Mathematics Level 5

Chapter 3 — Estimation and mathematical modelling

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

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Contents

Estimating, and checking the reasonableness of a solution

Code VC2M5N08 (Victorian Curriculum F–10 Version 2.0, Mathematics, Level 5; authority file `maths_5.json`): "check and explain the reasonableness of solutions to problems, including financial contexts using estimation strategies appropriate to the context". This section draws on `VC2M5N08.E01`, `.E02` and `.E03`.

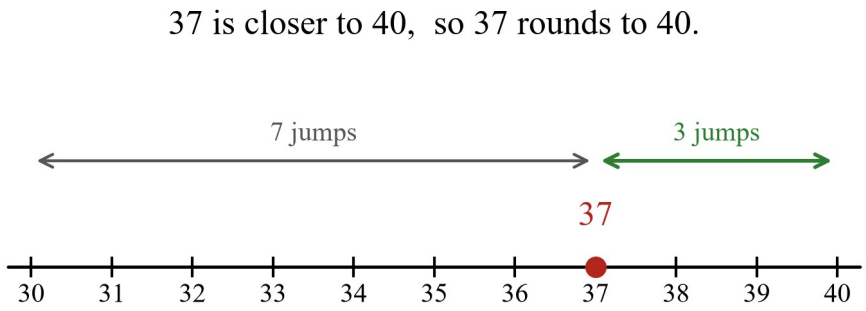
Achievement standard (Level 5, extract): "They check the reasonableness of their calculations using estimation."

What you need to know

In Year 4 you learned to round whole numbers to the nearest ten, hundred or thousand (`VC2M4N07`) and to round cash amounts to the nearest 5 cents (`VC2M4N08`). This section does not re-teach those skills — it puts them to work. The new job is judgement: deciding when a close answer is enough, predicting how rounding moves an answer, and checking that a finished answer makes sense. In 1C you already saw the habit in action — 857 ÷ 5 came out at 171.4, and the quick estimate 850 ÷ 5 = 170 said it was on the right track. Here the habit becomes the lesson.

Rounding — a quick look back

Rounding moves a number to the closest ten, hundred or thousand. On a number line, 37 is only 3 jumps from 40 but 7 jumps from 30:

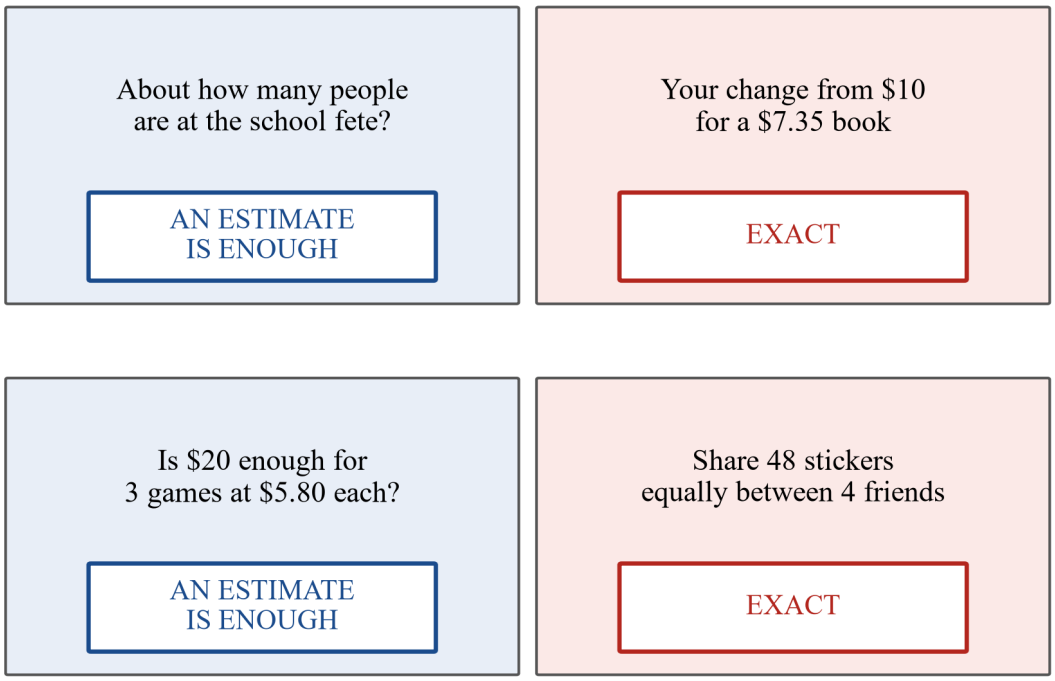


A number line from 30 to 40 with a red dot on 37. Arrows show that 37 is 7 jumps above 30 and only 3 jumps below 40, so 37 is closer to 40 and rounds to 40.

So 37 rounds to 40. One rule for numbers that sit exactly halfway, like 65: round up. So 65 rounds to 70.

Exact or estimate?

Before working anything out, decide what the question really needs (`VC2M5N08.E01`): an **exact** answer, or an **estimate** — a close answer that is good enough.



Four cards. Two blue cards ask about the size of a crowd at a school fete and whether $20 is enough for 3 games, and each is tagged 'an estimate is enough'. Two red cards ask for change from $10 and an equal share of stickers, and each is tagged 'exact'.

Look for clues in the words of the question:

- *About, roughly, close to, is it enough?* → an estimate is enough. Nobody needs the exact count of a crowd, and an "enough?" question only needs a safe, close answer.
- *Money handed over, or shared out equally* → exact. Change from $10 must be right to the cent, and a fair share means every friend gets exactly the same.

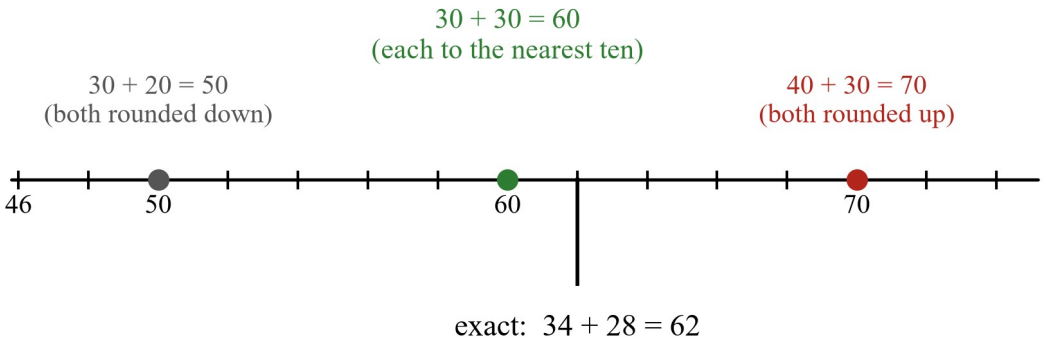
An estimate is fast to find; an exact answer takes longer. Choosing between them is part of the skill — and with money, the estimate is sometimes the better tool, as you will see below.

How rounding moves the answer

When you round before adding, subtracting, multiplying or dividing, the rounding pushes the estimate up or down. Knowing which way it pushes lets you pick a good estimate (`VC2M5N08.E02`).

Adding. Take 34 + 28. Round each number to the nearest ten: 34 → 30 (down) and 28 → 30 (up). One number lost 4 and the other gained 2, so the two shifts partly undo each other: 30 + 30 = 60, and the exact answer 62 is only 2 away. Round both numbers down instead (30 + 20 = 50) and the estimate is 12 too low; round both up (40 + 30 = 70) and it is 8 too high.

Estimates for 34 + 28 — 60 is closest to the exact answer.

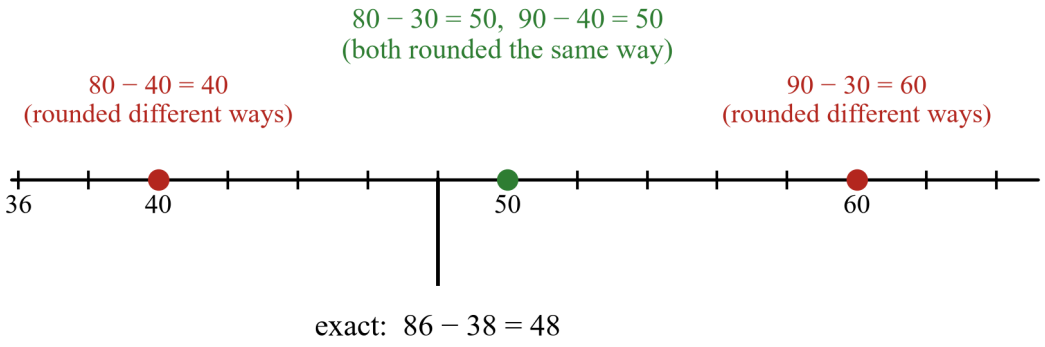


A number line showing three estimates for 34 plus 28: 50 from rounding both numbers down, 60 from rounding each number to the nearest ten, and 70 from rounding both numbers up. A flag marks the exact answer 62, which is closest to 60.

For addition, **round each number to the nearest ten** — the up-shifts and the down-shifts tend to undo each other.

Subtracting. Take 86 − 38. This time, rounding each number to the nearest ten means rounding both *up*: 90 − 40 = 50, only 2 from the exact answer 48. Round the numbers different ways and the shifts stack up instead of undoing: 80 − 40 = 40 is 8 too low, and 90 − 30 = 60 is 12 too high.

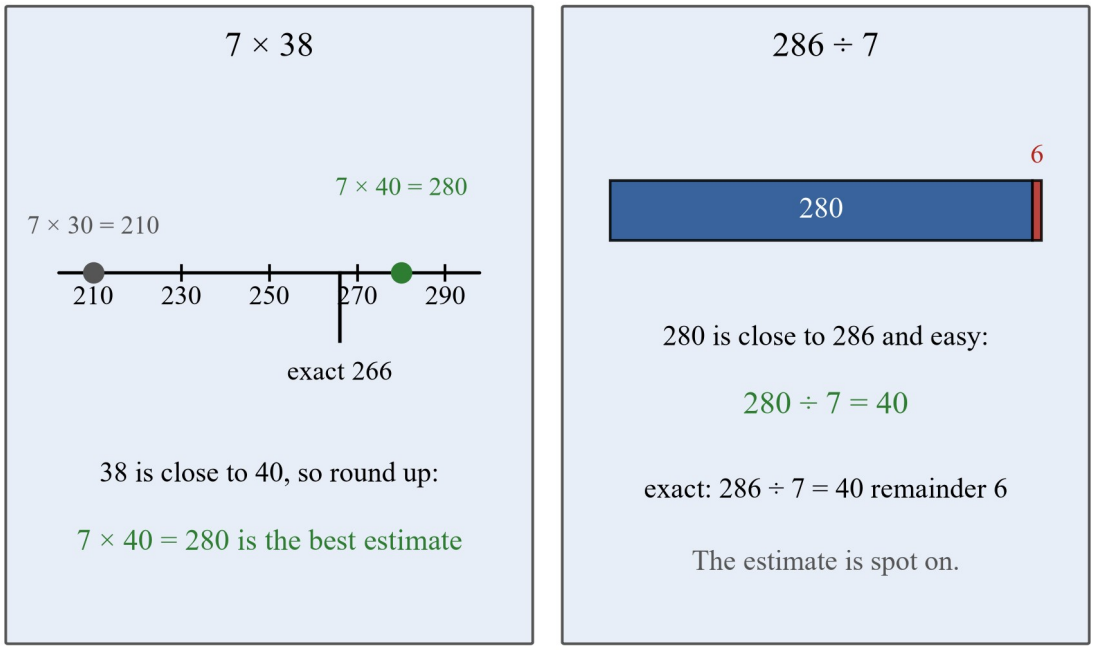
Estimates for 86 − 38 — 50 is closest to the exact answer.



A number line showing estimates for 86 minus 38: 40 from 80 minus 40, 50 from 80 minus 30 and from 90 minus 40 where both numbers were rounded the same way, and 60 from 90 minus 30. A flag marks the exact answer 48, which is closest to 50.

For subtraction, **round both numbers the same way** — both up, or both down. Then one shift adds about what the other takes away.

Multiplying and dividing. For 7 × 38, rounding 38 up to 40 gives 7 × 40 = 280, close to the exact product 266; rounding down to 30 gives 7 × 30 = 210, which is a long way off, because multiplying makes the rounding 7 times as big. For division, choose a **friendly number** close to the real one — a number the divisor goes into easily. For 286 ÷ 7, that number is 280, because 28 ÷ 7 is a times-table fact: 280 ÷ 7 = 40, and the exact answer is 40 remainder 6.

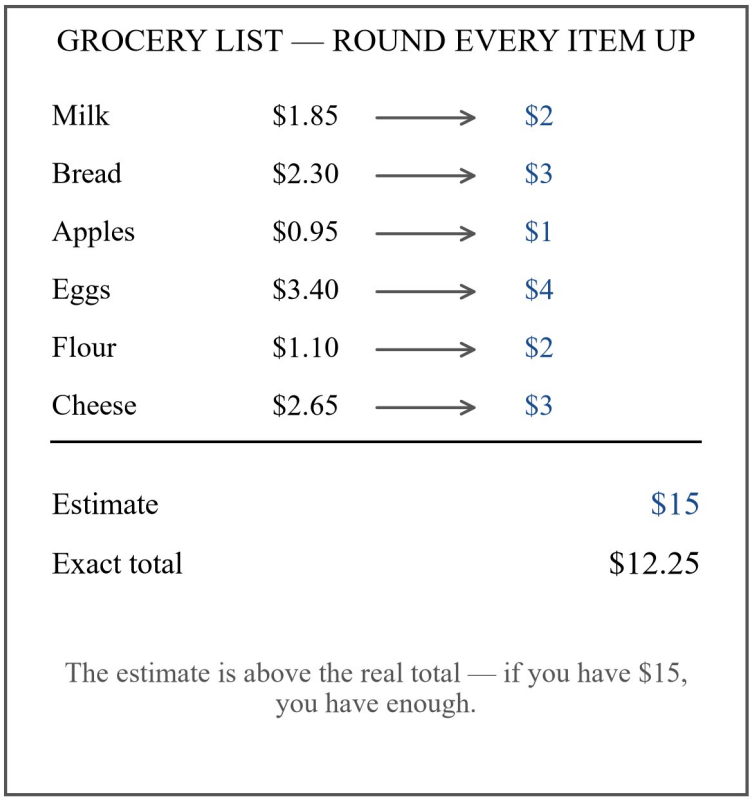


Two panels. On the left, a number line from 210 to 290 marks 7 times 30 as 210 and 7 times 40 as 280, with a flag on the exact product 266, so 280 is the best estimate for 7 times 38. On the right, a bar of 286 is split into 280 and 6, showing 280 divided by 7 is 40 and the exact answer is 40 remainder 6.

Rounding and money

Money has its own rounding rules, and the right rule depends on how you are paying (`VC2M5N08.E03`).

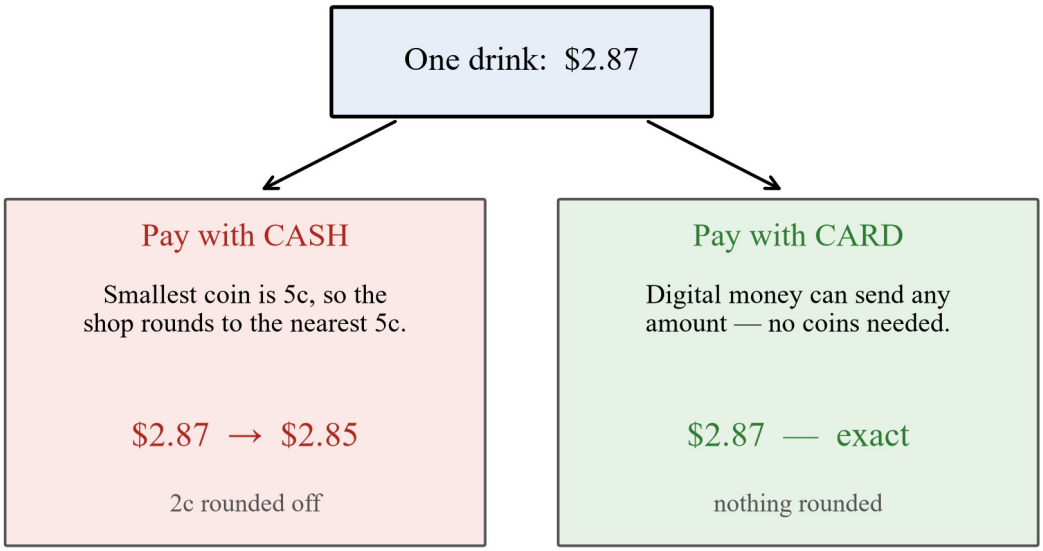
The groceries. Round every item *up* to the next dollar. The estimate comes out a little above the real total — and that is exactly what you want: if your money covers the estimate, it must cover the shopping.



A shopping list of 6 items with their prices. An arrow rounds each price up to the next dollar: $1.85 to $2, $2.30 to $3, $0.95 to $1, $3.40 to $4, $1.10 to $2 and $2.65 to $3. The rounded prices add to an estimate of $15, above the exact total of $12.25.

One purchase with cash. Australia's smallest coin is 5 cents, so a cash price rounds to the nearest 5 cents — up or down, whichever is closer.

A card or digital payment. Nothing rounds. The exact amount is charged.

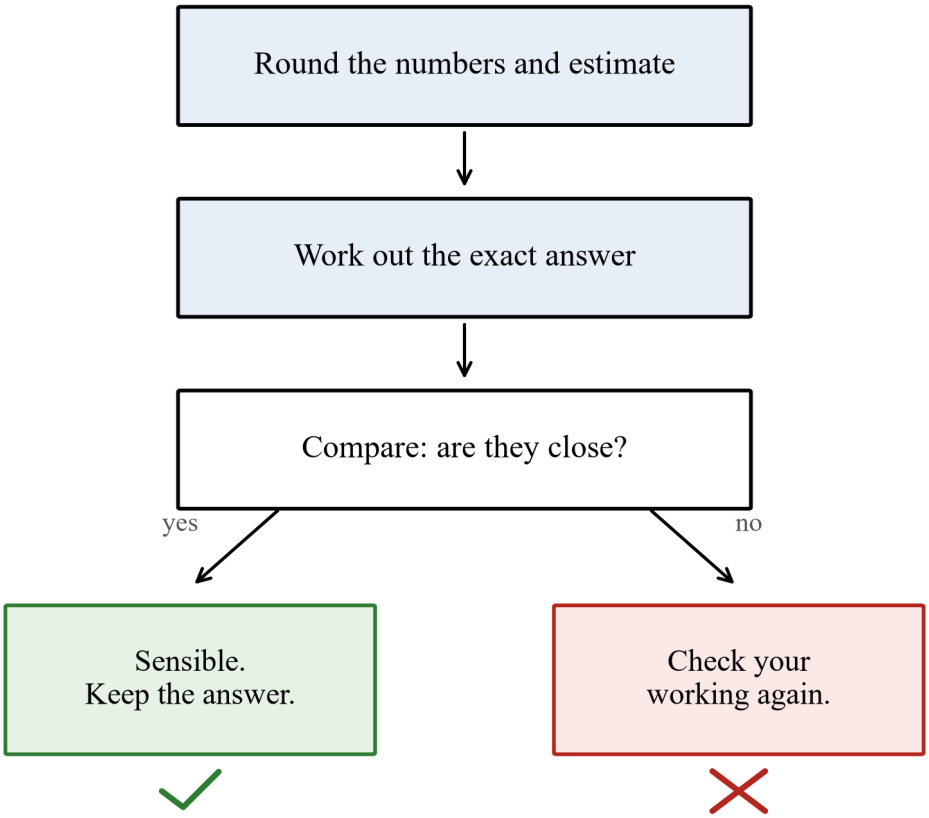


One drink costing $2.87 paid two ways. Paying with cash rounds to the nearest 5 cents, so you pay $2.85. Paying by card charges the exact $2.87.

Situation	Rounding	Why
A trolley of groceries	Round every item up to the next dollar	The estimate is never below the real total, so it keeps you safe
One purchase with cash	Round to the nearest 5 cents	There are no 1-cent or 2-cent coins
A card or digital payment	No rounding	The exact amount is charged

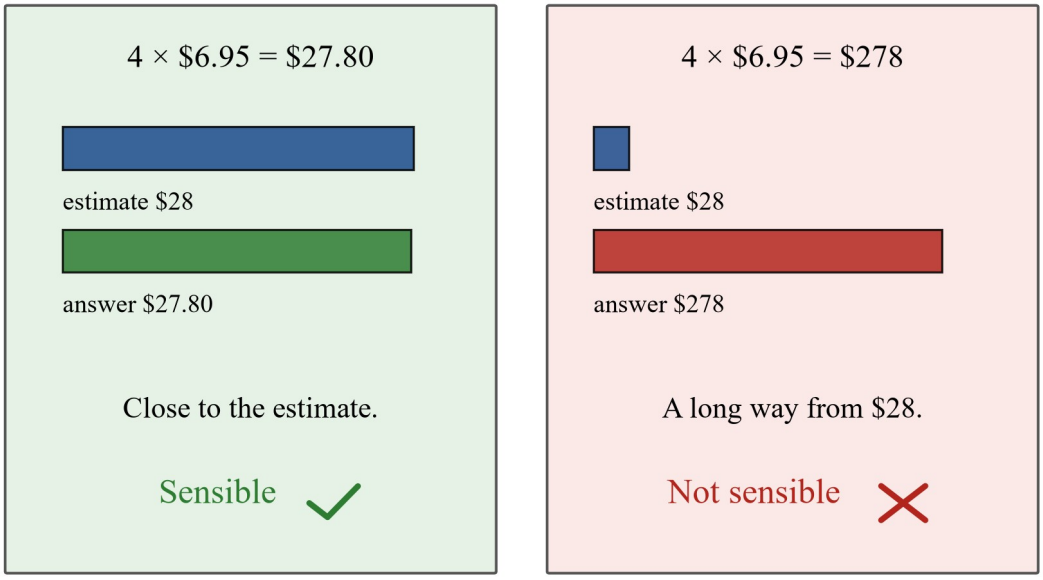
Is my answer sensible?

Estimation is also the fastest way to catch a mistake. Make this a habit for every big calculation (VC2M5N08):



A flow chart with three steps: round the numbers and estimate, work out the exact answer, then compare the two. If they are close, the answer is sensible and is kept. If they are not close, check the working again.

Round first, then work out the exact answer, then compare. If the two are close, the answer is sensible and you can keep it. If they are not close, your working needs another look.



Two panels checking answers to 4 times $6.95 against the estimate 4 times $7 is $28. On the left, the answer $27.80 sits right beside $28, so it is sensible. On the right, the answer $278 is ten times the estimate, so it is not sensible.

Four copies of a $6.95 book cost 4 × $6.95 = $27.80 — right beside the estimate of $28, so the answer is sensible. But $278 is ten times the estimate: something went wrong (the decimal point slipped one place). This is the check the Level 5 achievement standard asks for: check your calculations with estimation before you call them done.

Worked examples

Example 1 — step by step: exact or estimate?

Decide whether each question needs an exact answer or an estimate, and say why.

1. About how many people are at the school fete?
2. You buy a $7.35 book with a $10 note. What is your change?
3. Is $20 enough for 3 games at $5.80 each?
4. 48 stickers are shared equally between 4 friends. How many does each get?

Question	Decision	Reason
1	Estimate	The word *about* says a close count is enough.
2	Exact	Change must be right to the cent: 10 − 7.35 = $2.65.
3	Estimate	"Is it enough?" needs a safe check: round $5.80 up to $6, and 3 × 6 = 18. As $18 is under $20, $20 is enough.
4	Exact	A fair share must be equal: 48 ÷ 4 = 12 each.

Example 2 — step by step: pick the best estimate for a sum

Estimate 34 + 28 three ways, and say which estimate is best.

Working	Comment
Both down: 30 + 20 = 50.	34 loses 4 and 28 loses 8 — both shifts pull the estimate

Working	Comment
	down.
Nearest ten: 30 + 30 = 60.	34 loses 4 but 28 gains 2 — the shifts partly undo each other.
Both up: 40 + 30 = 70.	34 gains 6 and 28 gains 2 — both shifts push the estimate up.
Exact: 34 + 28 = 62.	60 is only 2 away; 50 is 12 away and 70 is 8 away.

The best estimate is **60**, because each number was rounded to the nearest ten.

Example 3 — step by step: round both the same way for subtraction

Estimate 86 − 38. Which rounding is best?

Working	Comment
Both up: 90 − 40 = 50.	Each number gains, and one shift adds about what the other takes away.
Different ways: 80 − 40 = 40, or 90 − 30 = 60.	The shifts stack up and drag the estimate away from the true answer.
Exact: 86 − 38 = 48.	50 is only 2 away; 40 is 8 away and 60 is 12 away.

The best estimate is **50**. For subtraction, round both numbers the same way.

Example 4 — step by step: friendly numbers for division

Estimate 286 ÷ 7, then use the estimate to check the exact answer.

Working	Comment
Pick a friendly number near 286: 280.	28 ÷ 7 is a times-table fact, so 280 divides easily by 7.
Estimate: 280 ÷ 7 = 40.	The answer should be near 40.
Exact: 286 ÷ 7 = 40 remainder 6.	7 × 40 = 280, and 286 − 280 = 6, with 6 less than 7. ✓

The exact answer sits right beside the estimate, so it is sensible.

Example 5 — step by step: is there enough money?

You have $15. The shopping list is milk $1.85, bread $2.30, apples $0.95, eggs $3.40, flour $1.10 and cheese $2.65. Estimate to decide whether $15 is enough.

Working	Comment
Round every item up: $2, $3, $1, $4, $2, $3.	Rounding up means the estimate cannot be below the real total.
Estimate: 2 + 3 + 1 + 4 + 2 + 3 = $15.	No messy cents were added at all.
$15 covers the estimate, so it covers the shopping.	Exact total: $12.25 — $15 is enough, with $2.75 to spare.

Yes, **$15 is enough**.

Example 6 — on your own: cash or card?

A drink costs $2.87 and a snack costs $4.93. What do you pay for each if you pay in cash? What does the card charge?

Cash rounds to the nearest 5 cents: $2.87 → **$2.85** (2 cents closer to $2.85 than to $2.90), and $4.93 → **$4.95** (2 cents closer to $4.95 than to $4.90). The card charges the exact amounts: **$2.87** and **$4.93**.

Example 7 — on your own: is the answer sensible?

Mia works out 4 × $6.95 and writes $278. Use an estimate to check her answer.

Round $6.95 up to $7: 4 × $7 = $28, so a sensible answer sits near $28. Mia's $278 is ten times the estimate — **not sensible**. The decimal point slipped one place: 4 × $6.95 is really **$27.80**.

Practice questions

Questions with help

Q1. Round to the nearest ten: (a) 47, (b) 83, (c) 65.

Q2. Exact or estimate? Say which each question needs, and why. (a) About how many marbles are in the jar? (b) You buy a $3.40 drink with a $5 note. What is your change? (c) 36 cards are shared equally between 3 players. How many does each get? (d) Is $50 enough for 4 books at $11.90 each?

Q3. Estimate 46 + 37 by rounding both numbers up. Then work out the exact answer. Is your estimate above or below it, and by how much?

Q4. Estimate 92 − 58 by rounding each number to the nearest ten. Then work out the exact answer. Why does this estimate come out 4 below the exact answer?

Q5. Estimate 6 × 4.95 by rounding 4.95 to the nearest whole number. Then work out the exact answer. Is your estimate above or below it?

Q6. Find a friendly number near 354 that divides easily by 9, and use it to estimate 354 ÷ 9. Then work out the exact answer.

Q7. You buy a $2.45 pencil case, a $1.70 notebook and a $3.25 pen. Round each price up to the next dollar and estimate the total. Then work out the exact total.

Q8. Tom says 7 × 42 = 294. Use an estimate to check whether his answer is sensible.

Questions on your own

Q9. 53 + 29 = 82. Estimate it (a) rounding both numbers up, (b) rounding both numbers down, and (c) rounding each number to the nearest ten. Which estimate is closest, and why?

Q10. 81 − 37 = 44. Estimate it (a) rounding both numbers down, (b) rounding both numbers up, and (c) rounding each number to the nearest ten. Which estimate is closest?

Q11. Estimate 8 × 31 two ways: rounding 31 down and rounding 31 up. Which is better? Check against the exact answer.

Q12. Estimate 178 ÷ 6 using 180 ÷ 6. Then work out the exact answer with a remainder.

Q13. A drink costs $3.43. What do you pay in cash, and what does the card charge?

Q14. Round each price up to the next dollar and estimate the total: $0.65, $2.20, $4.75, $1.05. Then work out the exact total. Why is this estimate safe to shop with?

Q15. Sam works out 5 × 4.86 and writes 243. Use an estimate to decide whether 243 is sensible. What is the exact answer?

Q16. Why do we round every item up — not to the nearest dollar — when estimating a trolley of groceries? Answer in one sentence.

Applied

Q17. The canteen orders 8 boxes of pies, with 39 pies in each box. Estimate the total by rounding 39 to the nearest ten. Is your estimate above or below the exact number? Check by working out the exact number.

Q18. Posters cost $7.85 each. You have $50 and want 6 posters. Round the price up to the nearest dollar and estimate the cost. Do you have enough? Explain why rounding up makes your check a safe one.

Q19. Three Year-5 classes raise $296, $317 and $388 for new sports gear. Round each amount to the nearest hundred and estimate the total. Then work out the exact total. How close is your estimate?

Q20. A trip is 246 km. The bus has driven 97 km. Round each number to the nearest ten and estimate how far is left. Then work out the exact distance left.

Answers

Q1. (a) 50. (b) 80. (c) 70 (65 is halfway; round up). **Q2.** (a) Estimate. (b) Exact: $1.60. (c) Exact: 12 cards each. (d) Estimate: 4 × $12 = $48, so yes. **Q3.** 50 + 40 = 90; exact 83; 7 above. **Q4.** 90 − 60 = 30; exact 34; 92 rounded down but 58 rounded up. **Q5.** 6 × 5 = 30; exact 29.70; 0.30 above. **Q6.** 360; estimate 40; exact 39 remainder 3. **Q7.** Estimate $9; exact $7.40. **Q8.** 7 × 40 = 280, which is close to 294, so sensible. **Q9.** (a) 90. (b) 70. (c) 80; (c), only 2 away. **Q10.** (a) 50. (b) 50. (c) 40; (c), only 4 away. **Q11.** 8 × 30 = 240; 8 × 40 = 320; 240 is better (exact 248). **Q12.** Estimate 30; exact 29 remainder 4. **Q13.** Cash $3.45; card $3.43. **Q14.** Estimate $11; exact $8.65; the estimate is never below the real total. **Q15.** No — 5 × 5 = 25, and 243 is about ten times that; exact 24.30. **Q16.** The estimate is never below the real total, so if your money covers the estimate it must cover the shopping. **Q17.** 8 × 40 = 320; above; exact 312. **Q18.** 6 × $8 = $48, so yes; the estimate is above the real cost, so covering it covers the real price too. **Q19.** 300 + 300 + 400 = $1000; exact $1001; only $1 away. **Q20.** 250 − 100 = 150 km; exact 149 km.

Worked answers

Q1. 47 is closer to 50; 83 is closer to 80; 65 sits exactly halfway, so it rounds up to 70.

Q2. (a) *About* says a close count is enough — estimate. (b) Change must be right to the cent: 5 − 3.40 = $1.60 — exact. (c) A fair share must be equal: 36 ÷ 3 = 12 — exact. (d) Round $11.90 up to $12: 4 × 12 = 48, and 48 is under 50, so $50 is enough — the exact cost is $47.60.

Q3. Both up: 50 + 40 = 90. Exact: 46 + 37 = 83. The estimate is 7 above, because both numbers were rounded up.

Q4. Nearest ten: 90 − 60 = 30. Exact: 92 − 58 = 34. 92 rounded down 2 but 58 rounded up 2, so the two shifts stack up and the estimate lands 4 below.

Q5. 4.95 rounds to 5, so 6 × 5 = 30. Exact: 6 × 4.95 = 29.70. The estimate is 0.30 above, because 4.95 was rounded up.

Q6. 360 is near 354 and 36 ÷ 9 = 4, so 360 ÷ 9 = 40. Exact: 354 ÷ 9 = 39 remainder 3, because 9 × 39 = 351.

Q7. Round up: $3 + $2 + $4 = $9. Exact: 2.45 + 1.70 + 3.25 = $7.40.

Q8. 42 rounds to 40, and 7 × 40 = 280. 294 is close to 280, so Tom's answer is sensible. ✓

Q9. (a) 60 + 30 = 90. (b) 50 + 20 = 70. (c) 50 + 30 = 80. The exact answer is 82, so (c) is closest — only 2 away — because each number was rounded to the nearest ten.

Q10. (a) 80 − 30 = 50. (b) 90 − 40 = 50. (c) 80 − 40 = 40. The exact answer is 44, so (c) is closest at 4 away; (a) and (b) are each 6 away.

Q11. Down: 8 × 30 = 240; up: 8 × 40 = 320. Exact: 8 × 31 = 248. 240 is better — 31 is only 1 away from 30 but 9 away from 40.

Q12. 180 ÷ 6 = 30, so the estimate is 30. Exact: 178 ÷ 6 = 29 remainder 4, because 6 × 29 = 174.

Q13. Cash rounds to the nearest 5 cents: $3.43 → $3.45. The card charges the exact $3.43.

Q14. Round up: $1 + $3 + $5 + $2 = $11. Exact: 0.65 + 2.20 + 4.75 + 1.05 = $8.65. Every item was rounded up, so the estimate is never below the real total — safe to shop with.

Q15. 4.86 rounds to 5, so the estimate is 5 × 5 = 25. 243 is about ten times that — not sensible. Exact: 5 × 4.86 = 24.30; Sam's decimal point slipped one place.

Q16. Rounding every item up means the estimate is never below the real total, so if your money covers the estimate it must cover the shopping.

Q17. 39 rounds to 40, so 8 × 40 = 320 — above the exact number, because 39 was rounded up. Exact: 8 × 39 = 312.

Q18. Round $7.85 up to $8: 6 × 8 = $48, and $48 is under $50, so yes. Because the price was rounded up, the estimate is above the real cost ($47.10), so covering the estimate guarantees covering the real price.

Q19. 296 → 300, 317 → 300, 388 → 400: estimate $1000. Exact: 296 + 317 + 388 = $1001 — the estimate is only $1 away.

Q20. 246 → 250 and 97 → 100, so the estimate is 250 − 100 = 150 km. Exact: 246 − 97 = 149 km.

Modelling additive and multiplicative problems, including simple financial planning

Code VC2M5N09 (Victorian Curriculum F–10 Version 2.0, Mathematics, Level 5; authority file `maths_5.json`): "use mathematical modelling to solve practical problems involving additive and multiplicative situations, including simple financial planning contexts; formulate the problems, choosing operations and efficient mental and written calculation strategies, and using digital tools where appropriate; interpret and communicate solutions in terms of the situation". This section draws on `VC2M5N09.E01`, `.E02` and `.E03`. Elaboration `.E04` is not covered here; see the front-of-book note on Aboriginal and Torres Strait Islander content.

Achievement standard (Level 5, extract): "Students use mathematical modelling to solve financial and other practical problems, formulating and solving problems, choosing arithmetic operations and interpreting results in terms of the situation."

What you need to know

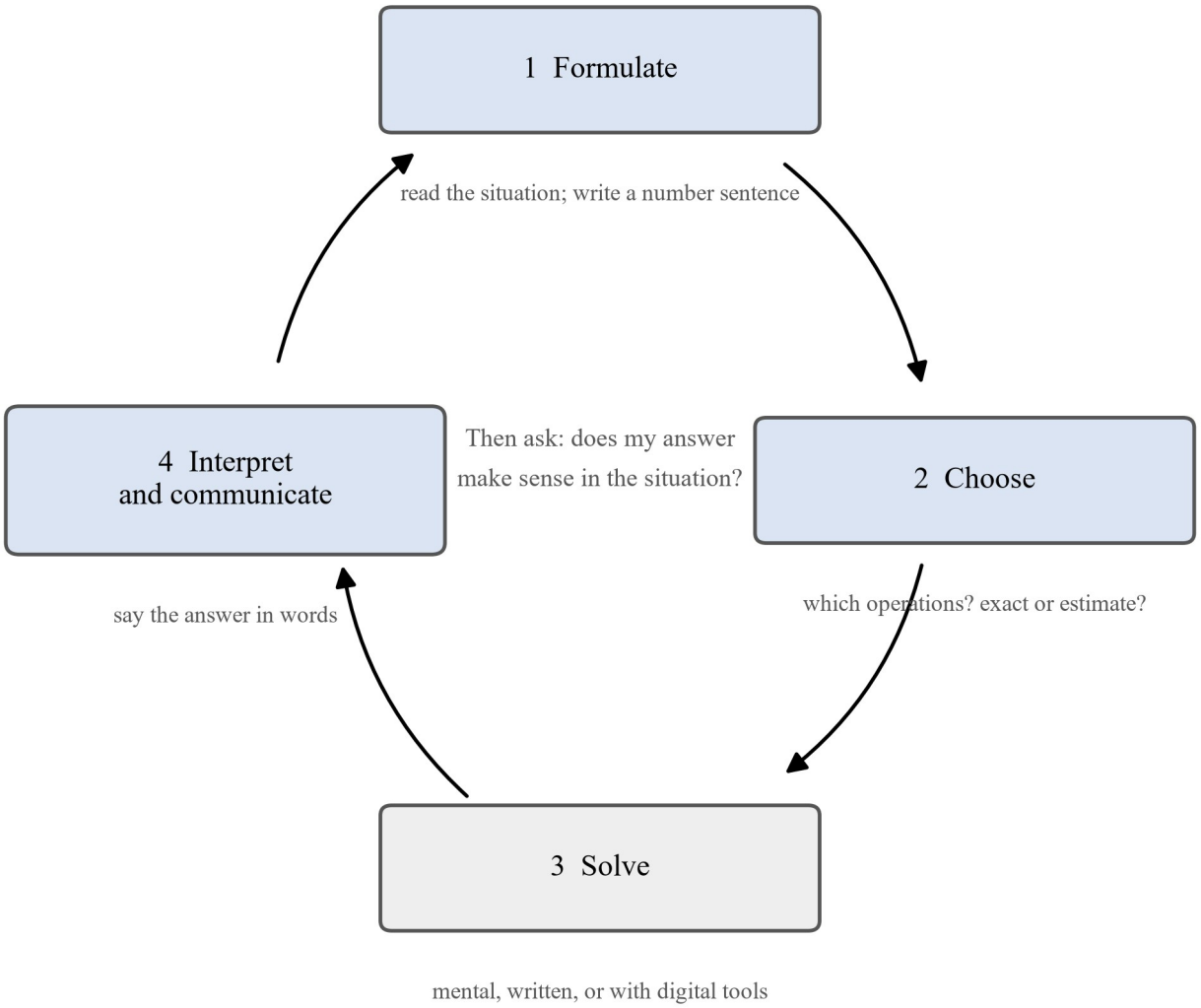
Nothing here is a new operation. The new skill is running the whole journey on every problem: turning a story into a number sentence, choosing the operation and the way to work it out, solving, and then saying what the answer means in the story. The tools you bring are already yours:

- multiplication facts to 10 × 10, known from earlier years;
- money sense from buying things: prices, totals and change to the nearest 5c;
- mental and written multiplication strategies from 1B;
- reading remainders from 1C — knowing when to round up, round down, keep or split them;
- the 3A habit: estimate first, so you know what a sensible answer looks like.

The modelling cycle

Mathematical modelling is the loop shown below. Every problem in this section runs the whole loop — a number on its own is never the finished job.

The modelling cycle



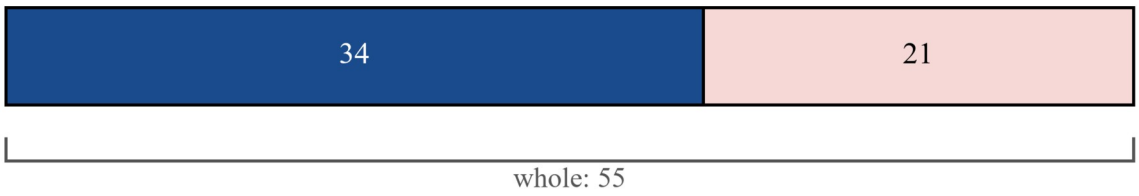
A cycle of four boxes joined by arrows. Box 1 Formulate: read the situation and write a number sentence. Box 2 Choose: which operations, exact or estimate? Box 3 Solve: mental, written, or with digital tools. Box 4 Interpret and communicate: say the answer in words. In the middle: then ask, does my answer make sense in the situation?

- **Formulate** means turning the story into maths — a number sentence, a bar model, a table. If something is unknown, draw a box: □.
- **Choose** is two decisions: which operation fits, and whether the job needs an exact number or an estimate (3A).
- **Solve** with the strategy that fits — mental, written, or a digital tool such as a calculator or spreadsheet.
- **Interpret and communicate** means saying the answer in words that fit the story — "9 trays", "$12 short" — and checking it makes sense.

Additive situations: joining and comparing

An additive situation is one where amounts are put together or compared. A bar model shows which operation fits (VC2M5N09.E01).

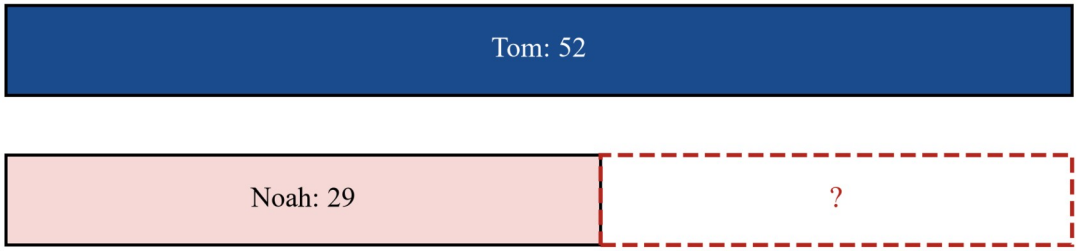
Joining — Mia had 34 stickers and got 21 more.



34 + 21 = 55 (add the parts)

Comparing — Tom has 52 cards. Noah has 29.

How many more does Tom have?



52 − 29 = 23 (find the difference)

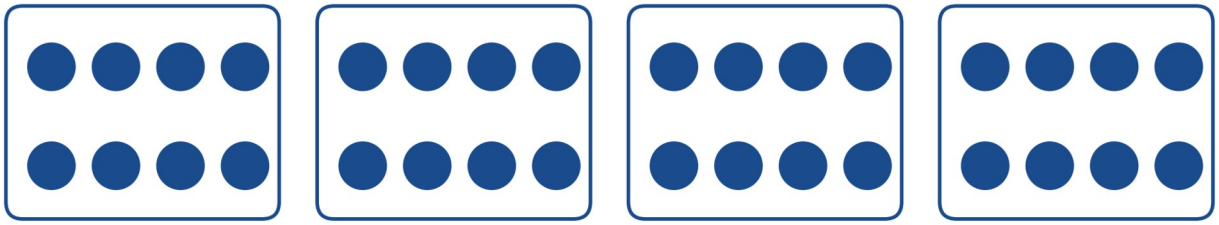
Two bar models. Top, joining: a bar of 34 joined to a bar of 21 more, with a line underneath marking the whole, 55, so 34 + 21 = 55. Bottom, comparing: Tom's bar of 52 above Noah's bar of 29, the gap to Tom's length drawn dashed and marked ?, so 52 − 29 = 23.

- **Joining** puts parts together to find the whole: 34 + 21 = 55.
- **Comparing** lines two amounts up and finds the difference: 52 − 29 = 23. "How many more?" is a subtraction story, even though nothing is taken away.

Multiplicative situations: equal groups and times as many

A multiplicative situation is one where equal groups are counted up (×) or shared out (÷).

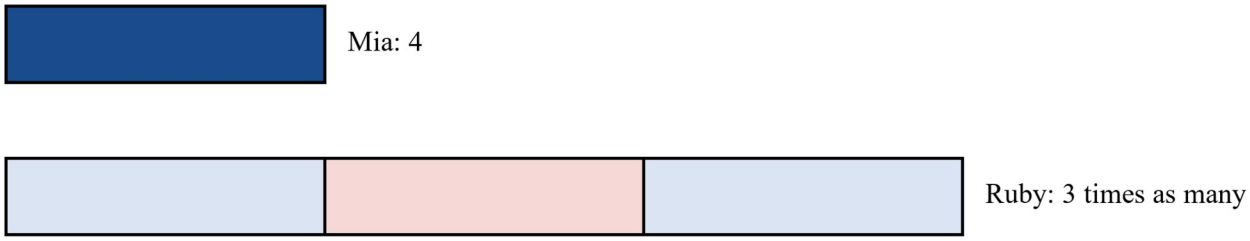
Equal groups — 4 rows of chairs, 8 in each row.



4 groups of 8: $4 \times 8 = 32$

Times as many — Mia read 4 books.

Ruby read 3 times as many.



$3 \times 4 = 12$ books

Two pictures. Top, equal groups: four boxes each holding 8 dots, so 4 groups of 8, and 4 × 8 = 32. Bottom, times as many: Mia's bar of 4 books, and Ruby's bar made of three copies of Mia's bar, so 3 times as many, and 3 × 4 = 12 books.

- **Equal groups** count up: 4 rows of 8 chairs is $4 \times 8 = 32$ chairs.
- **Times as many** is also multiplication: 3 times as many as 4 is $3 \times 4 = 12$.
- **Sharing equally** is division: \$72 shared 8 ways is $72 \div 8 = 9$.

Choosing the operation

The story decides the operation, not the numbers alone. Read what happens in the story, then match it:

Which operation fits the situation?

What happens in the story?	Operation	Number sentence
putting parts together — how many altogether?	+	34 + 21 = 55
taking away — how many left? how many more?	−	52 − 29 = 23
equal groups — times as many	×	4 × 8 = 32
sharing equally — how many in each group?	÷	72 ÷ 8 = 9

Say why the operation fits — the story decides, not the numbers alone.

A three-column table. Putting parts together, how many altogether? → + → 34 + 21 = 55. Taking away, how many left or how many more? → − → 52 − 29 = 23. Equal groups, times as many → × → 4 × 8 = 32. Sharing equally, how many in each group? → ÷ → 72 ÷ 8 = 9. Caption: say why the operation fits — the story decides, not the numbers alone.

Say the reason before you work out — *"the parts go together, so I add"* — because giving the reason is part of formulating the problem.

Exact or estimate?

Before working out, decide whether the story needs the exact number or whether an estimate is enough (VC2M5N09.E02).

Exact or estimate? Decide before you work out.

Ruby counts the ticket money.

57 students each pay $2.

57 × 2 = $114

Every dollar must be counted, so this needs the exact number.

Mia sets out chairs for 3 classes of about 29 students each.

3 × 30 = about 90

A head count can change, so about 90 chairs is enough to plan with.

Money, change and shares that must be fair → exact.

"About how many?" and quick checks → estimate (3A).

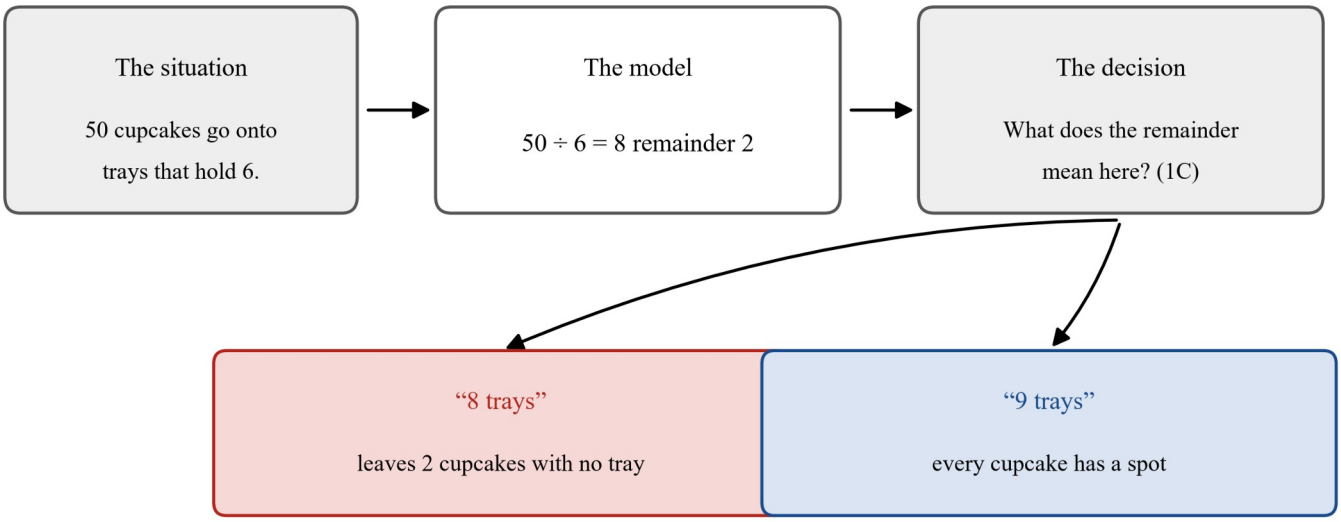
Two cards side by side. EXACT card: Ruby counts the ticket money; 57 students each pay $2; 57 × 2 = $114; every dollar must be counted, so this needs the exact number. ESTIMATE card: Mia sets out chairs for 3 classes of about 29 students each; 3 × 30 = about 90; a head count can change, so about 90 chairs is enough to plan with. Strip below: money, change and shares that must be fair → exact; "About how many?" and quick checks → estimate (3A).

- Money and change are exact: if the total is wrong, the money does not add up at the end.
- Planning numbers can often be estimates: rounding 29 up to 30 even leaves a spare chair.

An estimate also works as the 3A check on an exact answer. If 57 × 2 comes out near 120 (because 60 × 2 = 120), it is sensible; if it came out 214, something slipped.

Interpreting the answer: the number is not the answer

The last step of the cycle is a decision, and 1C taught the four usual decisions: round up, round down, split the remainder, or keep it. The picture below runs one through.



The number is not the answer. The decision is.

Three boxes in a row joined by arrows: the situation (50 cupcakes go onto trays that hold 6); the model (50 ÷ 6 = 8 remainder 2); the decision (what does the remainder mean here? (1C)). Two answer boxes below: “8 trays” leaves 2 cupcakes with no tray, marked wrong in red; “9 trays” gives every cupcake a spot, marked right in blue. Caption: the number is not the answer. The decision is.

50 ÷ 6 = 8 remainder 2 is only the model. The answer in words is **9 trays**, because the 2 leftover cupcakes still need a tray. In a money story the same remainder would be rounded down — the leftover dollars buy nothing more. Always communicate the decision in a sentence: that is interpreting the result in terms of the situation.

Simple financial planning: a class budget

A **budget** is a plan, made before an event, of the money coming in and the money going out. Money coming in is called **income**, money going out is called **expenses**, and income − expenses is the money the event raises. Class 5B is planning a movie afternoon to raise money for the Year 5 camp, and their first budget is below.

Class 5B movie afternoon — budget

Money coming in (income)		
Tickets, $2 each	60 × $2	$120
Popcorn bags, $1 each	40 × $1	$40
Total income		$160
Money going out (expenses)		
Popcorn kernels and bags		$25
Movie hire		$35
Paper cups		$12
Total expenses		$72
Money raised	160 − 72	$88
Goal: $100		$12 short

A budget plans the money coming in and the money going out before the event.

A budget table for the Class 5B movie afternoon. Money coming in (income): tickets $2 each, 60 × $2 = $120; popcorn bags $1 each, 40 × $1 = $40; total income $160. Money going out (expenses): popcorn kernels and bags $25; movie hire $35; paper cups $12; total expenses $72. Money raised: $160 − $72 = $88. Goal $100: $12 short. Caption: a budget plans the money coming in and the money going out before the event.

Read the budget the way the class checks it:

- income: 60 × $2 = $120 from tickets and 40 × $1 = $40 from popcorn, so $120 + $40 = $160;
- expenses: $25 + $35 + $12 = $72;
- money raised: $160 − $72 = $88.

The goal is $100, so the first plan is $12 short. That sentence — "$12 short of the $100 goal" — is the interpret step of the cycle: $88 only means something once it is read against the goal. A class budget stays simple: money in, money out, and what is left.

The budget in a spreadsheet

A spreadsheet is the natural digital tool for a budget (VC2M5N09.E03): every total is a formula — a number sentence the sheet works out for you — so changing one number updates everything that uses it.

D9	= D4 − D8

	A	B	C	D
2	Tickets	60	$2	$120
3	Popcorn bags	40	$1	$40
4	Total income			$160
5	Kernels and bags	1	$25	$25
6	Movie hire	1	$35	$35
7	Paper cups	1	$12	$12
8	Total expenses			$72
9	Money raised			$88

each line multiplies number × price

income − expenses = money raised

Change one number and every total that uses it updates.

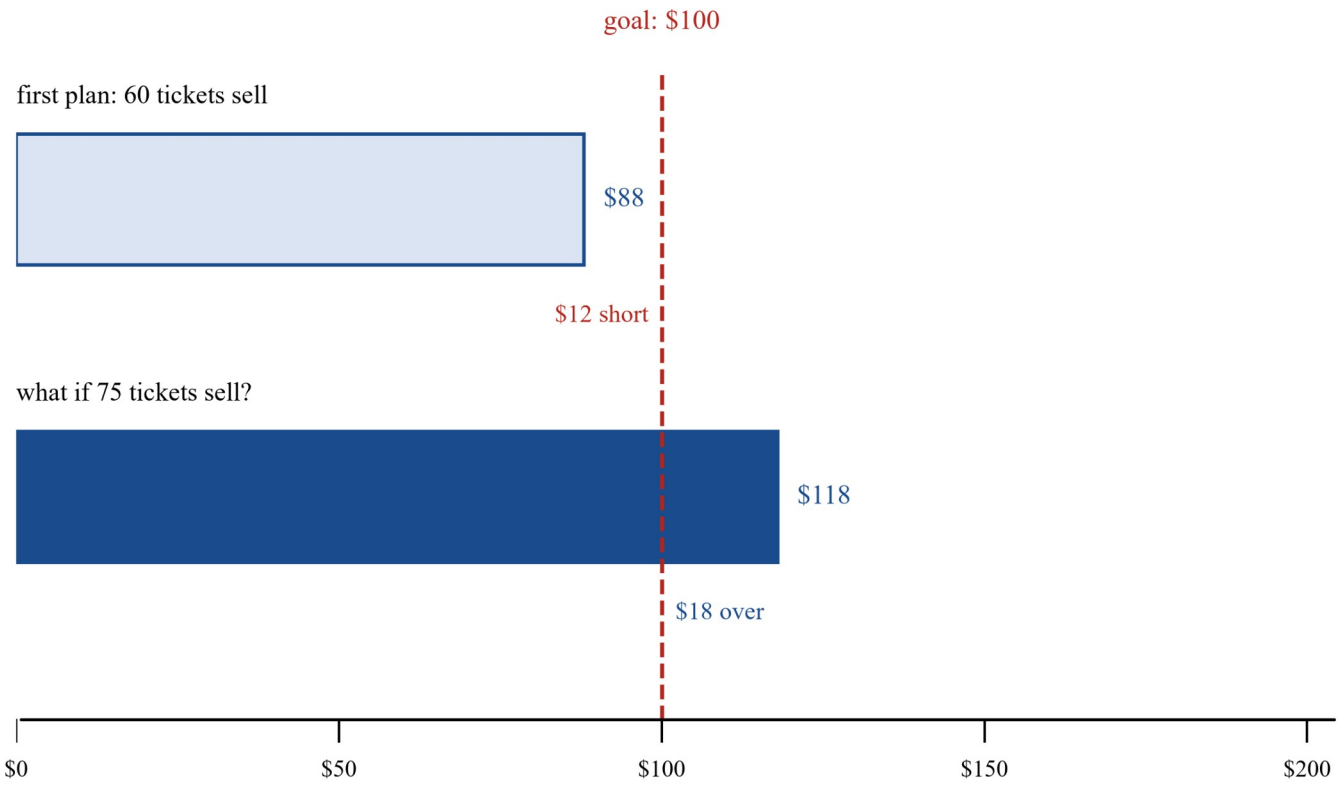
A spreadsheet of the same budget. Columns: A item, B number, C price, D total; rows 2 to 9. Rows: Tickets 60, $2, $120; Popcorn bags 40, $1, $40; Total income $160; Kernels and bags 1, $25, $25; Movie hire 1, $35, $35; Paper cups 1, $12, $12; Total expenses $72; Money raised $88. The formula bar shows the selected cell D9 as = D4 − D8. D2 is ringed in red with the note "each line multiplies number × price"; D9 is ringed in blue with the note "income − expenses = money raised". Caption: change one number and every total that uses it updates.

- Each money-in and money-out line multiplies number × price: D2 is = `B2 × C2`.
- Totals add the lines above them: D4 is = `D2 + D3`, and D8 is = `D5 + D6 + D7`.
- The money raised subtracts: D9 is = `D4 − D8`.

The cell names stand in for the numbers, just as □ stood in for the unknown when formulating.

What-if questions

A budget is a plan, not a promise, so the class asks *what if?* What if 75 tickets sell instead of 60? The spreadsheet answers at once: tickets become 75 × $2 = $150, income becomes $150 + $40 = $190, and the money raised becomes $190 − $72 = $118.



Two bars measured against a dashed goal line at $100. First plan, 60 tickets sell: a bar to $88, marked $12 short. What if 75 tickets sell: a bar to $118, marked $18 over.

Now the goal is reached — $18 over, in fact. Interpreting: selling 15 more tickets turns "$12 short" into "$18 over", because each extra ticket adds $2 to the money raised: 15 × $2 = $30, and $88 + $30 = $118. A what-if question is the modelling cycle run a second time on a changed situation.

Worked examples

Example 1 — step by step: joining, then comparing with a goal

Class 5B collected bread tags for two weeks. Week 1 brought in 47 tags and week 2 brought in 36. The sports gear they want needs 100 tags. How many more tags are still needed?

Working	Comment
Tags so far: 47 + 36. Think 47 + 30 = 77, then 77 + 6 = 83.	Joining → add. Mental strategy: add in tens, then ones (1B).
Tags still needed: 100 − 83 = 17.	Comparing with the goal → subtract.
Check: 83 + 17 = 100. ✓	The opposite operation checks the answer.
Answer in words: the class still needs 17 tags.	Interpret: the question asked "how many more?", so the answer says it.

Example 2 — step by step: equal groups, then comparing with what is needed

Cups for the movie afternoon come in packs of 24. Six packs are in the storeroom, and 150 students are coming. Are there enough cups? If not, what should the class do?

Working	Comment
Cups in the storeroom: 6 × 24. Think 6 × 20 = 120 and 6 × 4 = 24, so 120 + 24 = 144.	Equal groups → multiply. Split 24 into tens and ones (1B).

Working	Comment
150 − 144 = 6 students would miss out.	Comparing with 150 → subtract.
One more pack adds 24 cups, which covers the 6.	Every student needs a cup, so round up (1C).
Answer in words: 144 cups is not enough; the class must buy one more pack.	Interpret in terms of the situation.

Example 3 — step by step: exact or estimate, two jobs from one event

Same event, two jobs. (a) Mia sets out chairs for 3 classes of about 29 students each. About how many chairs should she set out? (b) Ruby counts the ticket money: 57 students each paid $2. How much must she count?

Working	Comment
(a) 3 × 30 = 90, so about 90 chairs.	A head count can change → estimate. Rounding 29 up to 30 leaves spare chairs.
(b) 57 × 2: think 50 × 2 = 100 and 7 × 2 = 14, so 100 + 14 = 114. She must count $114.	Money must be exact → work it out exactly.
Check (b): 60 × 2 = 120, and $114 is near $120. ✓	The estimate is the 3A check on the exact answer.

Answer in words: about 90 chairs to set out; exactly $114 to count.

Example 4 — step by step: reading the movie-afternoon budget

Use the budget from the theory. How much money does the movie afternoon raise, and does it reach the $100 goal?

Working	Comment
Income: 60 × $2 = $120; 40 × $1 = $40; $120 + $40 = $160.	Each line multiplies number × price, then the lines are added.
Expenses: $25 + $35 + $12 = $72.	The money going out, added.
Money raised: $160 − $72 = $88.	Income − expenses.
$100 − $88 = $12.	Read the result against the goal.
Answer in words: the afternoon raises $88, which is $12 short of the $100 goal.	Interpret: $88 only means something read against the goal.

Example 5 — on your own: a muffin drive runs the whole cycle

The class runs a muffin drive. They bake 3 trays of 12 muffins and sell every muffin for $2. The goal is $80. Do they reach it? If not, how many more muffins must they sell at $2 each?

Formulate: muffins baked is 3 × 12; money raised is that many × $2; how far short is $80 − money raised. Solve: 3 × 12 = 36 muffins, and 36 × $2 = $72, so $80 − $72 = $8 short. Each extra muffin adds $2, so $8 ÷ $2 = 4 more muffins. Check: 40 muffins × $2 = $80. ✓

Answer in words: the drive raises $72, which is $8 short of the goal — selling 4 more muffins would reach it.

Practice questions

Questions with help

Q1. Write a number sentence for each story, with □ for the unknown, and solve it. (a) A box held 28 stickers and 35 more were added. How many stickers now? (b) 48 students line up in 6 equal rows. How many students in each row? (c) 20 bread tags were on the board and 7 came off. How many are left? (d) 7 packs hold 6 cards each. How many cards altogether?

Q2. Picture a bar model: Mia had 34 stickers and got 21 more. Write the number sentence and solve it.

Q3. Equal groups: chairs are set out in 4 rows of 8. How many chairs?

Q4. Choose the operation, then solve. (a) A hall holds 90 chairs and 63 are taken. How many are free? (b) $36 is shared equally between 4 tables. How much does each table get? (c) 5 boxes hold 10 pencils each. How many pencils altogether? (d) 45 students are on the oval and 38 more arrive. How many students now?

Q5. Exact or estimate? Work it out the way you decide. (a) You pay $10 for 3 packs of cards at $3 each. How much change? (b) About how many biscuits are needed if 29 students each get 2?

Q6. A hall has 7 rows of 9 chairs. 60 students are coming. Are there enough chairs? How many are spare?

Q7. You have $20 and tickets cost $3 each. How many tickets can you buy, and what is left over?

Questions on your own

Q8. Two classes of 38 and 29 students come together for assembly. The hall has 95 seats. How many seats are empty?

Q9. Cupcakes come in boxes of 24. The class buys 3 boxes and shares them equally between 8 tables. How many cupcakes does each table get?

Q10. Three classes of about 29 students each go on an excursion. Each bus holds 45 students. About how many buses are needed?

Q11. 50 cupcakes go onto trays that hold 6. How many trays are needed so every cupcake has a spot?

Q12. Six friends share $3 equally. How much does each friend get? (Think in cents.)

Applied

Q13. A lemonade stall sells 40 cups at 50c each. Lemons cost $6, and cups and sugar cost $4. The goal is $15. How much money does the stall raise, and is the goal reached?

Q14. A sausage sizzle sells 10 packs of 12 sausages, cooked, at $2 each. The barbecue and bread cost $45. The goal is $200. How much money is raised, and is the goal reached?

Q15. Use the spreadsheet figure. (a) What formula gives D2? (b) What does D9 work out, and what is its formula? (c) If the class sells 50 popcorn bags instead of 40, which cells change, and what are their new values?

Q16. What if 75 tickets sell at the movie afternoon, with everything else as in the budget? Work out the new money raised and read it against the $100 goal.

Q17. Write a story that $6 \times 8 = 48$ solves, and say the answer in a sentence about your story.

Q18. Plan your own small class budget: one money-in line and two money-out lines. Work out the money raised and read it against a $50 goal.

Answers

Q1. (a) 28 + 35 = 63. (b) 48 ÷ 6 = 8. (c) 20 − 7 = 13. (d) 7 × 6 = 42. **Q2.** 34 + 21 = 55 stickers. **Q3.** 4 × 8 = 32 chairs. **Q4.** (a) 90 − 63 = 27. (b) 36 ÷ 4 = 9. (c) 5 × 10 = 50. (d) 45 + 38 = 83. **Q5.** (a) Exact: 3 × $3 = $9, change $10 − $9 = $1. (b) Estimate: about 60 biscuits. **Q6.** 63 chairs; enough, with 3 spare. **Q7.** 6 tickets, $2 left over. **Q8.** 28 empty seats. **Q9.** 9 cupcakes. **Q10.** About 2 buses. **Q11.** 9 trays. **Q12.** 50c each. **Q13.** $10 raised; $5 short of the goal. **Q14.** $195 raised; $5 short of the goal. **Q15.** (a) `= B2 × C2`. (b) The money raised; `= D4 − D8`. (c) B3 → 50, D3 → $50, D4 → $170, D9 → $98. **Q16.** $118; $18 over the goal. **Q17.** Any equal-groups story; sample in worked answers. **Q18.** Any budget that adds up; sample in worked answers.

Worked answers

Q1. (a) Parts go together → 28 + 35 = 63. (b) Sharing into equal rows → 48 ÷ 6 = 8. (c) Taking away → 20 − 7 = 13. (d) Equal groups → 7 × 6 = 42.

Q2. Joining → add: 34 + 21 = 55, so Mia now has 55 stickers.

Q3. Equal groups → multiply: 4 × 8 = 32 chairs.

Q4. (a) Comparing taken with held → 90 − 63 = 27 free chairs. (b) Sharing equally → 36 ÷ 4 = 9, so $9 a table. (c) Equal groups → 5 × 10 = 50 pencils. (d) Joining → 45 + 38 = 83 students.

Q5. (a) Change must be exact: 3 × $3 = $9 and $10 − $9 = $1 change. (b) A head count can change, so estimate: 29 is about 30, and 30 × 2 = 60, so about 60 biscuits.

Q6. 7 × 9 = 63 chairs, and 63 − 60 = 3, so yes — enough chairs, with 3 spare.

Q7. 3 × 6 = 18 and $20 − $18 = $2, so 6 tickets with $2 left over. The leftover $2 buys no ticket, so round down (1C).

Q8. 38 + 29 = 67 students, and 95 − 67 = 28 empty seats.

Q9. 3 × 24 = 72 cupcakes, and 72 ÷ 8 = 9, so each table gets 9 cupcakes.

Q10. Estimate: 29 is about 30, so 3 × 30 = 90 students. 90 ÷ 45 = 2, so about 2 buses. (The exact count, 3 × 29 = 87, still fits in 2 buses, because 45 + 45 = 90.)

Q11. 50 ÷ 6 = 8 remainder 2. The 2 leftover cupcakes still need a tray, so round up: 8 + 1 = 9 trays.

Q12. $3 = 300c, and 300c ÷ 6 = 50c, so each friend gets 50c.

Q13. Income: 40 × 50c = $20. Expenses: $6 + $4 = $10. Raised: $20 − $10 = $10. The goal is $15, so the stall is $5 short.

Q14. Sausages: 10 × 12 = 120. Income: 120 × $2 = $240. Raised: $240 − $45 = $195. The goal is $200, so the sizzle is $5 short.

Q15. (a) D2 multiplies number × price: `= B2 × C2`. (b) D9 works out the money raised: income − expenses, `= D4 − D8`. (c) B3 becomes 50, so D3 becomes 50 × $1 = $50; then D4 becomes $120 + $50 = $170, and D9 becomes $170 − $72 = $98.

Q16. Tickets: 75 × $2 = $150. Income: $150 + $40 = $190. Raised: $190 − $72 = $118. Read against the goal: $118 − $100 = $18, so the goal is reached with $18 over.

Q17. Sample: “The class sets out 6 rows of chairs with 8 chairs in each row. How many chairs in all?” Answer in words: the class sets out 48 chairs.

Q18. Sample: money in — 30 tickets at $2 = $60; money out — $14 for gifts and $6 for paper, so $20; raised: $60 − $20 = $40. Read against the $50 goal: $50 − $40 = $10, so the plan is $10 short.

Test

Chapter test T3 — Estimation and mathematical modelling

Codes: VC2M5N08, VC2M5N09 · **Total: 10 marks**

This is a classroom check, not an exam. The guidance time is **15 minutes** — about 1 minute per mark, plus 5 minutes of reading time.

You will need: paper and a pencil. No special equipment is needed for this paper.

Calculators: you may use a calculator if you want one, but the marks are for the strategy you choose and show — work out the items by hand first.

Show your working.

Section A — Estimating, and checking the reasonableness of a solution (VC2M5N08) — 5 marks

Q1. (2 marks) Decide whether each question needs an **exact** answer or an **estimate**, and say why.

(a) The canteen wants to know about how many pies to order for sports day.

(b) You buy a $4.65 drink with a $10 note. What is your change?

Q2. (2 marks) Ruby buys 6 books at $3.85 each. She works out 6 × $3.85 = $231.

(a) Use an estimate to check whether $231 is a sensible answer.

(b) Work out the exact cost of the 6 books.

Q3. (1 mark) Your trolley of groceries has 6 items. You have $20 and want a quick check that it is enough. Which estimate is the safest?

A Round every item's price up to the next dollar, and add.

B Round every item's price down to the dollar before, and add.

C Round every item's price to the nearest dollar, and add.

D Round only the most expensive item's price up to the next dollar, and ignore the rest.

Section B — Modelling additive and multiplicative problems, including simple financial planning (VC2M5N09) — 5 marks

Q4. (2 marks) Class 5B bakes cupcakes in trays of 8. They want one cupcake for each of the 45 students coming to the movie afternoon.

(a) Write a number sentence with □ for the number of trays, and work it out.

(b) How many trays must they bake? Answer in a full sentence, and say what you did with any leftover cupcakes.

Q5. (3 marks) Class 5A runs a fruit-cup stall at sports day to raise money for the Year 5 camp. They sell 28 fruit cups at $2 each. The fruit and cups cost $19.

(a) How much money does the stall raise? Show your working.

(b) The class goal is $35. Is the goal reached? Answer in words, saying how far over or short of the goal the stall is.

Solutions

Answer key

Q	Answer	Marks
Q1	(a) Estimate; (b) Exact, $5.35 change	2
Q2	(a) Not sensible — estimate 6 × $4 = $24; (b) $23.10	2
Q3	A	1
Q4	(a) 45 ÷ 8 = 5 remainder 5; (b) 6 trays	2
Q5	(a) $37; (b) Goal reached, $2 over	3
	Total	**10**

Worked solutions

Q1 (VC2M5N08, 2 marks).

(a) The word *about* says a close number is enough — **estimate**. Nobody needs an exact pie count before ordering.

(b) Change must be right to the cent — **exact**: $10 − $4.65 = $5.35.

Marking: 1 mark for each correct decision with a fitting reason.

Q2 (VC2M5N08, 2 marks).

(a) Round $3.85 to $4: 6 × $4 = $24, so a sensible answer sits near $24. Ruby's $231 is about ten times the estimate, so it is **not sensible** — her decimal point slipped one place.

(b) Exact cost, by doubling: 2 × $3.85 = $7.70, so 4 × $3.85 = $15.40, and 6 × $3.85 = $15.40 + $7.70 = **$23.10**.

Marking: 1 mark for the estimate and a correct judgement; 1 mark for the exact cost.

Q3 (VC2M5N08, 1 mark). A. Rounding every item up means the estimate is never below the real total — so if $20 covers the estimate, it must cover the shopping. B and C can land below the real total, and D leaves most of the trolley out of the estimate.

Q4 (VC2M5N09, 2 marks).

(a) One cupcake for each of 45 students, packed in trays of 8, is sharing into equal groups — divide: 45 ÷ 8 = □ remainder □. Since 8 × 5 = 40 and 45 − 40 = 5, 45 ÷ 8 = **5 remainder 5**.

(b) The 5 leftover cupcakes still need a tray, so round up: 5 + 1 = 6. Answer in words: **Class 5B must bake 6 trays.**

Marking: (a) 1 mark for a number sentence with □ and the correct working; (b) 1 mark for the rounded-up answer in words. An answer of "5 trays" scores 0 for part (b).

Q5 (VC2M5N09, 3 marks).

(a) Money in: 28 × $2 — double 28 — is $56. Money out is $19, so the money raised is $56 − $19. Mentally: 56 − 20 = 36, then 36 + 1 = 37. The stall raises **$37**.

(b) Read the result against the goal: $37 − $35 = $2. Answer in words: **the stall raises $37, which is $2 over the $35 goal, so the goal is reached.**

Marking: 1 mark for the income of $56; 1 mark for the money raised of $37; 1 mark for the comparison stated in words. A bare number with no words does not score the last mark.

Marks by content description

CD	Items	Marks
VC2M5N08	Q1 (2), Q2 (2), Q3 (1)	5
VC2M5N09	Q4 (2), Q5 (3)	5
Total	5 items	**10**

Each CD carries exactly 5 marks, per the §7 marking rule. The single multiple-choice item (1 of 10 marks) sits where selection is the skill being tested — choosing the rounding that keeps a shopping estimate safe (VC2M5N08.E03). No "no calculator" instruction appears on this paper (D10). The *formulate* and *communicate* verbs of VC2M5N09 are additionally evidenced by task I2 (§7).