FORMULA POSTER

CBSE Class 9 Mathematics

2026–27 syllabus · v3 Oct 2026

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formula-sheet-cbse9
Interactive version

CBSE gives no formula booklet: learn every result on this sheet. Organised by the chapters of the CBSE curriculum.

1 Number System

$\mathbb{N} \subset \mathbb{W} \subset \mathbb{Z} \subset \mathbb{Q} \subset \mathbb{R}$; $\frac{p}{q}$ terminates iff q (lowest terms) has only the primes 2, 5

Recurring decimal, e.g.: $0.\overline{47} = \frac{47}{99}$, $0.1\overline{6} = \frac{15}{90} = \frac{1}{6}$ → Convert recurring decimals into fractions using algebra

Surds: $\sqrt{ab} = \sqrt{a}\sqrt{b}$, $(\sqrt{a}+\sqrt{b})(\sqrt{a}-\sqrt{b}) = a - b$ → Simplify surds and expand brackets containing surds

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Rationalise: $\frac{1}{\sqrt{a}+\sqrt{b}} = \frac{\sqrt{a}-\sqrt{b}}{a-b}$ → Rationalise denominators such as $\frac{1}{3+\sqrt{5}}$

Exponents: $a^m a^n = a^{m+n}$, $(a^m)^n = a^{mn}$, $a^{-m} = \frac{1}{a^m}$, $a^{\frac{p}{q}} = (\sqrt[q]{a})^p$ → Simplifying powers and roots without a calculator

2 Polynomials

Polynomial: degree = highest power; linear polynomial and its zero: $p(x) = ax + b$ $(a \neq 0)$; $x = -\frac{b}{a}$

Line $y = ax + b$: slope a, y-intercept b: $a = \frac{y_2 - y_1}{x_2 - x_1}$ → Gradient and y-intercept of a straight line

Linear growth ($a > 0$) / decay ($a < 0$): equal change per equal step

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3 Sequences and Progressions

AP; GP: $a_n = a + (n-1)d$; $a_n = ar^{n-1}$ → Finding a term, or setting up equations from two terms

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Sum of naturals; of odd numbers: $1 + 2 + \cdots + n = \frac{n(n+1)}{2}$; $1 + 3 + \cdots + (2n-1) = n^2$ → Sums of consecutive natural numbers

Fibonacci; Tower of Hanoi: $F_{n+1} = F_n + F_{n-1}$; $M_n = 2M_{n-1} + 1 = 2^n - 1$

4 Algebraic Identities

Squares: $(a \pm b)^2 = a^2 \pm 2ab + b^2$, $(a+b)(a-b) = a^2 - b^2$ → Expand double brackets; the difference of two squares

Product: $(x+a)(x+b) = x^2 + (a+b)x + ab$ → Expand double brackets such as $(x+4)(x-7)$

Three terms: $(a+b+c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

Cubes: $(a \pm b)^3 = a^3 \pm b^3 \pm 3ab(a \pm b)$

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Sum/difference of cubes: $a^3 \pm b^3 = (a \pm b)(a^2 \mp ab + b^2)$

5 Linear Equations in Two Variables

$ax + by + c = 0$ (a, b not both 0): infinitely many solutions, all on one straight line

$x = a \parallel y$-axis; $y = b \parallel x$-axis; intercepts: put $y = 0$, then $x = 0$

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A point is on the line exactly when its coordinates satisfy the equation; $y = mx$ passes through the origin

6 Coordinate Geometry

Quadrants I to IV: $(+,+)$, $(-,+)$, $(-,-)$, $(+,-)$; on the x-axis $y = 0$, on the y-axis $x = 0$

Distance: $AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$; $OP = \sqrt{x^2 + y^2}$ → Distance between two points and from the origin

Mid-point: $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$ → Mid-point of a segment

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Parallelogram: diagonals share a mid-point; equidistant point P: $PA^2 = PB^2$ → Missing vertices of parallelograms: diagonals bisect each other

7 Euclid's Geometry

Axioms: things equal to the same thing are equal; equals added to (or taken from) equals give equals; the whole is greater than the part

Postulates: a line through any two points; extend a segment; a circle with any centre and radius; all right angles equal

Postulate 5: interior angles on one side $< 180°$ ⇒ lines meet on that side. Playfair: one parallel through a point not on a line

Measurement: C between A, B ⇒ $AC + CB = AB$; a segment has exactly one mid-point

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8 Lines and Angles

Linear pair sums to 180°; vertically opposite angles are equal; reflex angle of θ is $360° - \theta$

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Parallel lines: corresponding and alternate angles equal, co-interior angles sum to 180° (and conversely); $l \parallel m$, $m \parallel n \Rightarrow l \parallel n$ → Angle facts with parallel lines, giving a reason for each step

Angle sum 180°; exterior angle = sum of the two interior opposite angles; at least two angles of a triangle are acute → Missing angles in triangles, including exterior angles

9 Triangles – Congruence

Congruence: SSS, SAS, ASA/AAS, RHS (not SSA, not AAA); then CPCT. $\triangle ABC \cong \triangle PQR$: $A \leftrightarrow P$, $B \leftrightarrow Q$, $C \leftrightarrow R$ → Prove triangles congruent with SSS, SAS, ASA and RHS

Isosceles: equal sides ⇔ equal opposite angles; median to the base ⊥ base and bisects the vertex angle

"If P then Q": converse "if Q then P"; one counterexample disproves

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10 Quadrilaterals

Parallelogram: opposite sides/angles equal, diagonals bisect; rhombus diagonals ⊥; rectangle diagonals equal

Mid-point theorem: $DE \parallel BC$, $DE = \frac{1}{2}BC$

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Centroid divides each median 2 : 1: $AG = \frac{2}{3}AD$, $G = \left(\frac{x_1+x_2+x_3}{3}, \frac{y_1+y_2+y_3}{3}\right)$

Joining mid-points of any quadrilateral gives a parallelogram, perimeter $AC + BD$, half the area

11 Circles

Chord $2l$ at distance d from the centre: $r^2 = l^2 + d^2$ → Chord properties to find lengths

⊥ from centre bisects a chord; equal chords ⇔ equidistant from centre ⇔ equal angles at centre

Angle at centre = 2 × angle on the remaining arc; angles in the same segment are equal; angle in a semicircle = 90° → Find angles in circles, giving reasons

Cyclic quadrilateral: $\angle A + \angle C = \angle B + \angle D = 180°$ → Opposite angles of a cyclic quadrilateral add to 180°

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12 Area and Perimeter

Arc; sector (angle $\theta°$): $l = \frac{\theta}{360} \cdot 2\pi r$, $A = \frac{\theta}{360} \cdot \pi r^2$ → Sectors with the angle in degrees

Heron, $s = \frac{a+b+c}{2}$: $A = \sqrt{s(s-a)(s-b)(s-c)}$

Inradius; equilateral triangle: $A = rs$; $A = \frac{\sqrt{3}}{4}a^2$

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Brahmagupta (cyclic quad., $s = \frac{a+b+c+d}{2}$): $A = \sqrt{(s-a)(s-b)(s-c)(s-d)}$

Trapezium; rhombus: $\frac{1}{2}(a+b)h$; $\frac{1}{2}d_1d_2$ → Area and composite-shape questions

13 Surface Area and Volume

Cuboid; cube: $2(lb + bh + hl)$, lbh; $6a^2$, a^3 → Surface area and volume of single solids

Cylinder: $\text{CSA} = 2\pi rh$, $\text{TSA} = 2\pi r(r+h)$, $V = \pi r^2 h$ → Surface area and volume of single solids

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Cone, $l = \sqrt{r^2 + h^2}$: $\text{CSA} = \pi rl$, $\text{TSA} = \pi r(l+r)$, $V = \frac{1}{3}\pi r^2 h$ → Cone surface area when you are given the vertical height

Sphere; hemisphere: $4\pi r^2$, $\frac{4}{3}\pi r^3$; $2\pi r^2$ ($3\pi r^2$ total), $\frac{2}{3}\pi r^3$ → Surface area and volume of spheres and hemispheres

$1\ \text{m}^3 = 1000$ litres; scale factor k: areas × k^2, volumes × k^3 → Scaling areas and volumes of similar shapes and solids

14 Statistics

Mean; weighted mean: $\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$; $\bar{x}_w = \frac{\sum w_i x_i}{\sum w_i}$ → Mean from a frequency table

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Combined mean of two groups: $\frac{n_1\bar{x}_1 + n_2\bar{x}_2}{n_1+n_2}$ → Combined means; a new mean after a value is added

Mixture concentration: $\frac{q_1c_1 + q_2c_2}{q_1+q_2}$

Average speed = total distance ÷ total time; 100% stacked bars compare proportions, not totals

Median: middle value in order (n even: mean of the two middle values); mode: most frequent value → Median and quartiles from ordered lists

15 Probability

Experimental: $P(E) = \frac{\text{trials with } E}{\text{total trials}}$ → Estimate probabilities from experiments

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Theoretical (equally likely): $P(E) = \frac{\text{favourable}}{\text{total}}$; $P(\text{not } E) = 1 - P(E)$ → Probability from equally likely outcomes

$0 \leq P \leq 1$; tree diagram: one branch per stage; two coins 4, coin + die 12, two dice 36 outcomes

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