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ICAS-STYLE PREPARATION SERIES

# Paper G. Form 3 / Secondary 2 Student Workbook

Original ICAS-style practice questions with full worked answers, written for students sitting ICAS Paper G. The test is taken by Form 3 (Malaysia) and Secondary 2 (Singapore) students.

- English · 28 Q
- Writing · 2 practice tasks
- Science · 10 Q
- Mathematics · 12 Q

STUDENT NAME _____

SCHOOL _____

DATE _____

TOTAL QUESTIONS

**50 original ICAS-style questions + 2 writing tasks**

ANSWERS

**Full worked explanations at back**

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BEFORE YOU BEGIN

# How to Use This Workbook

Every question in this workbook is an original ICAS-style practice question, carefully written to match the format, text types, difficulty, and question style of real ICAS Paper G assessments for Form 3 and Secondary 2 students.

⭐ **MOST IMPORTANT RULE: NEVER LEAVE A QUESTION BLANK**

ICAS awards one mark for each correct answer and does **not** deduct marks for wrong answers. Always answer every question, because even a guess has a chance of scoring.

## Your Test at a Glance: Paper G / Form 3

*The real ICAS Paper G is shown below, alongside the practice provided in this workbook. Sources: eats.com.my and eats.com.sg. Digital Technologies is not assessed at Paper G.*

| SUBJECT | REAL TEST | TIME | IN THIS WORKBOOK | FORMAT |
|---|---|---|---|---|
| 📖 English | 55 questions | 60 min | 28 practice questions | Passage-based MCQ |
| ✍️ Writing | 1 task | 35 min | 2 practice tasks | Extended Response |
| 🔬 Science | 40 questions | 60 min | 10 practice questions | MCQ with visuals |
| 📐 Mathematics | 40 questions | 60 min | 12 practice questions | MCQ · Calculator OK |

## The Three-Pass Strategy

> **WORK SMART UNDER TIME PRESSURE**
>
> In a timed paper you cannot afford to spend four minutes on a single question. Use three passes through the paper instead of one slow walk:
>
> - **Pass 1, Sweep.** Answer every question you can do inside 30 to 40 seconds. If a question needs more thought, mark it and move on. Aim to reach the last question before the halfway mark on the clock.
> - **Pass 2, Settle.** Go back to the marked questions. Now you have time to read carefully, extract from tables, and run the calculation. Two minutes per question is fine here.
> - **Pass 3, Check.** In the last few minutes, re-read any answer you were not sure about. On Paper G the most common mistake is a sign error or a unit slip, not a wrong concept. A 30-second re-read catches most of them.

## How to Get the Most From This Workbook

You do not need to do the sections in order, and you do not need to finish in one sitting. A good approach is to do one section at a time, mark your answers against the explanations at the back, and then return to any questions you got wrong after a day or two has passed.

At Paper G, the reasoning steps are bigger, the vocabulary is wider, and the questions often combine a table, a graph, and a short paragraph in a single stimulus. This workbook is built around those lifts, not just to let you practise more questions, but to practise the *right* kinds of questions.

# English

READING · WRITER'S CRAFT · VOCABULARY · SYNTAX

28 questions | ~32 min

At Paper G you will read a wider range of texts than at Paper F, including persuasive essays on abstract topics, classical literary fiction, popular-science writing with embedded graphs, and reflective descriptions, and you will be expected to read them with an eye for *craft*, not just content. Questions will ask you to analyse the effect of a writer's choices, not just identify what is there.

### WHAT'S HARDER AT PAPER G

- **Abstract subjects.** Expect arguments about ideas (attention, memory, the nature of beauty) rather than concrete scenarios. Don't look for a simple event; look for a claim.
- **Dense syntax.** Especially in classical literary extracts. Read complex sentences twice if needed. Track who is doing what.
- **Craft questions.** "Why did the writer choose this word / sentence / structure?" The answer is rarely "to describe the event"; it is almost always about *effect on the reader*.
- **NOT / LEAST / EXCEPT questions.** Three of the four options will be supported by the text. Your job is to find the one that is *not*. Read all four options before deciding.

TEXT 1 OF 5

# THE CASE AGAINST CONSTANT CONNECTION

AN OPINION ESSAY

Somewhere between our tenth ping of the morning and our hundredth scroll of the afternoon, something quietly went missing. It left no note. It simply stopped being there.

I am talking about the kind of attention that used to be ordinary. It was the patient, unhurried attention we gave to a book, a conversation, a walk, a thought. Not concentration in the dramatic sense, not the kind required to solve a puzzle or finish a project, but the lower, steadier kind: the willingness to stay with one thing for longer than a few minutes without reaching for something else.

Defenders of our connected age will point out, rightly, that we are reading more than any generation before us. We process a staggering volume of words every day. They will argue that complaining about screens is the latest in a long tradition of complaining about new media, from the novel to the television, and that such complaints have always turned out to be overblown.

There is merit in that objection. Technology panics usually exaggerate. Each generation does, it seems, survive its new machine.

But a reply is not always a refutation. The volume of reading has certainly risen; what has fallen is the *kind*. Reading a five-hundred-word article is not the same cognitive experience as reading the same five hundred words scattered across forty notifications, each interrupted by the next. We have, in effect, traded depth for breadth and then congratulated ourselves on how much we now consume.

The costs are easy to miss because they are costs of absence rather than of excess. A mind trained to skim cannot easily switch back into the mode required to read a difficult chapter or hold a complex argument together in memory. We do not notice the loss because the capacity fades gradually, the way an unused language does.

Worse, we are training ourselves to find sustained thought uncomfortable. Silence now feels like a problem to be solved rather than a condition to be inhabited. Wait three minutes in a queue without reaching for a phone; the discomfort is real and it is recent.

None of this is an argument for throwing our devices into the sea. The connected life has made possible things, such as access to information, to distant friends, and to work beyond our geography, that no serious person would surrender. But it is worth asking, occasionally, what the trade has cost us, and whether the bargain is still the one we would knowingly choose today.

The answers may not be comfortable. They are, however, worth three uninterrupted minutes.

1 WRITER'S CRAFT

What is the main effect of the opening metaphor ("It left no note. It simply stopped being there.")?

A It introduces the subject humorously to distract from its seriousness.

B It frames the loss as something personal and mysterious, drawing the reader in.

C It suggests the writer has suffered a recent bereavement.

D It shows that the writer is uncertain about the argument that follows.

2 TEXT COMPREHENSION

When the writer says "a reply is not always a refutation", the point is that

A a reasonable-sounding response may not actually disprove the original claim.

B the defenders of technology are dishonest in their arguments.

C no one can ever truly refute an argument about social change.

D the writer prefers to avoid direct confrontation with opponents.

3 VOCABULARY

Which word is closest in meaning to *refutation* as used in the text?

A apology

B confirmation

C disproof

D explanation

4 TEXT COMPREHENSION

According to the writer, the main counter-argument that "defenders of our connected age" offer is that

A people read more words now than any previous generation, so literacy has improved.

B devices have made friendship and work possible across great distances.

C silence has never been something most people enjoyed for long.

D the costs of technology are always exaggerated when it is still new.

5 WRITER'S CRAFT

What is the effect of the final sentence, "They are, however, worth three uninterrupted minutes"?

A It refers back to an earlier image in the essay and gently challenges the reader.

B It summarises the main argument in a direct, instructive way.

C It suggests the writer is running out of time to finish the essay.

D It provides a surprising scientific statistic as evidence.

6 TEXT COMPREHENSION

Which of the following is the writer **NOT** arguing?

A We should give up our devices entirely and return to an earlier way of life.

B The kind of reading we do has changed, not just the amount.

C The losses caused by constant connection are easy to overlook because they are gradual.

D Sustained attention is increasingly uncomfortable for many people.

TEXT 2 OF 5

# THE VISIT

FROM A NOVEL

It had been three years since Clara had last walked the gravel path to her aunt's house, and in those three years she had discovered that the world was larger, crueller, and more indifferent than she had supposed at seventeen. She had expected the path to feel shorter now that she was a woman, that the lilacs would appear less tall, that the oak at the turning would reveal itself as merely a tree. It was a lesson in the smallness of one's earlier measurements that she had anticipated with some eagerness.

Nothing had shrunk. The lilacs were as tall as she remembered; the oak, if anything, seemed to have grown; and the house at the end of the path stood precisely where she had left it, unchanged in every particular, as though it had been waiting with the patience of stone for her return.

Only the doorbell, when she pressed it, produced a different sound, thinner somehow, less resonant than the one that had accompanied her childhood summonings. She wondered whether her memory had grown more elaborate than the real, and, on the strength of the doorbell alone, began to suspect that the lilacs and the oak and the house might, too, be diminished in ways her eye was too kind to register.

Aunt Eleanor opened the door herself. This was unexpected; Clara had been prepared, in the particular manner of those who brace themselves against the absence they fear, to be admitted by a housekeeper and delivered into a darkened parlour where her aunt would be waiting with a shawl and a grievance. The actual Aunt Eleanor, framed in her own doorway, was brighter and smaller and more immediate than the one Clara had rehearsed.

'You have grown,' said her aunt, with the calm surveying air of one evaluating livestock. 'Your mother's letters had prepared me for something more ruinous.'

Clara, who had walked from the station in a state of tender self-consciousness, was first startled and then, with the suddenness that characterised her aunt's effect upon her, amused. This was the Aunt Eleanor she had forgotten to remember: not the difficult woman of family legend but the woman who had once, in the middle of a funeral, turned to Clara and remarked that the flowers were inexpertly arranged.

'I hope I am not ruinous,' said Clara.

'You are not. But come in; I have very little patience for conversation on a threshold. Conversations on thresholds are either too brief to matter or too long to forgive.'

> And she stood aside to admit her niece, and Clara, stepping across the worn stone that had waited three years for her foot, felt for the first time in a long while the odd relief of being known.

**7** TEXT COMPREHENSION

Before arriving, Clara had **expected** that the visit would confirm

- **A** that her childhood memories had exaggerated the scale of everything.
- **B** that her aunt would be pleased to see her after three years.
- **C** that the house would be in a poor state of repair.
- **D** that the journey from the station would take longer than she remembered.

**8** WRITER'S CRAFT

What is the main purpose of the second paragraph ("Nothing had shrunk…")?

- **A** to describe the plants and architecture around Clara's aunt's house
- **B** to overturn the expectation Clara had just set up and unsettle her sense of change
- **C** to suggest that Clara's aunt has been preserving the house deliberately
- **D** to introduce the setting so the reader can picture the story's location

**9** VOCABULARY

The word *ruinous*, as the aunt uses it, most nearly means

- **A** wealthy and successful
- **B** damaged or in a poor state
- **C** exceptionally tall
- **D** unfashionably dressed

**10** TEXT COMPREHENSION

What does Clara realise about her aunt during the encounter at the door?

- **A** Her aunt is more frail and more in need of company than Clara had imagined.
- **B** Her aunt is a more distant and formal figure than she had been in childhood.
- **C** The real aunt is sharper, warmer in her own strange way, and less fearsome than the aunt she had been expecting.
- **D** Her aunt has changed substantially in the three years since they last met.

**11** WRITER'S CRAFT

The simile "with the calm surveying air of one evaluating livestock" is used in order to

- **A** suggest that the aunt is cruel and dismissive of her niece.
- **B** convey the aunt's detached, practical mode of judgement in a way that is slightly comic.
- **C** establish that the aunt has spent her life working on a farm.
- **D** show that Clara is uncomfortable being inspected by her relatives.

**12** TEXT COMPREHENSION

Which of the following is **NOT** a theme of the passage?

- **A** the gap between remembered people and real people
- **B** the strange comfort of being seen as one is
- **C** the disappointments of travel to unfamiliar places
- **D** the persistence of places and things across the years

13 WRITER'S CRAFT

The phrase "the odd relief of being known" is effective mainly because

A it uses the adjective "odd" to make an expected emotion unexpectedly precise.

B it reveals that Clara has been lonely for a long time.

C it echoes the vocabulary the aunt uses in her dialogue.

D it signals that Clara has forgiven her aunt for past difficulties.

TEXT 3 OF 5

# THE SLEEPING MIND

A POPULAR-SCIENCE ARTICLE

Every night you close your eyes and, in the space of a few hours, become temporarily absent from the world. From the outside, sleep looks like nothing much: a pause, a switch turned off, a body at rest. For most of human history, this was the assumption. Sleep was time subtracted from life, a biological inconvenience that made eight hours a day unproductive.

The modern neuroscience of sleep has reversed this picture almost completely. Far from being a period of inactivity, sleep is now understood to be one of the brain's most important active states: the time during which memory is consolidated, unnecessary connections are pruned, and the experiences of the day are organised into long-term storage. A student who revises for seven hours and sleeps for seven is, in effect, learning in both halves of that twenty-four-hour cycle.

The evidence for this claim has accumulated over decades, but it is at its most striking in controlled studies of memory retention. When participants learn a task and are tested immediately, sleep-deprived and well-rested groups perform similarly. The divergence appears only at the second test, conducted the next day. Here, the well-rested group retains most of what it learned; the sleep-deprived group retains a diminished fraction. Something that happens during sleep, and that can be disrupted by depriving the sleeper, is evidently doing the work of transferring today's learning into tomorrow's knowledge.

The relationship between sleep duration and next-day memory retention is not, however, a simple straight line. Retention rises steeply as sleep increases from a few hours toward a full night, but the curve then flattens: sleeping substantially longer than the normal seven or eight hours produces little further improvement. In other words, the first hours of sleep do most of the consolidation work, and extra sleep after that adds diminishing amounts of benefit.

Researchers have also begun to map the stages of sleep at which different kinds of memory consolidation occur. Motor skills, such as how to ride a bicycle or how to play a scale, appear to be processed in the early hours of the night, when slow-wave sleep predominates. Factual and emotional memories, by contrast, seem to benefit from the later stages, rich in what neuroscientists call REM sleep. A night cut short at either end is therefore not simply a night made shorter; it is a night in which particular kinds of learning have been selectively impaired.

The policy implications are considerable. A schooling culture that rewards students for sleeping less is, it appears, rewarding them for learning less; or at least, for retaining less of what they have learned. The old folk advice to 'sleep on it' before an important test, long dismissed as

superstition, may turn out to have been among the most scientifically sound recommendations ever offered.

**14** TEXT COMPREHENSION

According to the text, the main function of sleep is now understood to be

- **A** allowing the body to rest and recover from daily activity.
- **B** actively consolidating memory and organising learning into long-term storage.
- **C** reducing the number of hours available for productive work.
- **D** restoring the body's immune system against illness.

**15** VOCABULARY

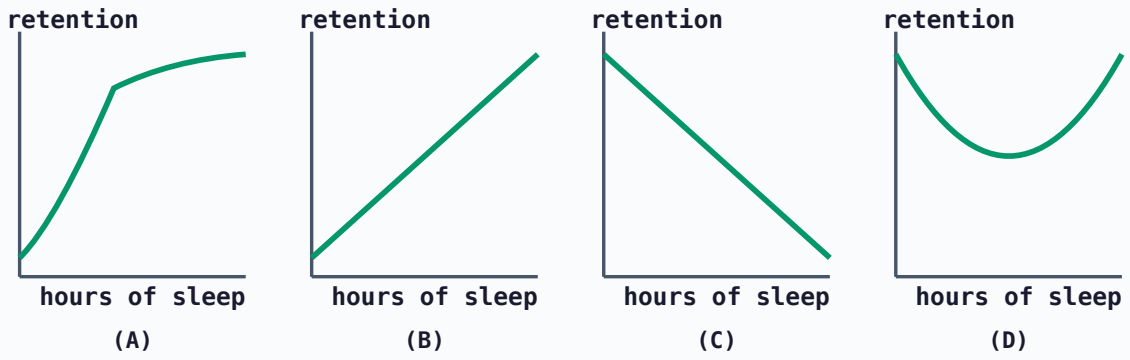
Which word is closest in meaning to *consolidated* as used in the text?

- **A** compressed
- **B** erased
- **C** examined
- **D** strengthened

**16** WRITER'S CRAFT · DIAGRAMMATIC

The fourth paragraph describes the relationship between hours of sleep and next-day memory retention. Which graph best represents this relationship?

CHOOSE THE BEST MATCH




- **A** Graph A
- **B** Graph B
- **C** Graph C
- **D** Graph D

**17** TEXT COMPREHENSION

According to the text, the difference between slow-wave sleep and REM sleep is that

- **A** slow-wave sleep processes motor skills, while REM sleep supports factual and emotional memory.
- **B** slow-wave sleep occurs in the later hours of the night, while REM sleep happens earlier.
- **C** slow-wave sleep is essential for memory, while REM sleep is not.
- **D** slow-wave sleep and REM sleep both contribute equally to all kinds of learning.

**18** WRITER'S CRAFT

Why does the writer mention the old folk advice to 'sleep on it' at the end of the article?

- **A** to give an example of the kind of superstition that science usually disproves
- **B** to show that ordinary people have long understood what scientists are only now confirming
- **C** to suggest that modern neuroscience has run out of new things to discover
- **D** to provide a test the reader can try for themselves tonight

**19** TEXT COMPREHENSION

The writer's view of schooling cultures that reward students for sleeping less is that such cultures

- **A** produce the most successful students in the long run.
- **B** may unintentionally reduce the amount students actually learn.
- **C** should be encouraged because they build resilience.
- **D** have no measurable effect on academic performance.

TEXT 4 OF 5

# THE LANGUAGE OF RUST

A REFLECTIVE ESSAY

In my garden there is an old iron gate that belonged to the house long before I did. It is the colour of autumn now: deep orange where the sun has reached it, darker browns in the hinges where the rain has worked longer. It does not, strictly speaking, work any more. The latch has fused itself shut in some slow chemical embrace that neither oil nor force has been able to separate.

I have thought, many times, about replacing it. A new gate would cost a modest sum and would open on its hinges the way a gate is supposed to. It would not weep red tears onto the pavement when it rains. A neighbour once offered me the name of a blacksmith who could strip the old one back to bare metal and begin it again, as though the gate had been born yesterday.

I have not done it.

The rust, I have come to understand, is not a failure of the iron but a record of its conversation with the world. Every drop of rain that has fallen here for eighty years has left a tiny, specific mark; every winter has rearranged the chemistry of the surface; every summer has baked it into a slightly different configuration of oxide and dust. What I am looking at, when I look at my gate, is not decay but biography. To strip it back would be to silence it.

There is a kind of beauty that is only available to things that have been allowed to age in place. It is not the beauty of the new, which is striking but uninformative; nor the beauty of the restored, which can only imitate the original surface without the time that made it. It is the beauty of the witness, of the thing that has stayed in one location long enough to remember the weather.

I do not think my gate is beautiful in the way a new gate would be. I think it is beautiful in a way a new gate cannot be. These are, I have come to believe, two different things, and I am no longer persuaded that the first is the more valuable of the two.

**20** WRITER'S CRAFT

What is the main purpose of the opening paragraph?

- **A** to describe a garden problem the writer intends to solve later in the essay
- **B** to establish the object (an old iron gate) that will carry the argument of the essay
- **C** to complain about the quality of metalwork produced in earlier generations
- **D** to give the reader a factual account of how iron corrodes

**21** VOCABULARY

When the writer describes the latch as being held in a "slow chemical *embrace*", the word *embrace* is used to

- **A** personify the chemistry of rust as an act of affection.
- **B** indicate that the rust has completely destroyed the latch.
- **C** suggest that the writer welcomes the damage to the gate.
- **D** show that the rust was caused by an accident rather than by time.

**22** WRITER'S CRAFT

What is the effect of the one-sentence paragraph "I have not done it"?

- **A** It shifts the essay abruptly from what the writer might have done to what the writer has chosen, inviting the reader to ask why.
- **B** It signals that the writer has run out of arguments.
- **C** It provides a factual statement that is not needed for the main argument.
- **D** It interrupts the flow of the essay for comic effect.

23 TEXT COMPREHENSION

The title "The Language of Rust" matches the theme of the essay because it suggests that rust

A is a scientific phenomenon that can be explained in technical vocabulary.

B acts as a record, a kind of writing, left by weather and time on the iron.

C is a problem that speaks for itself and does not require action.

D has been given a new vocabulary by modern chemistry.

TEXT 5 OF 5

# THE FIRST CLOCKS

A HISTORICAL CLOZE

Long before the first mechanical clock, people measured time by **24** steady movement of natural phenomena. The sun moved across the sky, a candle burned **25** a predictable rate, and a quantity of water, allowed to drip from one vessel into another, marked the hours with surprising reliability.

The ancient Egyptians are often credited with the invention of the water clock. **26** water clocks existed long before them (in China, in India, and in Mesopotamia), the Egyptian design was remarkable for its precision. A bowl, marked on the inside with horizontal lines, was filled to the brim; a small hole at the bottom allowed the water to escape at a steady rate; the priest on duty **27** read the time from whichever line the water had last passed.

Such devices served well enough for ceremonial purposes, but they **28**. A cold morning would slow the drip; a hot afternoon could accelerate it. The dream of a clock that did not notice the weather would wait, in fact, for nearly two thousand years.

**24** SYNTAX · CLOZE

Choose the option that best completes the text.

- A a
- B the
- C some
- D any

**25** SYNTAX · CLOZE

Choose the option that best completes the text.

- A in
- B on
- C at
- D to

**26** SYNTAX · CLOZE

Choose the option that best completes the text.

- **A** Because
- **B** Although
- **C** Therefore
- **D** Moreover

**27** SYNTAX · CLOZE

Choose the option that best completes the text.

- **A** should have
- **B** would
- **C** has
- **D** is

**28** SYNTAX · CLOZE

Choose the option that best completes the text.

- **A** were affected by the weather
- **B** always kept good time
- **C** were invented in Egypt
- **D** did not require maintenance

# Writing

PERSUASIVE & NARRATIVE · COMMON MARKING SCALE

2 tasks | ~70 min total

ICAS Writing is marked on a common scale across all levels. That means the rubric wording is the same at Paper G as it is at earlier papers, but the expectation of what a strong response looks like rises steadily. You are no longer being judged only on whether your writing is correct and clear. You are being judged on *craft*.

In the real paper you will be given one writing task to complete in 35 minutes. This workbook gives you two tasks, one persuasive and one narrative, so you can practise both. Set a timer for 35 minutes per task and resist the temptation to go over.

### WHAT MARKERS LOOK FOR AT PAPER G

- **Genre.** Your response should clearly belong to its genre. A persuasive piece needs a position, reasons, and an acknowledgement of the opposing view. A narrative needs a clear arc, a controlled point of view, and at least one moment that does something more than advance the plot.
- **Textual Grammar.** Vary your sentence structures for effect. A short sentence after a long one lands. Tense should be deliberate, not accidental; if you shift from past to present, it should be because you meant to.
- **Syntax & Punctuation.** Commas, full stops and capitalisation at a minimum; but at Paper G, confident use of colons, semicolons and dashes is rewarded. Every punctuation mark should be there on purpose.
- **Plan before you write.** Spend the first 3–5 minutes planning, not writing. A weak plan produces a weak first paragraph, and a weak first paragraph is almost impossible to recover from inside 35 minutes.

TASK 1 · PERSUASIVE

## Respected or liked?

**Some people say that it is better to be respected than to be liked. Others say that being liked is more important than being respected. Write a piece arguing for one of these positions, acknowledging the other.**

GENRE: Persuasive · TIME: 35 minutes · AUDIENCE: a thoughtful adult reader

**BEFORE YOU WRITE · TASK 1**

- Pick **one** side. A persuasive piece that refuses to choose is not a persuasive piece.
- Spend 3 minutes planning: position · two or three reasons · one good example per reason · one concession to the other side and why it doesn't win.
- At Paper G, markers reward a clear concessive move, something like "While it is true that…" or "Those who argue the opposite are not wrong when they say…". Plan where yours goes.
- Avoid opening with "I think" or "In my opinion". Start with the point itself.

**PLAN / DRAFT · TASK 1**

TASK 2 · NARRATIVE

# The Return

**Write the opening of a story in which a character returns to a place they have not seen for a long time. Show the character's feelings through what they notice, not by stating those feelings directly.**

GENRE: Narrative (opening stage) · TIME: 35 minutes · AUDIENCE: a reader who will read on if you give them a reason to

## BEFORE YOU WRITE · TASK 2

- This is an **opening**, not a whole story. You do not need to resolve anything. You need to set up a character, a place, a mood, and a hook.
- "Show the character's feelings through what they notice" is the craft test here. If your character feels anxious, don't write "she was anxious." Write what an anxious person would notice.
- Plan three things: **who** is returning, **where** they are returning to, and **what** has changed (or what has stayed exactly the same). One of those should be surprising.
- Let one detail do the work of a paragraph. A worn doorstep. An unfamiliar smell. A missing photograph. At Paper G, restraint earns marks; over-writing loses them.

## PLAN / DRAFT · TASK 2

# Science

REASONING · INVESTIGATING · INTERPRETING · PREDICTING

10 questions | ~15 min

At Paper G, Science is less about recalling facts and more about *applying* them. You are expected to know the core terms and concepts from your studies, then use them to interpret a diagram, run an experiment in your head, or work out what a graph is telling you. The questions reward careful reasoning, not just memory.

### WHAT'S NEW AT PAPER G

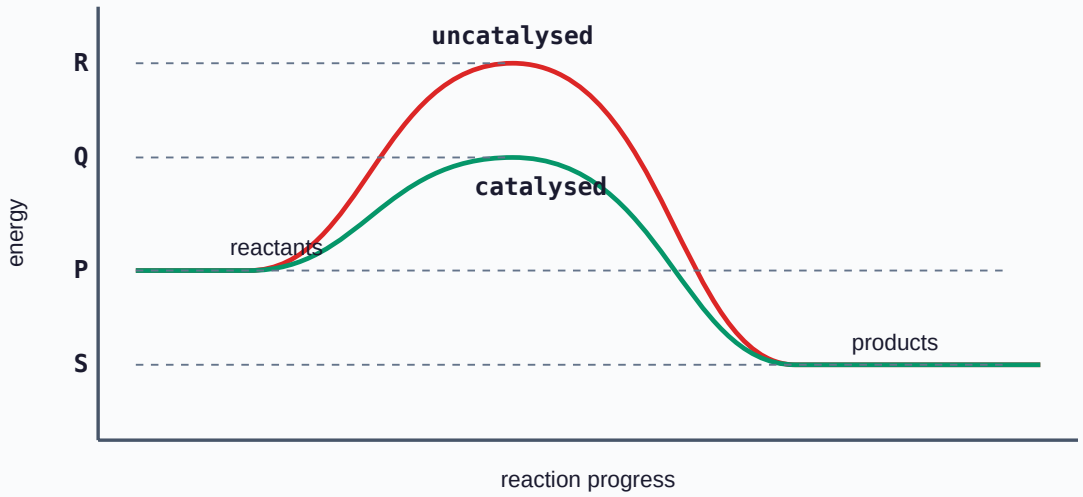
- **Chemistry depth.** Activation energy, empirical formulas, nuclear notation, reaction products are all new at G. Make sure you know the key terms before the exam.
- **Experimental design.** Expect questions about independent, dependent and controlled variables, fair tests, and whether evidence actually supports a conclusion.
- **Circuit analysis.** You will need to trace current paths through mixed series/parallel circuits and work out what lights when certain switches are closed.
- **Classification and sampling.** Cladograms, random sampling, and population estimation are framework-new content that often gets tested once per paper.

1

NATURAL & PROCESSED · INTERPRETING

The diagram shows the energy profile of a reaction carried out both with and without a catalyst. The energy levels P, Q, R and S are marked.

ENERGY PROFILE: CATALYSED AND UNCATALYSED



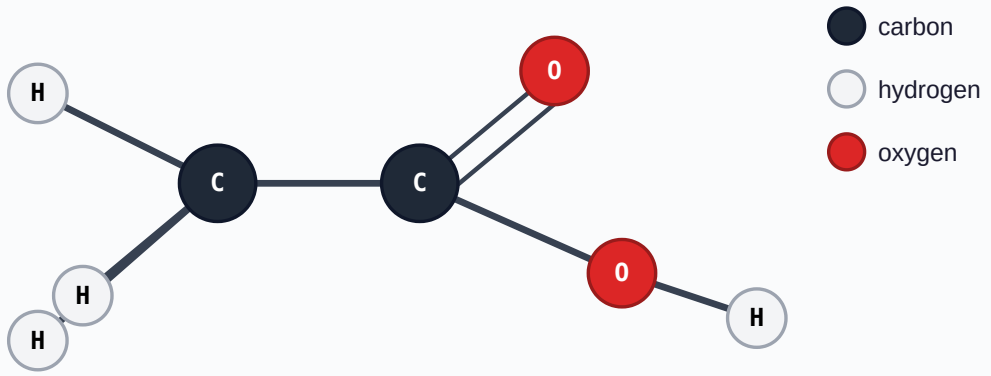

For the **catalysed** reaction, which expressions correctly give the activation energy and the energy change?

| | ACTIVATION ENERGY | ENERGY CHANGE |
|---|---|---|
| (A) | Q – P | S – P |
| (B) | R – P | S – P |
| (C) | Q | S |
| (D) | R – Q | P – S |

**2** NATURAL & PROCESSED · REASONING

The diagram shows a ball-and-stick model of the compound ethanoic acid.

BALL-AND-STICK MODEL OF ETHANOIC ACID




What is the empirical formula of ethanoic acid?

- **A** CHO
- **B** $CH_2O$
- **C** $C_2H_4O$
- **D** $C_2H_4O_2$

**3** NATURAL & PROCESSED · REASONING

In a nuclear equation, a particle is written with its mass number on the top left and its atomic number on the bottom left. For example, a sodium nucleus is written as $^{23}_{11}Na$.

Using this convention, how is an **alpha particle** written in a nuclear equation?

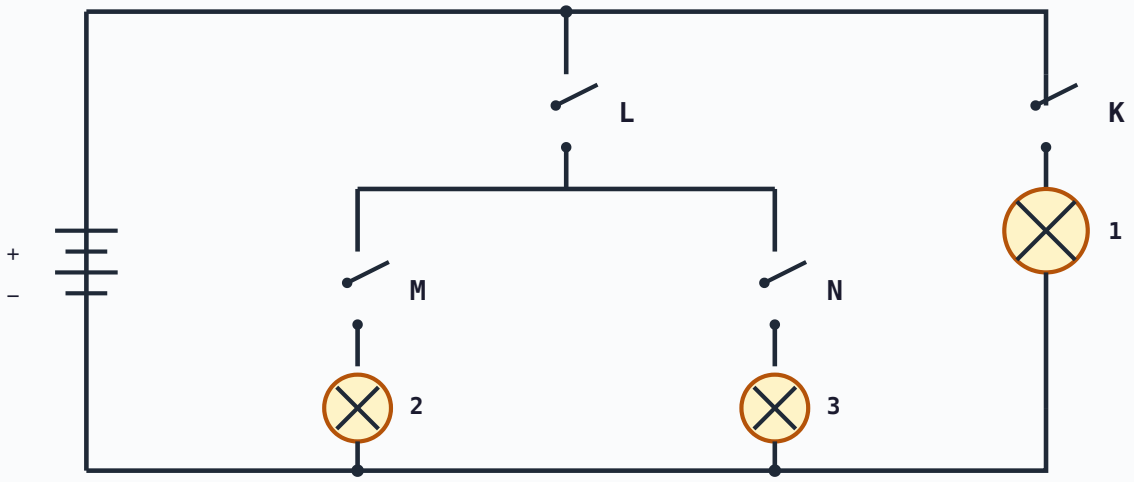
- **A** $^{2}_{4}He$
- **B** $^{2}_{2}He$
- **C** $^{4}_{2}He$
- **D** $^{4}_{4}He$

4

ENERGY & CHANGE · REASONING

The diagram shows a circuit with three globes and four switches. All globes are in working order, and the power supply is strong enough to light all three at the same time.

CIRCUIT WITH THREE GLOBES AND FOUR SWITCHES




Switches K, L, M, N are shown open (–/–).

Which switches must be closed so that **only globe 2** lights up?

A K and M only

B L and M only

C K, L and M

D L, M and N

5

LIFE & LIVING · INVESTIGATING

Jasmine set up five test tubes, each containing the same quantity of yeast and sugar solution. She placed each tube in a water bath at a different temperature and counted the number of bubbles of gas released in one minute. Her results are shown in the table.

JASMINE'S RESULTS

| TUBE | TEMPERATURE (°C) | BUBBLES PER MINUTE |
|---|---|---|
| 1 | 10 | 3 |
| 2 | 25 | 18 |
| 3 | 35 | 42 |
| 4 | 45 | 26 |
| 5 | 60 | 2 |

Which of the following correctly identifies the **independent**, **dependent** and **controlled** variables in Jasmine's experiment?

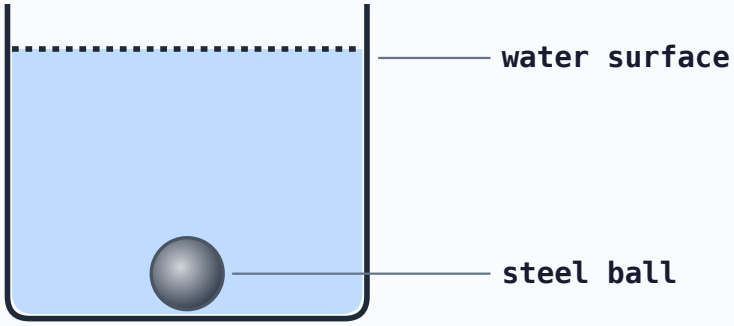
| | INDEPENDENT | DEPENDENT | CONTROLLED |
|---|---|---|---|
| (A) | bubbles / min | temperature | amount of yeast |
| (B) | temperature | bubbles / min | amount of yeast |
| (C) | temperature | amount of yeast | bubbles / min |
| (D) | amount of yeast | temperature | bubbles / min |

6

ENERGY & CHANGE · PREDICTING

A steel ball is placed in a beaker of water, as shown below, and sinks to the bottom. The densities of several substances are given in the table.

STEEL BALL IN WATER




| LIQUID / OBJECT | DENSITY (G/CM³) |
|---|---|
| water | 1.0 |
| cooking oil | 0.9 |
| steel | 7.8 |
| mercury | 13.6 |

The steel ball is removed from the water and placed in a beaker of mercury. What will happen?

A The steel ball will sink to the bottom, because steel is a metal and metals always sink.

B The steel ball will float, because its density is less than that of mercury.

C The steel ball will hang suspended in the middle of the mercury, because the densities are too similar.

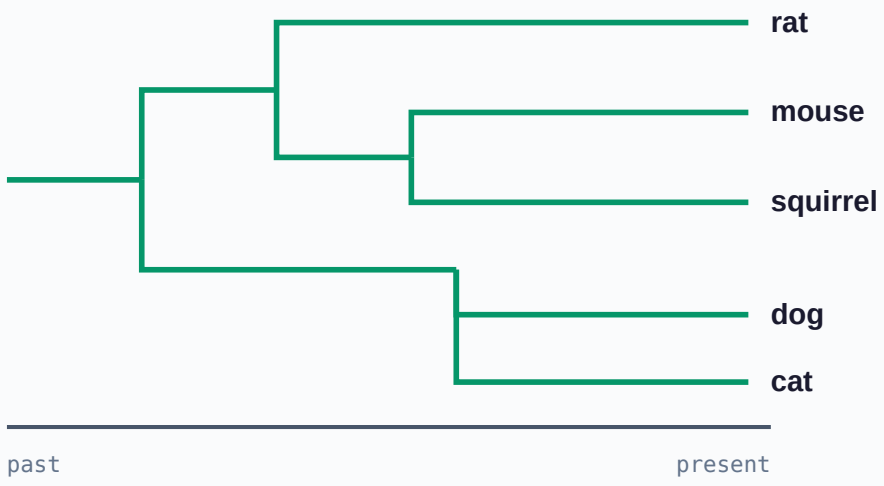
D The steel ball will sink more slowly than it would in water, but it will still reach the bottom.

7

LIFE & LIVING · INTERPRETING

The cladogram below shows the evolutionary relationships between five species. The group consisting of **dog and cat** forms a valid clade.

CLADOGRAM OF FIVE SPECIES




Which of the following groups **also** forms a valid clade?

A rat, mouse and squirrel

B rat and mouse (but not squirrel)

C rat, squirrel and dog

D mouse and cat

8

LIFE & LIVING · REASONING

A biologist estimated the number of snails in a garden of area 400 m² using a **quadrat sampling** method. She placed five 1 m² quadrats at random positions across the garden and counted the snails inside each quadrat.

QUADRAT RESULTS

| QUADRAT | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Snails counted | 8 | 12 | 15 | 9 | 11 |

Based on these samples, what is the best estimate of the total number of snails in the garden?

A 11

B 55

C 275

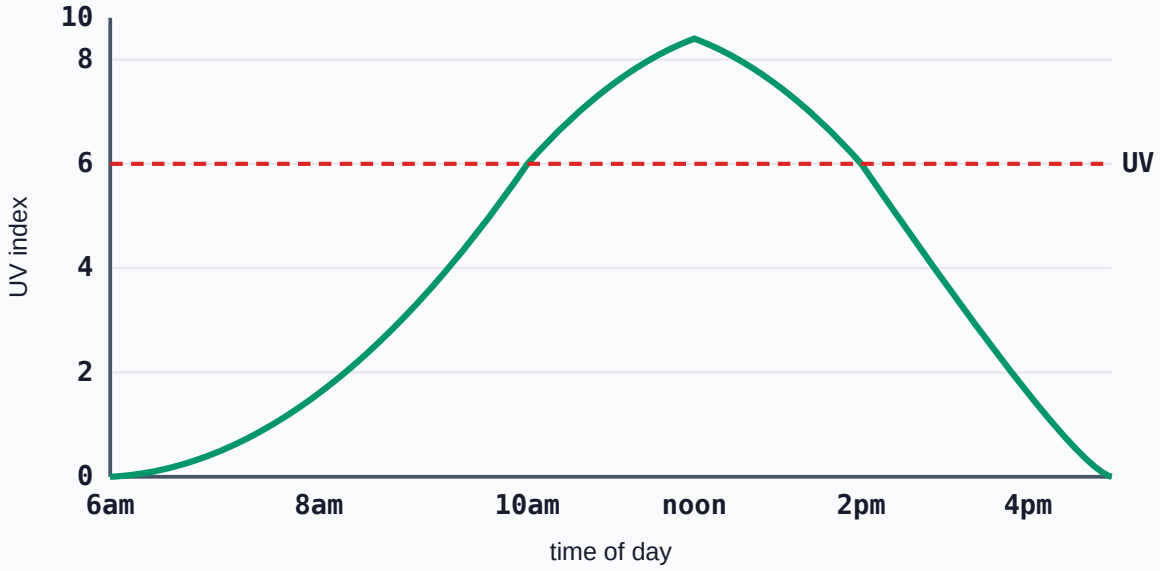
D 4400

9

EARTH & BEYOND · PREDICTING

Chen manages a garden containing plants that are damaged when the UV index rises above 6. He can move the plants under shade cover for part of the day. The graph shows the UV index at his location through a typical summer day.

UV INDEX THROUGH THE DAY (SUMMER)




During which time window must Chen keep his sensitive plants under shade cover?

A from around 8 am to around 4 pm

B from around 10 am to around 2 pm

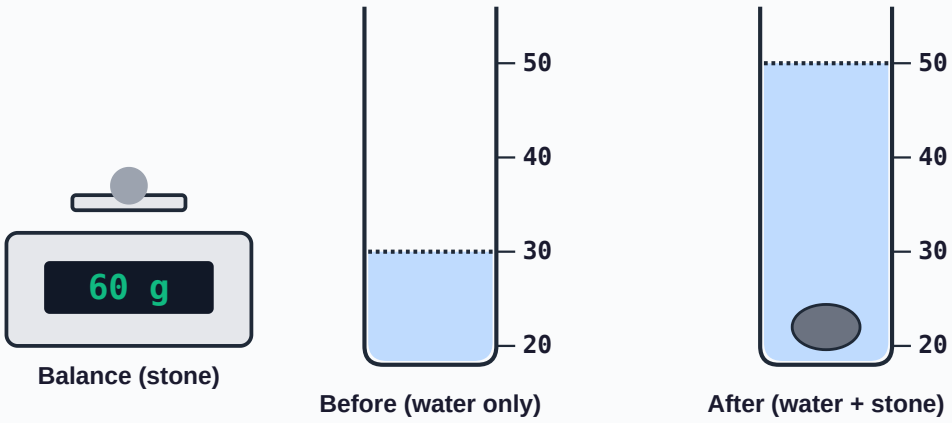
C from around 6 am to around noon

D only briefly, around noon

10 NATURAL & PROCESSED · REASONING

Rohan placed a small stone on a balance and recorded its mass. He then carefully lowered the stone into a measuring cylinder containing water, as shown below.

ROHAN'S MEASUREMENTS




What is the density of the stone?

A 0.33 g/cm³

B 1.2 g/cm³

C 2.0 g/cm³

D 3.0 g/cm³

# Mathematics

ALGEBRA · MEASUREMENT · NUMBER · PROBABILITY · DATA

12 questions | ~18 min

Paper G is where algebra steps forward and becomes the centre of the paper. You will be expected to expand and simplify expressions, solve linear equations algebraically, change the subject of a formula, and apply index laws, not just substitute values. Measurement also becomes more involved, with circles, Pythagoras, surface area of prisms, and composite shapes all in play for the first time.

### WHAT'S HARDER AT PAPER G

- **Sign discipline.** The most common mistake on algebra questions is not failing to see a method; it is dropping a sign when distributing a negative. When you expand $-2(x - 4)$, slow down.
- **Scale factor squared.** If all lengths of a shape are increased by k%, the area does *not* increase by k%. It increases by a factor of $(1 + k/100)^2 - 1$. Memorise this pattern; Paper G tests it almost every year.
- **"At least one" probability.** The fast route is the complement rule: P(at least one) = 1 − P(none). Learn this before the exam; it saves about 90 seconds each time.
- **Circles and π.** Know both formulas cold: $C = 2\pi r$ and $A = \pi r^2$. Most wrong answers come from mixing them up or using the diameter as the radius.

**1** ALGEBRA · EXPAND & SIMPLIFY

Simplify the expression shown below.

$$[\ 4(3x - 1) + 8\ ] \div 2 \quad - \quad 3(x - 2)$$

A 3x + 4

B 3x − 4

C 3x + 8

D 9x + 8

**2** ALGEBRA · SOLVE LINEAR EQUATION

Solve the equation shown below for *x*.

$$8 / x + 12 / x = 5 / 2$$

- **A** x = 4
- **B** x = 8
- **C** x = 10
- **D** x = 50

**3** ALGEBRA · CHANGE THE SUBJECT

The period of swing, *T*, of a pendulum of length *L* is given by the formula below, where *g* is a constant.

$$T = 2\pi \sqrt{(L / g)}$$

Which of the following correctly rearranges the formula to make *L* the subject?

- **A** $L = g T^2 / (4\pi^2)$
- **B** $L = T^2 / (4\pi^2 g)$
- **C** $L = g T / (2\pi)$
- **D** $L = g^2 T^2 / (4\pi^2)$

**4** NUMBER · INDEX LAWS

Simplify the expression shown below, assuming $x \neq 0$.

$$(3x^2)^3 \times x^0 \div x^4$$

- **A** $3x^2$
- **B** $9x^2$
- **C** $27x^2$
- **D** $27x^6$

**5** NUMBER · RECURRING DECIMALS

Which fraction, in its simplest form, is equal to the recurring decimal shown below?

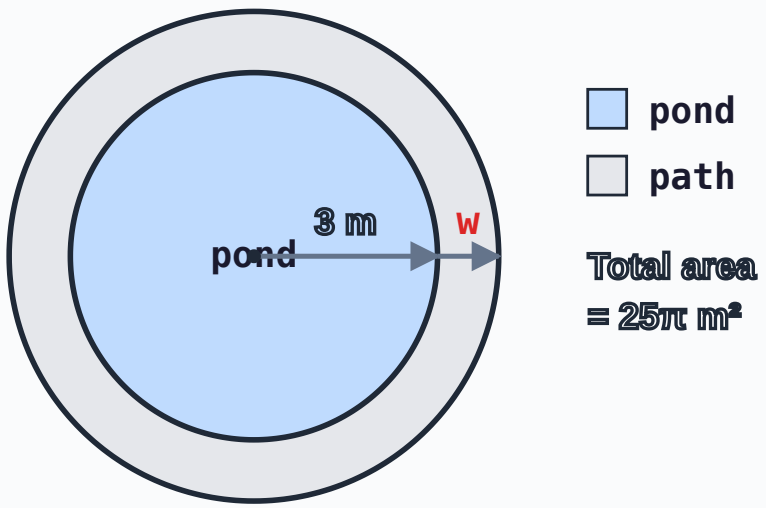
**0.272727…** (the digits "27" repeat forever)

- **A** 27 / 100
- **B** 1 / 3
- **C** 27 / 99
- **D** 3 / 11

**6** MEASUREMENT · CIRCLES

A circular garden pond has diameter 6 m. A stone path of uniform width *w* is built all the way around the pond, as shown. The **total area** covered by the pond and path together is 25π m².

POND WITH SURROUNDING PATH (TOP VIEW)




What is the width *w* of the path?

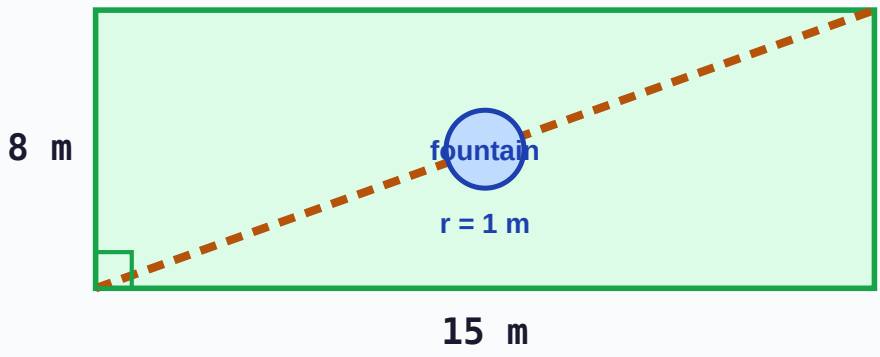
- **A** 1 m
- **B** 2 m
- **C** 4 m
- **D** 5 m

7

MEASUREMENT · PYTHAGORAS

A rectangular park measures 8 m by 15 m. A circular fountain of radius 1 m is built exactly at the centre of the park. A straight gravel path is built along the diagonal, from one corner of the park to the opposite corner.

RECTANGULAR PARK WITH DIAGONAL PATH AND CENTRAL FOUNTAIN




What is the total length of the diagonal path that lies **outside** the fountain?

A 13 m

B 15 m

C 16 m

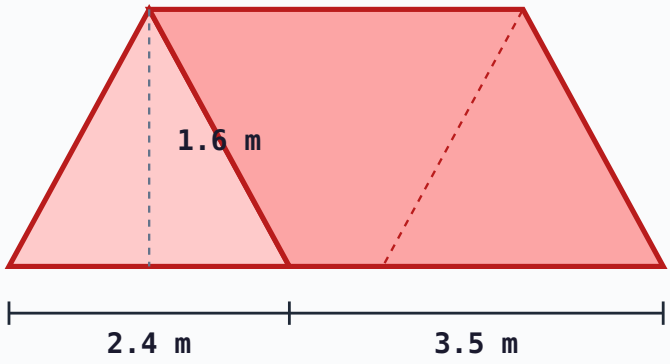
D 17 m

8

MEASUREMENT · PRISM SURFACE AREA

A camping tent has the shape of a right triangular prism. The triangular cross-section is isosceles, with a base of 2.4 m and a central height of 1.6 m. The tent is 3.5 m long.

TRIANGULAR PRISM TENT (ISOSCELES CROSS-SECTION)




What is the total area of fabric required to make just the **two sloping sides** of the tent? (Do not include the floor or the triangular ends.)

A 11.2 m²

B 14.0 m²

C 16.8 m²

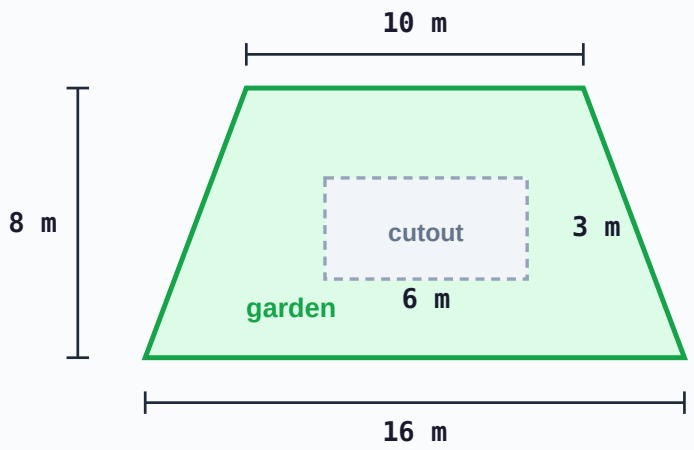
D 20.2 m²

9

MEASUREMENT · COMPOSITE AREA

A garden has the shape of a **trapezium** with parallel sides of 10 m and 16 m, and a perpendicular distance of 8 m between the parallel sides. A rectangular vegetable patch of 6 m by 3 m is cut out of the garden, as shown.

TRAPEZIUM GARDEN WITH RECTANGULAR CUTOUT (NOT TO SCALE)




What is the area of the garden that remains after the vegetable patch is cut out?

A 72 m²

B 86 m²

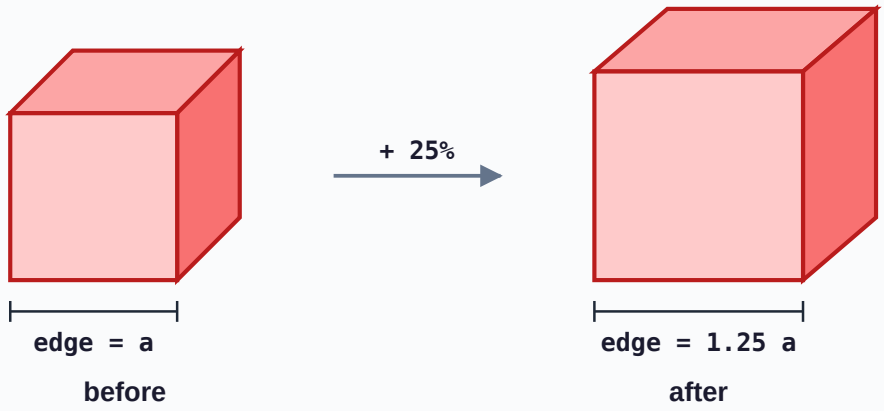
C 104 m²

D 122 m²

**10** GEOMETRY · SIMILAR FIGURES

The length of each edge of a cube is increased by 25%, as shown.

CUBE BEFORE AND AFTER ENLARGEMENT




By what percentage does the **total surface area** of the cube increase?

- **A** 25%
- **B** 50%
- **C** 56.25%
- **D** 95.3%

**11** CHANCE · COMPOUND PROBABILITY

Ria has a Mathematics test and an English test tomorrow. The outcomes of the two tests are independent. The probabilities of passing each test are given in the table below.

PROBABILITIES OF PASSING

| SUBJECT | PROBABILITY OF PASSING |
|---|---|
| Mathematics | 0.9 |
| English | 0.7 |

What is the probability that Ria passes **at least one** of the two tests?

- **A** 0.03
- **B** 0.63
- **C** 0.80
- **D** 0.97

12

DATA · EFFECT OF OUTLIERS

The test scores of nine students, arranged in order, are shown below.

ORIGINAL TEST SCORES (OUT OF 20)

**12 13 14 14 15 16 17 18 20**

A tenth student completes the test and scores **1**. When the new score is added to the data set, which measures of location **change**?

A the mean only

B the median only

C the mean and the median, but not the mode

D the mean, the median and the mode all change

# Answers & Explanations

CHECK YOUR WORK · UNDERSTAND WHAT WENT WRONG · LEARN FROM EVERY QUESTION

For every question, each wrong answer here is paired with the specific student error it is designed to catch. If you picked a wrong answer, find the error that matches; that is what you want to avoid next time.

## English

### Q1 ✓ B

The metaphor personifies the lost attention as if it were a friend who slipped away ("left no note"), making an abstract idea feel personal and quietly unsettling, a strong way to open an essay.

**Why the others are wrong:**

- **A.** misreads the tone: the metaphor is wry, not a distraction from seriousness.
- **C.** takes the metaphor literally; there is no real bereavement.
- **D.** confuses a lightly-handled opening with authorial uncertainty.

### Q2 ✓ A

The writer is distinguishing between *replying* to a claim (addressing it) and *refuting* it (disproving it). A response can sound reasonable without actually showing the original claim to be false.

**Why the others are wrong:**

- **B.** the writer never accuses opponents of dishonesty, only of being incomplete.
- **C.** the text does not claim refutation is impossible, only that it hasn't happened here.
- **D.** misreads the sentence as being about the writer's personality.

### Q3 ✓ C

A refutation is a proof that something is false, a disproof. Context makes this clear: the writer is saying a mere reply is not enough to *disprove* the original point.

**Why the others are wrong:**

- **A.** apology is emotional, not logical.
- **B.** confirmation is the opposite of refutation.
- **D.** explanation describes; refutation disproves.

### Q4 ✓ A

Paragraph 3 spells out the defenders' case: "we are reading more than any generation before us. We process a staggering volume of words every day." The counter-argument is specifically about *volume*.

**Why the others are wrong:**

- **B.** this is the writer's later concession, not the defenders' main argument.
- **C.** not claimed by either side.
- **D.** related but imprecise; the defenders say panics exaggerate, not that costs are always exaggerated.

### Q5 ✓ A

Earlier in the essay the writer dares the reader to "wait three minutes in a queue" without a phone. The final sentence echoes that image: if you could give the questions "three uninterrupted minutes", you'd already be proving the point.

**Why the others are wrong:**

- **B.** the sentence is oblique, not a direct summary.
- **C.** treats a craft choice as a word-count accident.
- **D.** there is no statistic; the number is symbolic.

**Q6** ✓ A

The writer explicitly says this is *not* an argument for throwing devices "into the sea"; the point is about trade-offs, not abandonment. This is a NOT question; read all options before choosing.

**Why the others are wrong:**

- **B, C, D.** all three are arguments the writer clearly makes. Only A is *not* argued.

**Q7** ✓ A

Clara expected "the lilacs would appear less tall" and the oak "would reveal itself as merely a tree". She anticipated discovering that her childhood measurements had exaggerated everything.

**Why the others are wrong:**

- **B.** the aunt's pleasure is never Clara's expectation.
- **C.** Clara says nothing about disrepair.
- **D.** she expected the path to feel *shorter*, not longer.

**Q8** ✓ B

The paragraph is a reversal: it directly contradicts Clara's expectation from the previous paragraph. "Nothing had shrunk" is the whole point: the world has failed to conform to her new measurements, which unsettles her.

**Why the others are wrong:**

- **A.** reads it as description; it is really an argument against her expectation.
- **C.** introduces an intention for the aunt that the text doesn't suggest.
- **D.** underplays the structural role; this is not scene-setting but an emotional reversal.

**Q9** ✓ B

"Ruinous" literally means reduced to ruins, or damaged and in a poor state. The aunt is teasing Clara: her mother's letters had implied Clara would arrive looking much worse than she does.

**Why the others are wrong:**

- **A.** opposite meaning.
- **C, D.** neither fits the sentence's logic.

**Q10** ✓ C

The "actual Aunt Eleanor… was brighter and smaller and more immediate than the one Clara had rehearsed". She is sharper in her observations and less formidable than the family legend.

**Why the others are wrong:**

- **A.** opposite of what Clara notices; her aunt is brighter, not frailer.
- **B.** the aunt is less formal and more immediate, not more distant.
- **D.** the text suggests Clara had misremembered, not that the aunt has changed.

**Q11** ✓ B

The simile makes the aunt's assessment sound practical and detached, and the comic comparison to evaluating livestock is funny precisely because Clara is her niece, not a cow. The effect is wry, not cruel.

**Why the others are wrong:**

- **A.** overstates the tone; the aunt is blunt but not cruel.
- **C.** literal reading; the aunt is not actually a farmer.
- **D.** Clara is amused, not uncomfortable.

**Q12** ✓ C

The passage is about visiting somewhere *familiar*: memory, recognition, the persistence of home. "Disappointments of travel to unfamiliar places" does not match the text. All other options are clearly present.

**Why the others are wrong:**

- **A, B, D.** all three are supported directly by the text. Only C is *not*.

**Q13** ✓ A

"Relief" alone would be predictable; "odd relief" is more precise; it captures the mixed feeling of being seen clearly by someone who doesn't soften what they see. The adjective does real work.

**Why the others are wrong:**

- **B.** reaches beyond the text; her loneliness is not stated.
- **C.** the phrase does not echo the aunt's vocabulary.
- **D.** there is nothing to suggest forgiveness, only recognition.

**Q14** ✓ B

Paragraph 2 is explicit: sleep is "one of the brain's most important active states" during which "memory is consolidated, unnecessary connections are pruned, and the experiences of the day are organised into long-term storage."

**Why the others are wrong:**

- **A.** this is the *old* view the article argues against.
- **C.** this is a criticism of sleep, not a function of it.
- **D.** the immune system is not discussed.

**Q15** ✓ D

To consolidate memory is to strengthen it and move it into long-term storage, making it firm. The context ("organised into long-term storage") points clearly to *strengthened*.

**Why the others are wrong:**

- **A.** compressed implies reduced size, not strengthening.
- **B.** opposite of the meaning.
- **C.** describes an examining process, not consolidation.

**Q16** ✓ A

The article describes a curve that "rises steeply" from a few hours of sleep towards a full night, then "flattens" after about seven to eight hours. Graph A shows exactly this pattern: steep rise, then level.

**Why the others are wrong:**

- **B.** a straight line would imply equal gains from every extra hour, which the text denies.
- **C.** falling retention with more sleep contradicts the whole argument.
- **D.** a U-shape has no support in the text.

**Q17** ✓ A

The article states slow-wave sleep (early in the night) processes motor skills; REM sleep (later) supports factual and emotional memory. The two stages do different jobs.

**Why the others are wrong:**

- **B.** reverses the timing.
- **C.** the text says both stages matter, just for different things.
- **D.** explicitly contradicts the article.

**Q18** ✓ B

The ending flips a "folk" saying into a scientific endorsement; ordinary wisdom turns out to have anticipated what neuroscience is only now confirming. It's a graceful closing move.

**Why the others are wrong:**

- **A.** the writer is endorsing, not debunking, the saying.
- **C.** nothing in the article suggests science is finished.
- **D.** the saying is not a test the reader is invited to run.

**Q19** ✓ B

The final paragraph argues that rewarding less sleep is "rewarding them for learning less, or at least for retaining less of what they have learned". The writer sees this culture as self-defeating.

**Why the others are wrong:**

- **A.** opposite of the writer's view.
- **C** "build resilience" is not in the text.
- **D.** contradicts the central claim of the article.

**Q20** ✓ B

The gate is the essay's central image; it carries the argument about time, beauty and the value of things allowed to age. Without it, the essay has nothing to stand on.

**Why the others are wrong:**

- **A.** the gate is not presented as a problem to solve; that's the point.
- **C.** no complaint about earlier metalwork.
- **D.** not a scientific essay; the focus is aesthetic and reflective.

**Q21** ✓ A

"Embrace" personifies the chemistry of rust as an act of affection, making corrosion feel intimate rather than destructive. This fits the essay's overall reframing of decay as biography.

**Why the others are wrong:**

- **B.** the latch is stuck, not destroyed.
- **C.** the writer welcomes the *history*, not the damage itself.
- **D.** accidents are never invoked; the cause is time.

**Q22** ✓ A

The abrupt single sentence creates a turn. The reader has been considering replacement and restoration, then "I have not done it" cuts everything off and forces the question: why?

**Why the others are wrong:**

- **B.** confuses brevity for emptiness; the essay continues with more argument.
- **C.** the sentence is essential: it is the pivot.
- **D.** the effect is not comic; it is quietly decisive.

**Q23** ✓ B

The title works because rust, for the writer, is a form of writing, a record left by weather and time, readable if you know how. The essay sustains this metaphor throughout.

**Why the others are wrong:**

- **A.** the essay is not technical; it is poetic.
- **C.** the writer does act (he refuses to restore); the rust is communicative, not just self-sufficient.
- **D.** there is no mention of modern chemistry's vocabulary.

**Q24** ✓ B

*The* fits because the phrase refers to a specific, already-known category of things ("the steady movement of natural phenomena"). An article like "a" or "some" would break the rhythm and make the phrase indefinite.

**Why the others are wrong:**

- **A, C, D.** all produce either an ungrammatical phrase or one that shifts the meaning away from a known category.

**Q25** ✓ C

The English preposition for a rate is *at*: "burned at a predictable rate". "In a rate" and "on a rate" are ungrammatical.

**Why the others are wrong:**

- **A, B, D.** none is the standard preposition for expressing a rate.

**Q26** ✓ B

The sentence sets up a contrast: Egyptians are credited with the invention, *but* water clocks existed elsewhere earlier. "Although" is the natural concessive connective.

**Why the others are wrong:**

- **A** "Because" suggests cause; there isn't one here.
- **C** "Therefore" suggests consequence; the two facts are in tension, not sequence.
- **D** "Moreover" adds agreement; here the clauses disagree.

**Q27** ✓ B

The habitual past is signalled by *would*: "the priest on duty would read the time". This matches the habitual description of the procedure.

**Why the others are wrong:**

- **A** "should have" implies regret or obligation unmet.
- **C** "has read" is present perfect, wrong tense for a habitual procedure described in the past.
- **D.** "is" is the wrong tense entirely.

**Q28** ✓ A

The next sentences explain that cold mornings slowed the drip and hot afternoons accelerated it, both weather effects. So the water clocks "were affected by the weather" is the coherent fill.

**Why the others are wrong:**

- **B.** contradicts the next sentence directly.
- **C.** irrelevant to the sentence's contrast with ceremonial purposes.
- **D.** maintenance is not the topic; climate sensitivity is.

## Writing: Marking Rubric

Use the rubric below to self-mark, or to ask a teacher or parent to mark your response. Be honest: the point is to find the next thing to practise, not to award yourself a high grade. Each column is scored independently.

**DIAGNOSTIC RUBRIC · PAPER G WRITING**

### GENRE

**STRONG**
Position or arc is clear from the first paragraph. For persuasive: a confident concessive move ("While X is true…") that strengthens the argument. For narrative: interiority is shown through deliberately chosen detail, not stated directly.

**SOUND**
Response belongs clearly to its genre with correct structure. Persuasive piece has a position and reasons; narrative has a character, a place, and a hint of conflict.

**EMERGING**
Genre features are present but muddled. Persuasive piece may list ideas without committing; narrative may tell rather than show.

**BASIC**
Genre is unclear or mixed. Reader is not certain what kind of text they are reading.

### TEXTUAL GRAMMAR

**STRONG**
Sentence lengths are varied for effect; short sentences land after longer ones. Paragraphing builds argument or narrative rhythm. Tense is controlled and deliberate; any shift is intentional.

**SOUND**
Paragraphs are used sensibly; each handles one main idea or story beat. Sentence structures show some variation. Tense is consistent.

**EMERGING**
Paragraphs exist but some are too long or too short. Most sentences follow the same pattern. Occasional tense slips.

**BASIC**
Little paragraphing. Most sentences are the same shape. Tense may shift without reason.

### SYNTAX & PUNCTUATION

**STRONG**
Confident use of colons, semicolons, and dashes where they add precision. Complex sentences unfold cleanly. Vocabulary is precise; word choice is deliberate. Spelling and capitalisation reliable.

**SOUND**
Commas, full stops and capitals used correctly throughout. Some evidence of range beyond the basics. Spelling mostly correct.

**EMERGING**
Basic punctuation usually correct but with lapses. Some run-on sentences. Vocabulary range is limited. Occasional spelling errors.

**BASIC**
Frequent comma or full stop errors. Sentences often run on or fragment. Vocabulary repetitive. Spelling errors affect meaning.

## Science

**Q1** ✓ A

For the catalysed (green) reaction, the activation energy is the energy gap between the reactants (P) and the top of the green hump (Q): **Q − P**. The energy change is the gap between the reactants (P) and the products (S): **S − P**, which is negative because products are lower.

**Why the others are wrong:**

- **B.** uses R (peak of the uncatalysed hump) for the catalysed reaction.
- **C.** treats the labels as absolute energies rather than energy differences.
- **D.** subtracts the wrong pairs entirely.

## Q2 ✓ B

Ethanoic acid has 2 carbon, 4 hydrogen and 2 oxygen atoms, giving the molecular formula $C_2H_4O_2$. Divide all subscripts by their greatest common factor (2) to get the empirical formula: **$CH_2O$**.

**Why the others are wrong:**

- **A.** divides C and O correctly but loses the H ratio.
- **C.** halves H and O but forgets to halve C.
- **D.** this is the molecular formula, not the simplest form.

## Q3 ✓ C

An alpha particle has 2 protons + 2 neutrons = 4 nucleons (mass number 4) and 2 protons (atomic number 2). So it is written as **$^{4}_{2}He$**.

**Why the others are wrong:**

- **A.** swaps the mass number and atomic number.
- **B.** uses 2 as the mass number, forgetting the neutrons.
- **D.** treats both subscripts as the total count of particles.

## Q4 ✓ B

For only globe 2 to light: **L must be closed** (to allow current into the lower branch), **M must be closed** (to complete the path through globe 2). K must stay open (otherwise globe 1 also lights) and N must stay open (otherwise globe 3 also lights). Answer: L and M only.

**Why the others are wrong:**

- **A.** K closed would light globe 1 too; L missing means no current reaches globe 2.
- **C.** closing K as well would also light globe 1.
- **D.** closing N as well would also light globe 3.

## Q5 ✓ B

The **independent** variable is what Jasmine deliberately changes, which is temperature. The **dependent** variable is what she measures in response, which is bubbles per minute. The **controlled** variable is what she keeps the same, which is the amount of yeast.

**Why the others are wrong:**

- **A.** swaps independent and dependent.
- **C.** confuses dependent with controlled.
- **D.** confuses all three columns.

## Q6 ✓ B

An object floats when its density is *less* than the density of the liquid. Steel (7.8 g/cm³) is denser than water (1.0) so it sinks in water. It is less dense than mercury (13.6), however, so it **floats** in mercury.

**Why the others are wrong:**

- **A.** generalises from one case ("metals sink") instead of comparing densities. An object floats when it is less dense than the liquid.
- **C.** neutral buoyancy would require equal densities; they differ by about 6 g/cm³.
- **D.** if the ball floats, it never reaches the bottom at all.

**Q7** ✓ A

A clade must include a common ancestor and *all* its descendants. Rat, mouse and squirrel share an ancestor on the upper branch, and together they include all the descendants of that ancestor, so they form a valid clade (just like the example given for dog and cat on the lower branch).

**Why the others are wrong:**

- **B.** the most recent common ancestor of rat and mouse is the root of the rodent branch, and squirrel is also a descendant of that ancestor. Excluding squirrel breaks the "all descendants" rule.
- **C.** this group takes two rodents plus a carnivore. Their only common ancestor is the root of the whole tree, whose descendants include mouse and cat as well. It is not a valid clade.
- **D.** mouse and cat are on opposite main branches. Their only common ancestor is the root, whose descendants include every species in the diagram.

**Q8** ✓ D

Mean count per $m^2$ = (8 + 12 + 15 + 9 + 11) ÷ 5 = 55 ÷ 5 = 11 snails per $m^2$. Scale up to the whole garden: 11 × 400 $m^2$ = **4400 snails**.

**Why the others are wrong:**

- **A.** this is just the mean per $m^2$, not scaled to the garden.
- **B.** this is the raw sum of the five samples, unscaled.
- **C.** scales the sum by 5 instead of using the mean × area.

**Q9** ✓ B

The UV index curve crosses the threshold of 6 at about 10 am on the way up and again at about 2 pm on the way down. So the dangerous window for Chen's sensitive plants is roughly **10 am to 2 pm**.

**Why the others are wrong:**

- **A** 8 am–4 pm is too wide; the UV index is well below 6 at those boundary times.
- **C.** the mornings up to 10 am are already safe (UV still below 6).
- **D** "only briefly" understates the time the UV stays above 6.

**Q10** ✓ D

The volume of water displaced by the stone equals its volume: 50 mL − 30 mL = 20 mL = 20 $cm^3$. Density = mass ÷ volume = 60 g ÷ 20 $cm^3$ = **3.0 g/$cm^3$**.

**Why the others are wrong:**

- **A.** inverts the density formula (20 ÷ 60 = 0.33).
- **B.** uses the final water level (50 mL) as the stone's volume: 60 ÷ 50 = 1.2.
- **C.** uses the initial water level (30 mL) as the volume: 60 ÷ 30 = 2.0.

## Mathematics

**Q1** ✓ C

Work inside the brackets first: 4(3x − 1) + 8 = 12x − 4 + 8 = 12x + 4. Divide by 2: (12x + 4)/2 = 6x + 2. Expand the second term with care: −3(x − 2) = −3x + 6. Combine: 6x + 2 − 3x + 6 = **3x + 8**.

**Why the others are wrong:**

- **A.** dropped the "+ 8" from inside the brackets. 12x − 4 then ÷ 2 gives 6x − 2, which leads to 3x + 4.
- **B.** sign error on −3(x − 2). If you write −3x − 6 instead of −3x + 6, you get 3x − 4.
- **D.** partial division: divided only the constant by 2 and forgot to divide 12x by 2.

## Q2 ✓ B

Both fractions on the left have the same denominator, so combine them first: $8/x + 12/x = 20/x$. The equation becomes $20/x = 5/2$. Cross-multiply: $2 \times 20 = 5 \times x$, so $40 = 5x$ and **$x = 8$**.

**Why the others are wrong:**

- **A.** solved only the first fraction: $8/x = 5/2 \rightarrow x = 16/5 \approx 3.2$ (and rounded). Must combine the fractions first.
- **C.** arithmetic slip after cross-multiplying.
- **D.** inverted the direction of cross-multiplication: $5 \times 20 \div 2 = 50$.

## Q3 ✓ A

Start with $T = 2\pi \sqrt{(L/g)}$. Square both sides: $T^2 = 4\pi^2 (L/g)$. Multiply both sides by g: $gT^2 = 4\pi^2 L$. Divide both sides by $4\pi^2$: **$L = gT^2/(4\pi^2)$**.

**Why the others are wrong:**

- **B.** g ended up in the denominator; squaring was correct but the rearrangement crossed it to the wrong side.
- **C.** did not square both sides; the square root and the $2\pi$ are still present in a rearranged form.
- **D.** incorrectly squared g as well as T.

## Q4 ✓ C

Apply the bracket first: $(3x^2)^3$ means both 3 and $x^2$ are cubed. So $(3x^2)^3 = 3^3 \times x^6 = 27x^6$. Any non-zero number to the zero power is 1, so $x^0 = 1$. Now divide by $x^4$: $27x^6 \times 1 \div x^4 =$ **$27x^2$**.

**Why the others are wrong:**

- **A.** forgot to cube the coefficient entirely; kept 3 instead of computing $3^3$.
- **B.** squared the coefficient ($3^2 = 9$) instead of cubing it.
- **D.** cubed the coefficient correctly but forgot to divide by $x^4$.

## Q5 ✓ D

Let $x = 0.272727\ldots$ Then $100x = 27.272727\ldots$, so $100x - x = 27$, giving $99x = 27$ and $x = 27/99$. Simplify by dividing top and bottom by 9: **3/11**.

**Why the others are wrong:**

- **A.** treats the decimal as if it were terminating (0.27 exactly).
- **B.** a guess; $1/3 = 0.333\ldots$, not $0.272727\ldots$
- **C.** correct unsimplified value, but the question asks for the simplest form.

## Q6 ✓ B

The total area (pond + path) is the outer circle: $\pi R^2 = 25\pi$, so $R^2 = 25$ and $R = 5$ m. The pond has diameter 6 m, so its radius is 3 m. Path width = outer radius − pond radius = 5 − 3 = **2 m**.

**Why the others are wrong:**

- **A.** found outer radius correctly (5 m) but then halved the difference by mistake.
- **C.** used diameter instead of radius in the subtraction (6 − 2 = 4 is not the path width).
- **D.** gave the outer radius itself, forgetting that the pond still occupies most of the circle.

## Q7 ✓ B

Step 1: find the diagonal by Pythagoras. $d^2 = 8^2 + 15^2 = 64 + 225 = 289$, so $d = 17$ m. Step 2: the diagonal passes through the centre of the rectangle, so it passes straight through the centre of the fountain. The chord it cuts across the circle is therefore a diameter = 2 × 1 = 2 m. Step 3: the length outside the fountain = 17 − 2 = **15 m**.

**Why the others are wrong:**

- **A.** subtracted 4 (perhaps treating "diameter" as 2 × diameter).
- **C.** subtracted only the radius (1 m), not the full diameter the path actually crosses.
- **D.** gave the diagonal itself, forgetting that the path goes through the fountain.

**Q8** ✓ B

The tent is isosceles, so the central height splits the base into two halves of 1.2 m each. Use Pythagoras to find the *slant* length of each sloped side: $s^2 = 1.2^2 + 1.6^2 = 1.44 + 2.56 = 4$, so s = 2 m. Each sloped side is a rectangle of size 2 m × 3.5 m = 7 m². There are two sides, so total fabric = 2 × 7 = **14 m²**.

**Why the others are wrong:**

- **A.** used the central height (1.6 m) as the slant length: 1.6 × 3.5 × 2 = 11.2. Missed that the slant is the hypotenuse, not the vertical.
- **C.** used the base length (2.4 m) as the slant.
- **D.** used the wrong Pythagoras setup: $\sqrt{(2.4^2 + 1.6^2)} \approx 2.88$ as the slant, giving 20.2 m².

**Q9** ✓ B

Area of trapezium = ½ × (sum of parallel sides) × perpendicular distance = ½ × (10 + 16) × 8 = ½ × 26 × 8 = 104 m². Area of rectangular cutout = 6 × 3 = 18 m². Remaining area = 104 − 18 = **86 m²**.

**Why the others are wrong:**

- **A.** likely miscomputed the trapezium area (perhaps averaged sides without the factor of 8, or similar).
- **C.** forgot to subtract the cutout; this is just the trapezium area.
- **D.** added the cutout area instead of subtracting it.

**Q10** ✓ C

Total surface area of a cube with edge *a* is $6a^2$. If the edge is multiplied by 1.25, the new surface area is $6 \times (1.25a)^2 = 6 \times 1.5625a^2 = 1.5625 \times$ (original). So the surface area is 1.5625 times as large, an increase of **56.25%**.

**Why the others are wrong:**

- **A.** the classic "scale factor" trap: assumes the linear percentage (25%) equals the area percentage. Area scales with the *square* of the linear factor.
- **B.** doubles the linear percentage to 50%, reasoning that a 2D surface grows "in two directions". The correct factor is $1.25^2$, not 1.25 × 2.
- **D** 95.3% is the correct increase for *volume* ($1.25^3 = 1.953125$), not surface area. Volume scales with the cube of the linear factor, surface area with the square.

**Q11** ✓ D

Use the complement rule: P(passes at least one) = 1 − P(fails both). P(fails Maths) = 0.1; P(fails English) = 0.3. Since they're independent, P(fails both) = 0.1 × 0.3 = 0.03. So P(at least one) = 1 − 0.03 = **0.97**.

**Why the others are wrong:**

- **A.** gives P(fails both); forgot to subtract from 1.
- **B.** multiplied the pass probabilities (0.9 × 0.7), which gives P(passes both), not "at least one".
- **C.** simple average of the two pass probabilities, which is not how probability works here.

**Q12** ✓ C

Original mean = 139 ÷ 9 ≈ 15.44; new mean = 140 ÷ 10 = 14.0 (CHANGES). Original median = 15 (5th of 9); new median = average of 5th and 6th = (14 + 15) ÷ 2 = 14.5 (CHANGES). Mode = 14 in both data sets (UNCHANGED, because the outlier "1" appears only once, so the most frequent value is still 14). So **mean and median change, but not the mode**.

**Why the others are wrong:**

- **A.** ignores that the median shifts because the middle position changes with an extra data point.
- **B.** ignores the effect of outliers on the mean (which are strong).
- **D.** the mode is robust: the outlier 1 appears only once and does not match any existing value.

## About this workbook

This workbook was prepared as an independent preparation resource for students attempting ICAS-style assessments at Paper G level (Form 3 / Secondary 2). Every question in this workbook is original and written specifically for this resource. The format and question types have been calibrated against the publicly available Paper G framework and past papers.

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