

# Class 10 Mathematics — Formula Sheet

All Chapters (CBSE / NCERT)



Scan this for more content

## 1. Real Numbers

| Concept                            | Formula / Result                                                                                                    |
|------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| Fundamental Theorem of Arithmetic  | Every composite number can be written as a product of primes, uniquely (apart from order)                           |
| HCF $\times$ LCM of two numbers    | $HCF(a, b) \times LCM(a, b) = a \times b$                                                                           |
| HCF of three numbers (note)        | $HCF(a, b, c) \times LCM(a, b, c) \neq a \times b \times c$                                                         |
| LCM of fractions                   | $LCM = \frac{\text{LCM of numerators}}{\text{HCF of denominators}}$                                                 |
| HCF of fractions                   | $HCF = \frac{\text{HCF of numerators}}{\text{LCM of denominators}}$                                                 |
| Irrational numbers                 | $\sqrt{2}, \sqrt{3}, \sqrt{5}$ are irrational; sum/difference/product of a rational and an irrational is irrational |
| Decimal expansion of $\frac{p}{q}$ | Terminating if $q = 2^m 5^n$ ; otherwise non-terminating repeating                                                  |

## 2. Polynomials

| Concept                                                    | Formula / Result                                           |
|------------------------------------------------------------|------------------------------------------------------------|
| Linear $ax + b$                                            | Zero: $x = -\frac{b}{a}$                                   |
| Quadratic equ. $ax^2 + bx + c$ with zeroes $\alpha, \beta$ | Sum: $\alpha + \beta = -\frac{b}{a}$                       |
|                                                            | Product: $\alpha\beta = \frac{c}{a}$                       |
| Quadratic Equ. from zeroes                                 | $x^2 - (\alpha + \beta)x + \alpha\beta$                    |
| Division algorithm                                         | $p(x) = g(x)q(x) + r(x)$ , where $\deg(r(x)) < \deg(g(x))$ |

## 3. Pair of Linear Equations in Two Variables

For  $a_1x + b_1y + c_1 = 0$  and  $a_2x + b_2y + c_2 = 0$ :

| Condition                                             | Nature of lines | Solutions                              |
|-------------------------------------------------------|-----------------|----------------------------------------|
| $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$                | Intersecting    | Unique solution (consistent)           |
| $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$ | Coincident      | Infinitely many solutions (consistent) |

| Condition                                                | Nature of lines | Solutions                  |
|----------------------------------------------------------|-----------------|----------------------------|
| $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ | Parallel        | No solution (inconsistent) |

Cross-multiplication method:  $\frac{x}{b_1c_2 - b_2c_1} = \frac{y}{c_1a_2 - c_2a_1} = \frac{1}{a_1b_2 - a_2b_1}$

#### 4. Quadratic Equations

| Concept                  | Formula / Result                                                 |
|--------------------------|------------------------------------------------------------------|
| Standard form            | $ax^2 + bx + c = 0, \quad a \neq 0$                              |
| Quadratic formula        | $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$                         |
| Discriminant             | $D = b^2 - 4ac$                                                  |
| $D > 0$                  | Two distinct real roots                                          |
| $D = 0$                  | Two equal real roots: $x = -\frac{b}{2a}$                        |
| $D < 0$                  | No real roots                                                    |
| Sum and product of roots | $\alpha + \beta = -\frac{b}{a}, \quad \alpha\beta = \frac{c}{a}$ |

#### 5. Arithmetic Progressions

| Concept                            | Formula                            |
|------------------------------------|------------------------------------|
| General form                       | $a, a + d, a + 2d, \dots$          |
| Common difference                  | $d = a_n - a_{n-1}$                |
| $n^{th}$ term                      | $a_n = a + (n - 1)d$               |
| $n^{th}$ term from the end         | $l - (n - 1)d$                     |
| Sum of first $n$ terms             | $S_n = \frac{n}{2}[2a + (n - 1)d]$ |
| Sum when last term $l$ is known    | $S_n = \frac{n}{2}(a + l)$         |
| $n^{th}$ term from sums            | $a_n = S_n - S_{n-1}$              |
| Sum of first $n$ natural numbers   | $\frac{n(n + 1)}{2}$               |
| Three terms in AP                  | $a - d, a, a + d$                  |
| Arithmetic mean of $a, b, c$ in AP | $b = \frac{a + c}{2}$              |

#### 6. Triangles

| Concept                                | Formula / Result                                                          |
|----------------------------------------|---------------------------------------------------------------------------|
| Basic Proportionality (Thales) Theorem | If $DE \parallel BC$ in $\triangle ABC$ : $\frac{AD}{DB} = \frac{AE}{EC}$ |

| Concept                   | Formula / Result                                                                                                        |
|---------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Converse of BPT           | If $\frac{AD}{DB} = \frac{AE}{EC}$ , then $DE \parallel BC$                                                             |
| Similarity criteria       | AAA (AA), SSS, SAS                                                                                                      |
| Similar triangles — sides | $\frac{AB}{PQ} = \frac{BC}{QR} = \frac{CA}{RP}$                                                                         |
| Ratio of areas            | $\frac{\text{ar}(\triangle ABC)}{\text{ar}(\triangle PQR)} = \frac{AB^2}{PQ^2} = \frac{BC^2}{QR^2} = \frac{CA^2}{RP^2}$ |
| Pythagoras Theorem        | $AC^2 = AB^2 + BC^2$ (right angle at B)                                                                                 |
| Converse of Pythagoras    | If $AC^2 = AB^2 + BC^2$ , then $\angle B = 90^\circ$                                                                    |
| Angle bisector theorem    | $\frac{AB}{AC} = \frac{BD}{DC}$                                                                                         |

## 7. Coordinate Geometry

| Concept                                  | Formula                                                             |
|------------------------------------------|---------------------------------------------------------------------|
| Distance formula                         | $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$                          |
| Distance from origin                     | $\sqrt{x^2 + y^2}$                                                  |
| Section formula (internal, ratio $m:n$ ) | $P\left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n}\right)$    |
| Mid-point                                | $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$             |
| Centroid of triangle                     | $\left(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3}\right)$ |
| Area of triangle                         | $\frac{1}{2}  x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2) $    |
| Collinear points                         | Area of triangle = 0                                                |

## 8. Introduction to Trigonometry

For a right triangle with angle  $\theta$ :

| Ratio        | Formula                                                                    | Reciprocal                                                          |
|--------------|----------------------------------------------------------------------------|---------------------------------------------------------------------|
| $\sin\theta$ | $\frac{\text{Perpendicular}}{\text{Hypotenuse}}$                           | $\csc\theta = \frac{1}{\sin\theta}$                                 |
| $\cos\theta$ | $\frac{\text{Base}}{\text{Hypotenuse}}$                                    | $\sec\theta = \frac{1}{\cos\theta}$                                 |
| $\tan\theta$ | $\frac{\text{Perpendicular}}{\text{Base}} = \frac{\sin\theta}{\cos\theta}$ | $\cot\theta = \frac{1}{\tan\theta} = \frac{\cos\theta}{\sin\theta}$ |

### Trigonometric identities

$$\sin^2\theta + \cos^2\theta = 1$$

$$1 + \tan^2 \theta = \sec^2 \theta$$

$$1 + \cot^2 \theta = \csc^2 \theta$$

**Table of trigonometric values**

| $\theta$      | $0^\circ$   | $30^\circ$           | $45^\circ$           | $60^\circ$           | $90^\circ$  |
|---------------|-------------|----------------------|----------------------|----------------------|-------------|
| $\sin \theta$ | 0           | $\frac{1}{2}$        | $\frac{1}{\sqrt{2}}$ | $\frac{\sqrt{3}}{2}$ | 1           |
| $\cos \theta$ | 1           | $\frac{\sqrt{3}}{2}$ | $\frac{1}{\sqrt{2}}$ | $\frac{1}{2}$        | 0           |
| $\tan \theta$ | 0           | $\frac{1}{\sqrt{3}}$ | 1                    | $\sqrt{3}$           | Not defined |
| $\csc \theta$ | Not defined | 2                    | $\sqrt{2}$           | $\frac{2}{\sqrt{3}}$ | 1           |
| $\sec \theta$ | 1           | $\frac{2}{\sqrt{3}}$ | $\sqrt{2}$           | 2                    | Not defined |
| $\cot \theta$ | Not defined | $\sqrt{3}$           | 1                    | $\frac{1}{\sqrt{3}}$ | 0           |

## 9. Some Applications of Trigonometry

| Concept                                  | Formula / Result                                                                               |
|------------------------------------------|------------------------------------------------------------------------------------------------|
| Angle of elevation                       | Angle between the horizontal line and the line of sight, when looking <b>up</b> at an object   |
| Angle of depression                      | Angle between the horizontal line and the line of sight, when looking <b>down</b> at an object |
| Height and distance                      | $\tan \theta = \frac{\text{height}}{\text{distance}}$                                          |
| Height of object                         | $h = d \tan \theta$                                                                            |
| Distance from base                       | $d = \frac{h}{\tan \theta} = h \cot \theta$                                                    |
| Line of sight length                     | $\sin \theta = \frac{h}{\text{line of sight}}$                                                 |
| Angle of elevation = angle of depression | Alternate interior angles are equal                                                            |

## 10. Circles

| Concept            | Result                                                                           |
|--------------------|----------------------------------------------------------------------------------|
| Tangent at a point | The tangent is perpendicular to the radius through the point of contact          |
| Number of tangents | From a point on the circle: 1; from an outside point: 2; from an inside point: 0 |

| Concept                | Result                                                                      |
|------------------------|-----------------------------------------------------------------------------|
| Equal tangents         | Lengths of the two tangents from an external point are equal: $PA = PB$     |
| Length of tangent      | $\sqrt{d^2 - r^2}$ , where $d$ is the distance of the point from the centre |
| Angle between tangents | $\angle APB + \angle AOB = 180^\circ$                                       |
| Tangent-chord (note)   | Centre lies on the bisector of the angle between the two tangents           |

## 11. Constructions

| Construction                                                         | Key Principle                                                                                                     |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Dividing a line segment in the ratio $m:n$                           | Draw a ray at an acute angle, mark $m + n$ equal arcs, join the last point to the end and draw parallels (BPT)    |
| Triangle similar to a given triangle with scale factor $\frac{m}{n}$ | Divide the base in $m:n$ using BPT; use equal ratios of sides                                                     |
| Tangents to a circle from an external point                          | Draw the circle on the segment joining the centre and the point as diameter; intersections give points of contact |

## 12. Areas Related to Circles

| Concept                                   | Formula                                                       |
|-------------------------------------------|---------------------------------------------------------------|
| Circumference                             | $C = 2\pi r = \pi d$                                          |
| Area of circle                            | $A = \pi r^2$                                                 |
| Area of semicircle                        | $\frac{1}{2}\pi r^2$                                          |
| Area of ring (annulus)                    | $\pi(R^2 - r^2)$                                              |
| Length of arc                             | $l = \frac{\theta}{360^\circ} \times 2\pi r$                  |
| Area of sector                            | $A = \frac{\theta}{360^\circ} \times \pi r^2 = \frac{1}{2}lr$ |
| Area of segment                           | Area of sector – Area of triangle                             |
| Area of minor segment                     | $\frac{\theta}{360^\circ}\pi r^2 - \frac{1}{2}r^2\sin\theta$  |
| Distance moved by a wheel in 1 revolution | $2\pi r$                                                      |
| Number of revolutions                     | $\frac{\text{Distance covered}}{2\pi r}$                      |
| Angle swept by minute hand in 1 minute    | $6^\circ$                                                     |
| Angle swept by hour hand in 1 hour        | $30^\circ$                                                    |
| Value of $\pi$                            | $\frac{22}{7}$ or 3.14                                        |

## 13. Surface Areas and Volumes

| Solid             | Curved / Lateral Surface Area | Total Surface Area                        | Volume                                      |
|-------------------|-------------------------------|-------------------------------------------|---------------------------------------------|
| Cuboid            | $2h(l + b)$                   | $2(lb + bh + hl)$                         | $lbh$                                       |
| Cube              | $4a^2$                        | $6a^2$                                    | $a^3$                                       |
| Cylinder          | $2\pi rh$                     | $2\pi r(r + h)$                           | $\pi r^2 h$                                 |
| Cone              | $\pi rl$                      | $\pi r(r + l)$                            | $\frac{1}{3}\pi r^2 h$                      |
| Sphere            | $4\pi r^2$                    | $4\pi r^2$                                | $\frac{4}{3}\pi r^3$                        |
| Hemisphere        | $2\pi r^2$                    | $3\pi r^2$                                | $\frac{2}{3}\pi r^3$                        |
| Hollow cylinder   | $2\pi h(R + r)$               | $2\pi(R + r)(R - r + h)$                  | $\pi h(R^2 - r^2)$                          |
| Frustum of a cone | $\pi(r_1 + r_2)l$             | $\pi(r_1 + r_2)l + \pi r_1^2 + \pi r_2^2$ | $\frac{1}{3}\pi h(r_1^2 + r_2^2 + r_1 r_2)$ |

## Other results

| Concept                       | Formula                                                                     |
|-------------------------------|-----------------------------------------------------------------------------|
| Slant height of cone          | $l = \sqrt{r^2 + h^2}$                                                      |
| Slant height of frustum       | $l = \sqrt{h^2 + (r_1 - r_2)^2}$                                            |
| Diagonal of cuboid            | $\sqrt{l^2 + b^2 + h^2}$                                                    |
| Diagonal of cube              | $\sqrt{3} a$                                                                |
| Melting and recasting         | Volume of old solid = Volume of new solid(s)                                |
| Number of small solids formed | $n = \frac{\text{Volume of large solid}}{\text{Volume of one small solid}}$ |
| Conversion                    | $1 \text{ m}^3 = 1000 \text{ litres}$                                       |

## 14. Statistics

| Concept              | Formula                                   |
|----------------------|-------------------------------------------|
| Mean (direct method) | $\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$ |

| Concept                      | Formula                                                                               |
|------------------------------|---------------------------------------------------------------------------------------|
| Mean (assumed mean method)   | $\bar{x} = a + \frac{\sum f_i d_i}{\sum f_i}, \quad d_i = x_i - a$                    |
| Mean (step-deviation method) | $\bar{x} = a + h \times \frac{\sum f_i u_i}{\sum f_i}, \quad u_i = \frac{x_i - a}{h}$ |
| Class mark                   | $x_i = \frac{\text{Upper limit} + \text{Lower limit}}{2}$                             |
| Mode (grouped data)          | $\text{Mode} = l + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$                       |
| Median (grouped data)        | $\text{Median} = l + \frac{\frac{n}{2} - cf}{f} \times h$                             |
| Empirical relationship       | $3 \text{ Median} = \text{Mode} + 2 \text{ Mean}$                                     |
| Mode                         | $\text{Mode} = 3 \text{ Median} - 2 \text{ Mean}$                                     |

Where  $l$  = lower limit of the modal / median class,  $h$  = class size,  $f_1$  = frequency of the modal class,  $f_0$  = frequency of the class before it,  $f_2$  = frequency of the class after it,  $cf$  = cumulative frequency of the class before the median class,  $f$  = frequency of the median class,  $n = \sum f_i$ .

## 15. Probability

| Concept                                       | Formula / Result                                                                      |
|-----------------------------------------------|---------------------------------------------------------------------------------------|
| Probability of an event $E$                   | $P(E) = \frac{\text{Number of favourable outcomes}}{\text{Total number of outcomes}}$ |
| Range of probability                          | $0 \leq P(E) \leq 1$                                                                  |
| Impossible event                              | $P(E) = 0$                                                                            |
| Sure (certain) event                          | $P(E) = 1$                                                                            |
| Complementary events                          | $P(E) + P(\overline{E}) = 1$                                                          |
|                                               | $P(\overline{E}) = 1 - P(E)$                                                          |
| Sum of probabilities of all elementary events | $1$                                                                                   |

### Useful facts for probability problems

| Item          | Details                                                          |
|---------------|------------------------------------------------------------------|
| Coin (1 toss) | Outcomes: H, T — Total = 2                                       |
| Die (1 throw) | Outcomes: 1,2,3,4,5,6 — Total = 6                                |
| Two dice      | Total = 36                                                       |
| Pack of cards | 52 cards: 26 red, 26 black; 4 suits of 13; 12 face cards; 4 aces |

| Item          | Details                     |
|---------------|-----------------------------|
| Leap year     | 366 days: 52 weeks + 2 days |
| Non-leap year | 365 days: 52 weeks + 1 day  |

### Useful Algebraic Identities (Quick Revision)

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

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

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

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

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

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

**EduSpark**  
LEARNING  
Learn • Practice • Improve

**Class 6 - 10**  
All Your Maths Needs  
in One Place!

Better Learning  
Brighter Future

**NCERT Solutions**  
Step-by-step, easy to understand

**Practice Papers**  
Half-yearly & Annual Exam Sets

**Case Studies**  
Real-life based questions

**Maths Battle**  
Play • Learn • Compete

**Paper Creator**  
Create Your Own Papers & Worksheets

**Worksheets**  
Practice Anytime, Anywhere

Study Smarter!

Maths  
Science  
Success

Visit Now:  
**edusparklearning.org**

Scan & Visit

Build Concepts

Improve Scores

Achieve Your Goals

Students & Teachers -  
Start Learning Today!