

INTUITION EDUCATION

HSC 2026 · PREDICTED PRACTICE PAPER

2026 HSC Mathematics Advanced

*Answers & marking notes***Paper total: 100 marks**

Sit the paper first. These are worked answers with the marking notes behind them — what earns the mark, and the traps the marking centre has flagged in past years. Where a note names a band, it describes what a top-band response does, not a guaranteed mark.

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Answers & marking notes

Section I — correct responses

Q	1	2	3	4	5	6	7	8	9	10
Answer	C	B	D	A	B	C	B	C	A	D

Brief reasons:

- Need $4 - x^2 > 0$ (strict — the surd is in a denominator): $-2 < x < 2$. Distractor A closes the endpoints; D forgets the radicand must be positive, not merely non-zero. **C**
- $2x = 4 \Rightarrow x = 2$, $y = f(4) + 1 = 4$: the point is $(2, 4)$. Distractor A doubles instead of halving; C forgets the $+1$. **B**
- An extreme high outlier drags the mean strongly; the median moves at most to the next data value. **D**
- Amplitude 2 about centre 3: $[3 - 2, 3 + 2] = [1, 5]$; the 4 affects only the period. **A**
- $h'(1) = f'(g(1)) \cdot g'(1) = f'(2) \times 6 = 3 \times 6 = 18$. Distractor A uses $f'(1) \cdot g'(1) = 24$. **B**
- $3 - x > 0 \Rightarrow x < 3$ (strict inequality — $\ln 0$ undefined). **C**
- $E(X) = 0(0.2) + 1(0.5) + 2(0.3) = 1.1$. Distractor D is $E(X^2) = 1.7$. **B**
- $P(-1 < Z < 2) = 34\% + 47.5\% = 81.5\%$. **C**
- $f(-x) = -x^3 + x = -f(x)$ for $f(x) = x^3 - x$; the others fail $f(-x) = -f(x)$. **A**
- f' changes sign from positive to negative at $x = 2$: local **maximum** of f . At $x = 3$, $f' < 0$ so f is decreasing (C wrong); B confuses the zero of f' with a zero of f'' . **D**

Question 11

- (a) $T_n = 6 + 5(n - 1) = 5n + 1$. Setting $5n + 1 = 2026$ gives $n = 405$, a positive integer — so 2026 is the 405th term. (1 mark forming T_n , 1 mark solving and stating n integer.)
- (b) $S_{405} = \frac{405}{2}(6 + 2026) = 405 \times 1016 = 411\,480$.

Question 12

- (a) $0.1 + 0.3 + k + 0.2 = 1 \Rightarrow k = 0.4$.
- (b) $E(X) = 0.1 + 0.6 + 1.2 + 0.8 = 2.7$. $E(X^2) = 0.1 + 1.2 + 3.6 + 3.2 = 8.1$, so
 $\text{Var}(X) = 8.1 - 2.7^2 = 0.81$ and $\sigma = 0.9$. (Marking note: the recurring flag — the standard deviation is the square root of the variance.)

Question 13

$$\text{LHS} = \frac{(1 - \sin \theta) + (1 + \sin \theta)}{(1 + \sin \theta)(1 - \sin \theta)} = \frac{2}{1 - \sin^2 \theta} = \frac{2}{\cos^2 \theta} = 2 \sec^2 \theta = \text{RHS. (Work one side only; 1 mark common denominator, 1 mark Pythagorean identity and completion.)}$$

Question 14

- (a) $x^2 + 2 \geq 2 > 0$ for all x , so the domain is all real x .
- (b) The denominator has minimum value 2 (at $x = 0$), so h has maximum value $\frac{3}{2}$.
- (c) As $|x| \rightarrow \infty$, $h(x) \rightarrow 0^+$ but never reaches 0: range is $0 < h(x) \leq \frac{3}{2}$, i.e. $(0, \frac{3}{2}]$.

Question 15

- (a) $\frac{dy}{dx} = 2x \ln x + x^2 \cdot \frac{1}{x} = 2x \ln x + x$.
- (b) From (a), $\int (2x \ln x + x) dx = x^2 \ln x$, so
- $$\int x \ln x dx = \frac{1}{2} \left(x^2 \ln x - \frac{x^2}{2} \right) + C = \frac{x^2 \ln x}{2} - \frac{x^2}{4} + C. \text{ (The "hence" is compulsory in spirit:}$$
- recognition, not integration by parts, which is not in this course.)

Question 16

- (a) $P(D) = 0.5(0.02) + 0.3(0.04) + 0.2(0.05) = 0.01 + 0.012 + 0.01 = 0.032$. (1 mark converting the ratio 5 : 3 : 2 to 0.5, 0.3, 0.2; 1 mark total probability.)
- (b) $P(C | D) = \frac{P(C \cap D)}{P(D)} = \frac{0.01}{0.032} = \frac{5}{16} = 0.3125$. (The conditioning event is the *outcome* — the reduced sample space is the defective items.)

Question 17

- (a) 6% p.a. quarterly $\Rightarrow r = 1.5\%$ per quarter, $n = 20$ periods: factor 23.124.
 $FV = 2000 \times 23.124 = \$46\,248$.
- (b) 8% p.a. quarterly $\Rightarrow r = 2\%$, $n = 24$: factor 30.422. Deposit = $\frac{80\,000}{30.422} = \$2629.68$. (**Divide** by the factor — the unknown is the contribution.)
- (c) Total deposits = $24 \times 2629.68 = \$63\,112.32$; interest = $80\,000 - 63\,112.32 = \$16\,887.68$.

Question 18

$$\frac{f(x+h) - f(x)}{h} = \frac{(x+h)^2 - 3(x+h) - x^2 + 3x}{h} = \frac{2xh + h^2 - 3h}{h} = 2x + h - 3. \text{ As } h \rightarrow 0,$$

$$f'(x) = 2x - 3. \text{ (1 mark correct expansion of the difference quotient, 1 mark taking the limit.)}$$

Question 19

- (a) $\Delta L = 30 = 10 \log_{10} \left(\frac{I_1}{I_2} \right) \Rightarrow \frac{I_1}{I_2} = 10^3 = 1000$ times more intense.
- (b) $\frac{I_P}{I_Q} = 10^{6/10} = 10^{0.6} \approx 3.98 \approx 4$.

Question 20

$(5 - k)^2 + k = 11 \Rightarrow 25 - 10k + k^2 + k = 11 \Rightarrow k^2 - 9k + 14 = 0 \Rightarrow (k - 2)(k - 7) = 0$, so $k = 2$ or $k = 7$. Since $0 < k < 5$, reject $k = 7$: $k = 2$. (1 mark substituting the point into the transformed equation — apply the translation to the *equation*, not the coordinate; 1 mark solving the quadratic; 1 mark the explicit rejection. Both roots satisfy the equation — the rejection must cite the condition.)

Question 21

(a) $h = 1$: $\int_0^4 f(x) dx \approx \frac{1}{2}[2 + 9.2 + 2(2.9 + 4.4 + 6.5)] = \frac{1}{2}(11.2 + 27.6) = 19.4$. (Five function values = four applications; the flagged error is confusing the two counts.)

(b) Concave up $\Rightarrow$ each chord lies **above** the curve, so the estimate is **greater** than the exact value (an overestimate).

Question 22

(a) $x^2 - 4x = 2x - x^2 \Rightarrow 2x^2 - 6x = 0 \Rightarrow 2x(x - 3) = 0 \Rightarrow x = 0, 3$.

(b) At $x = 1$: $2x - x^2 = 1$ and $x^2 - 4x = -3$, so $y = 2x - x^2$ lies above.

(c) $A = \int_0^3 [(2x - x^2) - (x^2 - 4x)] dx = \int_0^3 (6x - 2x^2) dx = \left[3x^2 - \frac{2x^3}{3}\right]_0^3 = 27 - 18 = 9$ square units. (Subtract in the correct order; substitute limits with brackets.)

Question 23

(a) $z = \frac{514 - 505}{6} = 1.5$: $P(X < 514) = 0.9332$.

(b) z -scores -1 and 1.5 : $P = 0.9332 - (1 - 0.8413) = 0.9332 - 0.1587 = 0.7745$. (1 mark both z -scores, 1 mark symmetry for the lower tail.)

(c) $P(X > 514) = 0.0668$: expected number $= 2000 \times 0.0668 = 133.6 \approx 134$ bags.

(d) $0.0808 = 1 - 0.9192 \Rightarrow z = -1.4$: mass $= 505 - 1.4 \times 6 = 496.6$ g. (Reverse use of the table with symmetry.)

Question 24

(a) $1200 = 800e^{5k} \Rightarrow e^{5k} = \frac{3}{2} \Rightarrow k = \frac{1}{5} \ln \frac{3}{2} \approx 0.0811$.

(b) $N(10) = 800e^{10k} = 800(e^{5k})^2 = 800 \times \left(\frac{3}{2}\right)^2 = 1800$ exactly.

(c) $N'(t) = kN(t)$, so $N'(10) = 0.0811 \times 1800 \approx 146$ bacteria per hour. ("Rate" means the derivative — the perennial flag.)

(d) $800e^{kt} = 3000 \Rightarrow e^{kt} = 3.75 \Rightarrow t = \frac{\ln 3.75}{k} \approx \frac{1.3218}{0.0811} \approx 16.3$ hours.

Question 25

- (a) The back-bearing from Q to P is $040^\circ + 180^\circ = 220^\circ$; the bearing of R from Q is 150° ; hence $\angle PQR = 220^\circ - 150^\circ = 70^\circ$.
- (b) $PR^2 = 9^2 + 7^2 - 2(9)(7) \cos 70^\circ = 130 - 126 \cos 70^\circ \approx 86.91$, so $PR \approx 9.32$ km. (Cosine rule — no right angle is available.)
- (c) Sine rule: $\frac{\sin \angle QPR}{7} = \frac{\sin 70^\circ}{9.32} \Rightarrow \sin \angle QPR \approx 0.7055 \Rightarrow \angle QPR \approx 45^\circ$ (acute, since the largest angle is at Q , opposite the longest side). Bearing of R from $P = 040^\circ + 45^\circ = 085^\circ$. (Convert the internal angle to a bearing — the flagged step.)

Question 26

- (a) For each additional hour of revision, the predicted test score increases by 4.2 marks. (Context and value both required.)
- (b) $\hat{y} = 4.2(6) + 38 = 63.2$.
- (c) $x = 20$ is far outside the observed data range (\$1 to 8 hours)—*extrapolation; the line predicts 4.2(20) + 38 = 122, an impossible score out of 100\$*.
- (d) The gradient measures the *rate of change* of predicted score, not the strength of the association; the correlation is measured by $r = 0.87$. A steep line can have weak correlation and vice versa.

Question 27

- (a) $\int_0^4 k(4-x) dx = k \left[4x - \frac{x^2}{2} \right]_0^4 = 8k = 1 \Rightarrow k = \frac{1}{8}$.
- (b) $F(x) = \int_0^x \frac{4-t}{8} dt = \frac{1}{8} \left(4x - \frac{x^2}{2} \right) = \frac{8x - x^2}{16}$ (and $F(4) = 1$, as required).
- (c) $F(m) = \frac{1}{2}: 8m - m^2 = 8 \Rightarrow m^2 - 8m + 8 = 0 \Rightarrow m = 4 \pm 2\sqrt{2}$. Since $0 \leq m \leq 4$, the median is $m = 4 - 2\sqrt{2}$. (Equate the **CDF** to 0.5 — pdf/CDF confusion is the flagged error.)
- (d) f is decreasing on $[0, 4]$, so its maximum is at the left endpoint: the mode is $x = 0$. (Do not differentiate — the monotone-density endpoint trap.)
- (e) $P(X > 2) = 1 - F(2) = 1 - \frac{12}{16} = \frac{1}{4}$.

Question 28

- (a) Product rule: $f'(x) = e^{-x} + x(-e^{-x}) = (1-x)e^{-x}$.
- (b) $f'(x) = 0 \Rightarrow x = 1$ (as $e^{-x} \neq 0$): stationary point $(1, e^{-1})$. For $x < 1$, $f' > 0$; for $x > 1$, $f' < 0$: a local **maximum**. (Reject $e^{-x} = 0$; justify the nature.)
- (c) $f''(x) = -e^{-x} - (1-x)e^{-x} = (x-2)e^{-x}$. $f''(2) = 0$, and f'' changes sign at $x = 2$ (negative before, positive after) — concavity **changes**, so $(2, 2e^{-2})$ is a point of inflection. ($f'' = 0$ alone is not sufficient.)
- (d) Curve through the origin, rising to the maximum $(1, e^{-1})$, inflection at $x = 2$, then decreasing and approaching the asymptote $y = 0$ from above as $x \rightarrow \infty$; unbounded below as $x \rightarrow -\infty$.

Question 29

- (a) Centre = $\frac{9+3}{2} = 6 = A$; amplitude = $\frac{9-3}{2} = 3 = B$. (Check: period = $\frac{2\pi}{\pi/6} = 12$ h, maximum 9 at $t = 0$, minimum 3 at $t = 6$. ✓)
- (b) One full cosine cycle from $(0, 9)$ down to $(6, 3)$ and back to $(12, 9)$, passing through $(3, 6)$ and $(9, 6)$; axes labelled, only the stated domain $[0, 12]$ drawn.
- (c) $6 + 3 \cos \frac{\pi t}{6} \geq 7.5 \Rightarrow \cos \frac{\pi t}{6} \geq \frac{1}{2}$. Within one cycle, $\frac{\pi t}{6} \in [0, \frac{\pi}{3}] \cup [\frac{5\pi}{3}, 2\pi]$, i.e. $t \in [0, 2] \cup [10, 12]$ — a total of 4 hours per cycle. (Adjust the domain before solving; take both quadrant solutions.)

Question 30

- (a) $A_1 = 400\,000(1.005) - M$;
 $A_2 = A_1(1.005) - M = 400\,000(1.005)^2 - M(1.005) - M = 400\,000(1.005)^2 - M(1 + 1.005)$.
- (b) Iterating, $A_n = 400\,000(1.005)^n - M(1 + 1.005 + \dots + (1.005)^{n-1})$. The geometric series (with n terms) sums to $\frac{(1.005)^n - 1}{0.005} = 200((1.005)^n - 1)$, giving the stated form. (1 mark building the series with the correct number of terms — the perennial flag; 1 mark summing.)
- (c) $A_{300} = 0$: $M = \frac{400\,000(1.005)^{300} \times 0.005}{(1.005)^{300} - 1}$. With $(1.005)^{300} \approx 4.46497$:
 $M = \frac{2000 \times 4.46497}{3.46497} \approx \$2577.20$.
- (d) With $M = 3000$: $A_n = 400\,000(1.005)^n - 600\,000((1.005)^n - 1) = 600\,000 - 200\,000(1.005)^n$.
Then $A_n < 200\,000 \Rightarrow (1.005)^n > 2 \Rightarrow n > \frac{\ln 2}{\ln 1.005} \approx 138.98$, so $n = 139$ months. (n must be a whole number of months, rounded **up**.)

Question 31

- (a) $h = \frac{432}{x^2}$. Base and top: area $2x^2$, cost $2 \times 2x^2 = 4x^2$ cents. Sides: area $4xh = \frac{1728}{x}$, cost $1 \times \frac{1728}{x}$ cents. Total $C = 4x^2 + \frac{1728}{x}$.
- (b) $C'(x) = 8x - \frac{1728}{x^2} = 0 \Rightarrow x^3 = 216 \Rightarrow x = 6$. $C''(x) = 8 + \frac{3456}{x^3} > 0$ for $x > 0$, so $x = 6$ gives a minimum. (Verify the nature — the four-times-flagged omission.)
- (c) $C(6) = 4(36) + \frac{1728}{6} = 144 + 288 = 432$ cents = \$4.32. (Answer the quantity asked — the cost, in dollars.)

Prediction provenance

Which consensus prediction each part of this paper realises. Full evidence panels:
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Paper item	Prediction	Agreement
Q31 cost-objective optimisation with nature verification	adv-q1-optimisation-capstone	$0.75 \cdot 6$ (all) — gemini's cost-context structural twist adopted
MC Q1 domain with open/closed endpoint distractors	adv-q2-domain-mc	$0.77 \cdot 5$ (fable, opus, grok, gpt-5.6-sol, deepseek)
Q22 area between two parabolas, intersections first	adv-q3-area-between-curves	$0.72 \cdot 6$ (all) — fresh curves; DeepSeek's pack-grounded $4x - x^2$ not reused
Q30 reducing-balance loan: show A_2 , sum series, log solve	adv-q4-loan-annuity-recurrence	$0.71 \cdot 6$ (all)
Q23 normal with supplied z -table, reverse lookup in (d)	adv-q5-normal-z-table	$0.71 \cdot 6$ (all)
Q27 pdf chain: k , CDF, exact median, endpoint mode	adv-q6-crv-pdf-chain	$0.69 \cdot 6$ (all)
MC Q2 transformation point-mapping + Q20 written variant	adv-q7-graph-transformations	$0.69 \cdot 6$ (all)
Q29 tide model: fit constants, sketch, duration inequality	adv-q8-trig-modelling	$0.69 \cdot 5$ (fable, opus, deepseek, grok, gpt-5.6-sol) — fresh constants, not DeepSeek's illustrative 5.2 m/1.4 m
Q11 arithmetic-series opener with 2026 planted as a term	adv-q9-series-opener	$0.67 \cdot 5$ (grok, opus, fable, gpt-5.6-sol, deepseek)
Q16 ratio-prior tree, then $P(\text{machine} \mid \text{defective})$	adv-q10-conditional-probability	$0.67 \cdot 5$ (fable, deepseek, grok, opus, gpt-5.6-sol) — type only; DeepSeek's canonical disease-test constants not used
Q15 differentiate $x^2 \ln x$, hence $\int x \ln x \, dx$	adv-q11-hence-pair	$0.66 \cdot 5$ (fable, opus, grok, gpt-5.6-sol, deepseek)
Q25 two-leg bearing walk: cosine rule, sine rule, bearing	adv-q12-bearings-3d-trig	$0.66 \cdot 6$ (all)
Q17 future-value factor table: multiply AND divide parts	adv-q13-interest-factor-table	$0.65 \cdot 6$ (all) — the shared 6% p.a. surface detail verified present in the evidence pack (no contamination)
Q26 regression: gradient in context, predict, refuse extrapolation, gradient $\neq r$	adv-q14-regression-scatterplot	$0.64 \cdot 6$ (all)
Q24 exponential growth: find k , rate, threshold time	watch list	$\sim 0.63 \cdot 6$
Q21 trapezoidal rule + concavity overestimate	watch list	$\sim 0.60 \cdot 6$
Q28 curve sketch of xe^{-x} with concavity-change proof	watch list	$\sim 0.62 \cdot 5$
Q12 discrete RV: missing k , $E(X)$, σ	watch list	$\sim 0.55 \cdot 5$
Q14 composite-style range via the denominator's minimum	watch list	$\sim 0.60 \cdot 4$

Paper item	Prediction	Agreement
Q20 equal-shift parabola, quadratic in k , reject a root	watch list	$\sim 0.48 \cdot 4$ (2025 Q30 lineage)
Q13 trig identity by common denominator	watch list	$\sim 0.50 \cdot 3$ (fable, opus, gpt-5.6-sol)
Q18 first principles (MA-C1 coverage-gap comeback)	watch list	$0.50 / 0.30 \cdot \text{deepseek} / \text{opus bold}$ — the panel's only rested topic, realised as the cheap-insurance 2-marker
Q19 logarithmic scale (decibels) — never examined 2020–25	watch list	$0.35 / 0.38 \cdot \text{fable} / \text{gpt-5.6-sol bold}$ coverage-gap calls
MC Q5 chain rule from tabulated values	watch list	$\sim 0.55 \cdot 3$ (fable, grok, gemini variant)
MC Q3 outlier effect on mean vs median; MC Q7 $E(X)$; MC Q4 trig range; MC Q6 $\ln$ domain; MC Q8 empirical rule; MC Q9 odd function; MC Q10 reasoning from f'	topic-level consensus	— · —
Not realised (closest cuts): arc/sector/segment (5 models, ~ 0.51), parallel box plots (4, ~ 0.53), trig equation quadratic in $\cos$ (gemini 0.75/deepseek 0.50), ambiguous-case sine rule revival, parameter-count trig finale (~ 0.49)	watch list	— · —

Built by an AI panel and backtested against the hidden 2025 papers before publication — method at intuitioneducation.com.au/hsc-2026/how-we-did-it. Scored publicly in November 2026. Independent Intuition Education material from publicly available NESA documents; not affiliated with or endorsed by NESA.