Class 9 Maths Formula Sheet

1 Number Systems

Sets of numbers	$\mathbf{N} \subset \mathbf{W} \subset \mathbf{Z} \subset \mathbf{Q} \subset \mathbf{R}$; real numbers = rationals + irrationals
Rational	$\frac{p}{q}$ (p, q integers, $q \neq 0$): decimal is **terminating** or **non-terminating recurring**
Irrational	not of the form $\frac{p}{q}$: decimal is **non-terminating non-recurring**; e.g. $\sqrt{2}$, $\sqrt{3}$, π
Recurring → $\frac{p}{q}$	$0.\overline{3} = \frac{1}{3}$, $0.\overline{47} = \frac{47}{99}$, $0.\overline{001} = \frac{1}{999}$
Mixing	rational $\pm$ irrational and (non-zero rational) $\times$ or $\div$ irrational are irrational
Laws of exponents ($a, b > 0$; p, q rational)	$a^p \cdot a^q = a^{p+q}$, $(a^p)^q = a^{pq}$, $\frac{a^p}{a^q} = a^{p-q}$ $a^p b^p = (ab)^p$, $a^0 = 1$, $a^{-n} = \frac{1}{a^n}$
Roots as powers	$a^{1/n} = \sqrt[n]{a}$, $a^{m/n} = (\sqrt[n]{a})^m = \sqrt[n]{a^m}$
Surd identities ($a, b > 0$)	$\sqrt{ab} = \sqrt{a}\sqrt{b}$, $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$ $(\sqrt{a} + \sqrt{b})(\sqrt{a} - \sqrt{b}) = a - b$ $(a + \sqrt{b})(a - \sqrt{b}) = a^2 - b$ $(\sqrt{a} + \sqrt{b})^2 = a + 2\sqrt{ab} + b$
Rationalising	$\frac{1}{\sqrt{a} + \sqrt{b}} = \frac{\sqrt{a} - \sqrt{b}}{a - b}$, $\frac{1}{a + \sqrt{b}} = \frac{a - \sqrt{b}}{a^2 - b}$

2 Polynomials

Degree	linear 1, quadratic 2, cubic 3; non-zero constant 0; zero polynomial: not defined
Zero of $p(x)$	c is a zero if $p(c) = 0$; zero of $ax + b$ is $-\frac{b}{a}$
Factor theorem	$(x - a)$ is a factor of $p(x) \iff p(a) = 0$
Squares	$(x \pm y)^2 = x^2 \pm 2xy + y^2$ $x^2 - y^2 = (x + y)(x - y)$
Product	$(x + a)(x + b) = x^2 + (a + b)x + ab$
Three terms	$(x + y + z)^2$ $= x^2 + y^2 + z^2 + 2xy + 2yz + 2zx$
Cubes	$(x + y)^3 = x^3 + y^3 + 3xy(x + y)$ $(x - y)^3 = x^3 - y^3 - 3xy(x - y)$
Sum / difference of cubes	$x^3 + y^3 = (x + y)(x^2 - xy + y^2)$ $x^3 - y^3 = (x - y)(x^2 + xy + y^2)$
Three cubes	$x^3 + y^3 + z^3 - 3xyz$ $= (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx)$
If $x + y + z = 0$	$x^3 + y^3 + z^3 = 3xyz$

3 Coordinate Geometry

Point (x, y)	abscissa x: signed distance from y-axis ordinate y: signed distance from x-axis

QUADRANT	I	II	III	IV
Signs of (x, y)	$(+, +)$	$(-, +)$	$(-, -)$	$(+, -)$

On the axes	$(x, 0)$ on the x-axis, $(0, y)$ on the y-axis, origin $(0, 0)$
Order matters	$(x, y) \neq (y, x)$ unless $x = y$

4 Linear Equations in Two Variables

General form	$ax + by + c = 0$, a, b not both zero
Solutions	**infinitely many**; choose any x, solve for y (e.g. put $x = 0$ for one solution, $y = 0$ for another)
One variable	$x = k$ is $1 \cdot x + 0 \cdot y - k = 0$

5 Introduction to Euclid's Geometry

Postulates. (1) A straight line can be drawn from any point to any other point. (2) A terminated line can be produced indefinitely. (3) A circle can be drawn with any centre and any radius. (4) All right angles are equal. (5) If a line falling on two lines makes the interior angles on one side less than two right angles, the two lines, produced indefinitely, meet on that side.

Some axioms. Things equal to the same thing are equal to one another. Equals added to (or subtracted from) equals give equals. The whole is greater than the part. Things that coincide are equal.

Facts. Through two distinct points there is a unique line. Two distinct lines cannot have more than one point in common.

6 Lines and Angles

Pairs of angles	complementary: sum 90°; supplementary: sum 180°
Linear pair	adjacent angles on a line add up to 180° (and conversely)
Vertically opposite	vertically opposite angles are equal
Parallel lines + transversal	corresponding angles equal; alternate interior angles equal; co-interior angles (same side) add up to 180°; each converse proves lines parallel
Triangle	$\angle A + \angle B + \angle C = 180^\circ$
Exterior angle	= sum of the two interior opposite angles

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7 Triangles

SAS	two sides and the **included** angle equal
ASA	two angles and the **included** side equal
AAS	two angles and a corresponding non-included side equal
SSS	all three sides equal
RHS	right angle, hypotenuse and one side equal

- **CPCT:** corresponding parts of congruent triangles are equal.
- **Isosceles triangle:** angles opposite equal sides are equal; conversely, sides opposite equal angles are equal.
- In an isosceles triangle, the bisector of the vertex angle is the perpendicular bisector of the base.
- Each angle of an equilateral triangle is 60°. (SSA and AAA do **not** prove congruence.)

8 Quadrilaterals

Angle sum $\angle A + \angle B + \angle C + \angle D = 360^\circ$

- **Parallelogram:** a diagonal divides it into two congruent triangles; opposite sides are equal; opposite angles are equal; diagonals bisect each other; adjacent angles add up to 180°.
- A quadrilateral is a parallelogram if: both pairs of opposite sides are equal, **or** both pairs of opposite angles are equal, **or** diagonals bisect each other, **or** one pair of opposite sides is equal and parallel.
- **Rectangle:** diagonals equal · **Rhombus:** diagonals bisect at 90° · **Square:** diagonals equal and bisect at 90°
- **Mid-point theorem:** the segment joining the mid-points of two sides is parallel to the third side and half of it.
- **Converse:** a line through the mid-point of one side, parallel to another side, bisects the third side.
- Joining the mid-points of the sides of any quadrilateral, in order, gives a parallelogram.

9 Circles

- Equal chords subtend equal angles at the centre (and conversely).
- The perpendicular from the centre to a chord bisects the chord; the line from the centre to the mid-point of a chord is perpendicular to it.
- Equal chords are equidistant from the centre (and conversely).
- Congruent arcs have equal chords and subtend equal angles at the centre.
- The angle an arc subtends at the centre is **double** the angle it subtends at any point on the remaining part of the circle.
- Angles in the same segment are equal.
- Angle in a semicircle $= 90^\circ$.
- **Cyclic quadrilateral:** opposite angles add up to 180°; conversely, if they do, the quadrilateral is cyclic.
- An exterior angle of a cyclic quadrilateral equals the interior opposite angle.

10 Heron's Formula

Sides a, b, c	$\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$ where $s = \dfrac{a+b+c}{2}$ (semi-perimeter)
Base and height	$\text{Area} = \dfrac{1}{2} \times \text{base} \times \text{height}$
Equilateral, side a	$\text{Area} = \dfrac{\sqrt{3}}{4}a^2$
Isosceles, equal sides a, base b	$\text{Area} = \dfrac{b}{4}\sqrt{4a^2 - b^2}$

11 Surface Areas and Volumes

SOLID	CSA	TSA	VOLUME
Cone r, h, l	$\pi r l$	$\pi r(l + r)$	$\frac{1}{3}\pi r^2 h$
Sphere r	$4\pi r^2$	$4\pi r^2$	$\frac{4}{3}\pi r^3$
Hemisphere r	$2\pi r^2$	$3\pi r^2$	$\frac{2}{3}\pi r^3$

Slant height of cone	$l = \sqrt{r^2 + h^2}$
Spherical shell	$V = \frac{4}{3}\pi(R^3 - r^3)$ (R outer, r inner radius)
Scaling	radius × 2 ⇒ surface area × 4, volume × 8
Units	$1000\ \text{cm}^3 = 1\ \text{L},\ \ 1\ \text{m}^3 = 1000\ \text{L}$

12 Statistics

Frequency	number of times a value (or class) occurs
Range	highest value − lowest value
Class size (width)	upper limit − lower limit of a continuous class (9.5–19.5 → 10)
Class mark	$\dfrac{\text{upper class limit} + \text{lower class limit}}{2}$

- **Inclusive → exclusive classes** (e.g. 10–19, 20–29): subtract half the gap from each lower limit and add it to each upper limit → 9.5–19.5, 19.5–29.5.
- **Bar graph:** bars of equal width with equal gaps; height shows the value.
- **Histogram:** rectangles on continuous class intervals with **no gaps**; area of each rectangle ∝ frequency.
- **Frequency polygon:** join the mid-points of the tops of the histogram rectangles (or plot class mark against frequency), and close it at the class marks of the empty classes before the first and after the last class.

Unequal widths: adjusted frequency	$\dfrac{\text{minimum class size}}{\text{class size}} \times \text{frequency}$ (use it as the height of the rectangle)

Note: Chapters follow the rationalised 12-chapter NCERT textbook. NCERT is introducing new textbooks class by class (for Class 9, *Ganita Manjari* from 2026-27), so check which book and syllabus your school follows.

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