

Numbers & Operations

Formulas, rules and quick reference • Primary to lower secondary

A practical international-friendly reference for number sense, operations, factors, fractions, decimals, percentages, integers, powers and roots.

Numbers & Place Value

Place value	Digit value = digit $\times$ value of its place.
Expanded form	Number = sum of the place values of all its digits.
Face value	Face value = the digit itself.
Rounding	Look at the next digit: 0–4 keep; 5–9 increase the rounding digit by 1.
Number line	Numbers increase from left to right; the farther-right number is greater.

Even, Odd, Prime & Composite

Even	A whole number divisible by 2; last digit is 0, 2, 4, 6 or 8.
Odd	A whole number not divisible by 2; last digit is 1, 3, 5, 7 or 9.
Prime	A whole number greater than 1 with exactly two factors: 1 and itself.
Composite	A whole number greater than 1 with more than two factors.
Special case	1 is neither prime nor composite; 0 is neither prime nor composite.

The Four Basic Operations

Addition	Addend + addend = sum.
Subtraction	Minuend – subtrahend = difference.
Multiplication	Factor $\times$ factor = product.
Division	Dividend $\div$ divisor = quotient, when there is no remainder.
Remainder	Dividend = (divisor $\times$ quotient) + remainder.

Operations & Their Properties

Rules for simplifying, rearranging and checking calculations

Properties of Addition

Commutative	$a + b = b + a$
Associative	$(a + b) + c = a + (b + c)$
Identity	$a + 0 = a$
Inverse	$a + (-a) = 0$

Properties of Multiplication

Commutative	$a \times b = b \times a$
Associative	$(a \times b) \times c = a \times (b \times c)$
Identity	$a \times 1 = a$
Zero property	$a \times 0 = 0$

Distributive Property

Addition	$a(b + c) = ab + ac$
Subtraction	$a(b - c) = ab - ac$
Reverse use	$ab + ac = a(b + c)$

Subtraction & Division

Subtraction	$a - b$ is generally not equal to $b - a$.
Division	$a \div b$ is generally not equal to $b \div a$.
Division by zero	Division by 0 is undefined.
Zero divided	$0 \div a = 0$, where $a \neq 0$.

Order of Operations

BODMAS/BIDMAS	Brackets $\rightarrow$ Orders/Indices $\rightarrow$ Division & Multiplication $\rightarrow$ Addition & Subtraction.
Same priority	Work from left to right when operations have equal priority.

Factors, Multiples & Divisibility

Core rules for working efficiently with whole numbers

Factors & Multiples

Factor	A number that divides another number exactly, leaving remainder 0.
Multiple	A number obtained by multiplying a number by a whole number.
Factor pair	For n , $a \times b = n$ gives a factor pair.
Prime factorisation	Write a composite number as a product of prime factors.

Divisibility Tests

2	Last digit is 0, 2, 4, 6 or 8.
3	Sum of digits is divisible by 3.
4	Last two digits form a number divisible by 4.
5	Last digit is 0 or 5.
6	Divisible by both 2 and 3.
8	Last three digits form a number divisible by 8.
9	Sum of digits is divisible by 9.
10	Last digit is 0.

HCF / GCF & LCM

HCF / GCF	Greatest common factor: greatest factor shared by the numbers.
LCM	Least common multiple: smallest positive multiple shared by the numbers.
Prime factors	HCF uses lowest powers of common primes; LCM uses highest powers of all required primes.
Key relationship	For positive a and b : $\text{HCF}(a,b) \times \text{LCM}(a,b) = a \times b$.

Fractions

Essential rules and formulas for fraction operations

Equivalent & Simplified Fractions

Equivalent	$a/b = (a \times n)/(b \times n), n \neq 0.$
Simplify	Divide numerator and denominator by their greatest common factor.
Mixed $\rightarrow$ improper	$a \frac{b}{c} = (ac + b)/c.$
Improper $\rightarrow$ mixed	Divide numerator by denominator; quotient is the whole part and remainder is the numerator.

Adding & Subtracting

Same denominator	$a/c + b/c = (a + b)/c.$
Same denominator	$a/c - b/c = (a - b)/c.$
Different denominators	Find a common denominator, then add or subtract the numerators.
Mixed numbers	Add/subtract whole and fractional parts, regrouping when necessary.

Multiplying & Dividing

Multiplication	$a/b \times c/d = ac/bd.$
Division	$a/b \div c/d = a/b \times d/c, \text{ where } c/d \neq 0.$
Whole number	$n \times a/b = na/b.$
Fraction of a quantity	Fraction of quantity = fraction $\times$ quantity.

Comparing Fractions

Same denominator	Larger numerator means the larger fraction.
Same numerator	For positive fractions, smaller denominator means the larger fraction.
Cross multiplication	For positive a/b and c/d , compare ad and bc .

Decimals & Percentages

Conversion and calculation formulas

Decimal Rules

Place values	Tenths = $1/10$; hundredths = $1/100$; thousandths = $1/1000$.
Decimal → fraction	Write over 10, 100, 1000, etc., then simplify.
Fraction → decimal	Divide numerator by denominator.
Add/subtract	Align decimal points.
Multiply	Multiply as whole numbers, then place the decimal using the total decimal places.
×10, ×100, ×1000	Move the decimal point 1, 2 or 3 places right.
÷10, ÷100, ÷1000	Move the decimal point 1, 2 or 3 places left.

Percentages

Meaning	$x\% = x/100$.
Percent → decimal	$x\% \div 100 = \text{decimal}$.
Decimal → percent	$\text{Decimal} \times 100 = \text{percent}$.
Fraction → percent	$\text{Fraction} \times 100\% = \text{percent}$.
Percentage of quantity	$(\text{percentage}/100) \times \text{quantity}$.
What percentage?	$(\text{part} \div \text{whole}) \times 100\%$.
Increase %	$(\text{increase} \div \text{original value}) \times 100\%$.
Decrease %	$(\text{decrease} \div \text{original value}) \times 100\%$.
New value, increase	$\text{Original} \times (1 + \text{rate}/100)$.
New value, decrease	$\text{Original} \times (1 - \text{rate}/100)$.

Integers, Powers & Roots

Rules for signed numbers and exponents

Integers

Same signs	Add absolute values and keep the common sign.
Different signs	Subtract smaller absolute value from larger; keep the sign of the larger absolute value.
Subtraction	$a - b = a + (-b)$.
$\times / \div$ signs	Same signs = positive; different signs = negative.
Absolute value	$ a $ is the distance of a from 0, so $ a \geq 0$.

Powers / Exponents

Meaning	a^n means a multiplied by itself n times.
Product rule	$a^m \times a^n = a^{(m+n)}$.
Quotient rule	$a^m / a^n = a^{(m-n)}$, $a \neq 0$.
Power of a power	$(a^m)^n = a^{(mn)}$.
Power of a product	$(ab)^n = a^n b^n$.
Power of a quotient	$(a/b)^n = a^n / b^n$, $b \neq 0$.
Zero exponent	$a^0 = 1$, $a \neq 0$.
Negative exponent	$a^{-n} = 1/a^n$, $a \neq 0$.

Squares, Cubes & Roots

Square	$n^2 = n \times n$.
Cube	$n^3 = n \times n \times n$.
Square root	$\sqrt{n}$ is the non-negative number whose square is n .
Cube root	$\sqrt[3]{n}$ is the number whose cube is n .
Perfect square	A whole number that can be written as n^2 .
Perfect cube	A whole number that can be written as n^3 .

Quick Reference & Checking Rules

Fast reminders for teaching, revision and self-checking

Calculation Checks

Addition	Subtract one addend from the sum to recover the other.
Subtraction	Difference + subtrahend = minuend.
Multiplication	Product $\div$ one factor = the other factor.
Division	Divisor $\times$ quotient + remainder = dividend.
Estimate first	Round to friendly values to predict a sensible answer.

Key Relationships

Inverse pairs	Addition $\leftrightarrow$ subtraction; multiplication $\leftrightarrow$ division.
Fraction $\leftrightarrow$ decimal	Use division or place-value representation.
Fraction $\leftrightarrow$ percent	Multiply by 100%.
Percent $\leftrightarrow$ decimal	Divide or multiply by 100.
Factors vs multiples	Factors divide exactly; multiples are produced by multiplication.

Common Mistakes to Watch

Order of operations	Do not always put multiplication before division; use left-to-right order at equal priority.
Fractions	Do not add denominators when adding fractions.
Percentages	Percentage change uses the original value as the denominator.
Negative numbers	Apply sign rules carefully for multiplication and division.
Units	Convert to the same unit before combining measurements.

Maths Connects Us All

Different curricula may use different terminology, but the mathematical relationships remain connected.