IB DP MATHS AA · EXAM SPECIAL · SL & HL · THE NO-CALCULATOR PAPER · ~8 MIN READ

IB Maths AA Paper 1: Non-Calculator Skills and Exact Values

The skills IB Maths AA Paper 1 tests without a calculator: exact trig values and the unit circle, logs, surds and indices, arithmetic shortcuts, sketching by hand, solving trig equations and the slips examiners see every session.

Paper 1 format · Exact trig values · Unit circle & CAST · Indices, logs & surds · Fast arithmetic · Sketching by hand · Trig equations · Calculus without a GDC

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

IN 30 SECONDS

- **Paper 1 is the no-calculator paper** in Maths AA: 80 marks in 1 hour 30 minutes at SL, 110 marks in 2 hours at HL. It is 40% of the SL grade and 30% of the HL grade.
- **The numbers are chosen to work out nicely.** If your arithmetic gives something ugly, such as √7.3 or 0.4286..., check your working.
- **Answers must be exact:** fractions, surds, π, e and ln, not decimals. Examiners repeatedly penalise unfinished forms like $\log_2 16$ or 0.2/0.35.

BY THE END YOU CAN

- Recall exact trig values and the unit circle instantly.
- Use index, log and surd laws fluently without a calculator.
- Sketch graphs and solve equations by hand.
- Present answers in their simplest exact form.

1 The paper at a glance

	SL	HL
Marks	80	110
Time	1 h 30 min	2 h
Weighting	40%	30%
A 7 needed (May 2025)	50–60 out of 80	70–76 out of 110
A 4 needed (May 2025)	18–24 out of 80	26–31 out of 110

- **Section A:** short questions (4–8 marks). **Section B:** a few long questions (14–20 marks each). Section B parts are linked; later parts often use earlier results.
- **5 minutes of reading time:** spot the easy marks and the questions with "exact" in them.

2 Exact trig values

The table to know by heart

θ (degrees)	0°	30°	45°	60°	90°
θ (radians)	0	π/6	π/4	π/3	π/2
sin θ	0	½	√2/2	√3/2	1
cos θ	1	√3/2	√2/2	½	0
tan θ	0	√3/3 (= 1/√3)	1	√3	undefined

- **Memory trick:** sin of 0°, 30°, 45°, 60°, 90° is √0/2, √1/2, √2/2, √3/2, √4/2. Cosine is the same list backwards.
- **Not in the formula booklet.** Neither is the conversion 180° = π radians.

The unit circle and CAST

- **Signs by quadrant** (anticlockwise from the positive x-axis): **A**ll positive in the 1st, **S**in in the 2nd, **T**an in the 3rd, **C**os in the 4th.
- **Related angles:** sin(π − θ) = sin θ; cos(π − θ) = −cos θ; sin(π + θ) = −sin θ; cos(2π − θ) = cos θ; sin(−θ) = −sin θ; cos(−θ) = cos θ.

WORKED EXAMPLE

Find the exact value of cos(5π/6) and of sin(4π/3).

1. 5π/6 = π − π/6 is in the 2nd quadrant, where cos < 0: cos(5π/6) = **−√3/2**
2. **4π/3 = π + π/3 is in the 3rd quadrant, where sin < 0: sin(4π/3) = −√3/2**

WORKED EXAMPLE

Given sin θ = 3/5 and π/2 < θ < π, find cos θ and sin 2θ exactly.

1. $\cos^2\theta = 1 - 9/25 = 16/25$, and cos θ < 0 in the 2nd quadrant, so cos θ = **−4/5**
2. **sin 2θ = 2 sin θ cos θ = 2 × 3/5 × (−4/5) = −24/25**

COMMON MISTAKE

Forgetting the sign. "cos θ = ±4/5" or "4/5" both lose the mark when the quadrant is given.

3 Trig equations by hand

- **Find the basic angle, then every solution in the interval.** Adjust the interval first if the angle is 2x or x + π/3.
- **Don't divide by cos x or sin x**: you lose solutions. Factorise instead.

WORKED EXAMPLE

Solve $2\sin^2 x = \sin x$ for $0 \le x \le 2\pi$.

1. $2\sin^2 x - \sin x = 0 \Rightarrow \sin x(2\sin x - 1) = 0$ M1
2. $\sin x = 0 \Rightarrow x = 0, \pi, 2\pi$ A1
3. $\sin x = \frac{1}{2} \Rightarrow x = \pi/6, 5\pi/6$ A1
4. **$x = 0, \pi/6, 5\pi/6, \pi, 2\pi$**

COMMON MISTAKE

Dividing by sin x first and getting only π/6 and 5π/6. Three solutions lost.

4 Indices, logs and surds

- **Index laws:** $a^m \times a^n = a^{m+n}$; $(a^m)^n = a^{mn}$; $a^{-n} = 1/a^n$; $a^{1/n} = \sqrt[n]{a}$; $a^0 = 1$.
- **Logs** (laws are in the booklet; using them fast isn't): $\log_2 32 = 5$; $\log_3(1/9) = -2$; $\ln e^4 = 4$; $e^{\ln 7} = 7$.
- **Common errors:** $\log(a + b)$ is **not** $\log a + \log b$; $\log 2^3 = 3\log 2$, not $(\log 2)^3$.
- **Surds:** $\sqrt{50} = 5\sqrt{2}$; $(\sqrt{3} + 1)(\sqrt{3} - 1) = 2$. Rationalise with the conjugate: $4/(\sqrt{5} - 1) = 4(\sqrt{5} + 1)/4 = \sqrt{5} + 1$.

WORKED EXAMPLE

Solve $4^x = 8^{x-1}$ exactly.

1. Write both as powers of 2: $2^{2x} = 2^{3(x-1)}$ M1
2. **$2x = 3x - 3 \Rightarrow x = 3$** A1

WORKED EXAMPLE

Solve $\log_2 x + \log_2(x - 2) = 3$.

1. $\log_2(x(x - 2)) = 3 \Rightarrow x^2 - 2x = 8$ [M1A1]
2. $(x - 4)(x + 2) = 0 \Rightarrow x = 4$ or $x = -2$ A1
3. **$x - 2 > 0$, so reject -2: $x = 4$** R1

5 Arithmetic without a calculator

- **Fractions before decimals:** 0.2/0.35 = 20/35 = 4/7. Leave π, e and surds in the answer.
- **Cancel before multiplying:** (12 × 35)/(14 × 15) = 2.
- **Squares to know:** 11^2 to 20^2 (121, 144, 169, 196, 225, 256, 289, 324, 361, 400), and $25^2 = 625$.
- **Powers:** $2^{10} = 1024$, $3^5 = 243$, $5^4 = 625$.
- **Binomial coefficients from Pascal's triangle:** row 5 is 1, 5, 10, 10, 5, 1; row 6 is 1, 6, 15, 20, 15, 6, 1.
- **Check each line.** Most lost Paper 1 marks are sign or bracket slips: $(-2)^2 = 4$, $(2x)^3 = 8x^3$, $-(x - 3) = -x + 3$.

6 Sketching by hand

- **Mark the key points with exact values:** intercepts, turning points, asymptotes (as equations, e.g. $y = 3/2$), endpoints of the domain.
- **Quadratics:** vertex form $a(x - h)^2 + k$ gives the vertex (h, k) directly.
- **Rational functions:** vertical asymptote where the denominator is 0; horizontal asymptote from the leading coefficients.
- I**f(x)**I**:** reflect the parts below the x-axis upwards. **f(**I**x**I**):** reflect the right-hand part in the y-axis.

7 Calculus without a GDC

- **Rewrite first:** $5/x^2 = 5x^{-2}$; $\sqrt{x} = x^{1/2}$.
- **Remember the inside derivative:** $\int e^{2x}\,dx = \frac{1}{2}e^{2x} + C$; $\int 1/(2x + 1)\,dx = \frac{1}{2}\ln|2x + 1| + C$.
- **Definite integrals in exact form:** $\int_0^{\pi/2} \cos x\,dx = \sin(\pi/2) - \sin 0 = 1$.
- **Tangent and normal lines:** find the gradient by substituting into $f'(x)$, then $y - y_1 = m(x - x_1)$. The normal gradient is $-1/m$.

COMMON MISTAKE

Leaving answers like $\ln 1$ or e^0 unsimplified: they are 0 and 1.

8 Final form of answers

- **Simplify to integers when possible:** write 3, not $\sqrt{9}$ or $6/2$.
- **Fractions don't need to be in lowest terms,** but the top and bottom must be integers.
- **"Exact" means no decimals.** 1.414 is not an exact form of $\sqrt{2}$.
- **Angles in radians** unless the question uses degrees.

LINKING QUESTION

Revise the content behind these skills in Trig identities, equations and graphs, Exponents and logarithms and Integration and kinematics. For what is and isn't given in the exam, see the AA formula booklet guide.

Test yourself — cover the answers first

QUICK CHECK

1. What is the exact value of $\tan(\pi/3)$?
2. What is $\sin(7\pi/6)$?
3. Simplify $3/(\sqrt{3})$.
4. Solve $9^x = 27$.
5. Why can't you divide $\sin x \cos x = \sin x$ by $\sin x$?
6. Simplify $\log_4 8$.

Show answers

1. √3
2. −½
3. √3
4. x = 3/2
5. you lose the solutions where sin x = 0
6. 3/2

Stuck on a question?

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