FORMULA SHEET

# CBSE Class 10 Mathematics

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CBSE gives no formula booklet: learn every result on this sheet. Organised by NCERT chapter.

## ❶ Real Numbers

Fundamental Theorem of Arithmetic: every composite number is a product of primes, uniquely apart from order

HCF = product of the smallest power of each common prime; LCM = product of the greatest power of each prime

For two positive integers: $\mathrm{HCF}(a,b) \times \mathrm{LCM}(a,b) = a \times b$

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$\sqrt{2}, \sqrt{3}, \sqrt{5}$ and $\sqrt{p}$ ($p$ prime) are irrational: prove by contradiction ($p \mid a^2 \Rightarrow p \mid a$)

## ❷ Polynomials

Zeroes $\alpha, \beta$ of $ax^2+bx+c$: $\alpha+\beta = -\frac{b}{a}$, $\alpha\beta = \frac{c}{a}$

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Quadratic with zeroes $\alpha, \beta$: $k\left[x^2 - (\alpha+\beta)x + \alpha\beta\right]$

Zeroes of $p(x)$ = $x$-coordinates where $y = p(x)$ meets the $x$-axis; degree $n \Rightarrow$ at most $n$ zeroes

## ❸ Pair of Linear Equations

$a_1x + b_1y + c_1 = 0$, $a_2x + b_2y + c_2 = 0$

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Unique solution (lines intersect): $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

No solution (parallel, inconsistent): $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

Infinitely many (coincident): $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

Solve by substitution or elimination; consistent = at least one solution

## ❹ Quadratic Equations

$ax^2+bx+c=0$, $a \neq 0$: $x = \frac{-b \pm \sqrt{D}}{2a}$, $D = b^2 - 4ac$

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Nature of roots:
$D > 0$ two distinct real;
$D = 0$ two equal real $\left(x = -\frac{b}{2a}\right)$;
$D < 0$ no real roots

## ❺ Arithmetic Progressions

$n$th term: $a_n = a + (n-1)d$

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Sum of first $n$ terms: $S_n = \frac{n}{2}\left[2a + (n-1)d\right] = \frac{n}{2}(a+l)$

From $S_n$: $a_n = S_n - S_{n-1}$

$n$th term from the end (last term $l$): $l - (n-1)d$

Three terms in AP; middle term: $a-d,\ a,\ a+d$; $b = \frac{a+c}{2}$

Natural numbers: $1 + 2 + \cdots + n = \frac{n(n+1)}{2}$

## ❻ Triangles

Basic Proportionality Theorem: if $DE \parallel BC$ in $\triangle ABC$: $\frac{AD}{DB} = \frac{AE}{EC}$

Converse: if a line divides two sides in the same ratio, it is parallel to the third side

Similar triangles (AA, SSS, SAS): corresponding angles equal, corresponding sides in the same ratio

Pythagoras (right angle at $B$): $AC^2 = AB^2 + BC^2$

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## ❼ Coordinate Geometry

Distance: $PQ = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}$; $OP = \sqrt{x^2+y^2}$

Section formula, ratio $m:n$ (internal): $\left(\frac{mx_2+nx_1}{m+n}, \frac{my_2+ny_1}{m+n}\right)$

Midpoint: $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$

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Ratio in which a line or axis divides $AB$: take $k:1$ and solve for $k$

## ❽ Introduction to Trigonometry

Ratios (right $\triangle$): $\sin A = \frac{P}{H}$, $\cos A = \frac{B}{H}$, $\tan A = \frac{P}{B} = \frac{\sin A}{\cos A}$

Reciprocals: $\operatorname{cosec} A = \frac{1}{\sin A}$, $\sec A = \frac{1}{\cos A}$, $\cot A = \frac{1}{\tan A}$

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Identities: $\sin^2 A + \cos^2 A = 1$, $1 + \tan^2 A = \sec^2 A$, $1 + \cot^2 A = \operatorname{cosec}^2 A$

$0°, 30°, 45°, 60°, 90°$: $\sin:\ 0, \frac{1}{2}, \frac{1}{\sqrt{2}}, \frac{\sqrt{3}}{2}, 1$; $\cos:\ 1, \frac{\sqrt{3}}{2}, \frac{1}{\sqrt{2}}, \frac{1}{2}, 0$

tan at the same angles: $0,\ \frac{1}{\sqrt{3}},\ 1,\ \sqrt{3},$ not defined

## ❾ Applications of Trigonometry

Height and distance: $\tan\theta = \frac{\text{height}}{\text{horizontal distance}}$

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Angle of elevation (looking up) = angle of depression (looking down) between the same two points; use 30°, 45°, 60°

## ❿ Circles

Tangent ⊥ radius at the point of contact

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Tangents from an external point are equal: $PA = PB$

Length of tangent from $P$, distance $d$ from centre: $\sqrt{d^2 - r^2}$

Tangents from a point: inside 0, on the circle 1, outside 2

## ⓫ Areas Related to Circles

Circle: $C = 2\pi r$, $A = \pi r^2$

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Arc length; sector area (angle $\theta$): $l = \frac{\theta}{360°} \times 2\pi r$, $A = \frac{\theta}{360°} \times \pi r^2$

Segment: area = sector $- \frac{1}{2} r^2 \sin\theta$

Segment, $\theta = 60°, 90°, 120°$: subtract $\frac{\sqrt{3}}{4}r^2$, $\frac{1}{2}r^2$, $\frac{\sqrt{3}}{4}r^2$

Perimeter of sector; ring: $2r + l$; $\pi(R^2 - r^2)$

Minute hand sweeps 6° per minute; hour hand 0.5° per minute

## ⓬ Surface Areas and Volumes

Cuboid $l, b, h$: $\mathrm{TSA} = 2(lb + bh + hl)$, $\mathrm{LSA} = 2h(l+b)$, $V = lbh$

Cube, edge $a$: $\mathrm{TSA} = 6a^2$, $V = a^3$

Cylinder: $\mathrm{CSA} = 2\pi rh$, $\mathrm{TSA} = 2\pi r(r+h)$, $V = \pi r^2 h$

Scan to practise

Cone, $l = \sqrt{r^2+h^2}$: $\mathrm{CSA} = \pi r l$, $\mathrm{TSA} = \pi r(l+r)$, $V = \frac{1}{3}\pi r^2 h$

Sphere: $\mathrm{SA} = 4\pi r^2$, $V = \frac{4}{3}\pi r^3$

Hemisphere: $\mathrm{CSA} = 2\pi r^2$, $\mathrm{TSA} = 3\pi r^2$, $V = \frac{2}{3}\pi r^3$

Combined solids: add only the surfaces you can see; volumes simply add (or subtract)

## ⓭ Statistics

Class mark: $x_i = \frac{\text{upper} + \text{lower limit}}{2}$

Mean: direct: $\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$

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Assumed mean, $d_i = x_i - a$: $\bar{x} = a + \frac{\sum f_i d_i}{\sum f_i}$

Step deviation, $u_i = \frac{x_i - a}{h}$: $\bar{x} = a + \frac{\sum f_i u_i}{\sum f_i} \times h$

Mode: $l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$

Median: $l + \frac{\frac{n}{2} - cf}{f} \times h$

Empirical relation: $3\,\text{Median} = \text{Mode} + 2\,\text{Mean}$

Mode: $l$, $f_1$ of the modal class, $f_0, f_2$ of the classes before/after. Median: $l$, $f$ of the median class, $cf$ = cumulative frequency before it.

## ⓮ Probability

Classical probability: $P(E) = \frac{\text{favourable outcomes}}{\text{total outcomes}}$

Complement; range: $P(E) + P(\bar{E}) = 1$; $0 \le P(E) \le 1$

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Sure event 1, impossible event 0; probabilities of all elementary events add to 1

Cards: 52 = 4 suits × 13; 26 red, 26 black; 12 face cards. Two dice: 36 outcomes



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