Mathematics Level 7

Investigation and modelling tasks

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Contents

Task

Task I1 — Plan and conduct a statistical investigation · Investigation task · 20 marks · Chapter 6 (6C, supported by 6A and 6B)

Codes: `VC2M7ST03` (`.E01`, `.E02`, `.E03`, `.E04`) · supported by `VC2M7ST01` (6A) and `VC2M7ST02` (6B)

> *plan and conduct statistical investigations for issues involving discrete and continuous numerical data, and data collected from primary and secondary sources; analyse and interpret distributions of data and report findings in terms of shape and summary statistics* — VC2M7ST03

Task I1 is an investigation task. It is not a test. You frame your own **statistical question** — a question answered with data that vary — plan the investigation, collect or obtain the data, display it, work out the summary numbers, and report what the data show. You follow the same six stages you learned in 6C, shown in Figure 1.

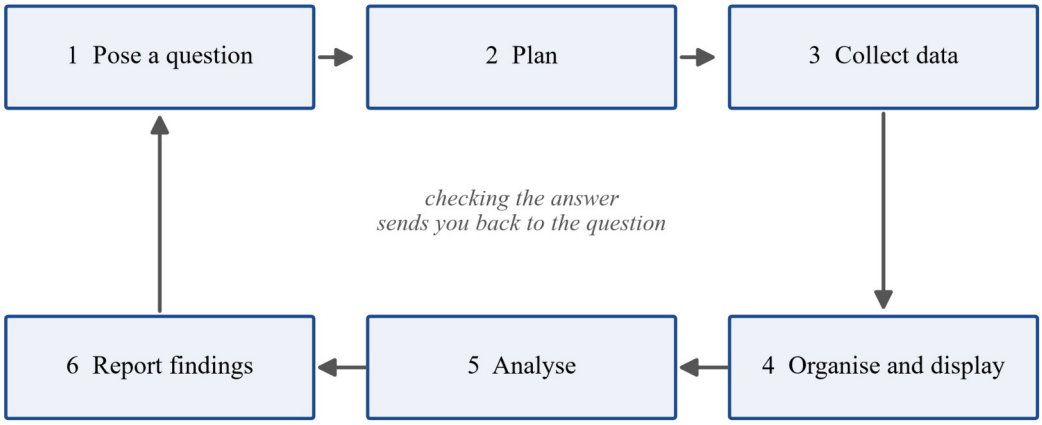


Figure 1. The six stages of a statistical investigation arranged in a loop: pose a question, plan, collect data, organise and display, analyse, report findings, with an arrow from the last stage back to the first.

Your variable must be **numerical**: either **discrete** (counted, whole-number values) or **continuous** (measured, any value within a range) — see 6A. You can obtain your data by either route in Figure 2:

- **Primary source** — you collect the data yourself: a class survey, your own measurements, your own experiment. Measuring reaction times with the ruler-drop test of 6C, or timing a design you have improved, are both primary routes.
- **Secondary source** — someone else collected the data and you obtain them: from the Australian Bureau of Statistics, the Bureau of Meteorology, a newspaper or the internet.

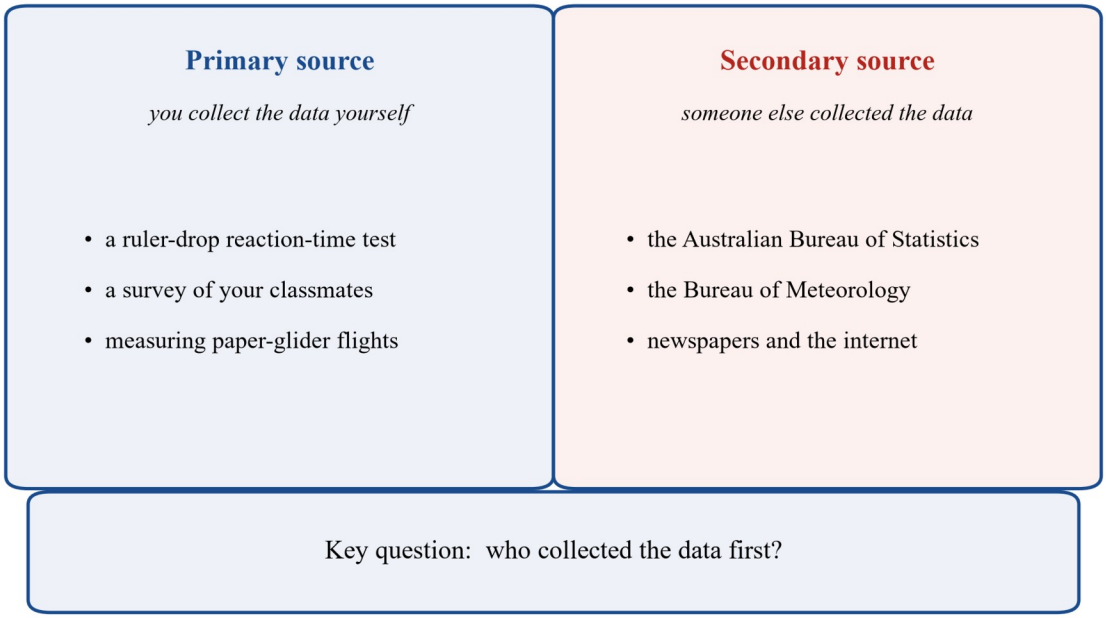


Figure 2. Two panels. Primary source — you collect the data yourself: a ruler-drop reaction-time test, a survey of your classmates, measuring paper-glider flights. Secondary source — someone else collected the data: the Australian Bureau of Statistics, the Bureau of Meteorology, newspapers and the internet. A strip below asks the key question: who collected the data first?

This task is worth 20 marks, in four parts of 5 marks each. It runs over about two lessons plus homework, and nothing in it is timed: lesson 1 for Parts A and B and for starting your collection, the time between lessons to finish collecting (as homework if you need it), and lesson 2 for Parts C and D. Your data source must be **named and dated** — a finding is only as trustworthy as its source (6C).

Equipment and rules. You will need the spaces in Parts A to D (they are your record sheets), a pencil and a ruler. A scientific calculator is permitted. Spreadsheet or graphing software is permitted for building your display, where it suits your data (6B). No other software or calculator may be used.

How I1 will be marked

Shown to students before the task begins.

I1 is marked with a **rubric** — a marking guide that describes what you must do to earn each mark. It has four **criteria** (parts that are marked separately), 5 marks each. Your teacher scores only what they can see you do or hear you say.

1. **Formulating** the problem or question — Part A (5 marks). To *formulate* a question is to frame it clearly, so it is ready to be answered with data.
2. **Choosing** a representation and a calculation strategy, with the choice justified — Part B (5 marks). Your *representation* is how you will show the data (your display) and how you will summarise it (your summary numbers); your *strategy* is your planned way of doing the calculations. To *justify* a choice is to give a reason for it.
3. **Executing** the mathematics accurately — Part C (5 marks). To *execute* the mathematics is to carry it out.
4. **Interpreting and communicating** the solution in terms of the situation — Part D (5 marks).

Part D is where the marks are most often won and most often lost, so its descriptors are written out in full here:

- **D a.** You answer the question you posed in Part A, in one or two sentences, about the people or things you actually investigated.
- **D b.** You describe the shape of the distribution using the shape words of 6B — *symmetric*, *positive skew*, *negative skew*, *bi-modal* — and features such as clusters and gaps.
- **D c.** You use at least two of your summary numbers (median, mean, mode, range) as reasons for what you report.

- **D d.** You say which measure of centre was the most useful one to report, and why — the decision of 6A, checked against your own data.
- **D e.** Your report carries your completed source line: the name of the source of your data and the date.

Words you need

Every word here was introduced in Chapter 6. This is a quick look-back, plus the few new words this task uses.

- A **statistical question** is answered with data that vary from one person or thing to the next (6C).
- A **variable** is the thing that is counted or measured (6C). A **discrete** variable is counted, with whole-number values; a **continuous** variable is measured and can take any value within a range (6A).
- A **primary source** is one where you collect the data yourself; a **secondary source** is one where someone else collected the data and you obtain them (6C).
- An **observation** is one recorded value — one measurement or one count.
- A **source line** is one sentence that says where the data came from and when.
- A **display** shows the whole data set at once: at Level 7, a dot plot or a stem-and-leaf plot (6B). A stem-and-leaf plot has a **key** that tells how to read each stem and leaf back into a value.
- The **distribution** is the overall picture the display shows. The shape words are **symmetric**, **positive skew**, **negative skew** and **bi-modal**; a **cluster** is a group of values close together, a **gap** is a stretch of the axis with no values, and an **outlier** is a value far away from the rest of the data (6B, 6A).
- The summary numbers are the **range** (spread) and the measures of centre: the **median**, the **mean** and the **mode** (6A).
- A **strategy** is a planned way of carrying out a calculation. A **criterion** is one part of a task that is marked separately. A **rubric** is a marking guide written as things you can be seen doing.

How to run I1

Teacher-facing. I1 is a classroom task, not an exam.

- **When** — after subtopics 6A, 6B and 6C of Chapter 6 have been taught.
- **Format** — each student frames their own question and runs their own investigation, by a primary or a secondary route. Students may collect data in pairs or small groups, but the plan, the display, the calculations and the report are each student's own. Score what you see and hear as you move between students, and check each student's sheets at the end of lesson 2. The variable must be numerical (discrete or continuous) — a categorical question such as "favourite sport" does not fit `VC2M7ST03` and needs redirecting in lesson 1.
- **Timing** — nothing is timed; there is no time limit on the students. The guidance here is for your planning, per the assessment plan (§7): about two lessons plus homework — lesson 1 for Parts A and B and the start of collection, the gap between lessons for finishing collection (homework where needed), lesson 2 for Parts C and D.
- **Equipment** — the list below.
- **Calculator and software** — a scientific calculator is permitted. Spreadsheet or graphing software is permitted for building displays, where appropriate — `VC2M7ST02` names software where appropriate, and it supports this task (D9). `VC2M7ST03` itself does not make any tool compulsory, so a fully hand-drawn and hand-calculated investigation is a complete investigation. No CAS.
- **Marking** — use the marking guide at the end of this file.
- **If a student is absent** — `VC2M7ST03` is assessed only by this task; Test T6 carries no 6C items (D10), so no written paper can stand in. Run the task again at a makeup session.

Equipment

Teacher. One set per student, or per pair/group where noted.

Everyone

- a printed copy of this task — the spaces in Parts A to D are the students' record sheets
- pencils, rulers, and a scientific calculator (permitted)

Primary-route groups

- 30 cm rulers for ruler-drop reaction-time tests, as in 6C
- tape measures and stopwatches for measurement investigations
- materials for a simple design test where a student is testing whether a modification has improved performance (for example, paper gliders), as in `VC2M7ST03.E04`

Secondary-route students

- a device with access to the Australian Bureau of Statistics or the Bureau of Meteorology, or a teacher-prepared printed copy of a published table with its source line already written (section-6 format)

Both routes

- access to spreadsheet or graphing software for building displays (permitted where appropriate; students may also draw displays by hand)
- grid paper for hand-drawn displays and rough work

Safety

Controls at the point of use. Read these to the class before the task starts.

For students:

- **Measuring people.** Ask before you measure anyone, and measure everyone the same way. Anyone may say no — thank them and move on. Record values, not names.
- **Moving around the school.** Walk, stay in the areas your teacher has agreed to, and keep doorways and walkways clear while you measure.
- **Outdoors.** Hat on and sunscreen on before you go out — the sun can be strong even on cloudy days. Drink water, and stay off roads and out of car parks.
- **Rulers and equipment.** Carry rulers and tape measures pointing down, and never throw or swing them. In a ruler-drop test, drop over clear floor and keep feet clear of the falling ruler.
- **Spills and hands.** Wipe up any water or spills straight away, and wash your hands after collecting data outdoors.

For the teacher:

- Approve each student's collection place and method before lesson 1 ends, and keep all collection inside the school grounds.
- Check outdoor sites before use — glass, holes, and traffic at edges.
- Keep the school's first-aid kit with you, and know the school's sun protection policy.
- For internet use, students obtain data from known published sources only — the Australian Bureau of Statistics, the Bureau of Meteorology, or a source you have approved.

Part A — Formulating the question (5 marks)

a. Write your statistical question. (1 mark)

Your question must need data, the values must vary, and it must name **who or what** is studied and **what will be counted or measured**. The variable must be numerical — discrete or continuous.

My question: ……..

……..

b. Name your variable and its unit, and say which kind it is. (1 mark)

My variable is ……, measured in …… .

Circle one: discrete · continuous

c. Say where your data will come from. (1 mark)

Circle one: primary source · secondary source

The data will come from …… .

d. Write your source line, with the date. (1 mark)

A **source line** names the source of the data and the date. For a secondary source, name the publication and the date you retrieved it, in this form:

Source: Australian Bureau of Statistics, "National, state and territory population", December 2025; retrieved 20 August 2026.

For a primary source, name who will collect the data, where, and when:

Data collected by …, at … school, on 3 September 2026.

My source line:

……..

e. Plan your observations, and keep the collection fair. (1 mark)

An **observation** is one recorded value. Plan at least 12 observations — more data usually give a clearer picture (6C).

I will collect …….. observations.

I will collect them this way:

……..

One thing I will do to keep the collection fair (for example, the same method and the same tool for everyone, or asking permission before measuring people):

……..

Part B — Choosing the display and the calculations (5 marks)

a. Choose your display. Circle one. (1 mark)

dot plot · stem-and-leaf plot

(If you are comparing two groups, a back-to-back stem-and-leaf plot, or two dot plots side by side, also fits — see 6B.)

b. Give one reason why that display suits your question and your variable. (1 mark)

……..

c. Choose your summary numbers. (1 mark)

Choose at least one measure of centre — median, mean or mode — and the range.

I will calculate: ……

d. Decide which centre you expect to be the most useful, and how you will decide. (1 mark)

Use the guide of 6A: if you expect an outlier or a skew, the median usually tells the truer "typical" value; if the values sit evenly, the mean uses every value; if the question is about what is most common, the mode answers it.

I expect the …….. to be the most useful centre, because

……..

e. Write your calculation strategy. (1 mark)

Write the steps you will follow to find the median and the mean — for example: order the values from smallest to largest; find the middle value (or the mean of the two middle values); add all the values and divide by how many there are. Say whether you will work by hand, with a scientific calculator, or with software.

……..

……..

Part C — Executing the mathematics (5 marks)

a. Collect your data, and record every observation as it comes in. (1 mark)

Record each value in a table straight away — data written on scraps of paper get lost or mixed up (6C). If your route is secondary, obtain the values from the source you named in Part A c and copy them into your table.

The observations I planned: …….. The observations I recorded: ……..

b. Build your chosen display. (1 mark)

Give it a title that says what was investigated and who — or where. Show every value: one dot per value on a dot plot, or every leaf with a key on a stem-and-leaf plot. You may build it by hand or with software (6B).

c. Order your values, and find the median. (1 mark)

Ordered values:

……..

Median: …….. Working:

……..

d. Find the mean and the range. (1 mark)

mean = sum of the values ÷ number of values

range = largest value − smallest value

Mean: …….. Working:

……..

Range: …….. Working:

……..

e. State the mode, and say whether there is an outlier. (1 mark)

Mode: …….. (If no value repeats, write "no mode".)

Is there an outlier? …….. A value far away from the rest of the data is an outlier (6A). Give your reason:

……..

Part D — Interpreting and communicating your findings (5 marks)

The descriptors below are the ones you were shown before the task.

a. Answer your question. (1 mark)

Write one or two sentences that answer the question you posed in Part A, about the people or things you actually investigated.

……..

……..

b. Describe the shape of the distribution. (1 mark)

Use the shape words of 6B — symmetric, positive skew, negative skew, bi-modal — and features such as clusters, gaps and outliers.

……..

……..

c. Use your summary numbers as reasons. (1 mark)

Use at least two of your summary numbers (median, mean, mode, range) in your report. Useful starters from 6C:

- "The distribution of … was …, with a cluster around …"
- "The median was …, so a typical … was about …"
- "The range was …, which shows the data …"

d. Say which centre was the most useful, and why. (1 mark)

Check the decision you planned in Part B d against the data you actually got. For example: "The outlier pulled the mean up to …, so the median of … is the truer typical value," or "The mean and the median were close, so the mean was a good summary because it uses every value" (6A).

……..

……..

e. Put your source line in your report. (1 mark)

Copy your completed source line from Part A d, with the date filled in.

……..

Total for this task: □ out of 20 marks

Marking guide

Teacher-facing. Score only what you can see the student do, or hear the student say. Investigations will differ — mark the action against the student's own question and data, not against any particular topic. A spoken answer counts the same as a written one. If you have to tell a student what to do before an action, do not give the mark for that action — record the prompt instead, so you know what to teach next.

Task I1 carries 20 marks in the four criteria of the assessment plan (§7), 5 marks each: **formulating the problem or question · choosing a representation and calculation strategy, with the choice justified · executing the mathematics accurately · interpreting and communicating the solution in terms of the situation**. It assesses `VC2M7ST03`, supported by `VC2M7ST01` (6A) and `VC2M7ST02` (6B). The fourth criterion's descriptors were shown to students in full before the task, as §7 requires. The Level 8 step of reviewing the appropriateness of the model is not assessed (§7; D4), and no population or sample language is to be drawn out of students (D4.15).

The rubric below is written against the achievement-standard extract carried on `VC2M7ST03` in the authority file (`maths_7.json`), quoted verbatim, so a teacher's judgement maps to the VCAA wording without translation.

> *Students plan and conduct statistical investigations involving discrete and continuous numerical data, using appropriate displays.* — VC2M7ST03, achievement-standard extract

Criterion A — Formulating the problem or question — 5 marks

Mark	What you can see the student do	Accept
a (1)	Writes a statistical question that names who or what is studied and what will be counted or measured.	"What are the reaction times of students in Year 7, measured with a ruler-drop test?" and "What were the daily maximum temperatures in Melbourne last month?" both qualify (numerical variables that vary). A question with one fixed answer, a question with no named group, or a categorical question ("What is our class's favourite sport?") does not — redirect before collection.
b (1)	Names the variable and its unit, and circles the correct kind for their own plan.	Counted values → discrete; measured values → continuous (6A). Mark against the student's own plan.
c (1)	Chooses primary or secondary, and names where the data will come from.	Own survey, measurements or experiment → primary; ABS, Bureau of Meteorology, a newspaper or a named internet publication → secondary (VC2M7ST03.E01). The route must actually be able to answer the question.
d (1)	Writes a source line that names the source and carries the date, in the section-6 format.	Secondary: publication name, its date, and the retrieval date. Primary: who collects, where, and the date of collection. The date may still be blank at the planning stage; the mark stands once the completed line appears in Part D e.
e (1)	Plans at least 12 observations and states one control that keeps the collection fair.	"Fifteen classmates, each measured once, same ruler, same drop height"; "Thirty days of Bureau of Meteorology rainfall, one station,

Mark	What you can see the student do	Accept
		one period." Fewer than 12 is acceptable only where the named secondary source genuinely holds fewer (for example, eight states and territories) and the student has noticed and said so.

Criterion B — Choosing a representation and calculation strategy, with the choice justified — 5 marks

Mark	What you can see the student do	Accept
a (1)	Chooses a display from the Level 7 set: a dot plot or a stem-and-leaf plot (back-to-back, or two side-by-side displays, where two groups are compared).	The display must suit numerical data (VC2M7ST02).
b (1)	Gives one reason tying the display to the question or the variable.	"A stem-and-leaf plot keeps every value and lists them in order, so I can find the median." "A dot plot shows the shape and any outlier for my 20 values." A reason that only restates a preference ("because I like dot plots") does not.
c (1)	States the summary numbers: at least one measure of centre (median, mean or mode) and the range.	Choosing all four is fine; fewer than one centre plus the range is incomplete.
d (1)	Names the centre they expect to be most useful, with the decision rule from 6A.	Accept "if there is an outlier or a skew I will trust the median", "symmetric data — the mean, because it uses every value", "the question asks what is most common — the mode", or "I will compare the mean and the median and report whichever sits with most of the data" (VC2M7ST01).
e (1)	Writes the steps of their calculation strategy for the median and the mean, and names how they will work — by hand, scientific calculator or software.	Steps complete enough to follow: order the values; take the middle value (or the mean of the two middle values); add the values and divide by how many there are.

Criterion C — Executing the mathematics accurately — 5 marks

Mark	What you can see the student do	Accept
a (1)	Collects (or obtains, for a secondary route) the planned number of observations and records each value in a table as it comes in.	Values appear during collection, not reconstructed afterwards. Secondary students copy the values from the source named in Part A c. A shortfall that the student notices and tops up still earns the mark.
b (1)	Builds the display chosen in Part B, correctly.	A title saying what was investigated and who — or where; a labelled number scale; every value shown (the dot count equals the number of

Mark	What you can see the student do	Accept
		observations; every leaf present, ordered, with a key). Hand-drawn or software-built both count (VC2M7ST02).
c (1)	Orders the values and finds the median correctly.	Check against the student's own ordered list; for an even count, the mean of the two middle values (6A).
d (1)	Finds the mean and the range correctly.	Mean: sum of the values ÷ number of values — accept rounding to one decimal place, or to the precision of the data. Range: largest value − smallest value (6A).
e (1)	States the mode correctly, and says whether there is an outlier, with a reason.	Accept "no value repeats, so no mode", and "no value sits far from the rest, so no outlier", when true. The outlier judgement must fit the working definition of 6A — a value far enough from the rest to check before trusting it.

Criterion D — Interpreting and communicating the solution in terms of the situation — 5 marks

Descriptors shown to students in full before the task (§7).

Mark	What you can see the student do	Accept
a (1)	Answers the question posed in Part A, in one or two sentences, about the people or things actually investigated.	The answer matches the student's own question and stays inside its scope (VC2M7ST03 — report findings in terms of the situation).
b (1)	Describes the shape of the distribution using the Level 7 shape words.	At least one of symmetric, positive skew, negative skew, bi-modal, used correctly, and/or a correct use of cluster, gap or outlier (VC2M7ST02.E03).
c (1)	Uses at least two summary numbers as reasons in the report.	"The median was 6 cm and the range was 4 cm, so …" The numbers must be the student's own, from Part C.
d (1)	States which measure of centre was the most useful, and why, checking the plan of Part B d against the data.	"The value 46 pulled the mean up, so the median tells the typical value better" (VC2M7ST01.E02); accept also "the mean and the median were close, so the mean was a good summary because it uses every value" — the decision is the mark, either way.
e (1)	The report carries the completed source line, with the name and the date.	The line planned in Part A d, now complete (section 6; §7).

How the marks map to the curriculum

Curriculum words	Marks
Plan and conduct statistical investigations; primary and	A c, A d, A e, C a

Curriculum words	Marks
secondary sources (VC2M7ST03; VC2M7ST03.E01)	
Issues involving discrete and continuous numerical data (VC2M7ST03)	A a, A b
Choose a representation and justify the choice (VC2M7ST03; VC2M7ST02)	B a, B b
Choose a calculation strategy — summary statistics and which centre is informative (VC2M7ST03; VC2M7ST01)	B c, B d, B e
Execute the mathematics accurately — display, median, mean, range, mode, outlier (VC2M7ST01; VC2M7ST02)	C b, C c, C d, C e
Analyse and interpret distributions of data — shape, centre and spread (VC2M7ST03; VC2M7ST02.E02, VC2M7ST02.E03)	D b, D c
Report findings in terms of shape and summary statistics, in context (VC2M7ST03)	D a, D c, D d
The data source named and dated (§6; §7)	A d, D e

Teacher recording sheet

Part	Criterion	Marks	Action notes
A	Formulating the problem or question	/5	
B	Choosing a representation and calculation strategy, with the choice justified	/5	
C	Executing the mathematics accurately	/5	
D	Interpreting and communicating the solution in terms of the situation	/5	
		/20	

What the marks say

The marks use the words VCAA carries on VC2M7ST03: *plan and conduct … analyse and interpret distributions of data and report findings in terms of shape and summary statistics*. A student who scores across all four criteria has run the whole investigation cycle of 6C on a question of their own framing — and has done the two things a timed written item cannot show: conducting the investigation and communicating its findings in context. A mark not scored here is a gap to teach next; VC2M7ST03 is assessed only by this task (no T6 items; D10), so an absent student completes it at a makeup session.

Record the total: □ out of 20

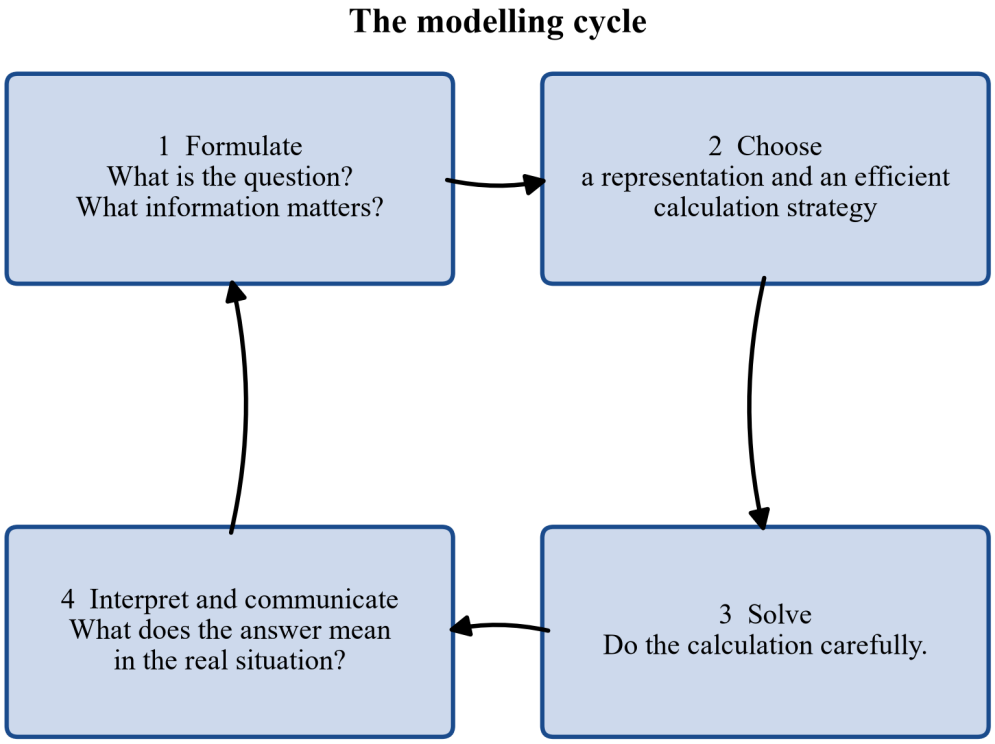
Task

Task I2 — A best-buy decision and a ratio mixture for the school market day · Applied modelling task · 20 marks · Chapter 2 (2G, supported by 2E and 2F) and Chapter 4 (4F, supported by 2F)

Codes: VC2M7N10 (2G; draws on .E02, .E03) and VC2M7M06 (4F; draws on .E01, .E02) · supported by VC2M7N07 (2E) and VC2M7N09 (2F)

> *use mathematical modelling to solve practical problems involving rational numbers and percentages, including financial contexts such as 'best buys'; formulate problems, choosing representations and efficient calculation strategies, designing algorithms and using digital tools as appropriate; interpret and communicate solutions in terms of the situation, justifying choices made about the representation* — VC2M7N10
>
> *use mathematical modelling to solve practical problems involving ratios of lengths, areas and volumes; formulate problems, interpret and communicate solutions in terms of the situation, justifying choices made about the representation* — VC2M7M06

Task I2 is a modelling task. It is not a test. Your class is planning a drink stall for the school market day, and two decisions need maths before the day: how much of each ingredient to mix, and what to buy and what it will cost. You run the four-step modelling cycle you know from 2G and 4F: step 1 formulate, step 2 choose a representation and a calculation strategy, step 3 solve, step 4 interpret and communicate. Parts A to D of this sheet follow those four steps, in that order.



In step 4, also justify why the representation was a good choice.

The modelling cycle: step 1 formulate, step 2 choose a representation and a strategy, step 3 solve, step 4 interpret and communicate, with arrows joining the steps in a loop and a note that step 4 also justifies the choice of representation.

This task is worth 20 marks. Each of Parts A to D is worth 5 marks. The task runs over about two lessons plus homework: the situation, Part A and Part B in lesson 1, Part C and Part D in lesson 2. Nothing here is timed. The marks for Part D are shown to you in full before you start — read the box before Part D before you begin the task.

You will need: the recording sheets in Parts A to D, a pencil and a ruler. The practical ratio check in lesson 1 uses the equipment listed below. A scientific calculator or a device with spreadsheet software may be used anywhere in this task, but neither is needed — every number in this task works cleanly by hand.

How to run I2

Teacher-facing. I2 is a classroom check, not an exam.

- **When** — after subtopics 2E, 2F and 2G (Chapter 2) and subtopic 4F (Chapter 4) have been taught.
- **Format** — each student works their own Parts A to D. Students may talk the plan through with a partner, but the writing, the maths and the note to the stall team are each student's own. Score what you see and hear as you move between students, and check each student's sheet at the end of lesson 2.
- **Timing** — nothing is timed; there is no time limit on the students. The guidance here is for your planning: about two lessons plus homework, with lesson 1 for the situation, Part A, Part B and the practical ratio check, and lesson 2 for Part C and Part D. The note in Part D e may be finished as homework.
- **Equipment** — the list below. The practical ratio check supports the representation chosen in Part B and is not marked.
- **Calculator and digital tools** — permitted, not required. `VC2M7N10` permits digital tools where appropriate, so a scientific calculator or a spreadsheet may be used for the divisions in Part C; `VC2M7M06` names no tools, and every number in this task works cleanly by hand. No CAS anywhere in this book (D9).
- **Marking** — use the marking guide at the end of this file. The Part D descriptors are shown to students in full before the task, as §7 requires.
- **If a student is absent** — `VC2M7N10` and `VC2M7M06` are also assessed in written form in Tests T2 and T4, 5 marks each (D8), so no student is left with an unassessed CD (§7).

Words you need

Every word here was introduced in 2E, 2F, 2G or 4F. This is a quick look-back.

- To **model** a situation is to choose maths to stand for it. **Modelling** is the whole job: turn the situation into maths, do the maths, then say the answer back in words about the situation (2G, 4F).
- To **formulate** is to say the situation as a maths question and pick out the information that matters (2G, 4F).
- A **representation** is the picture or table chosen to show the problem: a bar, a sketch, a table or a set of steps (2G, 4F).
- A **ratio** compares parts with each other, written like 1:4. The **part–part** view reads the parts against each other; the **part–whole** view reads one part as a fraction of the whole (2F, 4F).
- A **unit price** is the cost of one fixed amount — here, the cost per 100 mL. The **better buy** is the option with the lower unit price (2G).
- **Profit** is money taken minus money spent, when the result is positive. Writing the profit as a percentage of the money spent is one quantity as a percentage of another (2G, 2E).

Equipment

Teacher. One set per student, or per pair where noted.

Everyone

- a printed copy of this task — the sheets in Parts A to D are the students' recording sheets
- pencils and rulers; grid paper for drafting the bar (optional)

Practical ratio check (one set per pair, lesson 1)

- a 1 L measuring jug
- a second jug or a large beaker
- a small amount of water and one drop of food colouring
- paper towels

Optional

- scientific calculators
- devices with spreadsheet software

Safety

Controls at the point of use. Read these to the class before the task starts.

For students:

- **The practical check uses water and food colouring only.** Do not taste or drink anything mixed in this task. The stall's real drink is made on market day under the school's food rules.
- **Spills.** Wipe up spills straight away and tell your teacher — a wet floor is slippery.
- **Carrying.** Carry a jug with two hands, and fill it only to the line you need — water is heavy.
- **Colour.** Food colouring stains skin and clothes, so wash your hands after the practical.
- **Market day.** On the day, wash your hands before handling cups or drink, and follow the school's food rules and allergy plan. The stall stands outside: hat on, and sunscreen on, before setting up.

For the teacher:

- Before market day, check the syrup's ingredients label against the students' allergy plans, and keep the label to show.
- Keep paper towels and a wet-floor sign at hand during the practical check.
- The practical check is water and food colouring only — no tasting.

The situation

Your class is running a drink stall at the school market day to raise money. The stall sells a fruit drink, made by mixing fruit syrup with cold water.

Item	Value
Cups the stall expects to sell	120 cups, each holding 250 mL
The drink mix	fruit syrup and cold water, mixed at syrup:water = 1:4
Syrup, option A	750 mL bottle, $4.50
Syrup, option B	2 L bottle, $9.60
Water	from the tap, free
Cups for the stall	the class spends $11.20 on cups
Selling price	$1.00 per cup
Condition	bottles of syrup cannot be split

The two problems

Problem 1 — the mix (4F). How many litres of syrup and how many litres of water make up all the drink the stall needs?

Problem 2 — the buy (2G). Which bottle of syrup is the better buy, and how many bottles of that size should the class buy, and what do they cost? Then the money on the day: if every cup sells, find the money taken, the money spent and the profit, and write the profit as a percentage of the money spent.

Try it (not marked). In lesson 1, with a partner and the practical equipment: pour 100 mL of coloured water ("syrup") into the jug, then add 400 mL of plain water. The jug now holds 500 mL of "drink". Check the ratio 1:4 two ways: the coloured water is 1 part of the 5 parts in all, and 100 mL is $\frac{1}{5}$ of 500 mL. Do not drink it.

Part A — Formulating the problems (5 marks)

a. Problem 1, the mix. Write the question being asked, and list the information that matters. (1 mark)

……..

……..

b. Problem 2, the buy. Write the question being asked, and list the information that matters. (1 mark)

……..

……..

c. Write the link between the two problems, in one sentence. (1 mark)

……..

d. Write the total amount of drink the stall needs as a calculation, and give the answer in litres. (1 mark)

……..

e. List everything the class must find, with units. (1 mark)

……..

……..

Part B — Choosing a representation and a calculation strategy (5 marks)

a. Choose a representation for Problem 1 — a sketch, a bar or a table — and draw it. Label the parts and the whole. (1 mark)

b. Why does that representation fit Problem 1? Write one sentence. (1 mark)

……..

c. Circle the strategy you will use to compare the two bottles in Problem 2. (1 mark)

compare the prices as they are · compare the amounts in each bottle · compare the cost per 100 mL

d. Why does that strategy fit Problem 2? Write one sentence. (1 mark)

……..

e. Circle the calculation tool you will use for the divisions in this task, and write one reason for your choice. (1 mark)

mental · written · calculator · spreadsheet

Reason: ……..

Part C — Executing the mathematics (5 marks)

a. Split the drink the stall needs in the ratio syrup:water = 1:4. Show each step, and check the total. (1 mark)

b. Write the syrup as a fraction of the drink, and check it against your answer to part (a). (1 mark)

c. Find the cost per 100 mL of each bottle of syrup. Which size is the better buy? (1 mark)

d. How many bottles, and of which size, should the class buy to get the syrup the mix needs? What do they cost? (1 mark)

e. Money on the day: every cup sells for $1.00, and all 120 cups sell. Find the money taken, the money spent (syrup and cups), the profit, and the profit as a percentage of the money spent. (1 mark)

How Part D is marked — read this before you start

Every mark in Part D is won by what you write. Each mark below is earned when your writing does what it says.

Mark	What your writing must show
a (1)	The mixing answer said back in terms of the stall: how many litres of syrup and how many litres of water to mix, and why that is the amount the stall needs.
b (1)	A buying advice said back in terms of the stall: which bottle size, how many bottles, what they cost, and why that size — the better buy, and enough syrup for the mix.
c (1)	The profit percentage said back as dollars per $\$100$ spent — what it means for the class's money, not the bare number.
d (1)	At least two checks that tie a number back to the stall: for example, that the syrup and the water add to the drink the stall needs, and that the bottles bought hold the syrup the mix needs.
e (1)	A note of two or three sentences to the stall team that covers what to mix, what to buy, and the profit to expect if all 120 cups sell — in your own words.

Part D — Interpreting and communicating (5 marks)

a. State the mixing answer for the stall team, in terms of the stall. (1 mark)

……..

……..

b. State what the class should buy, and why, in terms of the stall. (1 mark)

……..

……..

c. Say what the profit percentage means for the class. (1 mark)

……..

d. Show that your answers make sense in the stall situation. Use at least two checks. (1 mark)

……..

……..

e. Write the note to the stall team: two or three sentences covering what to mix, what to buy, and the profit to expect if all 120 cups sell. (1 mark)

……..

……..

……..

Total for this task: □ out of 20 marks

Marking guide

Teacher-facing. Score only what you can see in the student's writing, or hear the student say. The data is fixed, so the mathematics has one right set of answers; mark the modelling actions around it. If you have to tell a student what to do before an action, do not give the mark for that action — record the prompt instead, so you know what to teach next. Calculators and spreadsheets are permitted, not required; a correct answer by hand counts the same as a correct answer with a tool.

Task I2 carries 20 marks in the four criteria of the assessment plan (§7), 5 marks each: **formulating the problem or question · choosing a representation and calculation strategy, with the choice justified · executing the mathematics accurately · interpreting and communicating the solution in terms of the situation**. It assesses VC2M7N10 (2G) and VC2M7M06 (4F), supported by VC2M7N07 (2E) and VC2M7N09 (2F). The Level 8 "review the appropriateness of the model" step is not assessed (§7, D4).

The rubrics below are written against the achievement-standard extract the authority file carries on both CDs, quoted verbatim, so a teacher's judgement maps to the VCAA wording without translation.

> *They use mathematical modelling to solve practical problems involving rational numbers, percentages and ratios in spatial, financial and other applied contexts, justifying choices of representation.* — shared achievement-standard extract on VC2M7N10 and VC2M7M06

Worked values used in the Accept columns: total drink $120 \times 250 = 30\,000$ mL $= 30$ L; the mix, $1 + 4 = 5$ parts with one part $30 \div 5 = 6$ L, so syrup 6 L and water 24 L; unit prices $\$0.60$ and $\$0.48$ per 100 mL; 3 bottles of 2 L at $\$28.80$; money taken $\$120.00$, money spent $\$40.00$, profit $\$80.00$, which is 200 % of the money spent.

Criterion A — Formulating the problem or question — 5 marks

Mark	What you can see the student do	Accept
a (1)	Writes the question Problem 1 asks, and lists the information that matters.	"How many litres of syrup and how many litres of water make the drink the stall needs?" Information: the ratio 1:4, and the drink total coming from 120 cups of 250 mL. A restatement that misses the ratio or the cups does not earn the mark.
b (1)	Writes the question Problem 2 asks, and lists the information that matters.	"Which bottle size is the better buy, and how many bottles are needed, and what do they cost?" Information: 750 mL at $\$4.50$; 2 L at $\$9.60$; bottles cannot be split; the syrup amount comes from Problem 1.
c (1)	Writes the link between the two problems in one sentence.	Any sentence that says Problem 2 waits on Problem 1: "you cannot know what to buy until you know how much syrup the mix needs."
d (1)	Writes the total drink as a calculation, and gives it in litres.	$120 \times 250 = 30\,000$ mL $= 30$ L. The L ↔ mL step is conversion maintained from VC2M6M01 (P1), not new content; accept it shown either way.
e (1)	Lists what the class must find, with units.	Accept a list covering at least five of: syrup (L), water (L), bottle size, number of bottles, cost of the syrup ($), money taken ($), profit ($), profit (%) — each with its unit.

Criterion B — Choosing a representation and calculation strategy, with the choice justified — 5 marks

Mark	What you can see the student do	Accept
a (1)	Chooses a representation for Problem 1 and draws it: a bar (or table) for the whole drink, split into parts matching syrup:water = 1:4, with the parts and the whole labelled.	The bar shows 5 equal parts — 1 part syrup, 4 parts water — and labels the whole (30 L, or "all the drink"). Parts drawn roughly equal are accepted; the labels carry the mark.
b (1)	Gives one reason the representation fits Problem 1.	"The bar shows the 1 part of syrup and the 4 parts of water inside the whole drink, so one division finds one part." A reason that does not name the parts or the whole ("it is easy") does not earn the mark.
c (1)	Circles the strategy for comparing the bottles: compare the cost per 100 mL.	Comparing the prices as they are, or the amounts only, does not earn the mark — the sizes differ, so the prices are not yet comparable (2G).
d (1)	Gives one reason the strategy fits Problem 2.	"Cost per 100 mL puts both bottles on the same amount, so the comparison is fair."
e (1)	Chooses the calculation tool (mental, written, calculator or spreadsheet) for the divisions, and gives a reason that fits the choice.	"Written — the divisions are by small numbers." "Calculator — $4.50 \div 7.5$ is quicker on the tool." "Spreadsheet — it can hold the prices and the totals together." VC2M7N10 permits digital tools where appropriate (D9); any tool with a fitting reason earns the mark.

Criterion C — Executing the mathematics accurately — 5 marks

Mark	What you can see the student do	Accept
a (1)	Splits 30 L in the ratio 1:4, and checks the total.	$1 + 4 = 5$ parts; one part $= 30 \div 5 = 6$ L; syrup $= 1 \times 6 = 6$ L; water $= 4 \times 6 = 24$ L; check $6 + 24 = 30$ L. The check is part of the mark — the answer without the check does not earn it (2F, 4F).
b (1)	Writes the syrup as a fraction of the drink, and checks it against the 30 L.	Syrup is 1 of the 5 parts: $\frac{1}{5}$ of the drink; check: $\frac{1}{5}$ of 30 L $= 6$ L, matching part (a). (VC2M7M06.E01, VC2M7N09.E04.)
c (1)	Writes both sizes in mL, finds each cost per 100 mL, and names the better buy.	2 L $= 2000$ mL. Small bottle: $4.50 \div 7.5 = \$0.60$ per 100 mL. Large bottle: $9.60 \div 20 = \$0.48$ per 100 mL. The 2 L bottle is the better buy. Both unit prices and the choice carry the mark.

Mark	What you can see the student do	Accept
d (1)	Finds the number of bottles of the better-buy size, and their total cost.	The mix needs 6 L of syrup; $6 \div 2 = 3$ bottles; $3 \times 9.60 = \$28.80$. Follow-through: a student whose part (c) chose the 750 mL bottle, and who carries that choice consistently ($6000 \div 750 = 8$ bottles, $8 \times 4.50 = \$36.00$), earns this mark; the error stays marked in part (c).
e (1)	Works out the market-day money: taken, spent, profit, and the profit as a percentage of the money spent.	Taken: $120 \times 1.00 = \$120.00$. Spent: $28.80 + 11.20 = \$40.00$. Profit: $120 - 40 = \$80.00$. Percentage: $80 \div 40 = 2 = 200\%$ of the money spent. All four, with the percentage, carry the mark. (`VC2M7N10.E03`, `VC2M7N07.E01`.) Follow-through: with the 750 mL plan, taken $\$120.00$, spent $36.00 + 11.20 = \$47.20$, profit $120 - 47.20 = \$72.80$, and $72.80 \div 47.20 \approx 154\%$ earns the mark when the method is right.

Criterion D — Interpreting and communicating the solution in terms of the situation — 5 marks

The five rows below mirror the student-facing box before Part D word for word, as §7 requires.

Mark	What your writing must show	Accept
a (1)	The mixing answer said back in terms of the stall: how many litres of syrup and how many litres of water to mix, and why that is the amount the stall needs.	"Mix 6 L of syrup with 24 L of water — that makes the 30 L of drink the stall needs for its 120 cups." Units and the stall both named; a bare "6 and 24" does not earn the mark.
b (1)	A buying advice said back in terms of the stall: which bottle size, how many bottles, what they cost, and why that size — the better buy, and enough syrup for the mix.	"Buy three 2 L bottles of syrup for $28.80 — that size is the better buy, and three bottles hold exactly the 6 L the mix needs." The reason must name both the lower unit price and having enough syrup.
c (1)	The profit percentage said back as dollars per $\$100$ spent — what it means for the class's money, not the bare number.	"For every $100 the class spends on the stall, it makes $200 in profit." Accept the reading with or without the condition "if all 120 cups sell"; the bare "200%" does not earn the mark.
d (1)	At least two checks that tie a number back to the stall: for example, that the syrup and the water add to the drink the stall needs, and that the bottles bought hold the syrup the mix needs.	"6 L + 24 L = 30 L, the drink the stall needs"; "3 bottles × 2 L = 6 L, the syrup the mix needs"; "$28.80 + $11.20 = $40.00, all the money spent." Two such checks, said in terms of the stall, earn the mark.
e (1)	A note of two or three sentences to	The note names the 6 L of syrup and

Mark	What your writing must show	Accept
	the stall team that covers what to mix, what to buy, and the profit to expect if all 120 cups sell — in your own words.	24 L of water, the three 2 L bottles at $28.80, and the $80.00 profit if all 120 cups sell. All three, in the student's own words, earn the mark.

How the marks map to the curriculum

Curriculum words	Marks
Formulating problems (VC2M7N10, VC2M7M06)	A a, A b
The link between the two problems, and the unknowns with their units (VC2M7N10)	A c, A e
Turning the situation into numbers — cups × size, with L ↔ mL conversion maintained from VC2M6M01 (P1)	A d
Choosing a representation — a bar of parts for a ratio (VC2M7M06.E01; VC2M7N09.E01, VC2M7N09.E02)	B a
Choosing efficient calculation strategies — unit price for a best buy; choosing a tool where digital tools are appropriate (VC2M7N10)	B c, B e
Justifying choices made about the representation (VC2M7N10, VC2M7M06)	B b, B d
Sharing a total in a given ratio — part–part and part–whole (VC2M7M06, VC2M7M06.E01, VC2M7M06.E02; VC2M7N09.E04)	C a, C b
Best buys by unit price, in a financial context (VC2M7N10)	C c, C d
A proportion of the stall's sales, and profit as a percentage of the money spent — one quantity as a percentage of another (VC2M7N10.E02, VC2M7N10.E03; VC2M7N07.E01)	C e
Interpreting and communicating solutions in terms of the situation (VC2M7N10, VC2M7M06)	D a, D b, D c, D e
The answers make sense in the situation (VC2M7N10, VC2M7M06)	D d

Teacher recording sheet

Part	Criterion	Marks	Action notes
A	Formulating the problem or question	/5	
B	Choosing a representation and calculation strategy, with the choice justified	/5	
C	Executing the mathematics accurately	/5	
D	Interpreting and communicating the solution in terms of the situation	/5	
		/20	

What the marks say

The marks use the words VCAA carries on VC2M7N10 and VC2M7M06: *formulate problems, choosing representations and efficient calculation strategies … interpret and communicate solutions in terms of the situation, justifying choices made about the representation*. A student who scores across all four criteria has run the whole modelling cycle on two linked, practical problems — and has done the two things a timed written item cannot show: justifying the choice of representation, and communicating a decision the class can act on: what to mix, what to buy, and what to expect. A mark not scored here is a gap to teach next; both CDs are also assessed in written form in Tests T2 (2G) and T4 (4F), 5 marks each (D8).

Record the total: □ out of 20