

Key Formulas, Annotated for 2026

The high-yield formulas with when-and-how notes, and what to memorise cold

The formula booklet is generous, but flipping to it mid-question costs time, and it never tells you *when* to use each formula. This is a 4S Academy guide to the highest-yield formulas with a usage note on each, plus the things you should simply know by heart. It is original commentary, not a copy of the booklet.

■ Part 1. Algebra and functions

Sequences, series, binomial

- $u_n = u_1 + (n - 1)d, \quad S_n = \frac{n}{2}(2u_1 + (n - 1)d)$

Arithmetic. Use $S_n = \frac{n}{2}(u_1 + u_n)$ when you already know the last term.

- $u_n = u_1 r^{n-1}, \quad S_n = \frac{u_1(r^n - 1)}{r - 1}, \quad S_\infty = \frac{u_1}{1 - r} \quad (|r| < 1)$

Geometric. S_∞ exists only for $|r| < 1$; check this before using it.

- $(a + b)^n = \sum_{k=0}^n \binom{n}{k} a^{n-k} b^k$

Binomial. For “term independent of x ” or “coefficient of x^m ”, write the general term and set the power of x equal to the target.

Functions and logs

- $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}, \quad \Delta = b^2 - 4ac$

Roots of a quadratic. The discriminant Δ alone tells you the number of real roots: > 0 two, $= 0$ one, < 0 none. Tangency questions set $\Delta = 0$.

- $\log_a xy = \log_a x + \log_a y, \quad \log_a \frac{x}{y} = \log_a x - \log_a y, \quad \log_a x^n = n \log_a x$

Log laws. Also $\log_a b = \frac{\log b}{\log a}$ (change of base) to evaluate any log on the GDC.

Rules you apply constantly

- $\frac{d}{dx}(fg) = f'g + fg'$, $\frac{d}{dx}\left(\frac{f}{g}\right) = \frac{f'g - fg'}{g^2}$

Product and quotient rules. Spot which you need before differentiating; mixing them is the most common slip.

- $\frac{d}{dx}f(g(x)) = f'(g(x))g'(x)$

Chain rule. Use for any “function inside a function”, e.g. $\ln(2x - 1)$ or e^{x^2} .

- $\int u dv = uv - \int v du$

Integration by parts. Choose u to *simplify* on differentiating (e.g. $u = x$ in $\int xe^{2x} dx$).

- $V = \pi \int_a^b y^2 dx$

Volume of revolution about the x axis. Square the function first, then integrate.

■ Part 3. Vectors, statistics, probability

Vectors

- $\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}||\mathbf{b}| \cos \theta \Rightarrow \cos \theta = \frac{\mathbf{a} \cdot \mathbf{b}}{|\mathbf{a}||\mathbf{b}|}$

Angle between vectors or lines. Take the modulus of the dot product for the *acute* angle. Perpendicular $\Leftrightarrow \mathbf{a} \cdot \mathbf{b} = 0$.

Statistics and probability

- $P(A | B) = \frac{P(A \cap B)}{P(B)}$

Conditional probability. “Given that” means divide by the probability of the condition.

- $X \sim B(n, p) : E(X) = np, \text{Var}(X) = np(1 - p)$

Binomial. Use the GDC’s binompdf / binomcdf for “exactly” vs “at most”.

- $X \sim N(\mu, \sigma^2) : z = \frac{x - \mu}{\sigma}$

Normal. Use normal cdf for a probability, inverse normal to find a boundary value from a percentage. Do not swap them.

Know these cold, no booklet needed. Exact values of $\sin, \cos, \tan$ at $0, 30, 45, 60, 90^\circ$; the quadrant sign rule (CAST); $\sin^2 \theta + \cos^2 \theta = 1$; the derivatives of $x^n, e^x, \ln x, \sin x, \cos x$; and how to complete the square. Reaching for the booklet on any of these wastes seconds you need for the hard parts.

4S Academy teaches not just the formulas but the instinct for which one a question is asking for. Book a free 15 minute consultation at **4sacademy.com**