

1. CHEMICAL REACTIONS AND EQUATIONS

1. KEY DEFINITIONS & TERMS (NCERT)

- Chemical Reaction:** A process where the initial substance changes its nature and identity by breaking/making bonds between atoms.
- Skeletal Equation:** An unbalanced chemical equation that represents a reaction without equalizing atoms on both sides.
- Balanced Chemical Equation:** An equation where the number of atoms of each element is equal on both sides to satisfy the **Law of Conservation of Mass**.
- Precipitate:** An insoluble solid formed during a reaction in a solution.
- Exothermic/Endothermic:** Exothermic reactions **release** heat (e.g., respiration); endothermic reactions **absorb** energy (heat, light, or electricity).
- Redox Reaction:** A reaction involving simultaneous oxidation (gain of O/loss of H) and reduction (loss of O/gain of H).
- Corrosion/Rancidity:** Damage to metals by moisture/acids (Corrosion) and oxidation of fats/oils in food (Rancidity).

2. IMPORTANT CHEMICAL EQUATIONS

- Combination:** $\text{CaO}(\text{s}) + \text{H}_2\text{O}(\text{l}) \longrightarrow \text{Ca}(\text{OH})_2(\text{aq}) + \text{Heat}$ (Quick Lime to Slaked Lime).
- Thermal Decomposition:** $2\text{Pb}(\text{NO}_3)_2(\text{s}) \xrightarrow{\Delta} 2\text{PbO}(\text{s}) + 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$ (**Brown fumes** of NO_2).
- Photolytic Decomposition:** $2\text{AgCl}(\text{s}) \xrightarrow{\text{Sunlight}} 2\text{Ag}(\text{s}) + \text{Cl}_2(\text{g})$ (White to grey; used in photography).
- Displacement:** $\text{Fe}(\text{s}) + \text{CuSO}_4(\text{aq}) \longrightarrow \text{FeSO}_4(\text{aq}) + \text{Cu}(\text{s})$ (Blue solution turns green).
- Double Displacement:** $\text{Na}_2\text{SO}_4(\text{aq}) + \text{BaCl}_2(\text{aq}) \longrightarrow \text{BaSO}_4(\text{s}) + 2\text{NaCl}(\text{aq})$ (**White precipitate**).
- Respiration (Exothermic):** $\text{C}_6\text{H}_{12}\text{O}_6(\text{aq}) + 6\text{O}_2(\text{aq}) \longrightarrow 6\text{CO}_2(\text{aq}) + 6\text{H}_2\text{O}(\text{l}) + \text{energy}$.

3. OBSERVATIONS

Reaction Indicators: Change in state, Change in color, Evolution of gas, Change in temperature.

Metal Corrosion	Coating Color
Iron	Reddish-brown (Rust)
Silver	Black
Copper	Green

4. EXAM SHORTCUTS & MNEMONICS

- Max Atom Rule:** Start balancing with the molecule having the **most atoms**.
- OIL RIG:** Oxidation Is Loss (of H), Reduction Is Gain (of H).
- Inert Packing:** Chips are flushed with **Nitrogen** to prevent oxidation/rancidity.

5. EXAM IMPORTANCE NOTES

- **2–3 Marks:** Balancing equations and identifying reaction types.
- **Observation Based:** Burning Mg (**dazzling white flame**), heating FeSO₄ (**burning sulphur smell**).
- **Board Favorite:** Why decomposition is the opposite of combination.

2.ACIDS, BASES AND SALTS

1. KEY DEFINITIONS & TERMS (NCERT)

- Acids/Bases:** Acids furnish H^+ (aq) ions (sour); Bases furnish OH^- (aq) ions (bitter/soapy).
- Alkali:** A base that is soluble in water, such as NaOH or KOH.
- Olfactory Indicators:** Substances whose **odour** changes in acidic or basic media, e.g., onion, vanilla, clove.
- Neutralisation:** Reaction between an acid and a base to produce salt and water: $\text{H}^+ + \text{OH}^- \longrightarrow \text{H}_2\text{O}$.
- Water of Crystallisation:** Fixed number of water molecules chemically combined in one formula unit of a salt.

2. IMPORTANT CHEMICAL EQUATIONS

- Acid + Metal:** $\text{Zn(s)} + \text{H}_2\text{SO}_4(\text{aq}) \longrightarrow \text{ZnSO}_4(\text{aq}) + \text{H}_2(\text{g})\uparrow$ (Test: Pop sound).
- Base + Metal:** $2\text{NaOH(aq)} + \text{Zn(s)} \longrightarrow \text{Na}_2\text{ZnO}_2(\text{s}) + \text{H}_2(\text{g})\uparrow$ (**Sodium Zincate**).
- Carbonates + Acid:** $\text{Na}_2\text{CO}_3(\text{s}) + 2\text{HCl(aq)} \longrightarrow 2\text{NaCl(aq)} + \text{H}_2\text{O(l)} + \text{CO}_2(\text{g})\uparrow$ (CO_2 turns lime water milky).
- Chlor-Alkali Process:** $2\text{NaCl(aq)} + 2\text{H}_2\text{O(l)} \xrightarrow{\text{elect.}} 2\text{NaOH(aq)} + \text{Cl}_2(\text{g}) + \text{H}_2(\text{g})$.
- Baking Soda to Washing Soda:** $2\text{NaHCO}_3 \xrightarrow{\Delta} \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$ then recrystallization.
- Plaster of Paris (POP):** $\text{CaSO}_4 \cdot 2\text{H}_2\text{O} \xrightarrow{373\text{K}} \text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O} + 1\frac{1}{2}\text{H}_2\text{O}$.

3. TABLES

Common Indicators:

Indicator	Color in Acid	Color in Base
Litmus	Red	Blue
Phenolphthalein	Colorless	Pink
Methyl Orange	Red	Yellow

Natural Acids: Vinegar (Acetic), Curd (Lactic), Lemon (Citric), Ant sting (Methanoic).

4. IMPORTANT LAWS & FORMULAE

- pH Scale:** Measures H^+ concentration (0–14). $\text{pH} < 7$ is Acidic; $\text{pH} > 7$ is Basic; $\text{pH} = 7$ is Neutral.
- Dilution Rule: Always add Acid to Water (A → W)** slowly with stirring; never water to acid to prevent splashing/burns.

5. EXAM SHORTCUTS & MNEMONICS

- ABR:** Acid turns Blue to Red.
- pH vs $[\text{H}^+]$:** Inverse relationship—>Higher $[\text{H}^+]$ concentration = Lower pH.
- POP Storage:** Must be kept in **moisture-proof** containers to avoid turning into hard Gypsum.

6. EXAM IMPORTANCE NOTES

- **Application:** Antacids (Milk of Magnesia) neutralize excess stomach acid.
- **pH values:** Tooth decay starts below **5.5**; Acid rain is below **5.6**.

3. METALS AND NON-METALS

1. PHYSICAL PROPERTIES & EXCEPTIONS (NCERT)

- Properties:** Metals are lustrous, malleable (beaten into sheets), and ductile (drawn into wires). They are sonorous and good conductors of heat/electricity.
- Exceptions:** Mercury is liquid at room temp. Sodium/Potassium/Lithium are soft (cut with knife). Iodine is a lustrous non-metal. Diamond (Carbon) is the hardest natural substance. Graphite (Carbon) conducts electricity.

2. KEY DEFINITIONS (METALLURGY & BONDING)

- Amphoteric Oxides:** Metal oxides reacting with both acids and bases (e.g., Al_2O_3 , ZnO).
- Reactivity Series:** Arrangement of metals in decreasing order of activity.
- Ionic Compounds:** Formed by electron transfer from metal to non-metal.
- Roasting/Calcination:** Roasting: Heating sulphide ores in excess air. Calcination: Heating carbonate ores in limited air.
- Anodising:** Forming a thick protective oxide layer on aluminium.

3. IMPORTANT CHEMICAL EQUATIONS

- Amphoteric Reaction:** $\text{Al}_2\text{O}_3 + 2\text{NaOH} \longrightarrow 2\text{NaAlO}_2$ (Sod· Aluminate) + H_2O .
- Metal + Water:** $2\text{K(s)} + 2\text{H}_2\text{O(l)} \longrightarrow 2\text{KOH(aq)} + \text{H}_2\text{(g)} + \text{Heat(Violent)}$.
- Steam on Iron:** $3\text{Fe(s)} + 4\text{H}_2\text{O(g)} \longrightarrow \text{Fe}_3\text{O}_4\text{(s)} + 4\text{H}_2\text{(g)}$.
- Thermit Reaction:** $\text{Fe}_2\text{O}_3\text{(s)} + 2\text{Al(s)} \longrightarrow 2\text{Fe(l)} + \text{Al}_2\text{O}_3\text{(s)} + \text{Heat}$.
- Roasting (ZnS):** $2\text{ZnS} + 3\text{O}_2 \xrightarrow{\Delta} 2\text{ZnO} + 2\text{SO}_2$.
- Calcination (ZnCO}_3\text{:}** $\text{ZnCO}_3 \xrightarrow{\Delta} \text{ZnO} + \text{CO}_2$.

4. TABLES

Properties of Ionic Compounds:

Property	Characteristic	Reason
Melting Point	Very High	Strong inter-ionic attraction
Solubility	Soluble in water	Polar nature
Conduction	Molten/Aqueous only	Ions are free to move

5. EXAM SHORTCUTS & MNEMONICS

- **Reactivity Series:** Please Stop Calling Me A Cute Zebra I Like Her Call Smart Goat (K, Na, Ca, Mg, Al, C, Zn, Fe, Pb, H, Cu, Ag, Au).
- **Aqua Regia:** 3:1 ratio of conc. HCl and conc. HNO₃; dissolves gold/platinum.
- **Rust Prevention:** Galvanisation (Zinc coating), Alloying (Stainless steel: Fe+Ni+Cr).

6. EXAM IMPORTANCE NOTES

- **Frequent:** Differences between Roasting and Calcination.
- **Conceptual:** Why H₂ is not evolved with HNO₃ (it is a strong oxidising agent).
- **Practical:** Arrangement of metals by displacement reactions.

4. CARBON AND ITS COMPOUNDS

1. KEY DEFINITIONS & TERMS (NCERT)

- **Covalent Bond:** A bond formed by **sharing** electron pairs between atoms. Carbon forms these because losing/gaining 4 electrons is energy-intensive.
- **Catenation:** Carbon's unique ability to form long chains, branches, or rings by bonding with other carbon atoms.
- **Tetravalency:** Carbon has four valence electrons, allowing it to bond with four other atoms.
- **Homologous Series:** A series of compounds with the same functional group where successive members differ by a $\text{--CH}_2\text{--}$ unit (14u mass).
- **Structural Isomers:** Compounds with the same molecular formula but different structural arrangements.
- **Heteroatom:** An atom (like O, N, S, or halogens) that replaces hydrogen in a hydrocarbon chain.

2. IMPORTANT CHEMICAL EQUATIONS

- **Combustion:** $\text{CH}_4 + 2\text{O}_2 \longrightarrow \text{CO}_2 + 2\text{H}_2\text{O} + \text{Heat} + \text{Light}$.
- **Oxidation:** $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{Alk. KMnO}_4 + \text{Heat}} \text{CH}_3\text{COOH}$ (Ethanol to Ethanoic acid).
- **Addition (Hydrogenation):** $\text{CH}_2=\text{CH}_2 + \text{H}_2 \xrightarrow{\text{Ni Catalyst}} \text{CH}_3-\text{CH}_3$ (Vegetable oil to fats).
- **Substitution:** $\text{CH}_4 + \text{Cl}_2 \xrightarrow{\text{Sunlight}} \text{CH}_3\text{Cl} + \text{HCl}$.
- **Esterification:** $\text{CH}_3\text{COOH} + \text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{Acid}} \text{CH}_3\text{COOCH}_2\text{CH}_3 + \text{H}_2\text{O}$.
- **Saponification:** Ester + NaOH \longrightarrow Alcohol + Sodium Salt of Carboxylic Acid.
- **Dehydration:** $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{Hot Conc. H}_2\text{SO}_4} \text{CH}_2=\text{CH}_2 + \text{H}_2\text{O}$.

3. TABLES

Hydrocarbon Classification:

Type	Bonding	General Formula	Reactivity
Alkanes	Single (Saturated)	$\text{C}_n\text{H}_{2n+2}$	Less Reactive
Alkenes	Double (Unsaturated)	C_nH_{2n}	More Reactive
Alkynes	Triple (Unsaturated)	$\text{C}_n\text{H}_{2n-2}$	More Reactive

Functional Groups: Alcohol ($-\text{OH}$), Aldehyde ($-\text{CHO}$), Ketone ($-\text{C}(=\text{O})-$), Carboxylic Acid ($-\text{COOH}$), Halo ($-\text{Cl}/-\text{Br}$).

4. EXAM SHORTCUTS & MNEMONICS

- **C-T Versatility:** Remember Catenation and Tetravalency as the dual reasons for millions of carbon compounds.
- **Flame Test:** Saturated = Clean blue flame; Unsaturated = Yellow sooty flame.
- **Micelle Rule:** Hydrophilic head (water-loving) and Hydrophobic tail (water-fearing/oil-loving).
- **Hard Water:** Soap + Hard Water ($\text{Ca}^{2+}/\text{Mg}^{2+}$ salts) = **Scum**.

5. EXAM IMPORTANCE NOTES

- **High Priority:** Drawing Electron Dot Structures for H₂, O₂, N₂, NH₃, CH₄, and CO₂.
- **Observation:** Ethanoic acid reacts with carbonates to evolve CO₂ which turns lime water milky.
- **Comparison:** Difference between soaps (biodegradable, scum in hard water) and detergents (non-biodegradable, effective in hard water).

5. LIFE PROCESSES

1. KEY TERMS & DEFINITIONS

- **Life Processes:** Collective maintenance jobs performed by living organisms even during inactivity.
- **Nutrition:** Transferring an external energy source (food) to the inside of the body.
- **Respiration:** Acquiring oxygen to break down food for cellular energy (ATP).
- **Transpiration:** Loss of water vapor from aerial parts of a plant.
- **Translocation:** Transport of soluble products of photosynthesis through the phloem.
- **Excretion:** Removal of harmful nitrogenous metabolic wastes from the body.

2. CORE PROCESSES / SEQUENCES

- **Photosynthesis:** Absorption of light (Chlorophyll) → Conversion (Light to Chemical) + Splitting of H₂O → Reduction of CO₂ to Carbohydrates.
- **Human Digestion:** Mouth (Salivary Amylase) → Oesophagus (Peristalsis) → Stomach (Pepsin/HCl) → Small Intestine (Villi absorption) → Large Intestine (H₂O absorption).
- **Glucose Breakdown (Cytoplasm → Pyruvate):**
 - **Aerobic (Mitochondria):** CO₂ + H₂O + Energy (High).
 - **Anaerobic (Yeast):** Ethanol + CO₂ + Energy.
 - **Lack of O₂ (Muscle):** Lactic Acid + Energy (Cramps).
- **Excretion Flow:** Nephron filtration → Selective re-absorption → Ureter → Bladder → Urethra.

3. TABLES / COMPARISONS

Feature	Arteries	Veins
Direction	Away from heart.	Toward the heart.
Wall Type	Thick, elastic (High Pressure).	Thin (Low Pressure).
Valves	Absent.	Present (Prevents backflow).

4. EXAM IMPORTANCE & TIPS

- **High Weightage:** Double circulation is necessary for birds/mammals to maintain body temperature.
- **Practical:** KOH is used in experiments to absorb CO₂.
- **Technical Detail:** Normal blood pressure is 120/80 mm of Hg.
- **Surface Area:** Alveoli (Lungs) and Villi (Intestine) both maximize area for exchange/absorption.

5. MNEMONICS & SHORTCUTS

- "**A-A**": Arteries carry blood Away.
- "**V-V**": Veins have Valves.
- "**Energy Currency**": ATP is the cell's battery.

6. CONTROL AND COORDINATION

1. KEY TERMS & DEFINITIONS

- **Receptors:** Nerve cell tips detecting stimuli (Gustatory: Taste; Olfactory: Smell).
- **Synapse:** The gap between neurons where electrical impulses become chemical signals.
- **Reflex Action:** Sudden, unconscious response to a stimulus.
- **Reflex Arc:** Pathway of impulse from receptor to effector via the spinal cord.
- **Tropic Movements:** Directional growth towards/away from a stimulus (e.g., light).

2. CORE PROCESSES / SEQUENCES

- **Nerve Impulse:** Dendrite (Acquisition) → Cell Body → Axon (Travel) → Nerve Ending (Chemical release).
- **Reflex Arc Sequence:** Stimulus → Receptor → Sensory Neuron → Spinal Cord → Motor Neuron → Effector (Muscle) → Response.
- **Phototropism (Auxin):** Light from one side → Auxin diffuses to shady side → Cells on shady side grow longer → Shoot bends toward light.
- **Feedback Mechanism (Insulin):** High blood sugar → Detected by Pancreas → More Insulin produced → Blood sugar falls → Insulin secretion reduced.

3. BRAIN & HORMONES

Part/Hormone	Region/Source	Key Function
Cerebrum	Fore-brain	Thinking, memory, sensory interpretation.
Cerebellum	Hind-brain	Precision of voluntary actions; Posture/Balance .
Medulla	Hind-brain	Involuntary: Blood pressure, salivation, vomiting.
Adrenaline	Adrenal Gland	Heart rate increases; blood diverted to skeletal muscles.
Abscisic Acid	Plant	Inhibits growth; causes wilting of leaves.

4. EXAM IMPORTANCE & TIPS

- **Protection:** Brain is in a **bony box** with fluid-filled shock absorbers; Spinal cord is in the **vertebral column**.
- **Plant Movement:** Sensitive plant (*Mimosa*) moves by changing water amount (swelling/shrinking), not growth.
- **Thyroxin:** Iodine is essential for its synthesis; deficiency causes Goitre (swollen neck).

5. MNEMONICS & SHORTCUTS

- "**C-C**": Cerebellum = Controls posture.
- "**M-M**": Medulla = Maintains involuntary/vital functions.
- "**Reflex Shortcut**": Formed in the spinal cord because the brain is too slow for emergencies.

7. HOW DO ORGANISMS REPRODUCE?

1. KEY TERMS & DEFINITIONS

- DNA Copying:** The basic event of reproduction using chemical reactions to create two genetic blueprint copies.
- Variation:** Inbuilt tendency for subtle differences during DNA copying; the basis for evolution and species survival.
- Placenta:** A disc-like tissue in the uterine wall providing nutrition and oxygen to the embryo.
- Menstruation:** Monthly cycle where the thickened uterine lining breaks down if fertilization does not occur.
- Puberty:** The period during adolescence when reproductive tissues begin to mature.

2. CORE PROCESSES / SEQUENCES

- DNA Copying Process:** DNA copy created → Additional cellular apparatus created → DNA copies separate → Cell divides into two.
- Why Reproduce?:** Not essential for individual survival, but necessary for the stability and existence of a species.
- Plant Fertilization:** Pollen on Stigma → Pollen tube grows through Style → Ovary → Male germ-cell fuses with Egg (Zygote).
- Post-Fertilization:** Zygote → Embryo; Ovule → Seed; Ovary → Fruit.
- DNA Stability:** Meiosis halves the chromosome number in germ-cells; fertilization restores the original DNA content in the progeny.

3. TABLES / COMPARISONS

Method	Organism	Key Feature
Binary Fission	<i>Amoeba</i>	Cell splits into two equal halves in any plane.
Multiple Fission	<i>Plasmodium</i>	One cell divides into many daughter cells simultaneously.
Fragmentation	<i>Spirogyra</i>	Body breaks into pieces; each grows into an individual.
Regeneration	<i>Planaria</i>	Specialized cells proliferate to grow whole body from cut parts.
Budding	<i>Yeast/Hydra</i>	An outgrowth develops and detaches from the parent.
Vegetative Prop.	<i>Bryophyllum</i>	New plants grow from roots, stems, or leaves.

Category	Method	Mechanism
Mechanical	Condoms	Blocks sperm; helps prevent STDs (HIV/Syphilis).
Chemical	Oral Pills	Changes hormonal balance to prevent egg release.
IUCD	Copper-T	Placed in uterus; prevents pregnancy but can cause irritation.
Surgical	Vasectomy/Tubectomy	Blocks vas deferens or fallopian tube to prevent gamete transfer.

4. IMPORTANT DIAGRAM POINTS

- **Flower (Fig 7.7): Stamen** (Male: Anther + Filament); **Pistil** (Female: Stigma + Style + Ovary).
- **Seed (Fig 7.9):** Contains **plumule** (future shoot) and **radicle** (future root).
- **Male System (Fig 7.10):** **Testes** in **scrotum** (lower temperature needed for sperm); **Urethra** is a common passage for sperm and urine.
- **Female System (Fig 7.11):** **Fallopian tube** (site of fertilization); **Uterus** (site of implantation and development).

5. EXAM IMPORTANCE & TIPS

- **Variation:** Vital for species survival against environmental changes like global warming.
- **Placenta Detail:** Villi on embryo side; blood spaces on mother side for exchange of glucose, O₂, and waste.
- **Testosterone:** Regulates sperm formation and secondary sexual characteristics in boys.
- **Tissue Culture:** Growing disease-free plants from a "callus" in an artificial medium.

6. MNEMONICS & SHORTCUTS

- "**B-V-L**": Bryophyllum = Vegetative buds on Leaves.
- "**S-S-S**": Sperm is Small and Swimmer (motile).
- "**A-V-U**": Anther has Pollen; Ovary has Ovules.
- "**P-P-P**": Placenta Provides Passage for nutrition.

8. HEREDITY

1. KEY TERMS & DEFINITIONS

- Heredity:** The process by which traits and characteristics are reliably inherited through reproduction.
- Variation:** Subtle differences in body design between individuals of the same species.
- Gene:** A section of DNA providing information for making one specific protein.
- Dominant Trait:** A trait expressed even if only a single copy (e.g., 'T') is present.
- Recessive Trait:** A trait expressed only when two identical copies (e.g., 'tt') are present.
- Chromosome:** Independent pieces of DNA; humans have 22 paired sets and 1 pair of sex chromosomes.

2. CORE PROCESSES / SEQUENCES

- Accumulation of Variation:** Original organism → Two individuals with subtle differences → Inherited differences + new differences in next generation.
- Monohybrid Cross (Height):** Parent (TT x tt) → F_1 (All Tt/Tall) → Self-pollination → F_2 (1/4 short 'tt', 3/4 tall 'TT' or 'Tt').
- Trait Expression Mechanism:** Gene (DNA) → Enzyme production → Enzyme efficiency → Hormone level → Characteristic (e.g., Height).
- DNA Stability:** Each parent contributes one gene set via germ cells → Combination restores normal chromosome number in progeny.

3. TABLES

Mendel's Monohybrid vs. Dihybrid Results

Cross Type	F_1 Generation	F_2 Phenotype Ratio	Key Conclusion
Monohybrid	All Tall	3:1 (Tall:Short)	Law of Dominance.
Dihybrid	All Round/Yellow	9:3:3:1	Independent Inheritance.

Sex Determination Strategies

Strategy	Mechanism	Example Organisms
Environmental	Temperature of fertilized eggs	Some reptiles.
Non-Genetic	Individuals can change sex	Snails.
Genetic	Inherited sex chromosomes (X, Y)	Human beings.

4. IMPORTANT DIAGRAM POINTS

- Diversity (Fig 8.1):** Shows inaccuracies in DNA copying create diversity over generations.
- Independent Inheritance (Fig 8.5):** New combinations (e.g., short/round) prove traits recombine independently.
- Sex Determination (Fig 8.6):** Females are XX; Males are XY. The **father** determines sex by contributing an X or Y.

5. EXAM IMPORTANCE & TIPS

- **High Weightage:** A trait in 60% of a population likely arose earlier than one in 10%.
- **35 Marks:** Independent inheritance is proven by "new combinations" in F_2 progeny.
- **Genetic Contribution:** Both parents contribute equal amounts of DNA to the child.

6. MNEMONICS & SHORTCUTS

- "**XY - Guy**": The Y chromosome is only in males and determines the boy.
- "**3:1 Physical**": 3:1 is what you *see* (Phenotype); 1:2:1 is the genetic makeup (Genotype).
- "**DNA → Protein → Trait**

9. LIGHT REFLECTION AND REFRACTION

1. KEY DEFINITIONS & LAWS (NCERT)

- Reflection of Light:** Process where a highly polished surface (mirror) reflects most incident light.
- Laws of Reflection:** (i) $\angle i = \angle r$. (ii) Incident ray, normal, and reflected ray lie in the same plane.
- Refraction of Light:** Change in direction of light when traveling obliquely between media.
- Snell's Law:** $\frac{\sin i}{\sin r} = \text{constant}$ (Refractive Index) for a given pair of media.
- Refractive Index (n):** Ratio of speed of light in vacuum (c) to speed in medium (v); $n = c/v$.
- Power of a Lens (P):** Reciprocal of focal length in meters ($P = 1/f$); unit is Dioptre (D).

2. IMPORTANT FORMULAE

Mirror Formula	$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$	$R = 2f$
Lens Formula	$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$	$P = \frac{1}{f} (\text{m})$
Magnification (m)	$m = \frac{h'}{h} = -\frac{v}{u}$ (Mirror)	$m = \frac{h'}{h} = \frac{v}{u}$ (Lens)
Refractive Index	$n_{21} = \frac{v_1}{v_2} = \frac{\sin i}{\sin r}$	$n_m = \frac{c}{v}$

3. IMAGE NATURE SUMMARY

- Concave Mirror / Convex Lens:** Usually Real & Inverted (RI). Forms Virtual & Erect (VE) and Enlarged image only when the object is between Pole(P) or optical center(O) and Focus(F).
- Convex Mirror / Concave Lens:** Always forms Virtual, Erect, and Diminished images regardless of object position.

4. DIAGRAM-BASED POINTS

- Ray Rules:**
 - (1) Parallel rays pass through F .
 - (2) Rays through F emerge parallel.
 - (3) Rays through C (mirrors) or O (lenses) return/pass undeviated.
- Lateral Displacement:** Emergent ray is parallel to incident ray but shifted sideward in a glass slab.

5. TEACHER SHORTCUTS & MNEMONICS

- Sign Convention:** u is **ALWAYS** negative. f is **Positive** for Convex, **Negative** for Concave.
- Nature:** "RI" (Real is Inverted) and "VE" (Virtual is Erect).
- Lens Power:** Total power $P = P_1 + P_2 + \dots$

6. EXAM IMPORTANCE MARKERS

- **Diagrams:** Concave mirror (object between $P - F$) and Convex lens are high-frequency 5-mark questions.
- **Application:** Convex mirrors provide a wider field of view for rear-view use.

11. THE HUMAN EYE AND THE COLOURFUL WORLD

1. KEY DEFINITIONS & LAWS (NCERT)

- Power of Accommodation:** The ability of the eye lens to adjust its focal length to see both nearby and distant objects clearly.
- Near Point (Least Distance of Distinct Vision):** The minimum distance (25 cm for a normal adult) to see objects without strain.
- Far Point:** The farthest distance visible clearly (Infinity for a normal eye).
- Dispersion:** The splitting of white light into its seven constituent colours (VIBGYOR) via a prism.
- Tyndall Effect:** Scattering of light by colloidal particles, making the light path visible.

2. IMPORTANT VALUES & DATA

Feature	Normal Eye Value
Eyeball Diameter	Approx. 2.3 cm
Near Point (D)	25 cm
Far Point	Infinity (∞)
Least Scattered Colour	Red (Longest wavelength)

3. VISION DEFECTS COMPARISON

Defect	Description	Causes	Correction
Myopia (Near-sighted)	Can't see far; image in front of retina.	Excessive lens curvature; eyeball elongation.	Concave Lens.
Hypermetropia (Far-sighted)	Can't see near; image behind retina.	Focal length too long; eyeball too small.	Convex Lens.
Presbyopia (Old-age)	Loss of accommodation power.	Weak ciliary muscles; rigid lens.	Bifocal Lenses.

4. PHENOMENA & DIAGRAM POINTS

- Prism Refraction:** Label Angle of Prism ($\angle A$) and Angle of Deviation ($\angle D$).
- Atmospheric Refraction:** Explains stars twinkling (point source) and why sun is seen 2 mins before actual sunrise.,
- Scattering:** Why sky is blue (fine particles scatter blue) and danger signals are red (least scattered).

5. TEACHER SHORTCUTS & EXAM MARKERS

- **Mnemonic:** "My Near Cave" (Myopia, Near-sighted, Concave).
- **Exclusion:** "Colour of sun at sunrise/sunset" is NOT for 2026 assessment.
- **Case-Based:** Eye donation (remove within 4-6 hours; one pair helps four people).

11. ELECTRICITY

1. KEY DEFINITIONS & LAWS (NCERT)

- **Electric Current (I):** The rate of flow of electric charges ($I = Q/t$).
- **Electric Potential Difference (V):** Work done to move a unit charge from one point to another ($V = W/Q$).
- **Ohm's Law:** The potential difference across a conductor is directly proportional to the current through it, provided temperature remains constant ($V \propto I$).
- **Resistance (R):** The property of a conductor to resist the flow of charges.
- **Resistivity (ρ):** A characteristic material property representing resistance per unit length and area.
- **Joule's Law of Heating:** Heat produced (H) is directly proportional to I^2 , R , and time t ($H = I^2 R t$).

2. IMPORTANT FORMULAE

Quantity	Formula	Symbols & Units
Current	$I = Q/t$	Q : Charge (C), t : Time (s)
Ohm's Law	$V = IR$	V : Potential (V), R : Resistance (Ω)
Resistivity	$R = \rho \frac{l}{A}$	l : Length (m), A : Area (m^2)
Electric Power	$P = VI = I^2 R = \frac{V^2}{R}$	Unit: Watt (W)
Electrical Energy	$E = P \times t$	Commercial unit: kWh (3.6×10^6 J)

3. SERIES vs. PARALLEL COMPARISON

Feature	Series Combination	Parallel Combination
Current (I)	Same through each resistor	Divided among branches
Voltage (V)	Divided ($V = V_1 + V_2 + V_3$)	Same across each resistor
Total Resistance	Increases ($R_s = R_1 + R_2 + R_3$)	Decreases ($1/R_p = \sum 1/R_i$)
Failure Effect	Circuit breaks if one component fails	Other components continue to work

4. DIAGRAM-BASED POINTS

- **Ammeter:** Always connected in **series**; measures current.
- **Voltmeter:** Always connected in **parallel** across points to measure V .
- **V-I Graph:** A straight line through the origin proves Ohm's Law.

5. TEACHER SHORTCUTS & MNEMONICS

- **MAT-L:** Factors affecting Resistivity/Resistance (Material, Area, Temperature, Length).
- **Parallel Shortcut:** For two resistors, $R_p = \frac{R_1 \times R_2}{R_1 + R_2}$ (Product over Sum).
- **Unit Conversion:** $1 \text{ mA} = 10^{-3} \text{ A}$ and $1 \mu\text{A} = 10^{-6} \text{ A}$.

6. EXAM IMPORTANCE MARKERS

- **Numerical-heavy:** Calculating equivalent resistance in complex circuits.
- **Conceptual:** Alloys (Nichrome) are used in heating elements because they have high resistivity and do not oxidise at high temperatures.

12. MAGNETIC EFFECTS OF ELECTRIC CURRENT

1. KEY DEFINITIONS & LAWS (NCERT)

- **Magnetic Field:** The region surrounding a magnet where its force can be detected.
- **Magnetic Field Lines:** Path along which a hypothetical free north pole would move; direction is North to South outside and South to North inside.
- **Right-Hand Thumb Rule:** Points thumb in current direction; wrapped fingers show magnetic field direction.
- **Solenoid:** A cylinder-shaped coil of many circular turns of insulated copper wire.
- **Fleming's Left-Hand Rule:** Mutually perpendicular Thumb (Force), Forefinger (Field), and Middle finger (Current).

2. FIELD PATTERNS & CHARACTERISTICS

- **Field Line Properties:** They are closed curves; they never intersect (otherwise two directions would exist at one point); closeness indicates field strength.
- **Straight Wire:** Field consists of concentric circles centred on the wire.
- **Solenoid:** Field inside is uniform (parallel straight lines) and similar to a bar magnet.
- **Electromagnet:** Formed by placing a soft iron core inside a current-carrying solenoid.

3. DOMESTIC ELECTRIC CIRCUITS

- **Supply:** 220 V potential difference and 50 Hz frequency AC power.
- **Wire Colors:** Live (Red), Neutral (Black), and Earth (Green).
- **Safety Devices:** **Fuse** (melts to break circuit during overloading/short-circuiting) and **Earth Wire** (prevents shocks from metallic bodies).
- **AC vs DC:** AC changes direction periodically; its main advantage is transmission over long distances without much energy loss.

4. TEACHER SHORTCUTS & MNEMONICS

- **Father-Mother-Child:** Fleming's Left-Hand Rule → Force, Magnetic Field, Current.
- **MRI Basis:** Weak ion currents in the heart and brain produce magnetic fields used for medical imaging.
- **Clock Face Rule:** Clockwise current = South pole; Anti-clockwise = North pole.

5. EXAM IMPORTANCE MARKERS

- **Force Magnitude:** Highest when current is at right angles (90°) to the magnetic field.
- **Diagram Compulsory:** Field lines around a bar magnet and a current-carrying solenoid.

13. OUR ENVIRONMENT

1. KEY TERMS & DEFINITIONS

- **Ecosystem:** Interaction between biotic (living) and abiotic (temperature, soil, wind) components.
- **Trophic Level:** Each step in a food chain where energy transfer occurs.
- **Biological Magnification:** Progressive accumulation of non-degradable chemicals (pesticides) at higher trophic levels, reaching maximum in humans.
- **Biodegradable:** Substances broken down by biological processes (bacteria/enzymes).
- **Non-biodegradable:** Inert substances (plastics) that persist and may harm the ecosystem.

2. CORE PROCESSES / SEQUENCES

- **Energy Flow:** Sunlight (1% captured by plants) → Producers → Primary Consumers → Secondary → Tertiary.
- **10% Law:** Only 10% of energy available at one level reaches the next; the rest is lost as heat or used for digestion/growth.
- **Ozone Formation:** High energy UV splits $O_2 \rightarrow O + O$. Then, $O + O_2 \rightarrow O_3$ (Ozone).
- **Unidirectional Flow:** Energy captured by autotrophs never reverts to solar input; energy moving to higher levels is no longer available to previous levels.

3. TABLES / COMPARISONS

Ecosystem Type	Examples	Origin
Natural	Forests, Ponds, Lakes	Nature-made.
Artificial	Gardens, Crop-fields, Aquariums	Human-made.

Level	Organism Type	Position
First	Producers (Autotrophs)	Base of the chain.
Second	Herbivores (Primary Consumers)	Second level.
Third/Fourth	Carnivores (Secondary/Tertiary)	Top levels.

4. IMPORTANT DIAGRAM POINTS

- **Food Web (Fig 13.3):** Branching lines showing how one organism is eaten by several others.
- **Energy Pyramid (Fig 13.2):** Narrows at the top as usable energy decreases at higher levels.
- **Ozone Shield:** Located in the stratosphere; shields Earth from damaging UV radiation.

5. EXAM IMPORTANCE & TIPS

- **Chain Length:** Food chains usually have only 3-4 steps because energy loss is too great to support more levels.
- **Ozone Depletion:** Linked to CFCs; 1987 UNEP agreement froze production to protect the atmosphere.
- **Decomposers:** Breakdown complex organic matter into simple inorganic substances for soil replenishment.
- **UV Effects:** Causes skin cancer and damage to organisms.

6. MNEMONICS & SHORTCUTS

- "**10% Rule**": Move up one level = Divide energy by 10.
- "**Uni-Energy**": Energy flow is a one-way street (Sun → Plant → Animal).
- "**CFC-Free**": Standard for refrigerators to prevent ozone holes.