THE COMPLETE

FORMULA HANDBOOK

Mathematics & Science — Chapter-wise

Based on the NCERT / CBSE Class 10 Syllabus

★ All Chapters | ★ Quick Revision | ★ Exam-Ready

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MATHEMATICS — Formula Reference

Chapter 1 Real Numbers

Key Theorems & Formulas

Euclid's Division Lemma	For positive integers a and b, $a = bq + r$, where $0 \le r < b$ (q = quotient, r = remainder).
Euclid's Division Algorithm (HCF)	To find HCF(a, b) with $a > b$: apply $a = bq + r$ repeatedly until $r = 0$. The last non-zero divisor is the HCF.
Fundamental Theorem of Arithmetic	Every composite number can be expressed (factorised) as a product of primes, and this factorisation is unique, apart from the order of the prime factors.
Relation between HCF, LCM and numbers	HCF(a, b) × LCM(a, b) = a × b
HCF from prime factorisation	HCF = product of the smallest power of each common prime factor.
LCM from prime factorisation	LCM = product of the greatest power of each prime factor involved.
Irrationality test	If p is a prime and p divides a^2, then p divides a.
Terminating decimal condition	A rational number p/q (in lowest terms) has a terminating decimal expansion if $q = 2^m \times 5^n$ for some non-negative integers m, n.

Chapter 2 Polynomials

Degree-based Names

Linear polynomial	$ax + b$, $a \neq 0$ — general form, 1 zero
Quadratic polynomial	$ax^2 + bx + c$, $a \neq 0$ — general form, at most 2 zeros
Cubic polynomial	$ax^3 + bx^2 + cx + d$, $a \neq 0$ — at most 3 zeros

Relationship between Zeroes and Coefficients

Quadratic $p(x) = ax^2+bx+c$, zeroes α, β	Sum: $\alpha + \beta = -b/a$ Product: $\alpha\beta = c/a$
Cubic $p(x) = ax^3+bx^2+cx+d$, zeroes α, β, γ	$\alpha+\beta+\gamma = -b/a$ $\alpha\beta+\beta\gamma+\gamma\alpha = c/a$ $\alpha\beta\gamma = -d/a$
Forming a quadratic from sum(S) & product(P) of zeroes	$x^2 - (S)x + P = 0$, i.e. $x^2 - (\alpha+\beta)x + \alpha\beta$

Division Algorithm for Polynomials	$p(x) = g(x) \times q(x) + r(x)$, where $r(x) = 0$ or degree of $r(x)$ < degree of $g(x)$

Chapter 3 Pair of Linear Equations in Two Variables

Standard Forms & Nature of Solutions

General pair of linear equations	$a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$
Unique solution (intersecting lines)	$a_1/a_2 \neq b_1/b_2$
Infinitely many solutions (coincident lines)	$a_1/a_2 = b_1/b_2 = c_1/c_2$
No solution (parallel lines)	$a_1/a_2 = b_1/b_2 \neq c_1/c_2$

Algebraic Methods of Solving

Cross-Multiplication Method	$x / (b_1c_2 - b_2c_1) = y / (c_1a_2 - c_2a_1) = 1 / (a_1b_2 - a_2b_1)$
Substitution Method	Express one variable in terms of the other from one equation and substitute into the second equation.
Elimination Method	Multiply equations to equalise coefficients of one variable, then add/subtract to eliminate it.

Chapter 4 Quadratic Equations

Standard Form & Roots

Standard form	$ax^2 + bx + c = 0, a \neq 0$
Quadratic Formula	$x = [-b \pm \sqrt{(b^2 - 4ac)}] / 2a$
Discriminant	$D = b^2 - 4ac$
Nature of roots: D > 0	Two distinct real roots
Nature of roots: D = 0	Two equal real roots (repeated), root = $-b/2a$
Nature of roots: D < 0	No real roots
Sum & Product of roots	Sum = $-b/a$ Product = c/a

Method of Completing the Square	Rewrite $ax^2+bx+c=0$ as $a(x + b/2a)^2 = (b^2–4ac)/4a$

Chapter 5 Arithmetic Progressions (AP)

Core Formulas

General form of AP	a, a+d, a+2d, a+3d, ... (a = first term, d = common difference)
Common difference	$d = a_n – a_{n-1}$ (any term minus its previous term)
n-th term (general term)	$a_n = a + (n – 1)d$
Sum of first n terms (using first term)	$S_n = n/2 [2a + (n – 1)d]$
Sum of first n terms (using last term l)	$S_n = n/2 (a + l)$
n-th term from sums	$a_n = S_n – S_{n-1}$
Sum of first n natural numbers	$S_n = n(n+1)/2$

Chapter 6 Triangles

Similarity Theorems

Basic Proportionality Theorem (Thales)	If DE ■ BC in ■ABC (D on AB, E on AC), then AD/DB = AE/EC
Converse of BPT	If AD/DB = AE/EC, then DE ■ BC
AA Similarity	If two angles of one triangle are equal to two angles of another, the triangles are similar.
SSS Similarity	If corresponding sides of two triangles are proportional, the triangles are similar.
SAS Similarity	If one angle of a triangle equals one angle of another and the sides including these angles are proportional, the triangles are similar.

Areas & Pythagoras

Ratio of Areas of Similar Triangles	Area(■1)/Area(■2) = $(side_1/side_2)^2$ = (perimeter ratio)^2 = (corresponding median/altitude ratio)^2

Pythagoras Theorem	In a right triangle: $(\text{Hypotenuse})^2 = (\text{Base})^2 + (\text{Perpendicular})^2$
Converse of Pythagoras Theorem	If $c^2 = a^2 + b^2$ in a triangle, then the angle opposite side c is 90°.

Chapter 7 Coordinate Geometry

Distance & Section Formulas

Distance Formula	Distance between (x_1,y_1) and $(x_2,y_2) = \sqrt{[(x_2-x_1)^2 + (y_2-y_1)^2]}$
Distance from Origin	$\sqrt{(x^2 + y^2)}$
Section Formula (internal division m:n)	$x = (mx_2+nx_1)/(m+n), \quad y = (my_2+ny_1)/(m+n)$
Mid-point Formula	$x = (x_1+x_2)/2, \quad y = (y_1+y_2)/2$
Centroid of a Triangle	$x = (x_1+x_2+x_3)/3, \quad y = (y_1+y_2+y_3)/3$
Area of a Triangle (given vertices)	$\text{Area} = 1/2 \lvert x_1(y_2-y_3) + x_2(y_3-y_1) + x_3(y_1-y_2)\rvert$
Collinearity of 3 points	Points are collinear if the Area of the triangle formed = 0

Chapter 8 Introduction to Trigonometry

Basic Trigonometric Ratios (right triangle)

sin θ	Opposite side / Hypotenuse
cos θ	Adjacent side / Hypotenuse
tan θ	Opposite side / Adjacent side = sinθ/cosθ
cosec θ	1/sin θ
sec θ	1/cos θ
cot θ	1/tan θ = cosθ/sinθ

Standard Angle Values (0°, 30°, 45°, 60°, 90°)

sin	0, 1/2, 1/√2, √3/2, 1

cos	1, √3/2, 1/√2, 1/2, 0
tan	0, 1/√3, 1, √3, not defined

Trigonometric Identities

Identity 1	$\sin^2\theta + \cos^2\theta = 1$
Identity 2	$1 + \tan^2\theta = \sec^2\theta$
Identity 3	$1 + \cot^2\theta = \text{cosec}^2\theta$
Complementary Angle Relations	$\sin(90°-\theta)=\cos\theta$, $\cos(90°-\theta)=\sin\theta$, $\tan(90°-\theta)=\cot\theta$, $\cot(90°-\theta)=\tan\theta$, $\sec(90°-\theta)=\text{cosec}\theta$, $\text{cosec}(90°-\theta)=\sec\theta$

Chapter 9 Some Applications of Trigonometry

Heights and Distances

Angle of Elevation	The angle formed by the line of sight with the horizontal, when the object is above the eye level.
Angle of Depression	The angle formed by the line of sight with the horizontal, when the object is below the eye level.
Core relation used	$\tan\theta$ = Height (opposite) / Distance (adjacent); apply sin, cos, tan as per the given sides.

Chapter 10 Circles

Tangent Properties

Tangent & Radius	A tangent to a circle is perpendicular to the radius at the point of contact.
Number of tangents from a point	From an external point, exactly two tangents can be drawn to a circle.
Equal Tangent Lengths	The lengths of the two tangents drawn from an external point to a circle are equal.

Chapter 11 Areas Related to Circles

Circle, Sector, Segment Formulas (r = radius)

Circumference of a Circle	$C = 2\pi r$
Area of a Circle	$A = \pi r^2$
Area of Semicircle	$1/2\ \pi r^2$
Perimeter of Semicircle	$\pi r + 2r$
Length of an Arc (angle θ at centre)	$l = (\theta/360°) \times 2\pi r$
Area of a Sector	$A = (\theta/360°) \times \pi r^2$ or $1/2 \times l \times r$
Area of a Segment	Area of sector – Area of corresponding triangle
Area of Segment (formula form)	$\pi r^2(\theta/360°) – 1/2r^2\sin\theta$

Chapter 12 Surface Areas and Volumes

Cube & Cuboid

Cuboid: Total Surface Area	$TSA = 2(lb + bh + hl)$
Cuboid: Lateral Surface Area	$LSA = 2h(l + b)$
Cuboid: Volume	$V = l \times b \times h$
Cuboid: Diagonal	$\sqrt{(l^2 + b^2 + h^2)}$
Cube: Total Surface Area	$TSA = 6a^2$
Cube: Volume	$V = a^3$
Cube: Diagonal	$a\sqrt{3}$

Cylinder, Cone, Sphere (r = radius, h = height, l = slant height)

Cylinder: Curved Surface Area	$CSA = 2\pi rh$
Cylinder: Total Surface Area	$TSA = 2\pi r(h + r)$
Cylinder: Volume	$V = \pi r^2 h$
Cone: Slant Height	$l = \sqrt{(r^2 + h^2)}$

Cone: Curved Surface Area	CSA = πrl
Cone: Total Surface Area	TSA = $\pi r(l + r)$
Cone: Volume	V = $1/3\ \pi r^2 h$
Sphere: Surface Area	SA = $4\pi r^2$
Sphere: Volume	V = $4/3\ \pi r^3$
Hemisphere: Curved Surface Area	CSA = $2\pi r^2$
Hemisphere: Total Surface Area	TSA = $3\pi r^2$
Hemisphere: Volume	V = $2/3\ \pi r^3$
Frustum of a Cone: Volume	V = $1/3\pi h(r_1^2 + r_2^2 + r_1 r_2)$
Frustum: Curved Surface Area	CSA = $\pi(r_1+r_2)l$, where $l = \sqrt{[h^2+(r_1-r_2)^2]}$
Frustum: Total Surface Area	TSA = $\pi(r_1+r_2)l + \pi r_1^2 + \pi r_2^2$

Chapter 13 Statistics

Measures of Central Tendency (Grouped Data)

Mean — Direct Method	Mean = $\Sigma f_i x_i / \Sigma f_i$
Mean — Assumed Mean Method	Mean = $a + (\Sigma f_i d_i / \Sigma f_i)$, where $d_i = x_i - a$
Mean — Step Deviation Method	Mean = $a + (\Sigma f_i u_i / \Sigma f_i) \times h$, where $u_i = (x_i - a)/h$
Median of Grouped Data	Median = $l + [\ (n/2 - cf) / f\ ] \times h$ (l = lower limit of median class, cf = cumulative freq. before it, f = freq. of median class, h = class width)
Mode of Grouped Data	Mode = $l + [\ (f_1 - f_0) / (2f_1 - f_0 - f_2)\ ] \times h$ (f_1=modal class freq., f_0=preceding, f_2=succeeding)
Empirical Relationship	Mode = 3 Median – 2 Mean

Chapter 14 Probability

Basic Probability

Theoretical Probability	P(E) = Number of favourable outcomes / Total number of possible outcomes
Range of Probability	$0 \leq P(E) \leq 1$
Probability of a sure event	P(E) = 1
Probability of an impossible event	P(E) = 0
Complementary Events	P(E) + P(not E) = 1, i.e. P(not E) = 1 – P(E)

SCIENCE — Formula Reference

Chapter 1

Chemical Reactions and Equations

Key Concepts & Equation Forms

Balanced Chemical Equation	Number of atoms of each element must be equal on both the reactant (LHS) and product (RHS) sides.
Combination Reaction (general form)	$A + B \rightarrow AB$
Decomposition Reaction (general form)	$AB \rightarrow A + B$ (may need heat, light, or electricity)
Displacement Reaction (general form)	$A + BC \rightarrow AC + B$
Double Displacement Reaction (general form)	$AB + CD \rightarrow AD + CB$
Oxidation	Gain of oxygen / loss of hydrogen / loss of electrons
Reduction	Loss of oxygen / gain of hydrogen / gain of electrons

Chapter 2

Acids, Bases and Salts

Key Relations

pH Scale	Ranges 0–14: pH < 7 acidic, pH = 7 neutral, pH > 7 basic
Neutralisation Reaction (general form)	Acid + Base → Salt + Water
Reaction of Metal with Acid (general form)	Metal + Acid → Salt + Hydrogen gas
Reaction of Metal Carbonate/Bicarbonate with Acid	Metal carbonate/bicarbonate + Acid → Salt + Water + Carbon dioxide
Water of Crystallisation (Gypsum example)	$CaSO_4 \cdot 2H_2O$ (Gypsum) → (heat) → $CaSO_4 \cdot 1/2H_2O$ (Plaster of Paris) + 11/2 H_2O

Chapter 3

Metals and Non-metals

Reactivity & Reactions

Reactivity Series (most to least reactive)	K > Na > Ca > Mg > Al > Zn > Fe > Pb > H > Cu > Ag > Au
Metal + Oxygen (general)	Metal + O_2 → Metal oxide (basic in nature)
Metal + Water (general)	Metal + Water → Metal oxide/hydroxide + Hydrogen gas
Metal + Dilute Acid (general)	Metal + Dilute Acid → Salt + Hydrogen gas
Thermite Reaction	Fe_2O_3 + 2Al → 2Fe + Al_2O_3 + Heat (used for welding rails)
Ionic (Electrovalent) Bond formation	Formed by transfer of electrons from a metal (loses e^-) to a non-metal (gains e^-)

Chapter 4 Carbon and its Compounds

Homologous Series & Formulas

Alkanes (saturated hydrocarbons)	General formula: C_nH_{2n+2}
Alkenes (one double bond)	General formula: C_nH_{2n}
Alkynes (one triple bond)	General formula: C_nH_{2n-2}
Complete Combustion of a hydrocarbon	Hydrocarbon + O_2 → CO_2 + H_2O + Heat & Light
Esterification (general form)	Alcohol + Acid ↔ (catalyst: conc. H_2SO_4) ↔ Ester + Water
Saponification (soap formation, general form)	Ester/Fat + NaOH → Soap + Glycerol

Chapter 5 Periodic Classification of Elements

Trends in the Modern Periodic Table

Valency across a Period	First increases from 1 to 4, then decreases to 0 (left to right)
Atomic Size across a Period	Decreases from left to right (increasing nuclear charge)
Atomic Size down a Group	Increases down a group (new shells are added)
Metallic Character across a Period	Decreases from left to right

Metallic Character down a Group	Increases down a group

Chapter 6 Light – Reflection and Refraction

Mirror & Lens Formulas (Cartesian sign convention)

Mirror Formula	$1/v + 1/u = 1/f$
Linear Magnification (mirror)	$m = -v/u = h'/h$
Lens Formula	$1/v - 1/u = 1/f$
Linear Magnification (lens)	$m = v/u = h'/h$
Power of a Lens	$P = 1/f$ (f in metres, P in dioptres D)
Focal Length & Radius of Curvature (spherical mirror)	$f = R/2$
Power of Combination of Lenses	$P = P_1 + P_2 + P_3 + ...$
Laws of Refraction / Refractive Index	$n = \sin i / \sin r$ (i = angle of incidence, r = angle of refraction)

Chapter 7 The Human Eye and the Colourful World

Key Points (mostly conceptual, few numeric)

Near Point of a normal (young adult) eye	About 25 cm from the eye
Far Point of a normal eye	Infinity
Power of Accommodation	Ability of the eye lens to adjust its focal length to focus objects at different distances
Angle of Deviation (prism, minimum deviation)	$\delta = (i + e) - A$ (i = angle of incidence, e = angle of emergence, A = angle of prism)

Chapter 8 Electricity

Core Formulas

Electric Current	$I = Q/t$ (Q in coulomb, t in second, I in ampere)
Potential Difference	$V = W/Q$ (W = work done, Q = charge)
Ohm's Law	$V = IR$
Resistance in terms of resistivity	$R = \rho l/A$ (ρ = resistivity, l = length, A = area of cross-section)
Resistors in Series	$R = R_1 + R_2 + R_3 + ...$
Resistors in Parallel	$1/R = 1/R_1 + 1/R_2 + 1/R_3 + ...$
Electric Power	$P = VI = I^2R = V^2/R$
Electrical Energy Consumed	$E = P \times t$ (commercial unit: 1 kWh = 3.6×10^6 J)
Heat produced (Joule's Law of Heating)	$H = I^2Rt$

Chapter 9 Magnetic Effects of Electric Current

Rules & Relations

Right-Hand Thumb Rule	If a current-carrying conductor is held in the right hand with the thumb pointing in the direction of current, the curled fingers show the direction of the magnetic field.
Fleming's Left-Hand Rule (force on a conductor)	Thumb = direction of Force (Motion), First finger = Field, Middle finger = Current (used for motors)
Fleming's Right-Hand Rule (induced current)	Thumb = Motion, First finger = Field, Middle finger = induced Current (used for generators)
Force on a current-carrying conductor in a magnetic field	$F = BIl$ (when field is perpendicular to the conductor; B = magnetic field, I = current, l = length)

Biology — Quick Reference

Biology chapters of Class 10 NCERT (Life Processes, Control & Coordination, How do Organisms Reproduce?, Heredity & Evolution, Our Environment, Management of Natural Resources) are largely concept and diagram based, with very few numerical formulas. Key quantitative points from Life Processes and Heredity are summarised below for completeness.

Life Processes — Key Numeric/Ratio Facts

Normal Human Heart Rate	Approximately 72 beats per minute (resting adult)

Breathing Rate (resting)	Approximately 15–18 breaths per minute in a healthy adult

Heredity — Mendelian Ratios

Monohybrid Cross — Phenotypic Ratio (F2)	3 : 1 (dominant : recessive)
Monohybrid Cross — Genotypic Ratio (F2)	1 : 2 : 1
Dihybrid Cross — Phenotypic Ratio (F2)	9 : 3 : 3 : 1

This handbook is intended as a quick-revision companion alongside the official NCERT textbooks. Always cross-check derivations and worked examples in the textbook for full conceptual understanding.