

Class 10 Science - Free Sample Pack

Board-focused Chemistry, Physics and Biology excerpts

- Chemistry: reaction evidence, equations and concept-linked learning.
- Physics: ray-optics reasoning with worked mirror problems and Brain-Twisters.
- Biology: Life Processes explained through visual pathways and memorable big ideas.

Selected preview - read, evaluate, then choose the complete book

TOPPER FORMULA CLASS 10 CHEMISTRY

CHAPTER 1

Chemical Reactions and Equations

*See the Change • Read the Evidence • Write the Chemistry***Lalit Kumar Mishra****Topper Formula Imprint****CHAPTER MYSTERY**

A silver ornament turns dark, an iron gate develops a reddish coating, milk becomes sour, a matchstick burns, and food slowly loses freshness. These changes look unrelated—but each tells the same hidden story: old chemical bonds are reorganising and new substances are forming.

Learning Outcomes

- Recognise a chemical reaction from observable evidence.
- Write word equations, skeletal equations and balanced chemical equations with correct state symbols.
- Apply the law of conservation of mass while balancing equations systematically.
- Classify combination, decomposition, displacement, double displacement, precipitation, exothermic, endothermic and redox reactions.
- Explain oxidation and reduction together using oxygen/hydrogen transfer and electron ideas appropriate to this level.
- Perform and interpret all important NCERT activities safely.
- Explain corrosion and rancidity and select suitable prevention methods.

1.1 The World Is Continuously Reacting

Chemistry begins with observation. A chemical reaction is a process in which one or more substances—the reactants—change into new substances—the products—with different composition and properties. Atoms are rearranged; they are neither created nor destroyed in an ordinary chemical reaction.

Everyday event	Visible clue	Chemical idea
Burning magnesium	dazzling white light; white ash	new oxide forms
Iron rusting	reddish-brown coating	slow oxidation
Curd formation	taste, smell and texture change	new substances form
Gas stove burning	heat and flame	exothermic combustion
Cut apple browning	surface darkens in air	oxidation

THINK LIKE A SCIENTIST

Do not decide from appearance alone. Ask: Is a new substance produced? Can the evidence be explained by gas evolution, colour change, temperature change, precipitate, light, odour or change of state?

1.2 How Do We Know a Reaction Has Occurred?

Evidence	Meaning	Example
Gas evolved	a gaseous product forms	acid + carbonate → carbon dioxide
Colour change	new coloured species may form	iron in copper sulphate
Temperature change	energy is released or absorbed	quicklime + water becomes hot
Precipitate	insoluble solid appears from solutions	barium sulphate formation
Light/flame	energy released rapidly	magnesium burning
Odour change	volatile products may form	food spoilage

HOW TO REMEMBER — REACTION EVIDENCE

Use G-C-T-P-L-O: Gas, Colour, Temperature, Precipitate, Light, Odour. Evidence supports a reaction; it is not itself the definition.

MISCONCEPTION ALERT

A change of state alone is usually physical, but a reaction may also include a state change. Conversely, colour change alone is not proof unless linked to formation of a new substance.

ACTIVITY 1.1 — Burning Magnesium Ribbon**AIM**

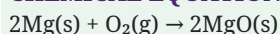
To observe a combination reaction and identify its product.

Materials: magnesium ribbon, sandpaper, tongs, burner and watch glass

Procedure:

1. Clean a short magnesium ribbon with sandpaper. Hold it with tongs and ignite it in a flame.
2. Collect the white ash on a watch glass. Compare the metallic ribbon with the powder formed.

What to observe	What it tells us
A dazzling white flame is produced.	A large amount of energy is released.
A white powder remains.	Magnesium oxide, a new substance, has formed.

CHEMICAL EQUATION

Inference: Magnesium combines with oxygen to form one product; this is combination, oxidation and exothermic reaction.

Safety and accuracy: Never stare directly at the intense flame. Use tongs. Cleaning removes the protective MgO layer so magnesium ignites readily.

HOW TO REMEMBER

MAGNESIUM: “Clean–Clamp–Combust–Collect.” The four C’s give the complete activity sequence.

ACTIVITY 1.2 — Formation of Lead Iodide**AIM**

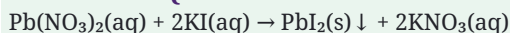
To observe a colour change and precipitation reaction.

Materials: dilute lead nitrate solution, potassium iodide solution, test tube and dropper

Procedure:

3. Take lead nitrate solution in a test tube. Add potassium iodide solution slowly and swirl.

What to observe	What it tells us
A bright yellow solid appears.	Insoluble lead iodide has formed.
The solid separates from solution.	The product is a precipitate.

CHEMICAL EQUATION

Inference: The ions exchange partners. It is both a double-displacement and precipitation reaction.

Safety and accuracy: Lead compounds are toxic. Use only teacher-supervised quantities, avoid skin contact and dispose of waste as instructed.

HOW TO REMEMBER

Yellow PbI₂: remember “Lead meets iodide → yellow slides out.”

ACTIVITY 1.3 — Metal–Acid Reaction**AIM**

To detect hydrogen gas formed when zinc reacts with a dilute acid.

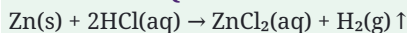
Materials: zinc granules, dilute hydrochloric or sulphuric acid, test tube and burning splint

Procedure:

4. Place zinc granules in a test tube. Add dilute acid carefully.
5. Observe bubbles. Bring a burning splint near the mouth only under supervision. Listen for the characteristic pop.

What to observe	What it tells us
Effervescence occurs.	A gas is being produced.

What to observe	What it tells us
The gas burns with a pop.	The gas is hydrogen.
The test tube may become warm.	The reaction releases heat.

CHEMICAL EQUATION

Inference: Zinc displaces hydrogen from dilute acid.

Safety and accuracy: Keep the test tube pointed away from people. Do not stopper it. Use only small quantities because hydrogen is flammable.

HOW TO REMEMBER

Metal + acid → Salt + Hydrogen. Think MASH: Metal–Acid–Salt–Hydrogen.

1.3 From Words to Chemical Equations

A word equation names the substances. A chemical equation uses symbols and formulae. The substances before the arrow are reactants; those after it are products. The arrow means “yields” or “forms”—not mathematical equality.

Representation	Example	What it communicates
Word equation	Magnesium + Oxygen → Magnesium oxide	identity of substances
Skeletal equation	$\text{Mg} + \text{O}_2 \rightarrow \text{MgO}$	correct formulae, not yet balanced
Balanced equation	$2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$	equal atoms of each element on both sides
Complete equation	$2\text{Mg(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{MgO(s)}$	coefficients plus physical states

1.3.1 State symbols and reaction conditions

Symbol	Meaning
(s)	solid
(l)	liquid
(g)	gas
(aq)	dissolved in water
Δ over arrow	heating
sunlight over arrow	photochemical condition
catalyst over arrow	catalyst speeds reaction without being consumed

HOW TO REMEMBER — STATE SYMBOLS

S-L-G-AQ follows the physical world: Solid, Liquid, Gas, Aqueous. Conditions belong near the arrow; coefficients belong before formulae.

1.4 Balancing Chemical Equations

A balanced equation contains the same number of atoms of every element on the reactant and product sides. This expresses the law of conservation of mass: total mass remains constant because atoms are rearranged, not created or destroyed.

GOLDEN RULE

Change only coefficients—the whole numbers written before formulae. Never alter subscripts inside a correct chemical formula; doing so changes the substance itself.

1.4.1 The Topper Formula balancing method

- Write the correct skeletal equation.
- Count atoms of every element on both sides.
- Begin with the most complex formula or an element appearing in the fewest places.
- Balance one element at a time by inserting coefficients.
- Leave free oxygen and hydrogen until later when convenient.
- Reduce coefficients to the smallest whole-number ratio.

TOPPER FORMULA

Light: Reflection and Refraction

Class 10 Physics • Chapter 1 • Detailed Textbook

2026–27 CBSE-ALIGNED EDITION Concept clarity • Experiments • Numericals • Competency practice

Lalit Kumar Mishra

Educator • Author • Student Success Mentor

Topper Formula Imprint

How to use this chapter

- Read the opening mystery and predict before reading the explanation.
- Draw every ray diagram with a ruler; label P, F, C or O, F_1 , F_2 before rays.
- Use the New Cartesian sign convention before substituting any number.
- Attempt the “Pause & Predict” and Brain-Twister prompts without looking at answers.
- For practicals, separate apparatus, variables, procedure, observations, calculation, precautions and errors.
- Finish with the competency studio, formula map and mastery checklist.

SYLLABUS COMPASS Board-assessed: curved-surface reflection, spherical mirrors and images, mirror formula and magnification; refraction, laws and refractive index; spherical lenses and images, lens formula, magnification and power; applications. Formula derivations are not required by CBSE, but are included here as concept enrichment. Three prescribed experiments are treated in full.

1. The disappearing coin and the mirror that enlarges

BIG IDEA Light changes direction in predictable ways; those changes let us see, magnify, correct vision and build instruments.

Place a coin in an opaque bowl and move back until its rim just hides the coin. Without moving your head, ask a friend to pour water into the bowl. The coin seems to rise into view. Nothing lifted it: light from the coin bent at the water–air boundary. Now look into the inner surface of a steel spoon. Far away your face is upside down; bring the spoon close and the image becomes upright and enlarged. One curved reflecting surface has produced two different image experiences.

Learning outcomes

- State and apply the laws of reflection and refraction.
- Construct and interpret ray diagrams for spherical mirrors and lenses.
- Use the New Cartesian sign convention consistently.
- Solve mirror, lens, magnification, refractive-index and power problems.
- Perform and explain the three prescribed optics experiments.
- Analyse unfamiliar optical situations using evidence, not memorised slogans.

PAUSE & PREDICT Why can no image formed by a plane mirror be caught on a screen? What must be true about the actual light rays?

2. Ray model, reflection and image language

BIG IDEA A ray is a direction marker for energy travel—not a thin material thread.

Reasoning checkpoint

- A larger field of view does not mean the mirror collects every possible ray; it maps a wider scene into a smaller image.
- The image remains erect because magnification is positive.
- The focal length of a convex mirror is positive under the New Cartesian convention because F lies behind the mirror.

HOTS A shopkeeper wants both an enlarged face view and a wide view of the shop. One spherical mirror cannot provide both for every object distance. Explain the trade-off and propose two mirrors.

7. New Cartesian sign convention

BIG IDEA Let the direction of incident light decide the signs—not memory alone.

- Take the pole P of a mirror or optical centre O of a lens as origin.
- Measure all distances along the principal axis from P or O.
- Distances measured in the direction of incident light are positive; opposite are negative.
- Heights above the principal axis are positive; below are negative.

Quantity	Concave mirror	Convex mirror
Object distance u	Negative	Negative
Focal length f	Negative	Positive
Real-image v	Negative	Not formed for real object
Virtual-image v	Positive	Positive

SIGN ALGORITHM Sketch → mark origin → draw incident-light arrow → assign signs → write formula → substitute with signs → interpret the answer.

8. Mirror formula and geometric derivation

BIG IDEA The formula connects object distance, image distance and focal length.

BOARD FORMULA $1/f = 1/v + 1/u$ and $m = h_i/h_o = -v/u$

Concept-enrichment derivation (not required for the 2026–27 board assessment): For a small-aperture concave mirror, use two paraxial rays from the top B of object AB. Let image be A'B'. From similar triangles ABP and A'B'P, $h_i/h_o = -v/u$. A second pair of similar triangles formed by a ray parallel to the axis and reflected through F gives $h_i/h_o = (f - v)/f$ under a consistent directed-distance treatment. Equating the two ratios and simplifying gives $uv = f(u + v)$, hence $1/f = 1/u + 1/v$. The algebraic signs automatically distinguish real and virtual images.

The relation $f = R/2$ follows for paraxial rays by considering a ray close to the axis striking the spherical mirror at M. CM is normal; the small angles made by CM with the axis and by the incident/reflected rays lead to $MP/FP \approx 2MP/CP$, hence $CP \approx 2FP$ and $R = 2f$.

DO NOT WRITE Do not replace signed distances with magnitudes midway. A negative image height is not “negative size”; it encodes inversion.

9. Mirror numericals: from routine to reasoning

BIG IDEA A reliable solution carries units, signs and a physical interpretation.

Worked Example 1

An object is 30 cm in front of a concave mirror of focal length 15 cm. Find image position and magnification.

METHOD $u = -30$ cm, $f = -15$ cm. $1/v = 1/f - 1/u = -1/15 + 1/30 = -1/30$, so $v = -30$ cm. $m = -v/u = -(-30)/(-30) = -1$.

Answer: Image forms 30 cm in front; real, inverted, same size.

Worked Example 2

A convex mirror has $f = +20$ cm and an object at $u = -30$ cm.

METHOD $1/v = 1/20 - (-1/30) = 1/12$, so $v = +12$ cm. $m = -12/(-30) = +0.40$.

Answer: Virtual, erect image 12 cm behind mirror, 0.40 times the object.

Worked Example 3

A concave mirror forms a real image three times the object at $v = -60$ cm. Find u and f .

METHOD $m = -3 = -v/u \Rightarrow v/u = 3 \Rightarrow u = -20$ cm. Then $1/f = -1/60 - 1/20 = -4/60$, so $f = -15$ cm.

Answer: $u = -20$ cm; $f = -15$ cm.

10. Brain-Twister workshop: mirrors

BIG IDEA Reverse the problem, compare possibilities, and test limiting cases.

Worked Example 4

A concave mirror forms an image twice the object. Find possible object positions in terms of f .

METHOD Case 1 real/inverted: $m = -2 = -v/u \Rightarrow v = 2u$. Substitute: $1/f = 1/(2u) + 1/u = 3/(2u)$, hence $u = 3f/2$. Case 2 virtual/erect: $m = +2 \Rightarrow v = -2u$. Thus $1/f = -1/(2u) + 1/u = 1/(2u)$, hence $u = f/2$. Since $f < 0$, both u values are physically in front.

Answer: Two positions: $u = 3f/2$ (real enlarged) and $u = f/2$ (virtual enlarged).

Worked Example 5

An object approaches a concave mirror from far away and crosses F . Describe v and m without calculating every point.

METHOD At infinity, $v \approx f$ and image is tiny. As object approaches F from outside, $|v|$ and $|m|$ grow to infinity. Just inside F , v changes sign and is very large positive; moving toward P makes the virtual image approach P and magnification decrease toward 1.

Answer: A discontinuity at the focal position separates real and virtual regimes.

- Prove mathematically that a convex mirror always gives $0 < m < 1$ for any real object.
- Can a concave mirror form a diminished virtual image of a real object? Justify with rays and formula.
- A student obtains $v = +25$ cm for a concave mirror. What must be true about the object position?

11. Experimental setup I: focal length of a concave mirror

BIG IDEA A distant object supplies nearly parallel rays; its sharp image forms near F .

CHAPTER 1

Life Processes

Life sustains itself through nutrition, respiration, transport and excretion.

TOPPER FORMULA LEARNING ROUTE

1. What keeps a living body alive?

BIG IDEA Life is continuous maintenance, even when no visible movement occurs.

A sleeping child, a germinating seed and a motionless tree are alive because organised chemical reactions continue inside their cells. These maintenance activities are life processes. Nutrition supplies raw materials and energy-rich food; respiration releases usable energy; transport delivers substances and collects wastes; excretion removes metabolic wastes and helps maintain a stable internal environment.

Process	Core question	Everyday evidence
Nutrition	Where do matter and energy-rich molecules come from?	Eating; a plant grows toward light
Respiration	How is usable cellular energy released?	Breathing rate rises during exercise
Transport	How do distant cells receive and send materials?	Pulse; wilting after xylem damage
Excretion	How are metabolic wastes removed?	Urine formation; leaf fall/resin

MEMORY: N-R-T-E Nutrition Receives, Respiration Releases, Transport Transfers, Excretion Eliminates.

The Living City Challenge

BIG IDEA Imagine shrinking until you can travel through a living body.

A living organism behaves like a self-repairing city. Food factories prepare or process raw material. Power stations release usable energy. Roads and pipelines deliver supplies. Treatment plants remove dangerous wastes. But unlike a city, every “building” is a cell and every pathway is controlled by membranes, enzymes and concentration differences. Throughout this chapter, ask one question: how does each structure solve a transport or exchange problem?

FOUR MISSION QUESTIONS FACTORY: how is food obtained? • POWER: how is ATP produced? • DELIVERY: how do materials reach cells? • CLEAN-UP: how are wastes removed?

Why visible movement is not enough

A dormant seed and a sleeping person are alive although obvious movement may be absent. At the molecular scale, substances continuously move, react, repair membranes and replace damaged components. Viruses show no independent cellular maintenance outside a host, which is one reason their living status is debated.

Why diffusion fails in a large body

Diffusion is effective only over very short distances. In a unicellular organism, the entire surface contacts the surroundings. In a large multicellular organism, most cells lie far from the surface and cellular demand is high; specialised exchange surfaces and bulk transport are therefore essential.

2. Nutrition: building and fuelling the body

BIG IDEA Food provides energy, raw materials and molecules for regulation.

Organisms differ in how they obtain food. Autotrophs manufacture organic food from simple inorganic substances using an external energy source. Green plants are photoautotrophs. Heterotrophs depend directly or indirectly on other organisms. Holozoic nutrition includes ingestion, digestion, absorption, assimilation and egestion; saprotrophs digest outside the body; parasites obtain food from a living host.

Mode	Method	Examples
Autotrophic	CO_2 + water $\rightarrow$ food using light/chlorophyll	green plants, algae
Holozoic	ingest and digest food internally	human, Amoeba
Saprotrophic	secrete enzymes; absorb soluble products	mushroom, bread mould
Parasitic	take nutrients from living host	Cuscuta, tapeworm, lice

Micro-world nutrition: Amoeba and Paramecium

BIG IDEA Body design determines the method of feeding.

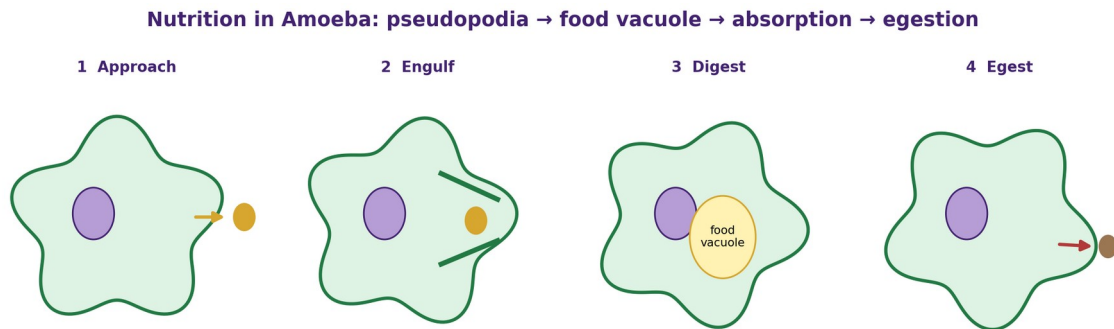


Figure 1. Holozoic nutrition in Amoeba.

Amoeba forms temporary finger-like pseudopodia around food. Their tips meet and enclose the particle in a food vacuole. Enzymes digest complex food, soluble products diffuse into cytoplasm and the undigested residue is expelled from any convenient point on the surface. Paramecium has a definite shape; coordinated cilia sweep food to a fixed oral groove. Both are unicellular, yet their feeding machinery differs.

MEMORY: I-D-A-A-E Ingestion → Digestion → Absorption → Assimilation → Egestion. "I Digest And Absorb Energy."

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