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Quadratic equations and nature of roots

Formulas and units, JEE Main. Status: Reviewed on 2026-11-20.

Result	Formula	Units or note
Roots	x = (-b +/- sqrt(b^2 - 4ac))/(2a) Valid when: a is non-zero; for non-real D use a complex square root	dimensionless
Discriminant and nature	D = b^2 - 4ac; D > 0 real distinct; D = 0 real equal; D < 0 non-real conjugates (real coefficients) Valid when: a, b, c real, a non-zero	dimensionless
Sum and product	p + q = -b/a; pq = c/a; equation: x^2 - (p + q)x + pq = 0 Valid when: a is non-zero; p, q the roots counted with multiplicity	dimensionless
Symmetric expressions	p^2 + q^2 = s^2 - 2m; p^3 + q^3 = s^3 - 3ms; |p - q| = sqrt(D)/|a| Valid when: p, q roots of ax^2 + bx + c = 0; s = p + q, m = pq	dimensionless
Equation from roots	roots p, q: x^2 - (p + q)x + pq = 0; roots kp, kq: x^2 - k(p + q)x + k^2 pq = 0; roots 1/p, 1/q: c x^2 + b x + a = 0 Valid when: a is non-zero (and c is non-zero for the reciprocal case)	dimensionless
Complex roots, real coefficients	D < 0: roots -b/(2a) +/- i sqrt(-D)/(2a); root 3 - 2i forces root 3 + 2i Valid when: a, b, c real, a non-zero, D < 0	dimensionless
Complex coefficients	roots = (-b +/- w)/(2a) where w^2 = D (complex); sum -b/a and product c/a still hold Valid when: at least one of a, b, c non-real; a non-zero	dimensionless
Conjugate roots	real coefficients: non-real roots occur as p + i q and p - i q Valid when: a, b, c real and a non-zero	dimensionless

Full lesson with worked examples:
https://www.engineeringrise.in/learn/learn/jee-main/mathematics/complex-numbers-and-quadratic-equations/quadratic-equations-ar

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