IB DP MATHS AA · EXAM SPECIAL · HL ONLY · TWO LONG INVESTIGATIONS, GDC ALLOWED · ~8 MIN READ

IB Maths AA HL Paper 3: Strategy for the Problem-Solving Paper

How to approach the IB Maths AA HL Paper 3 investigations: the structure of the paper, timing, a step-by-step method for unfamiliar problems, a worked mini-investigation, and what the 2024–25 examiners said.

Paper format & weighting | Grade boundaries | How questions are built | Timing | Reading new definitions | GDC exploration | Conjecture & proof | Induction

RS by Riyaz Sir
mentorriyaz.in

No tag = **SL and HL** HL ONLY HL students only FORMULA BOOKLET given in the exam
M1 A1 how marks are awarded highlight = comes up again and again HANDY worth memorising
Test yourself at the end

IN 30 SECONDS

- **Paper 3 is two long problem-solving questions** (about 27–28 marks each, 55 in total) on unfamiliar ideas built from the HL syllabus. A GDC is required.
- **It is worth 20% of the HL grade.** Papers 1 and 2 are 30% each and the exploration (IA) is 20%.
- **A 7 needed 42 to 48 out of 55 in May 2025,** and 45 in November 2024: high, because most parts are accessible if you keep going.

BY THE END YOU CAN

- Understand how Paper 3 questions are built.
- Use a clear method for unfamiliar problems: explore, conjecture, prove.
- Manage the time so that both questions get a full attempt.

1 The paper at a glance

	Details
Questions	2 compulsory, about 27–28 marks each (55 marks)
Time	Written for 1 hour; the May 2025 reports describe a 75-minute allowance. Check the time on your own paper
Calculator	GDC required (but some papers need it very little)
Weighting	20% of the HL grade
From 2029	50 marks, 1 hour (new syllabus)

Grade boundaries

Session	Grade 4	Grade 5	Grade 6	Grade 7
May 2025 TZ1	28–34	35–40	41–47	48–55
May 2025 TZ2	23–28	29–35	36–41	42–55
May 2025 TZ3	27–33	34–40	41–47	48–55
Nov 2024	24–30	31–37	38–44	45–55

- More boundaries are on the AA grade boundaries page.

2 How the questions are built

- **One idea, many small steps.** Each question introduces a theme in the first lines (a family of curves, a sequence, a new definition) and develops it through 10–15 short parts.
- **Specific, then general.** Early parts use numbers (k = 2, n = 3); middle parts look for a pattern; late parts ask you to generalise and **prove** it.
- **New definitions are explained in the question.** Recent papers have introduced ideas that aren't in the syllabus by name, for example curvature, a probability generating function, or angles on a sphere. Everything you need is defined on the page.
- **Typical endings:** a proof by induction, a limit (often l'Hôpital), a general formula in terms of n or k, or a result for a whole family of functions.

Themes seen in recent papers

Session	Themes (general topic only)
2022	Sums of powers and limits; surface areas by integration; a family of cubic-type curves; conditions for complex roots of polynomials
Nov 2024	Population models from recurrence relations; general polynomials and their roots
May 2025	Probability generating functions; curvature; oblique asymptotes and integration; vectors on a sphere; repeated composite functions and induction

EXAM TIP

Don't try to predict the topic. The examiners say it directly: any part of the syllabus can appear, usually combined with something new.

3 A method for any Paper 3 question

- **1 · Read the whole question first** (about 2 minutes). See where it ends; that tells you what the early parts are building towards.
- **2 · Do the routine parts quickly.** The first few parts are often 1–3 marks of straightforward work.
- **3 · Explore with numbers or the GDC.** Make a table, sketch several members of a family, or try n = 1, 2, 3, 4. Patterns become clear quickly.
- **4 · Conjecture, then prove.** State the pattern clearly ("it appears that…"), then prove it in general with algebra or induction.
- **5 · Use earlier results.** Almost every "hence" in Paper 3 is pointing at the part just before. If a later part seems impossible, look back.
- **6 · Keep going after you're stuck.** Given results ("show that…") let you re-enter later. Many students who couldn't do one part scored full marks on the next.

COMMON MISTAKE

Working out each new case from scratch when the pattern is already visible. In May 2025 TZ3, students who spotted the pattern early finished the question; others ran out of time.

4 Timing

- **About 1 minute per mark,** so roughly half the time per question. Write the halfway time at the top of your paper.
- **Move on from any part that takes twice its marks in minutes.** Come back if you have time left.
- **Don't leave the second question for the last ten minutes.** Its first parts are often the easiest marks on the paper.

5 Worked mini-investigation

WORKED EXAMPLE

Consider the family $y = x e^{-kx}$ for $x \geq 0$, where $k > 0$. (a) Show that the maximum point is at $x = 1/k$. (b) Find its coordinates. (c) Use your GDC with $k = 1, 2, 3$ and make a conjecture about where all the maximum points lie. (d) Prove your conjecture.

1. (a) $dy/dx = e^{-kx} - kx\, e^{-kx} = e^{-kx}(1 - kx)$ [M1A1]
2. $e^{-kx} > 0$, so $dy/dx = 0 \Rightarrow x = 1/k$ R1
3. (b) $y = (1/k)e^{-1}$, so the maximum is $(1/k, 1/(ke))$ A1
4. (c) $k = 1$: (1, 0.368); $k = 2$: (0.5, 0.184); $k = 3$: (0.333, 0.123). Each y is x × 0.368, so **all the maxima lie on the line y = x/e** A1
5. **(d) at the maximum $x = 1/k$ and $y = 1/(ke) = (1/k) \times (1/e) = x/e$, for every $k > 0$ [R1AG]**

- **The structure is typical:** a derivative, a specific case, a pattern from the GDC, then a general proof that's only one line long once you see it.
- **Extension (try it):** the points of inflection are at $x = 2/k$, where $y = (2/k)e^{-2}$. Show that they all lie on the line **$y = x/e^2$**.

6 Proof by induction on Paper 3

- **It appears in most sessions,** and examiners say rigour is still weak.
- **Structure:** prove the base case; write "**assume** true for n = k"; show the n = k + 1 case **using** the assumption; conclude "true for n = 1, and true for n = k ⇒ true for n = k + 1, so true for all n ∈ $\mathbb{Z}^+$".

WORKED EXAMPLE

A sequence has $a_1 = 1$ and $a_{n+1} = 2a_n + 1$. Find a_2, a_3, a_4, conjecture a formula for a_n and prove it.

1. $a_2 = 3$, $a_3 = 7$, $a_4 = 15$, so conjecture $a_n = 2^n - 1$ **A1**
2. $n = 1$: $2^1 - 1 = 1 = a_1$ ✓ **A1**
3. assume $a_k = 2^k - 1$ for some $k \in \mathbb{Z}^+$ **M1**
4. $a_{k+1} = 2a_k + 1 = 2(2^k - 1) + 1 = 2^{k+1} - 1$ [M1A1]
5. **true for n = 1, and true for n = k implies true for n = k + 1, so true for all n ∈ $\mathbb{Z}^+$** **R1**

COMMON MISTAKE

Writing "let n = k" instead of "assume true for n = k". The markschemes don't give the assumption mark for it.

7 What examiners said (2024–25)

- **Use the GDC when it's faster:** sketching a family, finding a root, checking a limit. Some students did long algebra instead.
- **Odd and even functions:** stating f(−x) = −f(x) isn't a justification; show it for the given function.
- **Notation in proofs:** write lim, use = and ⇒ correctly, keep modulus signs in ln |u| and the constant of integration.
- **Answer the general question in general terms.** A numerical example doesn't prove a statement for all n.
- **Give the full domain in sketches** and include every intercept, including (0, 0).

LINKING QUESTION

Paper 3 draws on all of HL. Revise Proof, counting and partial fractions, Polynomials, rational functions and inequalities, Differentiation and Differential equations and Maclaurin series. Practise the markscheme rules in Command terms and markscheme codes.

Test yourself — cover the answers first

QUICK CHECK

1. How many questions are on AA HL Paper 3?
2. What percentage of the HL grade is Paper 3?
3. What is a typical structure for a Paper 3 question?
4. What should you write instead of "let n = k" in induction?
5. Where do the maxima of $y = x\,e^{-kx}$ lie?

Show answers

1. two, about 27–28 marks each
2. 20%
3. specific cases, a pattern, then a general proof
4. assume the statement is true for n = k
5. on the line y = x/e

Stuck on a question?

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