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:

1. 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**
2. $2x = 4 \Rightarrow x = 2$, $y = f(4) + 1 = 4$: the point is $(2, 4)$. Distractor A doubles instead of halving; C forgets the $+1$. **B**
3. An extreme high outlier drags the mean strongly; the median moves at most to the next data value. **D**
4. Amplitude 2 about centre 3: $[3 - 2,\ 3 + 2] = [1, 5]$; the 4 affects only the period. **A**
5. $h'(1) = f'(g(1)) \cdot g'(1) = f'(2) \times 6 = 3 \times 6 = 18$. Distractor A uses $f'(1) \cdot g'(1) = 24$. **B**
6. $3 - x > 0 \Rightarrow x < 3$ (strict inequality — $\ln 0$ undefined). **C**
7. $E(X) = 0(0.2) + 1(0.5) + 2(0.3) = 1.1$. Distractor D is $E(X^2) = 1.7$. **B**
8. $P(-1 < Z < 2) = 34\% + 47.5\% = 81.5\%$. **C**
9. $f(-x) = -x^3 + x = -f(x)$ for $f(x) = x^3 - x$; the others fail $f(-x) = -f(x)$. **A**
10. 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) $S_{405} = \dfrac{405}{2}(6 + 2026) = 405 \times 1016 = 411\,480$.

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 $\mathrm{Var}(X) = 8.1 - 2.7^2 = 0.81$ and $\sigma = 0.9$. (Marking note: the recurring flag — the standard deviation is the square root of the variance.)

Question 13

LHS $= \dfrac{(1 - \sin\theta) + (1 + \sin\theta)}{(1 + \sin\theta)(1 - \sin\theta)} = \dfrac{2}{1 - \sin^2\theta} = \dfrac{2}{\cos^2\theta} = 2\sec^2\theta$ = 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 $|x| \to \infty$, $h(x) \to 0^+$ but never reaches 0: range is $0 < h(x) \leq \frac{3}{2}$, i.e. $\left(0, \frac{3}{2}\right]$.

Question 15

(a) $\dfrac{dy}{dx} = 2x\ln x + x^2 \cdot \dfrac{1}{x} = 2x\ln x + x$.

(b) From (a), $\int(2x\ln x + x)\,dx = x^2\ln x$, so $\int x\ln x\;dx = \frac{1}{2}\left(x^2\ln x - \frac{x^2}{2}\right) + C = \frac{x^2\ln x}{2} - \frac{x^2}{4} + C$. (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) $P(C \mid D) = \dfrac{P(C\cap D)}{P(D)} = \dfrac{0.01}{0.032} = \dfrac{5}{16} = 0.3125$. (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 $= \dfrac{80\,000}{30.422} = \$2629.68$. (**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

$\dfrac{f(x+h)-f(x)}{h} = \dfrac{(x+h)^2 - 3(x+h) - x^2 + 3x}{h} = \dfrac{2xh + h^2 - 3h}{h} = 2x + h - 3$. As $h \to 0$, $f'(x) = 2x - 3$. (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) $h = 1$: $\displaystyle\int_0^4 f(x)\,dx \approx \frac{1}{2}[2 + 9.2 + 2(2.9 + 4.4 + 6.5)] = \frac{1}{2}(11.2 + 27.6) = 19.4$. (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) $A = \displaystyle\int_0^3 \left[(2x - x^2) - (x^2 - 4x)\right]dx = \int_0^3 (6x - 2x^2)\,dx = \left[3x^2 - \frac{2x^3}{3}\right]_0^3 = 27 - 18 = 9$ square units. (Subtract in the correct order; substitute limits with brackets.)

Question 23

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

(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) $N(10) = 800e^{10k} = 800\left(e^{5k}\right)^2 = 800 \times \left(\frac{3}{2}\right)^2 = 1800$ 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) $800e^{kt} = 3000 \Rightarrow e^{kt} = 3.75 \Rightarrow t = \dfrac{\ln 3.75}{k} \approx \dfrac{1.3218}{0.0811} \approx 16.3$ 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: $\dfrac{\sin\angle QPR}{7} = \dfrac{\sin 70^\circ}{9.32} \Rightarrow \sin\angle QPR \approx 0.7055 \Rightarrow \angle QPR \approx 45^\circ$ (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 ($1*to*8*hours*)—*extrapolation*; *thelinepredicts*4.2(20) + 38 = 122, *animpossiblescoreoutof*100$.

(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) $\displaystyle\int_0^4 k(4 - x)\,dx = k\left[4x - \tfrac{x^2}{2}\right]_0^4 = 8k = 1 \Rightarrow k = \tfrac{1}{8}$.

(b) $F(x) = \displaystyle\int_0^x \tfrac{4-t}{8}\,dt = \tfrac{1}{8}\left(4x - \tfrac{x^2}{2}\right) = \dfrac{8x - x^2}{16}$ (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 $0 \le m \le 4$, 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 $\left(1, e^{-1}\right)$. 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 $\left(2, 2e^{-2}\right)$ is a point of inflection. ($f'' = 0$ alone is not sufficient.)

(d) Curve through the origin, rising to the maximum $\left(1, e^{-1}\right)$, inflection at $x = 2$, then decreasing and approaching the asymptote $y = 0$ from above as $x \to \infty$; unbounded below as $x \to -\infty$.

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, $\frac{\pi t}{6} \in \left[0, \frac{\pi}{3}\right] \cup \left[\frac{5\pi}{3}, 2\pi\right]$, 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, $A_n = 400\,000(1.005)^n - M\left(1 + 1.005 + \cdots + (1.005)^{n-1}\right)$. The geometric series (with n terms) sums to $\dfrac{(1.005)^n - 1}{0.005} = 200\left((1.005)^n - 1\right)$, giving the stated form. (1 mark building the series with the correct number of terms — the perennial flag; 1 mark summing.)

(c) $A_{300} = 0$: $M = \dfrac{400\,000(1.005)^{300} \times 0.005}{(1.005)^{300} - 1}$. With $(1.005)^{300} \approx 4.46497$: $M = \dfrac{2000 \times 4.46497}{3.46497} \approx \$2577.20$.

(d) With $M = 3000$: $A_n = 400\,000(1.005)^n - 600\,000\left((1.005)^n - 1\right) = 600\,000 - 200\,000(1.005)^n$. Then $A_n < 200\,000 \Rightarrow (1.005)^n > 2 \Rightarrow n > \dfrac{\ln 2}{\ln 1.005} \approx 138.98$, so $n = 139$ months. (n must be a whole number of months, rounded **up**.)

Question 31

(a) $h = \dfrac{432}{x^2}$. Base and top: area $2x^2$, cost $2 \times 2x^2 = 4x^2$ cents. Sides: area $4xh = \dfrac{1728}{x}$, cost $1 \times \dfrac{1728}{x}$ cents. Total $C = 4x^2 + \dfrac{1728}{x}$.

(b) $C'(x) = 8x - \dfrac{1728}{x^2} = 0 \Rightarrow x^3 = 216 \Rightarrow x = 6$. $C''(x) = 8 + \dfrac{3456}{x^3} > 0$ for $x > 0$, so $x = 6$ gives a minimum. (Verify the nature — the four-times-flagged omission.)

(c) $C(6) = 4(36) + \dfrac{1728}{6} = 144 + 288 = 432$ 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: intuitioneducation.com.au/hsc-2026

Paper item	Prediction	Agreement
Q31 cost-objective optimisation with nature verification	`adv-q1-optimisation-capstone`	0.75 · 6 (all) — gemini's cost-context structural twist adopted
MC Q1 domain with open/closed endpoint distractors	`adv-q2-domain-mc`	0.77 · 5 (fable, opus, grok, gpt-5.6-sol, deepseek)
Q22 area between two parabolas, intersections first	`adv-q3-area-between-curves`	0.72 · 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 · 6 (all)
Q23 normal with supplied z-table, reverse lookup in (d)	`adv-q5-normal-z-table`	0.71 · 6 (all)
Q27 pdf chain: k, CDF, exact median, endpoint mode	`adv-q6-crv-pdf-chain`	0.69 · 6 (all)
MC Q2 transformation point-mapping + Q20 written variant	`adv-q7-graph-transformations`	0.69 · 6 (all)
Q29 tide model: fit constants, sketch, duration inequality	`adv-q8-trig-modelling`	0.69 · 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 · 5 (grok, opus, fable, gpt-5.6-sol, deepseek)
Q16 ratio-prior tree, then P(machine | defective)	`adv-q10-conditional-probability`	0.67 · 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 · 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 · 6 (all)
Q17 future-value factor table: multiply AND divide parts	`adv-q13-interest-factor-table`	0.65 · 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 ≠ r	`adv-q14-regression-scatterplot`	0.64 · 6 (all)
Q24 exponential growth: find k, rate, threshold time	`watch list`	~0.63 · 6
Q21 trapezoidal rule + concavity overestimate	`watch list`	~0.60 · 6
Q28 curve sketch of xe^{-x} with concavity-change proof	`watch list`	~0.62 · 5
Q12 discrete RV: missing k, $E(X)$, σ	`watch list`	~0.55 · 5
Q14 composite-style range via the denominator's minimum	`watch list`	~0.60 · 4
Q20 equal-shift parabola, quadratic in k, reject a root	`watch list`	~0.48 · 4 (2025 Q30 lineage)
Q13 trig identity by common denominator	`watch list`	~0.50 · 3 (fable, opus, gpt-5.6-sol)
Q18 first principles (MA-C1 coverage-gap comeback)	`watch list`	0.50 / 0.30 · deepseek / 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 · fable / gpt-5.6-sol bold coverage-gap calls
MC Q5 chain rule from tabulated values	`watch list`	~0.55 · 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	`topic-level consensus`	— · —

Paper item	Prediction	Agreement
reasoning from f'		
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.