1. Real Numbers

1. IMPORTANT FORMULAS (NCERT ONLY)

- **Fundamental Theorem of Arithmetic (Theorem 1.1):** 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.
- **HCF and LCM Relationship (Two Numbers):** For any two positive integers a and b:

$$HCF(a,b) \times LCM(a,b) = a \times b.$$

- **HCF and LCM of Three Numbers (p,q,r):**
  - $LCM(p,q,r) = \dfrac{p \times q \times r \times HCF(p,q,r)}{HCF(p,q) \times HCF(q,r) \times HCF(p,r)}$.
  - $HCF(p,q,r) = \dfrac{p \times q \times r \times LCM(p,q,r)}{LCM(p,q) \times LCM(q,r) \times LCM(p,r)}$.
- **Divisibility Theorem (Theorem 1.2):** Let p be a prime number. If p **divides** a^2, then p **divides** a, where a is a positive integer.

2. STANDARD METHODS OF SOLVING QUESTIONS

- **Prime Factorization Method (Fundamental Theorem of Arithmetic):**
  1. Express each number as a product of powers of primes.
  2. **HCF:** Product of the **smallest power** of each common prime factor.
  3. **LCM:** Product of the **greatest power** of each prime factor involved in the numbers.
- **Proof by Contradiction (Irrationality Proofs):**
  1. Assume the number (e.g., $\sqrt{2}$) is rational and can be written as a/b where a and b are **coprime**.
  2. Use the Divisibility Theorem to show that both a and b share a common prime factor.
  3. Conclude that the assumption is false because it contradicts the fact that a and b are coprime.
- **Checking the Ending Digit of a^n:**
  1. Factorize the base a (e.g., $4^n = (2)^{2n}$ or $6^n = (2 \times 3)^n$).
  2. State that for a number to end with the digit zero, its prime factorization **must contain the prime 5**.
  3. Apply the **uniqueness** of the Fundamental Theorem of Arithmetic to show no other primes exist in the factorization.

3. METHOD $\rightarrow$ FORMULA LINKING

- **Calculating LCM via HCF:** Use $LCM(a,b) = \dfrac{a \times b}{HCF(a,b)}$.
- **Identifying Composite Numbers:** Express expressions like $7 \times 11 \times 13 + 13$ as a product of primes to prove they are composite.
- **Meeting Point Problems (Circular Paths):** Apply **LCM** to find the time when two individuals starting at the same time will meet again at the starting point.

4. MUST-REMEMBER RESULTS

- **Prime Factorization Notation:** For any composite number x, it can be factorized as $x = p_1 \times p_2 \dots p_n$ where $p_1 \leq p_2 \leq \cdots \leq p_n$ (ascending order).
- **Irrationality Facts:**
  - $\sqrt{p}$ is irrational for any prime p.
  - The **sum or difference** of a rational and an irrational number is irrational.
  - The **product and quotient** of a non-zero rational and irrational number is irrational.
- **Three-Number Property:** The product of three numbers is **not equal** to the product of their HCF and LCM ($p \times q \times r \neq HCF(p,q,r) \times LCM(p,q,r)$).
- **Coprime Definition:** Two integers a and b are **coprime** if they have no common factors other than 1.

2. Polynomials

1. IMPORTANT FORMULAS (NCERT ONLY)

- **Value of a Polynomial:** If $p(x)$ is a polynomial in x and k is any real number, the value obtained by replacing x by k in $p(x)$ is $p(k)$.
- **Zero of a Polynomial:** A real number k is a zero of a polynomial $p(x)$ if $p(k) = 0$.
- **Linear Polynomial** $(ax+b, a \neq 0)$**:**
  - Zero of the polynomial is $k = -\frac{b}{a} = \frac{-(\text{Constant term})}{\text{Coefficient of } x}$.
- **Quadratic Polynomial** $(ax^2+bx+c, a \neq 0)$**:**
  - Sum of zeroes $(\alpha+\beta) = -\frac{b}{a} = \frac{-(\text{Coefficient of } x)}{\text{Coefficient of } x^2}$.
  - Product of zeroes $(\alpha\beta) = \frac{c}{a} = \frac{\text{Constant term}}{\text{Coefficient of } x^2}$.

2. STANDARD METHODS OF SOLVING QUESTIONS

- **Geometrical Method:** The zeroes of a polynomial $p(x)$ are the x-coordinates of the points where the graph $y = p(x)$ intersects the x-axis.
- **Splitting the Middle Term:** Used to find zeroes of quadratic polynomials by factorizing them into two linear factors.
- **Verification Method:**
  1. Find zeroes (α, β) using factorisation.
  2. Calculate $(\alpha+\beta)$ and $(\alpha\beta)$.
  3. Compare these values with $-b/a$ and c/a from the polynomial coefficients.
- **Formation of a Quadratic Polynomial:** Given the sum (S) and product (P) of zeroes: $k[x^2 - (S)x + P]$, where k is a constant.

3. METHOD $\rightarrow$ FORMULA LINKING

- **Finding number of zeroes:** Count the points of intersection on the x-axis in a graph.
- **Finding zeroes of linear polynomial:** Set $ax+b=0$ to get $x = -b/a$.
- **Relating zeroes to coefficients:** Apply $\alpha+\beta = -b/a$ and $\alpha\beta = c/a$.

4. MUST-REMEMBER RESULTS

- **Degree and Zeroes:** A polynomial of degree n has at most n zeroes.
- **Linear Graph:** The graph of a linear polynomial $ax+b$ is a straight line.

- **Quadratic Graph (Parabola):** The graph is a **parabola** opening upwards if $a > 0$ and downwards if $a < 0$.
- **Parabola Intersection Cases:**
  1. Intersects x-axis at two distinct points (Two distinct zeroes).
  2. Intersects x-axis at exactly one point (Two coincident points / One zero).
  3. Does not intersect x-axis (No real zeroes).
- **Definition of Degree:** The highest power of x in $p(x)$ is the degree.
- **Linear vs. Quadratic:** A polynomial of degree 1 is linear; degree 2 is quadratic; degree 3 is cubic.

3. Pair of linear euqtions in teo variables

1. IMPORTANT FORMULAS (NCERT ONLY)

- **Standard Form of a Pair of Equations:**

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

- **Consistency and Algebraic Conditions:**

Sl. No.	Pair of Lines	Ratio Comparison	Graphical Rep.	Algebraic Interpretation
1	**Intersecting lines**	$\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$	Intersect at a single point	**Exactly one solution** (Unique)
2	**Coincident lines**	$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$	Lines coincide	**Infinitely many solutions**
3	**Parallel lines**	$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$	Lines are parallel	**No solution**

2. STANDARD METHODS OF SOLVING QUESTIONS

- **Graphical Method:**
  1. Find at least two solutions for each equation and represent them in a table.
  2. Plot the points on graph paper and draw the lines.
  3. The point of intersection (x,y) is the solution. If lines are parallel, no solution exists.
- **Substitution Method:**
  1. **Step 1:** Pick either equation and write one variable in terms of the other (e.g., x in terms of y).
  2. **Step 2:** Substitute this value into the **other** equation to reduce it to an equation in one variable.
  3. **Step 3:** Solve for that variable and substitute the result back into the Step 1 equation to find the second variable.
- **Elimination Method:**
  1. **Step 1:** Multiply equations by suitable non-zero constants to make the coefficients of one variable numerically equal.
  2. **Step 2:** Add or subtract the equations to eliminate that variable.
  3. **Step 3:** Solve the resulting equation in one variable and substitute back to find the other.

3. METHOD $\rightarrow$ FORMULA LINKING

- **Consistency Check:** Compare ratios $\frac{a_1}{a_2}, \frac{b_1}{b_2}$, and $\frac{c_1}{c_2}$ to predict solution nature before solving.
- **Situational Problems:** Formulate equations from real-life contexts (ages, costs, speed-distance) and solve using algebraic methods.

4. MUST-REMEMBER RESULTS

- **Consistent Pair:** Has at least one solution.
- **Inconsistent Pair:** Has no solution.
- **Dependent Pair:** Equivalent equations with infinite solutions; **always consistent**.
- **Graphical Limitations:** Inconvenient for non-integral coordinates (e.g., $\sqrt{3}, 2.7, \frac{4}{13}$).
- **Variable Elimination Logic:**
  - **True statement** (e.g., $18 = 18$): Infinitely many solutions.
  - **False statement** (e.g., $0 = 9$): No solution.
- **Two-Digit Numbers:** Expressed as $10x + y$; reversed digits are $10y + x$.

4. Quadratic Equations

1. IMPORTANT FORMULAS (NCERT ONLY)

- **Standard Form:** $ax^2 + bx + c = 0$, where a, b, c are real numbers and $a \neq 0$.
- **Quadratic Formula:** $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$, provided that $b^2 - 4ac \geq 0$.
- **Discriminant (D):** $D = b^2 - 4ac$. This value determines whether the equation has real roots.
- **Nature of Roots:**
  1. **Two distinct real roots:** If $b^2 - 4ac > 0$.
  2. **Two equal real roots (coincident roots):** If $b^2 - 4ac = 0$. In this case, each root is $-\dfrac{b}{2a}$.
  3. **No real roots:** If $b^2 - 4ac < 0$.

2. STANDARD METHODS OF SOLVING QUESTIONS

- **Factorization (Splitting the Middle Term):** Finding roots by expressing the quadratic polynomial as a product of two linear factors and equating each to zero.
- **Quadratic Formula Method:**
  1. Express the equation in standard form.
  2. Calculate the discriminant (D).
  3. If $D \geq 0$, apply the formula to find roots.
- **Simplification and Checking:** Rewriting equations in the form $p(x) = 0$ to determine if they are quadratic (degree 2) or not.
- **Mathematical Representation:** Formulating a quadratic equation from situational or real-life problems, such as the area of a rectangular hall or production costs.

3. METHOD $\rightarrow$ FORMULA LINKING

- **Checking existence of real roots:** Use the Discriminant formula $b^2 - 4ac$ before attempting to solve.
- **Solving by Factorization:** Equating linear factors $(x - \alpha)(x - \beta) = 0$ to find roots.
- **Finding the value of k for equal roots:** Set the discriminant formula to zero ($b^2 - 4ac = 0$).

4. MUST-REMEMBER RESULTS

- **Roots vs. Zeroes:** The zeroes of the quadratic polynomial $ax^2 + bx + c$ and the roots of the quadratic equation $ax^2 + bx + c = 0$ are the same.
- **Root Definition:** A real number α is a root if $a\alpha^2 + b\alpha + c = 0$. We also say $x = \alpha$ is a **solution** or that α **satisfies** the equation.

- **Maximum Roots:** Any quadratic equation can have **at most two roots**.
- **Descending Order:** The standard form requires terms to be written in descending order of their degrees.
- **Simplification Warning:** Some equations may appear quadratic but are not (e.g., $x(x+1)+8=(x+2)(x-2)$ simplifies to a linear equation), while others may appear cubic but are quadratic.

5. Arithmetic Progressions

1. IMPORTANT FORMULAS (NCERT ONLY)

- **General Form of an AP:** $a, a+d, a+2d, a+3d, \dots$.
- **Common Difference (d):** $d = a_{k+1} - a_k$.
- **nth Term (General Term) (a_n):** $a_n = a + (n-1)d$.
- **Sum of First n Terms (S_n):**
  - $S_n = \frac{n}{2}[2a + (n-1)d]$.
  - $S_n = \frac{n}{2}(a + l)$, where l is the last term.
- **Sum of first n positive integers:** $S_n = \frac{n(n+1)}{2}$.
- **Arithmetic Mean:** If a, b, c are in AP, then $b = \frac{a+c}{2}$.
- **Relationship between a_n and S_n:** $a_n = S_n - S_{n-1}$.

2. STANDARD METHODS OF SOLVING QUESTIONS

- **Verifying an AP:**
  1. Calculate the difference between consecutive terms ($a_2 - a_1, a_3 - a_2, \dots$).
  2. If $a_{k+1} - a_k$ is the same every time, the list is an AP.
- **Finding the nth Term from the End:**
  - **Method 1:** Find the total number of terms n. The mth term from the end is the $(n - m + 1)$th term from the beginning.
  - **Method 2 (Reversal):** Reverse the AP. The last term l becomes the first term (a), and the common difference becomes $-d$. Use the a_n formula.
- **Determining if a Number is a Term of an AP:**
  1. Set a_n equal to the given number and solve for n.
  2. If n is a **positive integer**, the number is a term; otherwise, it is not.
- **Solving Daily Life Problems:** Identify the first term (a) and fixed increment/decrement (d) to calculate future values (a_n) or total accumulation (S_n).

3. METHOD → FORMULA LINKING

- **Finding d when a and a_n are known:** Use $a_n = a + (n-1)d$.
- **Finding S_n when the first and last terms are known:** Use $S = \frac{n}{2}(a + l)$.
- **Finding a_n when only the sum formula is given:** Apply $a_n = S_n - S_{n-1}$.

4. MUST-REMEMBER RESULTS

- **Common Difference Properties:** d can be **positive, negative, or zero**.
- **Finite vs. Infinite AP:**
  - **Finite AP:** Contains a finite number of terms and has a **last term**.
  - **Infinite AP:** Does not have a last term and continues indefinitely.
- **Condition for n:** In all formulas, n **must always be a positive integer** because it represents the position of a term.
- **Summation Pattern:** In AP, the sum of terms is specifically governed by the S_n **quadratic pattern**.
- **General Term Note:** a_n is often called the general term. If there are m terms in an AP, a_m represents the last term (l).

6.. Triangles

1. IMPORTANT THEOREMS AND CRITERIA

According to the latest syllabus, students must distinguish between theorems for formal proof and those for application.

Theorems to be Proved

- **Basic Proportionality Theorem (BPT/Thales):** If a line is drawn parallel to one side of a triangle to intersect the other two sides in distinct points, the other two sides are divided in the same ratio.

Theorems to be Stated (Without Proof)

- **Converse of BPT:** If a line divides any two sides of a triangle in the same ratio, the line is parallel to the third side.
- **AAA Similarity Criterion (or AA):** If in two triangles, the corresponding angles are equal, then their corresponding sides are proportional and the triangles are similar.
- **SSS Similarity Criterion:** If the corresponding sides of two triangles are proportional, then their corresponding angles are equal and the two triangles are similar.
- **SAS Similarity Criterion:** If one angle of a triangle is equal to one angle of another triangle and the sides including these angles are proportional, then the two triangles are similar.

2. STANDARD METHODS OF SOLVING QUESTIONS

- **Proving Similarity:** Systematically use the AAA, SSS, or SAS criteria to establish that two triangles are similar before calculating unknown lengths.
- **Indirect Measurement:** Applying similarity properties to find heights or distances in real-world scenarios, such as using shadows or mirrors to find the height of a tower.
- **Logical Property Establishment:** Using BPT and its converse to solve problems related to line segments within triangles.

3. METHOD → FORMULA LINKING

- **Finding side lengths in parallel scenarios:** Link the parallel line condition to the **Basic Proportionality Theorem**:
$$\frac{AD}{DB} = \frac{AE}{EC}$$
.
- **Height/Distance calculations:** Link "Indirect Measurement" to the **AA similarity criterion**, as shadows and vertical objects often create similar right-angled triangles.

4. MUST-REMEMBER RESULTS

- **Congruence vs. Similarity:** All congruent figures are similar, but similar figures need not be congruent.
- **Similarity Conditions for Polygons:** Two polygons are similar only if **both** conditions are met: (i) their corresponding angles are equal **AND** (ii) their corresponding sides are proportional.
- **Definitions:** The curriculum requires understanding definitions, examples, and counter-examples of similar triangles.
- **Syllabus Note:** The current syllabus focus is strictly on **Similarity**; area of similar triangles and Pythagoras Theorem are not listed in the 2025-26 syllabus objectives provided.

7.Coordinate Geometry

1. IMPORTANT FORMULAS (NCERT ONLY)

- **Distance Formula:** The distance between $P(x_1, y_1)$ and $Q(x_2, y_2)$ is:

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

- **Distance from Origin:** The distance of a point $P(x, y)$ from the origin $(0, 0)$ is $\sqrt{x^2 + y^2}$.
- **Section Formula (Internal Division):** The coordinates of the 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:

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

- **Mid-point Formula:** The mid-point of a line segment joining $P(x_1, y_1)$ and $Q(x_2, y_2)$ is:

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

2. STANDARD METHODS OF SOLVING QUESTIONS

- **Collinearity Check:** To show that points A, B, and C are collinear, verify that the sum of the lengths of two segments equals the third (e.g., $AB + BC = AC$) using the distance formula.
- **Equidistance Problems:** To find a point P equidistant from A and B, set $PA = PB$ or $PA^2 = PB^2$ to solve without square roots.
- **Assume Ratio Method:** To find the ratio in which a point divides a segment, assume the ratio is $k : 1$. Substitute this into the section formula and solve for k using a known coordinate.
- **Finding Points on Axes:**
  - For a point on the x-**axis**, use coordinates $(x, 0)$.
  - For a point on the y-**axis**, use coordinates $(0, y)$.

3. METHOD $\rightarrow$ FORMULA LINKING

- **Ratio Finding:** Link the $k : 1$ assumption to the **Section Formula**.
- **Geometric Shapes Verification:** Use the **Distance Formula** to check if a triangle is isosceles or if a quadrilateral is a square (all sides and diagonals equal).
- **Parallelogram Properties:** Use the **Mid-point Formula** to find missing vertices, as the diagonals of a parallelogram bisect each other.

4. MUST-REMEMBER RESULTS

- **Abscissa and Ordinate:** The x-coordinate is the abscissa and the y-coordinate is the ordinate.
- **Parallelogram Diagonals:** The mid-point of diagonal AC is identical to the mid-point of diagonal BD.
- **Syllabus Restriction:** Study is restricted to the Distance and Section Formula (Internal Division); **Area of a Triangle is excluded**.
- **Origin Coordinates:** The origin is always $(0,0)$.

8. Introduction to Trigonometry

1. IMPORTANT FORMULAS (NCERT ONLY)

0.1 A. Trigonometric Ratios

The ratios for a right-angled ΔABC (where $\angle B = 90^\circ$) are defined for an acute angle $\angle A$:

Ratio	Abbreviation	Relation to Sides
Sine of $\angle A$	$\sin A$	$\frac{\text{Side opposite to } \angle A}{\text{Hypotenuse}} = \frac{BC}{AC}$
Cosine of $\angle A$	$\cos A$	$\frac{\text{Side adjacent to } \angle A}{\text{Hypotenuse}} = \frac{AB}{AC}$
Tangent of $\angle A$	$\tan A$	$\frac{\text{Side opposite to } \angle A}{\text{Side adjacent to } \angle A} = \frac{BC}{AB}$
Cosecant of $\angle A$	$\text{cosec } A$	$\frac{\text{Hypotenuse}}{\text{Side opposite to } \angle A} = \frac{AC}{BC}$
Secant of $\angle A$	$\sec A$	$\frac{\text{Hypotenuse}}{\text{Side adjacent to } \angle A} = \frac{AC}{AB}$
Cotangent of $\angle A$	$\cot A$	$\frac{\text{Side adjacent to } \angle A}{\text{Side opposite to } \angle A} = \frac{AB}{BC}$

0.2 B. Relationships between Ratios

- **Reciprocals:** $\text{cosec } A = \frac{1}{\sin A}$, $\sec A = \frac{1}{\cos A}$, $\cot A = \frac{1}{\tan A}$.
- **Quotients:** $\tan A = \frac{\sin A}{\cos A}$ and $\cot A = \frac{\cos A}{\sin A}$.

0.3 C. Trigonometric Identities

- $\sin^2 A + \cos^2 A = 1$
- $1 + \tan^2 A = \sec^2 A$ (for $0^\circ \leq A < 90^\circ$)
- $\cot^2 A + 1 = \text{cosec}^2 A$ (for $0^\circ < A \leq 90^\circ$)

2. TABLE OF RATIOS FOR SPECIFIC ANGLES

The syllabus requires values for $0^\circ, 30^\circ, 45^\circ, 60^\circ$, and 90°:

Angle (A)	0°	30°	45°	60°	90°
$\sin A$	0	$1/2$	$1/\sqrt{2}$	$\sqrt{3}/2$	1
$\cos A$	1	$\sqrt{3}/2$	$1/\sqrt{2}$	$1/2$	0
$\tan A$	0	$1/\sqrt{3}$	1	$\sqrt{3}$	Not Defined
$\text{cosec } A$	Not Defined	2	$\sqrt{2}$	$2/\sqrt{3}$	1
$\sec A$	1	$2/\sqrt{3}$	$\sqrt{2}$	2	Not Defined
$\cot A$	Not Defined	$\sqrt{3}$	1	$1/\sqrt{3}$	0

3. STANDARD METHODS OF SOLVING QUESTIONS

- **Pythagoras Theorem:** Given one ratio, identify two sides, use $a^2+b^2=c^2$ to find the third, then find other ratios.
- **Evaluation:** Substitute specific values from the table into algebraic expressions.
- **Proving Identities:** Use $\sin^2 A+\cos^2 A=1$ to transform one side of an equation into the other.

4. MUST-REMEMBER RESULTS

- **Values Range:** $\sin A$ and $\cos A$ are always ≤ 1; $\sec A$ and cosec A are always ≥ 1.
- **Identity Constraints:** Note undefined angles: $\tan A, \sec A$ (90°) and $\cot A$, cosec A (0°).
- **Syllabus Note:** Ratios of **complementary angles** are **not** included in the 2025-26 objectives.

9. Some Applications of trigonometry

1. IMPORTANT FORMULAS (NCERT ONLY)

The solving of heights and distances is based on the application of specific trigonometric ratios in right-angled triangles.

- **Primary Ratio (Height/Distance):**

$$\tan\theta = \frac{\text{Side opposite to } \theta \text{ (Height)}}{\text{Side adjacent to } \theta \text{ (Distance)}}.$$

- **Secondary Ratio (Height/Slant):**

$$\sin\theta = \frac{\text{Side opposite to } \theta \text{ (Height)}}{\text{Hypotenuse (Length of string/ladder)}}.$$

- **Standard Values (Syllabus Restricted):** Per the official syllabus, only the following angles are used for heights and distances:
  - 30°**:** $\sin 30^\circ = \frac{1}{2}$; $\tan 30^\circ = \frac{1}{\sqrt{3}}$.
  - 45°**:** $\sin 45^\circ = \frac{1}{\sqrt{2}}$; $\tan 45^\circ = 1$.
  - 60°**:** $\sin 60^\circ = \frac{\sqrt{3}}{2}$; $\tan 60^\circ = \sqrt{3}$.

2. STANDARD METHODS OF SOLVING QUESTIONS

0.4 Problem Setup and Visualization

1. Draw a clear diagram representing the **horizontal level**, the **line of sight**, and the **object**.
2. **Angle of Elevation:** The angle formed by the line of sight with the horizontal when the object is **above** the horizontal level.
3. **Angle of Depression:** The angle formed by the line of sight with the horizontal when the object is **below** the horizontal level.

0.5 Algebraic Solution

1. Identify the known side and the unknown side to be found.
2. Select the trigonometric ratio ($\sin, \cos$, or $\tan$) that links the known side, the unknown side, and the given angle.
3. Solve the resulting linear equation for the unknown side.

3. METHOD $\rightarrow$ FORMULA LINKING

- **Horizontal Distance between two points:** When two objects are observed from a single height, or one object is observed from two points, use **two right-angled triangles** sharing a common side.

- **Finding Slant Length:** Link the "Length of a ladder" or "kite string" to the **Sine formula** ($\sin\theta = \frac{\text{opp}}{\text{hyp}}$).
- **Finding Building/Tower Height:** Link the "Length of shadow" or "Distance from foot" to the **Tangent formula** ($\tan\theta = \frac{\text{opp}}{\text{adj}}$).

4. MUST-REMEMBER RESULTS / SYLLABUS RESTRICTIONS

- **Syllabus Complexity Limit:** Problems are restricted to involving **not more than two right triangles**.
- **Angular Restriction:** Angles of elevation or depression used in problems must be **only 30ř, 45ř, and 60ř**.
- **Alternate Angles Property:** The **Angle of Elevation** of an object as seen by an observer is equal to the **Angle of Depression** of the observer as seen from the object.
- **Line of Sight Definition:** The line drawn from the eye of an observer to the point in the object viewed by the observer.

10. Circles

1. IMPORTANT FORMULAS (NCERT ONLY)

- **Theorem 10.1 (Prove):** The tangent at any point of a circle is perpendicular ($\perp$) to the radius through the point of contact.
- **Theorem 10.2 (Prove):** The lengths of tangents drawn from an external point to a circle are equal.
- **Tangent Length Formula:** $PT = \sqrt{OT^2 - OP^2}$, where OT is the distance of the external point from the center and OP is the radius.

2. STANDARD METHODS OF SOLVING QUESTIONS

- **Finding Tangent Length:** Apply the Pythagoras Theorem to the right-angled triangle formed by the radius, the tangent, and the line joining the center to the external point ($OT^2 = OP^2 + PT^2$).
- **Using Angle Properties:**
  - Utilize the fact that the center of the circle lies on the bisector of the angle between two tangents drawn from an external point.
  - Solve problems involving the quadrilateral formed by the two radii and two tangents, noting that the angle between the tangents and the angle subtended by the line segments joining the points of contact at the center are **supplementary**.

3. METHOD $\rightarrow$ FORMULA LINKING

- **Calculating distances/lengths:** Link the "Tangent $\perp$ Radius" property to the **Pythagoras Theorem**.
- **Angle relationships:** Link the "External Tangents" property to the formula $\angle PTQ = 2\angle OPQ$, where T is the external point, P and Q are points of contact, and O is the center.

4. MUST-REMEMBER RESULTS

- **Point of Contact:** The common point of the tangent and the circle is called the point of contact.
- **Number of Tangents:**
  - **Inside the circle:** No tangent can be drawn through a point inside the circle.
  - **On the circle:** There is only one tangent to a circle passing through a point lying on the circle.
  - **Outside the circle:** There are exactly two tangents to a circle from a point lying outside the circle.
- **Parallel Tangents:** A circle can have at most **two parallel tangents** at any given time.
- **Tangent Definition:** A tangent to a circle is a line that intersects the circle at only one point.

11. Areas Related to Circles

1. IMPORTANT FORMULAS (NCERT ONLY)

- **Area of a Sector:** $\frac{\theta}{360} \times \pi r^2$.
- **Length of an Arc:** $\frac{\theta}{360} \times 2\pi r$.
- **Area of a Segment:** Area of the corresponding sector - Area of the corresponding triangle.
- **Major Sector Area:** πr^2 – Area of the minor sector.
  - *Alternative Formula:* $\frac{(360-\theta)}{360} \times \pi r^2$.
- **Major Segment Area:** πr^2 – Area of the minor segment.

2. STANDARD METHODS OF SOLVING QUESTIONS

- **Calculating Area of Segment:**
  1. Find the area of the sector using $\frac{\theta}{360} \times \pi r^2$.
  2. Find the area of the triangle formed by the radii and the chord.
  3. Subtract the triangle area from the sector area.
- **Trigonometric Method for Triangle Area (120ř case):**
  - To find the area of ΔOAB with central angle 120°, draw an altitude $OM \perp AB$.
  - Use trigonometry to find the base (AB) and height (OM): $OM = r\cos 60^\circ$ and $AM = r\sin 60^\circ$.
  - Area of $\Delta OAB = \frac{1}{2} \times AB \times OM$.
- **Unitary Method:** This is used to derive formulas by considering the circle as a sector with a 360° angle.

3. METHOD $\rightarrow$ FORMULA LINKING

- **Clock Problems:** Link the "minute hand" movement to sector area (e.g., in 5 minutes, the angle swept is $\frac{5}{60} \times 360^\circ = 30^\circ$).
- **Quadrant Calculations:** Link "quadrant" to a sector with a central angle of 90°.
- **Major Sector/Segment:** Link to the subtraction method: Total Area – Minor Part.

4. MUST-REMEMBER RESULTS

- **Syllabus Restriction:** Calculations for the area of a segment are strictly restricted to central angles of 60°**,** 90°**, and** 120° only.

- **Terminology:** Unless stated otherwise, the terms "segment" and "sector" always refer to the **minor segment** and **minor sector** respectively.
- **Sector Definition:** The portion of the circular region enclosed by two radii and the corresponding arc.
- **Segment Definition:** The portion of the circular region enclosed between a chord and the corresponding arc.
- **Pi (π) Usage:** Unless specified as 3.14, always use $\pi = \frac{22}{7}$.

12. Surface Areas and Volumes

1. IMPORTANT FORMULAS (NCERT ONLY)

The current syllabus restricts study to the **combinations of any two** of the following: cubes, cuboids, spheres, hemispheres, and right circular cylinders/cones.

- **Slant Height of a Cone (l):** $l = \sqrt{r^2 + h^2}$.
- **Total Surface Area (TSA) of Combined Solids:** Sum of the Curved Surface Areas (CSA) of individual parts.
  - *Note:* Overlapping or "stuck" faces are excluded from the surface area calculation.
- **Volume of Combined Solids:** Volume of Solid $1 +$ Volume of Solid 2.
- **Individual Component Formulas (Class X Application):**
  - **CSA of Hemisphere:** $2\pi r^2$.
  - **Volume of Hemisphere:** $\frac{2}{3}\pi r^3$.
  - **CSA of Cone:** πrl.
  - **Volume of Cone:** $\frac{1}{3}\pi r^2 h$.
  - **CSA of Cylinder:** $2\pi rh$.
  - **Volume of Cylinder:** $\pi r^2 h$.
  - **TSA of Cube:** $6 \times (\text{edge})^2$.
  - **Area of Circular Base:** πr^2.

2. STANDARD METHODS OF SOLVING QUESTIONS

- **Visualization Method:** Break the newly formed solid down into smaller, basic solids already studied in Class IX.
- **TSA Calculation Logic:** Identify which surfaces are "visible"; joined flat bases disappear from calculation.
- **The "Subtraction" Method for Cavities:** When a conical or hemispherical cavity is hollowed out of a cylinder, the TSA of the remaining solid is the **CSA of the cylinder + CSA of the hollowed shape + Area of the remaining base**.
- **The "Ring" Base Method:** If a cone is mounted on a larger cylinder, calculate the **CSA of the cone + CSA of the cylinder + (Base area of larger solid - Base area of smaller solid)**.

3. METHOD $\rightarrow$ FORMULA LINKING

- **Calculating Paint/Coloring Area:** Link "surface area" to the **Curved Surface Area** of the constituent parts.
- **Capacity/Air Space Problems:** Link "Volume" to the sum of the volumes of the individual constituent solids.
- **Mass Calculation:** Find the total **Volume** and multiply by the given mass per unit volume.

4. MUST-REMEMBER RESULTS

- **TSA Warning:** The total surface area of a combined solid is **not** necessarily the sum of the total surface areas of the individual parts.
- **Volume Advantage:** Unlike surface area, the volume of a combined solid is always the simple sum of the volumes of its constituents.
- **Apparent vs. Actual Capacity:** Actual Capacity = Apparent Capacity (Cylinder) - Volume of the raised portion (Hemisphere).
- **Syllabus Constraint:** Problems will not involve more than **two** different types of basic solids combined at once.
- π **Value:** Unless stated otherwise, take $\pi = \frac{22}{7}$; ensure 3.14 is used only if specified.

13. Statistics

1. IMPORTANT FORMULAS (NCERT ONLY)

0.6 A. Mean ($\bar{x}$) of Grouped Data

The mean is calculated by assuming the frequency of each class is centered at its **class mark**.

1. **Direct Method:** $\bar{x} = \dfrac{\sum f_i x_i}{\sum f_i}$
2. **Assumed Mean Method:** $\bar{x} = a + \dfrac{\sum f_i d_i}{\sum f_i}$
   Where a is the assumed mean and $d_i = x_i - a$ (deviations).
3. **Step-deviation Method:** $\bar{x} = a + h\left(\dfrac{\sum f_i u_i}{\sum f_i}\right)$
   Where h is the class size and $u_i = \dfrac{x_i - a}{h}$.

0.7 B. Mode of Grouped Data

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

- 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.

C. Median of Grouped Data

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

- l = lower limit of the **median class**.
- n = number of observations.
- cf = cumulative frequency of the class **preceding** the median class.
- f = frequency of the median class.
- h = class size.

D. Empirical Relationship

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

2. STANDARD METHODS OF SOLVING QUESTIONS

- **Calculating Class Marks (x_i):** Class mark $= \dfrac{\text{Upper class limit} + \text{Lower class limit}}{2}$.
- **Locating the Modal Class:** Identify the class with the **maximum frequency**.
- **Locating the Median Class:** Prepare a cumulative frequency (cf) column, find $n/2$, and identify the class whose cf is greater than (and nearest to) $n/2$.
- **Handling Discontinuous Classes:** If class intervals are not continuous (e.g., 118-126, 127-135), convert them (e.g., 117.5-126.5, 126.5-135.5) before using mode or median formulas.
- **Choosing Mean Method:** Use **Direct Method** for small numerical values; use **Assumed Mean** or **Step-deviation** for large values to reduce calculation.

3. METHOD $\rightarrow$ FORMULA LINKING

- **Finding Missing Frequencies:** Use provided Mean or Median values to create an equation for unknown variables (e.g., f or x, y).
- **Cumulative Frequency Distribution:**
  - **Less than type:** Uses **upper limits** of class intervals.
  - **More than type:** Uses **lower limits** of class intervals.

4. MUST-REMEMBER RESULTS

- **Syllabus Constraint:** Limited to grouped data; **bimodal situations are to be avoided**.
- **Continuity Requirement:** Class intervals **must be continuous** for mode and median calculations.
- **Central Tendency Interpretation:** **Mean** (average taking all observations into account), **Median** (middle-most value), **Mode** (most frequent/popular value).
- **Extreme Values:** The mean is affected by extreme values; the median is a better representative in such cases.

14. Probability

1. IMPORTANT FORMULAS (NCERT ONLY)

- **Theoretical (Classical) Probability $P(E)$:** Defined as:

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

- **Core Assumption:** This formula is valid only when we assume the outcomes of the experiment are **equally likely**.
- **Complementary Events:** For any event E, $P(E) + P(\bar{E}) = 1$, where $\bar{E}$ represents "not E".
  - **Rearranged:** $P(\bar{E}) = 1 - P(E)$.
- **Range of Probability:** $0 \leq P(E) \leq 1$.
- **Sure and Impossible Events:**
  - **Impossible Event:** An event that cannot happen has $P = 0$.
  - **Sure (Certain) Event:** An event certain to happen has $P = 1$.
- **Sum of Probabilities:** The sum of the probabilities of all the **elementary events** of an experiment is 1.

2. KEY DEFINITIONS & ASSUMPTIONS

- **Equidistance/Equally Likely Outcomes:** Outcomes where there is no reason to prefer one over the other, such as a "fair" coin.
- **Random Experiment:** An experiment where the outcome is not influenced by interference and all items are treated identically.
- **Elementary Event:** An event having only **one outcome** of the experiment.
- **Complementary Event:** The event $\bar{E}$ which occurs only when E does not occur.

3. STANDARD METHODS OF SOLVING QUESTIONS

- **Sample Space Creation:**
  - **Coins:** For one coin, outcomes are $\{H, T\}$ (2);
    for two coins tossed simultaneously, outcomes are $\{(H,H), (H,T), (T,H), (T,T)\}$ (4).
  - **Dice:** For one die, outcomes are $\{1,2,3,4,5,6\}$ (6); for two dice, there are $6 \times 6 = 36$ outcomes.
- **The Complement Method:** To find $P(\text{at least one } \ldots)$ or $P(\text{not } \ldots)$, it is often easier to calculate $1 - P(\text{opposite event})$.
- **Modified Totals:** In problems where an item is "drawn and put aside," the total possible outcomes for the second draw must be reduced by one.

4. MUST-REMEMBER DATA (SAMPLE SPACES)

- **The Deck of Playing Cards (52 Total):**
  - **4 Suits (13 cards each): Spades** ($\spadesuit$), **Hearts** ($\heartsuit$), **Diamonds** ($\diamondsuit$), **Clubs** ($\clubsuit$).
  - **Colors:** Spades and Clubs are **Black** (26); Hearts and Diamonds are **Red** (26).
  - **Face Cards (12 Total):** Kings, Queens, and Jacks (3 in each suit).
  - **Card Ranks:** Ace, 2, 3, 4, 5, 6, 7, 8, 9, 10, Jack, Queen, King.
- **Sum on Two Dice (2 to 12):**
  - Minimum Sum = 2 (1,1); Maximum Sum = 12 (6,6).
  - A sum of 8 has 5 outcomes: $\{(2,6),(3,5),(4,4),(5,3),(6,2)\}$.
- **Geometric Probability:** Probability can be calculated as the ratio of the **favorable area** to the **total area** (Note: Non-examination but in NCERT).

5. SYLLABUS ALIGNMENT (2025-26)

- **Focus:** Classical definition and simple problems on finding the probability of an event.
- **Constraints:** Problems are generally based on everyday events such as coins, dice, cards, or bags of items.