

Class 10 Maths Formula Sheet

All important formulas of the 12 units, in book order. Print it or keep it on your phone for revision.

UNIT 1

Exercises 1.1 to 1.4

Complex Numbers

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IMAGINARY UNIT

$$i = \sqrt{-1}, \quad i^2 = -1$$

POWERS OF I

$$i^3 = -i, \quad i^4 = 1 \quad (\text{repeat after every 4 steps})$$

EVEN POWER

$$i^{2n} = (-1)^n$$

ODD POWER

$$i^{2n+1} = (-1)^n i$$

ROOT OF A NEGATIVE NUMBER

$$\sqrt{-a} = i\sqrt{a}$$

STANDARD FORM

$$z = a + bi, \quad \text{Re}(z) = a, \quad \text{Im}(z) = b$$

EQUALITY

$$a + bi = c + di \Rightarrow a = c, b = d$$

ADDITION

$$(a + bi) + (c + di) = (a + c) + (b + d)i$$

SUBTRACTION

$$(a + bi) - (c + di) = (a - c) + (b - d)i$$

MULTIPLICATION

$$(a + bi)(c + di) = (ac - bd) + (ad + bc)i$$

CONJUGATE

$$\bar{z} = a - bi, \quad \overline{\bar{z}} = z$$

SUM AND DIFFERENCE WITH CONJUGATE

$$z + \bar{z} = 2a, \quad z - \bar{z} = 2bi$$

PRODUCT WITH CONJUGATE

$$(a + bi)(a - bi) = a^2 + b^2$$

MODULUS

$$|z| = \sqrt{a^2 + b^2}$$

MODULUS PROPERTIES

$$z\bar{z} = |z|^2, \quad |z| = |\bar{z}| = |-z|$$

RECIPROCAL

$$\frac{1}{a + bi} = \frac{a - bi}{a^2 + b^2}$$

UNIT 2

Exercises 2.1 to 2.7

Quadratic Equations and Inequalities

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STANDARD FORM

$$ax^2 + bx + c = 0, \quad a \neq 0$$

QUADRATIC FORMULA

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

DISCRIMINANT

$$D = b^2 - 4ac$$

SUM OF ROOTS

$$\alpha + \beta = -\frac{b}{a}$$

PRODUCT OF ROOTS

$$\alpha\beta = \frac{c}{a}$$

EQUATION FROM ROOTS

$$x^2 - (\alpha + \beta)x + \alpha\beta = 0$$

SUM OF SQUARES OF ROOTS

$$\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$$

VERTEX OF THE PARABOLA

$$x = -\frac{b}{2a}$$

INEQUALITY: BETWEEN THE ROOTS

$$(x - r_1)(x - r_2) \leq 0 \Rightarrow r_1 \leq x \leq r_2$$

INEQUALITY: OUTSIDE THE ROOTS

$$(x - r_1)(x - r_2) \geq 0 \Rightarrow x \leq r_1 \text{ or } x \geq r_2$$

SQUARE OF A REAL NUMBER

$$(x - a)^2 \geq 0 \quad \text{for every real } x$$

NATURE OF ROOTS

$$D > 0 \quad \text{real and unequal}$$

$$D = 0 \quad \text{real and equal}$$

$$D < 0 \quad \text{imaginary}$$

$$D > 0, \text{ perfect square} \quad \text{rational and unequal}$$

$$D > 0, \text{ not a perfect square} \quad \text{irrational and unequal}$$

RULES IN WORDS

Methods of solving: factorization, completing the square, the quadratic formula, or the graph (where the parabola cuts the x -axis).

Maximum or minimum: the vertex gives a maximum when $a < 0$ and a minimum when $a > 0$.

Graphical solution: the solution is the point where the two graphs meet. A line and a parabola meet at zero, one or two points.

Changing the subject: keep the required variable alone on one side. Whatever is done to one side is done to the other.

Solving an inequality: bring everything to one side, factorize, and find the critical points by putting each factor equal to zero. The critical points divide the number line into intervals; test a value in each interval. In the formulas above, $r_1 < r_2$.

Negative multiplier: multiplying or dividing by a negative number reverses the inequality sign.

End points: included for $\leq$ and $\geq$, excluded for $<$ and $>$.

UNIT 3

Exercises 3.1 to 3.6

Matrices and Determinants

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THE MATRIX A

$$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$$

DETERMINANT

$$|A| = ad - bc$$

ADJOINT

$$\text{Adj } A = \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$$

INVERSE

$$A^{-1} = \frac{1}{|A|} \text{Adj } A, \quad |A| \neq 0$$

SINGULAR AND NON-SINGULAR

$$|A| = 0 \text{ (singular)}, \quad |A| \neq 0 \text{ (non-singular)}$$

CHECKING AN INVERSE

$$AA^{-1} = A^{-1}A = I$$

INVERSE OF A PRODUCT

$$(AB)^{-1} = B^{-1}A^{-1}$$

MATRIX EQUATION

$$AX = B \Rightarrow X = A^{-1}B$$

CRAMER'S RULE

$$x = \frac{\Delta_x}{\Delta}, \quad y = \frac{\Delta_y}{\Delta}, \quad \Delta \neq 0$$

ORDER OF A PRODUCT

$$(m \times n)(n \times p) \rightarrow m \times p$$

ASSOCIATIVE LAW

$$A(BC) = (AB)C$$

DISTRIBUTIVE LAWS

$$A(B - C) = AB - AC, \quad (B + C)A = BA + CA$$

TRANSPOSE OF A PRODUCT

$$(BC)^t = C^t B^t$$

NOT COMMUTATIVE

$$AB \neq BA \text{ (usually)}$$

RULES IN WORDS

Order of a matrix: rows-by-columns (m -by- n).

Equal matrices: same order and same corresponding entries.

Transpose: rows become columns.

Negative of a matrix: change the sign of every entry.

Addition and subtraction: possible only for matrices of the same order.

Multiplication condition: columns of the first matrix = rows of the second.

Cramer's rule: replace the first column with the constants for Δ_x , and the second column for Δ_y .

Functions and Graphs

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SUM

$$(f + g)(x) = f(x) + g(x)$$

DIFFERENCE

$$(f - g)(x) = f(x) - g(x)$$

PRODUCT

$$(fg)(x) = f(x)g(x)$$

QUOTIENT

$$\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}, \quad g(x) \neq 0$$

COMPOSITE FUNCTIONS

$$(f \circ g)(x) = f(g(x)), \quad (g \circ f)(x) = g(f(x))$$

INVERSE FUNCTION

$$f(f^{-1}(x)) = x, \quad f^{-1}(f(x)) = x$$

ABSOLUTE VALUE GRAPH

$$y = a|x - h| + k, \quad \text{vertex } (h, k)$$

ABSOLUTE VALUE EQUATION

$$|A| = k \Rightarrow A = k \text{ or } A = -k$$

LESS THAN

$$|A| < k \Rightarrow -k < A < k$$

LESS THAN OR EQUAL

$$|A| \leq k \Rightarrow -k \leq A \leq k$$

GREATER THAN

$$|A| > k \Rightarrow A > k \text{ or } A < -k$$

GREATER THAN OR EQUAL

$$|A| \geq k \Rightarrow A \geq k \text{ or } A \leq -k$$

RULES IN WORDS

Domain and range of the inverse: domain of f^{-1} = range of f , and range of f^{-1} = domain of f .

Algebraic Fractions

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ALGEBRAIC FRACTION

$$\frac{P(x)}{Q(x)}, \quad Q(x) \neq 0$$

DIFFERENCE OF SQUARES

$$a^2 - b^2 = (a - b)(a + b)$$

SUM OF CUBES

$$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$$

DIFFERENCE OF CUBES

$$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$$

MULTIPLICATION

$$\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$$

DIVISION

$$\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c}$$

SPEED

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

WORK RATE

$$\text{Work rate} = \frac{1}{\text{Time}}$$

QUADRATIC FORMULA

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

RULES IN WORDS

Substitution: if x^4 appears, put $y = x^2$ to reduce the equation to quadratic form.

Vectors in Plane

COMPONENT FORM

$$\vec{a} = xi + yj$$

POSITION VECTOR OF P(X, Y)

$$\vec{OP} = xi + yj$$

VECTOR FROM A TO B

$$\vec{AB} = (x_2 - x_1)i + (y_2 - y_1)j$$

MAGNITUDE

$$|\vec{a}| = \sqrt{x^2 + y^2}$$

UNIT VECTOR

$$\hat{a} = \frac{\vec{a}}{|\vec{a}|}$$

ADDITION

$$\vec{a} + \vec{b} = (x_1 + x_2)i + (y_1 + y_2)j$$

SUBTRACTION

$$\vec{a} - \vec{b} = (x_1 - x_2)i + (y_1 - y_2)j$$

SCALAR MULTIPLICATION

$$k\vec{a} = kxi + kyj$$

TRANSLATION

$$(x, y) \rightarrow (x + a, y + b)$$

RULES IN WORDS

Vector from A to B: here A is the point (x_1, y_1) and B is the point (x_2, y_2) .

Equal vectors: two vectors are equal when their corresponding components are equal.

Parallel vectors: two non-zero vectors are parallel when one is a scalar multiple of the other, so the ratios of their components are equal.

Trigonometry

SINE RATIO

$$\sin \theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

COSINE RATIO

$$\cos \theta = \frac{\text{adjacent}}{\text{hypotenuse}}$$

TANGENT RATIO

$$\tan \theta = \frac{\text{opposite}}{\text{adjacent}}$$

FINDING AN ANGLE

$$\theta = \tan^{-1} \left(\frac{\text{opposite}}{\text{adjacent}} \right)$$

PYTHAGORAS THEOREM

$$a^2 + b^2 = c^2$$

ANGLES OF A TRIANGLE

$$\alpha + \beta + \gamma = 180^\circ$$

SINE RULE

$$\frac{a}{\sin \alpha} = \frac{b}{\sin \beta} = \frac{c}{\sin \gamma}$$

COSINE RULE

$$a^2 = b^2 + c^2 - 2bc \cos \alpha$$

$$b^2 = a^2 + c^2 - 2ac \cos \beta$$

$$c^2 = a^2 + b^2 - 2ab \cos \gamma$$

AREA: TWO SIDES AND THE INCLUDED ANGLE

$$\Delta = \frac{1}{2} ab \sin \gamma$$

AREA: ONE SIDE AND TWO ANGLES

$$\Delta = \frac{a^2 \sin \beta \sin \gamma}{2 \sin \alpha}$$

HERON'S FORMULA

$$\Delta = \sqrt{s(s-a)(s-b)(s-c)}, \quad s = \frac{a+b+c}{2}$$

ALLIED ANGLES WITH 180 DEGREES

$$\sin(180^\circ - \theta) = \sin \theta$$

$$\tan(180^\circ - \theta) = -\tan \theta$$

$$\csc(180^\circ - \theta) = \csc \theta$$

ALLIED ANGLES WITH 90 DEGREES

$$\cos(90^\circ + \theta) = -\sin \theta$$

$$\tan(90^\circ + \theta) = -\cot \theta$$

$$\sec(90^\circ - \theta) = \csc \theta$$

COMPONENTS OF A DISPLACEMENT D

$$\text{east} = d \sin(\text{bearing}), \quad \text{north} = d \cos(\text{bearing})$$

RULES IN WORDS

ASTC rule: All, Sin, Tan, Cos are positive in quadrants I, II, III and IV.

Angles $180^\circ \pm \theta$: the function stays the same; the sign depends on the quadrant.

Angles $90^\circ \pm \theta$: the function changes to its co-function; the sign depends on the quadrant.

Bearing: measured clockwise from North and written with three figures. The reverse bearing differs from the forward bearing by 180° .

Angle of elevation: measured above the horizontal line.

Angle of depression: measured below the horizontal line.

UNIT 8

Exercises 8.1 to 8.2

Chords and Arcs of a Circle

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PYTHAGORAS THEOREM

$$a^2 + b^2 = c^2$$

RULES IN WORDS

Chord bisecting theorem: a perpendicular drawn from the centre of a circle to a chord bisects the chord.

Converse: the perpendicular bisector of a chord passes through the centre of the circle.

Equal chords: equal chords of the same circle are equidistant from the centre.

Equal arcs: equal chords intercept equal arcs, and equal arcs subtend equal angles at the centre.

UNIT 9

Exercises 9.1 to 9.2

Tangent and Angles of a Circle

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ANGLE AT THE CENTRE

angle at centre = $2 \times$ angle at circumference

CYCLIC QUADRILATERAL

$$\angle A + \angle C = 180^\circ, \quad \angle B + \angle D = 180^\circ$$

CIRCLES TOUCHING EXTERNALLY

$$d = r_1 + r_2$$

CIRCLES TOUCHING INTERNALLY

$$d = r_1 - r_2, \quad r_1 > r_2$$

DEGREES TO RADIAN

$$\theta \text{ (radians)} = \theta \text{ (degrees)} \times \frac{\pi}{180}$$

ARC LENGTH

$$\ell = r\theta$$

AREA OF A SECTOR

$$A = \frac{1}{2} r^2 \theta$$

PERIMETER OF A SECTOR

$$P = 2r + \ell$$

AREA OF A CIRCLE

$$A = \pi r^2$$

CIRCUMFERENCE OF A CIRCLE

$$C = 2\pi r$$

RULES IN WORDS

Radians: in the arc length and sector formulas, θ is in radians.

Radius and tangent: the radius drawn to the point of contact is perpendicular to the tangent (90°).

Tangents from an external point: tangents drawn from the same external point are equal in length.

Angle in a semicircle: always a right angle (90°).

Angles in the same segment: equal.

Equal chords: equal chords subtend equal angles at the circumference.

Cyclic quadrilateral: opposite angles are supplementary, and the exterior angle equals the interior opposite angle.

Tangent-chord theorem: the angle between a tangent and a chord equals the angle in the alternate segment.

Practical Geometry of Circles

RULES IN WORDS

Perpendicular bisector of a chord: always passes through the centre of the circle.

Circle through three points: one and only one circle passes through three non-collinear points.

Tangent: touches the circle at exactly one point.

Radius and tangent: the radius drawn to the point of contact is perpendicular to the tangent.

Tangents from an external point: two tangents can be drawn, and they are equal in length.

Constructing tangents from an external point P: draw a circle on OP as diameter, centred at the midpoint M of OP . It cuts the given circle at the points of contact.

Angle between two tangents: supplementary to the angle between the two radii drawn to the points of contact.

Information Handling

MEDIAN POSITION ON THE OGIVE

$$\frac{N}{2}$$

LOWER QUARTILE POSITION

$$Q_1 : \frac{N}{4}$$

UPPER QUARTILE POSITION

$$Q_3 : \frac{3N}{4}$$

DECILE POSITION

$$D_k : \frac{kN}{10}$$

PERCENTILE POSITION

$$P_k : \frac{kN}{100}$$

VALUE FROM A GROUPED TABLE

$$l + \frac{\text{position} - c}{f} \times h$$

INTERQUARTILE RANGE

$$\text{IQR} = Q_3 - Q_1$$

RANGE

Range = highest value – lowest value

MEAN

$$\bar{x} = \frac{\sum x}{n}$$

MEAN FOR FREQUENCY DATA

$$\bar{x} = \frac{\sum fx}{\sum f}$$

VARIANCE

$$\sigma^2 = \frac{\sum (x - \bar{x})^2}{n}$$

VARIANCE, SHORT FORM

$$\sigma^2 = \frac{\sum x^2}{n} - \bar{x}^2$$

VARIANCE FOR FREQUENCY DATA

$$\sigma^2 = \frac{\sum fx^2}{\sum f} - \bar{x}^2$$

STANDARD DEVIATION

$$\sigma = \sqrt{\sigma^2}$$

RULES IN WORDS

Symbols: N is the total frequency. In the grouped-table formula, l is the lower boundary of the class, c is the cumulative frequency before the class, f is the frequency of the class and h is the class width.

Cumulative frequency: add the frequencies successively.

Less-than ogive: plot cumulative frequencies against the upper class boundaries.

Class mark: the midpoint of the class.

Ungrouped data: the median is the middle value in ascending order. Q_1 and Q_3 are the middle values of the lower and upper halves.

Comparing two data sets: the mean compares performance; the lower standard deviation shows the more consistent set.

Scatter diagram: positive correlation when both values rise together; negative correlation when one rises as the other falls.

Probability

PROBABILITY OF AN EVENT

$$P(E) = \frac{n(E)}{n(S)}$$

RANGE OF PROBABILITY

$$0 \leq P(E) \leq 1$$

IMPOSSIBLE EVENT

$$P(E) = 0$$

SURE EVENT

$$P(E) = 1$$

COMPLEMENT

$$P(A') = 1 - P(A)$$

ADDITION LAW

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

MUTUALLY EXCLUSIVE EVENTS

$$P(A \cap B) = 0, \quad P(A \cup B) = P(A) + P(B)$$

INDEPENDENT EVENTS

$$P(A \cap B) = P(A) \times P(B)$$

DEPENDENT EVENTS

$$P(A \cap B) = P(A) \times P(B | A)$$

RULES IN WORDS

Sample space: S is the set of all possible outcomes of a random experiment.

Sum of probabilities: the probabilities of all possible outcomes add up to 1.

Two dice: $6 \times 6 = 36$ outcomes.

Standard deck: 52 cards.