INFINITY THINK BEYOND
Mathematics Learning Initiative

MIND CURVE · STUDENT–TEACHER COMMUNITY

CLASS X · CBSE MATHEMATICS

FORMULA GUIDE

2026–27

LEARN → RECALL → APPLY

CBSE Curriculum 2026–27 | Standard (041) & Basic (241)

0 Foundation Recap (Classes VI–IX)

CHAPTER 0

❖ Algebraic Identities

(A) Square identities

- $(a+b)^2 = a^2 + 2ab + b^2$
- $(a-b)^2 = a^2 - 2ab + b^2$
- $a^2 - b^2 = (a+b)(a-b)$
- $(x+a)(x+b) = x^2 + (a+b)x + ab$
- $(a+b)^2 + (a-b)^2 = 2(a^2+b^2)$
- $(a+b)^2 - (a-b)^2 = 4ab$
- $(a+b+c)^2 = a^2+b^2+c^2+2ab+2bc+2ca$

(B) Cube identities

- $(a+b)^3 = a^3 + b^3 + 3ab(a+b)$
- $(a-b)^3 = a^3 - b^3 - 3ab(a-b)$
- $a^3 + b^3 = (a+b)(a^2 - ab + b^2)$
- $a^3 - b^3 = (a-b)(a^2 + ab + b^2)$
- $a^3 + b^3 + c^3 - 3abc = (a+b+c)(a^2+b^2+c^2-ab-bc-ca)$
  - ↪ Special case: if $a+b+c=0$, then $a^3+b^3+c^3 = 3abc$.

❖ Laws of Exponents & Surds $(a, b > 0)$

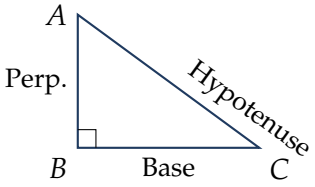
- $a^m \cdot a^n = a^{m+n}$
- $a^m \div a^n = a^{m-n}$
- $(a^m)^n = a^{mn}$
- $a^0 = 1$
- $a^{-n} = \dfrac{1}{a^n}$
- $(ab)^n = a^n b^n$
- $a^{p/q} = \sqrt[q]{a^p}$
- $\sqrt{ab} = \sqrt{a}\,\sqrt{b}$
- $\sqrt{\dfrac{a}{b}} = \dfrac{\sqrt{a}}{\sqrt{b}}$

- **Rationalising:** multiply numerator and denominator by the conjugate.
  - ↪ $\dfrac{1}{\sqrt{a}+\sqrt{b}} = \dfrac{1}{\sqrt{a}+\sqrt{b}} \times \dfrac{\sqrt{a}-\sqrt{b}}{\sqrt{a}-\sqrt{b}} = \dfrac{\sqrt{a}-\sqrt{b}}{a-b}$

❖ Geometry Facts & Pythagoras Theorem

(A) Lines and angles

- Angles on a straight line $= 180°$; angles at a point $= 360°$.
- Vertically opposite angles are equal.
- Parallel lines cut by a transversal:
  - alternate angles are equal;
  - corresponding angles are equal;
  - co-interior angles add up to $180°$.



$AC^2 = AB^2 + BC^2$

(B) Triangles and polygons

- Angle sum of a triangle $= 180°$.
- Exterior angle = sum of the two interior opposite angles.
- Angle sum of an n-sided polygon $= (n-2) \times 180°$.

(C) Pythagoras Theorem

- In right $\triangle ABC$ with $\angle B = 90°$: $AC^2 = AB^2 + BC^2$
  - ↪ (Hypotenuse)^2 = (Base)^2 + (Perpendicular)^2. The hypotenuse is always opposite the right angle.
- **Converse:** if $AC^2 = AB^2 + BC^2$, then $\angle B = 90°$.

- Common triplets: $(3,4,5)$, $(5,12,13)$, $(8,15,17)$, $(7,24,25)$, $(9,40,41)$ and their multiples.

(D) Circle facts

- Angle in a semicircle $= 90^\circ$; angles in the same segment are equal.
- Opposite angles of a cyclic quadrilateral add up to 180°.
- The perpendicular from the centre to a chord bisects the chord.

❖ Areas & Perimeters of Plane Figures

Figure	Area	Perimeter / Other
Rectangle ($l \times b$)	$l \times b$	$2(l+b)$; diagonal $= \sqrt{l^2+b^2}$
Square (side a)	$a^2 = \frac{1}{2}d^2$	$4a$; diagonal $= a\sqrt{2}$
Triangle	$\frac{1}{2} \times$ base $\times$ height	Heron: $\sqrt{s(s-a)(s-b)(s-c)}$, $s = \frac{a+b+c}{2}$
Equilateral triangle (side a)	$\frac{\sqrt{3}}{4}a^2$	height $= \frac{\sqrt{3}}{2}a$
Parallelogram	base $\times$ height	$2(a+b)$
Rhombus	$\frac{1}{2}d_1d_2$	$4a$; $a^2 = \left(\frac{d_1}{2}\right)^2 + \left(\frac{d_2}{2}\right)^2$
Trapezium	$\frac{1}{2}$(sum of parallel sides) $\times\, h$	sum of all sides

✎ **My Notes**

1 Real Numbers

CHAPTER 1

❖ Fundamental Theorem of Arithmetic

- Every composite number can be written as a **product of primes**.
- This factorisation is **unique** (only the order of the factors may change).
- Remember:
  - 1 is neither prime nor composite.
  - 2 is the only even prime; smallest prime $= 2$, smallest composite $= 4$.

Example: $3825 = 3 \times 3 \times 5 \times 5 \times 17 = 3^2 \times 5^2 \times 17$

❖ Finding HCF and LCM by Prime Factorisation

Step 1: Write each number as a product of prime powers.
Step 2: **HCF** $=$ product of the **common** primes, each with its **smallest** power.
Step 3: **LCM** $=$ product of **all** primes, each with its **greatest** power.

Example: $12 = 2^2 \times 3,\ 18 = 2 \times 3^2 \ \Rightarrow\ \text{HCF} = 2^1 \times 3^1 = 6,\ \text{LCM} = 2^2 \times 3^2 = 36.$

Key results

- For **two** numbers only: $\text{HCF}(a,b) \times \text{LCM}(a,b) = a \times b$
  - ↪ Check: $6 \times 36 = 216 = 12 \times 18$. This is **not** true for three numbers.
- HCF is always a factor of LCM.
- If a divides b: HCF $= a$ and LCM $= b$.
- If a, b are co-prime: HCF $= 1$ and LCM $= a \times b$.
- For three numbers p, q, r:

$$\text{LCM}(p,q,r) = \frac{p\,q\,r \cdot \text{HCF}(p,q,r)}{\text{HCF}(p,q) \cdot \text{HCF}(q,r) \cdot \text{HCF}(p,r)}$$

❖ Irrational Numbers

- **Theorem:** If a prime p divides a^2, then p divides a.
- $\sqrt{2},\ \sqrt{3},\ \sqrt{5},\ \sqrt{p}$ (p prime) are irrational.
- Rational $\pm$ irrational $=$ irrational.
- Non-zero rational $\times$ irrational $=$ irrational.
- Irrational $\pm$ / $\times$ irrational may be rational:
  - ↪ $\sqrt{2} \times \sqrt{2} = 2, \quad (2+\sqrt{3}) + (2-\sqrt{3}) = 4.$

❖ Proof: $\sqrt{3}$ is irrational (method of contradiction)

Step 1: Assume $\sqrt{3}$ is rational. So $\sqrt{3} = \dfrac{a}{b}$, where a, b are co-prime integers and $b \neq 0$.
Step 2: Square both sides: $3 = \dfrac{a^2}{b^2} \ \Rightarrow\ a^2 = 3b^2$.
  - ↪ So 3 divides a^2, hence 3 divides a (by the theorem above).

Step 3: Put $a = 3c$: $9c^2 = 3b^2 \ \Rightarrow\ b^2 = 3c^2$.
  - ↪ So 3 divides b^2, hence 3 divides b.

Step 4: Now 3 divides both a and b. This **contradicts** that a, b are co-prime.
Step 5: Hence our assumption is wrong. $\therefore$ $\sqrt{3}$ is irrational.

Proof: $5 + 2\sqrt{3}$ is irrational

Step 1: Assume $5 + 2\sqrt{3} = r$, where r is rational.

Step 2: Then $\sqrt{3} = \dfrac{r-5}{2}$. The right side is rational.

Step 3: But $\sqrt{3}$ is irrational — a contradiction. Hence $5 + 2\sqrt{3}$ is irrational.

☞ **Tips to Remember**

- **Does n^x end with 0?**
  - ↪ Only if its prime factors contain **both 2 and 5**. So $4^n,\ 6^n,\ 12^n$ never end with 0.
- **Which one to use: HCF or LCM?**
  - "Largest", "maximum", "greatest", equal groups/rows, tiles → **HCF**.
  - "Smallest", "least", bells ringing together, meeting again → **LCM**.
- Largest number dividing a, b, c leaving remainders r_1, r_2, r_3:
  - ↪ Answer $= \text{HCF}(a - r_1,\ b - r_2,\ c - r_3)$.
- Smallest number which leaves the same remainder r when divided by a, b, c:
  - ↪ Answer $= \text{LCM}(a, b, c) + r$.

✎ **My Notes**

2 Polynomials

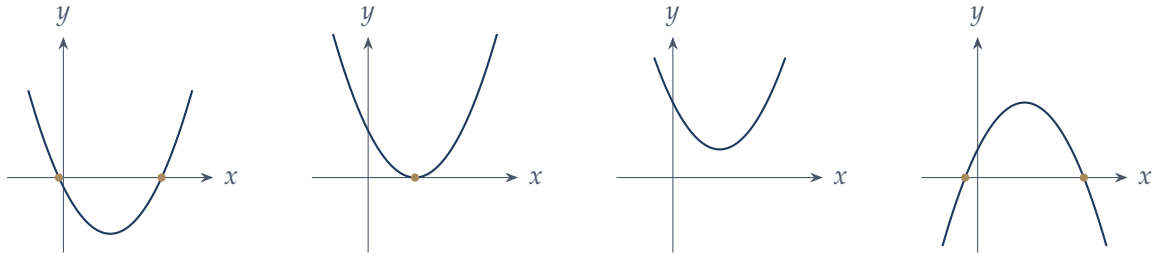
CHAPTER 2

❖ Basics

Type	General form	Degree	Maximum number of zeroes
Linear	$ax+b$	1	1 (zero $=-\frac{b}{a}$)
Quadratic	ax^2+bx+c	2	2
Cubic	ax^3+bx^2+cx+d	3	3

- k is a **zero** of $p(x)$ if $p(k)=0$.
- **Geometrical meaning:** number of zeroes = number of points where the graph of $y=p(x)$ **cuts or touches the x-axis**.

❖ Graph of $y=ax^2+bx+c$ (a parabola)



$a>0$, cuts at 2 points — **2 zeroes**

$a>0$, touches at 1 point — **1 zero**

$a>0$, does not meet — **0 zeroes**

$a<0$, opens downward — **2 zeroes**

- $a>0$: opens **upward** ($\cup$). $a<0$: opens **downward** ($\cap$).
- The graph cuts the y-axis at $(0,c)$. Vertex is at $x=-\dfrac{b}{2a}$.
- A cubic polynomial meets the x-axis at 1, 2 or 3 points.

❖ Relationship between Zeroes and Coefficients

Quadratic ax^2+bx+c (zeroes α,β)

- Sum: $\alpha+\beta=-\dfrac{b}{a}$
- Product: $\alpha\beta=\dfrac{c}{a}$

↪ Sum $=-\dfrac{\text{coeff. of } x}{\text{coeff. of } x^2}$, Product $=\dfrac{\text{constant}}{\text{coeff. of } x^2}$

Cubic ax^3+bx^2+cx+d (zeroes α,β,γ)

- $\alpha+\beta+\gamma=-\dfrac{b}{a}$
- $\alpha\beta+\beta\gamma+\gamma\alpha=\dfrac{c}{a}$
- $\alpha\beta\gamma=-\dfrac{d}{a}$

Forming a quadratic polynomial (when zeroes / their sum and product are given)

Step 1: Find $S=$ sum of zeroes and $P=$ product of zeroes.

Step 2: Write $p(x)=k\left[x^2-Sx+P\right]$, $k\neq 0$.

Step 3: Choose k to remove fractions (usually $k=$ LCM of denominators).

Example: $S=\frac{1}{4}$, $P=-1 \Rightarrow p(x)=k\left[x^2-\frac{1}{4}x-1\right]$; take $k=4$: $4x^2-x-4$.

↪ There are **infinitely many** such polynomials (one for each value of k).

❖ Useful Expressions in α and β

- $\alpha^2+\beta^2=(\alpha+\beta)^2-2\alpha\beta$
- $(\alpha-\beta)^2=(\alpha+\beta)^2-4\alpha\beta$
- $\frac{1}{\alpha}+\frac{1}{\beta}=\frac{\alpha+\beta}{\alpha\beta}$
- $\frac{\alpha}{\beta}+\frac{\beta}{\alpha}=\frac{\alpha^2+\beta^2}{\alpha\beta}$
- $\alpha^2\beta+\alpha\beta^2=\alpha\beta(\alpha+\beta)$
- $\alpha^3+\beta^3=(\alpha+\beta)^3-3\alpha\beta(\alpha+\beta)$
- $\frac{1}{\alpha^2}+\frac{1}{\beta^2}=\frac{\alpha^2+\beta^2}{\alpha^2\beta^2}$
- $(\alpha+1)(\beta+1)=\alpha\beta+(\alpha+\beta)+1$

Method: first find $\alpha+\beta$ and $\alpha\beta$, then substitute in the expression.

☞ Tips to Remember

Condition on zeroes	Meaning	Result
Zeroes are reciprocals (α and $\frac{1}{\alpha}$)	$\alpha\beta=1$	$c=a$
Equal in size, opposite in sign	$\alpha+\beta=0$	$b=0$
One zero is 0	$\alpha\beta=0$	$c=0$
Both zeroes are 0	sum $=$ product $=0$	$b=c=0$
Both zeroes have the same sign	$\alpha\beta>0$	a,c same sign
Zeroes have opposite signs	$\alpha\beta<0$	a,c opposite signs

✎ My Notes

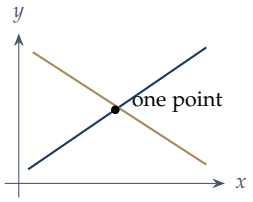
3 Pair of Linear Equations in Two Variables

CHAPTER 3

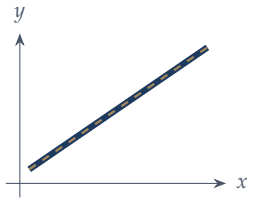
❖ General Form

- $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$
  - ↪ a_1, b_1 are not both zero; a_2, b_2 are not both zero.
- The graph of each equation is a **straight line**.
- A **solution** is a pair (x, y) that satisfies **both** equations, i.e., a common point of the two lines.

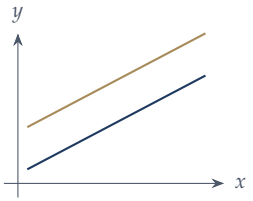
❖ Nature of Solutions — Compare the Ratios



Intersecting lines



Coincident lines



Parallel lines

	Intersecting	Coincident	Parallel
Ratio condition	$\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$	$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$	$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$
Solutions	Exactly one (**unique**)	**Infinitely many**	**No** solution
Consistency	Consistent	Consistent	Inconsistent
Type of lines	**Independent**	**Dependent**	—

- **Consistent** pair: has at least one solution (unique or infinitely many).
- **Inconsistent** pair: has no solution.
- **Independent** equations/lines ⇒ **unique** solution (lines intersect at exactly one point).
- **Dependent** equations/lines ⇒ **infinitely many** solutions (lines coincide; one equation is a multiple of the other).

❖ Method 1: Substitution

Step 1: From one equation, write y in terms of x (or x in terms of y).
Step 2: Substitute it in the other equation → an equation in one variable.
Step 3: Solve it to get the value of that variable.
Step 4: Put this value back in Step 1 to get the other variable.

Example: $x + y = 14$, $x - y = 4$. Step 1: $y = 14 - x$. Step 2: $x - (14 - x) = 4$. Step 3: $2x = 18 \Rightarrow x = 9$. Step 4: $y = 14 - 9 = 5$.

❖ Method 2: Elimination

Step 1: Multiply the equations by suitable numbers so that the coefficients of one variable become equal.
Step 2: Add or subtract the equations to eliminate that variable.
Step 3: Solve for the remaining variable.
Step 4: Substitute back to find the other variable.

↪ If both variables get eliminated and you get a **true** statement (like $0 = 0$) → infinitely many solutions.

↪ If you get a **false** statement (like $0 = 5$) → no solution.

Example: $9x - 4y = 2000$, $7x - 3y = 2000$. Multiply by 3 and 4: $27x - 12y = 6000$, $28x - 12y = 8000$. Subtract: $x = 2000$; then $y = 4000$.

❖ Method 3: Graphical

Step 1: For each equation, make a table of at least two (preferably three) points.

Step 2: Plot the points and draw both lines on the same graph.

Step 3: Read the point of intersection → that is the solution.

↪ Tip: the points where a line cuts the axes are easy to find — put $x = 0$, then $y = 0$.

❖ Lines and Axes

- $x = a$ is a line parallel to the y-axis; $y = b$ is a line parallel to the x-axis.
- $x = 0$ is the y-axis; $y = 0$ is the x-axis.
- The line $ax + by = c$ meets:
  - the x-axis at $\left(\frac{c}{a}, 0\right)$ (put $y = 0$);
  - the y-axis at $\left(0, \frac{c}{b}\right)$ (put $x = 0$).
- Area of the triangle formed by a line and the two axes $= \frac{1}{2} \times (x\text{-intercept}) \times (y\text{-intercept})$.

☞ Word Problems — How to Set Up

Step 1: Read carefully and let the two unknowns be x and y (write what they stand for).

Step 2: Convert each condition into an equation.

Step 3: Solve by substitution or elimination.

Step 4: Check the answer with the question and write it with units.

- **Two-digit number:** tens digit $= x$, units digit $= y$.
  ↪ Number $= 10x + y$; reversed number $= 10y + x$.
- **Fraction:** $\frac{x}{y}$. **Ages:** "n years ago" → $x - n$; "after n years" → $x + n$.
- **Boat & stream:** boat speed u, stream speed v.
  ↪ Downstream speed $= u + v$; upstream speed $= u - v$; time $= \dfrac{\text{distance}}{\text{speed}}$.
- **Geometry:** angle sum of a triangle $= 180°$; opposite angles of a cyclic quadrilateral add up to $180°$.

✘ Common Mistakes

- For **no solution**: use $\frac{a_1}{a_2} = \frac{b_1}{b_2}$ **and** check $\frac{b_1}{b_2} \neq \frac{c_1}{c_2}$.
- For **infinitely many solutions**: all three ratios must be equal.

✎ My Notes

4 Quadratic Equations

CHAPTER 4

❖ Standard Form

- $ax^2 + bx + c = 0$, where $a \neq 0$.
- α is a **root** if $a\alpha^2 + b\alpha + c = 0$ (the value satisfies the equation).
- A quadratic equation has **at most two** roots.

❖ Method 1: Factorisation (Splitting the Middle Term)

Step 1: Write the equation as $ax^2 + bx + c = 0$.
Step 2: Find two numbers whose **sum** $= b$ and **product** $= a \times c$.
Step 3: Split the middle term bx using these two numbers.
Step 4: Take common factors in pairs and factorise.
Step 5: Put each factor $= 0$ and find the roots.

Example: $2x^2 - 5x + 3 = 0$. Product $= 6$, sum $= -5 \to -2, -3$. $2x^2 - 2x - 3x + 3 = 0 \Rightarrow 2x(x-1) - 3(x-1) = 0 \Rightarrow (2x-3)(x-1) = 0 \Rightarrow x = \frac{3}{2}, 1$.

❖ Method 2: Quadratic Formula

Step 1: Compare with $ax^2 + bx + c = 0$; write a, b, c (with signs).
Step 2: Find the discriminant $D = b^2 - 4ac$
Step 3: If $D \geq 0$, use $x = \dfrac{-b \pm \sqrt{D}}{2a}$
Step 4: Write both roots separately.

D	Nature of roots
$D > 0$	Two **distinct real** roots
$D = 0$	Two **equal real** roots, each $= -\frac{b}{2a}$
$D < 0$	**No real** roots
$D \geq 0$	Real roots (equal or distinct)

- Sum of roots $= -\dfrac{b}{a}$; product of roots $= \dfrac{c}{a}$.
- Equation with roots α, β: $x^2 - (\alpha + \beta)x + \alpha\beta = 0$.

❖ Finding k for a Given Nature of Roots

Step 1: Identify a, b, c (they will contain k).
Step 2: Write $D = b^2 - 4ac$ in terms of k.
Step 3: Apply the condition: equal roots $\to D = 0$; real roots $\to D \geq 0$; no real roots $\to D < 0$.
Step 4: Solve for k and reject any value that makes $a = 0$.

☞ Tips to Remember

- First bring the equation to the form $ax^2 + bx + c = 0$ (remove fractions, expand brackets).
- **Speed problems:** time $= \dfrac{\text{distance}}{\text{speed}}$.
  - ↪ "takes 1 hour less" $\Rightarrow$ (slower time) $-$ (faster time) $= 1$.
- **Work problems:** if A alone takes x days, A's one-day work $= \dfrac{1}{x}$.
- **Consecutive numbers:** integers x, $x+1$; odd/even numbers x, $x+2$.
- Reject impossible values (negative length, speed, age, number of items) and **write the reason**.

5 Arithmetic Progressions

CHAPTER 5

❖ Basic Terms

- An **A.P.** is a list in which each term is obtained by adding a fixed number to the previous term.
- a = first term; d = common difference = $a_2 - a_1 = a_3 - a_2 = \dots$
- n = number of terms; l = last term; $a_n = n^{\text{th}}$ term; S_n = sum of first n terms.
- General form: $a,\ a+d,\ a+2d,\ a+3d,\ \dots$

↪ $d > 0$: increasing A.P. $d < 0$: decreasing A.P. $d = 0$: constant A.P.

❖ Formulae

To find	Formula
n^{th} term	$a_n = a + (n-1)d$
n^{th} term from the end	$l - (n-1)d$
Number of terms	$n = \dfrac{l-a}{d} + 1$
Sum of first n terms	$S_n = \dfrac{n}{2}[2a + (n-1)d]$
Sum when last term is known	$S_n = \dfrac{n}{2}(a+l)$
n^{th} term from the sum	$a_n = S_n - S_{n-1}$
Condition for a, b, c in A.P.	$2b = a + c$ (b is the arithmetic mean)

❖ Standard Results

- Sums to remember:
  - $1 + 2 + 3 + \cdots + n = \dfrac{n(n+1)}{2}$
  - Sum of first n odd numbers $= n^2$; sum of first n even numbers $= n(n+1)$.
- Taking terms for convenience:
  - 3 terms: $a-d,\ a,\ a+d$ 4 terms: $a-3d,\ a-d,\ a+d,\ a+3d$.
- If $a_n = pn + q$ (linear in n) $\Rightarrow$ it is an A.P. with $d = p$.
- If $S_n = pn^2 + qn \Rightarrow a = S_1 = p + q$ and $d = 2p$.
- $a_m - a_n = (m-n)d$.
- Middle term: n odd $\rightarrow \left(\frac{n+1}{2}\right)^{\text{th}}$ term; n even $\rightarrow \left(\frac{n}{2}\right)^{\text{th}}$ and $\left(\frac{n}{2}+1\right)^{\text{th}}$ terms.

☞ Tips to Remember

- **First negative term:** solve $a_n < 0$, then take the next whole number for n.
- **How many terms give sum S?** Put $S_n = S$, solve the quadratic in n.
  ↪ Both values may be valid when $d < 0$ (the extra terms add up to zero).
- **Multiples of k between two numbers:**
  Step 1: Find the first multiple (a) and the last multiple (l).
  Step 2: Take $d = k$ and use $n = (l-a)/d + 1$.
- Adding the same number to every term (or multiplying every term by the same non-zero number) gives another A.P.

6 Triangles

CHAPTER 6

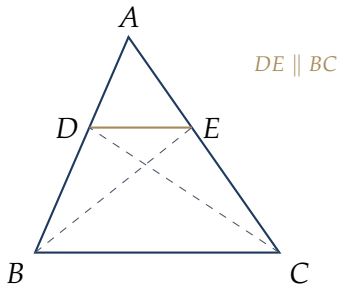
❖ Similar Figures

- Two polygons with the same number of sides are **similar** if:
  - their corresponding angles are equal, **and**
  - their corresponding sides are in the same ratio.
- All circles, all squares and all equilateral triangles are similar.
- Congruent figures are always similar, but similar figures need not be congruent.

❖ Basic Proportionality Theorem (BPT / Thales Theorem)

Statement (to be proved)

If a line is drawn **parallel to one side** of a triangle to intersect the other two sides in distinct points, then the other two sides are divided **in the same ratio**.



- In $\triangle ABC$, if $DE \parallel BC$, then $\dfrac{AD}{DB} = \dfrac{AE}{EC}$
- Also true: $\dfrac{AD}{AB} = \dfrac{AE}{AC}$ and $\dfrac{DB}{AB} = \dfrac{EC}{AC}$.
- Since $\triangle ADE \sim \triangle ABC$: $\dfrac{AD}{AB} = \dfrac{AE}{AC} = \dfrac{DE}{BC}$.

❖ BPT — Proof in Steps

Step 1: Join BE and CD. Draw $DM \perp AC$ and $EN \perp AB$.

Step 2: $\dfrac{ar(\triangle ADE)}{ar(\triangle BDE)} = \dfrac{\frac{1}{2} \cdot AD \cdot EN}{\frac{1}{2} \cdot DB \cdot EN} = \dfrac{AD}{DB}$ $\quad \ldots(1)$

Step 3: $\dfrac{ar(\triangle ADE)}{ar(\triangle DEC)} = \dfrac{\frac{1}{2} \cdot AE \cdot DM}{\frac{1}{2} \cdot EC \cdot DM} = \dfrac{AE}{EC}$ $\quad \ldots(2)$

Step 4: $ar(\triangle BDE) = ar(\triangle DEC)$ $\quad \ldots(3)$

↪ Same base DE and between the same parallels DE and BC.

Step 5: From (1), (2) and (3): $\dfrac{AD}{DB} = \dfrac{AE}{EC}$. Hence proved.

Converse of BPT

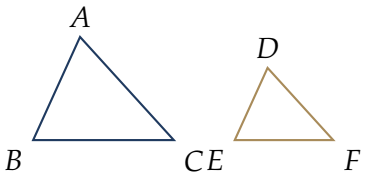
- If a line divides any two sides of a triangle in the same ratio, then it is **parallel to the third side**.

✘ Common Mistakes

- Write the similarity in the **correct order of corresponding vertices**.
  ↪ $\triangle ABC \sim \triangle PQR$ means $A \leftrightarrow P$, $B \leftrightarrow Q$, $C \leftrightarrow R$. It is not the same as $\triangle ABC \sim \triangle QPR$.

❖ Criteria for Similarity of Triangles

Criterion	Condition (for $\triangle ABC$ and $\triangle DEF$)
AA / AAA	$\angle A = \angle D$ and $\angle B = \angle E$ (then $\angle C = \angle F$)
SSS	$\frac{AB}{DE} = \frac{BC}{EF} = \frac{CA}{FD}$
SAS	$\frac{AB}{DE} = \frac{AC}{DF}$ and included angle $\angle A = \angle D$



$\triangle ABC \sim \triangle DEF$

- If $\triangle ABC \sim \triangle DEF$, then

$$\frac{AB}{DE} = \frac{BC}{EF} = \frac{CA}{FD} = \frac{\text{Perimeter of } \triangle ABC}{\text{Perimeter of } \triangle DEF}$$

  ↪ Corresponding altitudes, medians and angle bisectors are also in the same ratio.

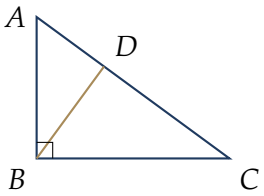
❖ How to Prove Two Triangles Similar

Step 1: Draw the figure and mark the given equal angles / parallel lines.
Step 2: Name the two triangles you want to prove similar.
Step 3: Find two pairs of equal angles (vertically opposite, alternate, common angle, 90°), **or** three sides in the same ratio, **or** two sides in ratio with the included angle equal.
Step 4: Write the criterion: $\therefore\ \triangle___ \sim \triangle___$ (AA / SSS / SAS).
Step 5: Write the ratio of corresponding sides and use it to find what is asked.

❖ Important Standard Results

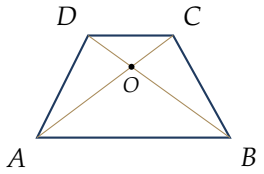
(A) Altitude on the hypotenuse

- In right $\triangle ABC$ ($\angle B = 90°$), $BD \perp AC$:
  - $\triangle ADB \sim \triangle ABC \sim \triangle BDC$
  - $AB^2 = AD \cdot AC$, $BC^2 = CD \cdot CA$, $BD^2 = AD \cdot DC$



(B) Trapezium

- Trapezium $ABCD$ ($AB \parallel DC$), diagonals meet at O:
  - $\triangle AOB \sim \triangle COD$ and $\frac{AO}{OC} = \frac{BO}{OD} = \frac{AB}{CD}$



(C) Shadow problems (AA similarity)

- At the same time of day:

$$\frac{\text{Height of object 1}}{\text{Its shadow}} = \frac{\text{Height of object 2}}{\text{Its shadow}}$$

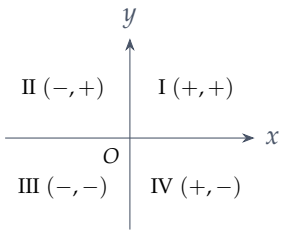
✎ **My Notes**

7 Coordinate Geometry

CHAPTER 7

❖ Basics

- Point $P(x, y)$:
  - x-coordinate (abscissa) = distance from the y-axis.
  - y-coordinate (ordinate) = distance from the x-axis.
- Point on the x-axis: $(x, 0)$; point on the y-axis: $(0, y)$; origin $(0, 0)$.
- Distance of (x, y) from the x-axis $= |y|$; from the y-axis $= |x|$.
- Signs in quadrants: I $(+,+)$, II $(-,+)$, III $(-,-)$, IV $(+,-)$.

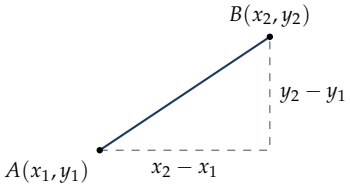


❖ Distance Formula

- Distance between $A(x_1, y_1)$ and $B(x_2, y_2)$:

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

- Distance of $P(x, y)$ from the origin $= \sqrt{x^2 + y^2}$.
  - ↪ It comes from Pythagoras: horizontal gap $= x_2 - x_1$, vertical gap $= y_2 - y_1$.



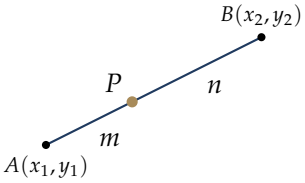
❖ Section Formula and Mid-point

- P divides the join of $A(x_1, y_1)$ and $B(x_2, y_2)$ internally in the ratio $m : n$:

$$P(x, y) = \left(\frac{mx_2 + nx_1}{m + n}, \frac{my_2 + ny_1}{m + n} \right)$$

  - ↪ Memory aid: "cross multiply" — m goes with B, n goes with A.
- **Mid-point** $(m = n = 1)$: $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$
- **Centroid** of a triangle with vertices $(x_1, y_1), (x_2, y_2), (x_3, y_3)$:

$$\left(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3} \right)$$



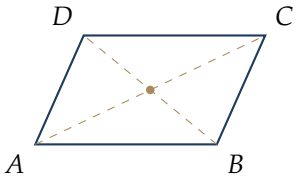
❖ Finding the Ratio in which a Point / Axis Divides a Segment

Step 1: Let the required ratio be $k : 1$.
Step 2: Write the coordinates of the dividing point using the section formula with $m = k,\ n = 1$.
Step 3: Equate with the given coordinate (or put $y = 0$ for the x-axis, $x = 0$ for the y-axis).
Step 4: Solve for k and write the ratio as $k : 1$.

- ↪ Shortcut: x-axis divides AB in the ratio $-y_1 : y_2$; y-axis divides it in $-x_1 : x_2$.
- ↪ Points of **trisection** of AB: divide in the ratios $1 : 2$ and $2 : 1$.

❖ Proving the Type of a Figure

- **Collinear** points A, B, C: $AB + BC = AC$.
- **Isosceles** triangle: two sides equal. **Equilateral**: all three sides equal.
- **Right** triangle: check $AB^2 + BC^2 = AC^2$.
- **Parallelogram**: diagonals bisect each other.
  - ↪ Mid-point of AC = mid-point of BD. Fourth vertex: $D = A + C - B$.



diagonals bisect each other

- **Rhombus**: all four sides equal.
- **Rectangle**: opposite sides equal **and** diagonals equal.
- **Square**: all four sides equal **and** diagonals equal.

↪ Tip: for a point **equidistant** from A and B, write $PA = PB$ and square both sides to avoid square roots.

✎ **My Notes**

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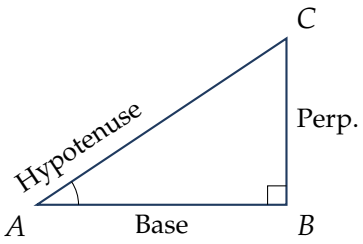
8 Introduction to Trigonometry

CHAPTER 8

❖ Trigonometric Ratios

In right $\triangle ABC$, $\angle B = 90°$. For $\angle A$:

- Side opposite $\angle A$ = **Perpendicular** (BC)
- Side next to $\angle A$ = **Base** (AB)
- Side opposite the right angle = **Hypotenuse** (AC)



$$\sin A = \frac{P}{H} = \frac{BC}{AC} \qquad \csc A = \frac{H}{P} = \frac{1}{\sin A}$$

$$\cos A = \frac{B}{H} = \frac{AB}{AC} \qquad \sec A = \frac{H}{B} = \frac{1}{\cos A}$$

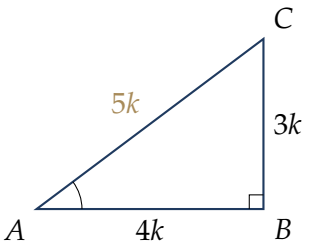
$$\tan A = \frac{P}{B} = \frac{BC}{AB} \qquad \cot A = \frac{B}{P} = \frac{1}{\tan A}$$

Memory aid: *Some People Have / Curly Brown Hair / Through Proper Brushing*
$\sin = \frac{P}{H}$, $\cos = \frac{B}{H}$, $\tan = \frac{P}{B}$

- Quotient relations: $\tan A = \dfrac{\sin A}{\cos A}$ $\quad \cot A = \dfrac{\cos A}{\sin A}$

❖ Given One Ratio, Find the Others

Step 1: Draw a right triangle and mark the angle.
Step 2: Use the given ratio to name two sides with k.
↪ $\tan A = \frac{3}{4} \Rightarrow$ Perp. $= 3k$, Base $= 4k$.
Step 3: Find the third side by Pythagoras.
↪ Hyp. $= \sqrt{(3k)^2 + (4k)^2} = 5k$.
Step 4: Write every ratio from the triangle (k cancels).
↪ $\sin A = \frac{3}{5}$, $\cos A = \frac{4}{5}$, $\csc A = \frac{5}{3}$, $\sec A = \frac{5}{4}$, $\cot A = \frac{4}{3}$.



❖ How to Prove an Identity

Step 1: Start from the **more complicated side** (usually LHS).
Step 2: If it has fractions → take LCM; if it has a square root → rationalise (multiply by the conjugate).
Step 3: If stuck, convert everything into sin and cos.
Step 4: Use the identities $\sin^2 A + \cos^2 A = 1$, etc., and algebraic identities like $a^2 - b^2 = (a+b)(a-b)$.
Step 5: Simplify until you reach the other side. Write "= RHS. Hence proved."

☞ Tips to Remember

- For $0° \le A \le 90°$:
  - $0 \le \sin A \le 1$ and $0 \le \cos A \le 1$; so $\sin A = \frac{4}{3}$ is impossible.
  - $\sec A \ge 1$ and $\csc A \ge 1$.
- $\sin^2 A$ means $(\sin A)^2$, **not** $\sin(A^2)$.
- $\sin(A+B) \ne \sin A + \sin B$. $\sin A$ is one quantity; never write $\sin \times A$.

❖ Values of Trigonometric Ratios of Standard Angles

$\angle A$	$0°$	$30°$	$45°$	$60°$	$90°$
$\sin A$	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	$\sqrt{3}$	N.D.
$\csc A$	N.D.	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1
$\sec A$	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	N.D.
$\cot A$	N.D.	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0

N.D. = not defined

How to remember the table

Step 1: Write $0, 1, 2, 3, 4$ under $0°, 30°, 45°, 60°, 90°$.

Step 2: Divide each by 4 and take the square root: $\sqrt{\frac{0}{4}}, \sqrt{\frac{1}{4}}, \sqrt{\frac{2}{4}}, \sqrt{\frac{3}{4}}, \sqrt{\frac{4}{4}} \rightarrow$ this is the sin row.

Step 3: Write the sin row in reverse order $\rightarrow$ cos row.

Step 4: $\tan = \frac{\sin}{\cos}$; then take reciprocals for csc, sec, cot.

↪ As A increases from $0°$ to $90°$: $\sin A$ increases $(0 \rightarrow 1)$, $\cos A$ decreases $(1 \rightarrow 0)$, $\tan A$ increases from 0.

❖ Trigonometric Identities

Identity	Other forms	Factor form
$\sin^2 A + \cos^2 A = 1$	$\sin^2 A = 1 - \cos^2 A$ $\cos^2 A = 1 - \sin^2 A$	$(1 - \sin A)(1 + \sin A) = \cos^2 A$
$1 + \tan^2 A = \sec^2 A$ $(A \neq 90°)$	$\sec^2 A - \tan^2 A = 1$ $\tan^2 A = \sec^2 A - 1$	$(\sec A - \tan A)(\sec A + \tan A) = 1$
$1 + \cot^2 A = \csc^2 A$ $(A \neq 0°)$	$\csc^2 A - \cot^2 A = 1$ $\cot^2 A = \csc^2 A - 1$	$(\csc A - \cot A)(\csc A + \cot A) = 1$

► Useful results: $\sec A + \tan A = \frac{1}{\sec A - \tan A}$, $\csc A + \cot A = \frac{1}{\csc A - \cot A}$.

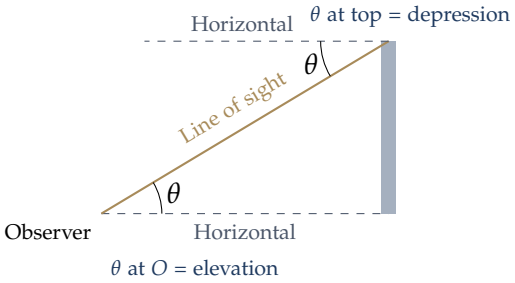
✎ **My Notes**

9 Some Applications of Trigonometry

CHAPTER 9

❖ Line of Sight, Angle of Elevation and Angle of Depression

- **Line of sight:** the line from the observer's eye to the object.
- **Angle of elevation:** object is **above** eye level.
  - ↪ Angle between line of sight and horizontal, looking **up**.
- **Angle of depression:** object is **below** eye level.
  - ↪ Angle between line of sight and horizontal, looking **down**.
- Angle of elevation of B from A = angle of depression of A from B.
  - ↪ They are alternate angles (horizontals are parallel).
- Moving **towards** the object, the angle of elevation **increases**.



❖ How to Solve Height & Distance Problems

Step 1: Draw a neat figure. Mark the right angle, the given angle(s) and the given length.

Step 2: Let the unknown height/distance be h or x.

Step 3: In each right triangle, choose the ratio that links the **known** side with the **unknown** side.

↪ Height and horizontal distance → use $\tan\theta = \dfrac{\text{height}}{\text{distance}}$.

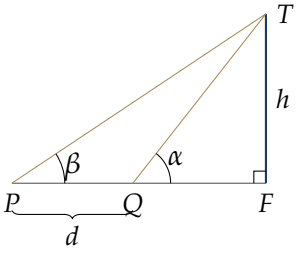
Step 4: Form the equations and solve.

Step 5: Use $\sqrt{3} = 1.732$, $\sqrt{2} = 1.414$ only at the last step (if asked).

❖ Standard Results

- Height seen at angle θ from distance x: $h = x\tan\theta$
  - $\theta = 30°$: $x = h\sqrt{3}$
  - $\theta = 45°$: $x = h$
  - $\theta = 60°$: $x = \dfrac{h}{\sqrt{3}}$
- From two points P, Q on the same side, d apart, angles $\alpha > \beta$:

$$h = \frac{d\tan\alpha\tan\beta}{\tan\alpha - \tan\beta}$$



- If the angles of elevation from distances a and b are complementary: $h = \sqrt{ab}$.

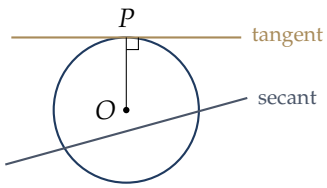
✎ **My Notes**

10 Circles

CHAPTER 10

❖ Tangent and Secant

- **Secant:** a line that meets the circle at **two** points.
- **Tangent:** a line that meets the circle at exactly **one** point.
  - ↪ That point is called the **point of contact**.
- Number of tangents from a point P:
  - P inside the circle $\rightarrow$ 0
  - P on the circle $\rightarrow$ exactly 1
  - P outside the circle $\rightarrow$ exactly 2
- A circle has infinitely many tangents; at most two tangents are parallel to a given line.



❖ Theorem 1: Tangent ⊥ Radius (to be proved)

Statement: The tangent at any point of a circle is perpendicular to the radius through the point of contact.

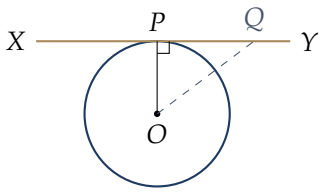
Step 1: Take any point Q on tangent XY, other than P. Join OQ.

Step 2: Q lies outside the circle (only P is on the circle).
  - ↪ So $OQ > OP$ (radius).

Step 3: This is true for every point Q on XY except P.

Step 4: So OP is the **shortest** distance from O to XY.

Step 5: The shortest distance is the perpendicular. $\therefore\ OP \perp XY$.



❖ Theorem 2: Tangents from an External Point are Equal (to be proved)

Statement: The lengths of the two tangents drawn from an external point to a circle are equal: $PA = PB$

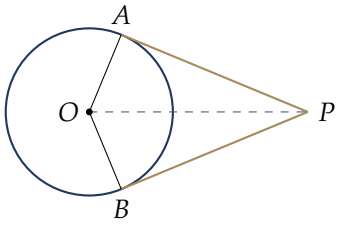
Step 1: Join OA, OB and OP.

Step 2: $\angle OAP = \angle OBP = 90^\circ$ *(tangent ⊥ radius)*

Step 3: In $\triangle OAP$ and $\triangle OBP$:
  - ↪ $OA = OB$ (radii); $OP = OP$ (common); right angles equal.

Step 4: $\triangle OAP \cong \triangle OBP$ (RHS)

Step 5: $\therefore\ PA = PB$ (CPCT). Hence proved.



Results that follow from Theorem 2

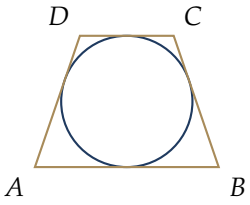
- OP bisects $\angle APB$ and $\angle AOB$; $\angle OPA = \angle OPB$.
- $\angle APB + \angle AOB = 180^\circ$ *(angle sum of quadrilateral $OAPB = 360^\circ$)*
- Length of tangent: $PA = \sqrt{OP^2 - r^2}$ *(Pythagoras in $\triangle OAP$)*
- OP is the perpendicular bisector of the chord AB.

✘ Common Mistakes

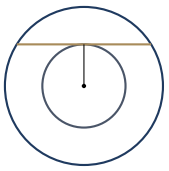
- The radius is perpendicular to the tangent **only at the point of contact**.
- Always mark this 90° in the figure before writing the solution.

❖ Other Important Results

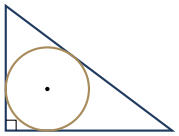
- Tangents at the two ends of a **diameter** are parallel.
- **Quadrilateral circumscribing a circle:**
  - $AB + CD = AD + BC$ (sum of opposite sides equal).
  - A parallelogram circumscribing a circle is a **rhombus**.
  - Opposite sides subtend supplementary angles at the centre.
- **Concentric circles** (radii $R > r$):
  - Chord of the bigger circle touching the smaller one is bisected at the point of contact.
  - Its length $= 2\sqrt{R^2 - r^2}$.
- **Circle inside a triangle** (incircle, radius r):
  - Tangent lengths from vertices: $s - a$, $s - b$, $s - c$ $\left(s = \frac{a+b+c}{2}\right)$.
  - Area of triangle $= \frac{1}{2} \times r \times$ perimeter.
  - Right triangle (legs a, b, hypotenuse c): $r = \dfrac{a + b - c}{2}$.



$AB + CD = AD + BC$



chord $= 2\sqrt{R^2 - r^2}$



$r = \frac{a+b-c}{2}$

✎ My Notes

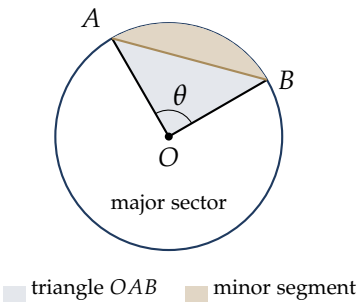
11 Areas Related to Circles

CHAPTER 11

❖ Circle, Sector and Segment

Radius r, central angle θ (in degrees):

- Circle: circumference $= 2\pi r$; area $= \pi r^2$.
- Semicircle: area $= \dfrac{\pi r^2}{2}$; perimeter $= \pi r + 2r$.
- Quadrant: area $= \dfrac{\pi r^2}{4}$.
- Length of arc: $l = \dfrac{\theta}{360^\circ} \times 2\pi r$
- Area of sector: $A = \dfrac{\theta}{360^\circ} \times \pi r^2$
  - ↪ Also $A = \frac{1}{2} l\, r$. Perimeter of sector $= 2r + l$.
- Area of major sector $= \pi r^2 -$ area of minor sector.
- Area of ring $= \pi(R^2 - r^2)$.



❖ Area of a Segment — Step by Step

Step 1: Find the area of the sector $OAB = \dfrac{\theta}{360^\circ} \times \pi r^2$.
Step 2: Find the area of $\triangle OAB$ (use the table below).
Step 3: Minor segment = sector − triangle.
Step 4: Major segment $= \pi r^2 -$ minor segment.

θ	Sector area	Area of $\triangle OAB$	Minor segment area
60°	$\dfrac{\pi r^2}{6}$	$\dfrac{\sqrt{3}}{4} r^2$ *(equilateral)*	$r^2\left(\dfrac{\pi}{6} - \dfrac{\sqrt{3}}{4}\right)$
90°	$\dfrac{\pi r^2}{4}$	$\dfrac{1}{2} r^2$	$r^2\left(\dfrac{\pi}{4} - \dfrac{1}{2}\right)$
120°	$\dfrac{\pi r^2}{3}$	$\dfrac{\sqrt{3}}{4} r^2$	$r^2\left(\dfrac{\pi}{3} - \dfrac{\sqrt{3}}{4}\right)$

↪ For 120°: draw $OM \perp AB$. Then $OM = \dfrac{r}{2}$ and $AB = r\sqrt{3}$, so area $= \frac{1}{2} \times r\sqrt{3} \times \frac{r}{2} = \frac{\sqrt{3}}{4} r^2$.

☞ Tips to Remember

- **Clock:**
  - Minute hand turns 6° per minute (360° in 60 minutes).
  - Hour hand turns 30° per hour (0.5° per minute).
- **Wheel:** distance in one revolution = circumference.
  - ↪ Number of revolutions $= \dfrac{\text{total distance}}{\text{circumference}}$.
- Two circles touching **externally**: distance between centres $= R + r$; **internally**: $R - r$.
- Take $\pi = \dfrac{22}{7}$ or 3.14 as given; use $\dfrac{22}{7}$ when r is a multiple of 7.

12 Surface Areas and Volumes

CHAPTER 12

❖ Formulae for Standard Solids

Figure	Solid	Lateral / Curved S.A.	Total Surface Area	Volume
	Cuboid (l, b, h)	$2h(l+b)$	$2(lb+bh+hl)$	lbh
	Cube (side 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)	$2\pi r^2$	$3\pi r^2$	$\frac{2}{3}\pi r^3$

- Slant height of a cone: $l = \sqrt{r^2 + h^2}$
- Diagonal of cuboid $= \sqrt{l^2 + b^2 + h^2}$; diagonal of cube $= a\sqrt{3}$.
- Volume of cone $= \frac{1}{3}\times$ volume of cylinder with the same base and height.

❖ Combination of Solids — Step by Step

Step 1: Identify the separate solids in the figure (cone, cylinder, hemisphere, . . .).

Step 2: **Volume:** add the volumes of the parts (subtract any part that is scooped out).

Step 3: **Surface area:** add only the surfaces you can **see from outside**.

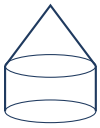
↪ Do not count the faces where two solids are joined.



Toy
cone + hemisphere



Capsule
cylinder + 2 hemispheres



Tent
cylinder + cone



Cube
+ hemisphere on top

Solid	Total Surface Area	Volume
Toy (cone on hemisphere)	CSA of cone + CSA of hemisphere	$V_{\text{cone}} + V_{\text{hemi}}$
Capsule	$2\pi rh + 2(2\pi r^2) = 2\pi r(h+2r)$	$\pi r^2 h + \frac{4}{3}\pi r^3$
Tent (cone on cylinder)	CSA of cylinder + CSA of cone	$V_{\text{cyl}} + V_{\text{cone}}$
Cube with hemisphere on top	$6a^2 - \pi r^2 + 2\pi r^2 = 6a^2 + \pi r^2$	$a^3 + \frac{2}{3}\pi r^3$
Hemispheres scooped from both ends of a cylinder	$2\pi rh + 2(2\pi r^2)$	$\pi r^2 h - \frac{4}{3}\pi r^3$
Cone scooped out of a cylinder	$2\pi rh + \pi r^2 + \pi rl$	$\pi r^2 h - \frac{1}{3}\pi r^2 h$

☞ Tips to Remember

- Units:
  - $1\ \text{m}^3 = 1000$ litres; 1 litre $= 1000\ \text{cm}^3$; $1\ \text{cm}^3 = 1$ mL.
  - Convert all lengths to the same unit before you start.
- Largest cone/cylinder cut from a cube of side a: $r = \frac{a}{2}$, $h = a$. Largest sphere: $r = \frac{a}{2}$.
- Which formula?
  - Painting, canvas, polishing, cost of covering $\rightarrow$ **surface area**.
  - Capacity, water, filling, melting $\rightarrow$ **volume**.

✎ My Notes

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13 Statistics

CHAPTER 13

❖ Mean of Grouped Data

► Class mark: $x_i = \dfrac{\text{upper limit} + \text{lower limit}}{2}$ (mid-point of the class).

Method	Formula	Use when
Direct method	$\bar{x} = \dfrac{\sum f_i x_i}{\sum f_i}$	x_i and f_i are small
Assumed mean method	$\bar{x} = a + \dfrac{\sum f_i d_i}{\sum f_i}$, $d_i = x_i - a$	x_i are large
Step-deviation method	$\bar{x} = a + \dfrac{\sum f_i u_i}{\sum f_i} \times h$, $u_i = \frac{x_i - a}{h}$	class sizes are equal

Steps (step-deviation method)

Step 1: Find the class marks x_i.
Step 2: Choose a = a class mark near the middle; h = class size.
Step 3: Find $u_i = \dfrac{x_i - a}{h}$ and then $f_i u_i$ for each class.
Step 4: Find $\sum f_i$ and $\sum f_i u_i$; substitute in the formula.
↪ All three methods give the **same** mean.

❖ Mode of Grouped Data

Step 1: Find the **modal class** = class with the highest frequency.
Step 2: Note l, h, f_1, f_0, f_2.
Step 3: Substitute in the formula.

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

↪ l = lower limit of the modal class; h = 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.

❖ Median of Grouped Data

Step 1: Make the cumulative frequency (c.f.) column.
Step 2: Find $\dfrac{n}{2}$, where $n = \sum f_i$.
Step 3: **Median class** = class whose c.f. is just greater than $\dfrac{n}{2}$.
Step 4: Note l, cf, f, h and substitute.

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

↪ l = lower limit of the median class; f = its frequency; h = class size.
↪ cf = cumulative frequency of the class **before** the median class.

Empirical relation

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

☞ **Tips to Remember**

- Classes like 10–19, 20–29 are not continuous. Make them continuous:
  ↪ Subtract 0.5 from each lower limit and add 0.5 to each upper limit → 9.5–19.5, 19.5–29.5.
- "Less than" / "more than" tables: first convert into an ordinary frequency table.
- Missing frequency with mean given: write $\sum f_i$ and $\sum f_i x_i$ in terms of the unknown and solve.
- Mean, median and mode are measures of central tendency.

✎ **My Notes**

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14 Probability

CHAPTER 14

❖ Theoretical (Classical) Probability

$$P(E) = \frac{\text{Number of outcomes favourable to } E}{\text{Total number of possible outcomes}}$$

- $0 \le P(E) \le 1$ — probability is never negative and never more than 1.
- Sure (certain) event: $P(E) = 1$; impossible event: $P(E) = 0$.
- Complementary event: $P(\text{not } E) = 1 - P(E)$, i.e., $P(E) + P(\bar{E}) = 1$.
- Sum of the probabilities of all elementary events $= 1$.

Steps to find a probability

Step 1: Write the total number of possible outcomes.
Step 2: List / count the outcomes favourable to the event.
Step 3: Divide: favourable ÷ total. Simplify the fraction.

❖ Standard Sample Spaces

Coins

- 1 coin: H, T (2 outcomes)
- 2 coins: HH, HT, TH, TT (4 outcomes)
- 3 coins: 8 outcomes
  - ↪ HHH, HHT, HTH, THH, HTT, THT, TTH, TTT

Dice

- One die: 1, 2, 3, 4, 5, 6.
  - ↪ Primes: 2, 3, 5; even: 2, 4, 6; odd: 1, 3, 5.
- Two dice: $6 \times 6 = 36$ outcomes; doublets: 6.

Sum	2	3	4	5	6	7	8	9	10	11	12
Ways	1	2	3	4	5	6	5	4	3	2	1

Deck of 52 playing cards

Colour	Suits	Cards
Red (26)	Hearts ♡, Diamonds ♢	13 each
Black (26)	Spades ♠, Clubs ♣	13 each

- Each suit: A, 2, 3, …, 10, J, Q, K.
- Face cards = 12 (J, Q, K of each suit).
  - ↪ Red face cards = 6; black face cards = 6.
- Aces = 4; kings = 4; queens = 4; jacks = 4.
- Honour cards (A, K, Q, J) = 16.

☞ Tips to Remember

- "At least one" $= 1 - P(\text{none})$; "not a king" $= 1 - P(\text{king})$.
- If a card / ball is removed first, reduce **both** the total and the favourable count.
- Probability can be a fraction, decimal or percentage: $\frac{1}{4} = 0.25 = 25\%$.
- A leap year has 52 weeks + 2 days $\Rightarrow P(53 \text{ Sundays}) = \frac{2}{7}$; a non-leap year $\Rightarrow \frac{1}{7}$.

✎ My Notes

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