HSC Maths Extension 1 Formula Sheet

Original worked revision examples with notes on units and assumptions.

Use the board PDF below for the official sheet. Coverage of examples varies by subject.

Official reference material

Official NESA reference PDF

Companion guide: HSC Maths Advanced Formula Sheet

What to work out beyond the sheet

This guide follows the reference sheet for the HSC through 2026. The shared sheet also prints Extension 2 material, including complex numbers, integration by parts and its mechanics formulas. Use the Advanced companion for the assumed formulas. For an Extension 1 differential equation, apply the initial condition and check the solution domain.

Formulas and worked examples

Polynomials · cubic roots and coefficients

Formula or reference: For $ax^3 + bx^2 + cx + d = 0$ with roots α, β, γ: $\alpha + \beta + \gamma = -b/a$, $\alpha\beta + \alpha\gamma + \beta\gamma = c/a$ and $\alpha\beta\gamma = -d/a$.

Units and conditions: $a \neq 0$. Count roots with multiplicity.

Worked example: The roots 1, 2 and 3 give sum 6, pairwise sum 11 and product 6, so the corresponding monic polynomial is $x^3 - 6x^2 + 11x - 6$.

Trigonometry · compound angles

Formula or reference: $\sin(A+B) = \sin A \cos B + \cos A \sin B$. $\cos(A+B) = \cos A \cos B - \sin A \sin B$. $\tan(A+B) = (\tan A + \tan B)/(1 - \tan A \tan B)$.

Units and conditions: Use consistent angle units. For the tangent form the individual tangents and denominator must be defined.

Worked example: With $A = 45°$ and $B = 30°$, the sine and cosine of 75° are $(\sqrt{6} + \sqrt{2})/4$ and $(\sqrt{6} - \sqrt{2})/4$, and its tangent is $2 + \sqrt{3}$.

Trigonometry · half-angle substitution

Formula or reference: For $t = \tan(A/2)$: $\sin A = 2t/(1+t^2)$, $\cos A = (1-t^2)/(1+t^2)$, $\tan A = 2t/(1-t^2)$.

Units and conditions: Use where t is defined, and $t \neq \pm 1$ for the tangent form.

Worked example: At $t = 1/2$, the sine, cosine and tangent of A are 4/5, 3/5 and 4/3.

Trigonometry · products to sums

Formula or reference: $\cos A \cos B = [\cos(A-B)+\cos(A+B)]/2$. $\sin A \sin B = [\cos(A-B)-\cos(A+B)]/2$. $\sin A \cos B = [\sin(A+B)+\sin(A-B)]/2$. $\cos A \sin B = [\sin(A+B)-\sin(A-B)]/2$.

Units and conditions: Keep A and B in the same angle unit, and preserve their order in the difference.

Worked example: With $A = 60°$ and $B = 30°$, the four products in order are $\sqrt{3}/4$, $\sqrt{3}/4$, 3/4 and 1/4.

Trigonometry · squared sine and cosine

Formula or reference: $\sin^2(nx) = [1 - \cos(2nx)]/2$. $\cos^2(nx) = [1 + \cos(2nx)]/2$.

Units and conditions: Use consistent angle units.

Worked example: For $nx = \pi/3$, $\cos(2nx) = -1/2$, so the squared sine is 3/4 and the squared cosine is 1/4.

Calculus · derivatives of inverse trig functions

Formula or reference: d(arcsin f)/dx = f′/√(1−f²). d(arccos f)/dx = −f′/√(1−f²). d(arctan f)/dx = f′/(1+f²).

Units and conditions: For the first two derivatives use |f| < 1. Inverse trig angles are in radians.

Worked example: For f(x) = 2x, the three derivatives at x = 0 are 2, −2 and 2.

Calculus · inverse-trig antiderivatives

Formula or reference: ∫ f′/√(a²−f²) dx = arcsin(f/a) + C. ∫ f′/(a²+f²) dx = arctan(f/a)/a + C.

Units and conditions: Use a > 0. The first form applies where |f| < a.

Worked example: For f(x) = 2x and a = 3, antiderivatives of 2/√(9−4x²) and 2/(9+4x²) are arcsin(2x/3) + C and arctan(2x/3)/3 + C.

Combinatorics · permutations and combinations

Formula or reference: P(n,r) = n!/(n−r)!. C(n,r) = n!/[r!(n−r)!].

Units and conditions: Use integer 0 ≤ r ≤ n. Permutations count order; combinations do not.

Worked example: From 5 people there are P(5,2) = 20 ways to fill two different roles and C(5,2) = 10 ways to select an unordered pair.

Algebra · binomial expansion

Formula or reference: The term with a^r in $(x+a)^n$ is C(n,r)x^(n−r)a^r, for r = 0, …, n.

Units and conditions: n is a non-negative integer.

Worked example: The term with a^2 in $(x+a)^5$ is $10x^3a^2$.

Probability · binomial distribution

Formula or reference: For X ~ Bin(n,p), P(X=r) = C(n,r)p^r(1−p)^(n−r), E(X) = np and Var(X) = np(1−p).

Units and conditions: Use n independent trials with fixed success probability p.

Worked example: For four trials with p = 1/2, P(X=2) = 6/16, E(X) = 2 and Var(X) = 1.

Vectors · magnitude and scalar product

Formula or reference: |(x,y)| = √(x²+y²). a · b = a_1b_1 + a_2b_2 = |a||b| cos θ.

Units and conditions: To find an angle, neither vector can be zero.

Worked example: For a = (2,0) and b = (1,√3), the dot product is 2 and both magnitudes are 2, giving θ = 60°.

Vectors · line equation

Formula or reference: r = a + λb

Units and conditions: a is a position vector on the line, b is a non-zero direction vector, and λ is real.

Worked example: For a = (1,2) and b = (3,−1), λ = 2 gives the point (7,0).

More worked examples

Angle between vectors

a · b = |a||b| cos θ for non-zero vectors.

Find the angle between a = (1,0) and b = (1,1).

a · b = 1, |a| = 1 and |b| = √2. Thus cos θ = 1/√2 and θ = 45°. The dot product is a scalar, not a vector.

Check: Divide by both magnitudes; the dot product alone is not cos θ.

A binomial coefficient

The term selecting k factors of bx from (a + bx)^n is C(n,k)a^(n−k)(bx)^k.

Find the coefficient of x^2 in (1 + 2x)^5.

Choose k = 2. The term is C(5,2) × 1^3 × (2x)^2 = 10 × $4x^2$ = $40x^2$. The coefficient requested is 40.

Check: The factor 2 is also squared; C(5,2) alone is only the number of selections.

An initial-value model

Separate dy/dx = ky as dy/y = k dx when y is non-zero.

Solve dy/dx = 2y with y(0) = 3.

Integrating gives ln|y| = 2x + C, so y = Ae^(2x). The initial condition makes A = 3, hence y = 3e^(2x). Substitution into the original equation verifies the solution.

Check: The constant is fixed by the initial condition. Differentiating the final expression is a quick independent check.