FORMULAS YOU MUST MEMORISE

IB Mathematics: Applications & Interpretation SL

IB Math Revision
ibmathrevision.com

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formula-sheet-slai
Learn-only list online

Not in the IB formula booklet: learn these by heart.

★ Not given in the exam: learn every formula on this page. The full sheet and the booklet have the rest.

Prior learning

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

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

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

1 Number & algebra

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

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

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

★ **Log facts:** $\log_{10} 10^x = x$, $\ln e^x = x$, $e^{\ln x} = x$
When: Logarithms as the inverse of exponentials

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

5 Calculus

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

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

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

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

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

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

2 Functions & models

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

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

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

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

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

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

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

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

3 Geometry & trigonometry

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

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

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

★ **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**
When: Add a site; the toxic waste dump problem

4 Statistics & probability

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

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

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

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

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

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

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

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

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

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

★ **Degrees of freedom:** independence: $(r-1)(c-1)$; goodness of fit: classes -1
When: 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)**
When: Compare a p-value with the significance level, then conclude in context

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

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