

Class 10 Science: Formulas and Key Equations

Physics formulas and chemical equations from the NCERT chapters · CBSE syllabus 2026-27 · NCERT textbook (Reprint 2026-27)

How to use this sheet. It collects every formula, chemical equation and rule-of-thumb from the 10 NCERT Class 10 Science chapters that have them. All of it is in the CBSE 2026-27 board-exam syllabus. The three biology chapters without equations (Control and Coordination, How do Organisms Reproduce?, Heredity) are not included. Chapter numbers match the NCERT textbook. Not assessed in the 2026-27 board exam: periodic classification, evolution, and the electric motor, electromagnetic induction and generator (formative only). Also not assessed: the colour of the Sun at sunrise and sunset.

1. Chemical Reactions and Equations
2. Acids, Bases and Salts
3. Metals and Non-metals
4. Carbon and its Compounds
5. Life Processes

6. Light: Reflection and Refraction
7. The Human Eye and the Colourful World
8. Electricity
9. Magnetic Effects of Electric Current
10. Our Environment

1 Chemical Reactions and Equations

BALANCING AND WRITING EQUATIONS

- Atoms of each element must be equal on both sides (law of conservation of mass)
- $3\text{Fe(s)} + 4\text{H}_2\text{O(g)} \longrightarrow \text{Fe}_3\text{O}_4\text{(s)} + 4\text{H}_2\text{(g)}$
- States: (s), (l), (g), (aq); conditions written above or below the arrow

COMBINATION

- $\text{CaO(s)} + \text{H}_2\text{O(l)} \longrightarrow \text{Ca(OH)}_2\text{(aq)} + \text{heat}$ (quicklime to slaked lime)
- Whitewash:
 $\text{Ca(OH)}_2\text{(aq)} + \text{CO}_2\text{(g)} \longrightarrow \text{CaCO}_3\text{(s)} + \text{H}_2\text{O(l)}$
- $\text{C(s)} + \text{O}_2\text{(g)} \longrightarrow \text{CO}_2\text{(g)}$;
 $2\text{H}_2\text{(g)} + \text{O}_2\text{(g)} \longrightarrow 2\text{H}_2\text{O(l)}$

DECOMPOSITION

- Heat: $2\text{FeSO}_4\text{(s)} \xrightarrow{\text{Heat}} \text{Fe}_2\text{O}_3\text{(s)} + \text{SO}_2\text{(g)} + \text{SO}_3\text{(g)}$
- Heat: $\text{CaCO}_3\text{(s)} \xrightarrow{\text{Heat}} \text{CaO(s)} + \text{CO}_2\text{(g)}$
- Heat:
 $2\text{Pb(NO}_3)_2\text{(s)} \xrightarrow{\text{Heat}} 2\text{PbO(s)} + 4\text{NO}_2\text{(g)} + \text{O}_2\text{(g)}$
- Light: $2\text{AgCl(s)} \xrightarrow{\text{Sunlight}} 2\text{Ag(s)} + \text{Cl}_2\text{(g)}$ (also AgBr; used in photography)
- Electricity: $2\text{H}_2\text{O(l)} \longrightarrow 2\text{H}_2\text{(g)} + \text{O}_2\text{(g)}$ (H_2 volume is twice O_2)

DISPLACEMENT AND DOUBLE DISPLACEMENT

- $\text{Fe(s)} + \text{CuSO}_4\text{(aq)} \longrightarrow \text{FeSO}_4\text{(aq)} + \text{Cu(s)}$ (blue solution turns pale green)
- $\text{Zn(s)} + \text{CuSO}_4\text{(aq)} \longrightarrow \text{ZnSO}_4\text{(aq)} + \text{Cu(s)}$
- Precipitation:
 $\text{Na}_2\text{SO}_4\text{(aq)} + \text{BaCl}_2\text{(aq)} \longrightarrow \text{BaSO}_4\text{(s)} \downarrow + 2\text{NaCl(aq)}$ (white ppt)

OXIDATION AND REDUCTION (REDOX)

- Oxidation: gain of oxygen or loss of hydrogen. Reduction: loss of oxygen or gain of hydrogen.
- $\text{CuO} + \text{H}_2 \xrightarrow{\text{Heat}} \text{Cu} + \text{H}_2\text{O}$: CuO is reduced, H_2 is oxidised
- $\text{ZnO} + \text{C} \longrightarrow \text{Zn} + \text{CO}$; $\text{MnO}_2 + 4\text{HCl} \longrightarrow \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2$
- Exothermic: respiration $\text{C}_6\text{H}_{12}\text{O}_6\text{(aq)} + 6\text{O}_2\text{(aq)} \longrightarrow 6\text{CO}_2\text{(aq)} + 6\text{H}_2\text{O(l)} + \text{energy}$. Endothermic: decomposition reactions.
- Corrosion (rusting of iron) and rancidity (oxidation of fats and oils) are everyday oxidation effects.



2 Acids, Bases and Salts

GENERAL REACTIONS

- Acid + Metal $\rightarrow$ Salt + Hydrogen gas
- Base + Metal:
 $2\text{NaOH(aq)} + \text{Zn(s)} \rightarrow \text{Na}_2\text{ZnO}_2\text{(s)} + \text{H}_2\text{(g)}$
- Metal carbonate / hydrogencarbonate + Acid $\rightarrow$ Salt + CO_2 + Water
- Neutralisation: Acid + Base $\rightarrow$ Salt + Water, e.g.
 $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
- Metal oxide + Acid $\rightarrow$ Salt + Water (metal oxides are basic)
- Non-metal oxide + Base $\rightarrow$ Salt + Water (non-metal oxides are acidic)

PH SCALE

- pH 7: neutral; below 7: acidic; above 7: basic (scale 0 to 14)
- Higher H^+ concentration means lower pH
- Tooth decay starts below pH 5.5
- Strong acids give many H^+ ions, weak acids give few

IONS IN WATER

- Acids give H^+ (as H_3O^+): $\text{HCl} + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{Cl}^-$
- Bases give OH^- : $\text{NaOH(s)} \xrightarrow{\text{H}_2\text{O}} \text{Na}^+(\text{aq}) + \text{OH}^-(\text{aq})$
- Neutralisation core: $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O(l)}$
- Water-soluble bases are alkalis. Always add acid to water, never water to acid (highly exothermic).

INDICATORS

Indicator	In acid	In base
Litmus	blue to red	red to blue
Phenolphthalein	colourless	pink
Methyl orange	red	yellow

Olfactory indicators: onion and vanilla lose their smell in a base.

CHEMICALS FROM COMMON SALT

- Chlor-alkali process: $2\text{NaCl(aq)} + 2\text{H}_2\text{O(l)} \rightarrow 2\text{NaOH(aq)} + \text{Cl}_2\text{(g)} + \text{H}_2\text{(g)}$ (Cl_2 at anode, H_2 at cathode)
- Bleaching powder: $2\text{Ca(OH)}_2 + 2\text{Cl}_2 \rightarrow \text{Ca(ClO)}_2 + \text{CaCl}_2 + 2\text{H}_2\text{O}$
- Baking soda: $\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2 + \text{NH}_3 \rightarrow \text{NH}_4\text{Cl} + \text{NaHCO}_3$; on heating $2\text{NaHCO}_3 \xrightarrow{\text{Heat}} \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$
- Baking powder: $\text{NaHCO}_3 + \text{H}^+ \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{sodium salt of acid}$ (CO_2 makes cake rise)
- Washing soda: $\text{Na}_2\text{CO}_3 + 10\text{H}_2\text{O} \rightarrow \text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
- Plaster of Paris: gypsum $\text{CaSO}_4 \cdot 2\text{H}_2\text{O} \xrightarrow{373\text{K}} \text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O} + \frac{3}{2}\text{H}_2\text{O}$; $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O} + \frac{3}{2}\text{H}_2\text{O} \rightarrow \text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ (sets hard)
- Water of crystallisation: blue $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ turns white on heating.

3 Metals and Non-metals

REACTIONS OF METALS

- With oxygen: $2\text{Cu} + \text{O}_2 \rightarrow 2\text{CuO}$;
 $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$
- Amphoteric oxides (Al_2O_3 , ZnO) react with both acids and bases
- Soluble metal oxides give alkalis:
 $\text{Na}_2\text{O(s)} + \text{H}_2\text{O(l)} \rightarrow 2\text{NaOH(aq)}$
- With water:
 $2\text{Na(s)} + 2\text{H}_2\text{O(l)} \rightarrow 2\text{NaOH(aq)} + \text{H}_2\text{(g)} + \text{heat}$;
 $\text{Ca(s)} + 2\text{H}_2\text{O(l)} \rightarrow \text{Ca(OH)}_2\text{(aq)} + \text{H}_2\text{(g)}$
- With steam: $3\text{Fe(s)} + 4\text{H}_2\text{O(g)} \rightarrow \text{Fe}_3\text{O}_4\text{(s)} + 4\text{H}_2\text{(g)}$

ACIDS, SALTS AND REACTIVITY

- Metal + dilute acid $\rightarrow$ salt + H_2 (H_2 only with very dilute HNO_3 , using Mg or Mn)
- Metal A + salt solution of B $\rightarrow$ salt solution of A + metal B (if A is more reactive)
- Reactivity series: $\text{K} > \text{Na} > \text{Ca} > \text{Mg} > \text{Al} > \text{Zn} > \text{Fe} > \text{Pb} > [\text{H}] > \text{Cu} > \text{Hg} > \text{Ag} > \text{Au}$
- Aqua regia: conc. HCl and conc. HNO_3 in 3 : 1; dissolves gold and platinum



IONIC COMPOUNDS

- $\text{Na} \longrightarrow \text{Na}^+ + \text{e}^-$; $\text{Cl} + \text{e}^- \longrightarrow \text{Cl}^-$;
 $\text{Na}^+ + \text{Cl}^- \longrightarrow \text{NaCl}$
- $\text{Mg} \longrightarrow \text{Mg}^{2+} + 2\text{e}^-$; $\text{Mg}^{2+} + 2\text{Cl}^- \longrightarrow \text{MgCl}_2$
- High melting and boiling points; conduct when molten or dissolved; soluble in water

EXTRACTING METALS

- Low reactivity (heat alone):
 $2\text{HgS} + 3\text{O}_2 \xrightarrow{\text{Heat}} 2\text{HgO} + 2\text{SO}_2$;
 $2\text{HgO} \xrightarrow{\text{Heat}} 2\text{Hg} + \text{O}_2$
- Middle: roasting $2\text{ZnS} + 3\text{O}_2 \xrightarrow{\text{Heat}} 2\text{ZnO} + 2\text{SO}_2$;
calcination $\text{ZnCO}_3 \xrightarrow{\text{Heat}} \text{ZnO} + \text{CO}_2$; then
 $\text{ZnO} + \text{C} \longrightarrow \text{Zn} + \text{CO}$
- Thermit reaction:
 $\text{Fe}_2\text{O}_3(\text{s}) + 2\text{Al}(\text{s}) \longrightarrow 2\text{Fe}(\text{l}) + \text{Al}_2\text{O}_3(\text{s}) + \text{heat}$
- High reactivity: electrolysis of molten chloride; cathode
 $\text{Na}^+ + \text{e}^- \longrightarrow \text{Na}$, anode $2\text{Cl}^- \longrightarrow \text{Cl}_2 + 2\text{e}^-$

REFINING, CORROSION, ALLOYS

- Electrolytic refining: impure metal is the anode, pure metal is the cathode; impurities form anode mud
- Corrosion: silver turns black (Ag_2S), copper turns green (basic copper carbonate), iron rusts. Prevent rusting by painting, oiling, greasing, galvanising (zinc coating), chrome plating, anodising or alloying.
- Alloys: brass ($\text{Cu} + \text{Zn}$), bronze ($\text{Cu} + \text{Sn}$), solder ($\text{Pb} + \text{Sn}$, low melting point), amalgam (mercury alloy)

4 Carbon and its Compounds**HYDROCARBON FORMULAE**

Series	General formula	Bond	Example
Alkane	$\text{C}_n\text{H}_{2n+2}$	single	CH_4 , C_2H_6
Alkene	C_nH_{2n}	double	C_2H_4
Alkyne	$\text{C}_n\text{H}_{2n-2}$	triple	C_2H_2

Successive members of a homologous series differ by CH_2 (14 u).

FUNCTIONAL GROUPS AND NAMES

Group	Formula	Suffix / prefix
Halogen	-Cl, -Br	chloro-, bromo-
Alcohol	-OH	-ol
Aldehyde	-CHO	-al
Ketone	$>\text{C}=\text{O}$	-one
Carboxylic acid	-COOH	-oic acid

CHEMICAL PROPERTIES

- Combustion: $\text{CH}_4 + 2\text{O}_2 \longrightarrow \text{CO}_2 + 2\text{H}_2\text{O} + \text{heat and light}$
- Oxidation:
 $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{alkaline KMnO}_4 + \text{heat or acidified K}_2\text{Cr}_2\text{O}_7 + \text{heat}} \text{CH}_3\text{COOH}$
- Addition (hydrogenation, Ni or Pd catalyst):
 $\text{R}_2\text{C}=\text{CR}_2 + \text{H}_2 \longrightarrow \text{R}_2\text{CH}-\text{CHR}_2$ (vegetable oils)
- Substitution: $\text{CH}_4 + \text{Cl}_2 \xrightarrow{\text{sunlight}} \text{CH}_3\text{Cl} + \text{HCl}$

ETHANOL

- With sodium:
 $2\text{Na} + 2\text{CH}_3\text{CH}_2\text{OH} \longrightarrow 2\text{CH}_3\text{CH}_2\text{O}^-\text{Na}^+ + \text{H}_2$
- Dehydration:
 $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{hot conc. H}_2\text{SO}_4, 443\text{ K}} \text{CH}_2=\text{CH}_2 + \text{H}_2\text{O}$

ETHANOIC ACID

- Esterification: $\text{CH}_3\text{COOH} + \text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{acid}} \text{CH}_3\text{COOCH}_2\text{CH}_3 + \text{H}_2\text{O}$ (sweet-smelling ester)
- Saponification: $\text{CH}_3\text{COOC}_2\text{H}_5 \xrightarrow{\text{NaOH}} \text{C}_2\text{H}_5\text{OH} + \text{CH}_3\text{COONa}$
- With base: $\text{NaOH} + \text{CH}_3\text{COOH} \longrightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O}$
- With carbonates: $2\text{CH}_3\text{COOH} + \text{Na}_2\text{CO}_3 \longrightarrow 2\text{CH}_3\text{COONa} + \text{H}_2\text{O} + \text{CO}_2$;
 $\text{CH}_3\text{COOH} + \text{NaHCO}_3 \longrightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O} + \text{CO}_2$
- 5-8% ethanoic acid in water is vinegar. Pure ethanoic acid freezes in cold weather (glacial acetic acid).



5 Life Processes

PHOTOSYNTHESIS

- Carbon dioxide + water $\xrightarrow{\text{sunlight, chlorophyll}}$ carbohydrates (stored as starch)
- Steps: light energy absorbed by chlorophyll; water split into hydrogen and oxygen; CO_2 reduced to carbohydrates
- Gas exchange through stomata

RESPIRATION PATHWAYS

- Glucose (6C) $\xrightarrow{\text{cytoplasm}}$ pyruvate (3C) + energy
- Yeast, no oxygen: pyruvate $\rightarrow$ ethanol + CO_2 + energy (anaerobic)
- Muscle, lack of oxygen: pyruvate $\rightarrow$ lactic acid + energy (causes cramps)
- Mitochondria, with oxygen: pyruvate $\rightarrow \text{CO}_2 + \text{H}_2\text{O} +$ energy (aerobic, most energy)
- Energy currency: ATP

9 Light: Reflection and Refraction

SPHERICAL MIRRORS

- Focal length: $f = \frac{R}{2}$, i.e. $R = 2f$
- Mirror formula:
$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$
- Magnification: $m = \frac{h'}{h} = -\frac{v}{u}$
- Negative m : real, inverted image. Positive m : virtual, erect image.

SIGN CONVENTION (NEW CARTESIAN)

- Distances measured from the pole (mirror) or optical centre (lens)
- Along the incident light: +; against it: –
- Heights above the principal axis: +; below: –
- Object distance u is always negative. Concave mirror and concave lens: $f < 0$. Convex mirror and convex lens: $f > 0$.

REFRACTION

- Snell's law: $\frac{\sin i}{\sin r} = n_{21}$ (constant)
- Absolute refractive index: $n_m = \frac{c}{v}$
- Relative: $n_{21} = \frac{v_1}{v_2} = \frac{n_2}{n_1}$
- Values: air 1.0003, water 1.33, kerosene 1.44, crown glass 1.52, diamond 2.42
- Optical density is not mass density: kerosene is optically denser than water but lighter.

SPHERICAL LENSES

- Lens formula:
$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$
- Magnification: $m = \frac{h'}{h} = \frac{v}{u}$
- Power: $P = \frac{1}{f}$ (f in metres), unit dioptre (D). Convex: + ; concave: –
- Lenses in contact: $P = P_1 + P_2 + P_3 + \dots$

10 The Human Eye and the Colourful World

THE EYE

- Near point (least distance of distinct vision): 25 cm. Far point: infinity
- Accommodation: ciliary muscles change the focal length of the eye lens
- Myopia (near-sightedness): image before retina; corrected by a concave lens
- Hypermetropia (far-sightedness): image behind retina; corrected by a convex lens
- Presbyopia: accommodation weakens with age

PRISM AND ATMOSPHERE

- Dispersion: white light splits into VIBGYOR; violet bends most, red least
- Rainbow: dispersion + refraction + internal reflection in raindrops (Sun behind you)
- Atmospheric refraction: twinkling of stars; advance sunrise and delayed sunset (about 2 minutes)
- Scattering: blue sky (fine particles scatter blue most); Tyndall effect



11 Electricity

CURRENT AND POTENTIAL DIFFERENCE

- $I = \frac{Q}{t}$; $1 \text{ A} = 1 \text{ C s}^{-1}$
- 1 C is the charge of nearly 6×10^{18} electrons; $e = 1.6 \times 10^{-19} \text{ C}$
- $V = \frac{W}{Q}$; $1 \text{ V} = 1 \text{ J C}^{-1}$
- Ammeter in series; voltmeter in parallel

OHM'S LAW AND RESISTIVITY

- Ohm's law: $V = IR$ (at constant temperature)
- $$R = \rho \frac{l}{A}$$

(ρ in $\Omega \text{ m}$)
- Metals and alloys: ρ from 10^{-8} to $10^{-6} \Omega \text{ m}$; insulators: 10^{12} to $10^{17} \Omega \text{ m}$
- Alloys (nichrome) have higher ρ and do not oxidise: used in heaters

RESISTORS IN COMBINATION

- Series: $R_s = R_1 + R_2 + R_3$ (same current)
- Parallel: $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ (same voltage)
- Home appliances are wired in parallel so each gets full voltage and can be switched separately.

HEATING EFFECT AND POWER

- Joule's law: $H = I^2 R t$ (also $H = V I t$)
- Power: $P = V I = I^2 R = \frac{V^2}{R}$; $1 \text{ W} = 1 \text{ V} \times 1 \text{ A}$
- Energy: $E = P t$; $1 \text{ kW h} = 3.6 \times 10^6 \text{ J}$ (1 "unit")
- Uses: heater, iron, bulb filament (tungsten), fuse (low melting point)

12 Magnetic Effects of Electric Current

FIELD FROM A CURRENT

- Right-hand thumb rule: thumb along current, fingers curl along field lines
- Straight wire: concentric circles; field $\propto I$, weaker farther away
- Circular loop: field $\propto$ current and number of turns
- Solenoid: uniform field inside, like a bar magnet; with soft iron core it makes an electromagnet

FORCE ON A CONDUCTOR

- Fleming's left-hand rule: forefinger = field, middle finger = current, thumb = force (motion)
- Force is greatest when current $\perp$ field
- Field lines never cross; they run N to S outside a magnet and S to N inside.

DOMESTIC CIRCUITS

- India: AC at 220 V, 50 Hz. DC flows one way; AC reverses direction periodically. AC can be sent over long distances with less loss.
- Live wire: red insulation. Neutral: black. Earth: green (connected to the metal body of appliances for safety).
- Fuse guards against overloading and short circuits; high-power appliances use a 15 A circuit, bulbs and fans 5 A.

13 Our Environment

ENERGY FLOW

- 10% law: only about 10% of the energy at one trophic level passes to the next
- Producers $\rightarrow$ herbivores $\rightarrow$ carnivores (energy flow is one-way)
- Biological magnification: pesticides build up along the food chain (highest at top)

OZONE

- $\text{O}_2 \xrightarrow{\text{UV}} \text{O} + \text{O}$
- $\text{O} + \text{O}_2 \rightarrow \text{O}_3$
- Ozone layer shields Earth from UV; depleted by CFCs
- Biodegradable vs non-biodegradable waste

