5 kPa on the analogue gauge.

**Q4.** (a) 16 bags. (b) 450 kg. (c) 50 kg over.

**Q5.** (a) 264 minutes. (b) 48 minutes. (c) 864 minutes = 14.4 hours.

**Q6.** (a) 5.9 mm to 6.1 mm. (b) No — 0.04 mm over the upper limit.

**Q7.** (a) 47.5 m. (b) 65 m. (c) 250 m<sup>2</sup>.

**Q8.** Correct mix 2% product; worker's mix 20% product; 10 times stronger. A mix this strong can burn skin and damage surfaces, so it is both a safety and a quality failure.

**Q9.** (a) 16 hours. (b) 2 days. (c) 6 hours.

**Q10.** (a) 4.32 m<sup>3</sup>. (b) 4320 L. (c) 96 minutes = 1 h 36 min.

**Q11.** (a) 9 mL. (b) 591 mL to 609 mL. (c) Accepted: 592, 608, 601, 595 mL (4 bottles). Rejected: 589 mL and 612 mL.

**Q12.** (a) 165 minutes. (b) 825 minutes = 13.75 hours. (c) 79% (to the nearest whole percent).

**Q13.** (a) 2.8 m. (b) Yes: 2.8 m = 2800 mm, which is more than 900 mm. (c) 6 boxes. (d) 24 boxes.

**Q14.** (a) 14.58 m<sup>2</sup>. (b) 29.16 m<sup>2</sup>. (c) 2.43 L. (d) The 4 L tin, because 2.43 L is more than a 2 L tin holds.

**Q15.** (a) 5.6 °C at 10:00 and 6.3 °C at 12:00. (b) 1.3 °C above. (c) 3.1 °C.

**Q16.** (a) +61 3 5334 9280. (b) The last two digits are swapped: 67 handwritten against 76 printed. (c) A read-back catches a misread or miswritten digit before the call, the delivery or the order goes to the wrong place.

**Q17.** 8 L = 8000 mL; 320:8000; divide both sides by 320 to get 1:25.

**Q18.** (a) 36 m. (b) 16 posts. (c) 9.6 m.

## Fully-worked solutions

**Q1.** (a) Australian mobiles start with 04, so the mobile is 0417 663 908; the other two numbers start with an area code, 03 and 02. (b) Counting digits: 0, 4, 1, 7, 6, 6, 3, 9, 0, 8 — that is 2 + 8 = 10 digits. (c) Drop the leading 0 and put +61 in front: +61 417 663 908.

**Q2.** (a) The ratio 1:24 is product : water, so the mix is 1 + 24 = 25 parts. (b) 15 L = 15 000 mL, and one part is 15 000 ÷ 25 = 600 mL of concentrate. (c) Water is 24 parts: 600 × 24 = 14 400 mL. Check: 600 + 14 400 = 15 000 mL = 15 L.

**Q3.** (a) The needle sits on the 40 mark, so the analogue gauge reads 40 kPa. (b) 40 – 38.6 = 1.4 kPa. (c) The digital readout shows one decimal place, so its smallest division is 0.1 kPa; the analogue gauge has marks every 5 kPa, so its smallest division is 5 kPa. 0.1 < 5, so the digital readout is the finer (more precise) device.

**Q4.** (a) 400 ÷ 25 = 16 bags exactly, so 16 bags is the maximum — 16 bags sits exactly on the limit, which is allowed. (b) 18 × 25 = 450 kg. (c) 450 – 400 = 50 kg over the limit. Check: 17 bags would be 17 × 25 = 425 kg, already over, so 16 is right.

**Q5.** (a) 22 × 12 = 264 minutes a week on paper. (b) 4 × 12 = 48 minutes a week on the app. (c) Saved each week: 264 – 48 = 216 minutes; over 4 weeks, 216 × 4 = 864 minutes. In hours: 864 ÷ 60 = 14.4 hours.

**Q6.** (a) Lower limit  $6.0 - 0.1 = 5.9$  mm; upper limit  $6.0 + 0.1 = 6.1$  mm. (b) 6.14 mm is above 6.1 mm, so the bit fails, by  $6.14 - 6.1 = 0.04$  mm.

**Q7.** (a) At 1:500, 1 cm on the plan is 500 cm real:  $9.5 \times 500 = 4750$  cm = 47.5 m. (b) Real sides:  $4 \times 500 = 2000$  cm = 20 m and  $2.5 \times 500 = 1250$  cm = 12.5 m; perimeter =  $2 \times (20 + 12.5) = 65$  m. (c) Area =  $20 \times 12.5 = 250$  m<sup>2</sup>. Check: half the drive (47.5 m) is 23.75 m, and the pad's 20 m side is a little under half of it — the plan looks the same shape.

**Q8.** Correct mix:  $1 + 49 = 50$  parts, so product is  $1 \div 50 = 0.02 = 2\%$  of the mix. Worker's mix:  $1 + 4 = 5$  parts, so product is  $1 \div 5 = 0.2 = 20\%$  of the mix. Strength comparison:  $20\% \div 2\% = 10$ , so the worker's mix is 10 times stronger than the sheet allows. A mix 10 times stronger than the SDS working mix can burn skin, give off fumes and damage the surfaces it touches, so it is an OHS breach as well as a quality failure — the batch must be remade, not used.

**Q9.** (a)  $1440 \div 90 = 16$  hours. (b)  $16 \div 8 = 2$  days exactly. (c) Together the machines run at  $90 + 150 = 240$  blocks per hour, so  $1440 \div 240 = 6$  hours. Check:  $240 \times 6 = 1440$  blocks.

**Q10.** (a)  $V = l \times w \times h = 2.4 \times 1.5 \times 1.2 = 4.32$  m<sup>3</sup>. (b)  $1 \text{ m}^3 = 1000$  L, so  $4.32 \times 1000 = 4320$  L. (c)  $4320 \div 45 = 96$  minutes;  $96 = 60 + 36$ , so 1 h 36 min. Check:  $45 \times 96 = 4320$  L.

**Q11.** (a)  $1.5\%$  of 600 mL =  $600 \times 0.015 = 9$  mL. (b) Accepted band:  $600 - 9 = 591$  mL up to  $600 + 9 = 609$  mL, limits included. (c) Test each fill: 592 mL inside — accepted; 608 mL inside — accepted; 589 mL below 591 — rejected; 601 mL inside — accepted; 612 mL above 609 — rejected; 595 mL inside — accepted. So 4 bottles are accepted and 2 are rejected (589 mL and 612 mL). Check:  $4 + 2 = 6$  bottles.

**Q12.** (a) 3.5 hours =  $3.5 \times 60 = 210$  minutes; saved  $210 - 45 = 165$  minutes a day. (b) Over 5 days:  $165 \times 5 = 825$  minutes;  $825 \div 60 = 13.75$  hours. (c) Percentage decrease =  $165 \div 210 \times 100 = 78.57\ldots\% \approx 79\%$ , to the nearest whole percent. Check:  $45 + 165 = 210$  minutes, the old daily time.

**Q13.** (a) The two rack rows take  $1.2 + 1.2 = 2.4$  m of the width, so the aisle is  $5.2 - 2.4 = 2.8$  m. (b) In one unit: 2.8 m = 2800 mm, and  $2800 > 900$ , so the store room meets the 900 mm rule with room to spare. (c) In one unit: 2.4 m = 240 cm;  $240 \div 40 = 6$  boxes exactly, so 6 boxes fit in a row. (d)  $6 \times 4 = 24$  boxes in one bay. Check: 6 boxes  $\times$  40 cm = 240 cm, the shelf length exactly.

**Q14.** (a) Area =  $5.4 \times 2.7 = 14.58$  m<sup>2</sup>. (b) Two coats cover the wall twice:  $14.58 \times 2 = 29.16$  m<sup>2</sup>. (c) Litres =  $29.16 \div 12 = 2.43$  L, to 2 decimal places. (d) A 2 L tin holds less than the 2.43 L needed, so the painter buys the 4 L tin. Check:  $2.43 \times 12 = 29.16$  m<sup>2</sup>, the area to be covered.

**Q15.** (a) The safe band ends at 5 °C. Reading across the chart: 5.6 °C at 10:00 and 6.3 °C at 12:00 are above it; every other reading is inside the band. (b) The warmest reading is 6.3 °C, which is  $6.3 - 5 = 1.3$  °C above the top of the band. (c) Highest 6.3 °C, lowest 3.2 °C, so the range is  $6.3 - 3.2 = 3.1$  °C. Check: 2 readings out + 4 readings inside = 6 readings on the chart.

**Q16.** (a) Drop the leading 0 of the area code and put +61 in front: +61 3 5334 9280. (b) Compare digit by digit: 0438 225 167 against 0438 225 176 — the first eight digits match, and the last two digits are swapped (6 then 7, against 7 then 6). (c) Reading a number back catches a swapped or misread digit before the call is made, so the delivery, the order or the emergency call reaches the right number first time.

**Q17.** Work in one unit, mL:

8 L of water =  $8 \times 1000 = 8000$  mL.

The mix as measured is 320:8000 (product : water).

Divide both sides by 320:  $320 \div 320 : 8000 \div 320 = 1 : 25$ .

$\therefore$  the mix is in the ratio 1:25 (product : water), as required.

**Q18.** (a) At 1 : 200, 1 cm on the plan is 200 cm real:  $18 \times 200 = 3600 \text{ cm} = 36 \text{ m}$ . (b) Spacing:  $36 \div 2.4 = 15$  gaps; a post at each end of every gap means one more post than gaps, so  $15 + 1 = 16$  posts. (c) Each hole is 600 mm deep:  $16 \times 600 = 9600 \text{ mm} = 9.6 \text{ m}$  of digging in total. Check: 16 posts make 15 gaps, and  $15 \times 2.4 = 36 \text{ m}$ , the fence length.

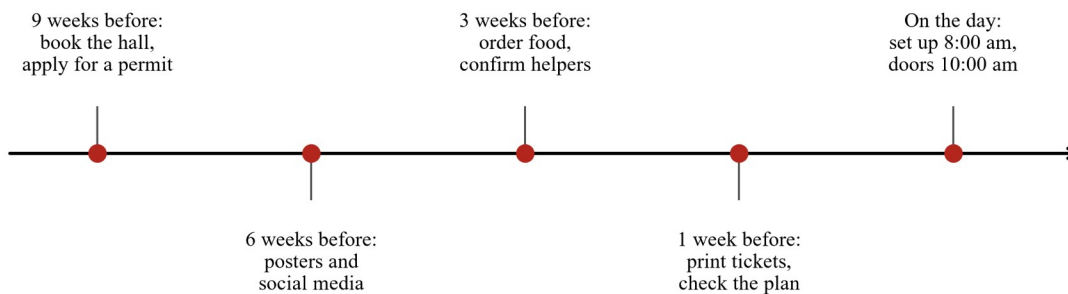
### Theory

**Recreation** is what you do in your own time for fun and for rest — sport, games, community events, making things, and screen time. **Recreational numeracy** is the maths hiding inside all of that: costing an event and comparing venues, running scoring systems and timings for games, working out the dimensions of community spaces like courts, playgrounds and giant chessboards, enlarging photos and craft patterns, and keeping an eye on how much of your week a habit is eating.

**About the numbers in this section.** Every event, venue, price, log, plan and schedule in this section is **made up** (not real), except the netball court dimensions, which are the real official measurements (see the Source line under the court diagram below). The made-up numbers are built for this book so you can practise recreational numeracy. Nothing else here is real data about a real person, business or place.

### Planning an event: steps and costings.

A community event — a fun day, a movie night, a championship day — runs as a sequence of steps: book the space, advertise, order food, print tickets, set up. A timeline keeps those steps in order.



*Planning steps for the Wattle Street Community Fun Day (made-up event)*

The money side of an event usually has two parts: a **fixed cost** (the room hire, paid once no matter how many people come) and a **per-person cost** (catering, paid per head). So

$$\text{total cost} = \text{fixed cost} + (\text{cost per person} \times \text{number of guests}).$$

*Worked model.* A hall costs \$95 to hire and catering is \$8.00 per person. For 40 guests the total is  $95 + 8 \times 40 = \$415.00$ , and the cost per person is  $415 \div 40 = 10.375$ , that is \$10.38 to the nearest cent.

### Comparing venues.

Two venues with different hire fees and different per-head prices can each be the cheaper choice, depending on the guest number. Cost both venues at the **same** guest number and compare the totals (Example 1 and Q7). Because one venue charges more per head and less hire (or the other way round), the cheaper venue can swap as the guest number grows — so always state the guest number your comparison is for.

### Games: scoring systems, penalties, fines and timing.

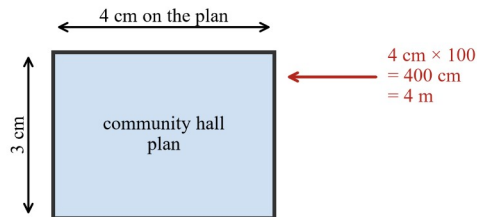
Competitions run on a **scoring system**: a ladder might give 3 points for a win, 1 point for a draw and 0 for a loss, so a team's points are  $(3 \times \text{wins}) + (1 \times \text{draws})$ . *Worked model:* 5 wins and 2 draws gives  $5 \times 3 + 2 \times 1 = 17$  points. A **penalty** subtracts points from a team's total; a **fine** subtracts money from a player's or club's account (Q10). Game **timing** adds every block in the fixture — quarters, breaks, half-time and changeovers — because the finish time depends on the total elapsed time, not just the playing time (Example 2 and Q9). *Worked model:* a session that starts at 10:15 and runs for 75 minutes finishes at 11:30.

## Scale plans and enlargements.

A **scale plan** is a drawing in which every length is a fixed fraction of the real length. A scale of 1:100 means 1 cm on the plan stands for 100 cm (1 m) in real life, so

$$\text{real length} = \text{plan length} \times 100.$$

Scale 1:100 (1 cm on the plan = 100 cm = 1 m in real life)

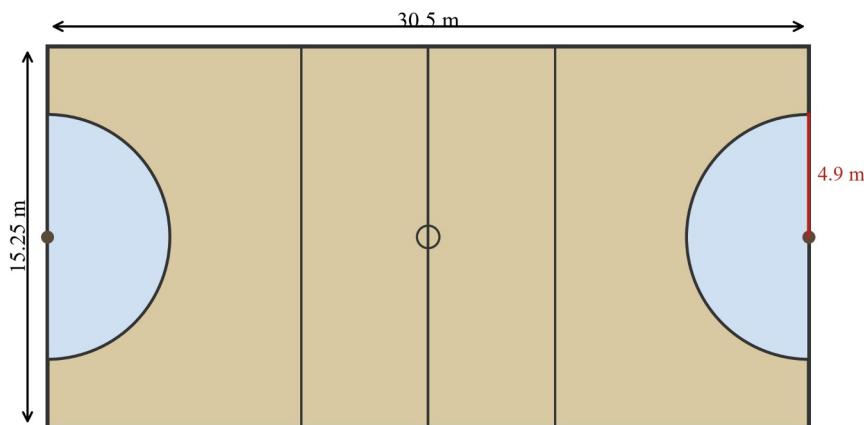


*The long wall measures 4 cm on the plan, so the real wall is 4 m long.*

An **enlargement** multiplies every length by the same **scale factor**  $k$ . Areas do not follow  $k$ : they follow  $k$  squared, because both dimensions grow. *Worked model:* a 10 cm × 15 cm photo enlarged by scale factor 2 becomes 20 cm × 30 cm; its area goes from  $10 \times 15 = 150 \text{ cm}^2$  to  $20 \times 30 = 600 \text{ cm}^2$ , that is  $\times 4 = 2^2$ , not  $\times 2$ .

## Community recreation dimensions.

Councils build courts, playgrounds and parks to published dimensions, so the perimeter and area work from Chapter 4 applies directly. The netball court below uses the real official dimensions: 30.5 m long, 15.25 m wide, with a goal circle of radius 4.9 m at each end.



*A netball court: each goal circle is a semicircle of radius 4.9 m drawn from the goal post.*

Source: Wikipedia, Netball, retrieved 2026-10-07.

## Art and craft dimensions.

Photo prints come in standard sizes (10 cm × 15 cm, 20 cm × 30 cm), costume patterns are paper pieces that get enlarged by a scale factor, and furniture is sold in mixed units — millimetres, centimetres and metres — so convert to one unit before comparing with a space (Q14). Enlarging a pattern or a photo is the same maths as above: lengths  $\times k$ , areas  $\times k^2$ .

## Overuse: how much of your week?

Recreation can be overdone, and screen-based recreation is the usual example. This section uses a **2 h-a-day recreational screen guideline** as its comparison line (Q16). To see how big a habit is, write its weekly hours as a percentage of the 168 hours in a week. *Worked model:* 21 h of gaming in a week is  $21 \div 168 \times 100 = 12.5\%$  of the week, to 1 decimal place.

### The problem-solving cycle and the toolkit.

Every task in this section runs through the four-stage problem-solving cycle: **identify the mathematics** (what is being asked, and which data matters); **act on and use mathematics** (carry out the costing, scaling, timing or area working); **evaluate and reflect** (is the answer reasonable — does the cheaper venue stay cheaper, does the bookcase actually fit?); and **communicate and report** (state the answer with its unit and its precision). For the toolkit, a spreadsheet handles a venue comparison neatly — guest numbers down one column, each venue’s cost formula in the next two columns — and a calculator handles the money. Both are demonstrated in this section but never required.

### Rounding, units and checking.

Carry every digit your calculator shows through the working, and round **only** where the question tells you to — “to 2 decimal places”, “to the nearest cent”, “to 1 decimal place”. Money is stated to the cent. When a count of bags or tins comes out fractional, round **up** to the next whole item and say so, because items cannot be bought in parts. Keep the unit attached: lengths in m or cm, areas in m<sup>2</sup> or cm<sup>2</sup>, and times as clock times or as hours and minutes.

## Worked examples

### Example 1 — scaffolded

The Wattle Street seniors’ club is booking a venue for its anniversary dinner, with 60 guests. Two venues quote as shown below.

| The Harbour Room             | Pavilion Function Centre     |
|------------------------------|------------------------------|
| Room hire: \$180             | Room hire: \$60              |
| Catering: \$14.00 per person | Catering: \$17.00 per person |

- (a) Find the total cost at The Harbour Room for 60 guests.
- (b) Find the total cost at the Pavilion Function Centre for 60 guests.
- (c) Which venue is cheaper for 60 guests, and by how much?

| Working                                                | Comment                                                                            |
|--------------------------------------------------------|------------------------------------------------------------------------------------|
| Harbour Room: $180 + 14 \times 60 = \$1\,020.00$       | Fixed hire \$180 plus \$14.00 per head for 60 guests.                              |
| Pavilion: $60 + 17 \times 60 = \$1\,080.00$            | Lower hire, but a higher per-head price.                                           |
| Difference: $1\,080.00 - 1\,020.00 = \$60.00$          | Subtract the smaller total from the bigger one.                                    |
| Check at 40 guests: both venues cost \$740.00          | The cheaper venue swaps at 40 guests, so a comparison must state its guest number. |
| The Harbour Room is cheaper for 60 guests, by \$60.00. | Answer (c) with the comparison and the difference stated.                          |

### Example 2 — scaffolded

A netball match runs four quarters of 12 minutes, with a 4-minute break after the first and third quarters and a 9-minute half-time break. The match starts at 13:45.



- Find the total playing time, in minutes.
- Find the total break time, in minutes.
- Find the clock time at which the match finishes.

Working

Comment

Playing:  $4 \times 12 = 48$  min

Four quarters of 12 min each.

Breaks:  $4 + 9 + 4 = 17$  min

Two quarter breaks plus half-time.

Duration:  $48 + 17 = 65$  min

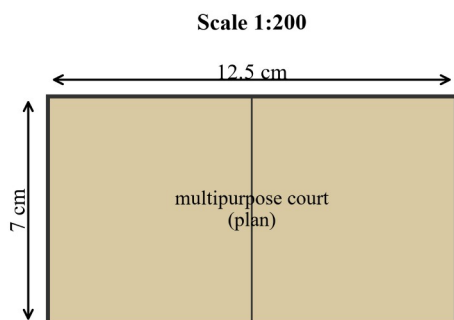
The clock keeps running through the breaks.

Finish: 13:45 plus 65 min is 14:50

Add the **whole** duration to the start time, not just the playing time.

### Example 3 — unscaffolded

Rosa has a plan of a multipurpose court drawn at a scale of 1:200. On the plan the court measures 12.5 cm long and 7 cm wide, as shown below. Find the real perimeter of the court in metres, and its real area in square metres.



Rosa measured the plan with a ruler. The scale tells her how big the real court is.

At a scale of 1:200, 1 cm on the plan stands for 200 cm in real life. The real length is

$$12.5 \times 200 = 2500 \text{ cm} = 25 \text{ m},$$

and the real width is

$$7 \times 200 = 1400 \text{ cm} = 14 \text{ m}.$$

The perimeter is

$$2 \times (25 + 14) = 2 \times 39 = 78 \text{ m},$$

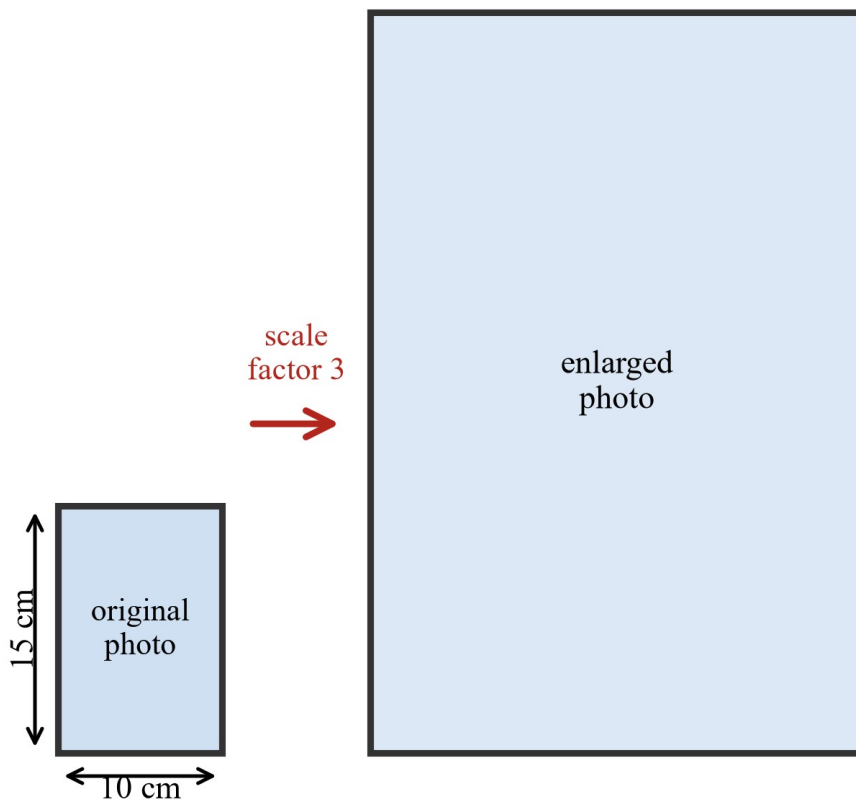
and the area is

$$25 \times 14 = 350 \text{ m}^2.$$

$\therefore$  the real court has a perimeter of 78 m and an area of 350 m<sup>2</sup>.

### Example 4 — unscaffolded

A photo measuring 10 cm  $\times$  15 cm is enlarged by scale factor 3 for a foyer display, as shown below. Find the dimensions and the area of the enlarged photo, and compare the areas and the perimeters of the two photos.



*The print shop multiplies every length by 3.*

Every length is multiplied by 3, so the enlarged photo measures

$$10 \times 3 = 30 \text{ cm by } 15 \times 3 = 45 \text{ cm.}$$

Its area is

$$30 \times 45 = 1350 \text{ cm}^2,$$

while the original area is  $10 \times 15 = 150 \text{ cm}^2$ , so the area is multiplied by

$$1350 \div 150 = 9 = 3^2,$$

not by 3. As a check, perimeters behave like lengths: the enlarged perimeter is  $2 \times (30 + 45) = 150 \text{ cm}$  against the original  $2 \times (10 + 15) = 50 \text{ cm}$ , exactly  $\times 3$ .

$\therefore$  the enlarged photo is  $30 \text{ cm} \times 45 \text{ cm}$  with an area of  $1350 \text{ cm}^2$  — 9 times the original area, while its perimeter is 3 times the original perimeter.

## Practice questions

### Scaffolded

**Q1.** A shed plan is drawn at a scale of 1:50. (a) A wall measures 3 cm on the plan. Find its real length, in metres. (b) A real wall is 4 m long. Find its length on the plan, in centimetres. (c) A door opening measures 5.5 cm on the plan. Find its real width, in metres.

**Q2.** A club movie night costs: room hire \$120.00, decorations \$45.00 and refreshments \$95.00. The club sells 110 tickets at \$5.50 each. (a) Find the total cost of the night, to the nearest cent. (b) Find the total ticket takings, to the nearest cent. (c) Find the profit, to the nearest cent.

*All amounts in this question are made up.*

**Q3.** A competition ladder gives 3 points for a win, 1 point for a draw and 0 points for a loss. A team has played 11 games: 8 wins and 3 draws. (a) Find the points from its wins. (b) Find the team’s total ladder points. (c) The team is given a 2-point penalty for fielding an ineligible player. Find its points after the penalty.

**Q4.** A swim squad trains from 16:35 to 18:05. (a) Find the length of the session, in minutes. (b) Maya leaves the pool 35 minutes after the session ends. Find the time she leaves. (c) The squad trains 3 sessions a week. Find the weekly training time in minutes, and in hours and minutes.

**Q5.** A poster measures 30 cm × 45 cm. It is enlarged by scale factor 2. (a) Write down the dimensions of the enlarged poster. (b) Find the perimeter of the enlarged poster. (c) Find the area of the enlarged poster, and compare it with the original area of 1350 cm<sup>2</sup>.

**Q6.** A rectangular multipurpose court measures 26 m by 15 m. (a) Find its perimeter. (b) Find its area. (c) A low fence goes right around the court, costing \$18.50 per metre. Find the cost of the fence, to the nearest cent.

### Unscaffolded

**Q7.** Priya is booking a room for her birthday party. Two venues quote as shown below.

| Lakeside Room                | Bowling Club Room            |
|------------------------------|------------------------------|
| Room hire: \$250             | Room hire: \$90              |
| Catering: \$22.00 per person | Catering: \$28.00 per person |

- Find the total cost at each venue for 25 guests, and say which is cheaper and by how much.
- Repeat the comparison for 40 guests.
- Explain why the cheaper venue changes between (a) and (b), and find the guest numbers at which the change happens.

**Q8.** The budget for a community fun day is:

| Item                 | Cost     |
|----------------------|----------|
| Council permit       | \$150.00 |
| Insurance            | \$85.00  |
| Equipment hire       | \$180.00 |
| Catering             | \$420.00 |
| Entertainment        | \$268.40 |
| Printing and signage | \$96.60  |

*All amounts in this table are made up.*

- Find the total cost of the day, to the nearest cent.
- The day expects 180 people. Find the cost per person, to the nearest cent.
- The day takes \$240.00 in sponsorships and sells 220 tickets at \$8.00 each. Find the total income, and the profit, to the nearest cent.

**Q9.** A fixture day runs three matches. Each match has four quarters of 10 minutes, a 3-minute break after the first and third quarters, and an 8-minute half-time. Between matches there is a 12-minute changeover. The first match starts at 09:00. (a) Find the elapsed time of one match, in minutes. (b) Find the clock time at which the third match finishes. (c) Find the total playing time (quarters only) across the three matches, in hours.

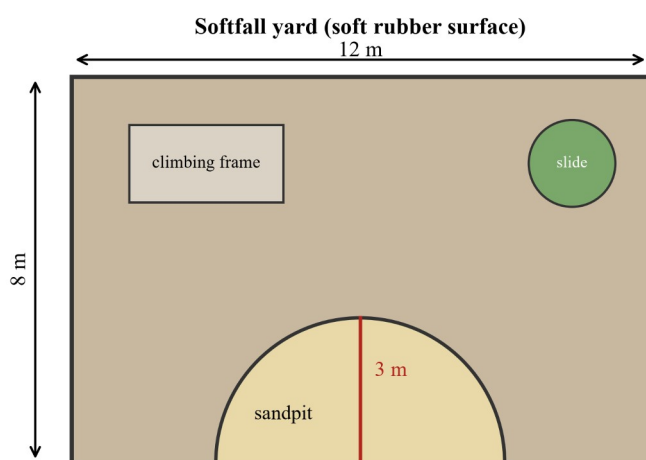
**Q10.** A club's fines schedule is:

| Fine                      | Amount  |
|---------------------------|---------|
| Late to training          | \$8.00  |
| Absent without notice     | \$20.00 |
| Wrong uniform on game day | \$5.00  |

*This schedule, and the records below, are made up.*

Mia was late 3 times, absent without notice once, and in the wrong uniform twice. Teo was late once, absent without notice twice, and in the wrong uniform once. (a) Find Mia's total fines, to the nearest cent. (b) Find Teo's total fines, to the nearest cent. (c) Find their combined fines, to the nearest cent.

**Q11.** A playground yard is a rectangle 12 m by 8 m. A semicircular sandpit of radius 3 m sits inside it on one edge, as shown below. The rest of the yard is softfall (soft rubber surface).



*The sandpit is a semicircle (half a circle) of radius 3 m, sitting inside the yard.*

- Find the area of the full rectangular yard.
- Find the area of the sandpit, to 2 decimal places.
- Softfall is laid from bags that each cover  $4 \text{ m}^2$ . Find the softfall area to 2 decimal places, the number of bags needed (whole bags), and their cost at \$36.00 a bag, to the nearest cent.

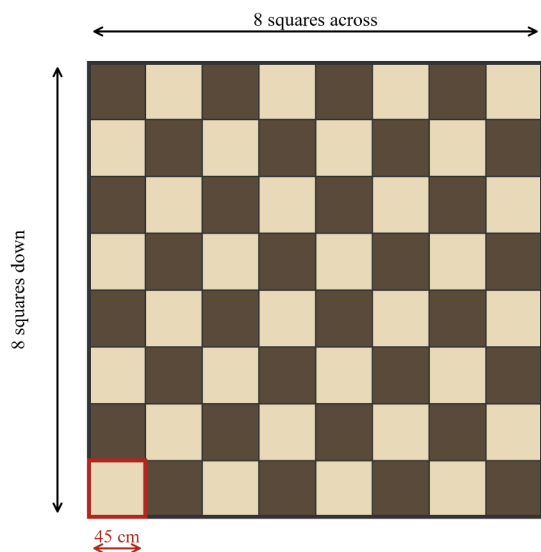
**Q12.** A netball court is 30.5 m long and 15.25 m wide. Each goal circle is a semicircle of radius 4.9 m drawn from the goal post (see the court diagram in the Theory). (a) Find the perimeter of the court rectangle. (b) Find the area of the court rectangle. (c) The two goal circles together make exactly one full circle of radius 4.9 m. Find their combined area, to 2 decimal places.

*The dimensions in this question are the real official netball measurements. Source: Wikipedia, Netball, retrieved 2026-10-07.*

**Q13.** A costume pattern piece measures  $32 \text{ cm} \times 18 \text{ cm}$ . It is enlarged by scale factor 1.25. (a) Find the dimensions of the enlarged piece. (b) Find the area of one enlarged piece. (c) Two enlarged pieces must be cut from one rectangular piece of fabric measuring  $50 \text{ cm} \times 35 \text{ cm}$ . Is the fabric enough? If not, by how much is it short?

**Q14.** A bookcase is 1380 mm wide, 1.95 m high and 32 cm deep. An alcove is 1.45 m wide, 2.10 m high and 35 cm deep. (a) Write the bookcase's width in centimetres, and in metres. (b) Decide, dimension by dimension, whether the bookcase fits the alcove. (c) If the bookcase is centred in the alcove, find the gap left on each side, in centimetres.

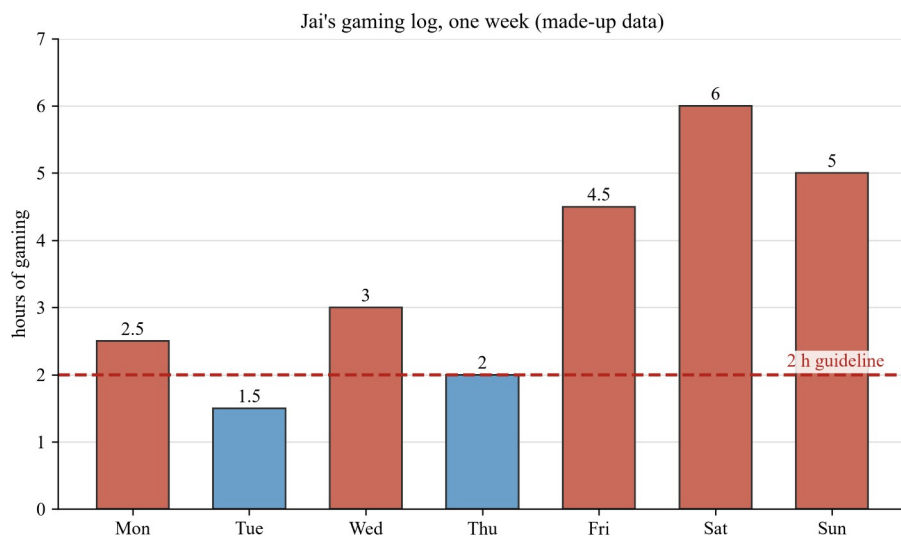
**Q15.** A park has a giant chessboard painted on the ground: 8 squares across and 8 squares down, with every square 45 cm wide, as shown below.



*The giant chessboard at Kirra Park (made up): every square is 45 cm wide.*

- Find the side length of the whole board, in centimetres and in metres.
- Find the area of the whole board, in square metres.
- Exactly 32 of the 64 squares are painted dark. Find the area of one square in square metres, and the total dark area.

**Q16.** The bar chart below shows how many hours Jai spent gaming on each day of one week, against the 2 h-a-day guideline used in this section.



- Find Jai's total gaming hours for the week.
- Find how many days went over the 2 h guideline, and the total hours over the guideline across the week.
- A week has 168 hours. Find Jai's gaming time as a percentage of the week, to 1 decimal place.

**Q17.** A print shop charges \$0.60 for a 10 cm × 15 cm photo print and \$1.80 for a 20 cm × 30 cm print. (a) Find the area of each print size. (b) The large print has twice the length and twice the width of the small print. By what factor is its area multiplied? (c) Find the cost per 100 cm<sup>2</sup> for each size, to the nearest cent, and say which size is the better value.

**Q18.** A club championship day hires 2 courts for 7 hours each, at \$30 per court per hour, and caters for 85 players at \$6.50 per head. Prizes and trophies cost \$215.00. (a) Find the total cost of the day, to the nearest cent. (b) The club wants the 85 entry fees to cover the total cost exactly. Show that an entry fee of \$13.97 falls short, and find the smallest entry fee, to the cent, that covers the cost. (c) The day runs for 9 hours 45 minutes from 08:30. Find the finish clock time, and how many minutes after 18:00 that is.

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## Answers

**Q1.** (a) 1.5 m. (b) 8 cm. (c) 2.75 m. **Q2.** (a) \$260.00. (b) \$605.00. (c) \$345.00. **Q3.** (a) 24 points. (b) 27 points. (c) 25 points. **Q4.** (a) 90 minutes. (b) 18:40. (c) 270 minutes = 4 h 30 min. **Q5.** (a)  $60\text{ cm} \times 90\text{ cm}$ . (b) 300 cm. (c)  $5400\text{ cm}^2$ , 4 times the original  $1350\text{ cm}^2$ . **Q6.** (a) 82 m. (b)  $390\text{ m}^2$ . (c) \$1 517.00. **Q7.** (a) Lakeside \$800.00, Bowling \$790.00; the Bowling Club Room is cheaper by \$10.00. (b) Lakeside \$1 130.00, Bowling \$1 210.00; the Lakeside Room is cheaper by \$80.00. (c) the Bowling Club Room's higher per-head price makes its total grow faster, so its early lead disappears; at 26 guests Bowling is still cheaper (\$818.00 vs \$822.00) and at 27 guests Lakeside is (\$844.00 vs \$846.00), so the swap happens between 26 and 27 guests. **Q8.** (a) \$1 200.00. (b) \$6.67. (c) income \$2 000.00, profit \$800.00. **Q9.** (a) 54 minutes. (b) 12:06. (c) 120 minutes = 2 h. **Q10.** (a) \$54.00. (b) \$53.00. (c) \$107.00. **Q11.** (a)  $96\text{ m}^2$ . (b)  $14.14\text{ m}^2$  (2 d.p.). (c)  $81.86\text{ m}^2$  (2 d.p.), 21 bags, \$756.00. **Q12.** (a) 91.5 m. (b)  $465.125\text{ m}^2$ . (c)  $75.43\text{ m}^2$  (2 d.p.). **Q13.** (a)  $40\text{ cm} \times 22.5\text{ cm}$ . (b)  $900\text{ cm}^2$ . (c) not enough; short by  $50\text{ cm}^2$ . **Q14.** (a)  $138\text{ cm} = 1.38\text{ m}$ . (b) yes:  $138\text{ cm} \leq 145\text{ cm}$ ,  $1.95\text{ m} \leq 2.10\text{ m}$ ,  $32\text{ cm} \leq 35\text{ cm}$ . (c) 3.5 cm on each side. **Q15.** (a)  $360\text{ cm} = 3.6\text{ m}$ . (b)  $12.96\text{ m}^2$ . (c)  $0.2025\text{ m}^2$  per square;  $6.48\text{ m}^2$  dark. **Q16.** (a) 24.5 h. (b) 5 days; 11 h over the guideline. (c) 14.6% (1 d.p.). **Q17.** (a)  $150\text{ cm}^2$  and  $600\text{ cm}^2$ . (b)  $\times 4$ . (c) small \$0.40, large \$0.30 per  $100\text{ cm}^2$ ; the large print is the better value. **Q18.** (a) \$1 187.50. (b) \$13.98 (since  $85 \times \$13.97 = \$1\,187.45$  falls short). (c) 18:15, which is 15 minutes after 18:00.

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## Fully-worked solutions

**Q1.** (a)  $3 \times 50 = 150\text{ cm} = 1.5\text{ m}$ . (b)  $4\text{ m} = 400\text{ cm}$ , and  $400 \div 50 = 8\text{ cm}$  on the plan. (c)  $5.5 \times 50 = 275\text{ cm} = 2.75\text{ m}$ .

**Q2.** (a)  $120.00 + 45.00 + 95.00 = \$260.00$ . (b)  $110 \times 5.50 = \$605.00$ . (c)  $605.00 - 260.00 = \$345.00$ .

**Q3.** (a)  $8 \times 3 = 24$  points. (b)  $24 + 3 \times 1 = 27$  points. (c)  $27 - 2 = 25$  points.

**Q4.** (a) 16:35 to 18:05 is 90 minutes. (b) 18:05 plus 35 minutes is 18:40. (c)  $3 \times 90 = 270$  minutes, and  $270 = 4\text{ h } 30\text{ min}$ .

**Q5.** (a)  $30 \times 2 = 60\text{ cm}$  and  $45 \times 2 = 90\text{ cm}$ . (b)  $2 \times (60 + 90) = 300\text{ cm}$ . (c)  $60 \times 90 = 5400\text{ cm}^2$ .  $5400 \div 1350 = 4$ , so the enlarged area is 4 times the original — the square of the scale factor.

**Q6.** (a)  $2 \times (26 + 15) = 82\text{ m}$ . (b)  $26 \times 15 = 390\text{ m}^2$ . (c)  $82 \times 18.50 = 1517.00$ , so the fence costs \$1 517.00, to the nearest cent.

**Q7.** (a) Lakeside:  $250 + 22 \times 25 = \$800.00$ . Bowling:  $90 + 28 \times 25 = \$790.00$ . The Bowling Club Room is cheaper, by  $800.00 - 790.00 = \$10.00$ . (b) Lakeside:  $250 + 22 \times 40 = \$1\,130.00$ . Bowling:  $90 + 28 \times 40 = \$1\,210.00$ . The Lakeside Room is cheaper, by  $1\,210.00 - 1\,130.00 = \$80.00$ . (c) The Lakeside Room has the higher hire but the lower per-head price (\$22 against \$28), so the Bowling Club Room's total grows faster with each extra guest and its early lead disappears. At 26 guests: Lakeside  $250 + 22 \times 26 = \$822.00$ , Bowling  $90 + 28 \times 26 = \$818.00$  (Bowling cheaper). At 27 guests: Lakeside  $250 + 22 \times 27 = \$844.00$ , Bowling  $90 + 28 \times 27 = \$846.00$  (Lakeside cheaper). The cheaper venue therefore swaps between 26 and 27 guests.

**Q8.** (a)  $150.00 + 85.00 + 180.00 + 420.00 + 268.40 + 96.60 = \$1\,200.00$ . (b)  $1\,200.00 \div 180 = 6.666667\dots$ , so \$6.67 per person to the nearest cent. (c) Income:  $220 \times 8.00 + 240.00 = \$2\,000.00$ . Profit:  $2\,000.00 - 1\,200.00 = \$800.00$ .

**Q9.** (a)  $4 \times 10 + 3 + 8 + 3 = 54$  minutes. (b) Three matches and two changeovers:  $3 \times 54 + 2 \times 12 = 186$  minutes = 3 h 6 min. 09:00 plus 3 h 6 min is 12:06. (c) Quarters only:  $3 \times 4 \times 10 = 120$  minutes = 2 h.

**Q10.** (a) Mia:  $3 \times 8.00 + 1 \times 20.00 + 2 \times 5.00 = \$54.00$ . (b) Teo:  $1 \times 8.00 + 2 \times 20.00 + 1 \times 5.00 = \$53.00$ . (c)  $54.00 + 53.00 = \$107.00$ .

**Q11.** (a)  $12 \times 8 = 96\text{ m}^2$ . (b)  $\frac{1}{2} \times \pi \times 3^2 = 14.13716\dots$ , so  $14.14\text{ m}^2$  to 2 decimal places. (c) Softfall:

$96 - 14.13716\dots = 81.86283\dots$ , that is  $81.86\text{ m}^2$  to 2 decimal places. Bags:  $81.86283\dots \div 4 = 20.4657\dots$ , and

bags cannot be bought in parts, so 21 bags are needed (using the rounded area,  $81.86 \div 4$  also rounds up to 21). Cost:  $21 \times 36.00 = \$756.00$ .

**Q12.** (a)  $2 \times (30.5 + 15.25) = 91.5$  m. (b)  $30.5 \times 15.25 = 465.125$  m<sup>2</sup>. (c) Two semicircles of radius 4.9 m make one full circle:  $\pi \times 4.9^2 = 75.42963\dots$ , so 75.43 m<sup>2</sup> to 2 decimal places.

**Q13.** (a)  $32 \times 1.25 = 40$  cm and  $18 \times 1.25 = 22.5$  cm. (b)  $40 \times 22.5 = 900$  cm<sup>2</sup>. (c) Two pieces need  $2 \times 900 = 1800$  cm<sup>2</sup>. The fabric is  $50 \times 35 = 1750$  cm<sup>2</sup>.  $1750 < 1800$ , so the fabric is **not** enough; it is short by  $1800 - 1750 = 50$  cm<sup>2</sup>.

**Q14.** (a)  $1380$  mm =  $138$  cm =  $1.38$  m. (b) Width:  $138$  cm  $\leq 145$  cm (the alcove's  $1.45$  m). Height:  $1.95$  m  $\leq 2.10$  m. Depth:  $32$  cm  $\leq 35$  cm. All three fit, so the bookcase fits the alcove. (c)  $145 - 138 = 7$  cm of spare width, so centring leaves  $7 \div 2 = 3.5$  cm on each side.

**Q15.** (a)  $8 \times 45 = 360$  cm =  $3.6$  m. (b)  $3.6 \times 3.6 = 12.96$  m<sup>2</sup>. (c) One square:  $0.45 \times 0.45 = 0.2025$  m<sup>2</sup>. Dark area:  $32 \times 0.2025 = 6.48$  m<sup>2</sup>. Check: half the board is  $12.96 \div 2 = 6.48$  m<sup>2</sup> — the same.

**Q16.** (a)  $2.5 + 1.5 + 3 + 2 + 4.5 + 6 + 5 = 24.5$  h. (b) Mon, Wed, Fri, Sat and Sun sit above the 2 h line: 5 days. Adding the five amounts over the line gives 11 h over the guideline for the week. (c)  $24.5 \div 168 \times 100 = 14.583333\dots\%$ , so 14.6 % of the week to 1 decimal place.

**Q17.** (a) Small:  $10 \times 15 = 150$  cm<sup>2</sup>. Large:  $20 \times 30 = 600$  cm<sup>2</sup>. (b) Lengths are  $\times 2$ , so the area is  $\times 2^2 = 4$  (and indeed  $600 \div 150 = 4$ ). (c) Small:  $0.60 \div 150 \times 100 = \$0.40$  per 100 cm<sup>2</sup>. Large:  $1.80 \div 600 \times 100 = \$0.30$  per 100 cm<sup>2</sup>, both to the nearest cent. The large print is the better value.

**Q18.** (a) Courts:  $2 \times 7 \times 30.00 = \$420.00$ . Catering:  $85 \times 6.50 = \$552.50$ . Total:  $420.00 + 552.50 + 215.00 = \$1187.50$ . (b)  $1187.50 \div 85 = 13.970588\dots$  At \$13.97 the fees raise  $85 \times 13.97 = \$1187.45$ , which falls short of \$1187.50, so rounding to the nearest cent is not enough here. Rounding **up** to the cent gives \$13.98:  $85 \times 13.98 = \$1188.30$ , which covers the cost. The smallest entry fee to the cent is \$13.98. (c) 08:30 plus 9 h 45 min is 18:15, which is 15 minutes after 18:00.

## Chapter 06 — Test A (multiple choice)

*Chapter 6 (Numeracy in context), sections 6A to 6F. Materials: pen, paper; a basic calculator may be used. Test A: 12 multiple-choice questions (12 marks). Approximate time: 20 minutes.*

**About the data in this test.** Every place, workplace, business, price and number in this test is **made up** (not real): pretend people, pretend places and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place. The health items are simplified maths practice — they are not medical advice.

*Choose the response that is correct for the question.*

### Question 1

The same juice is sold in two sizes: a 2 L bottle for \$7.80 and a 3 L bottle for \$10.50. Which of these statements is correct?

- A. The 2 L bottle is the better buy, at \$3.90 per litre.
- B. The 3 L bottle is the better buy, at \$3.90 per litre.
- C. The 3 L bottle is the better buy, at \$3.50 per litre.
- D. The 2 L bottle is the better buy, at \$2.60 per litre.

### Question 2

A car uses fuel at a rate of 8 L per 100 km. Fuel costs \$1.85 per litre. What is the cost of the fuel for a 250 km trip in this car?

- A. \$37.00
- B. \$14.80
- C. \$57.81
- D. \$370.00

### Question 3

In one year, a suburb with 25 000 residents recorded 60 crashes on its roads. What was the crash rate per 100 000 residents?

- A. 0.24
- B. 15
- C. 2 400
- D. 240

### Question 4

Over one year, the unemployment rate in a town rose from 4.0% to 5.0%. What was the change in percentage points, and the percentage increase in the rate?

- A. 1.0 percentage points; 20%
- B. 1.0 percentage points; 25%
- C. 25 percentage points; 1.0%
- D. 1.0 percentage points; 1.0%

### Question 5

A plumber quotes \$1 320 for a job, including GST. How much GST is in the quote?

- A. \$132.00
- B. \$1 200.00
- C. \$120.00
- D. \$1 452.00

### Question 6

Ben earns \$24 per hour. In one week he works 30 ordinary hours and 4 hours on Saturday at time-and-a-half. What is Ben's gross pay for the week?

- A. \$864.00
- B. \$816.00
- C. \$912.00
- D. \$1 224.00

### Question 7

A nurse counts 22 pulse beats in 15 seconds. What is the heart rate, in beats per minute (bpm)?

- A. 44 bpm
- B. 88 bpm
- C. 66 bpm
- D. 330 bpm

### Question 8

A child weighs 24 kg and is prescribed medicine at 15 mg per kg of body weight. The syrup strength is 250 mg per 5 mL. How many mL of syrup are in one dose?

- A. 1.44 mL
- B. 72 mL
- C. 360 mL
- D. 7.2 mL

### Question 9

A bolt is specified as 12.0 mm long, with a tolerance of  $\pm 0.2$  mm. Which measurement would be accepted?

- A. 11.75 mm
- B. 12.2 mm
- C. 12.25 mm
- D. 12.4 mm

**Question 10**

A filling machine fills jars at a steady rate of 180 jars per hour. How long does it take to fill an order of 1 350 jars?

- A. 7 hours 30 minutes
- B. 7 hours 5 minutes
- C. 8 hours
- D. 75 hours

**Question 11**

For a birthday party, the hall hire costs \$140 and catering costs \$8.50 per person. If 60 guests attend, what is the total cost?

- A. \$510.00
- B. \$650.00
- C. \$148.50
- D. \$8 910.00

**Question 12**

A photo measuring 8 cm by 12 cm is enlarged with a scale factor of 2.5. What is the area of the enlarged photo?

- A. 96 cm<sup>2</sup>
- B. 240 cm<sup>2</sup>
- C. 600 cm<sup>2</sup>
- D. 1 500 cm<sup>2</sup>

*End of Test A*

Test A — Answers

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

## Test A — Fully-worked solutions

| Question | Answer | Working                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | C      | <p>Per litre: the 2 L bottle is <math>7.80 \div 2 = \\$3.90</math> per L; the 3 L bottle is <math>10.50 \div 3 = \\$3.50</math> per L. Since <math>\\$3.50 &lt; \\$3.90</math>, the 3 L bottle is the better buy, at \$3.50 per litre. Option A quotes the right price for the wrong bottle — a lower total price (\$7.80 against \$10.50) does not mean better value; option B pairs the 3 L bottle with the 2 L bottle's unit price; option D divides by the wrong size (<math>7.80 \div 3 = \\$2.60</math>).</p> |
| 2        | A      | <p>Lots of 100 km: <math>250 \div 100 = 2.5</math>. Fuel used: <math>2.5 \times 8 = 20</math> L. Cost: <math>20 \times 1.85 = \\$37.00</math>. Option B is the fuel for only 100 km (<math>8 \times 1.85 = \\$14.80</math>); option C divides instead of multiplying (<math>250 \div 8 = 31.25</math> L, then <math>31.25 \times 1.85 = \\$57.81</math> to the nearest cent); option D counts 25 lots instead of 2.5 — ten times too much (\$370.00).</p>                                                           |
| 3        | D      | <p>Rate per 100 000: <math>60 \div 25\,000 \times 100\,000 = 240</math> crashes per 100 000 residents. Option A multiplies by 100 instead of 100 000 — that is the rate per 100 residents; option B multiplies instead of dividing (<math>60 \times 25\,000 \div 100\,000 = 15</math>); option C is out by a factor of 10.</p>                                                                                                                                                                                      |
| 4        | B      | <p>Percentage-point change: <math>5.0 - 4.0 = 1.0</math> pp. The percentage increase divides by the original rate: <math>1.0 \div 4.0 \times 100 = 25\%</math>. Option A divides by the new rate instead (<math>1.0 \div 5.0 \times 100 = 20\%</math>); option C swaps the two answers; option D confuses percentage points with a percentage change.</p>                                                                                                                                                           |
| 5        | C      | <p>A GST-inclusive price is made of 11 parts, so GST <math>= 1320 \div 11 = \\$120.00</math>. Check: <math>1200 + 120 = 1320</math> ✓. Option A takes 10% of the inclusive price (<math>1320 \times 0.10 = \\$132.00</math>) — the 10% belongs to the GST-free price, not the total; option B is the GST-free price itself (<math>1320 \div 1.1 = \\$1\,200.00</math>), not the GST; option D adds</p>                                                                                                              |

| Question | Answer | Working                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6        | A      | <p>another 10% on top (<math>1320 \times 1.1 = \\$1452.00</math>).</p> <p>Ordinary pay: <math>30 \times 24 = \\$720</math>.<br/> Saturday rate: <math>24 \times 1.5 = \\$36</math> per hour, so Saturday pay:<br/> <math>4 \times 36 = \\$144</math>. Gross:<br/> <math>720 + 144 = \\$864.00</math>. Option B pays all 34 hours at the ordinary rate (\$816.00); option C uses double time on Saturday (<math>4 \times 48 = \\$192</math>, total \$912.00); option D pays the whole week at time-and-a-half (<math>816 \times 1.5 = \\$1224.00</math>).</p> |
| 7        | B      | <p>There are four 15-second lots in a minute, so scale the count up by 4:<br/> <math>22 \times 4 = 88</math> bpm. Option A uses the 30-second rule (<math>\times 2</math>); option C uses the 20-second rule (<math>\times 3</math>); option D multiplies by the counting window itself (<math>22 \times 15 = 330</math>).</p>                                                                                                                                                                                                                               |
| 8        | D      | <p>Medicine needed: <math>24 \times 15 = 360</math> mg. The syrup has 250 mg in each 5 mL, so count the 5 mL steps:<br/> <math>360 \div 250 = 1.44</math>; volume:<br/> <math>1.44 \times 5 = 7.2</math> mL. Option A stops at the number of steps (1.44); option B divides by 5 instead of multiplying (<math>360 \div 5 = 72</math>); option C treats 360 mg as though it were 360 mL.</p>                                                                                                                                                                 |
| 9        | B      | <p>The accepted band runs from <math>12.0 - 0.2 = 11.8</math> mm to <math>12.0 + 0.2 = 12.2</math> mm, and the two limits themselves are accepted. 12.2 mm sits exactly on the upper limit, so it passes. Option A (11.75 mm) is below the band; options C (12.25 mm) and D (12.4 mm) are above it.</p>                                                                                                                                                                                                                                                      |
| 10       | A      | <p>Divide the job size by the rate:<br/> <math>1350 \div 180 = 7.5</math> hours. The 0.5 means half of an hour, so 7.5 hours is 7 hours 30 minutes. Option B reads the 0.5 as 5 minutes; option C rounds up to the next whole hour, which the question does not ask for; option D has a decimal slip (<math>1350 \div 18 = 75</math> hours).</p>                                                                                                                                                                                                             |
| 11       | B      | <p>Catering: <math>60 \times 8.50 = \\$510.00</math>.<br/> Total: <math>140 + 510 = \\$650.00</math>. Option A forgets the fixed hall hire; option C adds the per-person rate to the hire without multiplying it by the 60</p>                                                                                                                                                                                                                                                                                                                               |

| Question | Answer | Working                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12       | C      | <p>guests; option D multiplies the fixed hire by 60 as well (<math>140 \times 60 + 510 = \\$8910.00</math>) — a fixed cost is paid once, whatever the guest numbers.</p> <p>Enlarged sides: <math>8 \times 2.5 = 20</math> cm and <math>12 \times 2.5 = 30</math> cm, so the enlarged area is <math>20 \times 30 = 600</math> cm<sup>2</sup>.</p> <p>Equivalently, area scales by <math>k^2</math>: <math>2.5^2 = 6.25</math>, and <math>96 \times 6.25 = 600</math> cm<sup>2</sup>. Option A is the original area (<math>8 \times 12 = 96</math> cm<sup>2</sup>); option B scales the area by <math>k</math> instead of <math>k^2</math> (<math>96 \times 2.5 = 240</math> cm<sup>2</sup>); option D scales the area by <math>k^3</math> (<math>96 \times 15.625 = 1500</math> cm<sup>2</sup>).</p> |

## Chapter 06 — Test B (written response)

*Chapter 6 (Numeracy in context), sections 6A to 6F. Materials: pen, paper; a basic calculator may be used. Test B: 7 questions (39 marks). Approximate time: 45 minutes. Answer all questions in the spaces provided. In all questions where a numerical answer is required, you should only round when instructed to do so, and then to the precision stated. Where more than one mark is available, appropriate working must be shown.*

**About the data in this test.** Every place, workplace, business, price and number in this test is **made up** (not real): pretend people, pretend places and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place. The health items are simplified maths practice — they are not medical advice.

### Question 1 (5 marks)

A family is planning a holiday trip of 420 km. Their car uses fuel at a rate of 8.2 L per 100 km, and fuel costs \$1.87 per litre.

- a. Find the number of 100 km lots in the trip, and the number of litres of fuel used. 2 marks

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- b. Find the cost of the fuel for the trip, to the nearest cent. 2 marks

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- c. Muesli bars for the trip are sold in boxes of 12. The family needs at least 40 bars. How many whole boxes must they buy? 1 mark

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### Question 2 (5 marks)

The table shows the results of a council election in the made-up town of Wattle Grove.

| Election result            | Number |
|----------------------------|--------|
| Electors enrolled          | 32 000 |
| Votes cast                 | 27 200 |
| Informal votes             | 680    |
| Votes for candidate Marino | 10 608 |

*Made-up data: the town and candidate names, and every number in this table, are made up for this test.*

- a. Find the turnout rate — votes cast as a percentage of electors enrolled. 1 mark

---

- b. Find the number of formal votes, and Marino's share of the formal vote, as a percentage. 2 marks

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- c. At the previous election the turnout rate was 88.5%. Did turnout rise or fall? Find the change in percentage points, and the percentage change, to 1 decimal place. 2 marks

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**Question 3 (6 marks)**

Mia borrows \$8 000 at a simple interest rate of 7.5% per year to buy a used car. She repays the loan over 3 years in 36 equal monthly repayments.

a. Find the total interest charged over the 3 years.

1 mark

---

b. Find the total amount Mia repays, and her monthly repayment, to the nearest cent.

2 marks

---

c. Mia's electricity bill follows the rule  $C = F + u \times q$ , where  $F$  is the supply charge,  $u$  is the price per kWh and  $q$  is the number of kWh used. For a 90-day quarter, the supply charge is \$0.90 per day and Mia uses 1 150 kWh at \$0.27 per kWh. Find the bill for the quarter, to the nearest cent.

2 marks

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d. At \$0.27 per kWh, how many kWh would give a usage charge of exactly \$324.00?

1 mark

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**Question 4 (6 marks)**

At a medical centre, a nurse checks a patient. She records a temperature of  $38.2^{\circ}\text{C}$  and a blood pressure of 146/92. The GP charges \$78.00 for the visit and the Medicare rebate is \$51.60.

a. High blood pressure is a top number of 140 or above, or a bottom number of 90 or above. Is the patient's blood pressure high, and which number or numbers put it there?

2 marks

---

b. A fever is a temperature of  $38.0^{\circ}\text{C}$  or above. Does the patient have a fever, and by how many degrees is the temperature above or below the fever threshold?

1 mark

---

c. Find the gap for one visit, and the total gap for 5 visits at the same fee.

2 marks

---

d. The patient takes an antibiotic every 8 hours, with the first dose of the day at 06:00. List the three dose times for that day, in 24-hour time.

1 mark

---

**Question 5** (5 marks)

A cleaning crew mixes a disinfectant for a food-prep area. The safety data sheet gives the mixing ratio product : water = 1 : 49. The supervisor also records the person-hours spent on the crew's weekly fridge temperature checks.

a. How many parts are in the finished mixture?

1 mark

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b. The crew needs 4 L of finished mixture. Find the number of mL of product and the number of mL of water needed.

2 marks

---

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c. The old way — writing fridge temperatures on paper — takes 6 workers 2.2 hours each per week. A new app takes 2 workers 2.4 hours each per week. Find the person-hours saved each week, and the percentage decrease, to the nearest whole percent.

2 marks

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**Question 6** (6 marks)

A club holds its annual dinner. Two venues quote as shown in the table.

| Venue   | Hire  | Per person |
|---------|-------|------------|
| Venue 1 | \$220 | \$18       |
| Venue 2 | \$100 | \$24       |

*Made-up data: every number in this table is made up for this test.*

a. Find the cost of each venue for 30 guests.

2 marks

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b. Show that the two venues cost the same for 20 guests.

2 marks

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c. For 50 guests, which venue is cheaper, and by how much?

2 marks

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**Question 7** (6 marks)

A club runs a one-day championship. Each match has 4 quarters of 12 minutes, with a 4-minute break after the first quarter and after the third quarter, and a 9-minute half-time break. Three matches are played, with a 10-minute changeover between matches, and the first match starts at 09:30. For the day, the club pays \$250 to hire the courts and caters at \$5.50 per person; 80 people attend and each pays a \$12 ticket. On the ladder, a win earns 3 points, a draw 1 point and a loss 0 points.

**a.** Find the length of one match, in minutes.

1 mark

---

**b.** Find the clock time the third match finishes, in 24-hour time.

2 marks

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**c.** The home team finishes with 6 wins and 2 draws, and is then given a 3-point penalty. Find the home team's final ladder points.

1 mark

---

**d.** Find the total cost of the day, and the club's profit from ticket sales, to the nearest cent.

2 marks

---

---

*End of Test B*

## Test B — Answers

**Q1. a.** 4.2 lots; 34.44 L **b.** \$64.40 **c.** 4 boxes

**Q2. a.** 85% **b.** 26 520 formal votes; 40% **c.** turnout fell; 3.5 percentage points; 4.0%

**Q3. a.** \$1 800 **b.** \$9 800; \$272.22 per month **c.** \$391.50 **d.** 1 200 kWh

**Q4. a.** high; the top number (146) and the bottom number (92) are both over **b.** yes; 0.2 °C above the threshold **c.** \$26.40 per visit; \$132.00 in total **d.** 06:00, 14:00, 22:00

**Q5. a.** 40 parts **b.** 100 mL of product; 3 900 mL of water **c.** 8.4 person-hours saved; 64% decrease

**Q6. a.** Venue 1 \$760.00; Venue 2 \$820.00 **b.** both \$580.00, as required **c.** Venue 1, by \$180.00

**Q7. a.** 65 minutes **b.** 13:05 **c.** 17 points **d.** cost \$690.00; profit \$270.00

## Test B — Fully-worked solutions

### Question 1.

- a. Lots of 100 km:  $420 \div 100 = 4.2$ . Fuel used:  $4.2 \times 8.2 = 34.44$ . The trip has **4.2 lots** of 100 km and uses **34.44 L** of fuel.
- b. Cost:  $34.44 \times 1.87 = 64.4028$ . To the nearest cent, the deciding digit is  $2 < 5$ , so round down: **\$64.40**.
- c.  $40 \div 12 = 3.33\dots$ , and 3 boxes would give only  $3 \times 12 = 36$  bars — not enough. Boxes are sold whole and the goal is at least 40 bars, so round **up**, not to the nearest whole number: **4 boxes** ( $4 \times 12 = 48$  bars).

### Question 2.

- a. Turnout rate =  $27\,200 \div 32\,000 \times 100 = 85\%$ . The turnout rate was **85%**.
- b. Formal votes =  $27\,200 - 680 = 26\,520$ . Marino's share of the formal vote =  $10\,608 \div 26\,520 \times 100 = 40\%$ . **26 520 formal votes; 40%**.
- c. 85% is below 88.5%, so turnout **fell**. Change in percentage points:  $88.5 - 85 = 3.5$  pp. The percentage change divides by the original rate:  $3.5 \div 88.5 \times 100 = 3.9548\dots$ . To 1 decimal place the deciding digit is 5, so the 9 rounds up and carries into the ones: **4.0%**. Turnout fell by **3.5 percentage points**, a fall of **4.0%**.

### Question 3.

- a.  $I = P \times r \times n = 8000 \times 0.075 \times 3 = 1800$ . The interest is **\$1 800**.
- b. Total repaid =  $8000 + 1800 = 9800$ : **\$9 800**. Monthly repayment:  $9800 \div 36 = 272.2222\dots$ ; the deciding digit is  $2 < 5$ , so round down to **\$272.22** per month. Check:  $36 \times 272.22 = 9799.92$ , just under \$9 800, as expected when rounding down.
- c. Supply charge:  $0.90 \times 90 = \$81.00$ . Usage charge:  $1150 \times 0.27 = \$310.50$ . Bill:  $C = 81 + 310.50 = \$391.50$ .
- d.  $q = 324 \div 0.27 = 1200$ . A usage charge of \$324.00 comes from **1 200 kWh**.

### Question 4.

- a. The rule says high blood pressure is a top number of 140 or above **or** a bottom number of 90 or above. Here the top number is  $146 \geq 140$  and the bottom number is  $92 \geq 90$  — either one alone is enough, and both are over. The reading is **high**, and **both numbers** put it there.
- b.  $38.2 \geq 38.0$ , so **yes, the patient has a fever**. Above the threshold:  $38.2 - 38.0 = 0.2$ , so the temperature is **0.2°C above** the fever threshold.
- c. Gap for one visit:  $78.00 - 51.60 = \$26.40$ . For 5 visits:  $5 \times 26.40 = 132.00$ . **\$26.40 per visit; \$132.00 in total**.
- d. Every 8 hours gives  $24 \div 8 = 3$  doses in the day. Starting at 06:00: 06:00 → 14:00 → 22:00. The doses fall at **06:00, 14:00 and 22:00**.

### Question 5.

- a. The ratio is product : water = 1 : 49, so the finished mixture has  $1 + 49 = 40$  **parts**.
- b. 4 L = 4000 mL. Product:  $4000 \div 40 = 100$  mL. Water:  $4000 - 100 = 3900$  mL. Check:  $39 \times 100 = 3900$  mL, and  $100 : 3900 = 1 : 39$  ✓. So **100 mL of product and 3 900 mL of water**.
- c. Old way:  $6 \times 2.2 = 13.2$  person-hours. New way:  $2 \times 2.4 = 4.8$  person-hours. Saved:  $13.2 - 4.8 = 8.4$  person-hours. Percentage decrease:  $8.4 \div 13.2 \times 100 = 63.6363\dots$ ; to the nearest whole percent the deciding digit is  $6 \geq 5$ , so round up. The crew saves **8.4 person-hours** a week, a **64%** decrease.

### Question 6.

- a. Venue 1:  $220 + 18 \times 30 = 220 + 540 = \$760.00$ . Venue 2:  $100 + 24 \times 30 = 100 + 720 = \$820.00$ . For 30 guests, Venue 1 costs **\$760.00** and Venue 2 costs **\$820.00**.
- b. Venue 1:  $18 \times 20 = 360$ , and  $220 + 360 = 580$ , that is \$580.00. Venue 2:  $24 \times 20 = 480$ , and  $100 + 480 = 580$ , that is \$580.00. Both venues cost \$580.00 for 20 guests, **as required**.
- c. Venue 1:  $220 + 18 \times 50 = 220 + 900 = \$1120.00$ . Venue 2:  $100 + 24 \times 50 = 100 + 1200 = \$1300.00$ . Difference:  $1300 - 1120 = 180$ . **Venue 1 is cheaper, by \$180.00** — its higher hire but lower per-head price wins once the guest list grows past the equal-cost point of 20 guests.

### Question 7.

- a. Quarters:  $4 \times 12 = 48$  minutes. Breaks:  $4 + 4 + 9 = 17$  minutes. One match runs  $48 + 17 = 65$  minutes.
- b. Total time:  $3 \times 65 + 2 \times 10 = 195 + 20 = 215$  minutes. 215 minutes is 3 h 35 min. From 09:30, add 3 hours to get 12:30, then add 35 minutes: the third match finishes at **13:05**.
- c. Wins and draws:  $6 \times 3 + 2 \times 1 = 18 + 2 = 20$  points. Penalty:  $20 - 3 = 17$  points.
- d. Cost:  $250 + 80 \times 5.50 = 250 + 440 = \$690.00$ . Tickets:  $80 \times 12 = \$960.00$ . Profit:  $960 - 690 = 270$ . The day costs **\$690.00** and the club makes a profit of **\$270.00**.