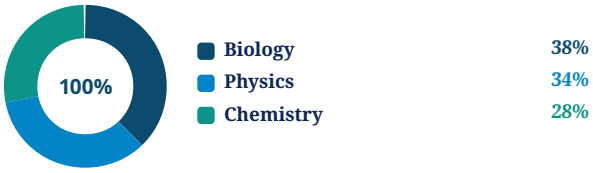
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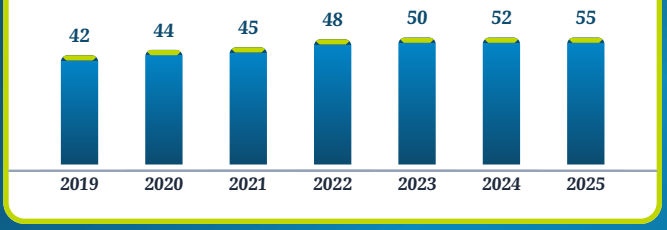
# COMPLETE GENERAL SCIENCE — NCERT PHYSICS, CHEMISTRY & BIOLOGY

SI Units, Mechanics, Gravitation, Heat, Optics, Sound, Electricity, Atomic Structure, Periodic Table, Chemical Bonding, Acids-Bases, Metals-Alloys, Carbon Compounds, Cell Biology, Human Organ Systems, Genetics & Diseases

### Topic-Wise Exam Weightage Distribution (%)




### Previous Years' Question Trend Analysis




### Target Competitive, Entrance & Departmental Examinations

**Railway ALP/Technician/NTPC/Group-D • SSC CGL/CHSL/MTS • NDA/CDS • UPPSC/BPSC/State PCS • Police • CTET Paper-2**

### Core Syllabus Pillars & Exam Question Weightage (%)

- Biology: Cytology, Human Organ Systems, Vitamins, Genetics & Diseases (38%)
- Physics: Units, Mechanics, Heat, Optics, Sound, Electricity & Magnetism (34%)
- Chemistry: Atomic Structure, Periodic Table, Acids-Bases, Metals & Polymers (28%)

**Complete Theory**
NCERT & Official Sources

**Visual Flowcharts**
Comparative Matrices

**Memory Tricks**
Exam Trap Alerts

**75+ Solved MCQs**
One-Liner Capsules

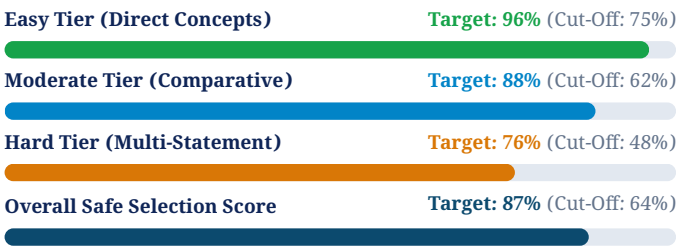
# Preface, Exam Weightage Dashboard & Study Strategy — COMPLETE GENERAL SCIENCE — NCERT PHYSICS, CHEMISTRY & BIOLOGY

IUC Academy (Inclusive Universal Careers Academy | www.iucacademy.com) • Official English Medium Study Notes

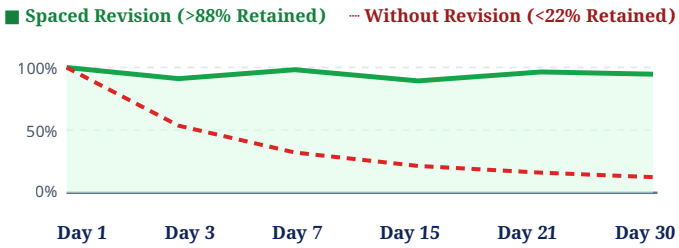
## Dear Aspirants,

Modern competitive, entrance, and departmental promotion examinations demand a combination of deep conceptual clarity, statutory precision, and rapid revision tools. Prepared by **Inclusive Universal Careers Academy (IUC Academy — www.iucacademy.com)**, these comprehensive English-medium study notes integrate **structured chapter theory, 4-node conceptual process flowcharts, multi-column comparative tables, inline mathematical/scientific formulas, 'Did You Know?' boxes, 'Exam Trap Alert' callouts, 'Memory Trick' mnemonics, Chapter-End Analytical Synthesis Matrices, 75+ Step-by-Step Solved MCQs, and Rapid-Fire One-Liner Revision Capsules**.

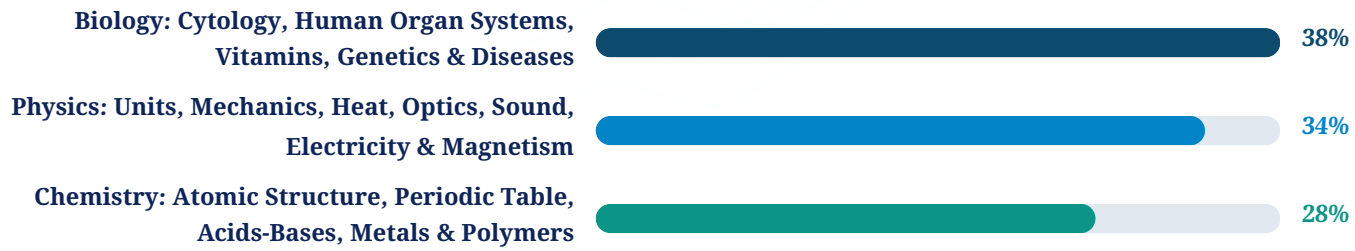
### Target Accuracy vs Qualifying Cut-Off Benchmark (%)




### Spaced Revision (1-3-7-21 Day Rule) & Retention Curve




### Topic-Wise Exam Question Weightage Index (%)




### Verified Official Curriculum & Statutory Reference Portals

- **NCERT Science Textbooks (Class 6–12)** (https://ncert.nic.in/textbook.php)
- **UPSC Official Portal** (https://upsc.gov.in/)
- **SSC Official Portal** (https://ssc.gov.in/)
- **IUC Academy Official Portal** (https://www.iucacademy.com)

# Detailed Table of Contents & Chapter Architecture

COMPLETE GENERAL SCIENCE — NCERT PHYSICS, CHEMISTRY & BIOLOGY • Complete Chapters, Comparative Matrices, Solved MCQs & Rapid Revision

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- 1.2 Kinematics, Newton's Laws of Motion, Work-Energy, and Gravitation

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**10. Extended Comparative & Analytical Practice Set (Questions 36–75)**

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# Chapter 1: SI Units, Dimensional Analysis, Kinematics, Newton Laws, Work-Energy & Gravitation

**Chapter Key Study Pillars — Chapter 1: SI Units, Dimensional Analysis, Kinematics, Newton Laws, Work-Energy & Gravitation**

**Key Study Pillar 1**
**Seven Fundamental SI Units, Dimensions, and Scalars vs. Vectors**

**Key Study Pillar 2**
**Kinematics, Newton's Laws of Motion, Work-Energy, and Gravitation**

## 1.1 Seven Fundamental SI Units, Dimensions, and Scalars vs. Vectors

• **The International System of Units (SI — 1971 CGPM):** As prescribed in NCERT Official Textbooks and taught on IUC Academy, all physical quantities are built upon 7 **Fundamental Base Quantities** and 2 **Supplementary Plane/Solid Angle Units**:

1. **Length: Metre (`m`)** — Dimension `[L]`.
2. **Mass: Kilogram (`kg`)** — Dimension `[M]`.
3. **Time: Second (`s`)** — Dimension `[T]`.
4. **Electric Current: Ampere (`A`)** — Dimension `[A]`.
5. **Thermodynamic Temperature: Kelvin (`K`)** — Dimension `[K]`.
6. **Amount of Substance: Mole (`mol`)** — Dimension `[mol]`.
7. **Luminous Intensity: Candela (`cd`)** — Dimension `[cd]`; while **Luminous Flux** is measured in **Lumen (`lm`)** and **Illuminance** in **Lux (`lx = lm/m^2`)**.

• **Supplementary Units (Dimensionless `[M^0 L^0 T^0]`): Plane Angle** = **Radian (`rad`)**; **Solid Angle** = **Steradian (`sr`)**.

• **Scalar vs. Vector Quantities (SSC Official Portal):**

• **Scalar Quantities (Magnitude only, no direction):** Distance, Speed, Mass, Time, Work, Energy, Power, Pressure, Electric Current, Electric Potential (Voltage), Resistance, Charge, Temperature, Frequency, Volume, and Density.

• **Vector Quantities (Magnitude + Direction + Vector Triangle Law):** Displacement, Velocity, Acceleration, Force, Linear Momentum (`p = mv`), *Impulse* (`J = F` t), Torque (`tau = r x F`), Angular Momentum, Weight (`W = m*g`), Electric Field, and Magnetic Field Intensity.

## 1.2 Kinematics, Newton's Laws of Motion, Work-Energy, and Gravitation

• **Equations of Uniformly Accelerated Motion & Projectile Motion:**

• First Equation: `v = u + at`; *Second Equation*: `s = u` t + (1/2)at^2; Third Equation: `v^2 - u^2 = 2as`; Distance in `nth` second: `S_n = u + (a/2)*(2n - 1)`.

• **Projectile Motion (Launched at angle `theta` with horizontal):** Time of Flight `T = (2usin(theta)) / g`; Maximum Height `H_max = (u^2 sin^2(theta)) / (2g)`; Horizontal Range `R = (u^2 sin(2theta)) / g`. **Maximum horizontal range** occurs at `theta = 45 degrees`, and ranges are identical for complementary launch angles `theta` **and** `(90 - theta)` (such as `30 degrees` and `60 degrees`).

• **Newton's Three Laws of Motion (NCERT Official Textbooks):**

• **First Law (Law of Inertia — Galileo):** Defines Force qualitatively; inertia is directly proportional to **Mass**.

• *Inertia of Rest*: Dust falls when a carpet is beaten; a coin on a card drops into a tumbler when flicked; passengers jerk backward when a bus starts suddenly.

• *Inertia of Motion*: Passengers jerk forward when a moving bus brakes suddenly; a long-jumper runs before taking a leap.

• **Second Law (`F = dp/dt = ma`):** *Rate of change of momentum is directly proportional to applied force.* ***Impulse*** **(`J = F Delta_t = Delta_p`)** explains why a cricket fielder pulls his hands backward while catching a fast ball (increasing `Delta_t` reduces impact force `F`).

• **Third Law (`F_12 = -F_21`):** Action and reaction forces are equal in magnitude, opposite in direction, and **always act on two different bodies** (recoil of a gun `m_1v_1 + m_2v_2 = 0`, rocket propulsion, swimming, walking).

• **Work, Kinetic Energy, Power, and Universal Gravitation:**

• **Work (`W = F s cos(theta)`):** Measured in **Joule (`1 J = 10^7 ergs`)**; work is **Zero** when `theta = 90 degrees` (such as a coolie walking horizontally carrying a load on his head, or centripetal force in circular motion).

• **Kinetic Energy & Momentum Relation:** `KE = (1/2)mv^2 = p^2 / (2m)` (`p = sqrt(2` m*KE)). If momentum `p` is doubled for a constant mass, Kinetic Energy becomes **4 times (`4x`)**!

• **Power:** `P = W / t = F v`; *SI unit =* ***Watt*** **(`J/s`)**; `1 Horsepower (HP) = 746 Watts`; *Commercial unit of electrical energy =* `1 kWh (1 Unit) = 3.6 10^6 Joules`.

• **Universal Gravitation (`F = Gm_1m_2 / r^2`):** `G = 6.67 10^-11 Nm^2/kg^2` (measured by Henry Cavendish). Acceleration due to gravity `g = G*M / R^2 = 9.8 m/s^2` is **maximum at the Poles, minimum at the Equator** (due to equatorial bulge `R_e > R_p` and centrifugal rotation), **decreases with both altitude (`h`) and depth (`d`)**, and is **Zero at the exact center of the Earth**.

• **Escape Velocity (`v_e = sqrt(2gR)`):** For Earth, `v_e = 11.2 km/s` (for the Moon, `v_e = 2.38 km/s`; for the Sun, `v_e = 618 km/s`), independent of the mass of the projected body!

**Step-by-Step Conceptual Process Flowchart**

| STEP 1 | STEP 2 | STEP 3 | STEP 4 |
|---|---|---|---|
| Force Applied on Mass m (F = m*a = dp/dt) | Displacement s Produces Work (W = Fscos(theta)) | Work Transfers Mechanical Energy (KE = p^2/2m, PE = mgh) | Rate of Work Delivers Power (P = W/t = F*v, 1 HP = 746 W) |

| Physical Quantity | Exact Formula | SI Unit & CGS Unit | Dimensional Formula ( [M L T] ) |
|---|---|---|---|
| Force & Weight | F = m *a* ; *W* = *m* g | Newton ( N ) ; Dyne ( 1 N = 10^5 dyne ) | [M^1 L^1 T^-2] |
| Work, Energy & Torque | W = F *s* cos(theta) ; tau = r * F | Joule ( J ) ; Erg ( 1 J = 10^7 erg ) | [M^1 L^2 T^-2] |
| Power | P = W / t = F * v | Watt ( W = J/s ) ( 1 HP = 746 W ) | [M^1 L^2 T^-3] |
| Pressure, Stress & Modulus | P = F / A | Pascal ( Pa = N/m^2 ) ( 1 Bar = 10^5 Pa ) | [M^1 L^-1 T^-2] |
| Linear Momentum & Impulse | p = m *v* ; *J* = *F* t = Delta_p | *kgm/s* ( *N* s) | [M^1 L^1 T^-1] |
| Gravitational Constant ( G ) | G = F *r*^2 / (*m*_1 m_2) | N*m*^2/*kg*^2 ( 6.67 10^-11) | [M^-1 L^3 T^-2] |

**Did You Know?:** A **Geostationary Satellite** orbits in the equatorial plane from West to East with an orbital period of exactly **24 hours** at an altitude of **35,786 km** ( **~36,000 km** ) above Earth's surface, appearing stationary relative to any fixed point on Earth (NCERT Official Textbooks).

**Exam Trap Alert: Electric Current ( Ampere )** and **Pressure ( Pascal )** both have directions associated with flow/force in circuits and fluids, yet both are **Scalar Quantities** because they obey simple algebraic addition rather than the triangle law of vector addition!

★ **Memory Trick:** For **Apparent Weight in a Lift ( R )**, remember **"U-A-Plus, D-A-Minus, Free-Zero"**: accelerating Upward -> **R = m(*g* + *a*)** (*heavier*); *accelerating **D**ownward* -> ***R* = *m*** (g - a) (lighter); **Free** fall ( **a = g** ) -> **R = 0** (weightlessness) (IUC Academy).

## Chapter *1* Comprehensive Analytical & Statutory Revision Matrix

| Core Sub-Domain | Key Concept / Provision | Verified Analytical Parameters & Exam Distinctions (NCERT Science Textbooks (Class 6–12)) |
|---|---|---|
| Seven Fundamental SI Units, Dimensions, and Scalars vs. Vectors | The International System of Units (SI — *1971* CGPM) | As prescribed in NCERT Official Textbooks and taught on IUC Academy, all physical quantities are built upon 7 **Fundamental Base Quantities** and **2 Supplementary Plane/Solid Angle Units |
| Kinematics, Newton's Laws of Motion, Work-Energy, and Gravitation | Length | Metre ( **m** )** — Dimension **[L]**. |
| Seven Fundamental SI Units, Dimensions, and Scalars vs. Vectors | Mass | Kilogram ( **kg** )** — Dimension **[M]**. |

| Core Sub-Domain | Key Concept / Provision | Verified Analytical Parameters & Exam Distinctions (NCERT Science Textbooks (Class 6–12)) |
|---|---|---|
| Kinematics, Newton's Laws of Motion, Work-Energy, and Gravitation | Time | Second ( s )** — Dimension [T]. |
| Seven Fundamental SI Units, Dimensions, and Scalars vs. Vectors | Electric Current | Ampere ( A )** — Dimension [A]. |
| Kinematics, Newton's Laws of Motion, Work-Energy, and Gravitation | Thermodynamic Temperature | Kelvin ( K )** — Dimension [K]. |
| Seven Fundamental SI Units, Dimensions, and Scalars vs. Vectors | Amount of Substance | Mole ( mol )** — Dimension [mol]. |
| Kinematics, Newton's Laws of Motion, Work-Energy, and Gravitation | Luminous Intensity | Candela ( cd ) — **Dimension** [cd]; **while** Luminous Flux **is measured in** Lumen ( lm ) **and** Illuminance **in** Lux ( lx = lm/m^2 )**. |
| Seven Fundamental SI Units, Dimensions, and Scalars vs. Vectors | Supplementary Units (Dimensionless [M^0 L^0 T^0]) | Plane Angle = Radian ( rad ); Solid Angle = Steradian ( sr )**. |
| Kinematics, Newton's Laws of Motion, Work-Energy, and Gravitation | Scalar Quantities (Magnitude only, no direction) | Distance, Speed, Mass, Time, Work, Energy, Power, Pressure, Electric Current, Electric Potential (Voltage), Resistance, Charge, Temperature, Frequency, Volume, and Density. |
| Seven Fundamental SI Units, Dimensions, and Scalars vs. Vectors | Vector Quantities (Magnitude + Direction + Vector Triangle Law) | Displacement, Velocity, Acceleration, Force, Linear Momentum ( p = mv ), *Impulse* ( J = F t), Torque ( tau = r x F ), Angular Momentum, Weight ( W = m*g ), Electric Field, and Magnetic Field Intensity. |
| Kinematics, Newton's Laws of Motion, Work-Energy, and Gravitation | Projectile Motion (Launched at angle theta with horizontal) | Time of Flight T = (2usin(theta)) / g; Maximum Height H_max = (u^2 sin^2(theta)) / (2g); Horizontal Range R = (u^2 sin(2theta)) / g. **Maximum horizontal range** occurs at theta = 45 degrees, and ranges are identical for complementary launch angles theta **and** (90 - theta) (such as 30 degrees and 60 degrees). |

| Core Sub-Domain | Key Concept / Provision | Verified Analytical Parameters & Exam Distinctions (NCERT Science Textbooks (Class 6–12)) |
|---|---|---|
| **Seven Fundamental SI Units, Dimensions, and Scalars vs. Vectors** | **First Law (Law of Inertia — Galileo)** | Defines Force qualitatively; inertia is directly proportional to **Mass**. |
| **Kinematics, Newton's Laws of Motion, Work-Energy, and Gravitation** | **Second Law (`F = dp/dt = m*a`)** | Rate of change of momentum is directly proportional to applied force. **Impulse (`J = F*Delta_t = Delta_p`)** explains why a cricket fielder pulls his hands backward while catching a fast ball (increasing `Delta_t` reduces impact force `F`). |

## Chapter *1* Multi-Statement Exam Verification Drills

**Chapter 1 Statement-Verification Drill #1** — Both Statements Verified Correct

**Statement-I (The International System of Units (SI — 1971 CGPM)):** As prescribed in NCERT Official Textbooks and taught on IUC Academy, all physical quantities are built upon 7 **Fundamental Base Quantities** and **2 Supplementary Plane/Solid Angle Units

**Statement-II (Length):** Metre (`m`)** — Dimension `[L]`.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 1 Statement-Verification Drill #2** — Both Statements Verified Correct

**Statement-I (Mass):** Kilogram (`kg`)** — Dimension `[M]`.

**Statement-II (Time):** Second (`s`)** — Dimension `[T]`.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 1 Statement-Verification Drill #3** — Both Statements Verified Correct

**Statement-I (Electric Current):** Ampere (`A`)** — Dimension `[A]`.

**Statement-II (Thermodynamic Temperature):** Kelvin (`K`)** — Dimension `[K]`.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 1 Statement-Verification Drill #4** — Both Statements Verified Correct

**Statement-I (Amount of Substance):** Mole (`mol`)** — Dimension `[mol]`.

**Statement-II (Luminous Intensity):** Candela (`cd`) — **Dimension** `[cd]`; **while** Luminous Flux **is measured in** Lumen (`lm`) **and** Illuminance **in** Lux (`lx = lm/m^2`)**.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 1 Statement-Verification Drill #5** — Both Statements Verified Correct

**Statement-I (Supplementary Units (Dimensionless `[M^0 L^0 T^0]`)):** Plane Angle = Radian (`rad`); Solid Angle = Steradian (`sr`)**.

**Statement-II (Scalar Quantities (Magnitude only, no direction)):** Distance, Speed, Mass, Time, Work, Energy, Power, Pressure, Electric Current, Electric Potential (Voltage), Resistance, Charge, Temperature, Frequency, Volume, and Density.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 1 Statement-Verification Drill #6** — Both Statements Verified Correct

**Statement-I (Vector Quantities (Magnitude + Direction + Vector Triangle Law)):** Displacement, Velocity, Acceleration, Force, Linear Momentum (`p = mv`), *Impulse* (`J = F` t), Torque (`tau = r x F`), Angular Momentum, Weight (`W = m*g`), Electric Field, and Magnetic Field Intensity.

**Statement-II (Projectile Motion (Launched at angle `theta` with horizontal)):** Time of Flight `T = (2usin(theta)) / g`; Maximum Height `H_max = (u^2 sin^2(theta)) / (2g)`; Horizontal Range `R = (u^2 sin(2theta)) / g`. **Maximum horizontal range** occurs at `theta = 45 degrees`, and ranges are identical for complementary launch angles `theta` and `(90 - theta)` (such as `30 degrees` and `60 degrees`).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

# Chapter 2: Properties of Matter, Thermodynamics, Wave Motion, Sound & Geometrical Optics

**Chapter Key Study Pillars — Chapter 2: Properties of Matter, Thermodynamics, Wave Motion, Sound & Geometrical Optics**

**Key Study Pillar 1**
**Fluid Mechanics, Surface Tension, Viscosity, and Thermodynamics**

**Key Study Pillar 2**
**Sound Waves, Mirrors, Lenses, Refraction, and Human Eye Defects**

## 2.1 Fluid Mechanics, Surface Tension, Viscosity, and Thermodynamics

• **Fluid Pressure, Pascal's Law, and Archimedes' Principle (NCERT Official Textbooks):**

• **Pascal's Law:** Pressure applied to an enclosed incompressible fluid is transmitted undiminished in all directions — forms the working principle of **Hydraulic Lifts, Hydraulic Brakes, and Hydraulic Presses**.

• **Archimedes' Principle & Buoyancy:** A body immersed in a fluid experiences an upward buoyant force equal to the weight of the fluid displaced. An iceberg floats in seawater with roughly `1/10th` (`~11%`) **of its volume above water** and `9/10th` (`~89%`) **submerged**; when a floating ice cube melts in a glass filled to the brim with pure water, the **water level remains unchanged**!

• **Bernoulli's Theorem (`P + (1/2)rhov^2 + rhogh = Constant`):** Based on **Conservation of Energy**; high fluid velocity produces low static pressure — explains **dynamic lift of an aircraft wing (aerofoil)**, spinning of a cricket ball (**Magnus Effect**), atomizer/sprayer action, and why tin roofs blow off during cyclones.

• **Surface Tension (`T = F / L`, unit `N/m`) & Capillarity:**

• Raindrops and mercury droplets are spherical because **Surface Tension minimizes surface area** for a given volume.

• Adding detergent, soap, kerosene oil, or heating water **decreases surface tension** (that is why hot soup tastes better and kerosene sprayed on stagnant water drowns mosquito larvae!).

• **Capillarity:** Rising of oil in a lamp wick, absorption of ink by blotting paper, and transport of subsurface water in soil capillaries.

• **Thermodynamics & Anomalous Expansion of Water (IUC Academy):**

• **Temperature Conversion Formula:** `C / 5 = (F - 32) / 9 = (K - 273.15) / 5`. Note that `-40 degrees C = -40 degrees F` (identical reading on Celsius and Fahrenheit scales!), normal human body temperature is `37 degrees C = 98.6 degrees F = 310.15 K`, and **Absolute Zero is** `0 K = -273.15 degrees C`.

• **Anomalous Expansion of Water (** `0 degrees C to 4 degrees C` **):** When water is heated from `0 degrees C` to `4 degrees C`, its **volume decreases** and its **density increases**, reaching **maximum density (** `1,000 kg/m^3` **or** `1 g/cm^3` **) at exactly** `4 degrees C`!

## *2.2* Sound Waves, Mirrors, Lenses, Refraction, and Human Eye Defects

• **Acoustics and Sound Waves:**

• Sound is a **longitudinal mechanical wave** (cannot travel through a vacuum!). Speed of sound is **maximum in Solids (** `Steel ~5,960 m/s` **or** `Aluminium ~6,420 m/s` **) > Liquids (** `Water ~1,498 m/s` **) > Gases (** `Air ~331 m/s at 0 degrees C`, `343 m/s at 20 degrees C` **)**.

• **Frequency Ranges: Infrasonic (** `<20 Hz` **):** Earthquakes, elephants, whales; **Audible (** `20 Hz to 20,000 Hz` / `20 kHz` **):** Human ear; **Ultrasonic (** `>20,000 Hz` **):** Bats, dolphins, SONAR, echocardiography, and ultrasonic cleaning.

• **Minimum Distance for Distinct Echo in Air:** Since persistence of hearing is `0.1 s`, `d = (v t) / 2 = (344 0.1) / 2 = 17.2 metres` (`~17 m`) (NCERT Official Textbooks).

• **Pitch vs. Loudness: Pitch** depends on **Frequency**; **Loudness** depends on **Amplitude** (`I proportional to A^2`) and is measured in **Decibels (** `dB` **)** (WHO safe conversational level `45–60 dB`).

• **Geometrical Optics, Total Internal Reflection (TIR), and Dispersion:**

• **Mirror Formula:** `1/v + 1/u = 1/f`; **Lens Formula:** `1/v - 1/u = 1/f`; **Power of a Lens:** `P = 1 / f(in metres)` measured in **Dioptres (** `D` **) (Convex lens =** `+D`, **Concave lens =** `-D`).

• **Total Internal Reflection (TIR):** Occurs when light travels from an **optically denser medium to a rarer medium** and the angle of incidence exceeds the **Critical Angle (** `i > theta_c` **)**. Applications: **Sparkling of diamond (** `n = 2.42`, `theta_c = 24.4 degrees` **)**, **Optical Fibres** (invented by Narinder Singh Kapany), **Mirage in deserts**, and **Endoscopy**.

• **Scattering of Light (** `Rayleigh Law: I proportional to 1 / lambda^4` **):** Blue/violet has the shortest wavelength and scatters most (**sky appears blue**), while **Red has the longest wavelength (** `~700 nm` **)** and scatters least (**danger/traffic stop signals are red** and the sun appears red at sunrise/sunset). In outer space (no atmosphere), the **sky appears black** to an astronaut!

### Step-by-Step Conceptual Process Flowchart

**STEP 1**
**Light Travels from Denser to Rarer Medium (n_1 > n_2)**

**STEP 2**
**Angle of Incidence Exceeds Critical Angle (i > theta_c)**

**STEP 3**
**100% Total Internal Reflection Without Transmission Loss**

**STEP 4**
**Powers Optical Fibres, Endoscopes, Diamond Brilliance & Mirages**

| Optical Device / Eye Defect | Mirror / Lens Used | Image Nature / Corrective Action | Key Practical Applications (NCERT) |
|---|---|---|---|
| **Concave Mirror** (Converging) | `f` is negative (`-f`) | Real & inverted (except when object is between `P` and `F` -> **Virtual, Erect & Magnified**) | **Shaving/Makeup mirror, Dentist mirror, ENT head mirror, Vehicle headlights, Solar furnaces** |
| **Convex Mirror** (Diverging) | `f` is positive (`+f`) | **Always Virtual, Erect & Diminished** with a wide field of view | **Rear-view (wing) mirrors in automobiles**, ATM security mirrors, street light reflectors |
| **Myopia (Near-Sightedness)** | **Concave (Diverging) Lens (`-D`)** | Near objects clear; distant objects focus **in front of the retina** (eyeball too long) | Concave lens diverges incoming parallel rays onto the retina |
| **Hypermetropia (Far-Sightedness)** | **Convex (Converging) Lens (`+D`)** | Distant objects clear; near objects focus **behind the retina** (eyeball too short; near point `>25 cm`) | Convex lens converges rays from `25 cm` (Least Distance of Distinct Vision) onto retina |
| **Presbyopia & Astigmatism** | **Bifocal Lens / Cylindrical Lens** | Presbyopia: old-age loss of ciliary muscle accommodation; Astigmatism: non-spherical cornea | Bifocal lens: **Upper part Concave** (distance) + **Lower part Convex** (reading) |

**Did You Know?: Rainbow formation** in the sky opposite the Sun after a rain shower is caused by a combination of **Dispersion (Refraction) + Internal Reflection + Refraction** inside suspended water droplets, with the **Primary Rainbow** having **Red on the outer arc and Violet on the inner arc** (NCERT Official Textbooks).

**Exam Trap Alert:** The speed of sound in a gas (`v = sqrt(gamma P / rho) = sqrt(gamma R * T / M)`) is **completely independent of changes in atmospheric pressure (`P`)** at constant temperature (because `P / rho` remains constant!), whereas it **increases with temperature (`+0.61 m/s per 1 degrees C`)** and **increases with humidity** (moist air is less dense than dry air)!

★ **Memory Trick:** For **Eye Defects**, remember **"M-C-N, H-C-X"**: **M**yopia (short word = short-sighted) uses a **C**o**N**cave lens; **H**ypermetropia (long word = long-sighted) uses a **C**onve**X** lens (SSC Official Portal).

## Chapter 2 Comprehensive Analytical & Statutory Revision Matrix

| Core Sub-Domain | Key Concept / Provision | Verified Analytical Parameters & Exam Distinctions (NCERT Science Textbooks (Class 6–12)) |
|---|---|---|
| Fluid Mechanics, Surface Tension, Viscosity, and Thermodynamics | Pascal's Law | Pressure applied to an enclosed incompressible fluid is transmitted undiminished in all directions — forms the working principle of **Hydraulic Lifts, Hydraulic Brakes, and Hydraulic Presses**. |
| Sound Waves, Mirrors, Lenses, Refraction, and Human Eye Defects | Archimedes' Principle & Buoyancy | A body immersed in a fluid experiences an upward buoyant force equal to the weight of the fluid displaced. An iceberg floats in seawater with roughly **1/10th** (**~11%**) **of its volume above water** and **9/10th** (**~89%**) **submerged**; when a floating ice cube melts in a glass filled to the brim with pure water, the **water level remains unchanged**! |
| Fluid Mechanics, Surface Tension, Viscosity, and Thermodynamics | Bernoulli's Theorem (**P + (1/2)*rho*v^2 + rhogh = Constant**) | Based on **Conservation of Energy**; high fluid velocity produces low static pressure — explains **dynamic lift of an aircraft wing (aerofoil)**, spinning of a cricket ball (**Magnus Effect**), atomizer/sprayer action, and why tin roofs blow off during cyclones. |
| Sound Waves, Mirrors, Lenses, Refraction, and Human Eye Defects | Capillarity | Rising of oil in a lamp wick, absorption of ink by blotting paper, and transport of subsurface water in soil capillaries. |
| Fluid Mechanics, Surface Tension, Viscosity, and Thermodynamics | Temperature Conversion Formula | **C / 5 = (F - 32) / 9 = (K - 273.15) / 5**. Note that **-40 degrees C = -40 degrees F** (identical reading on Celsius and Fahrenheit scales!), normal human body temperature is **37 degrees C = 98.6 degrees F = 310.15 K**, and **Absolute Zero is 0 K = -273.15 degrees C**. |
| Sound Waves, Mirrors, Lenses, Refraction, and Human Eye Defects | Anomalous Expansion of Water (**0 degrees C to 4 degrees C**) | When water is heated from **0 degrees C** to **4 degrees C**, its **volume decreases** and its **density increases**, reaching **maximum density** (**1,000 kg/m^3** or **1 g/cm^3**) **at exactly 4 degrees C**! |
| Fluid Mechanics, Surface Tension, Viscosity, and Thermodynamics | Frequency Ranges | Infrasonic (**<20 Hz**): **Earthquakes, elephants, whales;** Audible (**20 Hz to 20,000 Hz** / **20 kHz**): **Human ear;** Ultrasonic (**>20,000 Hz**):** Bats, dolphins, SONAR, echocardiography, and ultrasonic cleaning. |
| Sound Waves, Mirrors, Lenses, Refraction, and Human Eye Defects | Minimum Distance for Distinct Echo in Air | Since persistence of hearing is **0.1 s**, **d = (v *t*) / 2 = (344 0.1) / 2 = 17.2 metres** (**~17 m**) (NCERT Official Textbooks). |
| Fluid Mechanics, Surface Tension, Viscosity, and Thermodynamics | Pitch vs. Loudness | Pitch **depends on** Frequency; Loudness **depends on** Amplitude (**I proportional to A^2**) **and is measured in** Decibels (**dB**)** (WHO safe conversational level **45–60 dB**). |
| Sound Waves, Mirrors, Lenses, Refraction, and Human Eye Defects | Mirror Formula | **1/v + 1/u = 1/f**; **Lens Formula: 1/v - 1/u = 1/f**; **Power of a Lens: P = 1 / f(in metres)** measured in **Dioptres** (**D**) **(Convex lens = +D, Concave lens = -D**). |

| Core Sub-Domain | Key Concept / Provision | Verified Analytical Parameters & Exam Distinctions (NCERT Science Textbooks (Class 6–12)) |
|---|---|---|
| **Fluid Mechanics, Surface Tension, Viscosity, and Thermodynamics** | **Total Internal Reflection (TIR)** | Occurs when light travels from an **optically denser medium to a rarer medium** and the angle of incidence exceeds the **Critical Angle (`i > theta_c`)**. Applications: **Sparkling of diamond (`n = 2.42`, `theta_c = 24.4 degrees`)**, **Optical Fibres** (invented by Narinder Singh Kapany), **Mirage in deserts**, and **Endoscopy**. |
| **Sound Waves, Mirrors, Lenses, Refraction, and Human Eye Defects** | **Scattering of Light (`Rayleigh Law: I proportional to 1 / lambda^4`)** | Blue/violet has the shortest wavelength and scatters most (**sky appears blue**), while **Red has the longest wavelength (`~700 nm`)** and scatters least (**danger/traffic stop signals are red** and the sun appears red at sunrise/sunset). In outer space (no atmosphere), the **sky appears black** to an astronaut! |

## Chapter *2* Multi-Statement Exam Verification Drills

**Chapter 2 Statement-Verification Drill #1** — Both Statements Verified Correct

**Statement-I (Pascal's Law):** Pressure applied to an enclosed incompressible fluid is transmitted undiminished in all directions — forms the working principle of **Hydraulic Lifts, Hydraulic Brakes, and Hydraulic Presses**.

**Statement-II (Archimedes' Principle & Buoyancy):** A body immersed in a fluid experiences an upward buoyant force equal to the weight of the fluid displaced. An iceberg floats in seawater with roughly **`1/10th`** (**`~11%`**) **of its volume above water** and **`9/10th`** (**`~89%`**) **submerged**; when a floating ice cube melts in a glass filled to the brim with pure water, the **water level remains unchanged**!

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 2 Statement-Verification Drill #2** — Both Statements Verified Correct

**Statement-I (Bernoulli's Theorem (`P + (1/2)*rho*v^2 + rho*g*h = Constant`)):** Based on **Conservation of Energy**; high fluid velocity produces low static pressure — explains **dynamic lift of an aircraft wing (aerofoil)**, spinning of a cricket ball (**Magnus Effect**), atomizer/sprayer action, and why tin roofs blow off during cyclones.

**Statement-II (Capillarity):** Rising of oil in a lamp wick, absorption of ink by blotting paper, and transport of subsurface water in soil capillaries.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 2 Statement-Verification Drill #3** — Both Statements Verified Correct

**Statement-I (Temperature Conversion Formula):** **`C / 5 = (F - 32) / 9 = (K - 273.15) / 5`**. Note that **`-40 degrees C = -40 degrees F`** (identical reading on Celsius and Fahrenheit scales!), normal human body temperature is **`37 degrees C = 98.6 degrees F = 310.15 K`**, and **Absolute Zero is `0 K = -273.15 degrees C`**.

**Statement-II (Anomalous Expansion of Water (`0 degrees C to 4 degrees C`)):** When water is heated from **`0 degrees C`** to **`4 degrees C`**, its **volume decreases** and its **density increases**, reaching **maximum density (`1,000 kg/m^3`** or **`1 g/cm^3`**) **at exactly `4 degrees C`**!

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 2 Statement-Verification Drill #4** — Both Statements Verified Correct

**Statement-I (Frequency Ranges):** Infrasonic (`<20 Hz`): **Earthquakes, elephants, whales;** Audible (`20 Hz to 20,000 Hz` / `20 kHz`): **Human ear;** Ultrasonic (`>20,000 Hz`):** Bats, dolphins, SONAR, echocardiography, and ultrasonic cleaning.

**Statement-II (Minimum Distance for Distinct Echo in Air):** Since persistence of hearing is `0.1 s`, `d = (v t) / 2 = (344 0.1) / 2 = 17.2 metres` (`~17 m`) (NCERT Official Textbooks).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 2 Statement-Verification Drill #5** — Both Statements Verified Correct

**Statement-I (Pitch vs. Loudness):** Pitch **depends on** Frequency; Loudness **depends on** Amplitude (`I proportional to A^2`) **and is measured in** Decibels (`dB`)** (WHO safe conversational level `45–60 dB`).

**Statement-II (Mirror Formula):** `1/v + 1/u = 1/f`; **Lens Formula:** `1/v - 1/u = 1/f`; **Power of a Lens:** `P = 1 / f(in metres)` measured in **Dioptres (`D`)** (**Convex lens** = `+D`, **Concave lens** = `-D`).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 2 Statement-Verification Drill #6** — Both Statements Verified Correct

**Statement-I (Total Internal Reflection (TIR)):** Occurs when light travels from an **optically denser medium to a rarer medium** and the angle of incidence exceeds the **Critical Angle (`i > theta_c`)**. Applications: **Sparkling of diamond (`n = 2.42`, `theta_c = 24.4 degrees`)**, **Optical Fibres** (invented by Narinder Singh Kapany), **Mirage in deserts**, and **Endoscopy**.

**Statement-II (Scattering of Light (`Rayleigh Law: I proportional to 1 / lambda^4`)):** Blue/violet has the shortest wavelength and scatters most (**sky appears blue**), while **Red has the longest wavelength** (`~700 nm`) and scatters least (**danger/traffic stop signals are red** and the sun appears red at sunrise/sunset). In outer space (no atmosphere), the **sky appears black** to an astronaut!

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

# Chapter *3*: Electrostatics, Current Electricity, Magnetism, Semiconductors & Nuclear Physics

**Chapter Key Study Pillars — Chapter 3: Electrostatics, Current Electricity, Magnetism, Semiconductors & Nuclear Physics**

**Key Study Pillar 1**
**Ohm's Law, Resistor Combinations, Joule Heating, and Domestic Circuits**

**Key Study Pillar 2**
**Electromagnetism, Transformers, and Nuclear Fission vs. Fusion**

## *3.1* Ohm's Law, Resistor Combinations, Joule Heating, and Domestic Circuits

- **Electric Charge, Current, Potential, and Ohm's Law (NCERT Official Textbooks):**
- **Charge (`Q = n e = I t`):** SI unit = **Coulomb (`C`)**; elementary charge `e = 1.6 10^-19 C` (`1 C = 6.25` 10^18 electrons).
- **Ohm's Law (`V = I * R`):** At constant temperature, potential difference `V` (Volt) is directly proportional to current `I` (Ampere).

• **Electrical Resistance (`R = rho * L / A`):** Directly proportional to length `L` and inversely proportional to cross-sectional area `A`. **Resistivity (`rho`, unit `Ohm-metre`)** depends ONLY on the **nature of the material and temperature**, NOT on the wire's length or thickness!

• **Series vs. Parallel Resistors:**

• **Series (`Same Current I`):** `R_s = R_1 + R_2 + R_3` (used in fairy lights).

• **Parallel (`Same Voltage V`):** `1/R_p = 1/R_1 + 1/R_2 + 1/R_3` (**All domestic household appliances are connected in Parallel** so each receives `220 V` at `50 Hz` independently!).

• **Joule's Law of Heating (`H = I^2 R t = V I t = (V^2 / R) * t`):**

• **Electric Fuse Wire:** Made of an alloy of **Lead (`Pb`) and Tin (`Sn`)** having **High Resistance (Resistivity) and Low Melting Point**, connected in **Series** with the live wire.

• **Heating Element (Heater, Geyser, Electric Iron):** Made of **Nichrome** (`Nickel + Chromium + Manganese + Iron`) having **High Resistivity and High Melting Point** (resists oxidation when red-hot).

• **Incandescent Bulb Filament:** Made of **Tungsten (`W`, melting point `3,380 degrees C`)**, filled with chemically inert **Argon and Nitrogen** gases (IUC Academy).

## *3.2* Electromagnetism, Transformers, and Nuclear Fission vs. Fusion

• **Magnetic Effect of Current & Electromagnetic Induction:**

• **Oersted's Discovery (1820):** An electric current carrying wire produces a magnetic field in the adjacent space (direction given by **Maxwell's Right-Hand Thumb Rule**).

• **Fleming's Left-Hand Rule (Electric Motor — Electrical to Mechanical Energy):** Thumb = **Force/Motion**, Forefinger = **Magnetic Field**, Middle finger = **Current**.

• **Faraday's Law & Fleming's Right-Hand Rule (AC/DC Generator/Dynamo — Mechanical to Electrical Energy):** Induced EMF arises from a changing magnetic flux; **Lenz's Law** (direction of induced current opposes its cause) is a direct consequence of **Conservation of Energy**.

• **Transformer (`Mutual Induction`):** Works **ONLY on Alternating Current (AC)**, never on Direct Current (DC)! Step-up transformer (`N_s > N_p`) increases voltage and decreases current for long-distance transmission with minimal `I^2*R` line loss.

• **Nuclear Physics — Fission vs. Fusion (SSC Official Portal):**

• **Nuclear Fission (Otto Hahn & Fritz Strassmann, 1939):** Heavy nucleus (`U-235` or `Pu-239`) bombarded by a slow thermal neutron splits into lighter nuclei (`Ba-141 + Kr-92 + 3 neutrons + ~200 MeV`).

• *Uncontrolled Chain Reaction*: **Atom Bomb**.

• *Controlled Chain Reaction*: **Nuclear Reactor** (first built by **Enrico Fermi**, 1942), using **Moderators (Heavy Water `D2O`, Graphite, or Beryllium Oxide** to slow down fast neutrons), **Control Rods (Cadmium or Boron** to absorb excess neutrons), and **Coolants (Liquid Sodium, Heavy Water, or CO2)**.

• **Nuclear Fusion:** Two light nuclei (`Deuterium 1H2 + Tritium 1H3 -> Helium 2He4 + 1n0 + 17.6 MeV`) fuse at ultra-high temperature (`10^7 K`) — powers the **Sun, Stars, and the Hydrogen Bomb**.

### Step-by-Step Conceptual Process Flowchart

**STEP 1**
Slow Thermal Neutron Strikes U-235 Nucleus

**STEP 2**
Fission Releases Ba-141 + Kr-92 + 3 Fast Neutrons + 200 MeV

**STEP 3**
Moderator (D2O / Graphite) Slows Neutrons to Thermal Speed

**STEP 4**
Cadmium / Boron Control Rods Absorb 2 of 3 Neutrons for Steady Power

| Scientific Instrument / Device | Physical Principle / Function | Measured Quantity or Conversion | Inventor / Key Fact (NCERT) |
|---|---|---|---|
| **Ammeter vs. Voltmeter** | Ammeter: **Very Low Resistance**, connected in **Series**; Voltmeter: **Very High Resistance**, connected in **Parallel** | Ammeter: Electric Current (**A**); Voltmeter: Potential Difference (**V**) | An **Ideal Ammeter has Zero (0) resistance**; an **Ideal Voltmeter has Infinite (infinity) resistance** |
| **Galvanometer & Rectifier** | Galvanometer detects small currents; **Rectifier (p-n diode)** converts **AC to DC** | **Inverter** converts **DC to AC**; **Transformer** steps AC voltage up/down | Shunt (low resistance in parallel) converts a Galvanometer into an Ammeter |
| **Lactometer & Hydrometer** | **Archimedes' Principle of Flotation** | Lactometer: Purity/density of milk; Hydrometer: Relative density of liquids | **Hygrometer** measures **Relative Humidity** of air (do not confuse with Hydrometer!) |
| **Barometer, Manometer & Altimeter** | Atmospheric/Fluid Pressure measurement | Barometer: Atmospheric pressure (sudden drop = **Storm/Cyclone**); Altimeter: Altitude in aircraft | **Fathometer** measures ocean depth (SONAR); **Anemometer** measures wind speed |
| **Pyrometer, Seismograph & Sphygmomanometer** | Stefan-Boltzmann radiation / Seismic waves / Arterial pressure | Pyrometer: Very high temperatures (**>800 degrees C**, Sun/furnaces); Sphygmomanometer: Blood Pressure (**120/80 mmHg**) | **Richter Scale** measures earthquake magnitude; **Mercalli Scale** measures intensity |

**Did You Know?:** If a wire of resistance **R** is **stretched** to **n** times its original length (**L' = nL**), *its cross-sectional area shrinks to* ***A/n*** (*since volume* ***V = A***L is constant), so its **new resistance becomes** **R' = n^2 * R**, whereas its **resistivity (rho) remains completely unchanged** (NCERT Official Textbooks)!

**Exam Trap Alert:** Do not confuse **Hydrometer** (measures relative **D**ensity of liquids — **D** for Density) with **Hygrometer** (measures relative humidity / moisture in air)! Also remember: **Domestic wiring** is **Parallel** (**220 V, 50 Hz** in India; Live wire = **Red**, Neutral = **Black**, Earth = **Green**), whereas a **Fuse** is always in **Series**!

★ **Memory Trick:** For Nuclear Reactor components on IUC Academy, remember **"M-G-H, C-C-B"**: **M**oderator = **G**raphite or **H**eavy Water (**D2O**, slows neutrons); **C**ontrol Rods = **C**admium or **B**oron (absorbs neutrons).

## Chapter 3 Comprehensive Analytical & Statutory Revision Matrix

| Core Sub-Domain | Key Concept / Provision | Verified Analytical Parameters & Exam Distinctions (NCERT Science Textbooks (Class 6–12)) |
|---|---|---|
| Ohm's Law, Resistor Combinations, Joule Heating, and Domestic Circuits | Charge ( Q = n *e* = *I* t ) | SI unit = **Coulomb ( C )**; elementary charge e = 1.6 10^-19 *C* ( 1 *C* = 6.25 10^18 electrons). |
| Electromagnetism, Transformers, and Nuclear Fission vs. Fusion | Ohm's Law ( V = I * R ) | At constant temperature, potential difference V (Volt) is directly proportional to current I (Ampere). |
| Ohm's Law, Resistor Combinations, Joule Heating, and Domestic Circuits | Electrical Resistance ( R = rho * L / A ) | Directly proportional to length L and inversely proportional to cross-sectional area A. **Resistivity ( rho , unit Ohm-metre )** depends ONLY on the **nature of the material and temperature**, NOT on the wire's length or thickness! |
| Electromagnetism, Transformers, and Nuclear Fission vs. Fusion | Series ( Same Current I ) | R_s = R_1 + R_2 + R_3 (used in fairy lights). |
| Ohm's Law, Resistor Combinations, Joule Heating, and Domestic Circuits | Parallel ( Same Voltage V ) | 1/R_p = 1/R_1 + 1/R_2 + 1/R_3 **(All domestic household appliances are connected in Parallel** so each receives 220 V at 50 Hz independently!). |
| Electromagnetism, Transformers, and Nuclear Fission vs. Fusion | Electric Fuse Wire | Made of an alloy of **Lead ( Pb ) and Tin ( Sn )** having **High Resistance (Resistivity) and Low Melting Point**, connected in **Series** with the live wire. |
| Ohm's Law, Resistor Combinations, Joule Heating, and Domestic Circuits | Heating Element (Heater, Geyser, Electric Iron) | Made of **Nichrome** ( Nickel + Chromium + Manganese + Iron ) having **High Resistivity and High Melting Point** (resists oxidation when red-hot). |
| Electromagnetism, Transformers, and Nuclear Fission vs. Fusion | Incandescent Bulb Filament | Made of **Tungsten ( W , melting point 3,380 degrees C )**, filled with chemically inert **Argon and Nitrogen** gases (IUC Academy). |
| Ohm's Law, Resistor Combinations, Joule Heating, and Domestic Circuits | Oersted's Discovery (1820) | An electric current carrying wire produces a magnetic field in the adjacent space (direction given by **Maxwell's Right-Hand Thumb Rule**). |
| Electromagnetism, Transformers, and Nuclear Fission vs. Fusion | Fleming's Left-Hand Rule (Electric Motor — Electrical to Mechanical Energy) | Thumb = **Force/Motion**, Forefinger = **Magnetic Field**, Middle finger = **Current**. |

| Core Sub-Domain | Key Concept / Provision | Verified Analytical Parameters & Exam Distinctions (NCERT Science Textbooks (Class 6–12)) |
|---|---|---|
| **Ohm's Law, Resistor Combinations, Joule Heating, and Domestic Circuits** | **Faraday's Law & Fleming's Right-Hand Rule (AC/DC Generator/Dynamo — Mechanical to Electrical Energy)** | Induced EMF arises from a changing magnetic flux; **Lenz's Law** (direction of induced current opposes its cause) is a direct consequence of **Conservation of Energy**. |
| **Electromagnetism, Transformers, and Nuclear Fission vs. Fusion** | **Transformer (`Mutual Induction`)** | Works **ONLY on Alternating Current (AC)**, never on Direct Current (DC)! Step-up transformer (`N_s > N_p`) increases voltage and decreases current for long-distance transmission with minimal `I^2*R` line loss. |
| **Ohm's Law, Resistor Combinations, Joule Heating, and Domestic Circuits** | **Nuclear Fission (Otto Hahn & Fritz Strassmann, 1939)** | Heavy nucleus (`U-235` or `Pu-239`) bombarded by a slow thermal neutron splits into lighter nuclei (`Ba-141 + Kr-92 + 3 neutrons + ~200 MeV`). |
| **Electromagnetism, Transformers, and Nuclear Fission vs. Fusion** | **Nuclear Fusion** | Two light nuclei (`Deuterium 1H2 + Tritium 1H3 -> Helium 2He4 + 1n0 + 17.6 MeV`) fuse at ultra-high temperature (`10^7 K`) — powers the **Sun, Stars, and the Hydrogen Bomb**. |

## Chapter *3* Multi-Statement Exam Verification Drills

**Chapter 3 Statement-Verification Drill #1** — Both Statements Verified Correct

**Statement-I (Charge (`Q = n e = I t`)):** SI unit = **Coulomb (`C`)**; elementary charge `e = 1.6 10^-19 C` (`1 C = 6.25` 10^18 electrons).

**Statement-II (Ohm's Law (`V = I * R`)):** At constant temperature, potential difference `V` (Volt) is directly proportional to current `I` (Ampere).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 3 Statement-Verification Drill #2** — Both Statements Verified Correct

**Statement-I (Electrical Resistance (`R = rho * L / A`)):** Directly proportional to length `L` and inversely proportional to cross-sectional area `A`. **Resistivity (`rho`, unit `Ohm-metre`)** depends ONLY on the **nature of the material and temperature**, NOT on the wire's length or thickness!

**Statement-II (Series (`Same Current I`)):** `R_s = R_1 + R_2 + R_3` (used in fairy lights).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 3 Statement-Verification Drill #3** — Both Statements Verified Correct

**Statement-I (Parallel (`Same Voltage V`)):** `1/R_p = 1/R_1 + 1/R_2 + 1/R_3` **(All domestic household appliances are connected in Parallel** so each receives `220 V` at `50 Hz` independently!).

**Statement-II (Electric Fuse Wire):** Made of an alloy of **Lead (`Pb`) and Tin (`Sn`)** having **High Resistance (Resistivity) and Low Melting Point**, connected in **Series** with the live wire.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 3 Statement-Verification Drill #4** — Both Statements Verified Correct

**Statement-I (Heating Element (Heater, Geyser, Electric Iron)):** Made of **Nichrome** (`Nickel + Chromium + Manganese + Iron`) having **High Resistivity and High Melting Point** (resists oxidation when red-hot).

**Statement-II (Incandescent Bulb Filament):** Made of **Tungsten (`W`, melting point `3,380 degrees C`)**, filled with chemically inert **Argon and Nitrogen** gases (IUC Academy).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 3 Statement-Verification Drill #5** — Both Statements Verified Correct

**Statement-I (Oersted's Discovery (1820)):** An electric current carrying wire produces a magnetic field in the adjacent space (direction given by **Maxwell's Right-Hand Thumb Rule**).

**Statement-II (Fleming's Left-Hand Rule (Electric Motor — Electrical to Mechanical Energy)):** Thumb = **Force/Motion**, Forefinger = **Magnetic Field**, Middle finger = **Current**.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 3 Statement-Verification Drill #6** — Both Statements Verified Correct

**Statement-I (Faraday's Law & Fleming's Right-Hand Rule (AC/DC Generator/Dynamo — Mechanical to Electrical Energy)):** Induced EMF arises from a changing magnetic flux; **Lenz's Law** (direction of induced current opposes its cause) is a direct consequence of **Conservation of Energy**.

**Statement-II (Transformer (`Mutual Induction`)):** Works **ONLY on Alternating Current (AC)**, never on Direct Current (DC)! Step-up transformer (`N_s > N_p`) increases voltage and decreases current for long-distance transmission with minimal `I^2*R` line loss.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

# Chapter 4: Atomic Structure, Chemical Bonding, Periodic Table Trends & Chemical Reactions

**Chapter Key Study Pillars — Chapter 4: Atomic Structure, Chemical Bonding, Periodic Table Trends & Chemical Reactions**

**Key Study Pillar 1**
**Subatomic Particles, Atomic Models, and Isotopes/Isobars**

**Key Study Pillar 2**
**Modern Periodic Table, Periodic Trends, and Chemical Reactions**

## *4.1* Subatomic Particles, Atomic Models, and Isotopes/Isobars

• **Discovery of Fundamental Subatomic Particles (NCERT Official Textbooks):**

• **Electron (`e^-`):** Discovered by **J.J. Thomson (1897)** via cathode ray discharge tubes; charge = **`-1.6 10^-19 C`** (*measured by **R.A. Millikan's Oil-Drop Experiment***), *mass* = **`9.1`**10^-31 kg.

• **Proton (`p^+`):** Anode/canal rays observed by **E. Goldstein (1886)**, nuclear proton named and characterized by **Ernest Rutherford (1919)**; charge = **`+1.6 10^-19 C`**, *mass* = **`1.672`**10^-27 kg.

• **Neutron (`n^0`):** Discovered by **James Chadwick (1932)** by bombarding Beryllium with alpha particles; charge = **`0`**, mass = **`1.675 * 10^-27 kg`** (slightly heavier than a proton; **Protium `1H1` is the ONLY isotope in the universe with zero neutrons!**).

• **Atomic Nucleus:** Discovered by **Ernest Rutherford (1911)** via the **Alpha-Particle Gold Foil Scattering Experiment** (size of nucleus **`~10^-15 m = 1 Fermi`**; size of atom **`~10^-10 m = 1 Angstrom`**).

• **Atomic Number (`Z`), Mass Number (`A = Z + N`), and Nuclear Species:**

• **Isotopes (`Same Z, Different A`):** Same element with different neutron counts — e.g., Hydrogen isotopes **Protium (`1H1`), Deuterium (`1H2`), and Tritium (`1H3` — radioactive)**; **Carbon-14** (archaeological radiometric dating); **Uranium-235** (nuclear fuel); **Cobalt-60** (cancer radiation therapy); **Iodine-131** (thyroid goitre treatment) (SSC Official Portal).

• **Isobars (`Same A, Different Z`):** Different elements with identical mass numbers — e.g., **Argon (`18Ar40`), Potassium (`19K40`), and Calcium (`20Ca40`)**.

• **Isotones (`Same Neutrons N = A - Z`):** E.g., **`6C14`** (**`N=8`**) and **`8O16`** (**`N=8`**).

• **Isoelectronic Species (`Same Electron Count`):** E.g., **`N^3-, O^2-, F^-, Ne, Na^+, Mg^2+, Al^3+`** (all contain exactly **10 electrons**).

## *4.2* Modern Periodic Table, Periodic Trends, and Chemical Reactions

• **Evolution of the Periodic Table (IUC Academy):**

• **Dobereiner's Triads (1817):** Atomic mass of the middle element equals the average of the other two (**`Li, Na, K`**; **`Ca, Sr, Ba`**; **`Cl, Br, I`**).

• **Newlands' Law of Octaves (1866):** Every 8th element had properties similar to the 1st (valid only up to **Calcium**, ended with **Thorium**).

• **Mendeleev's Periodic Table (1869):** Based on **Atomic Mass** (**`63 elements`**, 8 groups, 6 periods); predicted **Eka-Boron (`Scandium`), Eka-Aluminium (`Gallium`), and Eka-Silicon (`Germanium`)**.

• **Modern Periodic Law (Henry Moseley, 1913):** Physical and chemical properties of elements are periodic functions of their **Atomic Number (`Z`)** — contains **18 Vertical Groups and 7 Horizontal Periods** (**`118 known elements`**, divided into **`s, p, d, f`** blocks).

• **Periodic Trends Across a Period (`Left to Right`) vs. Down a Group (`Top to Bottom`):**

• **Atomic Radius & Metallic Character: Decrease** across a period (**`Left -> Right`**) and **Increase** down a group (**`Top -> Bottom`**).

• **Ionization Energy, Electronegativity & Non-Metallic Character: Increase** across a period and **Decrease** down a group.

• **Periodic Extremes:** Highest Electronegativity = **Fluorine (F)**; Highest Electron Gain Enthalpy (Electron Affinity) = **Chlorine (Cl)**; Largest Atomic Radius & Most Electropositive = **Cesium (Cs / Francium)**; Lightest Metal = **Lithium (Li)**; Heaviest Metal = **Osmium (Os)**; Liquid Metal at room temp = **Mercury (Hg)** (Gallium & Cesium melt on the palm at **~30 degrees C**); Liquid Non-Metal at room temp = **Bromine (Br)**.

**Step-by-Step Conceptual Process Flowchart**

**STEP 1**
**Dobereiner Triads (1817) & Newlands Octaves (1866)**

**STEP 2**
**Mendeleev Periodic Law (1869 — Atomic Mass, 63 Elements)**

**STEP 3**
**Moseley Modern Periodic Law (1913 — Atomic Number Z)**

**STEP 4**
**18 Groups & 7 Periods (s, p, d, f Blocks — 118 Elements)**

| Periodic Property / Reaction Type | Trend Across Period (Left -> Right) | Trend Down Group (Top -> Bottom) | Key Exception / Exam Illustration (NCERT) |
|---|---|---|---|
| **Atomic Size (Radius)** | **Decreases** (nuclear charge pulls shell closer) | **Increases** (new electron shells added) | Noble gases have the largest Van der Waals radius in their respective periods |
| **Electronegativity** | **Increases** | **Decreases** | Top 3 most electronegative elements: **F (4.0) > O (3.5) > N (3.0) (FON)** |
| **Electron Affinity** | **Increases** | **Decreases** | **Chlorine (Cl) > Fluorine (F)** due to compact **2p** inter-electronic repulsion in Fluorine! |
| **Exothermic vs. Endothermic** | **Exothermic:** Releases heat (**Respiration, Quicklime + Water, Combustion**) | **Endothermic:** Absorbs heat (**Photosynthesis, Thermal Decomposition of CaCO3**) | **Rancidity** (oxidation of fats/oils in chips) is prevented by flushing bags with **Nitrogen (N2) gas** |
| **Redox (Oxidation-Reduction)** | **Oxidation:** Gain of **O**, Loss of **H**, or **Loss of Electrons (OIL)** | **Reduction:** Loss of **O**, Gain of **H**, or **Gain of Electrons (RIG)** | **Corrosion:** Rusting of Iron (**Fe2O3.xH2O**, reddish-brown), Silver (**Ag2S**, black), Copper (**CuCO3.Cu(OH)2**, green) |

**Did You Know?:** In Mendeleev's Periodic Table, he brilliantly left blank gaps for undiscovered elements and predicted their properties: **Eka-Boron** was later discovered as **Scandium (Sc)**, **Eka-Aluminium** as **Gallium (Ga)**, and **Eka-Silicon** as **Germanium (Ge)** (NCERT Official Textbooks).

**Exam Trap Alert:** While **Fluorine (F)** has the **highest Electronegativity** in the Periodic Table, **Chlorine (Cl)** has the **highest Electron Affinity (Electron Gain Enthalpy)**! Never pick Fluorine when the question specifically asks for Electron Affinity!

★ **Memory Trick:** Remember Mendeleev's three predicted elements with **"B-A-S = S-G-G"**: Eka-**B**oron = **S**candium, Eka-**A**luminium = **G**allium, Eka-**S**ilicon = **G**ermanium; and remember Electron Loss/Gain with **OIL RIG** (**O**xidation **I**s **L**oss of electrons, **R**eduction **I**s **G**ain of electrons) (IUC Academy).

## Chapter 4 Comprehensive Analytical & Statutory Revision Matrix

| Core Sub-Domain | Key Concept / Provision | Verified Analytical Parameters & Exam Distinctions (NCERT Science Textbooks (Class 6–12)) |
|---|---|---|
| Subatomic Particles, Atomic Models, and Isotopes/Isobars | Electron ( e^- ) | Discovered by **J.J. Thomson (1897)** via cathode ray discharge tubes; charge = -1.6 10^-19 C (*measured by **R.A. Millikan's Oil-Drop Experiment***), *mass* = 9.1 10^-31 kg. |
| Modern Periodic Table, Periodic Trends, and Chemical Reactions | Proton ( p^+ ) | Anode/canal rays observed by **E. Goldstein (1886)**, nuclear proton named and characterized by **Ernest Rutherford (1919)**; charge = +1.6 10^-19 C, *mass* = 1.672 10^-27 kg. |
| Subatomic Particles, Atomic Models, and Isotopes/Isobars | Neutron ( n^0 ) | Discovered by **James Chadwick (1932)** by bombarding Beryllium with alpha particles; charge = 0, mass = 1.675 * 10^-27 kg (slightly heavier than a proton; **Protium 1H1 is the ONLY isotope in the universe with zero neutrons!**). |
| Modern Periodic Table, Periodic Trends, and Chemical Reactions | Atomic Nucleus | Discovered by **Ernest Rutherford (1911)** via the **Alpha-Particle Gold Foil Scattering Experiment** (size of nucleus ~10^-15 m = 1 Fermi; size of atom ~10^-10 m = 1 Angstrom). |
| Subatomic Particles, Atomic Models, and Isotopes/Isobars | Isotopes ( Same Z, Different A ) | Same element with different neutron counts — e.g., Hydrogen isotopes **Protium ( 1H1 ), Deuterium ( 1H2 ), and Tritium ( 1H3 — radioactive)**; **Carbon-14** (archaeological radiometric dating); **Uranium-235** (nuclear fuel); **Cobalt-60** (cancer radiation therapy); **Iodine-131** (thyroid goitre treatment) (SSC Official Portal). |
| Modern Periodic Table, Periodic Trends, and Chemical Reactions | Isobars ( Same A, Different Z ) | Different elements with identical mass numbers — e.g., **Argon ( 18Ar40 ), Potassium ( 19K40 ), and Calcium ( 20Ca40 )**. |
| Subatomic Particles, Atomic Models, and Isotopes/Isobars | Isotones ( Same Neutrons N = A - Z ) | E.g., 6C14 ( N=8 ) and 8O16 ( N=8 ). |
| Modern Periodic Table, Periodic Trends, and Chemical Reactions | Isoelectronic Species ( Same Electron Count ) | E.g., N^3-, O^2-, F^-, Ne, Na^+, Mg^2+, Al^3+ (all contain exactly **10 electrons**). |
| Subatomic Particles, Atomic Models, and Isotopes/Isobars | Dobereiner's Triads (1817) | Atomic mass of the middle element equals the average of the other two ( Li, Na, K ; Ca, Sr, Ba ; Cl, Br, I ). |
| Modern Periodic Table, Periodic Trends, and Chemical Reactions | Newlands' Law of Octaves (1866) | Every 8th element had properties similar to the 1st (valid only up to **Calcium**, ended with **Thorium**). |
| Subatomic Particles, Atomic Models, and Isotopes/Isobars | Mendeleev's Periodic Table (1869) | Based on **Atomic Mass** ( 63 elements , 8 groups, 6 periods); predicted **Eka-Boron ( Scandium ), Eka-Aluminium ( Gallium ), and Eka-Silicon ( Germanium )**. |

| Core Sub-Domain | Key Concept / Provision | Verified Analytical Parameters & Exam Distinctions (NCERT Science Textbooks (Class 6–12)) |
|---|---|---|
| **Modern Periodic Table, Periodic Trends, and Chemical Reactions** | **Modern Periodic Law (Henry Moseley, 1913)** | Physical and chemical properties of elements are periodic functions of their **Atomic Number ( Z )** — contains **18 Vertical Groups and 7 Horizontal Periods** ( **118 known elements** , divided into **s, p, d, f** blocks). |
| **Subatomic Particles, Atomic Models, and Isotopes/Isobars** | **Atomic Radius & Metallic Character** | Decrease **across a period ( Left -> Right ) and** Increase** down a group ( **Top -> Bottom** ). |
| **Modern Periodic Table, Periodic Trends, and Chemical Reactions** | **Ionization Energy, Electronegativity & Non-Metallic Character** | Increase **across a period and** Decrease** down a group. |

## Chapter 4 Multi-Statement Exam Verification Drills

**Chapter 4 Statement-Verification Drill #1** — Both Statements Verified Correct

**Statement-I (Electron ( e^- )):** Discovered by **J.J. Thomson (1897)** via cathode ray discharge tubes; charge = **-1.6 10^-19 C** (*measured by **R.A. Millikan's Oil-Drop Experiment***), *mass* = **9.1** 10^-31 kg.

**Statement-II (Proton ( p^+ )):** Anode/canal rays observed by **E. Goldstein (1886)**, nuclear proton named and characterized by **Ernest Rutherford (1919)**; charge = **+1.6 10^-19 C** , *mass* = **1.672** 10^-27 kg.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 4 Statement-Verification Drill #2** — Both Statements Verified Correct

**Statement-I (Neutron ( n^0 )):** Discovered by **James Chadwick (1932)** by bombarding Beryllium with alpha particles; charge = **0** , mass = **1.675 * 10^-27 kg** (slightly heavier than a proton; **Protium 1H1 is the ONLY isotope in the universe with zero neutrons!**).

**Statement-II (Atomic Nucleus):** Discovered by **Ernest Rutherford (1911)** via the **Alpha-Particle Gold Foil Scattering Experiment** (size of nucleus **~10^-15 m = 1 Fermi** ; size of atom **~10^-10 m = 1 Angstrom** ).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 4 Statement-Verification Drill #3** — Both Statements Verified Correct

**Statement-I (Isotopes ( Same Z, Different A )):** Same element with different neutron counts — e.g., Hydrogen isotopes **Protium ( 1H1 ), Deuterium ( 1H2 ), and Tritium ( 1H3 — radioactive)**; **Carbon-14** (archaeological radiometric dating); **Uranium-235** (nuclear fuel); **Cobalt-60** (cancer radiation therapy); **Iodine-131** (thyroid goitre treatment) (SSC Official Portal).

**Statement-II (Isobars ( Same A, Different Z )):** Different elements with identical mass numbers — e.g., **Argon ( 18Ar40 ), Potassium ( 19K40 ), and Calcium ( 20Ca40 ).**

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 4 Statement-Verification Drill #4** — Both Statements Verified Correct

**Statement-I (Isotones (Same Neutrons N = A - Z)):** E.g., 6C14 (N=8) and 8O16 (N=8).

**Statement-II (Isoelectronic Species (Same Electron Count)):** E.g., N^3-, O^2-, F^-, Ne, Na^+, Mg^2+, Al^3+ (all contain exactly **10 electrons**).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 4 Statement-Verification Drill #5** — Both Statements Verified Correct

**Statement-I (Dobereiner's Triads (1817)):** Atomic mass of the middle element equals the average of the other two (Li, Na, K; Ca, Sr, Ba; Cl, Br, I).

**Statement-II (Newlands' Law of Octaves (1866)):** Every 8th element had properties similar to the 1st (valid only up to **Calcium**, ended with **Thorium**).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 4 Statement-Verification Drill #6** — Both Statements Verified Correct

**Statement-I (Mendeleev's Periodic Table (1869)):** Based on **Atomic Mass** (63 elements, 8 groups, 6 periods); predicted **Eka-Boron** (Scandium), **Eka-Aluminium** (Gallium), and **Eka-Silicon** (Germanium).

**Statement-II (Modern Periodic Law (Henry Moseley, 1913)):** Physical and chemical properties of elements are periodic functions of their **Atomic Number** (Z) — contains **18 Vertical Groups and 7 Horizontal Periods** (118 known elements, divided into s, p, d, f blocks).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

# Chapter 5: Acids, Bases, Salts, Metals, Non-Metals, Metallurgy & Electrochemistry

**Chapter Key Study Pillars — Chapter 5: Acids, Bases, Salts, Metals, Non-Metals, Metallurgy & Electrochemistry**

**Key Study Pillar 1**
**Natural Organic Acids, pH Scale, and Industrial Salts**

**Key Study Pillar 2**
**Reactivity Series, Ores, Metallurgy, and Alloys**

## 5.1 Natural Organic Acids, pH Scale, and Industrial Salts

• **Natural Sources of Organic Acids (NCERT Official Textbooks):**

• **Vinegar:** Acetic Acid (CH3COOH); **Citrus fruits (Lemon, Orange):** Citric Acid; **Tamarind & Grapes:** Tartaric Acid; **Tomato & Spinach:** Oxalic Acid (also used to remove rust/ink stains from clothes!); **Sour Milk / Curd:** Lactic Acid; **Apple:** Malic Acid; **Ant Sting & Nettle Leaf Sting:** Methanoic Acid (**Formic Acid**, HCOOH — relieved by rubbing mild base like Baking Soda!).

• **The Sorensen pH Scale (0 to 14, pH = -log10[H^+]):**

• pH < 7 is **Acidic**; pH = 7 is **Neutral** (pure water); pH > 7 is **Basic / Alkaline**.

• **High-Yield NCERT pH Values:** Gastric Juice = 1.2; Lemon Juice = 2.2; **Acid Rain** = < 5.6; **Tooth Enamel (Calcium Hydroxyapatite, hardest substance in the human body)** corrodes when mouth pH drops < 5.5;

Milk = 6.5–6.8; **Human Blood & Tears** = 7.35–7.45 (7.4); **Milk of Magnesia (Mg(OH)2, Antacid)** = 10.0; Sodium Hydroxide (NaOH) = 14.0.

• **Five Essential NCERT Chemical Salts (SSC Official Portal):**

1. **Caustic Soda (Sodium Hydroxide, NaOH):** Prepared by the **Chlor-Alkali Process** (electrolysis of aqueous NaCl brine releasing Cl2 at anode and H2 at cathode).

2. **Bleaching Powder (Calcium Oxychloride, CaOCl2):** Prepared by passing Cl2 gas over dry **Slaked Lime (Ca(OH)2)**.

3. **Baking Soda (Sodium Hydrogen Carbonate / Bicarbonate, NaHCO3):** Used in antacids, soda-acid fire extinguishers, and **Baking Powder** (NaHCO3 + mild edible Tartaric Acid).

4. **Washing Soda (Sodium Carbonate Decahydrate, Na2CO3.10H2O):** Used in glass, soap, and paper industries, and for **removing permanent hardness of water**.

5. **Plaster of Paris (CaSO4.(1/2)H2O, Calcium Sulphate Hemihydrate):** Prepared by heating **Gypsum (CaSO4.2H2O)** at 373 K (100 degrees C).

## *5.2* Reactivity Series, Ores, Metallurgy, and Alloys

• **Reactivity Series of Metals (Decreasing Order):** K > Na > Ca > Mg > Al > Zn > Fe > Pb > [H] > Cu > Hg > Ag > Au > Pt.

• **Sodium (Na) and Potassium (K)** are soft metals (can be cut with a knife) that react violently with air and cold water, so they are **stored immersed in Kerosene Oil** (whereas **White Phosphorus** is stored **under Cold Water**!).

• **Amphoteric Oxides (React with both Acids and Bases): Aluminium Oxide (Al2O3) and Zinc Oxide (ZnO)**.

• **Aqua Regia ("Royal Water"):** Freshly prepared mixture of **Concentrated Hydrochloric Acid (HCl) and Concentrated Nitric Acid (HNO3) in a 3 : 1 molar/volume ratio** — dissolves noble metals **Gold (Au) and Platinum (Pt)** (IUC Academy).

• **Metallurgical Processes:**

• **Roasting:** Heating **Sulphide ores** (ZnS, PbS, HgS) strongly in the **presence of excess air**.

• **Calcination:** Heating **Carbonate ores** (ZnCO3, CaCO3) strongly in the **absence or limited supply of air**.

• **Galvanization:** Coating iron/steel with a protective layer of **Zinc (Zn)** to prevent rusting; **Anodizing:** Forming a thick oxide layer on **Aluminium (Al)**.

**Step-by-Step Conceptual Process Flowchart**

| STEP 1 | STEP 2 | STEP 3 | STEP 4 |
|---|---|---|---|
| Concentration of Ore (Froth Flotation for Sulphides) | Conversion to Oxide (Roasting for Sulphides / Calcination for Carbonates) | Reduction to Metal (Carbon Smelting / Thermite Reaction Fe2O3 + 2Al) | Electrolytic Refining (Impure Metal at Anode, Pure Metal at Cathode) |

| Common Name / Alloy | Chemical Formula / Composition | Primary Ore / Source | Key Industrial & Exam Application (NCERT) |
|---|---|---|---|
| **Quicklime, Slaked Lime & Limestone** | Quicklime: `CaO`; Slaked Lime: `Ca(OH)2`; Limestone/Marble/Chalk: `CaCO3` | **Dolomite:** `CaCO3.MgCO3`; **Calamine (Zinc):** `ZnCO3` | Passing `CO2` through **Lime Water (`Ca(OH)2`)** turns it milky due to insoluble `CaCO3` |
| **Blue, Green & White Vitriol** | **Blue:** `CuSO4.5H2O`; **Green:** `FeSO4.7H2O`; **White:** `ZnSO4.7H2O` | **Cinnabar (`HgS`):** Ore of Mercury; **Galena (`PbS`):** Ore of Lead | **Bauxite (`Al2O3.2H2O`):** Ore of Aluminium; **Pitchblende (`U3O8`):** Ore of Uranium |
| **Brass vs. Bronze** | **Brass:** `Copper (Cu) + Zinc (Zn)`; **Bronze:** `Copper (Cu) + Tin (Sn)` | **German Silver:** `Cu + Zn + Ni` **(Contains 0% Silver!)** | **Gun Metal:** `Cu + Sn + Zn`; **Bell Metal:** `Cu (80%) + Sn (20%)` |
| **Solder, Stainless Steel & Amalgam** | **Solder:** `Lead (Pb) + Tin (Sn)`; **Stainless Steel:** `Fe + Cr + Ni + C` | **Amalgam:** Any alloy where one metal is **Mercury (`Hg`)** | Iron (`Fe`), Platinum (`Pt`), and Tungsten (`W`) do **NOT** form amalgams with Mercury |

**Did You Know?:** The **Thermite Reaction** (`Fe2O3 + 2Al -> 2Fe(molten) + Al2O3 + Heat`) is so intensely exothermic that the iron is produced in the molten state, making it the standard method for **joining cracked railway tracks and heavy machine parts** (NCERT Official Textbooks)!

**Exam Trap Alert: German Silver (`Copper + Zinc + Nickel`) contains ZERO percent (`0%`) Silver (`Ag`),** just as **Fool's Gold (`Iron Pyrites, FeS2`) contains ZERO Gold,** and **Lead Pencils (`Graphite + Clay`) contain ZERO Lead (`Pb`)!**

★ **Memory Trick:** For **Brass vs. Bronze**, remember **"Z in Brass, S-N in Bronze"**: **BraSS** has Zinc (`Cu + Zn`), while **BroNze** has **Sn (Tin)** (`Cu + Sn`). And for **Aqua Regia (`3 HCl : 1 HNO3`)**, notice that `HCl` **has 3 letters -> ratio 3**, while `HNO3` **has 1 nitrogen -> ratio 1**!

## Chapter 5 Comprehensive Analytical & Statutory Revision Matrix

| Core Sub-Domain | Key Concept / Provision | Verified Analytical Parameters & Exam Distinctions (NCERT Science Textbooks (Class 6–12)) |
|---|---|---|
| **Natural Organic Acids, pH Scale, and Industrial Salts** | Vinegar | Acetic Acid (`CH3COOH`); **Citrus fruits (Lemon, Orange):** Citric Acid; **Tamarind & Grapes:** Tartaric Acid; **Tomato & Spinach:** Oxalic Acid (also used to remove rust/ink stains from clothes!); **Sour Milk / Curd:** Lactic Acid; **Apple:** Malic Acid; **Ant Sting & Nettle Leaf Sting:** Methanoic Acid (**Formic Acid**, `HCOOH` — relieved by rubbing mild base like Baking Soda!). |
| **Reactivity Series, Ores, Metallurgy, and Alloys** | High-Yield NCERT pH Values | Gastric Juice = `1.2`; Lemon Juice = `2.2`; **Acid Rain** = `< 5.6`; **Tooth Enamel (`Calcium Hydroxyapatite`, hardest substance in the human body)** corrodes when mouth pH drops `< 5.5`; Milk = `6.5–6.8`; **Human Blood & Tears** = `7.35–7.45` (`7.4`); **Milk of Magnesia (`Mg(OH)2`, Antacid)** = `10.0`; Sodium Hydroxide (`NaOH`) = `14.0`. |
| **Natural Organic Acids, pH Scale, and Industrial Salts** | Caustic Soda (Sodium Hydroxide, `NaOH`) | Prepared by the **Chlor-Alkali Process** (electrolysis of aqueous `NaCl` brine releasing `Cl2` at anode and `H2` at cathode). |

| Core Sub-Domain | Key Concept / Provision | Verified Analytical Parameters & Exam Distinctions (NCERT Science Textbooks (Class 6–12)) |
|---|---|---|
| Reactivity Series, Ores, Metallurgy, and Alloys | Bleaching Powder (Calcium Oxychloride, $CaOCl2$) | Prepared by passing $Cl2$ gas over dry **Slaked Lime** ($Ca(OH)2$). |
| Natural Organic Acids, pH Scale, and Industrial Salts | Baking Soda (Sodium Hydrogen Carbonate / Bicarbonate, $NaHCO3$) | Used in antacids, soda-acid fire extinguishers, and **Baking Powder** ($NaHCO3$ + **mild edible Tartaric Acid**). |
| Reactivity Series, Ores, Metallurgy, and Alloys | Washing Soda (Sodium Carbonate Decahydrate, $Na2CO3.10H2O$) | Used in glass, soap, and paper industries, and for **removing permanent hardness of water**. |
| Natural Organic Acids, pH Scale, and Industrial Salts | Plaster of Paris ($CaSO4.(1/2)H2O$, Calcium Sulphate Hemihydrate) | Prepared by heating **Gypsum** ($CaSO4.2H2O$) **at** $373\ K\ (100\ degrees\ C)$. |
| Reactivity Series, Ores, Metallurgy, and Alloys | Reactivity Series of Metals (Decreasing Order) | $K > Na > Ca > Mg > Al > Zn > Fe > Pb > [H] > Cu > Hg > Ag > Au > Pt$. |
| Natural Organic Acids, pH Scale, and Industrial Salts | Sodium ($Na$) and Potassium ($K$) | are soft metals (can be cut with a knife) that react violently with air and cold water, so they are **stored immersed in Kerosene Oil** (whereas **White Phosphorus** is stored **under Cold Water**!). |
| Reactivity Series, Ores, Metallurgy, and Alloys | Amphoteric Oxides (React with both Acids and Bases) | Aluminium Oxide ($Al2O3$) and Zinc Oxide ($ZnO$)**. |
| Natural Organic Acids, pH Scale, and Industrial Salts | Aqua Regia ("Royal Water") | Freshly prepared mixture of **Concentrated Hydrochloric Acid** ($HCl$) **and Concentrated Nitric Acid** ($HNO3$) **in a** $3:1$ **molar/volume ratio** — dissolves noble metals **Gold** ($Au$) **and Platinum** ($Pt$) (IUC Academy). |
| Reactivity Series, Ores, Metallurgy, and Alloys | Roasting | Heating **Sulphide ores** ($ZnS, PbS, HgS$) strongly in the **presence of excess air**. |
| Natural Organic Acids, pH Scale, and Industrial Salts | Calcination | Heating **Carbonate ores** ($ZnCO3, CaCO3$) strongly in the **absence or limited supply of air**. |
| Reactivity Series, Ores, Metallurgy, and Alloys | Galvanization | Coating iron/steel with a protective layer of **Zinc** ($Zn$) to prevent rusting; **Anodizing:** Forming a thick oxide layer on **Aluminium** ($Al$). |

## Chapter 5 Multi-Statement Exam Verification Drills

### Chapter 5 Statement-Verification Drill #1

Both Statements Verified Correct

**Statement-I (Vinegar):** Acetic Acid (`CH3COOH`); **Citrus fruits (Lemon, Orange):** Citric Acid; **Tamarind & Grapes:** Tartaric Acid; **Tomato & Spinach:** Oxalic Acid (also used to remove rust/ink stains from clothes!); **Sour Milk / Curd:** Lactic Acid; **Apple:** Malic Acid; **Ant Sting & Nettle Leaf Sting:** Methanoic Acid (**Formic Acid**, `HCOOH` — relieved by rubbing mild base like Baking Soda!).

**Statement-II (High-Yield NCERT pH Values):** Gastric Juice = `1.2`; Lemon Juice = `2.2`; **Acid Rain** = `< 5.6`; **Tooth Enamel** (`Calcium Hydroxyapatite`, **hardest substance in the human body**) corrodes when mouth pH drops `< 5.5`; Milk = `6.5–6.8`; **Human Blood & Tears** = `7.35–7.45` (`7.4`); **Milk of Magnesia** (`Mg(OH)2`, **Antacid**) = `10.0`; Sodium Hydroxide (`NaOH`) = `14.0`.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

### Chapter 5 Statement-Verification Drill #2

Both Statements Verified Correct

**Statement-I (Caustic Soda (Sodium Hydroxide, `NaOH`)):** Prepared by the **Chlor-Alkali Process** (electrolysis of aqueous `NaCl` brine releasing `Cl2` at anode and `H2` at cathode).

**Statement-II (Bleaching Powder (Calcium Oxychloride, `CaOCl2`)):** Prepared by passing `Cl2` gas over dry **Slaked Lime** (`Ca(OH)2`).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

### Chapter 5 Statement-Verification Drill #3

Both Statements Verified Correct

**Statement-I (Baking Soda (Sodium Hydrogen Carbonate / Bicarbonate, `NaHCO3`)):** Used in antacids, soda-acid fire extinguishers, and **Baking Powder** (`NaHCO3 + mild edible Tartaric Acid`).

**Statement-II (Washing Soda (Sodium Carbonate Decahydrate, `Na2CO3.10H2O`)):** Used in glass, soap, and paper industries, and for **removing permanent hardness of water**.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

### Chapter 5 Statement-Verification Drill #4

Both Statements Verified Correct

**Statement-I (Plaster of Paris (`CaSO4.(1/2)H2O`, Calcium Sulphate Hemihydrate)):** Prepared by heating **Gypsum** (`CaSO4.2H2O`) **at** `373 K (100 degrees C)`.

**Statement-II (Reactivity Series of Metals (Decreasing Order)):**
`K > Na > Ca > Mg > Al > Zn > Fe > Pb > [H] > Cu > Hg > Ag > Au > Pt`.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

### Chapter 5 Statement-Verification Drill #5

Both Statements Verified Correct

**Statement-I (Sodium (`Na`) and Potassium (`K`)):** are soft metals (can be cut with a knife) that react violently with air and cold water, so they are **stored immersed in Kerosene Oil** (whereas **White Phosphorus** is stored **under Cold Water**!).

**Statement-II (Amphoteric Oxides (React with both Acids and Bases)):** Aluminium Oxide (`Al2O3`) and Zinc Oxide (`ZnO`)**.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 5 Statement-Verification Drill #6** — Both Statements Verified Correct

**Statement-I (Aqua Regia ("Royal Water")):** Freshly prepared mixture of **Concentrated Hydrochloric Acid (`HCl`) and Concentrated Nitric Acid (`HNO3`) in a `3 : 1` molar/volume ratio** — dissolves noble metals **Gold (`Au`) and Platinum (`Pt`)** (IUC Academy).

**Statement-II (Roasting):** Heating **Sulphide ores** (`ZnS, PbS, HgS`) strongly in the **presence of excess air**.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

# Chapter *6:* Carbon & Organic Chemistry, Polymers, Everyday Chemistry & Environmental Chemistry

**Chapter Key Study Pillars — Chapter 6: Carbon & Organic Chemistry, Polymers, Everyday Chemistry & Environmental Chemistry**

**Key Study Pillar 1**
**Allotropes of Carbon, Hydrocarbons, and Functional Groups**

**Key Study Pillar 2**
**Fuels, Polymers, Soaps/Detergents, and Environmental Chemistry**

## *6.1* Allotropes of Carbon, Hydrocarbons, and Functional Groups

• **Catenation, Tetravalency, and Allotropes of Carbon (NCERT Official Textbooks):**

• **Diamond (`sp^3` hybridized):** Each carbon atom is bonded to 4 other carbon atoms in a rigid **3D tetrahedral lattice**; hardest natural substance, **bad conductor of electricity** (no free electrons), but an **excellent conductor of heat**.

• **Graphite (`sp^2` hybridized):** Each carbon atom is bonded to 3 other carbon atoms in **hexagonal layered sheets** with **1 free delocalized electron per atom**; **good conductor of electricity**, soft and slippery (used as a dry high-temperature lubricant and in pencil cores).

• **Fullerenes (`C-60`, Buckminsterfullerene):** Geodesic football-shaped cage consisting of **20 hexagons and 12 pentagons** (`60 vertices`).

• **Homologous Series of Hydrocarbons (Differ by `-CH2-` unit or `14 u` molecular mass):**

• **Alkanes (Saturated, Single Bonds `C-C`):** General formula `C_n H_(2n+2)` (Methane `CH4`, Ethane `C2H6`, Propane `C3H8`, Butane `C4H10`). Undergo **Substitution Reactions** and burn with a clean **blue non-sooty flame**.

• **Alkenes (Unsaturated, Double Bond `C=C`):** General formula `C_n H_(2n)` (Ethene `C2H4` — used for artificial fruit ripening alongside Acetylene).

• **Alkynes (Unsaturated, Triple Bond `C#C`):** General formula `C_n H_(2n-2)` (Ethyne / Acetylene `C2H2` — used in **Oxy-Acetylene welding torches**).

• **Hydrogenation of Vegetable Oils:** Unsaturated vegetable oils (`liquid`) are converted into saturated **Vanaspati Ghee (`solid`)** by adding Hydrogen (`H2`) in the presence of a **Nickel (`Ni`) or Palladium (`Pd`) catalyst** (IUC Academy).

## *6.2* Fuels, Polymers, Soaps/Detergents, and Environmental Chemistry

• **Gaseous & Liquid Fuels (SSC Official Portal):**

• **LPG (Liquefied Petroleum Gas):** Primarily **Butane (** `C4H10` **) and Propane (** `C3H8` **)** + **Ethyl Mercaptan (** `C2H5SH` **)** added as a foul-smelling agent to detect leaks!

• **CNG (Compressed Natural Gas) & Biogas (Gobar Gas):** Primarily **Methane (** `CH4` **, 75%–90%)**; **Marsh Gas** and coal-mine **Firedamp** are also Methane (`CH4`).

• **Water Gas (Syngas):** `CO + H2`; **Producer Gas:** `CO + N2`.

• **Octane Number** measures the anti-knock quality of **Petrol (Gasoline)** (improved by BTX aromatics; formerly Tetraethyl Lead), whereas **Cetane Number** measures the ignition quality of **Diesel**.

• **Polymers, Soaps vs. Detergents, and Atmospheric Pollutants:**

• **Saponification & Micelle Formation: Soaps** are sodium or potassium salts of long-chain fatty acids (`R-COO^- Na^+`, failed in hard water due to insoluble calcium/magnesium scum), whereas **Detergents** are sodium salts of long-chain **benzene sulphonic acids** that work effectively in **both hard and soft water**.

• **Hardness of Water: Temporary Hardness** is caused by **Bicarbonates** of Calcium and Magnesium (removed by simple boiling or Clark's slaked-lime method); **Permanent Hardness** is caused by **Chlorides and Sulphates** of Calcium and Magnesium (`CaCl2, MgSO4` — removed by **Washing Soda** `Na2CO3`, Calgon, or Permutit/Zeolite ion-exchange).

**Step-by-Step Conceptual Process Flowchart**

**STEP 1**
**Unsaturated Vegetable Oil (C=C Double Bonds, Liquid)**

**STEP 2**
**Pass H2 Gas Over Finely Divided Nickel (Ni) Catalyst at 473 K**

**STEP 3**
**Addition Reaction Saturates C=C into C-C Single Bonds**

**STEP 4**
**Forms Saturated Vanaspati Ghee & Margarine**

| Organic / Everyday Compound | Chemical Name / Monomer | Formula / Structure | Key Exam Application (NCERT) |
|---|---|---|---|
| **Chloroform & Iodoform** | Trichloromethane / Triiodomethane | `CHCl3` / `CHI3` | Chloroform stored in dark brown bottles to prevent oxidation into poisonous **Phosgene gas (** `COCl2` **)** |
| **Teflon (PTFE) & Bakelite** | Polytetrafluoroethylene (`CF2=CF2`) / Phenol + Formaldehyde | Thermoplastic vs. Thermosetting | **Teflon:** Non-stick cookware coating; **Bakelite:** Thermosetting electrical switches & utensil handles |
| **Natural & Vulcanized Rubber** | Cis-1,4-polyisoprene (**Monomer: Isoprene**) | Heated with **3%–5% Sulphur (** `S` **)** | **Vulcanization (Charles Goodyear):** Sulphur cross-links make rubber elastic, hard, and heat-resistant |
| **Bhopal Gas Tragedy (Dec 1984)** | **Methyl Isocyanate (MIC)** | `CH3-N=C=O` | Leaked from Union Carbide pesticide plant; **Freons (CFCs)** deplete stratospheric Ozone (`O3`) |

| Organic / Everyday Compound | Chemical Name / Monomer | Formula / Structure | Key Exam Application (NCERT) |
|---|---|---|---|
| **Laughing Gas, Dry Ice & Tear Gas** | **Laughing Gas:** Nitrous Oxide; **Dry Ice:** Solid Carbon Dioxide | `N2O` / Solid `CO2` / Chloropicrin (`CCl3NO2`) | **Silver Iodide (`AgI`)** is used for **Artificial Rain (Cloud Seeding)**; **Silver Bromide (`AgBr`)** in photography |

**Did You Know?: Methanol (`CH3OH`, Wood Spirit)** is extremely toxic—consuming even small quantities oxidizes it in the liver into **Methanal (Formaldehyde)**, which coagulates cellular protoplasm and damages the **optic nerve**, causing permanent blindness and death (NCERT Official Textbooks)!

**Exam Trap Alert:** Do not confuse **Isoprene** (the monomer of **Natural Rubber**) with **Neoprene** (synthetic rubber made from **Chloroprene**), and never confuse **Methyl Isocyanate (`MIC, CH3NCO` — Bhopal Gas Tragedy)** with Methyl Cyanide or Methyl Salicylate (**Oil of Wintergreen**, used in pain-relief balms)!

★ **Memory Trick:** For **Silver Halide Applications** on IUC Academy, remember **"I for Indradev (Rain), Br for Black-and-White Photo, N for Nitrate (Voter Ink)"**: **AgI** = Artificial Rain, **AgBr** = Black-and-white Photography, **AgNO3 (Silver Nitrate / Lunar Caustic)** = Indelible Voter's Ink!

## Chapter *6* Comprehensive Analytical & Statutory Revision Matrix

| Core Sub-Domain | Key Concept / Provision | Verified Analytical Parameters & Exam Distinctions (NCERT Science Textbooks (Class 6–12)) |
|---|---|---|
| **Allotropes of Carbon, Hydrocarbons, and Functional Groups** | **Diamond (`sp^3` hybridized)** | Each carbon atom is bonded to 4 other carbon atoms in a rigid **3D tetrahedral lattice**; hardest natural substance, **bad conductor of electricity** (no free electrons), but an **excellent conductor of heat**. |
| **Fuels, Polymers, Soaps/Detergents, and Environmental Chemistry** | **Graphite (`sp^2` hybridized)** | Each carbon atom is bonded to 3 other carbon atoms in **hexagonal layered sheets** with **1 free delocalized electron per atom**; **good conductor of electricity**, soft and slippery (used as a dry high-temperature lubricant and in pencil cores). |
| **Allotropes of Carbon, Hydrocarbons, and Functional Groups** | **Fullerenes (`C-60`, Buckminsterfullerene)** | Geodesic football-shaped cage consisting of **20 hexagons and 12 pentagons** (`60 vertices`). |
| **Fuels, Polymers, Soaps/Detergents, and Environmental Chemistry** | **Alkanes (Saturated, Single Bonds `C-C`)** | General formula `C_n H_(2n+2)` (Methane `CH4`, Ethane `C2H6`, Propane `C3H8`, Butane `C4H10`). Undergo **Substitution Reactions** and burn with a clean **blue non-sooty flame**. |
| **Allotropes of Carbon, Hydrocarbons, and Functional Groups** | **Alkenes (Unsaturated, Double Bond `C=C`)** | General formula `C_n H_(2n)` (Ethene `C2H4` — used for artificial fruit ripening alongside Acetylene). |

| Core Sub-Domain | Key Concept / Provision | Verified Analytical Parameters & Exam Distinctions (NCERT Science Textbooks (Class 6–12)) |
|---|---|---|
| **Fuels, Polymers, Soaps/Detergents, and Environmental Chemistry** | **Alkynes (Unsaturated, Triple Bond C#C)** | General formula **C_n H_(2n-2)** (Ethyne / Acetylene **C2H2** — used in **Oxy-Acetylene welding torches**). |
| **Allotropes of Carbon, Hydrocarbons, and Functional Groups** | **Hydrogenation of Vegetable Oils** | Unsaturated vegetable oils (**liquid**) are converted into saturated **Vanaspati Ghee (solid)** by adding Hydrogen (**H2**) in the presence of a **Nickel (Ni) or Palladium (Pd) catalyst** (IUC Academy). |
| **Fuels, Polymers, Soaps/Detergents, and Environmental Chemistry** | **LPG (Liquefied Petroleum Gas)** | Primarily **Butane (C4H10) and Propane (C3H8) + Ethyl Mercaptan (C2H5SH)** added as a foul-smelling agent to detect leaks! |
| **Allotropes of Carbon, Hydrocarbons, and Functional Groups** | **CNG (Compressed Natural Gas) & Biogas (Gobar Gas)** | Primarily **Methane (CH4, 75%–90%)**; **Marsh Gas** and coal-mine **Firedamp** are also Methane (**CH4**). |
| **Fuels, Polymers, Soaps/Detergents, and Environmental Chemistry** | **Water Gas (Syngas)** | **CO + H2**; Producer Gas: **CO + N2** **. |
| **Allotropes of Carbon, Hydrocarbons, and Functional Groups** | **Octane Number** | measures the anti-knock quality of **Petrol (Gasoline)** (improved by BTX aromatics; formerly Tetraethyl Lead), whereas **Cetane Number** measures the ignition quality of **Diesel**. |
| **Fuels, Polymers, Soaps/Detergents, and Environmental Chemistry** | **Saponification & Micelle Formation** | Soaps **are sodium or potassium salts of long-chain fatty acids (R-COO^-Na^+, failed in hard water due to insoluble calcium/magnesium scum), whereas** Detergents **are sodium salts of long-chain** benzene sulphonic acids **that work effectively in** both hard and soft water**. |
| **Allotropes of Carbon, Hydrocarbons, and Functional Groups** | **Hardness of Water** | Temporary Hardness **is caused by** Bicarbonates **of Calcium and Magnesium (removed by simple boiling or Clark's slaked-lime method);** Permanent Hardness **is caused by** Chlorides and Sulphates **of Calcium and Magnesium (CaCl2, MgSO4 — removed by** Washing Soda **Na2CO3** **, Calgon, or Permutit/Zeolite ion-exchange). |

## Chapter *6* Multi-Statement Exam Verification Drills

**Chapter 6 Statement-Verification Drill #1** — Both Statements Verified Correct

**Statement-I (Diamond (`sp^3` hybridized)):** Each carbon atom is bonded to 4 other carbon atoms in a rigid **3D tetrahedral lattice**; hardest natural substance, **bad conductor of electricity** (no free electrons), but an **excellent conductor of heat**.

**Statement-II (Graphite (`sp^2` hybridized)):** Each carbon atom is bonded to 3 other carbon atoms in **hexagonal layered sheets** with **1 free delocalized electron per atom**; **good conductor of electricity**, soft and slippery (used as a dry high-temperature lubricant and in pencil cores).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 6 Statement-Verification Drill #2** — Both Statements Verified Correct

**Statement-I (Fullerenes (`C-60`, Buckminsterfullerene)):** Geodesic football-shaped cage consisting of **20 hexagons and 12 pentagons** (`60 vertices`).

**Statement-II (Alkanes (Saturated, Single Bonds `C-C`)):** General formula `C_n H_(2n+2)` (Methane `CH4`, Ethane `C2H6`, Propane `C3H8`, Butane `C4H10`). Undergo **Substitution Reactions** and burn with a clean **blue non-sooty flame**.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 6 Statement-Verification Drill #3** — Both Statements Verified Correct

**Statement-I (Alkenes (Unsaturated, Double Bond `C=C`)):** General formula `C_n H_(2n)` (Ethene `C2H4` — used for artificial fruit ripening alongside Acetylene).

**Statement-II (Alkynes (Unsaturated, Triple Bond `C#C`)):** General formula `C_n H_(2n-2)` (Ethyne / Acetylene `C2H2` — used in **Oxy-Acetylene welding torches**).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 6 Statement-Verification Drill #4** — Both Statements Verified Correct

**Statement-I (Hydrogenation of Vegetable Oils):** Unsaturated vegetable oils (`liquid`) are converted into saturated **Vanaspati Ghee (`solid`)** by adding Hydrogen (`H2`) in the presence of a **Nickel (`Ni`) or Palladium (`Pd`) catalyst** (IUC Academy).

**Statement-II (LPG (Liquefied Petroleum Gas)):** Primarily **Butane (`C4H10`) and Propane (`C3H8`)** + **Ethyl Mercaptan (`C2H5SH`)** added as a foul-smelling agent to detect leaks!

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 6 Statement-Verification Drill #5** — Both Statements Verified Correct

**Statement-I (CNG (Compressed Natural Gas) & Biogas (Gobar Gas)):** Primarily **Methane (`CH4`, 75%–90%)**; **Marsh Gas** and coal-mine **Firedamp** are also Methane (`CH4`).

**Statement-II (Water Gas (Syngas)):** `CO + H2`; Producer Gas: `CO + N2`**.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 6 Statement-Verification Drill #6** — Both Statements Verified Correct

**Statement-I (Octane Number):** measures the anti-knock quality of **Petrol (Gasoline)** (improved by BTX aromatics; formerly Tetraethyl Lead), whereas **Cetane Number** measures the ignition quality of **Diesel**.

**Statement-II (Saponification & Micelle Formation):** Soaps **are sodium or potassium salts of long-chain fatty acids (** `R-COO^-Na^+` **, failed in hard water due to insoluble calcium/magnesium scum), whereas** Detergents **are sodium salts of long-chain** benzene sulphonic acids **that work effectively in** both hard and soft water**.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

# Chapter 7: Cell Biology, Genetics, Plant Kingdom, Photosynthesis & Plant Physiology

**Chapter Key Study Pillars — Chapter 7: Cell Biology, Genetics, Plant Kingdom, Photosynthesis & Plant Physiology**

**Key Study Pillar 1**
**Cytology, Cell Organelles, Mitosis-Meiosis, and Nucleic Acids**

**Key Study Pillar 2**
**Genetics, Plant Kingdom Taxonomy, Plant Tissues, and Phytohormones**

## 7.1 Cytology, Cell Organelles, Mitosis-Meiosis, and Nucleic Acids

• **Landmarks in Cell Discovery (NCERT Official Textbooks):**

• **Robert Hooke (1665):** Discovered dead cork cells in *Micrographia*; **Anton van Leeuwenhoek (1674):** First observed living cells (bacteria, protozoa, RBCs, sperm); **Robert Brown (1831):** Discovered the **Nucleus**; **Schleiden (1838) & Schwann (1839):** Formulated the **Cell Theory**, expanded by **Rudolf Virchow (1855)** with "*Omnis cellula-e-cellula*" (all cells arise from pre-existing cells).

• **Prokaryotic vs. Eukaryotic Cells:** Prokaryotes (Bacteria, Blue-Green Algae/Cyanobacteria, **Mycoplasma / PPLO — smallest living cell**) lack a nuclear membrane and membrane-bound organelles and contain **70S ribosomes**, whereas Eukaryotes possess a true membrane-bound nucleus and **80S cytoplasmic ribosomes**.

• **Structure and Functions of Major Cell Organelles:**

• **Cell Wall:** Present in Plants (**Cellulose**), Fungi (**Chitin**), and Bacteria (**Peptidoglycan**); completely **absent in Animal Cells**!

• **Plasma Membrane (Fluid Mosaic Model — Singer & Nicolson, 1972):** Selectively permeable phospholipid bilayer with embedded proteins.

• **Mitochondria ("Powerhouse of the Cell", discovered by Altmann, named by Benda):** Site of aerobic cellular respiration (Krebs cycle) synthesizing **ATP (Adenosine Triphosphate — Energy Currency of the Cell)**.

• **Plastids (Plants & Euglenoids only): Chloroplasts** (contain green **Chlorophyll with a central Magnesium** `Mg^2+` **ion** for photosynthesis), **Chromoplasts** (carotenoid pigments: **Lycopene** in red tomato, **Carotene** in carrot, **Betanin** in beetroot, **Anthocyanin** in purple/blue petals), and **Leucoplasts** (colourless storage: Amyloplasts store starch, Elaioplasts store oils, Aleuroplasts store proteins).

• **Semi-Autonomous Organelles: Mitochondria and Chloroplasts** (along with the **Nucleus**) are the **ONLY organelles containing their own circular DNA and `70S` ribosomes**!

• **Lysosomes ("Suicidal Bags of the Cell", Christian de Duve):** Contain powerful hydrolytic digestive enzymes active at acidic pH.

• **Ribosomes ("Protein Factories of the Cell", George Palade):** The **ONLY non-membrane-bound organelle** found in both prokaryotes and eukaryotes!

## *7.2* Genetics, Plant Kingdom Taxonomy, Plant Tissues, and Phytohormones

• **Genetics & Nucleic Acids (IUC Academy):**

• **Gregor Johann Mendel ("Father of Genetics"):** Conducted hybridization experiments on **Garden Pea (*Pisum sativum*)**; **Monohybrid Cross (`F2`)** Phenotypic Ratio = **`3 : 1`**, Genotypic Ratio = **`1 : 2 : 1`**; **Dihybrid Cross (`F2`)** Phenotypic Ratio = **`9 : 3 : 3 : 1`**.

• **DNA vs. RNA (Double Helix Model by Watson & Crick, 1953):** DNA contains Deoxyribose sugar and nitrogenous bases **Adenine (`A = T`, 2 H-bonds), Guanine (`G === C`, 3 H-bonds), Thymine (`T`), and Cytosine (`C`)**; in **RNA**, **Uracil (`U`) replaces Thymine (`T`)**!

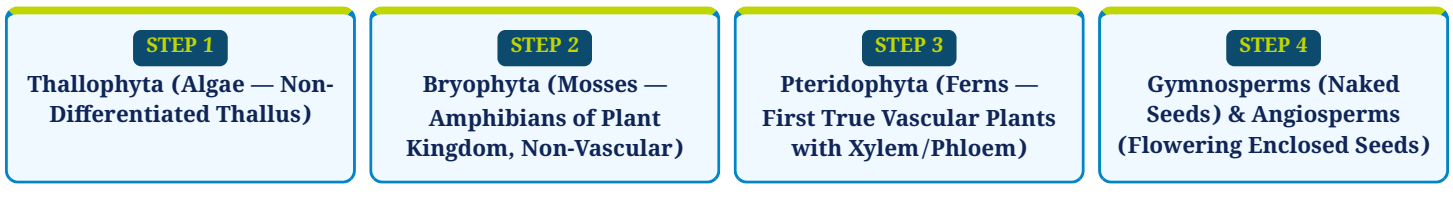
• **Human Chromosomes: `23 Pairs = 46 Chromosomes`** (**`22 pairs of Autosomes + 1 pair of Sex Chromosomes`**: Female = **`XX`**, Male = **`XY`** — the **father's Y-chromosome determines the sex of the child**).

• **Plant Kingdom & Plant Physiology (SSC Official Portal):**

• **Five Plant Divisions: Thallophyta** (Algae — *Spirogyra*, *Chlorella*, *Laminaria*; **Lichen** = symbiotic association of **Algae/Phycobiont** + **Fungi/Mycobiont**, acts as a natural bio-indicator of **`SO2` air pollution**!), **Bryophyta** (*Mosses*, *Funaria*, *Marchantia* — **"Amphibians of the Plant Kingdom"**, non-vascular), **Pteridophyta** (*Ferns*, *Selaginella*, *Equisetum* — **first terrestrial plants with vascular tissues Xylem & Phloem**), **Gymnosperms** (*Pinus*, *Cycas*, *Ephedra* — naked seeds without fruit/ovary wall), and **Angiosperms** (Flowering plants with seeds enclosed inside fruits; exhibit **Double Fertilization** discovered by Nawaschin).

• **Plant Vascular & Meristematic Tissues: Xylem** conducts **water and minerals unidirectionally** upward from roots; **Phloem** translocates **food (sucrose) bidirectionally** from leaves; **Apical Meristem** increases shoot/root length, **Lateral Meristem (Cambium)** increases stem girth (secondary growth), and **Sclerenchyma** (dead lignified tissue, e.g., **coconut husk**) provides rigid mechanical strength.

**Step-by-Step Conceptual Process Flowchart**



| Plant Hormone (Phytohormone) | Category (Promoter / Inhibitor) | Primary Physiological Function in Plants | Key Exam Fact / Agricultural Use (NCERT) |
|---|---|---|---|
| **Auxins (IAA, IBA, 2,4-D)** | Growth Promoter | Apical dominance, **phototropism** (bending toward light), root initiation in stem cuttings | 2,4-D is widely used as a selective **weedicide** to kill dicot weeds in monocot wheat fields |
| **Gibberellins (GA3)** | Growth Promoter | Stem **internode elongation (bolting)**, breaking seed dormancy, inducing parthenocarpy (seedless large grapes) | Discovered from the fungus *Gibberella fujikuroi* causing "foolish seedling" (*bakanae*) disease in rice |
| **Cytokinins (Zeatin, Kinetin)** | Growth Promoter | Promotes rapid **cell division (cytokinesis)**, delays leaf senescence (**Richmond-Lang Effect**), opens stomata | Found in high concentration in **coconut water** and developing root apices/fruits |
| **Ethylene (C2H4)** | **Gaseous** Regulator | **Natural fruit ripening**, accelerates abscission of leaves/flowers, breaks bud dormancy | The **ONLY gaseous plant hormone**; artificial ripening agent **Ethephon** releases ethylene |
| **Abscisic Acid (ABA)** | Growth Inhibitor ("Stress Hormone") | Induces **closure of stomata** during drought to prevent transpiration loss, maintains seed dormancy | Acts as a physiological antagonist to Gibberellins |

**Step-by-Step Conceptual Process Flowchart**

**STEP 1**

**Did You Know?: During Photosynthesis** (`6CO2 + 12H2O -- (Light + Chlorophyll)**

**STEP 2**

**C6H12O6 + 6O2 + 6H2O), the Oxygen (O2) gas released into the atmosphere comes 100% from the photolysis (splitting) of Water (H2O), NOT from Carbon Dioxide (CO2), and photosynthesis occurs at its maximum rate in Red light (660–700 nm`) followed by Blue light, and is minimum in Green light (NCERT Official Textbooks)!**

**Exam Trap Alert:** Remember that **Mitochondria and Chloroplasts** (along with the **Nucleus**) are the **only three structures in a plant cell that contain their own DNA**; in an **animal cell** (which lacks plastids), only the **Nucleus and Mitochondria** contain DNA!

★ **Memory Trick:** For **Xylem vs. Phloem**, use the phonetic trick **"J-a-l = Xylem, Ph-a-l (Food) = Phloem"**: **Xylem** carries **Jal (Water & Minerals)** upward, while **Phloem** carries **Phal (Food / Sucrose)** throughout the plant (IUC Academy).

## Chapter 7 Comprehensive Analytical & Statutory Revision Matrix

| Core Sub-Domain | Key Concept / Provision | Verified Analytical Parameters & Exam Distinctions (NCERT Science Textbooks (Class 6–12)) |
|---|---|---|
| **Cytology, Cell Organelles, Mitosis-Meiosis, and Nucleic Acids** | **Robert Hooke (1665)** | Discovered dead cork cells in *Micrographia*; **Anton van Leeuwenhoek (1674):** First observed living cells (bacteria, protozoa, RBCs, sperm); **Robert Brown (1831):** Discovered the **Nucleus**; **Schleiden (1838) & Schwann (1839):** Formulated the **Cell Theory**, expanded by **Rudolf Virchow (1855)** with "*Omnis cellula-e-cellula*" (all cells arise from pre-existing cells). |

| Core Sub-Domain | Key Concept / Provision | Verified Analytical Parameters & Exam Distinctions (NCERT Science Textbooks (Class 6–12)) |
|---|---|---|
| **Genetics, Plant Kingdom Taxonomy, Plant Tissues, and Phytohormones** | **Prokaryotic vs. Eukaryotic Cells** | Prokaryotes (Bacteria, Blue-Green Algae/Cyanobacteria, **Mycoplasma / PPLO — smallest living cell**) lack a nuclear membrane and membrane-bound organelles and contain `70S` **ribosomes**, whereas Eukaryotes possess a true membrane-bound nucleus and `80S` **cytoplasmic ribosomes**. |
| **Cytology, Cell Organelles, Mitosis-Meiosis, and Nucleic Acids** | **Cell Wall** | Present in Plants (**Cellulose**), Fungi (**Chitin**), and Bacteria (**Peptidoglycan**); completely **absent in Animal Cells**! |
| **Genetics, Plant Kingdom Taxonomy, Plant Tissues, and Phytohormones** | **Plasma Membrane (`Fluid Mosaic Model — Singer & Nicolson, 1972`)** | Selectively permeable phospholipid bilayer with embedded proteins. |
| **Cytology, Cell Organelles, Mitosis-Meiosis, and Nucleic Acids** | **Mitochondria ("Powerhouse of the Cell", discovered by Altmann, named by Benda)** | Site of aerobic cellular respiration (Krebs cycle) synthesizing **ATP (`Adenosine Triphosphate` — Energy Currency of the Cell)**. |
| **Genetics, Plant Kingdom Taxonomy, Plant Tissues, and Phytohormones** | **Plastids (Plants & Euglenoids only)** | Chloroplasts **(contain green** Chlorophyll with a central Magnesium `Mg^2+` ion **for photosynthesis),** Chromoplasts **(carotenoid pigments:** Lycopene **in red tomato,** Carotene **in carrot,** Betanin **in beetroot,** Anthocyanin **in purple/blue petals), and** Leucoplasts** (colourless storage: Amyloplasts store starch, Elaioplasts store oils, Aleuroplasts store proteins). |
| **Cytology, Cell Organelles, Mitosis-Meiosis, and Nucleic Acids** | **Semi-Autonomous Organelles** | Mitochondria and Chloroplasts **(along with the** Nucleus**) are the** ONLY organelles containing their own circular DNA and `70S` ribosomes**! |
| **Genetics, Plant Kingdom Taxonomy, Plant Tissues, and Phytohormones** | **Lysosomes ("Suicidal Bags of the Cell", Christian de Duve)** | Contain powerful hydrolytic digestive enzymes active at acidic pH. |
| **Cytology, Cell Organelles, Mitosis-Meiosis, and Nucleic Acids** | **Ribosomes ("Protein Factories of the Cell", George Palade)** | The **ONLY non-membrane-bound organelle** found in both prokaryotes and eukaryotes! |
| **Genetics, Plant Kingdom Taxonomy, Plant Tissues, and Phytohormones** | **Gregor Johann Mendel ("Father of Genetics")** | Conducted hybridization experiments on **Garden Pea (*Pisum sativum*)**; **Monohybrid Cross (`F2`)** Phenotypic Ratio = `3 : 1`, Genotypic Ratio = `1 : 2 : 1`; **Dihybrid Cross (`F2`)** Phenotypic Ratio = `9 : 3 : 3 : 1`. |
| **Cytology, Cell Organelles, Mitosis-Meiosis, and Nucleic Acids** | **DNA vs. RNA (Double Helix Model by Watson & Crick, 1953)** | DNA contains Deoxyribose sugar and nitrogenous bases **Adenine (`A = T`, 2 H-bonds), Guanine (`G === C`, 3 H-bonds), Thymine (`T`), and Cytosine (`C`)**; in **RNA, Uracil (`U`) replaces Thymine (`T`)**! |

| Core Sub-Domain | Key Concept / Provision | Verified Analytical Parameters & Exam Distinctions (NCERT Science Textbooks (Class 6–12)) |
|---|---|---|
| **Genetics, Plant Kingdom Taxonomy, Plant Tissues, and Phytohormones** | **Human Chromosomes** | **23 Pairs = 46 Chromosomes** ( **22 pairs of Autosomes + 1 pair of Sex Chromosomes** : **Female** = **XX**, **Male** = **XY** — **the** father's Y-chromosome determines the sex of the child**). |
| **Cytology, Cell Organelles, Mitosis-Meiosis, and Nucleic Acids** | **Five Plant Divisions** | Thallophyta **(Algae — *Spirogyra*, *Chlorella*, *Laminaria*;** Lichen = **symbiotic association of** Algae/Phycobiont + Fungi/Mycobiont**, acts as a natural bio-indicator of** **SO2** air pollution**!),** Bryophyta **(*Mosses*, *Funaria*, *Marchantia* —** "Amphibians of the Plant Kingdom"**, non-vascular),** Pteridophyta **(*Ferns*, *Selaginella*, *Equisetum* —** first terrestrial plants with vascular tissues Xylem & Phloem**),** Gymnosperms **(*Pinus*, *Cycas*, *Ephedra* — naked seeds without fruit/ovary wall), and** Angiosperms **(Flowering plants with seeds enclosed inside fruits; exhibit** Double Fertilization** discovered by Nawaschin). |
| **Genetics, Plant Kingdom Taxonomy, Plant Tissues, and Phytohormones** | **Plant Vascular & Meristematic Tissues** | Xylem **conducts** water and minerals unidirectionally **upward from roots;** Phloem **translocates** food (sucrose) bidirectionally **from leaves;** Apical Meristem **increases shoot/root length,** Lateral Meristem (Cambium) **increases stem girth (secondary growth), and** Sclerenchyma **(dead lignified tissue, e.g.,** coconut husk**) provides rigid mechanical strength. |

## Chapter 7 Multi-Statement Exam Verification Drills

**Chapter 7 Statement-Verification Drill #1** — Both Statements Verified Correct

**Statement-I (Robert Hooke (1665)):** Discovered dead cork cells in *Micrographia*; **Anton van Leeuwenhoek (1674):** First observed living cells (bacteria, protozoa, RBCs, sperm); **Robert Brown (1831):** Discovered the **Nucleus**; **Schleiden (1838) & Schwann (1839):** Formulated the **Cell Theory**, expanded by **Rudolf Virchow (1855)** with "*Omnis cellula-e-cellula*" (all cells arise from pre-existing cells).

**Statement-II (Prokaryotic vs. Eukaryotic Cells):** Prokaryotes (Bacteria, Blue-Green Algae/Cyanobacteria, **Mycoplasma / PPLO — smallest living cell**) lack a nuclear membrane and membrane-bound organelles and contain **70S** **ribosomes**, whereas Eukaryotes possess a true membrane-bound nucleus and **80S** **cytoplasmic ribosomes**.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 7 Statement-Verification Drill #2** — Both Statements Verified Correct

**Statement-I (Cell Wall):** Present in Plants (**Cellulose**), Fungi (**Chitin**), and Bacteria (**Peptidoglycan**); completely **absent in Animal Cells**!

**Statement-II (Plasma Membrane (** **Fluid Mosaic Model — Singer & Nicolson, 1972** **)):** Selectively permeable phospholipid bilayer with embedded proteins.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 7 Statement-Verification Drill #3** — Both Statements Verified Correct

**Statement-I (Mitochondria ("Powerhouse of the Cell", discovered by Altmann, named by Benda)):** Site of aerobic cellular respiration (Krebs cycle) synthesizing **ATP (`Adenosine Triphosphate` — Energy Currency of the Cell)**.

**Statement-II (Plastids (Plants & Euglenoids only)):** Chloroplasts **(contain green** Chlorophyll with a central Magnesium `Mg^2+` ion **for photosynthesis),** Chromoplasts **(carotenoid pigments:** Lycopene **in red tomato,** Carotene **in carrot,** Betanin **in beetroot,** Anthocyanin **in purple/blue petals), and** Leucoplasts** (colourless storage: Amyloplasts store starch, Elaioplasts store oils, Aleuroplasts store proteins).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 7 Statement-Verification Drill #4** — Both Statements Verified Correct

**Statement-I (Semi-Autonomous Organelles):** Mitochondria and Chloroplasts **(along with the** Nucleus**) are the** ONLY organelles containing their own circular DNA and `70S` ribosomes**!

**Statement-II (Lysosomes ("Suicidal Bags of the Cell", Christian de Duve)):** Contain powerful hydrolytic digestive enzymes active at acidic pH.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 7 Statement-Verification Drill #5** — Both Statements Verified Correct

**Statement-I (Ribosomes ("Protein Factories of the Cell", George Palade)):** The **ONLY non-membrane-bound organelle** found in both prokaryotes and eukaryotes!

**Statement-II (Gregor Johann Mendel ("Father of Genetics")):** Conducted hybridization experiments on **Garden Pea (*Pisum sativum*); Monohybrid Cross (`F2`)** Phenotypic Ratio = `3 : 1`, Genotypic Ratio = `1 : 2 : 1`; **Dihybrid Cross (`F2`)** Phenotypic Ratio = `9 : 3 : 3 : 1`.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 7 Statement-Verification Drill #6** — Both Statements Verified Correct

**Statement-I (DNA vs. RNA (Double Helix Model by Watson & Crick, 1953)):** DNA contains Deoxyribose sugar and nitrogenous bases **Adenine (`A = T`, 2 H-bonds), Guanine (`G === C`, 3 H-bonds), Thymine (`T`), and Cytosine (`C`)**; in **RNA, Uracil (`U`) replaces Thymine (`T`)**!

**Statement-II (Human Chromosomes):** `23 Pairs = 46 Chromosomes` **(`22 pairs of Autosomes + 1 pair of Sex Chromosomes`: Female =** `XX`**, Male =** `XY` **— the** father's Y-chromosome determines the sex of the child**).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

# Chapter 8: Animal Taxonomy, Human Organ Systems, Endocrinology, Nutrition & Human Diseases

**Chapter Key Study Pillars — Chapter 8: Animal Taxonomy, Human Organ Systems, Endocrinology, Nutrition & Human Diseases**

**Key Study Pillar 1**
**Animal Kingdom Phyla and Human Organ Systems**

**Key Study Pillar 2**
**Endocrine Glands, Vitamins, and Communicable / Deficiency Diseases**

## 8.1 Animal Kingdom Phyla and Human Organ Systems

• **Key Non-Chordate and Chordate Phyla (NCERT Official Textbooks):**

• **Porifera** (*Sponges — Sycon, Spongilla, Euspongia*): Cellular level of organization, canal system with ostia and osculum.

• **Cnidaria / Coelenterata** (*Hydra, Jellyfish/Aurelia, Sea Anemone/Adamsia, Corals*): Tissue level, stinging cnidoblasts.

• **Platyhelminthes (Flatworms):** *Planaria, Liver Fluke* (*Fasciola*), *Tapeworm* (*Taenia*) — dorso-ventrally flattened, **acoelomate**, excretion via **Flame Cells (Protonephridia)**.

• **Aschelminthes / Nematoda:** *Ascaris, Wuchereria* (*Filarial worm*), *Ancylostoma* (*Hookworm*) — **pseudocoelomate**!

• **Annelida (Segmented Worms):** *Earthworm* (*Pheretima*), *Leech* (*Hirudinaria*), *Nereis* — true coelomate, metamerism, excretion via **Nephridia**.

• **Arthropoda (Largest Phylum in Animal Kingdom):** *Insects, Spiders, Scorpions, Crabs, Prawns* — jointed appendages, chitinous exoskeleton, open circulatory system, excretion via **Malpighian Tubules** (Green glands in prawns).

• **Mollusca (Second Largest Phylum):** *Octopus* ("*Devil Fish*"), *Sepia* ("*Cuttlefish*"), *Pila, Pinctada* — soft body with calcareous shell.

• **Echinodermata (Exclusively Marine):** *Starfish* (*Asterias*), *Sea Urchin, Sea Cucumber* — spiny skin, **Water Vascular System**, radial symmetry in adults (bilateral in larvae!).

• **Human Digestive, Circulatory, Excretory, and Nervous Systems (IUC Academy):**

• **Digestion:** Starts in the mouth via **Salivary Amylase (Ptyalin)** digesting starch into maltose (**pH 6.8**); **Stomach** secretes **HCl**, **Pepsin** (digests proteins), and **Rennin** (digests milk protein **Casein** in infants); **Liver** (largest gland in the body, **~1.5 kg**) secretes alkaline **Bile Juice** (stored in the Gall Bladder; **contains NO enzymes**, yet **emulsifies fats!**); **Pancreas** (second-largest gland, mixed exocrine-endocrine gland) secretes **Trypsin** (proteins), **Amylase** (carbohydrates), and **Lipase** (fats); complete digestion and villi absorption occur in the **Small Intestine** (**Duodenum -> Jejunum -> Ileum**).

• **Blood & Heart:** Human heart is **4-chambered** (**SA Node** in the Right Atrium is the natural **Pacemaker**); **Arteries** carry oxygenated blood away from the heart (**Exception: Pulmonary Artery** carries deoxygenated

blood to the lungs!), while **Veins** carry deoxygenated blood toward the heart (**Exception: Pulmonary Vein** carries oxygenated blood from lungs to Left Atrium!). **ABO Blood Groups** discovered by **Karl Landsteiner (1900)**: **Universal Donor** = **O negative (O^-)** (no antigens); **Universal Recipient** = **AB positive (AB^+)** (no antibodies).

• **Kidneys & Brain:** Structural and functional unit of the Kidney is the **Nephron** (**~1 million per kidney**, performs ultrafiltration in **Bowman's Capsule**; yellow colour of urine is due to **Urochrome**); functional unit of the Nervous System is the **Neuron** (**Cerebrum** = intelligence, memory, voluntary thought; **Hypothalamus** = body temperature, hunger, thirst, circadian clock; **Cerebellum** = posture and muscular balance; **Medulla Oblongata** = involuntary heartbeat, breathing, vomiting, and sneezing).

## *8.2* Endocrine Glands, Vitamins, and Communicable / Deficiency Diseases

• **Endocrine Glands & Hormones (SSC Official Portal):**

• **Pituitary Gland ("Master Gland", controlled by Hypothalamus):** Secretes Growth Hormone (**GH** — deficiency causes Dwarfism, excess causes Gigantism and adult bone-enlargement disorder), **TSH**, **ACTH**, Prolactin, **Oxytocin** (birth/milk ejection hormone), and **Vasopressin (ADH — deficiency causes Diabetes Insipidus)**.

• **Thyroid Gland (Largest Endocrine Gland):** Requires **Iodine** to synthesize **Thyroxine (T4)**; deficiency causes **Simple Goitre, Cretinism (children), and Myxoedema (adults)**.

• **Pancreas (Islets of Langerhans): Beta (beta) cells** secrete **Insulin** (discovered by Banting & Best; converts excess blood glucose into glycogen — **deficiency causes Diabetes Mellitus**), while **Alpha (alpha) cells** secrete **Glucagon** (raises blood glucose).

• **Adrenal Gland ("Emergency 3F Gland — Fight, Flight, Fright"):** Secretes **Adrenaline (Epinephrine)**.

**Step-by-Step Conceptual Process Flowchart**

**STEP 1**
**Mouth (Salivary Amylase Digests Starch at pH 6.8)**

**STEP 2**
**Stomach (HCl + Pepsin Digests Proteins at pH 1.8)**

**STEP 3**
**Duodenum (Liver Bile Emulsifies Fats + Pancreatic Trypsin/ Amylase/Lipase)**

**STEP 4**
**Ileum Villi Absorb Glucose, Amino Acids & Fatty Acids into Blood/Lymph**

| Vitamin (Fat vs. Water Soluble) | Chemical Name | Major Deficiency Disease / Disorder | Rich Dietary Sources & Special Facts (NCERT) |
|---|---|---|---|
| **Vitamin A** (Fat-Soluble) | **Retinol** | **Night Blindness (Nyctalopia)** & **Xerophthalmia** (dryness/ keratinization of cornea) | Carrot, Golden Rice, Papaya, Cod liver oil, Green leafy vegetables |
| **Vitamin B1, B2, B3, B12** (Water-Soluble) | **B1:** Thiamine; **B2:** Riboflavin; **B3:** Niacin; **B12: Cyanocobalamin** | **B1: Beri-Beri**; **B2:** Cheilosis; **B3: Pellagra (4D Syndrome)**; **B12: Pernicious Anaemia** | **Vitamin B12 contains Cobalt (Co) metal!** (**B6** = Pyridoxine, **B7** = Biotin, **B9** = Folic Acid) |
| **Vitamin C** (Water-Soluble) | **Ascorbic Acid** | **Scurvy** (bleeding gums, delayed wound healing) | **Amla (Indian Gooseberry)**, Citrus fruits; destroyed by heating; excreted in urine (**absent in milk & eggs**) |

| Vitamin (Fat vs. Water Soluble) | Chemical Name | Major Deficiency Disease / Disorder | Rich Dietary Sources & Special Facts (NCERT) |
|---|---|---|---|
| **Vitamin D** (Fat-Soluble) | **Calciferol** (**D2** Ergocalciferol, **D3** Cholecalciferol) | **Rickets** (in children) & **Osteomalacia** (in adults) | Synthesized by human skin in **morning sunlight** ("Sunshine Vitamin"); promotes Calcium absorption |
| **Vitamin E & Vitamin K** (Fat-Soluble) | **E: Tocopherol**; **K: Phylloquinone** (Naphthoquinone) | **E: Reproductive Sterility / Muscular Weakness**; **K: Non-clotting of Blood (Haemorrhage)** | Vitamin E is called the **"Beauty / Anti-Sterility Vitamin"**; Vitamin K synthesizes **Prothrombin** in the liver |

**Did You Know?: False Fishes vs. True Fishes (Pisces): Jellyfish (Cnidaria), Starfish (Echinodermata), Devilfish / Cuttlefish (Mollusca), Silverfish (Arthropoda — wingless insect)**, and **Crayfish (Arthropoda — crustacean)** are **NOT true fishes**, whereas **Seahorse (*Hippocampus*), Dogfish (*Scoliodon* — Shark), Sawfish, and Flying Fish (*Exocoetus*)** ARE **true vertebrate fishes** (and **Whales & Dolphins** are warm-blooded **Mammals**!) (NCERT Official Textbooks).

**Exam Trap Alert:** Never confuse the causative pathogens of major human diseases:

- **Bacterial Diseases: Tuberculosis (TB — *Mycobacterium tuberculosis*, BCG vaccine), Typhoid (*Salmonella typhi*, Widal Test), Cholera (*Vibrio cholerae*), Tetanus, Diphtheria, Pertussis (Whooping Cough — DPT vaccine), Leprosy (Hansen's Disease), Plague, and Pneumonia.**
- **Viral Diseases: AIDS (HIV retrovirus, ELISA Test), Dengue (*Aedes aegypti* mosquito, platelet drop), Polio, Rabies (Hydrophobia, vaccine by Louis Pasteur), Measles, Mumps, Chickenpox, Smallpox (vaccine by Edward Jenner), Hepatitis (Jaundice — affects Liver), Influenza, and COVID-19.**
- **Protozoan Diseases: Malaria (*Plasmodium*, vector: Female *Anopheles* mosquito, treated with Quinine from Cinchona bark), Kala-Azar (*Leishmania donovani*, vector: Sandfly), Sleeping Sickness (*Trypanosoma*, vector: Tsetse fly), and Amoebic Dysentery (*Entamoeba histolytica*)!**

★ **Memory Trick:** Remember **Water-Soluble vs. Fat-Soluble Vitamins** with **"W-B-C, K-E-D-A"**: Only **Vitamins B and C are Water-Soluble (WBC)**, while **Vitamins K, E, D, and A (KEDA) are Fat-Soluble** and stored in the liver and adipose tissues (IUC Academy).

## Chapter *8* Comprehensive Analytical & Statutory Revision Matrix

| Core Sub-Domain | Key Concept / Provision | Verified Analytical Parameters & Exam Distinctions (NCERT Science Textbooks (Class 6–12)) |
|---|---|---|
| **Animal Kingdom Phyla and Human Organ Systems** | **Porifera** | (*Sponges — Sycon, Spongilla, Euspongia*): Cellular level of organization, canal system with ostia and osculum. |
| **Endocrine Glands, Vitamins, and Communicable / Deficiency Diseases** | **Cnidaria / Coelenterata** | (*Hydra, Jellyfish/Aurelia, Sea Anemone/Adamsia, Corals*): Tissue level, stinging cnidoblasts. |

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| **Endocrine Glands, Vitamins, and Communicable / Deficiency Diseases** | **Aschelminthes / Nematoda** | Ascaris, Wuchereria (Filarial worm), Ancylostoma (Hookworm)* — **pseudocoelomate**! |
| **Animal Kingdom Phyla and Human Organ Systems** | **Annelida (Segmented Worms)** | Earthworm (Pheretima), Leech (Hirudinaria), Nereis* — true coelomate, metamerism, excretion via **Nephridia**. |
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| **Endocrine Glands, Vitamins, and Communicable / Deficiency Diseases** | **Echinodermata (Exclusively Marine)** | Starfish (Asterias), Sea Urchin, Sea Cucumber* — spiny skin, **Water Vascular System**, radial symmetry in adults (bilateral in larvae!). |
| **Animal Kingdom Phyla and Human Organ Systems** | **Digestion** | Starts in the mouth via **Salivary Amylase (Ptyalin)** digesting starch into maltose (**pH 6.8**); **Stomach** secretes **HCl**, **Pepsin** (digests proteins), and **Rennin** (digests milk protein **Casein** in infants); **Liver** (largest gland in the body, **~1.5 kg**) secretes alkaline **Bile Juice** (stored in the Gall Bladder; **contains NO enzymes**, yet **emulsifies fats**!); **Pancreas** (second-largest gland, mixed exocrine-endocrine gland) secretes **Trypsin** (proteins), **Amylase** (carbohydrates), and **Lipase** (fats); complete digestion and villi absorption occur in the **Small Intestine** (**Duodenum -> Jejunum -> Ileum**). |
| **Endocrine Glands, Vitamins, and Communicable / Deficiency Diseases** | **Blood & Heart** | Human heart is **4-chambered** (**SA Node** in the Right Atrium is the natural **Pacemaker**); **Arteries** carry oxygenated blood away from the heart (**Exception: Pulmonary Artery** carries deoxygenated blood to the lungs!), while **Veins** carry deoxygenated blood toward the heart (**Exception: Pulmonary Vein** carries oxygenated blood from lungs to Left Atrium!). **ABO Blood Groups** discovered by **Karl Landsteiner (1900)**: **Universal Donor** = **O negative (O^-)** (no antigens); **Universal Recipient** = **AB positive (AB^+)** (no antibodies). |
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| **Endocrine Glands, Vitamins, and Communicable / Deficiency Diseases** | **Pancreas (Islets of Langerhans)** | Beta (`beta`) cells **secrete** Insulin **(discovered by Banting & Best; converts excess blood glucose into glycogen** — deficiency causes Diabetes Mellitus**), while** Alpha (`alpha`) cells **secrete** Glucagon** (raises blood glucose). |

## Chapter *8* Multi-Statement Exam Verification Drills

**Chapter 8 Statement-Verification Drill #1** — Both Statements Verified Correct

**Statement-I (Porifera):** (*Sponges — Sycon, Spongilla, Euspongia*): Cellular level of organization, canal system with ostia and osculum.

**Statement-II (Cnidaria / Coelenterata):** (*Hydra, Jellyfish/Aurelia, Sea Anemone/Adamsia, Corals*): Tissue level, stinging cnidoblasts.

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**Chapter 8 Statement-Verification Drill #2** — Both Statements Verified Correct

**Statement-I (Platyhelminthes (Flatworms)):** Planaria, Liver Fluke (Fasciola), Tapeworm (Taenia)* — dorso-ventrally flattened, **acoelomate**, excretion via **Flame Cells (Protonephridia)**.

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**Statement-II (Arthropoda (Largest Phylum in Animal Kingdom)):** Insects, Spiders, Scorpions, Crabs, Prawns* — jointed appendages, chitinous exoskeleton, open circulatory system, excretion via **Malpighian Tubules** (Green glands in prawns).

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**Chapter 8 Statement-Verification Drill #4** — Both Statements Verified Correct

**Statement-I (Mollusca (Second Largest Phylum)):** Octopus ("Devil Fish"), Sepia ("Cuttlefish"), Pila, Pinctada* — soft body with calcareous shell.

**Statement-II (Echinodermata (Exclusively Marine)):** Starfish (Asterias), Sea Urchin, Sea Cucumber* — spiny skin, **Water Vascular System**, radial symmetry in adults (bilateral in larvae!).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 8 Statement-Verification Drill #5** — Both Statements Verified Correct

**Statement-I (Digestion):** Starts in the mouth via **Salivary Amylase (Ptyalin)** digesting starch into maltose (**pH 6.8**); **Stomach** secretes **HCl**, **Pepsin** (digests proteins), and **Rennin** (digests milk protein **Casein** in infants); **Liver** (largest gland in the body, **~1.5 kg**) secretes alkaline **Bile Juice** (stored in the Gall Bladder; **contains NO enzymes**, yet **emulsifies fats**!); **Pancreas** (second-largest gland, mixed exocrine-endocrine gland) secretes **Trypsin** (proteins), **Amylase** (carbohydrates), and **Lipase** (fats); complete digestion and villi absorption occur in the **Small Intestine** (**Duodenum -> Jejunum -> Ileum**).

**Statement-II (Blood & Heart):** Human heart is **4-chambered** (**SA Node** in the Right Atrium is the natural **Pacemaker**); **Arteries** carry oxygenated blood away from the heart (**Exception: Pulmonary Artery** carries deoxygenated blood to the lungs!), while **Veins** carry deoxygenated blood toward the heart (**Exception: Pulmonary Vein** carries oxygenated blood from lungs to Left Atrium!). **ABO Blood Groups** discovered by **Karl Landsteiner (1900)**: **Universal Donor** = **O negative (O^-)** (no antigens); **Universal Recipient** = **AB positive (AB^+)** (no antibodies).

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

**Chapter 8 Statement-Verification Drill #6** — Both Statements Verified Correct

**Statement-I (Kidneys & Brain):** Structural and functional unit of the Kidney is the **Nephron** (**~1 million per kidney**, performs ultrafiltration in **Bowman's Capsule**; yellow colour of urine is due to **Urochrome**); functional unit of the Nervous System is the **Neuron** (**Cerebrum** = intelligence, memory, voluntary thought; **Hypothalamus** = body temperature, hunger, thirst, circadian clock; **Cerebellum** = posture and muscular balance; **Medulla Oblongata** = involuntary heartbeat, breathing, vomiting, and sneezing).

**Statement-II (Pituitary Gland ("Master Gland", controlled by Hypothalamus)):** Secretes Growth Hormone (**GH** — deficiency causes Dwarfism, excess causes Gigantism and adult bone-enlargement disorder), **TSH**, **ACTH**, Prolactin, **Oxytocin** (birth/milk ejection hormone), and **Vasopressin (ADH — deficiency causes Diabetes Insipidus)**.

✓ **Exam Verification Key: Both Statement-I and Statement-II are factually accurate as per NCERT Science Textbooks (Class 6–12) & IUC Academy.**

## Solved Exam Practice Questions (MCQs)

**Practice Question #1** — Solved Exam MCQ

1. **What is the SI unit of Luminous Intensity?** (NCERT Official Textbooks)
(A) Lumen
(B) Lux
(C) Candela
(D) Weber

**Answer:** (C) Candela — **Explanation:** Candela (**cd**) is the fundamental SI unit of luminous intensity, whereas Lumen (**lm**) is the unit of luminous flux and Lux (**lx**) is the unit of illuminance.

**Practice Question #2** Solved Exam MCQ

2. **Which of the following is a Vector Quantity?** (SSC Official Portal)
(A) Electric Current
(B) Pressure
(C) Impulse
(D) Work
**Answer:** (C) Impulse — **Explanation:** Impulse ( `J = F * t = Delta_p` ) has both magnitude and direction and obeys vector addition, whereas current, pressure, and work are scalars.

**Practice Question #3** Solved Exam MCQ

3. **If the linear momentum of a body is doubled while its mass remains constant, its Kinetic Energy becomes:** (NCERT Official Textbooks)
(A) 2 times
(B) 4 times
(C) 8 times
(D) Half
**Answer:** (B) 4 times — **Explanation:** Since `KE = p^2 / (2*m)` , doubling momentum `p` makes kinetic energy `(2)^2 = 4 times` its initial value.

**Practice Question #4** Solved Exam MCQ

4. **What is the escape velocity of a projectile from the surface of the Earth?** (NCERT Official Textbooks)
(A) 7.9 km/s
(B) 9.8 km/s
(C) 11.2 km/s
(D) 2.38 km/s
**Answer:** (C) 11.2 km/s — **Explanation:** Escape velocity on Earth is `v_e = sqrt(2gR) = 11.2 km/s` ( `7.9 km/s` is orbital velocity near Earth's surface, and `2.38 km/s` is escape velocity on the Moon).

**Practice Question #5** Solved Exam MCQ

5. **Hydraulic brakes in automobiles work on the direct application of:** (SSC Official Portal)
(A) Bernoulli's Theorem
(B) Archimedes' Principle
(C) Pascal's Law
(D) Torricelli's Law
**Answer:** (C) Pascal's Law — **Explanation:** Pascal's Law states that pressure applied to an enclosed fluid is transmitted equally in all directions, operating hydraulic brakes and lifts.

**Practice Question #6** Solved Exam MCQ

6. **At what temperature do the Celsius and Fahrenheit thermometers show the exact same numerical reading?** (NCERT Official Textbooks)
(A) 0 degrees
(B) -40 degrees
(C) 32 degrees
(D) -273.15 degrees
**Answer:** (B) -40 degrees — **Explanation:** Setting `C = F = x` in `x/5 = (x - 32)/9` yields `9x = 5x - 160 -> 4x = -160 -> x = -40 degrees` .

**Practice Question #7** Solved Exam MCQ

7. **Pure water has its maximum density ( 1 g/cm^3 ) and minimum volume at:** (NCERT Official Textbooks)
(A) 0 degrees C
(B) 4 degrees C
(C) 100 degrees C
(D) -4 degrees C
**Answer:** (B) 4 degrees C — **Explanation:** Due to anomalous expansion of water between 0 degrees C and 4 degrees C, water reaches its peak density at 4 degrees C.

**Practice Question #8** Solved Exam MCQ

8. **Sound waves cannot travel through:** (SSC Official Portal)
(A) Steel
(B) Water
(C) Dry Air
(D) Vacuum
**Answer:** (D) Vacuum — **Explanation:** Sound is a longitudinal mechanical wave requiring a material medium; it cannot propagate through a vacuum.

**Practice Question #9** Solved Exam MCQ

9. **Optical fibres used in high-speed telecommunications and medical endoscopy operate on the principle of:** (NCERT Official Textbooks)
(A) Diffraction of light
(B) Polarization of light
(C) Total Internal Reflection (TIR)
(D) Dispersion of light
**Answer:** (C) Total Internal Reflection (TIR) — **Explanation:** Light entering the core ( higher refractive index ) strikes the cladding ( lower refractive index ) at an angle greater than the critical angle, undergoing repeated Total Internal Reflection.

**Practice Question #10** Solved Exam MCQ

10. **Which mirror is always used as a rear-view (side-wing) mirror in motor vehicles?** (NCERT Official Textbooks)
(A) Concave Mirror
(B) Plane Mirror
(C) Convex Mirror
(D) Cylindrical Mirror
**Answer:** (C) Convex Mirror — **Explanation:** A convex mirror always forms an erect, virtual, and diminished image and provides a much wider field of view of traffic behind.

**Practice Question #11** Solved Exam MCQ

11. **A person suffering from Myopia (short-sightedness) is advised to wear spectacles with a:** (SSC Official Portal)
(A) Convex lens of positive power
(B) Concave lens of negative power
(C) Cylindrical lens
(D) Plane glass plate
**Answer:** (B) Concave lens of negative power — **Explanation:** In myopia, distant images form in front of the retina; a diverging concave lens ( -D ) shifts the focus back onto the retina.

**Practice Question #12** Solved Exam MCQ

12. **An electrical fuse wire must possess which combination of physical properties?** (NCERT Official Textbooks)
(A) Low resistance and high melting point
(B) High resistance and low melting point
(C) Low resistance and low melting point
(D) High resistance and high melting point
**Answer:** (B) High resistance and low melting point — **Explanation:** Made of a Lead-Tin alloy, a fuse wire has high resistivity (to heat up rapidly via `I^2Rt` during overload) and a low melting point (to melt and break the circuit safely).

**Practice Question #13** Solved Exam MCQ

13. **Which material is used as Control Rods in a nuclear fission reactor to absorb excess neutrons?** (IUC Academy)
(A) Graphite
(B) Heavy Water (`D2O`)
(C) Cadmium or Boron
(D) Liquid Sodium
**Answer:** (C) Cadmium or Boron — **Explanation:** Cadmium and Boron rods have high neutron-absorption cross-sections; Graphite and Heavy Water are moderators, and Liquid Sodium is a coolant.

**Practice Question #14** Solved Exam MCQ

14. **Who discovered the Neutron in 1932?** (NCERT Official Textbooks)
(A) J.J. Thomson
(B) Ernest Rutherford
(C) James Chadwick
(D) Niels Bohr
**Answer:** (C) James Chadwick — **Explanation:** James Chadwick discovered the neutral subatomic particle (neutron) in 1932 by bombarding Beryllium with alpha particles.

**Practice Question #15** Solved Exam MCQ

15. **Atoms of different elements having the same Mass Number (`A`) but different Atomic Numbers (`Z`), such as `18Ar40` and `20Ca40`, are called:** (NCERT Official Textbooks)
(A) Isotopes
(B) Isobars
(C) Isotones
(D) Allotropes
**Answer:** (B) Isobars — **Explanation:** Isobars have identical mass numbers (`A = 40`) but belong to different elements (`Z = 18` and `Z = 20`).

**Practice Question #16** Solved Exam MCQ

16. **Which element has the highest Electron Gain Enthalpy (Electron Affinity) in the Modern Periodic Table?** (NCERT Official Textbooks)
(A) Fluorine
(B) Chlorine
(C) Oxygen
(D) Bromine
**Answer:** (B) Chlorine — **Explanation:** Fluorine has the highest electronegativity, whereas Chlorine (`Cl`) has the highest electron affinity because Fluorine's tiny `2p` subshell experiences inter-electronic repulsion.

**Practice Question #17** Solved Exam MCQ

17. **Which acid is injected into the human skin by an Ant Sting or Nettle Leaf hair?** (NCERT Official Textbooks)
(A) Acetic Acid
(B) Oxalic Acid
(C) Methanoic Acid (Formic Acid)
(D) Tartaric Acid
**Answer:** (C) Methanoic Acid (Formic Acid) — **Explanation:** Ant stings and stinging nettle leaves inject Methanoic acid (HCOOH), which is neutralized by rubbing baking soda (NaHCO3).

**Practice Question #18** Solved Exam MCQ

18. **What is the chemical formula of Plaster of Paris?** (SSC Official Portal)
(A) CaSO4.2H2O
(B) CaSO4.(1/2)H2O
(C) CaOCl2
(D) Na2CO3.10H2O
**Answer:** (B) CaSO4.(1/2)H2O — **Explanation:** Plaster of Paris is Calcium Sulphate Hemihydrate (CaSO4.(1/2)H2O), formed by heating Gypsum (CaSO4.2H2O) at 373 K.

**Practice Question #19** Solved Exam MCQ

19. **Which non-metal exists as a reddish-brown liquid at room temperature?** (NCERT Official Textbooks)
(A) Mercury
(B) Gallium
(C) Bromine
(D) Iodine
**Answer:** (C) Bromine — **Explanation:** Bromine (Br, Z = 35) is the only non-metal that is liquid at room temperature; Mercury (Hg) is a liquid metal.

**Practice Question #20** Solved Exam MCQ

20. **Bronze is an alloy composed of:** (SSC Official Portal)
(A) Copper and Zinc
(B) Copper and Tin
(C) Copper, Zinc, and Nickel
(D) Lead and Tin
**Answer:** (B) Copper and Tin — **Explanation:** Bronze is an alloy of Copper (Cu) and Tin (Sn), whereas Brass is an alloy of Copper (Cu) and Zinc (Zn).

**Practice Question #21** Solved Exam MCQ

21. **Cinnabar (HgS) is the principal sulphide ore of which metal?** (NCERT Official Textbooks)
(A) Lead
(B) Zinc
(C) Mercury
(D) Silver
**Answer:** (C) Mercury — **Explanation:** Cinnabar (HgS) is the primary ore of Mercury (Hg), while Galena (PbS) is the ore of Lead.

**Practice Question #22** Solved Exam MCQ

22. **Which foul-smelling sulphur compound is added to domestic LPG cylinders to detect gas leakage?** (IUC Academy)
(A) Methyl Isocyanate
(B) Ethyl Mercaptan
(C) Chloropicrin
(D) Phosgene
**Answer:** (B) Ethyl Mercaptan — **Explanation:** Butane and Propane in LPG are odourless, so Ethyl Mercaptan (`C2H5SH` / Ethanethiol) is added for instant smell detection.

**Practice Question #23** Solved Exam MCQ

23. **Which catalyst is used in the hydrogenation of unsaturated vegetable oils to manufacture Vanaspati Ghee?** (NCERT Official Textbooks)
(A) Iron (`Fe`)
(B) Vanadium Pentoxide (`V2O5`)
(C) Nickel (`Ni`)
(D) Manganese Dioxide (`MnO2`)
**Answer:** (C) Nickel (`Ni`) — **Explanation:** Finely divided Nickel (`Ni`) or Palladium (`Pd`) catalyzes the addition of `H2` across `C=C` double bonds in vegetable oils.

**Practice Question #24** Solved Exam MCQ

24. **Which cell organelle is known as the "Suicidal Bag of the Cell" because it contains powerful hydrolytic enzymes?** (NCERT Official Textbooks)
(A) Mitochondria
(B) Ribosome
(C) Lysosome
(D) Golgi Apparatus
**Answer:** (C) Lysosome — **Explanation:** Discovered by Christian de Duve, lysosomes burst and digest damaged cells using acid hydrolase enzymes during autolysis.

**Practice Question #25** Solved Exam MCQ

25. **Apart from the Nucleus, which two organelles in a plant cell possess their own circular DNA and `70S` ribosomes?** (NCERT Official Textbooks)
(A) Golgi body and Endoplasmic Reticulum
(B) Mitochondria and Chloroplasts
(C) Lysosome and Vacuole
(D) Ribosome and Centrosome
**Answer:** (B) Mitochondria and Chloroplasts — **Explanation:** Mitochondria and Plastids (Chloroplasts) are semi-autonomous organelles containing their own circular DNA and `70S` ribosomes.

**Practice Question #26** Solved Exam MCQ

26. **Which metallic ion is located at the center of the porphyrin ring of the Chlorophyll molecule?** (SSC Official Portal)
(A) Iron (`Fe^2+`)
(B) Magnesium (`Mg^2+`)
(C) Cobalt (`Co^2+`)
(D) Zinc (`Zn^2+`)
**Answer:** (B) Magnesium (`Mg^2+`) — **Explanation:** Magnesium (`Mg^2+`) sits at the center of Chlorophyll, Iron (`Fe^2+`) in Haemoglobin, and Cobalt (`Co`) in Vitamin B12.

**Practice Question #27** Solved Exam MCQ

27. **Which division of plants is known as the "Amphibians of the Plant Kingdom" because they live on soil but require water for sexual reproduction?** (NCERT Official Textbooks)
(A) Thallophyta
(B) Bryophyta
(C) Pteridophyta
(D) Gymnosperms
**Answer:** (B) Bryophyta — **Explanation:** Bryophytes (mosses and liverworts) grow in moist terrestrial habitats but need a film of water for flagellated antherozoids to reach the archegonium.

**Practice Question #28** Solved Exam MCQ

28. **Which is the ONLY naturally occurring gaseous plant hormone that promotes fruit ripening?** (NCERT Official Textbooks)
(A) Auxin
(B) Gibberellin
(C) Cytokinin
(D) Ethylene
**Answer:** (D) Ethylene — **Explanation:** Ethylene ( **C2H4** ) is a gaseous phytohormone that triggers climacteric respiration and fruit ripening.

**Practice Question #29** Solved Exam MCQ

29. **Which digestive juice contains NO enzymes, yet plays a vital role in the digestion and emulsification of fats?** (NCERT Official Textbooks)
(A) Pancreatic Juice
(B) Gastric Juice
(C) Bile Juice
(D) Succus Entericus
**Answer:** (C) Bile Juice — **Explanation:** Secreted by the Liver and stored in the Gall Bladder, Bile Juice contains bile salts (sodium glycocholate and taurocholate) that emulsify large fat globules without any digestive enzymes.

**Practice Question #30** Solved Exam MCQ

30. **Which blood vessel in the human body carries Deoxygenated Blood despite being an artery?** (IUC Academy)
(A) Aorta
(B) Coronary Artery
(C) Pulmonary Artery
(D) Renal Artery
**Answer:** (C) Pulmonary Artery — **Explanation:** The Pulmonary Artery carries deoxygenated blood from the Right Ventricle to the lungs for oxygenation, while the Pulmonary Vein carries oxygenated blood from the lungs to the Left Atrium.

**Practice Question #31** Solved Exam MCQ

31. **Which part of the human brain regulates body temperature (thermoregulation), hunger, thirst, and the pituitary gland?** (NCERT Official Textbooks)
(A) Cerebellum
(B) Medulla Oblongata
(C) Hypothalamus
(D) Pons Varolii
**Answer:** (C) Hypothalamus — **Explanation:** Located at the base of the forebrain (diencephalon), the Hypothalamus regulates body temperature ( **37 degrees C** ), appetite, thirst, and neuroendocrine secretion.

**Practice Question #32** Solved Exam MCQ

32. **Deficiency of which vitamin causes Night Blindness and Xerophthalmia?** (SSC Official Portal)
(A) Vitamin A (Retinol)
(B) Vitamin B1 (Thiamine)
(C) Vitamin C (Ascorbic Acid)
(D) Vitamin D (Calciferol)
**Answer:** (A) Vitamin A (Retinol) — **Explanation:** Vitamin A synthesizes rhodopsin (visual purple) in retinal rod cells; its deficiency causes Night Blindness and Xerophthalmia.

**Practice Question #33** Solved Exam MCQ

33. **Which vitamin is essential for the synthesis of Prothrombin in the liver and normal clotting of blood?** (NCERT Official Textbooks)
(A) Vitamin E
(B) Vitamin K
(C) Vitamin B12
(D) Vitamin C
**Answer:** (B) Vitamin K — **Explanation:** Vitamin K (Phylloquinone) is required for hepatic synthesis of clotting factors (including Prothrombin), along with Calcium ions ( `Ca^2+` ) and Fibrinogen.

**Practice Question #34** Solved Exam MCQ

34. **The** Widal Test **is a standard diagnostic blood test used to confirm which bacterial disease?** (NCERT Official Textbooks)
(A) Tuberculosis
(B) Malaria
(C) Typhoid Fever
(D) Dengue Fever
**Answer:** (C) Typhoid Fever — **Explanation:** Typhoid fever is caused by the bacterium *Salmonella typhi* (transmitted via contaminated food and water) and is diagnosed by the Widal Test.

**Practice Question #35** Solved Exam MCQ

35. **Which of the following is a Protozoan disease transmitted by the bite of an infected Sandfly?** (SSC Official Portal)
(A) Sleeping Sickness
(B) Kala-Azar (Visceral Leishmaniasis)
(C) Filariasis (Elephantiasis)
(D) Japanese Encephalitis
**Answer:** (B) Kala-Azar (Visceral Leishmaniasis) — **Explanation:** Kala-Azar is caused by the protozoan *Leishmania donovani* and transmitted by the Sandfly (*Phlebotomus*), whereas Sleeping Sickness (*Trypanosoma*) is transmitted by the Tsetse fly.

# Extended Comparative & Analytical Practice Set (Questions *36* to *75*)

**Practice Question #36** — High-Yield Comparative MCQ

**Q36. With reference to Physical Quantity and Exact Formula, which of the following is accurately matched with "Force & Weight"?**

(A) `F = m a` ; `W = m` g
(B) `W = F s cos(theta)` ; `tau = r * F`
(C) `P = W / t = F * v`
(D) `P = F / A`

**Correct Answer: (A)** | **Explanation:** For **Force & Weight** (Physical Quantity), the verified Exact Formula is `F = m a` ; `W = m` **g**. Furthermore, Newton ( `N` ) ; Dyne ( `1 N = 10^5 dyne` ). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #37** — High-Yield Comparative MCQ

**Q37. With reference to Physical Quantity and Exact Formula, which of the following is accurately matched with "Work, Energy & Torque"?**

(A) `P = W / t = F * v`
(B) `W = F s cos(theta)` ; `tau = r * F`
(C) `P = F / A`
(D) `p = m v` ; `J = F` t = Delta_p

**Correct Answer: (B)** | **Explanation:** For **Work, Energy & Torque** (Physical Quantity), the verified Exact Formula is `W = F s cos(theta)` ; `tau = r * F`. Furthermore, Joule ( `J` ) ; Erg ( `1 J = 10^7 erg` ). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #38** — High-Yield Comparative MCQ

**Q38. With reference to Physical Quantity and Exact Formula, which of the following is accurately matched with "Power"?**

(A) `P = F / A`
(B) `p = m v` ; `J = F` t = Delta_p
(C) `P = W / t = F * v`
(D) `G = F r^2 / (m_1 m_2)`

**Correct Answer: (C)** | **Explanation:** For **Power** (Physical Quantity), the verified Exact Formula is `P = W / t = F * v`. Furthermore, Watt ( `W = J/s` ) ( `1 HP = 746 W` ). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #39** — High-Yield Comparative MCQ

**Q39. With reference to Physical Quantity and Exact Formula, which of the following is accurately matched with "Pressure, Stress & Modulus"?**

(A) `p = m v` ; `J = F` t = Delta_p
(B) `G = F r^2 / (m_1 m_2)`
(C) `f` is negative ( `-f` )
(D) `P = F / A`

**Correct Answer: (D)** | **Explanation:** For **Pressure, Stress & Modulus** (Physical Quantity), the verified Exact Formula is `P = F / A`. Furthermore, Pascal ( `Pa = N/m^2` ) ( `1 Bar = 10^5 Pa` ). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #40** High-Yield Comparative MCQ

**Q40. With reference to Physical Quantity and Exact Formula, which of the following is accurately matched with "Linear Momentum & Impulse"?**

(A) `p = m v` ; `J = F` t = Delta_p
(B) `G = F r^2 / (m_1 m_2)`
(C) `f` is negative (`-f`)
(D) `f` is positive (`+f`)

**Correct Answer: (A)** | **Explanation:** For **Linear Momentum & Impulse** (Physical Quantity), the verified Exact Formula is `p = m v` ; `J = F` t = **Delta_p**. Furthermore, `kgm/s` (`N` s). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #41** High-Yield Comparative MCQ

**Q41. With reference to Physical Quantity and Exact Formula, which of the following is accurately matched with "Gravitational Constant (`G`)"?**

(A) `f` is negative (`-f`)
(B) `G = F r^2 / (m_1 m_2)`
(C) `f` is positive (`+f`)
(D) Concave (Diverging) Lens (`-D`)

**Correct Answer: (B)** | **Explanation:** For **Gravitational Constant (`G`)** (Physical Quantity), the verified Exact Formula is `G = F r^2 / (m_1 m_2)`. Furthermore, `Nm^2/kg^2` (`6.67` 10^-11). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #42** High-Yield Comparative MCQ

**Q42. With reference to Optical Device / Eye Defect and Mirror / Lens Used, which of the following is accurately matched with "Concave Mirror (Converging)"?**

(A) `f` is positive (`+f`)
(B) Concave (Diverging) Lens (`-D`)
(C) `f` is negative (`-f`)
(D) Convex (Converging) Lens (`+D`)

**Correct Answer: (C)** | **Explanation:** For **Concave Mirror (Converging)** (Optical Device / Eye Defect), the verified Mirror / Lens Used is `f` **is negative (`-f`)**. Furthermore, Real & inverted (except when object is between `P` and `F` -> Virtual, Erect & Magnified). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #43** High-Yield Comparative MCQ

**Q43. With reference to Optical Device / Eye Defect and Mirror / Lens Used, which of the following is accurately matched with "Convex Mirror (Diverging)"?**

(A) Concave (Diverging) Lens (`-D`)
(B) Convex (Converging) Lens (`+D`)
(C) Bifocal Lens / Cylindrical Lens
(D) `f` is positive (`+f`)

**Correct Answer: (D)** | **Explanation:** For **Convex Mirror (Diverging)** (Optical Device / Eye Defect), the verified Mirror / Lens Used is `f` **is positive (`+f`)**. Furthermore, Always Virtual, Erect & Diminished with a wide field of view. (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #44** High-Yield Comparative MCQ

**Q44. With reference to Optical Device / Eye Defect and Mirror / Lens Used, which of the following is accurately matched with "Myopia (Near-Sightedness)"?**

(A) Concave (Diverging) Lens ( **-D** )
(B) Convex (Converging) Lens ( **+D** )
(C) Bifocal Lens / Cylindrical Lens
(D) Ammeter: Very Low Resistance, connected in Series; Voltmeter: Very High Resistance, connected in Parallel

**Correct Answer: (A)** | **Explanation:** For **Myopia (Near-Sightedness)** (Optical Device / Eye Defect), the verified Mirror / Lens Used is **Concave (Diverging) Lens ( -D )**. Furthermore, Near objects clear; distant objects focus in front of the retina (eyeball too long). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #45** High-Yield Comparative MCQ

**Q45. With reference to Optical Device / Eye Defect and Mirror / Lens Used, which of the following is accurately matched with "Hypermetropia (Far-Sightedness)"?**

(A) Bifocal Lens / Cylindrical Lens
(B) Convex (Converging) Lens ( **+D** )
(C) Ammeter: Very Low Resistance, connected in Series; Voltmeter: Very High Resistance, connected in Parallel
(D) Galvanometer detects small currents; Rectifier ( **p-n diode** ) converts AC to DC

**Correct Answer: (B)** | **Explanation:** For **Hypermetropia (Far-Sightedness)** (Optical Device / Eye Defect), the verified Mirror / Lens Used is **Convex (Converging) Lens ( +D )**. Furthermore, Distant objects clear; near objects focus behind the retina (eyeball too short; near point **>25 cm** ). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #46** High-Yield Comparative MCQ

**Q46. With reference to Optical Device / Eye Defect and Mirror / Lens Used, which of the following is accurately matched with "Presbyopia & Astigmatism"?**

(A) Ammeter: Very Low Resistance, connected in Series; Voltmeter: Very High Resistance, connected in Parallel
(B) Galvanometer detects small currents; Rectifier ( **p-n diode** ) converts AC to DC
(C) Bifocal Lens / Cylindrical Lens
(D) Archimedes' Principle of Flotation

**Correct Answer: (C)** | **Explanation:** For **Presbyopia & Astigmatism** (Optical Device / Eye Defect), the verified Mirror / Lens Used is **Bifocal Lens / Cylindrical Lens**. Furthermore, Presbyopia: old-age loss of ciliary muscle accommodation; Astigmatism: non-spherical cornea. (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #47** High-Yield Comparative MCQ

**Q47. With reference to Scientific Instrument / Device and Physical Principle / Function, which of the following is accurately matched with "Ammeter vs. Voltmeter"?**

(A) Galvanometer detects small currents; Rectifier ( **p-n diode** ) converts AC to DC
(B) Archimedes' Principle of Flotation
(C) Atmospheric/Fluid Pressure measurement
(D) Ammeter: Very Low Resistance, connected in Series; Voltmeter: Very High Resistance, connected in Parallel

**Correct Answer: (D)** | **Explanation:** For **Ammeter vs. Voltmeter** (Scientific Instrument / Device), the verified Physical Principle / Function is **Ammeter: Very Low Resistance, connected in Series; Voltmeter: Very High Resistance, connected in Parallel**. Furthermore, Ammeter: Electric Current ( **A** ); Voltmeter: Potential Difference ( **V** ). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #48** High-Yield Comparative MCQ

**Q48. With reference to Scientific Instrument / Device and Physical Principle / Function, which of the following is accurately matched with "Galvanometer & Rectifier"?**

(A) Galvanometer detects small currents; Rectifier (**p-n diode**) converts AC to DC
(B) Archimedes' Principle of Flotation
(C) Atmospheric/Fluid Pressure measurement
(D) Stefan-Boltzmann radiation / Seismic waves / Arterial pressure

**Correct Answer: (A)** | **Explanation:** For **Galvanometer & Rectifier** (Scientific Instrument / Device), the verified Physical Principle / Function is **Galvanometer detects small currents; Rectifier (p-n diode) converts AC to DC**. Furthermore, Inverter converts DC to AC; Transformer steps AC voltage up/down. (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #49** High-Yield Comparative MCQ

**Q49. With reference to Scientific Instrument / Device and Physical Principle / Function, which of the following is accurately matched with "Lactometer & Hydrometer"?**

(A) Atmospheric/Fluid Pressure measurement
(B) Archimedes' Principle of Flotation
(C) Stefan-Boltzmann radiation / Seismic waves / Arterial pressure
(D) Decreases (nuclear charge pulls shell closer)

**Correct Answer: (B)** | **Explanation:** For **Lactometer & Hydrometer** (Scientific Instrument / Device), the verified Physical Principle / Function is **Archimedes' Principle of Flotation**. Furthermore, Lactometer: Purity/density of milk; Hydrometer: Relative density of liquids. (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #50** High-Yield Comparative MCQ

**Q50. With reference to Scientific Instrument / Device and Physical Principle / Function, which of the following is accurately matched with "Barometer, Manometer & Altimeter"?**

(A) Stefan-Boltzmann radiation / Seismic waves / Arterial pressure
(B) Decreases (nuclear charge pulls shell closer)
(C) Atmospheric/Fluid Pressure measurement
(D) Increases

**Correct Answer: (C)** | **Explanation:** For **Barometer, Manometer & Altimeter** (Scientific Instrument / Device), the verified Physical Principle / Function is **Atmospheric/Fluid Pressure measurement**. Furthermore, Barometer: Atmospheric pressure (sudden drop = Storm/Cyclone); Altimeter: Altitude in aircraft. (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #51** High-Yield Comparative MCQ

**Q51. With reference to Scientific Instrument / Device and Physical Principle / Function, which of the following is accurately matched with "Pyrometer, Seismograph & Sphygmomanometer"?**

(A) Decreases (nuclear charge pulls shell closer)
(B) Increases
(C) Exothermic: Releases heat (**Respiration, Quicklime + Water, Combustion**)
(D) Stefan-Boltzmann radiation / Seismic waves / Arterial pressure

**Correct Answer: (D)** | **Explanation:** For **Pyrometer, Seismograph & Sphygmomanometer** (Scientific Instrument / Device), the verified Physical Principle / Function is **Stefan-Boltzmann radiation / Seismic waves / Arterial pressure**. Furthermore, Pyrometer: Very high temperatures (**>800 degrees C**, Sun/furnaces); Sphygmomanometer: Blood Pressure (**120/80 mmHg**). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #52** High-Yield Comparative MCQ

**Q52. With reference to Periodic Property / Reaction Type and Trend Across Period (Left -> Right), which of the following is accurately matched with "Atomic Size (Radius)"?**

(A) Decreases (nuclear charge pulls shell closer)

(B) Increases

(C) Exothermic: Releases heat (Respiration, Quicklime + Water, Combustion)

(D) Oxidation: Gain of O, Loss of H, or Loss of Electrons (OIL)

**Correct Answer: (A)** | **Explanation:** For **Atomic Size (Radius)** (Periodic Property / Reaction Type), the verified Trend Across Period (Left -> Right) is **Decreases (nuclear charge pulls shell closer)**. Furthermore, Increases (new electron shells added). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #53** High-Yield Comparative MCQ

**Q53. With reference to Periodic Property / Reaction Type and Trend Across Period (Left -> Right), which of the following is accurately matched with "Electronegativity"?**

(A) Exothermic: Releases heat (Respiration, Quicklime + Water, Combustion)

(B) Increases

(C) Oxidation: Gain of O, Loss of H, or Loss of Electrons (OIL)

(D) Quicklime: CaO; Slaked Lime: Ca(OH)2; Limestone/Marble/Chalk: CaCO3

**Correct Answer: (B)** | **Explanation:** For **Electronegativity** (Periodic Property / Reaction Type), the verified Trend Across Period (Left -> Right) is **Increases**. Furthermore, Decreases. (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #54** High-Yield Comparative MCQ

**Q54. With reference to Periodic Property / Reaction Type and Trend Across Period (Left -> Right), which of the following is accurately matched with "Electron Affinity"?**

(A) Exothermic: Releases heat (Respiration, Quicklime + Water, Combustion)

(B) Oxidation: Gain of O, Loss of H, or Loss of Electrons (OIL)

(C) Increases

(D) Quicklime: CaO; Slaked Lime: Ca(OH)2; Limestone/Marble/Chalk: CaCO3

**Correct Answer: (C)** | **Explanation:** For **Electron Affinity** (Periodic Property / Reaction Type), the verified Trend Across Period (Left -> Right) is **Increases**. Furthermore, Decreases. (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #55** High-Yield Comparative MCQ

**Q55. With reference to Periodic Property / Reaction Type and Trend Across Period (Left -> Right), which of the following is accurately matched with "Exothermic vs. Endothermic"?**

(A) Oxidation: Gain of O, Loss of H, or Loss of Electrons (OIL)

(B) Quicklime: CaO; Slaked Lime: Ca(OH)2; Limestone/Marble/Chalk: CaCO3

(C) Blue: CuSO4.5H2O; Green: FeSO4.7H2O; White: ZnSO4.7H2O

(D) Exothermic: Releases heat (Respiration, Quicklime + Water, Combustion)

**Correct Answer: (D)** | **Explanation:** For **Exothermic vs. Endothermic** (Periodic Property / Reaction Type), the verified Trend Across Period (Left -> Right) is **Exothermic: Releases heat (Respiration, Quicklime + Water, Combustion)**. Furthermore, Endothermic: Absorbs heat (Photosynthesis, Thermal Decomposition of CaCO3). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #56** High-Yield Comparative MCQ

**Q56. With reference to Periodic Property / Reaction Type and Trend Across Period (Left -> Right), which of the following is accurately matched with "Redox (Oxidation-Reduction)"?**

(A) Oxidation: Gain of **O**, Loss of **H**, or Loss of Electrons (OIL)

(B) Quicklime: **CaO**; Slaked Lime: **Ca(OH)2**; Limestone/Marble/Chalk: **CaCO3**

(C) Blue: **CuSO4.5H2O**; Green: **FeSO4.7H2O**; White: **ZnSO4.7H2O**

(D) Brass: **Copper (Cu) + Zinc (Zn)**; Bronze: **Copper (Cu) + Tin (Sn)**

**Correct Answer: (A)** | **Explanation:** For **Redox (Oxidation-Reduction)** (Periodic Property / Reaction Type), the verified Trend Across Period (**Left -> Right**) is **Oxidation: Gain of O, Loss of H, or Loss of Electrons (OIL)**. Furthermore, Reduction: Loss of **O**, Gain of **H**, or Gain of Electrons (RIG). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #57** High-Yield Comparative MCQ

**Q57. With reference to Common Name / Alloy and Chemical Formula / Composition, which of the following is accurately matched with "Quicklime, Slaked Lime & Limestone"?**

(A) Blue: **CuSO4.5H2O**; Green: **FeSO4.7H2O**; White: **ZnSO4.7H2O**

(B) Quicklime: **CaO**; Slaked Lime: **Ca(OH)2**; Limestone/Marble/Chalk: **CaCO3**

(C) Brass: **Copper (Cu) + Zinc (Zn)**; Bronze: **Copper (Cu) + Tin (Sn)**

(D) Solder: **Lead (Pb) + Tin (Sn)**; Stainless Steel: **Fe + Cr + Ni + C**

**Correct Answer: (B)** | **Explanation:** For **Quicklime, Slaked Lime & Limestone** (Common Name / Alloy), the verified Chemical Formula / Composition is **Quicklime: CaO; Slaked Lime: Ca(OH)2; Limestone/Marble/Chalk: CaCO3**. Furthermore, Dolomite: **CaCO3.MgCO3**; Calamine (Zinc): **ZnCO3**. (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #58** High-Yield Comparative MCQ

**Q58. With reference to Common Name / Alloy and Chemical Formula / Composition, which of the following is accurately matched with "Blue, Green & White Vitriol"?**

(A) Brass: **Copper (Cu) + Zinc (Zn)**; Bronze: **Copper (Cu) + Tin (Sn)**

(B) Solder: **Lead (Pb) + Tin (Sn)**; Stainless Steel: **Fe + Cr + Ni + C**

(C) Blue: **CuSO4.5H2O**; Green: **FeSO4.7H2O**; White: **ZnSO4.7H2O**

(D) Trichloromethane / Triiodomethane

**Correct Answer: (C)** | **Explanation:** For **Blue, Green & White Vitriol** (Common Name / Alloy), the verified Chemical Formula / Composition is **Blue: CuSO4.5H2O; Green: FeSO4.7H2O; White: ZnSO4.7H2O**. Furthermore, Cinnabar (**HgS**): Ore of Mercury; Galena (**PbS**): Ore of Lead. (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #59** High-Yield Comparative MCQ

**Q59. With reference to Common Name / Alloy and Chemical Formula / Composition, which of the following is accurately matched with "Brass vs. Bronze"?**

(A) Solder: **Lead (Pb) + Tin (Sn)**; Stainless Steel: **Fe + Cr + Ni + C**

(B) Trichloromethane / Triiodomethane

(C) Polytetrafluoroethylene (**CF2=CF2**) / Phenol + Formaldehyde

(D) Brass: **Copper (Cu) + Zinc (Zn)**; Bronze: **Copper (Cu) + Tin (Sn)**

**Correct Answer: (D)** | **Explanation:** For **Brass vs. Bronze** (Common Name / Alloy), the verified Chemical Formula / Composition is **Brass: Copper (Cu) + Zinc (Zn); Bronze: Copper (Cu) + Tin (Sn)**. Furthermore, German Silver: **Cu + Zn + Ni** (Contains 0% Silver!). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #60** High-Yield Comparative MCQ

**Q60. With reference to Common Name / Alloy and Chemical Formula / Composition, which of the following is accurately matched with "Solder, Stainless Steel & Amalgam"?**

(A) Solder: **Lead (Pb) + Tin (Sn)**; Stainless Steel: **Fe + Cr + Ni + C**
(B) Trichloromethane / Triiodomethane
(C) Polytetrafluoroethylene (**CF2=CF2**) / Phenol + Formaldehyde
(D) Cis-1,4-polyisoprene (Monomer: Isoprene)

**Correct Answer: (A)** | **Explanation:** For **Solder, Stainless Steel & Amalgam** (Common Name / Alloy), the verified Chemical Formula / Composition is **Solder: Lead (Pb) + Tin (Sn); Stainless Steel: Fe + Cr + Ni + C**. Furthermore, Amalgam: Any alloy where one metal is Mercury (**Hg**). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #61** High-Yield Comparative MCQ

**Q61. With reference to Organic / Everyday Compound and Chemical Name / Monomer, which of the following is accurately matched with "Chloroform & Iodoform"?**

(A) Polytetrafluoroethylene (**CF2=CF2**) / Phenol + Formaldehyde
(B) Trichloromethane / Triiodomethane
(C) Cis-1,4-polyisoprene (Monomer: Isoprene)
(D) Methyl Isocyanate (MIC)

**Correct Answer: (B)** | **Explanation:** For **Chloroform & Iodoform** (Organic / Everyday Compound), the verified Chemical Name / Monomer is **Trichloromethane / Triiodomethane**. Furthermore, **CHCl3** / **CHI3**. (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #62** High-Yield Comparative MCQ

**Q62. With reference to Organic / Everyday Compound and Chemical Name / Monomer, which of the following is accurately matched with "Teflon (PTFE) & Bakelite"?**

(A) Cis-1,4-polyisoprene (Monomer: Isoprene)
(B) Methyl Isocyanate (MIC)
(C) Polytetrafluoroethylene (**CF2=CF2**) / Phenol + Formaldehyde
(D) Laughing Gas: Nitrous Oxide; Dry Ice: Solid Carbon Dioxide

**Correct Answer: (C)** | **Explanation:** For **Teflon (PTFE) & Bakelite** (Organic / Everyday Compound), the verified Chemical Name / Monomer is **Polytetrafluoroethylene (CF2=CF2) / Phenol + Formaldehyde**. Furthermore, Thermoplastic vs. Thermosetting. (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #63** High-Yield Comparative MCQ

**Q63. With reference to Organic / Everyday Compound and Chemical Name / Monomer, which of the following is accurately matched with "Natural & Vulcanized Rubber"?**

(A) Methyl Isocyanate (MIC)
(B) Laughing Gas: Nitrous Oxide; Dry Ice: Solid Carbon Dioxide
(C) Growth Promoter
(D) Cis-1,4-polyisoprene (Monomer: Isoprene)

**Correct Answer: (D)** | **Explanation:** For **Natural & Vulcanized Rubber** (Organic / Everyday Compound), the verified Chemical Name / Monomer is **Cis-1,4-polyisoprene (Monomer: Isoprene)**. Furthermore, Heated with 3%–5% Sulphur (**S**). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #64** High-Yield Comparative MCQ

**Q64. With reference to Organic / Everyday Compound and Chemical Name / Monomer, which of the following is accurately matched with "Bhopal Gas Tragedy (Dec 1984)"?**

(A) Methyl Isocyanate (MIC)
(B) Laughing Gas: Nitrous Oxide; Dry Ice: Solid Carbon Dioxide
(C) Growth Promoter
(D) Gaseous Regulator

**Correct Answer: (A)** | **Explanation:** For **Bhopal Gas Tragedy (Dec 1984)** (Organic / Everyday Compound), the verified Chemical Name / Monomer is **Methyl Isocyanate (MIC)**. Furthermore, `CH3-N=C=O`. (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #65** High-Yield Comparative MCQ

**Q65. With reference to Organic / Everyday Compound and Chemical Name / Monomer, which of the following is accurately matched with "Laughing Gas, Dry Ice & Tear Gas"?**

(A) Growth Promoter
(B) Laughing Gas: Nitrous Oxide; Dry Ice: Solid Carbon Dioxide
(C) Gaseous Regulator
(D) Growth Inhibitor ("Stress Hormone")

**Correct Answer: (B)** | **Explanation:** For **Laughing Gas, Dry Ice & Tear Gas** (Organic / Everyday Compound), the verified Chemical Name / Monomer is **Laughing Gas: Nitrous Oxide; Dry Ice: Solid Carbon Dioxide**. Furthermore, `N2O` / Solid `CO2` / Chloropicrin (`CCl3NO2`). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #66** High-Yield Comparative MCQ

**Q66. With reference to Plant Hormone (Phytohormone) and Category (Promoter / Inhibitor), which of the following is accurately matched with "Auxins (`IAA, IBA, 2,4-D`)"?**

(A) Gaseous Regulator
(B) Growth Inhibitor ("Stress Hormone")
(C) Growth Promoter
(D) Retinol

**Correct Answer: (C)** | **Explanation:** For **Auxins (`IAA, IBA, 2,4-D`)** (Plant Hormone (Phytohormone)), the verified Category (Promoter / Inhibitor) is **Growth Promoter**. Furthermore, Apical dominance, phototropism (bending toward light), root initiation in stem cuttings. (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #67** High-Yield Comparative MCQ

**Q67. With reference to Plant Hormone (Phytohormone) and Category (Promoter / Inhibitor), which of the following is accurately matched with "Gibberellins (`GA3`)"?**

(A) Gaseous Regulator
(B) Growth Inhibitor ("Stress Hormone")
(C) Retinol
(D) Growth Promoter

**Correct Answer: (D)** | **Explanation:** For **Gibberellins (`GA3`)** (Plant Hormone (Phytohormone)), the verified Category (Promoter / Inhibitor) is **Growth Promoter**. Furthermore, Stem internode elongation (bolting), breaking seed dormancy, inducing parthenocarpy (seedless large grapes). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #68** High-Yield Comparative MCQ

**Q68. With reference to Plant Hormone (Phytohormone) and Category (Promoter / Inhibitor), which of the following is accurately matched with "Cytokinins ( Zeatin, Kinetin )"?**

(A) Growth Promoter
(B) Gaseous Regulator
(C) Growth Inhibitor ("Stress Hormone")
(D) Retinol

**Correct Answer: (A)** | **Explanation:** For **Cytokinins ( Zeatin, Kinetin )** (Plant Hormone (Phytohormone)), the verified Category (Promoter / Inhibitor) is **Growth Promoter**. Furthermore, Promotes rapid cell division (cytokinesis), delays leaf senescence (Richmond-Lang Effect), opens stomata. (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #69** High-Yield Comparative MCQ

**Q69. With reference to Plant Hormone (Phytohormone) and Category (Promoter / Inhibitor), which of the following is accurately matched with "Ethylene ( C2H4 )"?**

(A) Growth Inhibitor ("Stress Hormone")
(B) Gaseous Regulator
(C) Retinol
(D) B1: Thiamine; B2: Riboflavin; B3: Niacin; B12: Cyanocobalamin

**Correct Answer: (B)** | **Explanation:** For **Ethylene ( C2H4 )** (Plant Hormone (Phytohormone)), the verified Category (Promoter / Inhibitor) is **Gaseous Regulator**. Furthermore, Natural fruit ripening, accelerates abscission of leaves/flowers, breaks bud dormancy. (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #70** High-Yield Comparative MCQ

**Q70. With reference to Plant Hormone (Phytohormone) and Category (Promoter / Inhibitor), which of the following is accurately matched with "Abscisic Acid ( ABA )"?**

(A) Retinol
(B) B1: Thiamine; B2: Riboflavin; B3: Niacin; B12: Cyanocobalamin
(C) Growth Inhibitor ("Stress Hormone")
(D) Ascorbic Acid

**Correct Answer: (C)** | **Explanation:** For **Abscisic Acid ( ABA )** (Plant Hormone (Phytohormone)), the verified Category (Promoter / Inhibitor) is **Growth Inhibitor ("Stress Hormone")**. Furthermore, Induces closure of stomata during drought to prevent transpiration loss, maintains seed dormancy. (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #71** High-Yield Comparative MCQ

**Q71. With reference to Vitamin (Fat vs. Water Soluble) and Chemical Name, which of the following is accurately matched with "Vitamin A (Fat-Soluble)"?**

(A) B1: Thiamine; B2: Riboflavin; B3: Niacin; B12: Cyanocobalamin
(B) Ascorbic Acid
(C) Calciferol ( D2 Ergocalciferol, D3 Cholecalciferol)
(D) Retinol

**Correct Answer: (D)** | **Explanation:** For **Vitamin A (Fat-Soluble)** (Vitamin (Fat vs. Water Soluble)), the verified Chemical Name is **Retinol**. Furthermore, Night Blindness (Nyctalopia) & Xerophthalmia (dryness/keratinization of cornea). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #72** High-Yield Comparative MCQ

**Q72. With reference to Vitamin (Fat vs. Water Soluble) and Chemical Name, which of the following is accurately matched with "Vitamin B1, B2, B3, B12 (Water-Soluble)"?**

(A) B1: Thiamine; B2: Riboflavin; B3: Niacin; B12: Cyanocobalamin

(B) Ascorbic Acid

(C) Calciferol ( D2 Ergocalciferol, D3 Cholecalciferol)

(D) E: Tocopherol; K: Phylloquinone (Naphthoquinone)

**Correct Answer: (A)** | **Explanation:** For **Vitamin B1, B2, B3, B12 (Water-Soluble)** (Vitamin (Fat vs. Water Soluble)), the verified Chemical Name is **B1: Thiamine; B2: Riboflavin; B3: Niacin; B12: Cyanocobalamin**. Furthermore, B1: Beri-Beri; B2: Cheilosis; B3: Pellagra (4D Syndrome); B12: Pernicious Anaemia. (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #73** High-Yield Comparative MCQ

**Q73. With reference to Vitamin (Fat vs. Water Soluble) and Chemical Name, which of the following is accurately matched with "Vitamin C (Water-Soluble)"?**

(A) Calciferol ( D2 Ergocalciferol, D3 Cholecalciferol)

(B) Ascorbic Acid

(C) E: Tocopherol; K: Phylloquinone (Naphthoquinone)

(D) F = m a ; W = m g

**Correct Answer: (B)** | **Explanation:** For **Vitamin C (Water-Soluble)** (Vitamin (Fat vs. Water Soluble)), the verified Chemical Name is **Ascorbic Acid**. Furthermore, Scurvy (bleeding gums, delayed wound healing). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #74** High-Yield Comparative MCQ

**Q74. With reference to Vitamin (Fat vs. Water Soluble) and Chemical Name, which of the following is accurately matched with "Vitamin D (Fat-Soluble)"?**

(A) E: Tocopherol; K: Phylloquinone (Naphthoquinone)

(B) F = m a ; W = m g

(C) Calciferol ( D2 Ergocalciferol, D3 Cholecalciferol)

(D) W = F s cos(theta) ; tau = r * F

**Correct Answer: (C)** | **Explanation:** For **Vitamin D (Fat-Soluble)** (Vitamin (Fat vs. Water Soluble)), the verified Chemical Name is **Calciferol ( D2 Ergocalciferol, D3 Cholecalciferol)**. Furthermore, Rickets (in children) & Osteomalacia (in adults). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

**Practice Question #75** High-Yield Comparative MCQ

**Q75. With reference to Vitamin (Fat vs. Water Soluble) and Chemical Name, which of the following is accurately matched with "Vitamin E & Vitamin K (Fat-Soluble)"?**

(A) F = m a ; W = m g

(B) W = F s cos(theta) ; tau = r * F

(C) P = W / t = F * v

(D) E: Tocopherol; K: Phylloquinone (Naphthoquinone)

**Correct Answer: (D)** | **Explanation:** For **Vitamin E & Vitamin K (Fat-Soluble)** (Vitamin (Fat vs. Water Soluble)), the verified Chemical Name is **E: Tocopherol; K: Phylloquinone (Naphthoquinone)**. Furthermore, E: Reproductive Sterility / Muscular Weakness; K: Non-clotting of Blood (Haemorrhage). (Source: NCERT Science Textbooks (Class 6–12) & IUC Academy).

## Rapid-Fire Last-Minute One-Liner Revision Capsule

1. **1 Light Year** = **9.46 * 10^12 km** and **1 Parsec** = **3.26 Light Years** — both are units of **Astronomical Distance**, not time (NCERT Official Textbooks).

2. **1 Horsepower (HP)** = **746 Watts** and **1 kWh (1 Commercial Unit of Electricity) = 3.6 * 10^6 Joules**.

3. A projectile achieves **maximum horizontal range** when launched at an angle of **45 degrees** with the horizontal.

4. **Action and Reaction forces** (Newton's 3rd Law) always act on **two different bodies** and never cancel each other out.

5. Acceleration due to gravity **g** (**9.8 m/s^2**) **is maximum at the Poles, minimum at the Equator, and Zero at the center of the Earth**.

6. **Escape Velocity on Earth is 11.2 km/s** (**v_e = sqrt(2gR)**), and it does **not** depend on the mass of the escaping body.

7. The time period of a simple pendulum (**T = 2pisqrt(L/g)**) **increases** when a girl standing on a swing sits down (**L** increases), and becomes **infinite** (**doesn't oscillate**) **inside an orbiting satellite** (**g_eff = 0**).

8. Raindrops are spherical due to **Surface Tension**, and oil rises in a lamp wick due to **Capillarity** (SSC Official Portal).

9. Pure water has **maximum density** (**1,000 kg/m^3**) **and minimum volume at 4 degrees C** (anomalous expansion of water).

10. **-40 degrees** is the unique temperature where **Celsius and Fahrenheit scales read the exact same value**.

11. Sound waves are **longitudinal mechanical waves**; they **cannot be polarized** and **cannot travel through a vacuum**.

12. Light waves (electromagnetic waves) are **transverse waves**; they **exhibit polarization** and travel fastest in a **vacuum** (**3 * 10^8 m/s**).

13. The minimum distance required to hear a distinct **Echo in air at 20 degrees C is 17.2 metres** (**~17 m**).

14. **SONAR** (*Sound Navigation and Ranging*) uses **Ultrasonic waves** (**>20,000 Hz**) to measure ocean depth and locate submarines.

15. **Sparkling of diamond, Mirage in deserts, and Optical Fibres** all work on **Total Internal Reflection (TIR)** (IUC Academy).

16. **Concave mirrors** are used by **dentists, in shaving mirrors, and in vehicle headlights**; **Convex mirrors** are used as **rear-view mirrors**.

17. **Myopia (Short-sightedness)** is corrected by a **Concave Lens** (**-D**); **Hypermetropia (Far-sightedness)** is corrected by a **Convex Lens** (**+D**).

18. For a normal adult human eye, the **Least Distance of Distinct Vision (Near Point) is 25 cm** and the **Far Point is Infinity**.

19. Primary Colours of Light are **Red, Green, and Blue** (**RGB**); mixing all three produces **White light**.

20. All household electrical appliances are connected in **Parallel** (**220 V, 50 Hz in India**), while a **Fuse** (**Pb + Sn alloy**) **is connected in Series**.

21. A **Bulb filament** is made of **Tungsten** (**W**, **melting point 3,380 degrees C**), while a **Heater coil** is made of **Nichrome**.

22. A **Transformer** works on **Mutual Induction** and operates **strictly on Alternating Current (AC)**, never on DC.

23. **Electron** was discovered by **J.J. Thomson**, **Proton** characterized by **Rutherford (anode rays by Goldstein)**, and **Neutron** by **James Chadwick** (NCERT Official Textbooks).

24. **Protium (`1H1`)** is the **only atom in the periodic table that has zero neutrons** in its nucleus.

25. **Cobalt-60** is used in cancer radiation therapy, **Iodine-131** for thyroid goitre, and **Carbon-14** for fossil age determination.

26. **Mendeleev's Periodic Table (1869)** was based on **Atomic Mass**, whereas **Moseley's Modern Periodic Table (1913)** is based on **Atomic Number (`Z`)**.

27. **Fluorine (`F`)** has the highest **Electronegativity**, while **Chlorine (`Cl`)** has the highest **Electron Affinity**.

28. **Sodium (`Na`) and Potassium (`K`)** are stored in **Kerosene Oil**, whereas **White Phosphorus (`P4`)** is stored under **Cold Water**.

29. **Mercury (`Hg`)** is the only **liquid Metal** at room temperature; **Bromine (`Br`)** is the only **liquid Non-Metal** at room temperature.

30. **Tooth Enamel (`Calcium Hydroxyapatite`)** is the hardest substance in the human body and corrodes when mouth **pH falls below `5.5`**.

31. **Human Blood** is slightly alkaline with a tightly regulated **pH of `7.35 to 7.45` (`7.4`)**.

32. **Baking Soda** is **Sodium Bicarbonate (`NaHCO3`)**; **Washing Soda** is **Sodium Carbonate Decahydrate (`Na2CO3.10H2O`)** (SSC Official Portal).

33. **Bleaching Powder** is **Calcium Oxychloride (`CaOCl2`)**; **Plaster of Paris** is **Calcium Sulphate Hemihydrate (`CaSO4.(1/2)H2O`)**.

34. **Aqua Regia ("Royal Water")** is a **`3 : 1`** **mixture of concentrated `HCl`** **and concentrated `HNO3`** that dissolves Gold and Platinum.

35. **Galvanization** is the process of coating Iron or Steel with a thin layer of **Zinc (`Zn`)** to prevent rusting.

36. During **Rusting of Iron (`Fe2O3.xH2O`)**, the **weight of the iron nail always INCREASES** due to combined oxygen and moisture!

37. **Brass** is an alloy of **`Copper + Zinc`**; **Bronze** is an alloy of **`Copper + Tin`**; **Solder** is an alloy of **`Lead + Tin`**.

38. **German Silver (`Cu + Zn + Ni`)** contains **0% Silver (`Ag`)**!

39. **LPG** consists mainly of **Butane and Propane** with **Ethyl Mercaptan** added for smell; **CNG and Biogas** consist mainly of **Methane (`CH4`)**.

40. **Graphite** is a non-metal carbon allotrope that is a **good conductor of electricity** due to free delocalized electrons (NCERT Official Textbooks).

41. **Vulcanization of Rubber** involves heating natural rubber (**monomer: Isoprene**) with **3%–5% Sulphur (`S`)**.

42. **Mycoplasma (`PPLO`)** is the **smallest living cell** (lacks a cell wall); the **Ostrich Egg** is the **largest isolated single cell**.

43. **Mitochondria** is the **"Powerhouse of the Cell"** (`ATP` synthesis); **Ribosome** is the **"Protein Factory"**; **Lysosome** is the **"Suicidal Bag"**.

44. **Plant Cell Walls** are made of **Cellulose**, while **Fungal Cell Walls** are made of **Chitin**.

45. **DNA** contains **Adenine, Guanine, Cytosine, and Thymine (`A, G, C, T`)**; **RNA** contains **Uracil (`U`) instead of Thymine (`T`)**.

46. **Lichens** (symbiotic Algae + Fungi) are sensitive natural **bio-indicators of Sulphur Dioxide (`SO2`) air pollution** (IUC Academy).

47. **Xylem** transports **water and minerals** upward from roots; **Phloem** translocates **food (sucrose)** from leaves to all plant parts.

48. During **Photosynthesis**, the evolved **Oxygen (`O2`) gas comes entirely from Water (`H2O`)**, not from `CO2`.

49. **Liver** is the **largest gland** in the human body (`secretes enzyme-free Bile Juice` and synthesizes **Urea** via the Ornithine cycle).

50. **Pancreas** is the **second-largest gland** and a **mixed (heterocrine) gland**; its **Beta (`beta`) cells secrete Insulin**.

51. **Red Blood Cells (RBCs / Erythrocytes)** are formed in the **Red Bone Marrow**, lack a nucleus in adult mammals (except Camel and Llama), have a lifespan of `120 days`, and are destroyed in the **Spleen ("Graveyard of RBCs")**.

52. **Blood Group** `O negative (O^-)` is the **Universal Donor**; **Blood Group** `AB positive (AB^+)` is the **Universal Recipient**.

53. **Nephron** is the structural and functional filtration unit of the **Kidney**; **Neuron** is the longest cell and functional unit of the **Nervous System**.

54. **Femur (Thigh Bone)** is the **longest and strongest bone** in the human body; **Stapes (Middle Ear)** is the **smallest bone**.

55. **Vitamins B and C are Water-Soluble**, whereas **Vitamins A, D, E, and K are Fat-Soluble** (NCERT Official Textbooks).

56. **Vitamin B12 (`Cyanocobalamin`)** contains **Cobalt (`Co`) metal**, and its deficiency causes **Pernicious Anaemia**.

57. **Vitamin C (`Ascorbic Acid`, richest in Amla)** deficiency causes **Scurvy**, and **Vitamin D (`Calciferol`)** deficiency causes **Rickets / Osteomalacia**.

58. **Minamata Disease** is caused by **Mercury (`Hg`)** poisoning; **Itai-Itai Disease** by **Cadmium (`Cd`)**; **Blue Baby Syndrome** by excess **Nitrates (`NO3^-`)**.

59. **Malaria** is caused by the **Protozoan *Plasmodium*** (transmitted by **Female *Anopheles* mosquito**); **Dengue** is caused by a **Virus** (transmitted by **Female *Aedes aegypti* mosquito**).

60. **BCG Vaccine** protects against **Tuberculosis (TB)**, **Widal Test** diagnoses **Typhoid**, and **ELISA Test** screens for **HIV/AIDS** (SSC Official Portal).

# IUC Academy *1-3-7-21* Day Spaced-Revision & Self-Assessment Tracker (www.iucacademy.com)

| Chapter / Study Section | Day 1 (First Read) | Day 3 (Active Recall) | Day 7 (MCQ Drill) | Day 21 (Exam Ready) |
|---|---|---|---|---|
| **1. Chapter 1: SI Units, Dimensional Analysis, Kinematics, Newton Laws, Work-Energy & Gravitation** | ☐ Completed (100% Concept Clarity) | ☐ Flowchart & Tables Revised | ☐ 75+ MCQs Solved (>85% Accuracy) | ☐ **Final Rapid Recall Ready** |
| **2. Chapter 2: Properties of Matter, Thermodynamics, Wave Motion, Sound & Geometrical Optics** | ☐ Completed (100% Concept Clarity) | ☐ Flowchart & Tables Revised | ☐ 75+ MCQs Solved (>85% Accuracy) | ☐ **Final Rapid Recall Ready** |
| **3. Chapter 3: Electrostatics, Current Electricity, Magnetism, Semiconductors & Nuclear Physics** | ☐ Completed (100% Concept Clarity) | ☐ Flowchart & Tables Revised | ☐ 75+ MCQs Solved (>85% Accuracy) | ☐ **Final Rapid Recall Ready** |
| **4. Chapter 4: Atomic Structure, Chemical Bonding, Periodic Table Trends & Chemical Reactions** | ☐ Completed (100% Concept Clarity) | ☐ Flowchart & Tables Revised | ☐ 75+ MCQs Solved (>85% Accuracy) | ☐ **Final Rapid Recall Ready** |
| **5. Chapter 5: Acids, Bases, Salts, Metals, Non-Metals, Metallurgy & Electrochemistry** | ☐ Completed (100% Concept Clarity) | ☐ Flowchart & Tables Revised | ☐ 75+ MCQs Solved (>85% Accuracy) | ☐ **Final Rapid Recall Ready** |
| **6. Chapter 6: Carbon & Organic Chemistry, Polymers, Everyday Chemistry & Environmental Chemistry** | ☐ Completed (100% Concept Clarity) | ☐ Flowchart & Tables Revised | ☐ 75+ MCQs Solved (>85% Accuracy) | ☐ **Final Rapid Recall Ready** |
| **7. Chapter 7: Cell Biology, Genetics, Plant Kingdom, Photosynthesis & Plant Physiology** | ☐ Completed (100% Concept Clarity) | ☐ Flowchart & Tables Revised | ☐ 75+ MCQs Solved (>85% Accuracy) | ☐ **Final Rapid Recall Ready** |
| **8. Chapter 8: Animal Taxonomy, Human Organ Systems, Endocrinology, Nutrition & Human Diseases** | ☐ Completed (100% Concept Clarity) | ☐ Flowchart & Tables Revised | ☐ 75+ MCQs Solved (>85% Accuracy) | ☐ **Final Rapid Recall Ready** |
| **9. Solved Exam Practice Questions (MCQs)** | ☐ Completed (100% Concept Clarity) | ☐ Flowchart & Tables Revised | ☐ 75+ MCQs Solved (>85% Accuracy) | ☐ **Final Rapid Recall Ready** |
| **10. Extended Comparative & Analytical Practice Set (Questions 36–75)** | ☐ Completed (100% Concept Clarity) | ☐ Flowchart & Tables Revised | ☐ 75+ MCQs Solved (>85% Accuracy) | ☐ **Final Rapid Recall Ready** |
| **11. Rapid-Fire Last-Minute One-Liner Revision Capsule** | ☐ Completed (100% Concept Clarity) | ☐ Flowchart & Tables Revised | ☐ 75+ MCQs Solved (>85% Accuracy) | ☐ **Final Rapid Recall Ready** |