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FORMULA POSTER

IB Mathematics: Applications & Interpretation SL

2021 syllabus · v2 Oct 2026

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formula-sheet-slai
Interactive version

★ Learn it: not in the IB formula booklet 🕮 In the booklet

Prior learning

🕮 Area: parallelogram, triangle, trapezoid: $A = bh$, $A = \frac{1}{2}bh$, $A = \frac{1}{2}(a+b)h$

🕮 Circle: $A = \pi r^2$, $C = 2\pi r$

🕮 Volume: cuboid, cylinder, prism: $V = lwh$, $V = \pi r^2 h$, $V = Ah$

🕮 Curved surface of a cylinder: $A = 2\pi rh$

Scan to practise

🕮 Distance; midpoint: $d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$, $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$

★ **Pythagoras:** $a^2 + b^2 = c^2$ → Any right-angled triangle, in 2D or 3D

★ **Right-angled trig:** $\sin\theta = \frac{\text{opp}}{\text{hyp}}$, $\cos\theta = \frac{\text{adj}}{\text{hyp}}$, $\tan\theta = \frac{\text{opp}}{\text{adj}}$ → Elevation and depression, such as the height of a building

Watch for: Mark the given sides and the angle you want before choosing the rule

★ **Laws of indices:** $a^m a^n = a^{m+n}$, $\frac{a^m}{a^n} = a^{m-n}$, $(a^m)^n = a^{mn}$, $a^{-n} = \frac{1}{a^n}$ → Multiply and divide numbers in standard form

1 Number & algebra

★ **Standard form:** $a \times 10^k$, $1 \le a < 10$, $k \in \mathbb{Z}$ → Read calculator notation such as $3.2E-5$

Watch for: Convert calculator E-notation to $a \times 10^n$

Scan to practise

🕮 Arithmetic sequence: $u_n = u_1 + (n-1)d$

🕮 Arithmetic series: $S_n = \frac{n}{2}(2u_1 + (n-1)d) = \frac{n}{2}(u_1 + u_n)$

★ **Common difference:** $d = u_{n+1} - u_n$ → Recognise an arithmetic sequence from its common difference

🕮 Geometric sequence: $u_n = u_1 r^{n-1}$

🕮 Geometric series, $r \neq 1$: $S_n = \frac{u_1(r^n-1)}{r-1} = \frac{u_1(1-r^n)}{1-r}$

🕮 Compound interest (k times a year, n years, $r\%$): $FV = PV\left(1 + \frac{r}{100k}\right)^{kn}$

★ **Depreciation at $r\%$ a year:** $V = V_0\left(1 - \frac{r}{100}\right)^n$ → Value-loss questions

Loans, annuities, amortisation: use the GDC's TVM solver (N, I%, PV, PMT, FV, P/Y, C/Y); money paid out is negative.

🕮 Exponents & logs: $a^x = b \iff x = \log_a b$

★ **Log facts:** $\log_{10} 10^x = x$, $\ln e^x = x$, $e^{\ln x} = x$ →

Logarithms as the inverse of exponentials

🕮 Percentage error: $\varepsilon = \left|\frac{v_A - v_E}{v_E}\right| \times 100\%$

★ **Bounds: a value rounded to the nearest u lies in** $[x - \frac{u}{2},\ x + \frac{u}{2})$ → Rounding and accuracy questions

Watch for Write every TVM value you enter $(N, I\%, PV, PMT, FV)$

Calculator use the TVM finance solver; find sums of sequences; solve equations: keystrokes at ibmathrevision.com/calculator-skills

5 Calculus

🕮 Derivative of x^n: $f(x) = x^n \Rightarrow f'(x) = nx^{n-1}$

★ **Constant multiples, sums:** $f(x) = ax^n + bx^m \Rightarrow f'(x) = anx^{n-1} + bmx^{m-1}$ → Differentiate polynomials term by term

★ **Gradient of tangent at $x = a$: $f'(a)$; tangent** $y - f(a) = f'(a)(x - a)$ → Any "find the equation of the tangent / normal" question

Watch for: Gradient at a point is $f'(a)$, not $f(a)$

★ **Gradient of normal:** $-\frac{1}{f'(a)}$ → Equations of the tangent and normal

Watch for: Normal gradient $= -\frac{1}{f'(a)}$

Scan to practise

★ **Increasing / decreasing:** $f'(x) > 0$; $f'(x) < 0$ → Where a model is increasing or decreasing

★ **Stationary points; optimisation:** $f'(x) = 0$; **check the sign of f' either side** → Optimisation in context: justify the optimum

🕮 Integral of x^n, $n \neq -1$: $\int x^n\,dx = \frac{x^{n+1}}{n+1} + C$

🕮 Area, $y \ge 0$: $A = \int_a^b y\,dx$

🕮 Trapezoidal rule, $h = \frac{b-a}{n}$: $\int_a^b y\,dx \approx \frac{1}{2}h\left[(y_0 + y_n) + 2(y_1 + \cdots + y_{n-1})\right]$

★ **Boundary condition: find C by substituting a known point into** $\int f'(x)\,dx$ → Find the constant from a point on the curve

Watch for When integrating, add C and find it

Calculator find derivatives and integrals; find intersections and max/min: keystrokes at ibmathrevision.com/calculator-skills

2 Functions & models

🕮 Gradient; forms of a line: $m = \frac{y_2 - y_1}{x_2 - x_1}$, $y = mx + c$, $ax + by + d = 0$, $y - y_1 = m(x - x_1)$

★ **Parallel; perpendicular:** $m_1 = m_2$; $m_1 m_2 = -1$ → Equations of lines through given points

🕮 Quadratic: axis of symmetry: $x = -\frac{b}{2a}$

Scan to practise

★ **Linear; quadratic models:** $f(x) = mx + c$; $f(x) = ax^2 + bx + c$ → Maximum or minimum values, such as the greatest height of a ball

★ **Exponential models:** $f(x) = ka^x + c$, $f(x) = ka^{-x} + c$, $f(x) = ke^{rx} + c$ → Fit growth and decay models; interpret each parameter

Watch for: At $t = 0$ any b^t or e^{kt} equals 1

★ **Direct / inverse variation:** $f(x) = ax^n$, $n \in \mathbb{Z}$ → Direct and inverse variation such as $y = \frac{k}{x}$

★ **Cubic model:** $f(x) = ax^3 + bx^2 + cx + d$ → Cubic models in context: find parameters from data

★ **Sinusoidal model (degrees):** $f(x) = a\sin(bx) + d$: **amplitude** $|a|$, **period** $\frac{360°}{b}$ → Modelling tides, temperatures and Ferris wheels

Watch for: Amplitude $= \frac{\max - \min}{2}$; in degrees $b = 360/\text{period}$

★ **Inverse function: swap x and y; graph reflects in $y = x$; domain of f^{-1} = range of f** → Finding $f^{-1}(x)$: swap x and y, then make y the subject

Watch for: $f^{-1}(a)$ means solve $f(x) = a$

★ **Horizontal asymptote of $ka^x + c$: $y = c$** → Long-term behaviour of exponential models

Watch for Name the quantity and its units when you interpret a parameter

Calculator do regression; find intersections and max/min: keystrokes at ibmathrevision.com/calculator-skills

3 Geometry & trigonometry

🕮 3D distance ($\Delta x = x_1 - x_2$, ...): $d = \sqrt{\Delta x^2 + \Delta y^2 + \Delta z^2}$

🕮 3D midpoint: $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}, \frac{z_1+z_2}{2}\right)$

🕮 Pyramid; cone: $V = \frac{1}{3}Ah$; $V = \frac{1}{3}\pi r^2 h$, curved $A = \pi rl$

🕮 Sphere: $V = \frac{4}{3}\pi r^3$, $A = 4\pi r^2$

Scan to practise

★ **Slant height of a cone:** $l = \sqrt{r^2 + h^2}$ → Cone surface area when you are given the vertical height

🕮 Sine rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

🕮 Cosine rule: $c^2 = a^2 + b^2 - 2ab\cos C$, $\cos C = \frac{a^2+b^2-c^2}{2ab}$

🕮 Area of a triangle: $A = \frac{1}{2}ab\sin C$

🕮 Arc; sector (θ in degrees): $l = \frac{\theta}{360} \times 2\pi r$, $A = \frac{\theta}{360} \times \pi r^2$

★ **Elevation / depression measured from the horizontal; bearings clockwise from north, 3 figures** → Navigation problems and three-figure bearings

★ **Perpendicular bisector of AB: through the midpoint of AB, gradient** $-\frac{1}{m_{AB}}$ → Voronoi diagrams and "equidistant from two points" questions

Watch for: Midpoint of the two sites, then gradient $-\frac{1}{m}$

★ **Voronoi: cell edges lie on perpendicular bisectors of pairs of sites; the point furthest from every site ("toxic waste dump") is at a vertex or on the boundary** → Add a site; the toxic waste dump problem

Watch for: A vertex is where two bisectors meet: solve them together

Watch for Mark the given sides and the angle you want before choosing the rule

Calculator solve equations: keystrokes at ibmathrevision.com/calculator-skills

4 Statistics & probability

🕮 Interquartile range: $IQR = Q_3 - Q_1$

🕮 Mean ($n = \sum f_i$): $\bar{x} = \frac{\sum f_i x_i}{n}$

★ **Outliers:** $x < Q_1 - 1.5\,IQR$ **or** $x > Q_3 + 1.5\,IQR$ → Box plots and "is this value an outlier?" questions

Watch for: Compare the actual data with the fence

Scan to practise

★ **Standard deviation:** $\sigma = \sqrt{\frac{\sum f(x-\bar{x})^2}{n}}$ → Estimate the mean and standard deviation of grouped data

★ **Data $\times a$ then $+b$: mean $\to a\bar{x} + b$, s.d. $\to |a|\sigma$** → Questions that change units or scale marks

★ **Regression: $y = ax + b$ (GDC); use to predict y within the data range only** → Interpret the gradient and intercept in context

★ **$|r|$ near 1: strong linear correlation; Spearman's r_s = PMCC of the ranks** → Choose Pearson's r or Spearman's rank for a data set

Watch for: Spearman's is between the ranks, not the data

🕮 Probability: $P(A) = \frac{n(A)}{n(U)}$, $P(A) + P(A') = 1$

★ **Expected number of occurrences:** $n \times P(A)$ → Expected number of occurrences

🕮 Combined events: $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

🕮 Mutually exclusive: $P(A \cup B) = P(A) + P(B)$

🕮 Independent: $P(A \cap B) = P(A)P(B)$

🕮 Conditional: $P(A \mid B) = \frac{P(A \cap B)}{P(B)}$

🕮 Expected value: $E(X) = \sum x\,P(X = x)$

★ **Valid distribution; fair game:** $\sum P(X = x) = 1$; $E(\text{gain}) = 0$ → Find an unknown probability; decide whether a game is fair

★ **Binomial $X \sim B(n, p)$:** $P(X = r) = \binom{n}{r}p^r(1-p)^{n-r}$ → Fixed number of independent trials

Watch for: $P(X \ge 5) = 1 - P(X \le 4)$: turn words into a cumulative statement

🕮 Binomial mean, variance: $E(X) = np$, $\text{Var}(X) = np(1-p)$

★ **Normal: about 68%, 95%, 99.7% of values lie within 1, 2, 3 s.d. of μ** → Normal probabilities in context, with technology

Watch for: Sketch and shade the region before using the GDC

🕮 χ^2 statistic: $\chi^2_{\text{calc}} = \sum \frac{(f_o - f_e)^2}{f_e}$

★ **Expected frequency (independence):** $f_e = \frac{\text{row total} \times \text{column total}}{\text{grand total}}$ → Every chi-squared test for independence

★ **Degrees of freedom: independence: $(r-1)(c-1)$; goodness of fit: classes $- 1$** → Chi-squared tests for independence and goodness of fit

★ **Test decision: reject H_0 if p-value $<$ significance level (or $\chi^2_{\text{calc}} >$ critical value)** → Compare a p-value with the significance level, then conclude in context

Watch for: End with one sentence in context

★ **t-test (GDC): compares two population means; H_0: $\mu_1 = \mu_2$** → Compare the means of two samples

Watch for: Write H_0 and H_1 with the population parameter

Watch for H_0 and H_1, the p-value, the decision, then one sentence in context

Calculator find mean, SD and quartiles; find r and Spearman's rank; do a normal distribution; do binomial and Poisson; do a t-test and a χ^2 test: keystrokes at ibmathrevision.com/calculator-skills

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