

Algebra

Formulas, rules and quick reference - Primary to lower secondary

A practical reference covering algebraic notation, expressions, simplifying, substitution, equations, sequences, identities, inequalities and real-life algebra.

1. Algebra Vocabulary

Variable	A letter or symbol representing an unknown or changing value.
Constant	A fixed number whose value does not change.
Coefficient	The numerical factor multiplying a variable.
Term	A number, variable, or product of numbers and variables separated by + or - signs.
Expression	A mathematical phrase made from numbers, variables and operations; it does not contain an equals sign.
Equation	A statement that two expressions are equal and contains an equals sign.

2. Algebraic Notation

Multiplication	$3 \times a$ is usually written as $3a$.
Variable products	$a \times b$ is written as ab .
Division	a divided by b can be written as a/b .
Powers	$a \times a$ can be written as a squared; $a \times a \times a$ as a cubed.
Like terms	Terms with the same variable part can be combined.

3. Evaluating Expressions

Substitution	Replace each variable with its given value.
Order	After substitution, use the correct order of operations.
Check	Estimate the expected size before calculating when possible.

Simplifying Algebraic Expressions

Collecting like terms and using the distributive property

4. Like Terms

Rule	Only like terms can be combined by addition or subtraction.
Examples	$3x + 5x = 8x$; $7a - 2a = 5a$.
Unlike terms	$3x$ and $3y$ are unlike terms and cannot be combined.
Constants	Number-only terms can be combined with other number-only terms.

5. Distributive Property

Addition	$a(b + c) = ab + ac$.
Subtraction	$a(b - c) = ab - ac$.
Common factor	$ab + ac = a(b + c)$.
Negative sign	A minus sign outside brackets changes the sign of every term inside.

6. Removing Brackets

Positive bracket	$a + (b + c) = a + b + c$.
Subtraction bracket	$a - (b + c) = a - b - c$.
Multiplying bracket	$k(a + b) = ka + kb$.
Two brackets	Expand one bracket at a time, then collect like terms.

7. Algebraic Fractions

Common denominator	Use a common denominator before adding or subtracting algebraic fractions.
Simple multiplication	$\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$, where denominators are non-zero.
Simplify	Cancel common factors when valid before completing the calculation.

Linear Equations

Essential rules for solving one-step and multi-step equations

8. Balance Principle

Core rule	Whatever operation is performed on one side of an equation must also be performed on the other side.
Goal	Isolate the variable to find its value.
Check	Substitute the answer back into the original equation.

9. One-Step Equations

Addition	$x + a = b \rightarrow x = b - a.$
Subtraction	$x - a = b \rightarrow x = b + a.$
Multiplication	$ax = b \rightarrow x = b/a$, where a is not 0.
Division	$x/a = b \rightarrow x = ab$, where a is not 0.

10. Two-Step Equations

General form	$ax + b = c.$
Step 1	Undo the addition or subtraction.
Step 2	Undo the multiplication or division.
Solution	$x = (c - b)/a$, where a is not 0.

11. Equations with Brackets

Method	Expand brackets first, then collect like terms and solve.
Alternative	Sometimes divide by a common factor before expanding.
Check	Substitute the final value into both sides.

Inequalities & Number Lines

Rules for comparing algebraic quantities

12. Inequality Symbols

Greater than	$a > b$ means a is greater than b.
Less than	$a < b$ means a is less than b.
Greater/equal	$a \geq b$ means a is greater than or equal to b.
Less/equal	$a \leq b$ means a is less than or equal to b.

13. Solving Inequalities

Addition/subtraction	Add or subtract the same number on both sides.
Multiplication/division	Multiply or divide both sides by the same positive number.
Negative multiplier	When multiplying or dividing by a negative number, reverse the inequality sign.
Number line	Use an open circle for $<$ or $>$ and a closed circle for $\leq$ or $\geq$.

14. Compound Inequalities

Meaning	A compound inequality combines two comparison statements.
Example form	$a < x < b$ means x is greater than a and less than b.
Number line	Show the interval between the two boundary values.

Sequences & Patterns

Rules for finding terms and describing patterns

15. Arithmetic Sequences

Common difference	The same number is added or subtracted each time.
nth term	$\text{nth term} = \text{first term} + (n - 1) \times \text{common difference}.$
General form	$\text{nth term} = an + b$ for constants a and b .
Check	Subtract consecutive terms to identify the common difference.

16. Geometric Sequences

Common ratio	Each term is multiplied by the same non-zero number.
nth term	$\text{nth term} = \text{first term} \times \text{common ratio raised to } (n - 1).$
Identify	Divide a term by the previous term to find the common ratio when appropriate.

17. Patterns in Tables

Input-output	Apply the same rule to each input to produce the output.
Rule	Look for addition, subtraction, multiplication or a combination.
Algebra	Use a variable to represent the input and write a formula for the output.

18. Position-to-Term Thinking

Position	The term number can be represented by n .
Rule	A sequence rule connects n to the value of the term.
Check	Substitute small values of n to confirm the rule.

Algebraic Identities & Powers

Useful expansion and factorisation relationships

19. Square of a Sum

Identity	$(a + b)^2 = a^2 + 2ab + b^2$
Pattern	First square + twice the product + second square.
Use	Useful for expansion and recognising perfect-square expressions.

20. Square of a Difference

Identity	$(a - b)^2 = a^2 - 2ab + b^2$
Pattern	First square - twice the product + second square.

21. Difference of Two Squares

Identity	$a^2 - b^2 = (a - b)(a + b)$
Use	Useful for factorisation and simplifying expressions.

22. Laws of Indices

Product	$a^m \times a^n = a^{m+n}$
Quotient	$a^m \div a^n = a^{m-n}$, for $a \neq 0$.
Power of a power	$(a^m)^n = a^{m \times n}$
Zero power	$a^0 = 1$, for $a \neq 0$.
Negative power	$a^{-n} = 1 / a^n$, for $a \neq 0$.

Algebra in Real Life & Quick Reference

Equations, formulas, checking and common mistakes

23. Formulas

Substitution	Replace variables with known values before calculating.
Rearranging	Use inverse operations to make the required variable the subject.
Example structure	If $y = 3x + 2$, then for $x = 4$, $y = 3(4) + 2$.

24. Direct Proportion

Relationship	If y is directly proportional to x , $y = kx$ for a constant k .
Constant of proportionality	$k = y/x$, where x is not 0.
Scaling	If x is multiplied by a factor, y is multiplied by the same factor.

25. Algebra in Everyday Life

Shopping	Write expressions for total cost, discounts and repeated purchases.
Travel	Use formulas for distance, speed and time.
Patterns	Describe repeated patterns using a sequence rule.
Budgeting	Represent fixed and variable costs using algebra.
Measurement	Use variables in formulas for area, perimeter and volume.

26. Common Mistakes to Watch

Like terms	Do not combine unlike terms.
Signs	Take special care when subtracting brackets.
Equations	Keep both sides balanced.
Inequalities	Reverse the sign when multiplying or dividing by a negative.
Substitution	Use brackets when replacing a variable with a negative number.
Indices	Do not add exponents when multiplying unlike bases.

27. Checking Algebra

Substitute back	Put the answer into the original equation.
Expand back	Multiply out a factorised expression to check it.
Estimate	Check whether the size of the answer is sensible.
Test sequence	Check a rule against several terms.

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