

Algebra formulas: every formula from Grade 8 to Algebra 2, by the job it does

Powers are written a^m . US names first, CBSE/UK names in brackets. Learn each one with the problem it solves; derive the three marked * once.

Laws of exponents (indices)

Formula	Use it when
$a^m \times a^n = a^{(m+n)}$; $a^m \div a^n = a^{(m-n)}$	Same base: add or subtract the exponents
$(a^m)^n = a^{(mn)}$; $(ab)^n = a^n b^n$	Power of a power; power of a product
$a^0 = 1$; $a^{-n} = 1/a^n$; $a^{(1/n)} = \text{nth root of } a$	Zero, negative and rational exponents

Identities (factoring patterns)

Formula	Use it when
$(a + b)^2 = a^2 + 2ab + b^2$ *	Expanding; completing the square
$(a - b)^2 = a^2 - 2ab + b^2$	Same with a minus
$(a + b)(a - b) = a^2 - b^2$	Difference of squares; rationalising
$(x + a)(x + b) = x^2 + (a + b)x + ab$	Factoring trinomials, leading coefficient 1
$(a \pm b)^3 = a^3 \pm 3a^2b + 3ab^2 \pm b^3$	Cubes (Class 9)
$a^3 \pm b^3 = (a \pm b)(a^2 \mp ab + b^2)$	Sum and difference of cubes
$(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$	Three-term squares (Class 9)

Quadratics

Formula	Use it when
$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ *	Any $ax^2 + bx + c = 0$; always works
$D = b^2 - 4ac$: >0 two roots, $=0$ one, <0 none	How many real roots
Sum of roots $-b/a$; product c/a	Checking; building a quadratic from roots (Class 10)
Vertex $x = -b/2a$; $y = a(x - h)^2 + k$	Max and min; graphing
$x^2 + bx = (x + b/2)^2 - (b/2)^2$	Completing the square

Lines and coordinates

Formula	Use it when
$m = (y_2 - y_1)/(x_2 - x_1)$	Slope from two points
$y = mx + b$ (US) / $y = mx + c$; $y - y_1 = m(x - x_1)$; $Ax + By = C$	The three forms of a line
Parallel: equal slopes; perpendicular: $m_1 \times m_2 = -1$	Algebra 1, Geometry
$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$; midpoint $((x_1 + x_2)/2, (y_1 + y_2)/2)$	Distance; midpoint
$((m x_2 + n x_1)/(m + n), (m y_2 + n y_1)/(m + n))$	Section formula (Class 10)

Sequences and series

Formula	Use it when
$a_n = a_1 + (n - 1)d$; $S_n = n/2 [2a_1 + (n - 1)d] = n/2 (a_1 + a_n)$	Arithmetic (AP): nth term and sum
$a_n = a_1 r^{(n-1)}$; $S_n = a_1 (1 - r^n)/(1 - r)$	Geometric (GP): nth term and sum
$S = a_1/(1 - r)$ when $ r < 1$	Infinite geometric sum

Exponentials and logarithms

Formula	Use it when
$y = a(1 + r)^t$; $y = a(1 - r)^t$	Growth and decay (r as a decimal)
$A = P(1 + r/n)^{(nt)}$; $A = Pe^{(rt)}$; $I = Prt$	Compound, continuous and simple interest
$\log_a x = y$ means $a^y = x$	Converting forms
$\log(xy) = \log x + \log y$; $\log(x/y) = \log x - \log y$; $\log x^n = n \log x$	Simplifying; solving exponential equations
$\log_a x = \log x / \log a$; $\log 1 = 0$; $\ln e = 1$	Change of base; checks

Percent, ratio and the small ones

Formula	Use it when
% change = $(\text{new} - \text{old})/\text{old} \times 100$	Any percentage change
Price = $P(1 - r)$ discount; $P(1 + r)$ markup or tax	Shopping, tax
Average speed = total distance / total time	Motion (not the average of speeds)
$1/t = 1/t_1 + 1/t_2$	Working together
$y = kx$ direct; $y = k/x$ inverse	Variation
$ x = a$ means $x = a$ or $x = -a$	Absolute value
Multiply or divide an inequality by a negative: reverse the sign	Every inequality

The twelve mistakes

- [] $(a + b)^2$ written as $a^2 + b^2$
- [] Multiplying exponents when multiplying powers
- [] $a^{(-n)}$ made negative
- [] Dividing only the root by $2a$ in the quadratic formula
- [] $-4ac$ with the wrong sign
- [] The sign of h in $(x - h)^2$
- [] Subtracting in different orders in the slope
- [] n instead of $n - 1$ in the nth term
- [] r as a percent instead of a decimal
- [] $\log(x + y)$ treated as $\log x + \log y$
- [] Percent change divided by the new value
- [] Forgetting to reverse an inequality

From

sciencewithshobha.com/blog/algebra-formulas-list-every-formula-from-grade-8-to-algebra-2-with-when-to-use-each-and-a-printable-sheet

/