Class 10 Maths Formula Sheet

1 Real Numbers

Fundamental Theorem of Arithmetic: every composite number is a product of primes, unique apart from the order of the factors.

HCF / LCM	HCF = product of **smallest** powers of **common** primes; LCM = product of **greatest** powers of **all** primes
Two numbers a, b	$\text{HCF}(a,b) \times \text{LCM}(a,b) = a \times b$ (only for two numbers)
Co-prime a, b	$\text{HCF} = 1,\ \text{LCM} = a \times b$
Prime p	if p divides a^2, then p divides a
Irrational numbers	$\sqrt{2},\ \sqrt{3},\ \sqrt{5}$; rational $\pm$ irrational and (non-zero rational) $\times$ or $\div$ irrational are irrational

2 Polynomials

Zero of $p(x)$	k is a zero if $p(k) = 0$; zero of $ax + b$ is $-\frac{b}{a}$
Number of zeros	degree $n \Rightarrow$ at most n zeros (where the graph meets the x-axis)
$ax^2 + bx + c$, zeros α, β	$\alpha + \beta = -\dfrac{b}{a}, \quad \alpha\beta = \dfrac{c}{a}$
Graph of quadratic	parabola; opens up if $a > 0$, down if $a < 0$
Forming a quadratic	$k\left[x^2 - (\alpha+\beta)x + \alpha\beta\right],\ k \neq 0$

3 Pair of Linear Equations in Two Variables

$a_1x + b_1y + c_1 = 0,\ a_2x + b_2y + c_2 = 0$ (graph, substitution, elimination)

RATIOS	LINES	SOLUTIONS	SYSTEM
$\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$	intersecting	exactly one	consistent
$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$	coincident	infinitely many	consistent
$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$	parallel	none	inconsistent

4 Quadratic Equations

Standard form	$ax^2 + bx + c = 0,\ a \neq 0$
Factorisation	split bx into two terms whose coefficients add to b and multiply to ac
Quadratic formula	$x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
Discriminant $D = b^2 - 4ac$	$D > 0$: two distinct real roots $D = 0$: two equal real roots, each $-\frac{b}{2a}$ $D < 0$: no real roots

5 Arithmetic Progressions

nth term	$a_n = a + (n-1)d,\ d = a_{k+1} - a_k$
nth term from end	$l - (n-1)d$ (l = last term)
Sum of first n terms	$S_n = \dfrac{n}{2}[2a + (n-1)d] = \dfrac{n}{2}(a + l)$
nth term from sums	$a_n = S_n - S_{n-1}\ \ (n \geq 2),\ a_1 = S_1$
Three terms in AP	$a - d,\ a,\ a + d$
Test for AP	a, b, c in AP $\iff 2b = a + c$
Standard sums	$1 + 2 + \cdots + n = \dfrac{n(n+1)}{2}$ $1 + 3 + 5 + \cdots + (2n-1) = n^2$

6 Triangles

- $\triangle ABC \sim \triangle DEF \Rightarrow \angle A = \angle D, \angle B = \angle E, \angle C = \angle F$ and $\dfrac{AB}{DE} = \dfrac{BC}{EF} = \dfrac{CA}{FD}$
- **BPT (Thales):** a line parallel to one side, meeting the other two sides at distinct points, divides them in the same ratio: $DE \parallel BC \Rightarrow \dfrac{AD}{DB} = \dfrac{AE}{EC}$
- All congruent figures are similar; all circles, all squares and all equilateral triangles are similar.
- **Converse of BPT:** a line dividing two sides in the same ratio is parallel to the third side.
- **Similarity criteria: AA** (two pairs of angles equal) · **SSS** (all sides in the same ratio) · **SAS** (one angle equal, sides including it in the same ratio)

7 Coordinate Geometry

Distance formula	$PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
Distance from origin	$OP = \sqrt{x^2 + y^2}$
Section formula (internal, $m_1 : m_2$)	$\left(\dfrac{m_1x_2 + m_2x_1}{m_1 + m_2}, \dfrac{m_1y_2 + m_2y_1}{m_1 + m_2}\right)$
Ratio $k : 1$	$\left(\dfrac{kx_2 + x_1}{k+1}, \dfrac{ky_2 + y_1}{k+1}\right)$
Mid-point	$\left(\dfrac{x_1 + x_2}{2}, \dfrac{y_1 + y_2}{2}\right)$
Points on the axes	$(x, 0)$ on the x-axis, $(0, y)$ on the y-axis
Points of trisection	divide AB in the ratios $1:2$ and $2:1$
Collinear A, B, C	$AB + BC = AC$ (B between A and C)
Parallelogram	diagonals bisect each other, so they share the same mid-point

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8 Introduction to Trigonometry

△ABC, right angle at B. For angle A: opposite BC, adjacent AB, hypotenuse AC.

Ratios	$\sin A = \frac{BC}{AC},\ \cos A = \frac{AB}{AC},\ \tan A = \frac{BC}{AB}$
Reciprocals	$\operatorname{cosec} A = \frac{1}{\sin A},\ \sec A = \frac{1}{\cos A},\ \cot A = \frac{1}{\tan A}$
Quotients	$\tan A = \frac{\sin A}{\cos A},\ \cot A = \frac{\cos A}{\sin A}$
Identities	$\sin^2 A + \cos^2 A = 1\ \ (0^\circ \le A \le 90^\circ)$ $1 + \tan^2 A = \sec^2 A\ \ (0^\circ \le A < 90^\circ)$ $1 + \cot^2 A = \operatorname{cosec}^2 A\ \ (0^\circ < A \le 90^\circ)$

$\angle A$	0°	30°	45°	60°	90°
$\sin A$	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
$\cos A$	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
$\tan A$	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	not defined
$\operatorname{cosec} A$	not defined	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1
$\sec A$	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	not defined
$\cot A$	not defined	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0

From 0° to 90°: $\sin A$ rises from 0 to 1, $\cos A$ falls from 1 to 0.

9 Some Applications of Trigonometry

- **Elevation:** line of sight above the horizontal (looking up).
- **Depression:** line of sight below the horizontal (looking down).
- Elevation of B from A = depression of A from B.

Height, distance	$h = d\tan\theta$, line of sight $= \frac{h}{\sin\theta} = \frac{d}{\cos\theta}$
Same side, d apart, $\alpha > \beta$	$h = \frac{d\tan\alpha\tan\beta}{\tan\alpha - \tan\beta}$

10 Circles

- A **tangent** touches the circle at one point. Tangents from a point inside: 0; on: 1; outside: **2**.
- Tangent ⊥ **radius** at the point of contact.
- Tangents from an external point P are **equal**: $PA = PB$, and OP bisects $\angle APB$.

Tangent length	$PA = \sqrt{OP^2 - r^2}$

11 Areas Related to Circles

Circle	$C = 2\pi r,\ A = \pi r^2$ (θ below in degrees)
Arc length	$l = \frac{\theta}{360^\circ} \times 2\pi r$
Area of sector	$\frac{\theta}{360^\circ} \times \pi r^2 = \frac{lr}{2}$
Minor segment	sector − △OAB; △OAB $= \frac{1}{2}r^2$ ($\theta = 90^\circ$), $\frac{\sqrt{3}}{4}r^2$ ($\theta = 60^\circ$)
Major sector / segment	πr^2 − minor sector / minor segment

12 Surface Areas and Volumes

SOLID	CSA	TSA	VOLUME
Cuboid l, b, h	$2h(l + b)$	$2(lb + bh + hl)$	lbh
Cube a	$4a^2$	$6a^2$	a^3
Cylinder r, h	$2\pi rh$	$2\pi r(r + h)$	$\pi r^2 h$
Cone r, h, l	πrl	$\pi r(l + r)$	$\frac{1}{3}\pi r^2 h$
Sphere r	$4\pi r^2$	$4\pi r^2$	$\frac{4}{3}\pi r^3$
Hemisphere r	$2\pi r^2$	$3\pi r^2$	$\frac{2}{3}\pi r^3$

Cone slant height	$l = \sqrt{r^2 + h^2}$
Combined solids	TSA = sum of **exposed** surfaces only; volume = sum of volumes

13 Statistics (grouped data)

x_i = class mark (mid-point of the class), f_i = frequency, $n = \sum f_i$, h = class size, a = assumed mean

Mean: direct	$\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$
Assumed mean	$\bar{x} = a + \frac{\sum f_i d_i}{\sum f_i},\ d_i = x_i - a$
Step deviation	$\bar{x} = a + h\left(\frac{\sum f_i u_i}{\sum f_i}\right),\ u_i = \frac{x_i - a}{h}$
Mode	$l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$

Modal class = highest frequency. l = its lower limit, f_1 = its frequency, f_0 / f_2 = frequency of the class before / after it.

Median	$l + \left(\frac{\frac{n}{2} - cf}{f}\right) \times h$

Median class = class whose cumulative frequency is greater than (and nearest to) $\frac{n}{2}$. l = its lower limit, f = its frequency, cf = c.f. of the class preceding it.

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

14 Probability

Probability of E (equally likely outcomes)	$P(E) = \frac{\text{outcomes favourable to } E}{\text{all possible outcomes}}$
Range	$0 \le P(E) \le 1$; sure event 1, impossible 0
Complement	$P(E) + P(\text{not } E) = 1$
Elementary events	their probabilities add up to 1

- **Coins:** 1 coin: 2 · 2 coins: 4 (HH, HT, TH, TT) · 3 coins: 8
- **Dice:** 1 die: 6 · 2 dice: 36 · sum 7 is the most likely (6 ways)
- **Cards:** 52 = 4 suits × 13. Spades ♠, clubs ♣ black; hearts ♥, diamonds ♦ red. Face cards J, Q, K → 12.

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