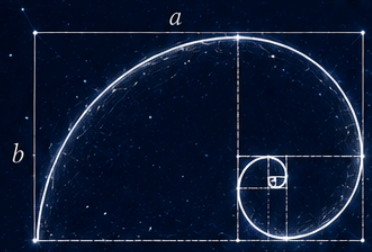
A-LEVEL MATHEMATICS

100 AI PROMPTS

for Smarter Revision *and* Exam Prep

Active recall, exam technique, and mark-scheme thinking — without cheating.



$$\int_a^b f(x)\,dx = F(b) - F(a)$$

$$\frac{a+b}{a} = \frac{a}{b} = \varphi$$

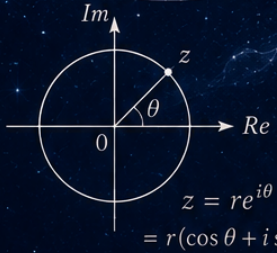
$$\varphi = \frac{1+\sqrt{5}}{2}$$

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

π

$\pi = 3.1415926535\ 8979323846\ldots$

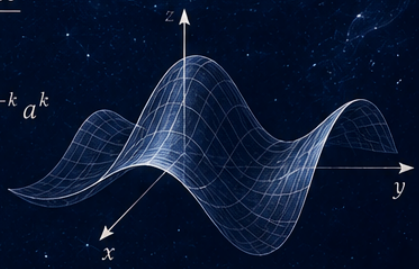
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$



$$z = re^{i\theta}$$
$$= r(\cos\theta + i\sin\theta)$$

$$(x+a)^n = \sum_{k=0}^{n} \binom{n}{k} x^{n-k} a^k$$

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$$



by James R. Martin

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The author has made use of artificial intelligence tools to assist with drafting, structuring, and generating example material. All educational guidance, explanations, and exam-related advice have been reviewed, edited, and curated by the author. Any resemblance to specific published materials is unintentional.

This book is intended to support revision and exam preparation. It does not replace formal teaching, textbooks, or official specifications. Students are responsible for ensuring that all work submitted for assessment is their own.

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How to Use This Book

For a long time, high-quality tutoring has been a major contributor to elite academic achievement. Used well, AI can now act as a powerful tutor that most students and parents could not previously afford.

This book is a **starting point**, not a rulebook. Each prompt is designed to help you revise, test your understanding, and think more clearly — not to give perfect answers. You are encouraged to **adapt, improve, and remix** these prompts.

You are learning how to think carefully about the questions you ask — a skill that will matter far beyond these exams.

Note on Exam Boards and Syllabi

This book has been designed to support A-Level Mathematics students across all major exam boards, including AQA, Edexcel, OCR, and OCR MEI. The prompts cover the full two-year A-Level course content, not just the AS component, ensuring comprehensive preparation for final examinations.

While the core pure mathematics content is largely consistent across exam boards, there are subtle differences in emphasis and notation. For example, OCR MEI places particular emphasis on comprehension tasks and modelling, while Edexcel tends to examine integration techniques with a wider variety of function types. The prompts in this book encompass the broadest possible range to ensure no topic is missed regardless of your specification.

The statistics and mechanics content in this book covers the compulsory applied components found across all major specifications. Whether your board uses large data set analysis, real-world modelling contexts, or specific hypothesis testing frameworks, you will find prompts that target these skills directly.

Each prompt has been written to reflect the style and demand of genuine A-Level examination questions, including multi-step problems, proof-based reasoning, and questions that require you to link different areas of mathematics together. Command words such as 'show that', 'hence', 'prove', and 'determine' are used throughout to mirror real exam language.

To get the most from this book, identify which exam board and specification you are following, then work through all sections systematically. Where a prompt covers a topic not on your particular specification,

simply skip it and move on. The vast majority of content applies universally to A-Level Mathematics.

Contents

Section 1

Pure Mathematics — Algebra and Functions

Algebra and functions form the backbone of A-Level Mathematics, underpinning virtually every other topic you will study. Mastery of algebraic manipulation, including working with surds, indices, polynomials, and rational expressions, is essential for success in both pure and applied papers.

At A-Level, you are expected to go well beyond GCSE algebra. You must be confident with the factor theorem, polynomial division, partial fractions, and the modulus function. Questions often combine several algebraic techniques in a single problem, requiring fluency and strategic thinking.

The prompts in this section progress from foundational recall of key laws and definitions through to complex multi-step problems involving proof and modelling. Use them to build confidence with manipulation before tackling the more demanding application-style questions.

Prompt 1: Laws of Indices

Copy this prompt into your AI tool:

Test me on the laws of indices at A-Level standard. Give me a mix of expressions to simplify, including fractional and negative indices applied to algebraic terms. After each answer, tell me if I am correct and explain any errors.

What this helps you practise:

Simplifying expressions using index laws with fractional and negative powers

How to use it well:

Work through these regularly to maintain fluency, as

indices appear constantly in calculus and exponentials topics later in the course.

Prompt 2: Surd Manipulation

Copy this prompt into your AI tool:

Test me on surd manipulation at A-Level standard. Give me expressions involving surds to simplify, including rationalising denominators with single and compound surds. Ask me to expand brackets containing surds and simplify the results. After each answer, tell me whether I am correct and explain any mistakes. If I struggle, remind me of the key rule that the square root of a times b equals the square root of a times the square root of b.

What this helps you practise:

Rationalising denominators and simplifying surd expressions

How to use it well:

Focus on showing every step of your working, as examiners award method marks for correct rationalisation procedures.

Prompt 3: Completing the Square

Copy this prompt into your AI tool:

Quiz me on completing the square at A-Level standard. Give me quadratic expressions in the form ax squared plus bx plus c and ask me to rewrite them in completed-square form. Include examples where a is not equal to one. After each answer, check my working step by step and correct any errors. Then ask me to use completed-square form to find the vertex of a parabola and solve a quadratic equation. Wait for my answer before giving feedback.

What this helps you practise:

Completing the square for quadratics with non-unit leading coefficients

How to use it well:

Practise this until automatic, as completed square form is needed for integration, circle equations, and optimisation problems.

Prompt 4: Discriminant Analysis

Copy this prompt into your AI tool:

Present me with a series of quadratic equations involving a parameter k. For each, ask me to find the values of k for which the equation has two distinct real roots, equal roots, or no real roots. Check my use of the discriminant.

What this helps you practise:

Using the discriminant to analyse quadratic equations with unknown parameters

How to use it well:

These questions test inequality work alongside algebra and frequently appear in exam papers, so ensure you can set up and solve the discriminant condition confidently.

Prompt 5: Polynomial Division and Factor Theorem

Copy this prompt into your AI tool:

You are an A-Level examiner. Give me a cubic polynomial and ask me to show that a given linear expression is a factor using the factor theorem. Then ask me to factorise the polynomial completely by performing polynomial division. Award marks as an examiner would.

What this helps you practise:

Applying the factor theorem and polynomial long division to cubic expressions

How to use it well:

Pay careful attention to the 'show that' command word, which means you must present clear logical steps, not just state the answer.

Prompt 6: Algebraic Fractions

Copy this prompt into your AI tool:

Test me on algebraic fractions at A-Level standard. Give me expressions to simplify by factorising numerators and denominators, adding and subtracting fractions with different denominators, and multiplying or dividing algebraic fractions. Include examples that require factorising quadratics or recognising the difference of two squares. After each answer, check my working and correct any errors. Ask each question one at a time and wait for my response before proceeding to the next.

What this helps you practise:

Manipulating algebraic fractions including factorisation of components

How to use it well:

Strong algebraic fraction skills are prerequisites for partial fractions and integration of rational functions, so invest time here early.

Prompt 7: Partial Fractions — Distinct Linear Factors

Copy this prompt into your AI tool:

Quiz me on partial fractions with distinct linear factors. Give me rational expressions where the denominator factorises into two or three distinct linear factors, and ask me to decompose them into partial fractions. Test whether I can set up the correct form, find the constants using substitution or comparing coefficients, and check my answer by recombining. After each answer, verify my working and highlight any errors. Present questions one at a time.

What this helps you practise:

Decomposing rational expressions into partial fractions with distinct linear factors

How to use it well:

Always verify your answer by recombining the partial fractions; this is a reliable self-check method and examiners sometimes require it.

Prompt 8: Partial Fractions — Repeated and Quadratic Factors

Copy this prompt into your AI tool:

Test me on partial fractions involving repeated and quadratic factors. Give me expressions with a repeated linear factor in the denominator, and also expressions with an irreducible quadratic factor. Ask me to write down the correct partial fraction form before solving. Check whether I include the right number of terms for repeated factors and use Ax plus B over the quadratic factor. After each answer, verify my constants and correct any errors.

What this helps you practise:

Partial fraction decomposition with repeated or irreducible quadratic factors

How to use it well:

These harder forms appear at the top end of A-Level papers. Being comfortable with them gives you access to full marks on integration questions.

Prompt 9: Modulus Function Equations

Copy this prompt into your AI tool:

Present me with three equations involving the modulus function, such as |2x - 3| = x + 1. Ask me to solve each algebraically and sketch a supporting graph. Check both my solutions and whether I have correctly rejected any invalid answers.

What this helps you practise:

Solving modulus equations algebraically and graphically, including checking validity

How to use it well:

Always substitute your answers back into the

original equation to verify they satisfy both sides, as extraneous solutions are a common trap.

Prompt 10: Modulus Inequalities

Copy this prompt into your AI tool:

Quiz me on modulus inequalities at A-Level standard. Give me inequalities involving modulus signs to solve, such as the modulus of 2x minus 3 is less than 5, and the modulus of x plus 1 is greater than the modulus of x minus 2. Ask me to solve them algebraically and sketch number-line diagrams to represent the solution sets. After each answer, check whether my critical values and direction of inequalities are correct. Present one question at a time.

What this helps you practise:

Solving modulus inequalities and expressing solutions in set or interval notation

How to use it well:

Sketch the graphs alongside your algebraic work so you can visually confirm which region satisfies the inequality.

Prompt 11: Transformations of Graphs

Copy this prompt into your AI tool:

Give me the equation of a function and then describe a sequence of transformations. Ask me to write the equation of the transformed function and describe the effect on specific points and asymptotes. Test me on stretches, reflections, and translations in both x and y directions.

What this helps you practise:

Applying and describing combinations of graph transformations to functions

How to use it well:

Understand transformations conceptually rather than memorising rules, as exam questions often

combine multiple transformations in unfamiliar contexts.

Section 2

Pure Mathematics — Coordinate Geometry and Trigonometry

Coordinate geometry at A-Level extends your GCSE knowledge of straight lines and circles into more sophisticated territory, including parametric curves and implicit equations. You must be able to find tangents, normals, and intersection points with confidence and precision.

Trigonometry at this level introduces radian measure, the reciprocal and inverse trigonometric functions, compound and double angle formulae, and the harmonic form R sin(x + a). These identities are not merely topics in their own right but essential tools for calculus and further pure mathematics.

This section builds from core definitions and identities through to problems requiring you to combine coordinate geometry with trigonometric reasoning, mirroring the synoptic nature of A-Level exam questions.

Prompt 12: Equations of Circles

Copy this prompt into your AI tool:

Test me on circle geometry at A-Level. Give me problems involving finding the equation of a circle from given conditions, determining whether a point lies inside or outside a circle, and finding the length of a tangent from an external point. Present three questions, one at a time.

What this helps you practise:

Finding and interpreting equations of circles in Cartesian form

How to use it well:

Always convert to completed square form to identify

the centre and radius clearly before attempting any geometric reasoning.

Prompt 13: Tangents and Normals to Circles

Copy this prompt into your AI tool:

Give me an A-Level style question asking me to find the equation of the tangent to a circle at a given point. Then ask me to find where the tangent meets the axes. Check my gradient calculations and final equations.

What this helps you practise:

Finding equations of tangents and normals to circles using perpendicularity

How to use it well:

Remember that the tangent is perpendicular to the radius at the point of contact; this geometric fact is the key to every circle-tangent problem.

Prompt 14: Radian Measure Fundamentals

Copy this prompt into your AI tool:

Test me on radian measure fundamentals. Ask me to convert between degrees and radians, use exact values in terms of pi, and apply radian measure in arc length and sector area calculations. Include questions that combine both formulae in a single problem, such as finding the perimeter or area of a segment. After each answer, check my working and highlight any errors. Present one question at a time and wait for my response before giving the next.

What this helps you practise:

Working with radian measure for arc length and sector area calculations

How to use it well:

Ensure your calculator is in the correct mode for each question, and practise leaving answers in exact form involving pi where appropriate.

Prompt 15: Trigonometric Identities — Core

Copy this prompt into your AI tool:

Quiz me on core trigonometric identities at A-Level standard. Test whether I can state and apply the Pythagorean identities sin squared plus cos squared equals one, one plus tan squared equals sec squared, and one plus cot squared equals cosec squared. Give me equations to solve using these identities, and expressions to simplify. After each answer, check my working and tell me if I am correct. Present one question at a time and wait for my response.

What this helps you practise:

Simplifying expressions using fundamental trigonometric identities

How to use it well:

These identities are used so frequently that they must be instant recall; they underpin almost every trigonometric proof and equation at A-Level.

Prompt 16: Solving Trigonometric Equations

Copy this prompt into your AI tool:

Ask me to solve trigonometric equations in a given interval, such as 0 to 2pi. Include equations requiring the use of identities to reduce to a single trigonometric function. Present one equation at a time, check my solutions, and highlight any I have missed.

What this helps you practise:

Solving trigonometric equations in specified intervals using identities

How to use it well:

Use the CAST diagram or unit circle to systematically find all solutions in the required interval; missing solutions is the most common error.

Prompt 17: Reciprocal Trigonometric Functions

Copy this prompt into your AI tool:

Test me on reciprocal trigonometric functions — sec, cosec, and cot. Ask me to state their definitions, sketch their graphs, and identify their domains and ranges. Give me equations involving reciprocal trig functions to solve, including ones that require me to use Pythagorean identities to convert between forms. After each answer, check my solution and correct any errors. Present questions one at a time and wait for my response before proceeding.

What this helps you practise:

Understanding and applying reciprocal trigonometric functions sec, cosec, and cot

How to use it well:

Know the graphs and asymptotes thoroughly; exam questions often require you to read off or deduce solutions from the shape of the graph.

Prompt 18: Compound Angle Formulae

Copy this prompt into your AI tool:

Quiz me on compound angle formulae at A-Level standard. Test whether I can state the formulae for sin of A plus B, cos of A plus B, and tan of A plus B, and use them to find exact values such as sin of 75 degrees. Give me problems that require these formulae, including deriving double angle formulae from them. After each answer, verify my working and correct any errors. Present questions one at a time and wait for my response.

What this helps you practise:

Applying compound angle formulae and deriving double angle results

How to use it well:

Learn the compound angle formulae perfectly; the double angle formulae can always be derived from them if you forget, saving you from relying on pure memorisation.

Prompt 19: Double Angle and Half Angle Formulae

Copy this prompt into your AI tool:

You are an A-Level examiner. Set me a question where I must use double angle formulae to solve an equation of the form a cos(2x) + b sin(x) + c = 0 in a given interval. Mark my response using a mark scheme approach.

What this helps you practise:

Using double angle formulae to solve equations reducible to single-function form

How to use it well:

Identify which version of cos(2x) to use based on what other trigonometric function appears in the equation, so you can reduce to one function.

Prompt 20: Harmonic Form R sin(x + alpha)

Copy this prompt into your AI tool:

Ask me to express a sin(x) + b cos(x) in the form R sin(x + alpha). Then ask me to use my result to find the maximum value and the value of x at which it occurs. Provide specific numerical values and check my method.

What this helps you practise:

Expressing linear combinations of sin and cos in harmonic form

How to use it well:

This technique converts a sum into a single sinusoidal function, making it straightforward to find maximum and minimum values and solve equations.

Prompt 21: Small Angle Approximations

Copy this prompt into your AI tool:

Present me with expressions involving sin(x), cos(x), and tan(x) for small x. Ask me to state the small angle approximations and use them to simplify the

given expressions. Then ask me to compare the approximation with the exact value for a specific small angle.

What this helps you practise:

Applying small angle approximations for sin, cos, and tan in simplification problems

How to use it well:

These approximations are specific to A-Level and frequently appear in show-that questions; always state which approximation you are using for full marks.

Prompt 22: Inverse Trigonometric Functions and Restricted Domains

Copy this prompt into your AI tool:

Test me on inverse trigonometric functions and restricted domains. Ask me to explain why we must restrict the domain of sin, cos, and tan to define their inverses, and state the standard restricted domains and ranges. Give me questions involving evaluating arcsin, arccos, and arctan for specific values, including negative inputs. After each answer, check whether I give the correct principal value and understand why. Present questions one at a time.

What this helps you practise:

Evaluating inverse trigonometric functions and understanding domain restrictions

How to use it well:

Sketch the graphs of inverse trig functions from memory and annotate them with key values to help you answer evaluation questions quickly.

Section 3

Pure Mathematics — Calculus

Calculus is the most heavily weighted topic in A-Level Mathematics and appears across both pure and applied papers. You must be fluent in differentiation and integration of a wide range of functions, including polynomials, trigonometric, exponential, and logarithmic functions.

At A-Level, calculus extends to the chain rule, product rule, quotient rule, integration by substitution, integration by parts, and the use of partial fractions in integration. You are also expected to solve first-order differential equations and interpret their solutions in context.

The prompts in this section cover the full range of calculus skills from basic differentiation through to differential equations and applications. Work through them in order to build your technique systematically before attempting the most challenging synthesis questions.

Prompt 23: Differentiation from First Principles

Copy this prompt into your AI tool:

Quiz me on differentiation from first principles at A-Level standard. Ask me to differentiate functions such as x squared, x cubed, and sin x using the limit definition. Check that I set up the expression f of x plus h minus f of x all over h correctly, expand and simplify, and then take the limit as h tends to zero. After each answer, verify each step of my working. Present one question at a time and wait for my response.

What this helps you practise:

Differentiating functions from first principles using the limit of the difference quotient

How to use it well:

Even though you will rarely use first principles in practice, examiners test it regularly; ensure your notation is rigorous and includes the limit correctly.

Prompt 24: Differentiation Rules — Chain, Product, Quotient

Copy this prompt into your AI tool:

Give me a set of functions to differentiate, requiring me to identify and apply the chain rule, product rule, and quotient rule. Include composite functions such as e^(sin x), x^2 ln(x), and sin(x)/x^2. Present one at a time and check my choice of rule.

What this helps you practise:

Applying the chain, product, and quotient rules to composite and compound functions

How to use it well:

Before differentiating, always pause to identify which rule is needed and clearly label the component parts; this reduces errors and earns method marks.

Prompt 25: Differentiating Trigonometric Functions

Copy this prompt into your AI tool:

Test me on differentiating trigonometric functions at A-Level standard. Give me functions involving sin x, cos x, tan x, and their reciprocals to differentiate. Include problems requiring the chain rule, product rule, or quotient rule applied to trigonometric functions, such as differentiating sin of 3x squared or x times cos x. After each answer, check my working step by step and correct any errors. Present one question at a time and wait for my response.

What this helps you practise:
Differentiating standard and composite trigonometric functions
How to use it well:
Create a reference card of all standard trig derivatives and test yourself until you can recall every one without hesitation.

Prompt 26: Implicit Differentiation
Copy this prompt into your AI tool:
Present me with equations defined implicitly, such as x^2 + y^2 = 25 or x^2y + xy^2 = 6. Ask me to find dy/dx using implicit differentiation. Then ask me to find the gradient at a specific point on the curve. Check my use of the chain rule on y terms.
What this helps you practise:
Finding dy/dx for implicitly defined curves using implicit differentiation
How to use it well:
Remember to apply the chain rule every time you differentiate a y term with respect to x, multiplying by dy/dx; this is the most common source of errors.

Prompt 27: Stationary Points and Nature
Copy this prompt into your AI tool:
Give me a function and ask me to find all stationary points and determine their nature using the second derivative test. Then present a case where the second derivative test is inconclusive and ask me to use an alternative method. Assess my reasoning.
What this helps you practise:
Locating stationary points and classifying them using second derivative or sign analysis
How to use it well:
When the second derivative equals zero, use a sign table for the first derivative around the point to classify it; state this method explicitly for full credit.

Prompt 28: Connected Rates of Change

Copy this prompt into your AI tool:

Set me an A-Level problem involving connected rates of change. For example, a scenario where the volume of a sphere is increasing at a given rate and I must find the rate of change of the radius when the radius has a particular value. Check my use of the chain rule to connect the rates.

What this helps you practise:

Solving connected rates of change problems using the chain rule

How to use it well:

Write out the chain rule relationship explicitly before substituting any values; this keeps your working clear and helps you identify what you know and what you need.

Prompt 29: Integration of Standard Functions

Copy this prompt into your AI tool:

Quiz me on integration of standard functions at A-Level standard. Give me a mix of functions to integrate, including powers of x, exponentials, reciprocals giving logarithms, and trigonometric functions. Include both indefinite and definite integrals. Check that I include the constant of integration where needed and evaluate definite integrals correctly. After each answer, verify my working and correct any mistakes. Present one question at a time and wait for my response.

What this helps you practise:

Integrating standard functions at A-Level including exponential and trigonometric forms

How to use it well:

Forgetting the constant of integration in indefinite integrals costs marks every year; build the habit of writing +C as part of your final line automatically.

Prompt 30: Integration by Substitution

Copy this prompt into your AI tool:

Give me an A-Level style question requiring integration by substitution. Provide a suitable substitution in the first problem, then in subsequent problems ask me to choose my own substitution. Include one trigonometric substitution. Check my handling of the limits when the integral is definite.

What this helps you practise:

Integration by substitution with algebraic and trigonometric substitutions

How to use it well:

When performing a definite integral by substitution, either change the limits to the new variable or substitute back and use the original limits; never mix the two.

Prompt 31: Integration by Parts

Copy this prompt into your AI tool:

Present me with integrals requiring integration by parts, including those needing the method applied twice and the special case of integrating ln(x). Ask me to state the formula and show my choice of u and dv/dx. Assess whether my choices are strategic.

What this helps you practise:

Applying integration by parts including repeated application and ln(x)

How to use it well:

Use the LIATE hierarchy to guide your choice of u: Logarithmic, Inverse trig, Algebraic, Trigonometric, Exponential — choose u from whichever appears earliest.

Prompt 32: Integration Using Partial Fractions

Copy this prompt into your AI tool:

Test me on integration using partial fractions. Give me rational functions to integrate by first decomposing them into partial fractions and then integrating each term separately. Include examples with distinct linear factors and repeated factors. Check that I correctly decompose the fraction, integrate each term including any logarithmic or power terms, and include the constant of integration. After each answer, verify my working and correct any errors. Present one question at a time.

What this helps you practise:

Integrating rational functions via partial fraction decomposition

How to use it well:

This topic combines two techniques; practise the partial fractions and the integration separately first, then bring them together for full exam-style questions.

Prompt 33: Areas and Volumes by Integration

Copy this prompt into your AI tool:

You are an A-Level examiner. Set me a question requiring me to find the area enclosed between a curve and a line, or between two curves. Then ask me to find the volume of revolution when this region is rotated 2pi radians about the x-axis. Mark my solution against a mark scheme.

What this helps you practise:

Calculating areas between curves and volumes of revolution using integration

How to use it well:

Always sketch the region first to determine the correct limits and which function is on top; this prevents sign errors in area calculations.

Prompt 34: First-Order Differential Equations

Copy this prompt into your AI tool:

Give me a first-order separable differential equation set in a modelling context, such as population growth or cooling. Ask me to separate variables, integrate both sides, and find the particular solution given an initial condition. Check my algebra and my interpretation of the result.

What this helps you practise:

Solving first-order separable differential equations with initial conditions

How to use it well:

After solving, always check that your particular solution satisfies the original differential equation and the initial condition; this catches algebraic errors.

Section 4

Pure Mathematics — Sequences, Series, and Proof

Sequences and series at A-Level encompass arithmetic and geometric progressions, sigma notation, the binomial expansion for both positive integer and fractional powers, and the convergence of infinite geometric series. These topics provide powerful tools for modelling and approximation.

Proof is a distinctive feature of A-Level Mathematics that goes well beyond GCSE. You must be able to construct proofs by deduction, exhaustion, and contradiction, and on some specifications, proof by mathematical induction. Examiners look for logical rigour and clear communication of reasoning.

This section takes you from the fundamentals of sequences through to demanding proof questions. The ability to write a well-structured proof is a skill that develops with practice, so use these prompts repeatedly until your arguments are watertight.

Prompt 35: Arithmetic Sequences and Series

Copy this prompt into your AI tool:

Quiz me on arithmetic sequences and series at A-Level standard. Ask me to find the nth term and the sum of the first n terms of arithmetic sequences. Give me problems involving finding the common difference, determining how many terms are needed for the sum to exceed a given value, and applying arithmetic series to real-world contexts. After each answer, check my working and formulas used. Present one question at a time and wait for my response before proceeding.

What this helps you practise:

Applying arithmetic sequence and series formulae to find terms and sums

How to use it well:

Write out the formulae you are using before substituting values; this helps the examiner follow your logic and earns you method marks.

Prompt 36: Geometric Sequences and Series

Copy this prompt into your AI tool:

Test me on geometric sequences and series at A-Level standard. Ask me to find the nth term, the sum of n terms, and the sum to infinity where the common ratio has modulus less than one. Give me problems that require setting up and solving equations involving geometric sequences, and applying them to contexts such as compound interest or depreciation. After each answer, check my working and correct any errors. Present one question at a time.

What this helps you practise:

Working with geometric sequences, sums, and convergence conditions

How to use it well:

Pay close attention to the condition $|r| < 1$ for convergence of the infinite sum; examiners frequently test whether you understand why this condition is necessary.

Prompt 37: Sigma Notation

Copy this prompt into your AI tool:

Quiz me on sigma notation at A-Level standard. Give me sums written in sigma notation and ask me to evaluate them by expanding or using standard series formulae. Also give me expanded series and ask me to write them in sigma notation. Include examples involving arithmetic and geometric series, and sums

of squares or cubes. After each answer, check whether my limits, general term, and evaluation are correct. Present one question at a time.

What this helps you practise:

Interpreting and writing sums in sigma notation across different series types

How to use it well:

Practise writing out the first few terms of any sigma notation expression to check your understanding before attempting to evaluate or manipulate it.

Prompt 38: Binomial Expansion — Positive Integer Powers

Copy this prompt into your AI tool:

Ask me to expand expressions of the form (a + bx)^n using the binomial theorem for positive integer n. Include cases where I need to find a specific term or coefficient. Then ask me to use an expansion to approximate a numerical value.

What this helps you practise:

Applying the binomial theorem for positive integer exponents and finding specific terms

How to use it well:

Remember that the general term formula nCr * a^(n-r) * (bx)^r allows you to jump directly to any term without expanding everything.

Prompt 39: Binomial Expansion — Fractional and Negative Powers

Copy this prompt into your AI tool:

Give me an A-Level style question on the binomial expansion of (1 + x)^n where n is fractional or negative. Ask me to state the expansion up to a given term and specify the range of validity. Then ask me to use partial fractions and binomial expansion together.

What this helps you practise:

Binomial expansion for fractional and negative indices with validity conditions

How to use it well:

The validity condition |x| < 1 (or similar) must always be stated; examiners specifically allocate marks for this, and omitting it is a guaranteed loss.

Prompt 40: Recurrence Relations

Copy this prompt into your AI tool:

Present me with recurrence relations such as u_{n+1} = 3u_n - 2 with a given first term. Ask me to generate the first several terms, describe the behaviour of the sequence, and determine whether it converges. Then ask me to find the limit if it exists.

What this helps you practise:

Generating terms from recurrence relations and analysing convergence behaviour

How to use it well:

If a recurrence relation converges, set u_{n+1} = u_n = L and solve for L to find the limit; this technique appears regularly in exam questions.

Prompt 41: Proof by Deduction

Copy this prompt into your AI tool:

Test me on proof by deduction at A-Level standard. Give me statements to prove, such as proving algebraic identities, divisibility results, or properties of even and odd numbers. Ask me to set up each proof with a clear logical chain from assumptions to conclusion. After each attempt, check whether my reasoning is rigorous and complete, whether I have stated my assumptions, and whether each step follows logically. Present one problem at a time.

What this helps you practise:

Constructing algebraic proofs by deduction with clear logical structure

How to use it well:

Start each proof by clearly defining your variables and assumptions, then proceed step by step; never skip logical steps even if the result seems obvious.

Prompt 42: Proof by Exhaustion

Copy this prompt into your AI tool:

Give me a statement that can be proved by exhaustion, such as a result about small cases or specific sets of values. Ask me to prove it by systematically checking all possible cases. Then give me one that is better suited to deduction and ask me to explain why exhaustion is not practical.

What this helps you practise:

Proving results by exhaustion and recognising when exhaustion is appropriate

How to use it well:

Proof by exhaustion works only when there are finitely many cases; understanding its limitations helps you choose the right proof strategy in exams.

Prompt 43: Proof by Contradiction

Copy this prompt into your AI tool:

You are an A-Level examiner. Ask me to prove that the square root of 2 is irrational by contradiction. Then set me a second proof by contradiction involving a different result. Mark my proof for logical completeness, identifying any gaps in reasoning.

What this helps you practise:

Constructing proofs by contradiction with rigorous logical argument

How to use it well:

The key steps are: assume the negation, derive a contradiction, then conclude the original statement must be true. State each step explicitly.

Prompt 44: Proof by Mathematical Induction

Copy this prompt into your AI tool:

Ask me to prove a result about the sum of a series using mathematical induction. Then ask me to prove a divisibility result using induction. For each, check that I have correctly established the base case, stated the inductive hypothesis, and completed the inductive step.

What this helps you practise:

Proving results by mathematical induction for summation and divisibility problems

How to use it well:

Examiners require all three stages — base case, inductive hypothesis, and inductive step with conclusion — to be clearly labelled. Missing any one loses significant marks.

Prompt 45: Disproof by Counter-Example

Copy this prompt into your AI tool:

Quiz me on disproof by counter-example. Present me with mathematical statements that are false and ask me to find a specific counter-example that disproves each one. Include statements about properties of numbers, functions, or sequences that look plausible but fail for certain values. After each answer, check whether my counter-example is valid and genuinely disproves the statement. If I give an incorrect counter-example, explain why it does not work. Present one question at a time.

What this helps you practise:

Identifying false mathematical statements and constructing counter-examples

How to use it well:

A single well-chosen counter-example is sufficient to disprove a universal statement; make sure your example clearly violates the claimed result.

Section 5

Pure Mathematics — Exponentials, Logarithms, and Numerical Methods

Exponential and logarithmic functions are central to A-Level Mathematics and appear in modelling contexts across both pure and applied components. You need complete fluency with the laws of logarithms, the natural logarithm, and the exponential function e^x, including their derivatives and integrals.

Numerical methods provide essential tools for solving equations that have no algebraic solution. At A-Level, you must understand change of sign methods, iteration, the Newton-Raphson method, and the trapezium rule, including their strengths and limitations.

These prompts cover the key skills from logarithmic manipulation through to the application and analysis of numerical techniques. Understanding when and why numerical methods succeed or fail is just as important as being able to apply them.

Prompt 46: Laws of Logarithms

Copy this prompt into your AI tool:

Test me on the laws of logarithms at A-Level standard. Give me expressions to simplify using the addition, subtraction, and power laws of logarithms. Include problems that require combining multiple laws in a single expression, and problems involving change of base. Also ask me to solve equations by applying logarithm laws. After each answer, check my working and correct any errors in my application of the rules. Present one question at a time.

What this helps you practise:
Applying the laws of logarithms to simplify expressions and solve equations
How to use it well:
Write out which law you are applying at each step; this makes your working transparent and helps you catch errors before they propagate.

Prompt 47: Exponential Equations
Copy this prompt into your AI tool:
Quiz me on exponential equations at A-Level standard. Give me equations involving exponentials to solve, including ones that require taking logarithms of both sides, substituting to form quadratic equations in terms of e to the x, and recognising exponential growth or decay contexts. After each answer, check my working and whether I give exact answers where appropriate. Present one question at a time and wait for my response before giving feedback.
What this helps you practise:
Solving exponential equations using logarithms and substitution techniques
How to use it well:
When an exponential equation has terms like 3^(2x) = (3^x)^2, use a substitution such as y = 3^x to convert to a quadratic; this is a powerful and frequently tested technique.

Prompt 48: Exponential Growth and Decay Models
Copy this prompt into your AI tool:
Present me with a modelling problem involving exponential growth or decay, such as radioactive decay or population growth. Ask me to form the model equation, find constants from given data, and

make predictions. Then ask me to evaluate the limitations of the model.

What this helps you practise:

Forming and using exponential models for growth and decay in context

How to use it well:

Always interpret your mathematical answer in the context of the problem; examiners award marks for contextual interpretation, not just the numerical result.

Prompt 49: Natural Logarithm and Exponential Function

Copy this prompt into your AI tool:

Test me on the natural logarithm and exponential function at A-Level standard. Ask me to explain the relationship between ln x and e to the x, solve equations involving both functions, and sketch their graphs showing key features. Give me problems involving differentiation and integration of e to the kx and ln x. After each answer, check my working and correct any errors. Present one question at a time and wait for my response before proceeding.

What this helps you practise:

Working with ln(x) and e^x including differentiation, integration, and graph sketching

How to use it well:

Remember that d/dx[ln(f(x))] = f'(x)/f(x); recognising this pattern allows you to integrate many rational functions by inspection.

Prompt 50: Reducing Equations to Linear Form

Copy this prompt into your AI tool:

Give me data that follows a relationship of the form y = ax^n or y = ab^x. Ask me to take logarithms and reduce the relationship to linear form, then ask

me to determine the constants from a log-log or log-linear graph. Provide the plotted values.

What this helps you practise:

Using logarithms to reduce power and exponential relationships to linear form for data analysis

How to use it well:

This technique links logarithms to the statistics and data analysis aspects of the course, so practise interpreting gradients and intercepts of log graphs.

Prompt 51: Change of Sign and Locating Roots

Copy this prompt into your AI tool:

Ask me to show that an equation f(x) = 0 has a root in a given interval using a change of sign argument. Then present a case where the change of sign method fails and ask me to explain why. Test my understanding of the continuity condition.

What this helps you practise:

Using change of sign methods to locate roots and understanding failure conditions

How to use it well:

For full marks in a 'show that' question, you must evaluate f(x) at both endpoints, state that a sign change occurs, and invoke the continuity of f.

Prompt 52: Iterative Methods — Fixed Point Iteration

Copy this prompt into your AI tool:

Present me with an equation that I need to rearrange into the form x = g(x). Ask me to generate a sequence of iterates from a given starting value. Then give me a different rearrangement and ask me to explain why one converges and the other does not, using cobweb or staircase diagrams.

What this helps you practise:

Applying fixed point iteration and analysing convergence using graphical methods

How to use it well:

The convergence condition $|g'(x)| < 1$ near the root determines whether your rearrangement will work; check this if your iteration seems to diverge.

Prompt 53: Newton-Raphson Method

Copy this prompt into your AI tool:

You are an A-Level examiner. Set me a question asking me to use the Newton-Raphson method to find a root of a given equation to a specified degree of accuracy. Ask me to show the formula, perform the iterations, and then ask me to describe a situation where Newton-Raphson fails.

What this helps you practise:

Applying the Newton-Raphson method and understanding its limitations

How to use it well:

Draw a sketch showing the tangent line at each iteration to build geometric intuition for why the method converges and how it can fail near turning points.

Prompt 54: Trapezium Rule

Copy this prompt into your AI tool:

Give me an A-Level style question where I must use the trapezium rule with a given number of strips to estimate a definite integral. Ask me to state the formula, calculate the strip width, and show my working in a table. Then ask me whether the estimate is an overestimate or underestimate and why.

What this helps you practise:

Estimating definite integrals using the trapezium rule and evaluating accuracy

How to use it well:

Sketch the curve and the trapezoids to determine

whether the estimate is an over- or underestimate; the answer depends on the concavity of the function.

Prompt 55: Comparing Numerical Methods

Copy this prompt into your AI tool:

Ask me to compare the Newton-Raphson method, fixed point iteration, and interval bisection for finding roots of equations. For each method, ask me to state one advantage and one disadvantage. Then give me a specific equation and ask me which method I would choose and why.

What this helps you practise:

Comparing and evaluating numerical root-finding methods for appropriateness

How to use it well:

Exam questions sometimes ask you to justify your choice of method; having clear, concise comparative statements prepared will help you answer these efficiently.

Prompt 56: Modelling with Differential Equations and Exponentials

Copy this prompt into your AI tool:

Set me a problem combining differential equations with exponential functions in a modelling context. For example, a cooling problem modelled by dT/dt = -k(T - T_room). Ask me to solve the equation, find the constant using initial conditions, and interpret my solution in context.

What this helps you practise:

Solving and interpreting exponential models arising from differential equations

How to use it well:

These questions link multiple topics from across the specification; practise identifying which techniques are needed before jumping into the working.

Section 6

Pure Mathematics — Vectors and Further Algebra

Vectors at A-Level provide a powerful framework for describing positions, displacements, and geometric relationships in two and three dimensions. You must be able to work with position vectors, find distances, and use vectors to prove geometric results.

Parametric equations offer an alternative to Cartesian form for describing curves and are particularly useful when a curve cannot be easily expressed as y = f(x). You must be able to convert between parametric and Cartesian forms, differentiate parametric equations, and find tangents to parametric curves.

This section draws together vector geometry and further algebraic techniques, building towards the kind of multi-step reasoning that distinguishes higher-grade A-Level performance.

Prompt 57: Position Vectors and Displacements

Copy this prompt into your AI tool:

Test me on position vectors and displacement vectors in two and three dimensions. Ask me to find the displacement between two points, the midpoint of a line segment, and a point that divides a segment in a given ratio. Check my vector notation.

What this helps you practise:

Calculating displacements, midpoints, and section points using position vectors

How to use it well:

Use consistent notation throughout — either column vectors or i, j, k notation — and ensure you clearly

distinguish between position vectors and displacement vectors.

Prompt 58: Magnitude and Unit Vectors

Copy this prompt into your AI tool:

Give me vectors in two and three dimensions and ask me to find their magnitudes and corresponding unit vectors. Then ask me to find a vector of a given magnitude in a specified direction. Include problems requiring the distance between two points in 3D.

What this helps you practise:

Finding magnitudes, unit vectors, and distances between points in 2D and 3D

How to use it well:

Always simplify surds in your magnitude calculations; exact answers are expected at A-Level unless the question specifies a decimal.

Prompt 59: Scalar Product

Copy this prompt into your AI tool:

Quiz me on the scalar product of vectors at A-Level standard. Give me pairs of vectors and ask me to calculate their scalar (dot) product. Test whether I can use the scalar product to find the angle between two vectors, determine whether vectors are perpendicular, and solve geometric problems such as finding the projection of one vector onto another. After each answer, check my calculation and correct any errors. Present one question at a time.

What this helps you practise:

Computing scalar products and using them to find angles and prove perpendicularity

How to use it well:

The scalar product equals zero if and only if the vectors are perpendicular; this is a powerful and frequently tested result for geometric proofs.

Prompt 60: Vector Equations of Lines

Copy this prompt into your AI tool:

Ask me to write vector equations of lines in 3D given a point and direction vector, or given two points. Then ask me to determine whether two lines are parallel, intersecting, or skew. If they intersect, ask me to find the point of intersection.

What this helps you practise:

Forming vector equations of lines and determining geometric relationships between lines

How to use it well:

To check for intersection, solve the parametric equations simultaneously; if you get consistent values for both parameters, the lines intersect at that point.

Prompt 61: Geometric Proof with Vectors

Copy this prompt into your AI tool:

Set me a challenge: give me a geometric configuration and ask me to prove a result using vectors. For example, proving that the diagonals of a parallelogram bisect each other, or that the medians of a triangle are concurrent. Assess the clarity and rigour of my proof.

What this helps you practise:

Constructing geometric proofs using vector methods

How to use it well:

Define your base vectors clearly at the start and express all other vectors in terms of them; this systematic approach prevents confusion in longer proofs.

Prompt 62: Parametric Equations — Sketching and Converting

Copy this prompt into your AI tool:

Test me on parametric equations, including sketching curves and converting to Cartesian form.

Give me sets of parametric equations and ask me to eliminate the parameter, sketch the curve showing the direction of increasing parameter, and find specific points or tangents. Include examples involving trigonometric parametric equations. After each answer, check my working and whether my sketch is accurate. Present one question at a time and wait for my response.

What this helps you practise:

Converting between parametric and Cartesian forms and sketching parametric curves

How to use it well:

When eliminating the parameter, use trigonometric identities if the parametric equations involve sin and cos; the identity sin^2 + cos^2 = 1 is especially useful.

Prompt 63: Differentiation of Parametric Equations

Copy this prompt into your AI tool:

Present me with parametric curves and ask me to find dy/dx using the chain rule result dy/dx = (dy/dt)/(dx/dt). Then ask me to find the equation of the tangent and normal at a given value of the parameter. Check my working and final equations.

What this helps you practise:

Finding gradients, tangents, and normals for parametrically defined curves

How to use it well:

Remember that dy/dx = (dy/dt) / (dx/dt); you do not need to eliminate the parameter to differentiate, which makes this method often simpler than converting first.

Prompt 64: Integration with Parametric Equations

Copy this prompt into your AI tool:

Give me an A-Level style question asking me to find the area under a parametric curve using the formula integral of y(dx/dt)dt. Ask me to determine the correct limits in terms of the parameter and evaluate the integral. Check my limit conversion.

What this helps you practise:

Finding areas under parametric curves using integration with parameter substitution

How to use it well:

Ensure you convert the x-limits to t-limits correctly and check the direction of traversal; reversing limits changes the sign of your answer.

Prompt 65: Implicit Differentiation — Further Applications

Copy this prompt into your AI tool:

Ask me to use implicit differentiation to find dy/dx for curves such as x^3 + y^3 = 3xy or e^(xy) = x + y. Then ask me to find the second derivative d^2y/dx^2 implicitly. Assess my handling of the product rule on mixed terms.

What this helps you practise:

Advanced implicit differentiation including second derivatives and exponential terms

How to use it well:

When finding the second derivative implicitly, you will need to substitute your expression for dy/dx back in; keep your working organised to avoid errors.

Prompt 66: Further Algebraic Division and Remainders

Copy this prompt into your AI tool:

You are an A-Level examiner. Give me a polynomial of degree 4 or higher and ask me to divide it by a quadratic expression. Then ask me to express the

result in the form f(x) = q(x)d(x) + r(x) and verify my answer. Mark my solution.

What this helps you practise:

Performing polynomial division by quadratic divisors and expressing results with remainders

How to use it well:

Verify your division by multiplying the quotient by the divisor and adding the remainder; if you recover the original polynomial, your division is correct.

Prompt 67: Combining Parametric and Vector Methods

Copy this prompt into your AI tool:

Present me with a problem where a curve is defined parametrically and I must use vectors to find the distance between two points on the curve or prove a geometric property. Ask me to show all working using both parametric and vector techniques.

What this helps you practise:

Integrating parametric and vector methods to solve geometric problems

How to use it well:

These cross-topic questions reflect the synoptic nature of A-Level exams; practise identifying which technique to apply at each stage of a multi-part problem.

Section 7

Statistics — Statistical Distributions and Hypothesis Testing

The statistics component of A-Level Mathematics builds on GCSE data handling to introduce formal probability distributions, the language of hypothesis testing, and the use of correlation and regression for bivariate data. These tools are essential for interpreting data in a rigorous, mathematical framework.

You must be confident with the binomial and normal distributions, including calculating probabilities, finding unknown parameters, and using the normal approximation to the binomial. Hypothesis testing requires you to formulate hypotheses, calculate test statistics, and draw conclusions using critical values or p-values.

The prompts here progress from distribution fundamentals through to full hypothesis test questions. Many A-Level statistics questions are set in real-world contexts, so practise interpreting your answers in context and using correct statistical language throughout.

Prompt 68: Binomial Distribution — Setup and Probability

Copy this prompt into your AI tool:

Test me on identifying when the binomial distribution is an appropriate model and calculating binomial probabilities. Give me scenarios and ask me to state the conditions, define X ~ B(n, p), and calculate P(X = k), P(X <= k), and P(X >= k). Check my use of the formula and tables.

What this helps you practise:
Modelling with the binomial distribution and calculating cumulative probabilities
How to use it well:
Always check the four conditions for a binomial model: fixed number of trials, two outcomes, constant probability, and independence. State these when setting up your model.

Prompt 69: Normal Distribution — Standard and General
Copy this prompt into your AI tool:
Quiz me on the normal distribution. Ask me to calculate probabilities for both standard normal Z ~ N(0,1) and general normal X ~ N(mu, sigma^2) distributions. Include problems requiring me to standardise and use the inverse normal function. Check my z-score calculations.
What this helps you practise:
Calculating probabilities and finding values using the normal distribution
How to use it well:
Always draw a sketch of the normal curve, shade the required area, and standardise before looking up values; this systematic approach prevents errors with symmetry and tails.

Prompt 70: Finding Unknown Parameters
Copy this prompt into your AI tool:
Give me an A-Level style problem where X ~ N(mu, sigma^2) and I am given probability information to find an unknown mean or standard deviation. Include a problem where I must set up and solve simultaneous equations using two probability conditions. Assess my algebra.

What this helps you practise:

Determining unknown normal distribution parameters from given probability information

How to use it well:

These questions require you to work backwards from probabilities to z-values to equations; practise the reverse process until it feels as natural as forward calculations.

Prompt 71: Normal Approximation to the Binomial

Copy this prompt into your AI tool:

Present me with a binomial distribution problem where n is large and ask me to approximate probabilities using the normal distribution. Ask me to state the conditions for the approximation to be valid and to apply the continuity correction. Check my correction is in the right direction.

What this helps you practise:

Applying the normal approximation to the binomial with continuity correction

How to use it well:

The continuity correction adjusts by 0.5 in the direction that makes the normal probability approximate the discrete probability; sketch a bar chart and a curve to visualise which way to adjust.

Prompt 72: Correlation and Regression

Copy this prompt into your AI tool:

Give me a bivariate data set and ask me to calculate the product moment correlation coefficient. Then ask me to find the equation of the regression line of y on x and use it for prediction. Ask me to evaluate the reliability of my prediction, distinguishing interpolation from extrapolation.

What this helps you practise:

Calculating correlation coefficients, fitting regression lines, and evaluating predictions

How to use it well:

Always comment on whether a prediction involves interpolation or extrapolation, and assess the strength of correlation before making predictions; examiners specifically reward this critical evaluation.

Prompt 73: Hypothesis Testing — Binomial

Copy this prompt into your AI tool:

You are an A-Level examiner. Set me a one-tailed hypothesis test for the proportion p of a binomial distribution. Ask me to state the null and alternative hypotheses, find the critical region, compare with the observed value, and write a conclusion in context. Mark my solution.

What this helps you practise:

Conducting hypothesis tests for proportions using the binomial distribution

How to use it well:

Your conclusion must be written in context, using non-definitive language such as 'there is sufficient evidence to suggest that...' rather than stating the result as fact.

Prompt 74: Hypothesis Testing — Normal Distribution

Copy this prompt into your AI tool:

Set me a hypothesis test for the mean of a normal distribution with known variance. Include both one-tailed and two-tailed examples. Ask me to calculate the test statistic, compare with the critical value, and state my conclusion clearly. Check that I use the correct significance level for the two-tailed test.

What this helps you practise:

Performing hypothesis tests for the mean using the normal distribution

How to use it well:

For a two-tailed test at the 5% level, use z-critical values for 2.5% in each tail; a very common exam error is using 5% in each tail instead.

Prompt 75: Interpreting Correlation Hypothesis Tests

Copy this prompt into your AI tool:

Give me the product moment correlation coefficient for a sample and ask me to test whether there is significant correlation in the population. Provide critical value tables and ask me to carry out the test at a given significance level. Ask me to interpret the result in context.

What this helps you practise:

Testing for significant correlation using PMCC and critical value tables

How to use it well:

Remember that a significant correlation does not imply causation; always state this caveat in your conclusion when discussing the relationship between variables.

Prompt 76: Probability and Venn Diagrams at A-Level

Copy this prompt into your AI tool:

Quiz me on probability and Venn diagrams at A-Level standard. Present problems involving two or three events and ask me to construct Venn diagrams, calculate probabilities of unions, intersections, and complements, and determine whether events are independent or mutually exclusive. Include conditional probability questions that require reading from the diagram. After each

answer, check my diagram and probability calculations. Present one question at a time and wait for my response.

What this helps you practise:

Calculating conditional probabilities and testing for independence using diagrams and formulae

How to use it well:

Two events are independent if and only if P(A and B) = P(A) x P(B); check this condition explicitly rather than assuming independence from context.

Prompt 77: Large Data Set Awareness

Copy this prompt into your AI tool:

Ask me questions about working with large data sets as required by A-Level specifications. Quiz me on the types of questions that use the large data set, what I should know about its structure, and how sampling methods apply. Ask me to interpret summary statistics in context.

What this helps you practise:

Understanding large data set context and sampling methods as required by exam boards

How to use it well:

Familiarise yourself with your exam board's specific large data set; questions may assume you know its structure, variables, and any quirks in the data.

Prompt 78: Statistical Problem-Solving in Context

Copy this prompt into your AI tool:

Give me an extended A-Level statistics problem set in a real-world context. Require me to choose an appropriate distribution, calculate probabilities, perform a hypothesis test, and evaluate my findings critically. Assess whether I communicate my statistical reasoning using correct terminology.

What this helps you practise:

Applying statistical methods to contextual problems with critical evaluation

How to use it well:

These multi-part questions mirror the style of A-Level exam papers; practise writing your answers as a coherent statistical argument rather than isolated calculations.

Section 8

Mechanics — Forces, Motion, and Kinematics

Mechanics at A-Level applies mathematical methods to the physical world, modelling motion, forces, and equilibrium with precision. You must be comfortable using SUVAT equations, Newton's laws, and vector methods to analyse a range of problems involving particles and connected bodies.

The topics in this section include kinematics in one and two dimensions, projectile motion, Newton's laws applied to systems of particles, moments, and equilibrium. These problems require careful force diagrams and systematic application of equations of motion.

These prompts progress from straightforward kinematics recall through to complex connected particle and projectile problems. Drawing a clear, labelled force diagram before writing any equations is the single most important habit you can develop for mechanics.

Prompt 79: SUVAT Equations

Copy this prompt into your AI tool:

Test me on the SUVAT equations for constant acceleration in mechanics. Give me problems that require selecting and applying the correct equation from the set. Include problems where I need to determine which quantities are known and which equation to use, multi-stage problems involving different phases of motion, and problems requiring the use of more than one equation. After each answer, check my equation choice and working. Present one problem at a time.

What this helps you practise:

Selecting and applying SUVAT equations to solve constant acceleration problems

How to use it well:

Before choosing an equation, list which quantities you know and which you need to find; this helps you select the correct SUVAT formula without trial and error.

Prompt 80: Velocity-Time and Displacement-Time Graphs

Copy this prompt into your AI tool:

Present me with velocity-time and displacement-time graphs and ask me to interpret them. Ask me to find acceleration from a v-t graph, displacement from the area under a v-t graph, and velocity from the gradient of an s-t graph. Include multi-stage journeys.

What this helps you practise:

Interpreting and analysing kinematics graphs for multi-stage motion

How to use it well:

Remember that the area under a v-t graph represents displacement and can be negative if the velocity is negative; handle areas below the time axis carefully.

Prompt 81: Newton's Second Law — Single Particles

Copy this prompt into your AI tool:

Give me problems involving a single particle subject to multiple forces. Ask me to draw a force diagram, resolve forces, and apply $F = ma$ to find unknown forces or accelerations. Include problems with friction and air resistance. Assess the quality of my force diagrams.

What this helps you practise:
Applying Newton's second law to single particle problems with multiple forces
How to use it well:
Always start with a clearly labelled force diagram showing all forces acting on the particle; examiners can award marks for a correct diagram even if your algebra contains errors.

Prompt 82: Connected Particles — Pulleys
Copy this prompt into your AI tool:
Set me an A-Level style question involving two particles connected by a light inextensible string over a smooth pulley. Ask me to find the acceleration of the system and the tension in the string. Then modify the problem to include a rough surface and ask me to incorporate friction.
What this helps you practise:
Solving connected particle problems with pulleys including friction
How to use it well:
Draw separate force diagrams for each particle and write an equation of motion for each; the key constraint is that both particles share the same magnitude of acceleration.

Prompt 83: Connected Particles — Towing
Copy this prompt into your AI tool:
Present me with a problem where a car tows a trailer along a horizontal road via a towbar. Ask me to model the system, find the acceleration, and calculate the tension in the towbar. Then ask me what happens when the car brakes. Check my treatment of the thrust/tension switch.
What this helps you practise:
Modelling towing problems with towbars and analysing braking scenarios

How to use it well:

When braking, the towbar changes from tension to thrust (compression); identify this transition and adjust your force diagrams and equations accordingly.

Prompt 84: Projectile Motion

Copy this prompt into your AI tool:

Give me an A-Level projectile motion problem where a particle is launched at an angle to the horizontal. Ask me to resolve the initial velocity into components, find the time of flight, maximum height, and range. Then ask me to find the speed and direction of motion at a given time.

What this helps you practise:

Analysing projectile motion by resolving into horizontal and vertical components

How to use it well:

Treat horizontal and vertical motion independently: horizontal velocity is constant, vertical motion has acceleration g. Always state your positive direction convention clearly.

Prompt 85: Momentum and Impulse

Copy this prompt into your AI tool:

Quiz me on the principles of momentum and impulse. Give me problems involving collisions between particles where I must apply conservation of momentum. Include one problem where I must determine whether a collision is elastic by checking kinetic energy. Verify my calculations.

What this helps you practise:

Applying conservation of momentum and impulse-momentum theorem to collision problems

How to use it well:

Define a positive direction before writing your momentum equation; sign errors in momentum

problems are extremely common and can be eliminated with a clear convention.

Prompt 86: Moments and Equilibrium

Copy this prompt into your AI tool:

You are an A-Level examiner. Set me a question involving moments about a point. Include a rigid body (such as a beam) with multiple forces acting on it. Ask me to take moments about a suitable point, resolve forces, and find unknown forces or distances. Mark my solution.

What this helps you practise:

Calculating moments about a point and solving equilibrium problems for rigid bodies

How to use it well:

Choose your pivot point strategically to eliminate unknowns from the moment equation; taking moments about the point where an unknown force acts simplifies the problem significantly.

Prompt 87: Resolving Forces on Inclined Planes

Copy this prompt into your AI tool:

Present me with a particle on an inclined plane at angle theta to the horizontal. Ask me to resolve forces parallel and perpendicular to the plane, find the normal reaction, and determine the acceleration. Include friction with a given coefficient. Check my angle work.

What this helps you practise:

Resolving forces parallel and perpendicular to inclined planes with friction

How to use it well:

The weight component parallel to the plane is mg sin(theta) and perpendicular is mg cos(theta); draw the angle in your force diagram to confirm you have these the correct way round.

Prompt 88: Projectile Motion from Elevated Positions

Copy this prompt into your AI tool:

Give me a projectile problem where the particle is launched horizontally from a height, or at an angle from the top of a cliff. Ask me to find where and when it lands, and the speed at impact. Include a problem where I must find the angle of elevation of the projectile from a ground observer at a given instant.

What this helps you practise:

Solving projectile problems with non-zero initial height and complex trajectories

How to use it well:

Set up your coordinate system with the origin at the launch point and be consistent with sign conventions for displacement and acceleration throughout.

Prompt 89: Equilibrium of Forces in Two Dimensions

Copy this prompt into your AI tool:

Ask me to solve problems involving a particle in equilibrium under three or more coplanar forces. Require me to resolve forces in two perpendicular directions and solve the resulting simultaneous equations. Include forces given in magnitude-direction form and in i-j vector form.

What this helps you practise:

Resolving coplanar forces in two dimensions to solve equilibrium problems

How to use it well:

For three-force equilibrium problems, consider using a triangle of forces as an alternative to resolving; this can sometimes simplify the working considerably.

Section 9

Mechanics — Further Dynamics and Applications

Further dynamics at A-Level extends kinematics and Newton's laws to situations where acceleration is not constant. Using calculus, you can model variable acceleration problems by differentiating and integrating velocity and displacement functions with respect to time.

This section also covers more demanding applications of forces, including problems involving multiple connected particles on inclined planes, friction in detailed scenarios, and the analysis of pulleys with resistance. These problems require confident multi-step problem-solving and careful algebraic manipulation.

The prompts here are designed to push your mechanics skills to A-Level standard and beyond. Many of these problems combine techniques from across the mechanics specification and require you to make modelling assumptions, solve complex systems, and interpret your results physically.

Prompt 90: Variable Acceleration — Using Calculus

Copy this prompt into your AI tool:

Test me on variable acceleration. Give me a velocity-time function v(t) and ask me to find the acceleration at a given time by differentiating, and the displacement over an interval by integrating. Then give me an acceleration function and ask me to find v(t) and s(t) using initial conditions.

What this helps you practise:

Analysing variable acceleration using differentiation and integration of kinematic functions

How to use it well:

Remember that acceleration = dv/dt and velocity = ds/dt; when integrating, always determine the constant of integration from the given initial conditions.

Prompt 91: Displacement, Velocity, and Acceleration Relationships

Copy this prompt into your AI tool:

Give me a position vector as a function of time, r(t), in two dimensions. Ask me to differentiate to find velocity and acceleration vectors, and then ask me to find the speed and magnitude of acceleration at a specific time. Check my vector calculus.

What this helps you practise:

Differentiating position vectors to find velocity and acceleration in two dimensions

How to use it well:

Speed is the magnitude of the velocity vector, not the velocity itself; always find the components first, then calculate the magnitude using Pythagoras.

Prompt 92: Variable Force Problems

Copy this prompt into your AI tool:

Present me with a problem where a force varies with position or time. Ask me to use $F = ma$ where $a = v(dv/ds)$ or $a = dv/dt$ to set up and solve a differential equation for the velocity. Include a problem involving a resistive force proportional to velocity.

What this helps you practise:

Solving problems with position- or velocity-dependent forces using calculus

How to use it well:

Choose the correct form of acceleration based on the given information: use dv/dt when force depends on time, and v(dv/ds) when force depends on position.

Prompt 93: Work, Energy, and Power

Copy this prompt into your AI tool:

Quiz me on work done, kinetic energy, potential energy, and power at A-Level. Give me problems where I must use the work-energy theorem and conservation of energy. Include a problem involving power output of a vehicle moving at constant velocity against resistive forces.

What this helps you practise:

Applying work-energy theorem and power calculations to mechanical systems

How to use it well:

At constant velocity, the driving force equals the total resistive force, so power = Fv can be applied directly; this is a key insight for vehicle mechanics problems.

Prompt 94: Friction — Detailed Analysis

Copy this prompt into your AI tool:

Set me a challenge: present a problem where friction plays a critical role. Include a body on a rough surface where I must determine whether it moves or remains in static equilibrium. Ask me to find the coefficient of friction from given information and apply the friction model $F <= mu R$.

What this helps you practise:

Analysing static and kinetic friction including limiting equilibrium

How to use it well:

Friction force equals mu R only when the body is on the point of moving or is moving; for a body in

equilibrium, friction may be less than its maximum value.

Prompt 95: Connected Particles on Inclined Planes

Copy this prompt into your AI tool:

Give me an A-Level problem involving two particles connected by a string where one is on an inclined plane and the other hangs vertically. Include friction. Ask me to determine whether the system moves and, if so, to find the acceleration and tension. Assess my force diagrams.

What this helps you practise:

Solving systems of connected particles on inclined planes with friction

How to use it well:

Consider the direction of motion carefully before assigning signs in your equations; if you assume the wrong direction, you will get a negative acceleration indicating the system moves the other way.

Prompt 96: Pulleys and Strings — Multiple Configurations

Copy this prompt into your AI tool:

Quiz me on pulleys and strings with multiple configurations in mechanics. Present problems involving smooth and rough pulleys, connected particles on inclined planes, and systems with more than two masses. Ask me to draw clear diagrams, apply Newton's second law to each particle, and solve for accelerations and tensions. After each answer, check my free-body diagrams and equations of motion. Present one problem at a time and wait for my response.

What this helps you practise:

Analysing pulley systems with light inextensible strings and smooth pulleys

How to use it well:

The assumptions of a light inextensible string and smooth pulley mean the tension is the same throughout the string and the pulley only redirects the force; state these assumptions explicitly.

Prompt 97: Motion Under Gravity with Resistance

Copy this prompt into your AI tool:

Give me a problem where a ball is thrown vertically upward and experiences air resistance proportional to its speed. Ask me to set up separate differential equations for the upward and downward phases of motion and solve for the velocity and displacement.

What this helps you practise:

Modelling vertical motion with speed-dependent air resistance

How to use it well:

The upward and downward phases have different equations because air resistance always opposes motion; handle the change of direction explicitly in your working.

Prompt 98: Energy Methods in Complex Systems

Copy this prompt into your AI tool:

You are an A-Level examiner. Set me a problem requiring energy conservation to find the velocity of a particle after moving along a surface with both smooth and rough sections. Ask me to account for work done against friction. Mark my solution step by step.

What this helps you practise:

Using energy conservation with friction losses to solve multi-stage mechanics problems

How to use it well:

The work-energy approach is often simpler than

using Newton's second law for problems with changing conditions; compare both methods to develop flexibility.

Prompt 99: Mathematical Modelling in Mechanics

Copy this prompt into your AI tool:

Present me with a real-world scenario and ask me to create a mathematical model using mechanics. Ask me to state my modelling assumptions, set up equations, solve them, and then critically evaluate whether the model is realistic. Discuss refinements I could make.

What this helps you practise:

Creating and evaluating mathematical models for real-world mechanical situations

How to use it well:

Examiners increasingly reward the ability to critique models and suggest improvements; practise identifying which assumptions are most significant and what effect relaxing them would have.

Prompt 100: Multi-Topic Mechanics Problem

Copy this prompt into your AI tool:

Set me an extended A-Level mechanics problem that combines kinematics, Newton's laws, energy methods, and moments. The problem should have multiple parts that build on each other. If I get stuck on one part, guide me without giving the answer so I can still attempt later parts.

What this helps you practise:

Solving extended mechanics problems integrating multiple topics and techniques

How to use it well:

In multi-part exam questions, later parts often use answers from earlier parts; if you cannot solve an

earlier part, use the given or stated answer to continue with subsequent parts.

Final Closing Note

You have now worked through 100 prompts designed to help you think more clearly, revise more effectively, and prepare more confidently for your GCSE.

Remember: the goal was never to rely on AI for answers. The goal was to use it as a tool to test, challenge, and strengthen your own understanding.

The strongest students are not those who avoid difficulty, but those who engage with it deliberately. Each mistake you identified, each explanation you improved, and each gap you filled has strengthened your thinking.

As you continue your studies, aim to depend less on prompts and more on your own judgement. AI can support you — but your reasoning, clarity, and persistence are what earn marks.
Approach your exams calmly. Think carefully. Write clearly.
You are more prepared than you think.

Using AI Beyond This Book

The prompts in this book are starting points, not final forms.

As you grow more confident, begin modifying them:

- Add constraints (for example, “limit to three key points”).
- Increase difficulty gradually.
- Ask the AI to challenge your reasoning.
- Request alternative explanations.
- Ask it to critique your thinking rather than provide answers.

The most powerful use of AI is not asking it to tell you things — it is asking it to test and refine your thinking.

In the future, those who understand how to use tools intelligently will have an advantage. Treat AI as a tutor, not a shortcut. The skill of asking better questions will continue to matter long after your exams are over.

About the Author

James R. Martin holds an MSci in Physics from the University of Bristol and a PGCE with a Physics focus from the University of Oxford. He has over a decade of experience teaching and tutoring students aged 11–18 across a range of subjects, including Physics, Biology, Chemistry, Mathematics, Economics, and Electronics.

He has worked with multiple syllabi, including GCSE, A-Level, KS3, and the International Baccalaureate Diploma Programme (IBDP), supporting students of varying abilities to develop clarity, confidence, and exam success.

His work focuses on effective revision strategies, independent thinking, and the responsible use of artificial intelligence as a tool to strengthen — not replace — understanding.

Other Titles in This Series

The *100 AI Prompts for Smarter Revision* series supports students across GCSE, A-Level, and IBDP subjects.

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