

Class 10 Mathematics

Comprehensive Study Guide & Formula Sheet

Based on the Latest Exam Pattern

Introduction

This comprehensive guide is designed to help Class 10 students master Mathematics. It contains chapter-wise summaries, essential formulas, key concepts, and practice questions aligned with the latest syllabus pattern. Use this material for quick revision, concept building, and exam preparation.

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1 Real Numbers

1.1 Fundamental Theorem of Arithmetic

Every composite number can be expressed (factorized) as a product of primes, and this factorization is unique, apart from the order in which the prime factors occur.

1.2 HCF and LCM

For any two positive integers a and b :

$$\text{HCF}(a, b) \times \text{LCM}(a, b) = a \times b$$

Note: This property is valid only for two numbers.

1.3 Irrational Numbers

A number is called irrational if it cannot be written in the form $\frac{p}{q}$, where p and q are integers and $q \neq 0$. Examples: $\sqrt{2}, \sqrt{3}, \pi$. **Theorem:** Let p be a prime number. If p divides a^2 , then p divides a , where a is a positive integer.

2 Polynomials

2.1 Zeroes of a Polynomial

A real number k is a zero of a polynomial $P(x)$ if $P(k) = 0$. Geometrically, the zeroes of a polynomial are the x -coordinates of the points where the graph of $y = P(x)$ intersects the x -axis.

2.2 Relationship Between Zeroes and Coefficients

For a quadratic polynomial $ax^2 + bx + c$, let the zeroes be α and β :

- **Sum of zeroes:** $\alpha + \beta = -\frac{b}{a} = -\frac{\text{Coefficient of } x}{\text{Coefficient of } x^2}$
- **Product of zeroes:** $\alpha\beta = \frac{c}{a} = \frac{\text{Constant term}}{\text{Coefficient of } x^2}$

3 Pair of Linear Equations in Two Variables

The general form of a pair of linear equations is:

$$a_1x + b_1y + c_1 = 0$$

$$a_2x + b_2y + c_2 = 0$$

3.1 Conditions for Solvability

- **Intersecting Lines (Unique Solution):** $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ (Consistent system)
- **Coincident Lines (Infinitely Many Solutions):** $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$ (Consistent and dependent system)
- **Parallel Lines (No Solution):** $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ (Inconsistent system)

4 Quadratic Equations

A quadratic equation in the variable x is an equation of the form $ax^2 + bx + c = 0$, where a, b, c are real numbers, $a \neq 0$.

4.1 Quadratic Formula

The roots of the quadratic equation $ax^2 + bx + c = 0$ are given by:

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

4.2 Nature of Roots

The discriminant is $D = b^2 - 4ac$.

- If $D > 0$: Two distinct real roots.
- If $D = 0$: Two equal real roots.
- If $D < 0$: No real roots.

5 Arithmetic Progressions (A.P.)

An arithmetic progression is a list of numbers in which each term is obtained by adding a fixed number (common difference, d) to the preceding term except the first term (a).

5.1 Formulas

- **n th term of an A.P.:** $a_n = a + (n - 1)d$
- **Sum of first n terms (S_n):**

$$S_n = \frac{n}{2} [2a + (n - 1)d]$$

Alternatively, if the last term l is known:

$$S_n = \frac{n}{2} (a + l)$$

6 Coordinate Geometry

6.1 Distance Formula

The distance between two points $P(x_1, y_1)$ and $Q(x_2, y_2)$ is:

$$PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

6.2 Section Formula

The coordinates of point $P(x, y)$ which divides the line segment joining $A(x_1, y_1)$ and $B(x_2, y_2)$ internally in the ratio $m_1 : m_2$ are:

$$\left(\frac{m_1x_2 + m_2x_1}{m_1 + m_2}, \frac{m_1y_2 + m_2y_1}{m_1 + m_2} \right)$$

6.3 Mid-point Formula

If $m_1 = m_2 = 1$, the coordinates of the midpoint are:

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

7 Introduction to Trigonometry

Trigonometry deals with the measurement of sides and angles of a right-angled triangle.

7.1 Trigonometric Ratios

For a right-angled triangle with angle θ :

- $\sin \theta = \frac{\text{Opposite}}{\text{Hypotenuse}}$
- $\cos \theta = \frac{\text{Adjacent}}{\text{Hypotenuse}}$
- $\tan \theta = \frac{\text{Opposite}}{\text{Adjacent}} = \frac{\sin \theta}{\cos \theta}$

7.2 Trigonometric Identities

1. $\sin^2 \theta + \cos^2 \theta = 1$
2. $1 + \tan^2 \theta = \sec^2 \theta$
3. $1 + \cot^2 \theta = \text{cosec}^2 \theta$

8 Statistics

8.1 Mean ($\bar{x}$)

- **Direct Method:** $\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$
- **Assumed Mean Method:** $\bar{x} = a + \frac{\sum f_i d_i}{\sum f_i}$, where $d_i = x_i - a$

8.2 Mode

$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

Where: l = lower limit of the modal class, h = size of the class interval, f_1 = frequency of the modal class, f_0 = frequency of the class preceding the modal class, f_2 = frequency of the class succeeding the modal class.

8.3 Median

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

Where: l = lower limit of median class, n = number of observations, cf = cumulative frequency of class preceding the median class, f = frequency of median class, h = class size.

9 Probability

The theoretical (classical) probability of an event E , written as $P(E)$, is defined as:

$$P(E) = \frac{\text{Number of outcomes favorable to } E}{\text{Number of all possible outcomes of the experiment}}$$

- $0 \leq P(E) \leq 1$
- $P(E) + P(\text{not } E) = 1$

10 Practice Questions

- Q1.** Prove that $\sqrt{5}$ is an irrational number.
- Q2.** Find the zeroes of the quadratic polynomial $x^2 - 2x - 8$, and verify the relationship between the zeroes and the coefficients.
- Q3.** Solve the following pair of linear equations by the substitution method: $7x - 15y = 2$ and $x + 2y = 3$.

- Q4.** Find the roots of the quadratic equation $2x^2 - 7x + 3 = 0$ using the quadratic formula.
- Q5.** Find the 10th term of the A.P.: 2, 7, 12, ...
- Q6.** Find the coordinates of the point which divides the join of $(-1, 7)$ and $(4, -3)$ in the ratio 2 : 3.
- Q7.** Prove the identity: $(\sin A + \operatorname{cosec} A)^2 + (\cos A + \sec A)^2 = 7 + \tan^2 A + \cot^2 A$.
- Q8.** A die is thrown once. Find the probability of getting (i) a prime number; (ii) a number lying between 2 and 6.

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