Mathematics Elevate Series
IB Math AI HL Mastery

The 7 Scorer's Exam Prep Companion

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Chapter 1

Introduction: How to Use This Book

1.1 Purpose and Audience

The purpose of this book is simple yet ambitious: to guide every IB Mathematics: Analysis and Approaches (AA) Higher Level student toward achieving excellence in their final examinations. Whether you are aiming for a score of **6 or 7**, or working to boost your confidence and secure steady progress, this book is designed as your complete companion during the crucial last 4–8 weeks before your exam.

Unlike standard textbooks, which focus primarily on teaching the entire syllabus in depth, this guidebook is focused on **exam preparation, strategy, and mastery**. It condenses years of experience, examiner insights, and common pitfalls into a single structured volume that prioritises clarity and efficiency.

This book has been carefully crafted to serve three categories of learners:

1. **High-achieving students** who want to fine-tune their revision, identify small gaps, and aim for perfection in scoring.
2. **Dedicated learners** aiming to raise their performance from a mid-level grade (4–5) to a strong 6 or higher through structured practice and strategy.
3. **Anxious exam-takers** who want a clear, reliable roadmap to make the most of limited preparation time while reducing stress.

In short, this book is written for every IB Math AA HL student who values **clarity, structure, and confidence** during exam preparation.

1.2 How this Book Is Structured

To make your revision effective, this guidebook is divided into four main parts, each targeting a specific stage of preparation. By following this structure, you will move from learning exam strategy, through active recall and problem practice, to full mock examinations.

- **Part I: Strategy and Exam Technique** This section explains how to approach each IB paper (Paper 1, Paper 2, and Paper 3) with confidence. You will learn time-management techniques, calculator usage tips, and common mistakes to avoid. Each subsection highlights how examiners allocate marks and how you can maximise your score through effective exam behaviour.

- **Part II: Topic Checklists and Active Recall** Instead of passively reading through notes, you will revise actively using structured **checklists**. Each checklist covers subtopics such as Calculus, Geometry and Trigonometry, Algebra, Probability, and Statistics. These checklists are phrased as recall questions, encouraging you to test your memory and reinforce understanding.

- **Part III: Topic Mastery (Worked Examples)** This section revisits each core topic through carefully chosen IB-style problems. Every example is solved step by step with commentary, highlighting not just the solution but also the thought process behind selecting a method. Common errors are discussed, and alternative solution paths are shown where appropriate.

- **Part IV: Mock Papers and Timed Practice** To truly excel in the exam, practice under timed conditions is essential. This section contains ten complete mock exams for each paper type. The papers are designed to reflect the real difficulty level, structure, and marking style of the IB. Solutions are provided, with examiner-style feedback to guide your self-assessment.

- **Appendices: Formulae, Marking Tips, and Resources** The book concludes with a concise collection of formulae, examiner reports, and strategies to avoid common errors. These serve as a quick-reference tool in the final days before your exam.

By following the structure of this book from start to finish, you will not only revise every topic thoroughly but also develop the mindset, speed, and accuracy required to perform at the highest level in the IB Mathematics AA HL exam.

Chapter 3

Active-Recall Checklists by Topic

3.1 Calculus

Code	Topic / Recall Question	
C1	Can I define a limit and use limit laws? Do I know $\lim_{x\to 0} \frac{\sin x}{x}$?	
C2	Do I understand continuity? Can I state the formal ε–δ definition?	
C3	Can I apply rules of differentiation (power, product, quotient, chain, implicit)?	
C4	Can I differentiate exponential, logarithmic, and trigonometric functions?	
C5	Do I understand second derivatives and their meaning for concavity/inflection points?	
C6	Can I solve optimization problems (max/min with constraints)?	
C7	Am I confident with related rates problems?	
C8	Can I use differentiation to find equations of tangents and normals?	
C9	Do I understand indefinite integrals and basic integration rules?	
C10	Can I compute definite integrals and interpret them as area under curves?	
C11	Can I apply integration by substitution and by parts?	
C12	Do I know how to integrate rational functions (including partial fractions)?	
C13	Can I use integrals to find volumes of revolution?	
C14	Do I understand differential equations and solve first-order separable ODEs?	
C15	Do I know how to apply slope fields (direction fields) for differential equations?	

Chapter 4

Mock Papers: Full-length 30 Mock Papers (10 for each Paper 1, 2, and 3)

How to Use the Mock Papers — Time Pressure Strategy

To truly prepare for the IB Math AA HL exam, it is essential to train not just your knowledge but also your **speed and efficiency under exam conditions**. The mock papers are designed to help you achieve that.

1. **Work Under Time Constraints:**
    - For each mock, aim to complete it in approximately **80% of the official allotted time**:
        - Paper 1: 1 hour 36 minutes (instead of 2 hours)
        - Paper 2: 1 hour 36 minutes (instead of 2 hours)
        - Paper 3: 48 minutes (instead of 1 hour)
    - This simulates a **time-strained environment**, forcing you to **prioritize questions, work efficiently, and make quick decisions**.
2. **Develop Exam Stamina:**
    - By practicing in less than the official time, you train your mind to **think faster, reduce hesitation, and manage stress**.
    - Over time, this improves your ability to complete the full exam comfortably within the real allotted time.
3. **Prioritize and Strategize:**
    - Start with questions you are most confident in to secure marks quickly.
    - Leave the most challenging or time-consuming questions for last.

- Use your watch or timer to track progress and adjust pace as needed.

4. **Reflect and Analyze:**
   - After completing a timed mock, **review mistakes carefully**.
   - Note which questions took too long and why — were they calculation errors, conceptual gaps, or poor strategy?
   - Apply this insight in the next timed session to improve speed and accuracy.
5. **Motivational Note:**
   - Completing your mock in **80% of the time** is challenging but extremely effective.
   - It builds **confidence, resilience, and focus** — the qualities that separate a 7-scorer from the rest.
   - Remember: mastery is not just about knowing mathematics; it is about **applying it swiftly and correctly under pressure**.

Tip: Treat each mock as a **dress rehearsal for the real exam**. The more you practice under time pressure, the more comfortable you will be on exam day, making last-minute stress manageable and boosting your overall performance.

Candidate session number

Mathematics: Analysis and Approaches Higher level — Paper 1 (Mock)

Time allowed: 2 hours No calculator permitted

Total marks: 110

Instructions to candidates

- Write your session number in the boxes above.
- Do not open this paper until instructed to do so.
- Unless otherwise stated, answers should be exact or correct to 3 significant figures.
- A clean copy of the Mathematics: Analysis and Approaches HL formula booklet is required.
- Section A: answer all questions. Write your answers in the spaces provided.
- Section B: answer all questions. Show all working.

Section A — Answer all questions. (40 marks)

Write your answers in the spaces provided. Calculators are not permitted in this section.

1. (5 marks) Let $f(x) = x^3 - 3x^2 + ax + b$ where $a, b \in \mathbb{R}$. Given that $f(1) = 0$ and $f'(1) = 4$, find a and b.

2. (4 marks) A fair six-sided die is rolled twice. Find the probability that the sum is 7 *and* at least one roll is a 4. Give your answer as a fraction in simplest form.

3. (4 marks) Expand and simplify $(1 + 2x)^4$, and state the coefficient of x^3.

4. (5 marks) Given the sequence defined by $u_n = 3 \cdot 2^{n-1} + n$, compute $S_5 = \sum_{k=1}^{5} u_k$.

5. (4 marks) Let $g(x) = \ln(2x + 1)$. Find $g'(x)$ and evaluate $g'(0)$.

6. (4 marks) The triangle ABC has sides $AB = 7$, $AC = 8$ and included angle $\angle BAC = 60^\circ$. Find the area of $\triangle ABC$ (exact form).

7. (6 marks) Solve the equation $2\cos^2\theta - 3\cos\theta + 1 = 0$ for θ in the interval $0 \le \theta < 2\pi$.

8. (8 marks) Consider the function $h(x) = \dfrac{2x}{x^2 + 1}$. Determine the x-coordinates of any stationary points and classify each as local max/min.

2. **Weeks 3–4: Worked Examples and Targeted Practice**
    - Complete all worked examples for Calculus, Algebra, Functions, Trigonometry, Vectors, and Statistics.
    - Identify your weak areas and focus on them.
    - Attempt mini timed sessions for each topic (30–45 minutes).
3. **Weeks 5–6: Mock Exams and Final Consolidation**
    - Complete full mock papers for each paper type under **80% time pressure**.
    - Review mistakes immediately and redo problematic questions.
    - Summarize formulas, strategies, and common IB patterns in a condensed **revision notebook**.

5.3 4-Week Plan

1. **Week 1: Rapid Topic Revision**
    - Revise all topics quickly using checklists.
    - Focus on formulas, identities, and key problem-solving steps.
2. **Week 2: Intensive Problem Solving**
    - Solve all worked examples and past IB questions for weak topics.
    - Complete mini timed sets (30–60 minutes) daily to maintain speed.
3. **Week 3: Full Mock Papers**
    - Complete 3–4 timed mock papers (all paper types).
    - Analyze and correct all mistakes.
    - Focus on efficient time management and exam strategy.
4. **Week 4: Final Polishing**
    - Revisit difficult problems and topics where marks were lost.
    - Review final cheat sheet and key strategies.
    - Simulate one full exam per paper type in a timed environment.
    - Rest well before the actual exam to optimize performance.

Tip: Stick strictly to the plan, avoid distractions, and maintain a balance of **study, practice, and rest**. The goal is **efficient mastery and confidence** leading up to the IB Math AA HL exam.

Applications

- Area under curve: $A = \int_a^b f(x)dx$
- Volume of revolution (x-axis): $V = \pi \int_a^b [f(x)]^2 dx$
- Volume of revolution (y-axis): $V = 2\pi \int_a^b xf(x)dx$
- Derivative of inverse functions: $(f^{-1})'(x) = \frac{1}{f'(f^{-1}(x))}$
- Related rates: $\frac{dy}{dt} = \frac{dy}{dx}\frac{dx}{dt}$
- Slope of tangent: $m = \frac{dy}{dx}$, slope of normal: $m_\perp = -\frac{1}{m}$

Tips for Quick Reference

- Memorize all **common derivatives and integrals** — they appear repeatedly in Paper 1, 2, and 3.
- Always check **units and dimensions** in applied problems.
- Use **substitution first**, then parts if necessary; avoid long, brute-force integration.
- Keep this section open while solving **mock papers** for faster recall.

6.2 Important Formulae: Algebra

Polynomials and Factorization

- Factor theorem: If $f(a) = 0$, then $(x - a)$ is a factor of $f(x)$.
- Remainder theorem: $f(a)$ is the remainder when $f(x)$ is divided by $(x - a)$.
- Sum and product of roots for quadratic $ax^2 + bx + c = 0$:

$$\alpha + \beta = -\frac{b}{a}, \quad \alpha\beta = \frac{c}{a}$$

- Vieta's formulae for cubic and quartic equations.

Sequences and Series

- Arithmetic sequence: $u_n = u_1 + (n-1)d$, $S_n = \frac{n}{2}(u_1 + u_n)$
- Geometric sequence: $u_n = u_1 r^{n-1}$, $S_n = u_1 \frac{1-r^n}{1-r}$ $(r \neq 1)$
- Sum to infinity of geometric series: $S_\infty = \frac{u_1}{1-r}$, $|r| < 1$

Logarithms and Exponentials

- $\log_a(xy) = \log_a x + \log_a y$
- $\log_a\left(\frac{x}{y}\right) = \log_a x - \log_a y$
- $\log_a(x^n) = n \log_a x$
- Change of base: $\log_a x = \frac{\log_b x}{\log_b a}$
- Exponent rules: $a^m a^n = a^{m+n}$, $\quad (a^m)^n = a^{mn}$, $\quad \frac{a^m}{a^n} = a^{m-n}$

Tips for Quick Reference

- Always draw diagrams for vector problems — helps visualize angles and directions.
- Remember the distinction between dot (angle) and cross (perpendicular vector) products.
- Use polar form for multiplying, dividing, or finding powers/roots of complex numbers.
- Check real and imaginary parts separately in algebraic solutions.

6.5 Important Formulae: Probability and Statistics

Probability Rules

- Probability of event: $P(A) = \frac{\text{Number of favorable outcomes}}{\text{Total outcomes}}$
- Complement rule: $P(A') = 1 - P(A)$
- Union of two events: $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
- Conditional probability: $P(A|B) = \frac{P(A \cap B)}{P(B)}, \quad P(B) \neq 0$
- Independent events: $P(A \cap B) = P(A)P(B)$

Random Variables

- Expectation (mean): $E(X) = \sum x_i P(X = x_i)$
- Variance: $\text{Var}(X) = E[(X - E(X))^2] = E(X^2) - [E(X)]^2$
- Standard deviation: $\sigma = \sqrt{\text{Var}(X)}$

Common Distributions

- **Binomial:** $X \sim B(n, p)$ $P(X = k) = \binom{n}{k} p^k (1-p)^{n-k}$, $E(X) = np$, $\text{Var}(X) = np(1-p)$
- **Normal:** $X \sim N(\mu, \sigma^2)$ Standardize: $Z = \frac{X - \mu}{\sigma}$
- **Poisson:** $X \sim \text{Poisson}(\lambda)$ $P(X = k) = \frac{\lambda^k e^{-\lambda}}{k!}$, $E(X) = \lambda$, $\text{Var}(X) = \lambda$

Statistics

- Sample mean: $\bar{x} = \frac{1}{n} \sum_{i=1}^{n} x_i$
- Sample variance: $s^2 = \frac{1}{n-1} \sum_{i=1}^{n} (x_i - \bar{x})^2$
- Linear regression: $y = a + bx$, $b = \frac{\text{Cov}(X,Y)}{\text{Var}(X)}$, $a = \bar{y} - b\bar{x}$
- Correlation coefficient: $r = \frac{\text{Cov}(X,Y)}{\sigma_X \sigma_Y}$

Tips for Quick Reference

- Check independence carefully; many IB questions test conditional probability.
- Use standardization for normal distribution problems.
- Keep formulas for expectation, variance, and regression handy during exams.
- Draw probability trees for multi-step problems to avoid missing outcomes.

About the Author

Rishabh Kumar is an experienced educator and mlobal math mentor, alumnus of IIT Guwahati and the Indian Statistical Institute. With over six years of teaching experience and mentorship, Rishabh has guided hundreds of students to achieve top marks in their respective exams.

He is the author of the **Math By Rishabh Series** and the **Mathematics Elevate Series**, a collection of comprehensive resources designed to elevate conceptual understanding, problem-solving skills, and exam mastery for students worldwide. Passionate about making mathematics accessible and engaging, Rishabh combines rigorous academic insight with practical strategies for success.