Algebra 1 formulas & conditions

For revision. Not the official testing reference sheet or permission to bring notes into the exam.

Distribution

$$a(b+c) = ab + ac$$

Multiply every term; signs remain part of each term.

Product and quotient of powers

$$a^m a^n = a^{m+n}, \quad a^m / a^n = a^{m-n}$$

For the quotient, a must be nonzero.

Power of a power

$$(a^m)^n = a^{mn}$$

Apply within the real domain where both expressions are defined.

Zero and negative exponents

$$a^0 = 1, \quad a^{-n} = 1/a^n$$

$a \neq 0$; a negative exponent means reciprocal.

Rational powers

$$a^{m/n} = (\sqrt[n]{a}\,)^m$$

Reduce $\frac{m}{n}$; check the real domain for even roots.

Radical product

$$\sqrt{a}\,\sqrt{b} = \sqrt{ab}$$

For real square roots, a,$b \geq 0$.

Root of a square

$$\sqrt{x^2} = |x|$$

Do not assume x is nonnegative unless stated.

Slope

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Distinct x-values; vertical slope is undefined.

Slope-intercept form

$$y = mx + b$$

m is rate and $(0, b)$ is the y-intercept.

Point-slope form

$$y - y_1 = m(x - x_1)$$

Uses a known point and a finite slope.

Standard line form

$$Ax + By = C$$

A and B are not both zero for a line.

Parallel and perpendicular

$$m_1 = m_2, \qquad m_1 m_2 = -1$$

Distinct parallel lines; reciprocal rule excludes horizontal/vertical pairs.

Average rate

$$\frac{f(b) - f(a)}{b - a}$$

$a \neq b$; include output units per input unit.

Direct variation

$$y = kx$$

Constant ratio at nonzero inputs and graph through the origin.

Negative inequality divisor

$$a < b \implies -a > -b$$

Reverse the comparison when multiplying or dividing by a negative.

Equations, nonlinear models & statistics

System determinant

$$D = a_1b_2 - a_2b_1$$

$D \neq 0$ gives a unique solution for $a_1x + b_1y = c_1$ and $a_2x + b_2y = c_2$.

Difference of squares

$$a^2 - b^2 = (a - b)(a + b)$$

The operation must be subtraction.

Square of a binomial

$$(a \pm b)^2 = a^2 \pm 2ab + b^2$$

Include the middle product with the matching sign.

Monic trinomial

$$x^2 + (p + q)x + pq = (x + p)(x + q)$$

The constants must match both sum and product.

Quadratic formula

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

For $ax^2 + bx + c = 0$ with $a \neq 0$.

Discriminant

$$D = b^2 - 4ac$$

Positive: two real roots; zero: repeated root; negative: no real roots.

Quadratic vertex

$$h = -\frac{b}{2a}, \qquad k = f(h)$$

Vertex (h, k); symmetry axis $x = h$.

Vertex form

$$y = a(x - h)^2 + k$$

$a > 0$ gives a minimum, $a < 0$ a maximum.

Factored quadratic

$$y = a(x - r_1)(x - r_2)$$

Real zeros are r_1,r_2; midpoint is the symmetry input.

Absolute value

$$|u| = d \implies u = d \text{ or } u = -d$$

Requires $d \geq 0$; $d = 0$ gives one branch.

Exponential model

$$A = A_0b^t$$

$b > 0$; match the time period to the factor.

Growth and decay

$$b = 1 + r \quad \text{or} \quad b = 1 - r$$

r is a positive decimal gain or loss rate, respectively.

Simple interest

$$I = Prt, \qquad A = P(1 + rt)$$

Annual rate and time in years; no added cash flows.

Compound interest

$$A = P(1 + r/n)^{nt}$$

Nominal annual rate, n compounds per year; no cash flows.

Statistics and residual

$$x = \frac{\sum x}{N}, \quad \text{IQR} = Q_3 - Q_1, \quad e = y - \hat{y}$$

$N > 0$; residual is observed minus predicted.

Checks: Substitute a solution into the original equation. Expand factors to verify every coefficient. Match period units in growth models. Test every constraint and include practical domain restrictions.