Key Topics in Mathematics for Class VI

NUMBER SYSTEM

(i) Knowing Numbers: Consolidating the *sense* of numberness upto 5 digits, Size, estimation of numbers, identifying smaller, larger, etc. Place value (recapitulation and extension), connectives: use of symbols =, <, > and use of brackets, word problems on number operations involving large numbers up to a maximum of 5 digits in the answer after all operations. This would include conversions of units of length and mass (from the larger to the smaller units), estimation of outcome of number operations. Introduction to a sense of the largeness of, and initial familiarity with, large numbers upto 8 digits and approximation (of large numbers)

(ii) Playing with Numbers: Simplification of brackets, Multiples and factors, divisibility rule of 2, 3, 4, 5, 6, 8, 9, 10, 11. (All these through observing patterns. Children would be helped in deducing some and then asked to derive some that are a combination of the basic patterns of divisibility.) Even/odd and prime/ composite numbers, Coprime numbers, prime factorization, every number can be written as products of prime factors. HCF and LCM, prime factorization and division method for HCF and LCM, the property LCM x HCF = product of two numbers. All this is to be embedded in contexts that bring out the significance and provide motivation to the child for learning these ideas.

(iii) Whole numbers: Natural numbers, whole numbers, properties of numbers (commutative, associative, distributive, additive identity, multiplicative identity), number line. Seeing patterns, identifying and formulating rules to be done by children. *(As familiarity with algebra grows, the child can express the generic pattern.)*

(iv) Negative Numbers and Integers: How negative numbers arise, models of negative numbers, connection to daily life, ordering of negative numbers, representation of negative numbers on number line. *Children to s*ee patterns, identify and formulate rules. What are integers, identification of integers on the number line, operation of addition and subtraction of integers, showing the operations on the number line (addition of negative integer reduces the value of the number) comparison of integers, ordering of integers.

(v) Fractions: Revision of what a fraction *is*, Fraction as a part of whole, Representation of fractions (pictorially and on number line), fraction as a division, proper, improper and mixed fractions, equivalent fractions, comparison of fractions, addition and subtraction of fractions (Avoid large and complicated unnecessary tasks). (Moving towards abstraction in fractions) Review of the idea of a decimal *fraction*, place value in the context of decimal *fraction*, inter conversion of fractions and decimal fractions (avoid recurring decimals at this stage), word problems involving addition and subtraction of decimals (two operations together on money, mass, length and temperature)

ALGEBRA

(i) Introduction to Algebra
- Introduction to variable through patterns and through appropriate word problems and generalizations (example 5x1=5 etc.)
- Generate such patterns with more examples.
- Introduction to unknowns through examples with simple contexts (single operations)

(ii) Ratio and Proportion
- Concept of Ratio • Proportion as equality of two ratios
- Unitary method (with only direct variation)
- Word problems

GEOMETRY

(i) Basic geometrical ideas (2 D): Introduction to geometry. Its linkage with and reflection in everyday experience.
- Line, line segment, ray
- Open and closed figures.
- Interior and exterior of *closed* figures.
- Curvilinear and linear *boundaries*
- Angle-Vertex, arm, interior and exterior,
- Triangle-vertices, sides, angles, interior and exterior, altitude and median
- Quadrilateral-Sides, vertices, angles, diagonals, adjacent sides and opposite sides (only convex quadrilateral are to be discussed), interior and exterior of a quadrilateral.
- Circle-Centre, radius, diameter, arc, sector, chord, segment, semicircle, circumference, interior and exterior.

(ii) Understanding Elementary Shapes
   (2 D and 3 D)
- Measure of line segment
- Measure of angles
- Pair of lines
- Intersecting and perpendicular lines
- Parallel lines
- Types of angles-acute, obtuse, right, straight reflex, complete and zero angle
- *Classification* of triangles (*on the basis of* sides, and of angles)
- Properties of parallel lines with transversal (alternate, corresponding, interior, exterior angles)

MENSURATION

Concept of perimeter and introduction to area: Introduction and general understanding *of perimeter* using many shapes. Shapes of different kinds with the same perimeter. Concept of area, Area of a rectangle and a square. *Counter examples to different misconcepts related to perimeter and area.* Perimeter of a rectangle – and its special case – a square. Deducing the formula of the perimeter for a rectangle and then a square through pattern and generalization.

DATA HANDLING

(i)   What is data-choosing data to examine a hypothesis?
(ii) Collection and organisation of data examples of organising it in tally bars and a table.
(iii)Pictograph-Need for scaling in pictographs interpretation and construction.
(iv)Making bar graphs for given data interpreting bar graphs.

Key Topics in Science for Class VI

1. Food

Sources of food

What are the various sources of our food?

What do other animals eat?

Components of food

What is our food made up of? Why do we eat a variety of food?

Cleaning food

How do we separate the grains after harvesting the wheat / rice crop?

2. Materials

Materials of daily use

What are our clothes made of ? How did people manage when there were no clothes?

Are some of our clothes made of materials obtained from plants?

In what kinds of places do these plants grow?

Which parts of the plants are used for making clothes?

Different kinds of materials

What kinds of things do we see around us?

How things change/react with one another

In what ways do things change on being heated? Do they change back on being cooled? Why does a burning candle get shorter? How much salt can be dissolved in a cup of water?

3. The World of the Living

Things around us

Are all things around us living? What is the difference between living and non-living? Are all living things similar? Do all living things move?

Where do plants and animals live? Can we grow plants in the dark?

The habitat of the living

How does habitat affect plants and animals? How do fish live in water?

Plants - form and function

What is the structure and function of various parts of the plants - stem, leaf and roots? How do different flowers differ from one another? How does one study flowers?

Animals - form and function

What is inside jour bodies? How do animals move? Do all animals have bones in their bodies? How do fishes move? And birds fly? What about snakes, snails, earthworms?

4. Moving Things, People and Ideas

Moving

How did people travel from one place to another in earlier times? How did they know how far they had travelled?
How do we know that something is moving?
How do we know how far it has moved?

5. How things work

Electric current and circuits

How does a torch work?
Do all materials allow current to flow through them?

Magnets

What is a magnet?
Where on a magnet do things stick?
How is a magnet used to find direction?
How do two magnets behave when brought close to each other?

6. Natural Phenomena

Rain, thunder and lightning

Where does rain come from? How do clouds form?

Light

Which are the things we can see through?
When are shadows formed? Do you get a shadow at night - when there is no light in the room, moonlight or other source of light? What colour is a shadow?
On what kinds of surfaces can we see images?

7. Natural Resources

Importance of water

What will happen to soil, people, domestic animals, rivers, ponds and plants and animals if it does not rain this year?
What ; will happen to soil, people, domestic animals, plants and animals living in rivers and points, if it rains heavily?

Importance of air

Why do earthworms come out of the soil when it rains?

Waste

Do you throw away fruit and vegetable peels and cuttings? Can these be reused? If we dump them anywhere, will it harm the surroundings? What if we throw them in plastic bags?

Key Topics in Mathematics for Class VII

Number System

(i) Knowing our Numbers: Integers
- Multiplication and division of integers (through patterns). Division by zero is meaningless
- Properties of integers (including identities for addition & multiplication, *commutative, associative, distributive*) through patterns. These would include examples from whole numbers as well. Involve expressing commutative and associative properties in a general form. Construction of counter examples, including some by children. Counter examples like subtraction is not commutative.
- Word problems including integers (all operations).

(ii) Fractions and rational numbers:
- Multiplication of fractions
- Fraction as an operator
- Reciprocal of a fraction
- Division of fractions
- Word problems involving mixed fractions
- Introduction to rational numbers (with representation on number line)
- Operations on rational numbers (all operations)

- Representation of rational number as a decimal.
- Word problems on rational numbers (all operations)
- Multiplication and division of decimal fractions
- Conversion of units (lengths & mass)
- Word problems (including all operations)

(iii) Powers:
- Exponents (only natural numbers.)
- Laws of exponents (through observing patterns to arrive at generalization.)
  i. $a^m . a^n = a^{m+n}$
  ii. $(a^m)^n = a^{mn}$
  iii. $\dfrac{a^m}{a^n} = a^{m-n}$, where $m - n \in N$
  iv. $a^m . b^m = (ab)^m$

Algebra
Algebraic Expressions
- Generate algebraic expressions (simple) involving one or two variables
- Identifying constants, coefficient, powers
- Like and unlike terms, degree of
  expressions e.g. xy^2 etc. (exponent $\leq$ 3 number of variables $\leq$ 2)
- Addition, subtraction of algebraic expressions (coefficients should be integers).
- Simple linear equations in one variable (in contextual problems) with two operations (avoid complicated coefficients).

Ratio and Proportion
- Ratio and proportion (revision)
- Unitary method continued consolidation, general expression.
- Percentage introduction.
- Understanding percentage as a fraction with denominator 100
- Converting fractions and decimals into percentage and viceversa.
- Application of profit & loss (single transaction only)
- Application of simple interest (time period in complete years)

Geometry
(i) Understanding shapes:
- Pairs of angles (linear, supplementary, complementary, adjacent, vertically opposite) (verification and simple proof of vertically opposite angles)
- Properties of parallel lines with transversal (alternate, corresponding, interior, exterior angles).

(ii) Properties of triangles:
- Angle sum property (with notions of proof & verification through paper folding, proofs using property of parallel lines, difference between proof and verification.)
- Exterior angle property.
- Sum of two sides of a Δ > it's third side.
- Pythagoras Theorem (Verification only).

(iii) Symmetry
- Recalling reflection symmetry
- Idea of rotational symmetry, observations of rotational symmetry of 2D objects. (90°, 120°, 180°)
- Operation of rotation through 90° & 180° of simple figures.
- Examples of figures with both rotation and reflection symmetry (both operations)
- Examples of figures that have reflection and rotation symmetry and vice versa.

(iv) Representing 3D in 2D:
- Drawing 3D figures in 2D showing hidden faces.

- Identification & counting of vertices edges, faces, nets (for cubes cuboids, & cylinders, cones).
- Matching pictures with objects (Identifying names).
- Mapping the space around approximately through visual estimation.

(v) Congruence
- Congruence through superposition (examples-blades, stamps, etc.).
- Extend congruence to simple geometrical shapes e.g. triangles, circles.
- Criteria of congruence (by verification) SSS, SAS, ASA, RHS.

(vi) Construction (Using scale, protractor, compass)
- Construction of a line parallel to a given line from a point outside it.(Simple proof as remark with the reasoning of alternate angles)
- Construction of simple triangles. Like given three sides, given a side and two angles on it, given two sides and the angle between them.

Mensuration
- Revision of perimeter, Idea of π , Circumference of Circle.

Area
- Concept of measurement using a basic unit area of a square, rectangle, triangle, parallelogram and circle, area between two rectangles and two concentric circles.

Data handling
(i) Collection and organisation of data choosing the data to collect for a hypothesis testing.
(ii) Mean, median and mode of ungrouped data understanding what they represent.
(iii) Constructing bargraphs.
(iv) Feel of probability using data through experiments. Notion of chance in events like tossing coins, dice etc. Tabulating and counting occurrences of 1 through 6 in a number of throws. Comparing the observation with that for a coin. Observing strings of throws, notion of randomness.

Key Topics in Science for Class VII

1. Food

Sources of food
What are the various sources of our food?

Utilisation of food
How do plants and animals utilise their food?

2. Materials

Materials of daily use
Do some of our clothes come from animal sources?
Which are these animals?
Who rears them?
Which part of the animals yield the yarn? How is the yarn extracted?
What kinds of clothes help us to keep warm?
What is heat?
What is the meaning of 'cool'/'cold' and 'warm' hot?
How does heat flow from/to our body to / from the surroundings?

Different kinds of materials
Why does turmeric stain become red on applying soap?

How things change/react with one another
What gets deposited on a *tawa/khurpi/kudal* if left in a moise state?
Why does the exposed surface of a cut brinjal become black?
Why is seawater salty? Is it possible to separate salt from seawater?

3. The World of the Living
Surroundings affect the living
Why are nights cooler? How does having winters and summers affect soil? Are all soils similar? Can we make a pot similar? Can we make a pot with sand? Is soil similar when you dig into the ground? What happens to water when it falls on the cemented/bare ground?

The breath of life
Why do we/animals breathe? Do plants also breathe? Do they also respire? How do plants / animals live in water?

Movement of substances
How does water move in plants? How is food transported in plants?
Why do animals drink water? Why do we sweat? Why and how is there blood in all part of the body? Why is blood red? Do all animals have blood? What is there in urine?

Multiplication in plants
Why are some plant parts like potato, onion swollen - are they of any use to the plants? What is the function of flowers? How are fruits and seed formed? How are they dispersed?

4. Moving Things, People and Ideas
Moving objects
Why do people feel the need to measure time?
How do we know how fast something is moving?

5. How Things Work
Electric current and circuits
How can we conveniently represent an electric circuit?
Why does a bulb get hot?
How does a fuse work?
How does the current in a wire affect the direction of a compass needle?
What is an electromagnet?
How does an electric bell work?

6. Natural Phenomena
Rain, thunder and lightning
What causes storms? What are the effects of storms? Why are roofs blown off?

Light
Can we see a source of light through a bent tube?
How can we throw sunlight on a wall?
What things given image that are magnified or diminished in size?
How can we make a coloured disc appear white?

7. Natural Resources
Scarcity of water
Where and how do you get water for your domestic needs? Is it enough? Is there rough water for agricultural needs? What happens to plants when there is not enough water for plants? Where does a plant go when it dies?

Forest products
What are the products we get from forests? Do other animals also benefit from forests?What will happen if forests disappear?

Waste Management
Where does dirty water from your house go? Have you seen a drain? Does the water stand in it sometimes? does this have any harmful effect?

Key Topics in Mathematics for Class VIII
Number System
(i) Rational Numbers:
• Properties of rational numbers. (including identities). Using general form of expression to describe properties.
• Consolidation of operations on rational numbers.
• Representation of rational numbers on the number line.

- Between any two rational numbers there lies another rational number (Making children see that if we take two rational numbers then unlike for whole numbers, in this case you can keep finding more and more numbers that lie between them.)
- Word problem (higher logic, two operations, including ideas like area)

(ii) Powers
- Integers as exponents.
- Laws of exponents with integral powers

(iii) Squares, Square roots, Cubes, Cube roots.
- Square and Square roots
- Square roots using factor method and division method for numbers containing (a) not more than total 4 digits and (b) not more than 2 decimal places
- Cubes and cubes roots (only factor method for numbers containing at most 3 digits)
- Estimating square roots and cube roots. Learning the process of moving nearer to the required number.

(iv) Playing with numbers
- Writing and understanding 2 and 3 digit numbers *in generalized form* ($100a + 10b + c$, where a, b, c can be only digit 09) and engaging with various puzzles concerning this. (Like finding the missing numerals represented by alphabets in sums involving any of the four operations.) Children to solve and create problems and puzzles.
- Number puzzles and games
- Deducing the divisibility test rules of 2,3,5,9,10 for a two or three digit number expressed in the general form.

Algebra
(i) Algebraic Expressions
- Multiplication and division of algebraic exp.(Coefficient should be integers)
- Some common errors $2 + x$ ¹ $2x$,
  $7x + y$ ¹ $7xy$
- Identities $(a \pm b)^2 = a^2 \pm 2ab + b^2$, $a^2 - b^2 = (a - b)(a + b)$ Factorisation (simple cases only) as examples of the following types $a(x + y)$, $(x \pm y)^2$, $a^2 - b^2$, $(x + a)(x + b)$
- Solving linear equations in one variable in contextual problems involving multiplication and division (word problems) (avoid complex coefficient in the equations).

Ratio and Proportion
- Slightly advanced problems involving applications on percentages, profit and loss, overhead expenses, discount, tax.
- Difference between simple and compound interest (compounded yearly upto 3 years or half yearly upto 3 steps only), Arriving at the formula for compound interest through patterns and using it for simple problems.
- Direct variation : Simple and direct word problems.
- Inverse variation : Simple and direct word problems.
- Time and work problems: Simple and direct word problems.

Geometry
(i) Understanding shapes
- Properties of quadrilaterals – Sum of angles of a quadrilateral is equal to 360°. (By verification)
- Properties of parallelogram (By verification)
(i) Opposite sides of a parallelogram are equal,
(ii) Opposite angles of a parallelogram are equal.
(iii) Diagonals of a parallelogram bisect each other. [Why (iv), (v) and (v) followed from (ii)]
(iv) Diagonals of a rectangle are equal and bisect each other.
(v) Diagonals of a rhombus bisect each other at right angles.
(vi) Diagonals of a square are equal and bisect each other at right angles.

(ii) Representing 3D in 2D
- Identify and match pictures with objects [more complicated e.g. nested, joint 2D and 3D shapes (not more than 2)]
- Drawing 2D representation of 3D objects (Continued and extended)
- Counting vertices, edges and faces and verifying Euler's relation for 3D figures with flat faces (cubes, cuboids, tetrahedrons, prisms and pyramids).

(iii) Construction:
   Construction of Quadrilaterals:
*   Given four sides and one diagonal.
*   Three sides and two diagonals.
*   Three sides and two included angles.
*   Two adjacent sides and three angles.

Mensuration
(i) Area of a trapezium and a polygon.
(ii) Concept of volume, measurement of volume using a basic unit, volume of a cube, cuboid and cylinder.
(iii) Volume and capacity (measurement of capacity).
(iv) Surface area of a cube, cuboid and cylinder.

Data handling
(i) Ungrouped data, arranging it into groups, representation of grouped data through bargraphs, constructing and interpreting bargraphs.
(ii) Simple Pie charts with reasonable data numbers
(iii) Consolidating and generalising the notion of chance in events like tossing coins, dice etc. Relating it to chance in life events. Visual representation of frequency outcomes of repeated throws of the same kind of coins or dice. Throwing a large number of identical dice/coins together and aggregating the result of the throws to get large number of individual events. Observing the aggregating numbers over a large number of repeated events. Comparing with the data for a coin. Observing strings of throws, notion of randomness.

Introduction to graphs:
Preliminaries:
(i) Axes (Same units), Cartesian Plane.
(ii) Plotting points for different kind of situations (perimeter Vs length for squares, area as a function of side of a square, plotting of multiples of different numbers, simple interest Vs number of years etc.).
(iii) Reading off from the graphs.
*   Reading of linear graphs.
*   Reading of distance vs time graph.

Key Topics in Science for Class VIII

Food

Crop production
Crop production : How are different food crops produced?
What are the various foods we get from animal sources?

Micro-organism
What living organisms do we see under a microscope in a drop of water? What helps make curd? How does food to bad? How do we preserve food?

2. Materials

Materials in daily life
Are some of our clothes synthetic? How are they made? Where do the raw materials come from?
Do we use other materials that are synthetic?
Do we use cloth (fabric) for purposes other than making clothes to wear? What kind of fabric do we see around us?
What are they used for?

Different kinds of materials and their reaction.
Can a wire be drawn out of wood?
Do copper or aluminium also rust like iron?
What is the black material inside a pencil?
Why are electrical wires made of aluminium or copper?

How things change/react with one another
What happens to the wax when a candle is burnt? Is it possible to get this wax back?
What happens to kerosene/natural gas when it is burnt?
Which fuel is the best? Why?

3. The World of the Living

Why conserve
What are reserve forests/sanctuaries etc? How do we keep track of our plants and animals? How do we know that some species are in danger of disappearing?
What would happen if you continuously cut trees?

The cell
What is the internal structure of a plant what will we see if we look under the microscope? Which cells from our bodies can be easily seen? Are all cells similar?

How babies are formed
How do babies develop inside the mother? Why does our body change when we reach our teens? How is the sex of the child determined? Who looks after the babies in your homes? Do all animals give birth to young ones?

4. Moving things, People and Ideas

Idea of force
What happens when we push or pull anything?
How can we change the speed, direction of a moving object?
How can we change the shape of an object?

Friction
What makes a ball rolling on the ground slow down?

Pressure
Why are needles made pointed? Why does a balloon burst if too much air is blown into it? Why does an inverted glass/bottle/pitcher resist being pushed down into water? How can air/liquids exert pressure?

Sound
How do we communicate through sound? How is sound produced? What characterises different sounds?

5. How Thing Work

Electric current and circuits
Why do we get a shock when we touch an electric appliance with wet hands?
What happens to a conducting solution when electric current flows through it?
How can we coat an object with a layer of metal?

6. Natural Phenomena

Rain, thunder and lightning
What is lightning? What safety measures should we take against lightning strikes?

Light
What are the differences between the image formed on a new utensil and an old one? Why is there this difference?
When you see your image in the mirror it appears as if the left is on the right why?
Why don't we see images on all surfaces around us?
What makes things visible?
How do we see image of our back in a mirror?
Why do we sometimes see colours on oil films on water?
What is inside our eye that enables us to see?
Why are some people unable to see?

Night sky

What do we see in the sky at night? How can we identify stars and planets?

Earthquakes
What happens during an earthquake? What can we do to minimise its effects?

7. Natural Resources

Man's intervention in phenomena of nature
What do we do with wood?
What if we had no wood?
What will happen it we go on cutting trees / grass without limit?
What do we do with coal and petroleum?
Can we create coal and petroleum artificially?

Pollution of air and water
What are the various activities by human beings that make air impure?
Does clear, transparent water indicate purity?

Key Topics in Mathematics for Class IX

1. **Rational and Irrational Numbers :** Rational numbers, Real Number Line; Surds; Rationalisation of Surds.

2. **Polynomials :** Factorisation of Polynomials : Review; Factorisation of Expressions of the Form $ax^2 + bx + c$; Factorisation of $x^3 \pm y^3$; Factorisation of $x^3 + y^3 + z^3 - 3xyz$; Remainder Theorem and Factor Theorem; Factorising a Polynomial.

3. **Ratio and Proportion :** Ratio and its application; Proportion and its application.

4. **Linear Equations in Two Variables :** Linear equations in one variable; coordinates; plotting of points on graph paper; linear equations in two variables; graph of a linear equation in two variables; graph of a linear equation in one variable.

5. **Percentage and its Application :** Profit and Loss; Discount; Sales Tax; Cost of Living Index.

6. **Compound Interest :** Growth and Depreciation.

7. **Banking :** Computation of Interest on Savings Bank Account.

8. **Lines; Angles and Triangles :** Basic geometrical Concepts; Points and Lines; Part of a line and a Line and a Plane; Angles made by a Transversal with Two Lines; Two Lines Parallel to the Same Line; Sum of the Angles of a Triangle.

9. **Congruence of Triangles :** Different Criteria for Congruence of Two Triangles; Properties of an Isosceles Triangle; Congruence of Two Right Triangles.

10. **Inequalities in a Triangle :** Sides and Angles of a Triangle; Sum of any Two Sides of a Triangle; Perpendicular Line-Segment is the Shortest.

11. **Parallelograms :** Properties of a Parallelogram; Particular Types of Parallelograms.

12. **Loci and Concurrent Lines in Triangles :** Points Equidistance from Two Given Points; Points Equidistant from Two Intersecting Lines; Concurrent Lines in a Triangle.

13. **Areas :** Areas of Parallelograms and Triangles.

14. **Geometrical Constructions :** Constructions of Triangles; Construction of a Triangle Equal in Area to a Quadrilateral.

15. **Trignometry :** Trignometric Rations of Angles; Other Trignometric Ratios; Trigonometric Ratios of Some Specific Angles.

16. **Mensuration of Plane Figures :** Polygon; Area of a Triangle; Area of a Quadrilateral; Circle; Circle; Sector and Segment of a Circle; Area of Sector and Segment of a Circle.

17. **Mensuration of Solid Figures :** Right Prisms; Right Triangular Prisms; Pyramids; Right Pyramids; Lateral Surface Area and Whole Surface Area of a Right Triangular Prism; Volume of a Right Triangular Prism; Pyramids; Right Pyramids; Lateral Surface Area of a Right Pyramid; Volume of a Right Pyramid; Regular Tetrahedron; Regular Octahedron.

18. **Statistics :** Statistics and Statistical Data; Primary and Secondary Data; Presentation of Data-Raw/Ungrouped Data; Graphical Representation of Statistical Data; Measures of Central Tendency; Properties of Mean; Properties of Median; Properties of Mode.

19. **Sets :** Sets, subsets and venn diagram.

Key Topics in Physics for Class IX

1. **Motion :** Motion of Living and Non Living Objects; Displacement and Distance; Uniform and Non-uniform Motion; Velocity and Acceleration; Graphics and their Uses; Uniform Circular Motion.

2. **Force :** Newtons First Law of Motion; Inertia and Mass; Newtons Second Law of Motion; Momentum; Newton's Third Law of Motion; Conservation of Momentum; Friction; Thrust and Pressure; Archimede's Principal; Relative Density.

3. **Gravitation :** Universal Law of Gravitation; Centre of Mass and Centre of Gravity; Newton's Law of Gravitation; Motion of Particle under Gravity; Projectile Motion; Mass and Weight; Geotropism.

4. **Work, Power and Energy :** Work; Energy - Kinetic and Potential; Power; Transformation of Energy; Conservation of Energy.

5. **Heat :** Temperature; Thermal Equilibrium; Mercury Thermometer; Specific Heat; Effect of Heat; Change of State.

6. **Wave Motion and Sound :** Simple Pendulum; Wave Motion; Transverse and Longitudinal Waves; Graphical Representation of SH Waves; Characteristics of Homonic Waves; Relation between Wave Velocity, Frequency and Wavelength for a Periodic Wave; Nature and Propagation of Sound; Speed of Sound; Audible Range of Sound in Human; Reflections of Sound; Echoes, the Sonar.

Key Topics in Chemistry for Class IX

1. **Measurement :** Measurement System; International System of Units (SI); Multiples and Fractions.

2. **Nature of Matter :** Classification of Matter; Elements, Compounds and Mixtures; Solution, Suspension and Colloids; Law of Constant Proprotion; Atom and Atomic Theory of Matter; Atomic and Molecular Masses; Mole Concepts; Emperical and Molecular Formula.

3. **Atomic Structure :** Discovery of Electron; Positive Rays; X-rays and Radioactivity; Atomic Nucleus; Rutherford Model and Bohr Model; Neutron Discovery; Atomic Number and Atomic Mass; Isotopes.

4. **Classification of Elements :** Mendeleev's Classification; Modern Periodic Table; Periodic Properties; Group Properties; Ionisation Energy; Electron Affinity; Metallic and Non Metallic Properties.

5. **Chemical Bonding :** Formation of Chemical Bond; Formation and Properties of Ionic Bonds; Formation and Properties of Covalent Bonds; Hydrogen Bonds.

6. **Chemical Reaction :** Chemical Formula; Chemical Equation; Balancing a Chemical Equation Utilizing a Equation; Types of Chemical Reactions - Combination Reaction, Decomposition Reaction, Displacement Reaction, Double Displacement Reaction; Oxidation and Reduction; Redox Reaction.

Key Topics in Biology for Class IX

1. **Cell and Cell Structure :** Structure of Cell; Types of Cell; Cell Division - Mitosis & Meiosis.

2. **Tissues in Plants :** Meristematic Tissues - Types and Characteristics Function; Permanent Tissues - Types of Characteristics Function.

3. **Tissues in Animals :** Epithelial Tissue - Types, Characteristics and Function; Muscle Tissue - Types, Characteristics and Function; Connective Tissue - Types, Characteristics and Function; Nervous Tissue - Types, Characteristics and Function.

4. **Diversity in the Living World :** Classification, Nomenclature, Plant Kingdom - Subdivisions and Their Features; Animal Kingdom - Phylum and their Feature.

5. **Food Nutrition and Health :** Community Health and Personal Health; Conditions for Good Health; Components of Food; Under Nutrition; Malnutrition; Food Adulteration; Drinking Water.

6. **Human Disease :** Communicable Disease - Symptoms, Preventions and Control; AIDS; Nutritional Disorders.

7. **Natural Resources :** Types of Natural Resources; Biotic Resources - Flora and Fauna; Abiotic Resources - Air, Water, Soil, Sunlight; Fossil Resources - Coal, Petroleum, Natural Gas; Food Resources - Plants; Food Resources - Animals.

8. **Environment :** Habitant and Adaptation in Plants; Habitat and Adaptation in Animals; Conservation of Habitat; Biosphere; Ecosystem - Structure, Components and Types; Biogeochemical Cycles; Biodiversity; Inter-relationship among biotic and Abiotic Factors.

Key Topics in Mathematics for Class X

1. **Linear Equations in Two Variables :** Graphical Solutions of a Linear Equation in Two Variables : Review; Graphical Solutions of a Pair of Linear Equations in Two Variables; Algebraic Solution of a System of Linear Equations; Solution of a System of Linear Equations by Cross Multiplications; Applications to Practical Problems.

2. **HCF and LCM of Polynomials :** Factors of Polynomials; HCF of Polynomials; LCM of Polynomials.

3. **Rational Expressions :** Rational Expressions in Lowest Terms; Addition of Rational Expressions; Multiplication of Rational Expressions; Division of Rational Expressions.

4. **Quadratic Equations :** Quadratic Polynomials; Zeros of Quadratic Polynomials; Quadratic Equations; Factorisation Method for Quadratic Equation.

5. **Arithmetic Progression :** Arithmetic Progressions; The nth term of an Arithmetic Progressions; Sum of a Finite Number of Terms of an AP.

6. **Instalments and Taxation :** Instalment Buying (Purchase) Scheme; Repayment of Loan, Classification of Taxes; Income Tax.

7. **Similar Triangles :** Similar Polygons; Basic Proportionality Theorem; Criteria for Similarity of Two Triangles; Area of Two Similar Triangles; Similarity of Triangles formed by an Altitude of a Right Triangle; Pythagoras Theorem.

8. **Circles and Tangents to a Circle:** Circle and its Parts; Congruence of Circles; Equal Chords and Congruent Arcs; Perpendicular from the Centre on a Chord; Chords Equidistant from the Centre; Angles Subtended by Arcs and Chords at Points on the Circle; Angles in a Cyclic Quadrilateral., Number of Tangents to a Circle from a Point; Properties of Tangents; Chords of a Circle Intersecting in a Point; Alternate Segments and its Angles; Common Tangents to Two Circles.

9. **Geometrical Constructions :** Construction of a Tangent to a Circle; Constructions of Incircle and Circumcircle of a Triangle; Some More Constructions.

10. **Trignometry :** Trignometric Identities; Trigonometric Ratios of Complementary Angles and height & distance problems.

11. **Surface Areas and Volumes :** Conversion of Solids; Surface Areas and Volume of Combinations of Solids; Frustum of a Right Circular Cone; Volume and Surface Area of a Frustum of a Right Circular Cone.

12. **Statistics :** Pie Chart; Mean of Raw Data; Mean of Ungrouped Data; Assumed Mean Method and Step-Deviation Method for Computing the Mean; Mean of Grouped Data; Probability; Probability as a Meaasure of Uncertainity.

13. **Coordinate Geometry :** Coordinates of a Point; Distance between Two Points; Section Formula; An Application of Section Formula.

14. **Profit and Loss :** Question based on profit and loss.

Key Topics in Physics for Class X

1. **Light and its Properties :** Nature of light; Reflection of light by mirrors (plane; concave; convex); Refraction of light; Dispersion of white light at a glass prism; Colour of object.

2. **Optical Instruments :** The Human Eye; Diffect of vision and their correction; Microscope Telescope.

3. **Electricity; its heating and chemical effects :** Electric charges and its properties; Conductors and Insulaters; Electric current

– charges in motion; Electruc potential and potential difference; Ohm's law – Resistors in series and parallel; Heating effect of electric currents; Chemical effects of electric currents – Faraday law; Dry cell.

4. **Magnetic Effects of electric currents :** Magnetic field; Magnetic field lines; Magnetic field around current carrying straight conductor; Magnetic field due to current flowing in a solenoid; Force on a current carrying conductoe ina magnetic field; Electric motors; Electromagnetic induction; Electric generators; Electric fuse.

5. **Sources of energy :** Renewable and non renewable source of energy; Solar energy; Wind energy; Water energy; Geothermal energy; Bio energy; Fossil fuels.

6. **Nuclear fission and fusion :** Nuclear fission; Energy relaeasd in nuclear fission; Chain reaction; Nuclear fusion; Nuclear reactors; Nuclear hazards and safety measures.

7. **The universe :** Solar system; The structure and evolution of the earth; Stars; constellation and galaxy; Space exploration.

KeyTopics in Chemistry for Class X

1. **Rate of Chemical Reaction :** Slow and Fast Reaction; Rate of Chemical Reaction; Energy Changes during a Chemical Reaction; Factors Affecting Rate of Reaction; Reversible and Irreversible Reaction.

2. **Chemical Equilibrium :** Reverse and Forward Reaction; Dynamic Equilibrium; Dissociation of Electrolyte; Acids and Bases; pH Scale.

3. **Important Chemical Compounds :** Washign Soda; Baking Soda; Bleaching Powder; Plaster of Paris; Lime; Glass; Steel.

4. **Metals and Non Metals :** Physical Properties of Metals; Chemical Properties of Metals; Relative Reactivities of Metals; Metallurgical Process; Extraction of Aluminium and Iron and Alloys; Physical and Chemical Properties of Non Metals; Properties of Hydrogen; Ammonia; Sulphur; Sulphur Dioxide; Sulphuric Acid.

5. **Carbon Compounds :** Functional Group; Alcohols; Aldehydes and Ketones; Carboxylic Acids; Synthetic Polymers; Soaps and Synthetic Detergents.

Key Topics in Biology for Class X

1. **Nutrition and Respiration :** Modes of Nutrition; Nutrition in Plants - Photosynthesis; Nutrition in Animals; Digestive System in Amoeba and Grasshopper; Human Digestive System; Types of Respiration; Respiration in Plants; Respiration in Animals; Respiratory System in Human.

2. **Transportation and Excretion :** Transport of Material in Plants; Conducting Tissues in Plants; Transport of Materials in Animals; Human Heart and blood and blood vessels; Lymphatic System; Excretion in Animals; Excretion in Human Beings; Osmoregulation; Renal Failure.

3. **Control and Coordiantion in Plants :** Phytohormones; Plant Movements; Photoperiodism; Phytochromes; Coordiantion in Animals - Receptors; Human Nervous System - Parts of Brain; Central Nervous System; Autonomic Nervous System; Reflex Action; Hormones and Endocrine Glands.

4. **Reproduction :** Types of Reproduction; Reproduction in Plants; Human Reproductive System; Fertilization; Population Control; Sexually Transmitted Disease.

5. **Heredity and Evolution :** Heredity and Variation; Chromosone and genes and DNA; Genetic Engineering; Sex Determiantion; Evidences of Evolution; Theories of Evolution; Organic Evolution.

6. **Environment :** Pollution; Types of Pollution (Air; water; soil; noise; thermal); Effects of Pollution; Control of Pollution; Relationshi among Biotic and Abiotic Component.scalar triple products and their geometrical interpretations.

Key Topics in Mathematics for Class XI and XII

I. **ALGEBRA**

1. **Sets, Relations and Functions :** Sets and their Representations, Union, intersection and complements of sets, and their

algebraic properties, Relations, equivalence relations, mappings, one-one, into and onto mappings, composition of mappings

2. **Complex Numbers :** Complex number in the form $a + ib$ and their representation in a plane. Argand diagram. Algebra of complex numbers, Modulous and Arguments (or amplitude) of a complex number, square root of a complex number. Cube roots of unity, triangle – inequality.

3. **Matrices and Determinants :** Determinants and matrices of order two and three, properties of determinants, Evaluation of determinants. Area of triangles using determinants, Addition and multiplication of matrices, adjoint and inverse of matrix. Test of consistency and solution of simultaneous linear equations using determinants and matrices.

4. **Quadratic Equations :** Quadratic equation in real and complex number system and their solutions. Relation between roots and co-efficients, nature of roots, formation of quadratic equations with given roots; Symmetric functions of roots.

5. **Permutation and Combination :** Fundamental principle of counting; Permutation as an arrangement. Meaning of $P(n, r)$ and $C(n, r)$. Simple applications.

6. **Mathematical Induction and Its applications :**

7. **Binomial Theorem and its Applications :** Binomial Theorem for a positive integral index; general term and middle term; Binomial Theorem for any index. Properties of Binomial Co-efficients. Simple applications for approximations.

8. **Sequences and Series :** Arithmetic, Geometric and Harmonic progressions. Special cases of Sn, $Sn2$, $Sn3$. Arithmetic-Geometric Series, Exponential and Logarithmic series.

II. CALCULUS

9. **Differential Calculus :** Polynomials, rational, trigonometric, logarithmic and exponential functions, Inverse functions. Graphs of simple functions. Limits, Continuity; differentiation of the sum, difference, product and quotient of two functions. differentiation of trigonometric, inverse trigonometric, logarithmic, exponential, composite and implicit functions; derivatives of order upto three. Applications of derivative: monotonic functions, Maxima and minima of functions of one variable.

10. **Integral Calculus :** Integral as an anti-derivative. Fundamental integrals involving algebraic, trigonometric, exponential and logarithmic functions. Integration by substitution, by parts and by partial fractions. Integration using trigonometric identities. Integral as limit of a sum. Properties of definite integrals. Evaluation of indefinite integrals; Determining areas of the regions bounded by simple curves.

11. **Differential Equations :** Ordinary differential equations, their order and degree. Solution of differential equations by the method of separation of variables. Solution of homogeneous and linear differential equations.

III. TWO AND THREE DIMENSIONAL GEOMETRY

12. **Two dimensional Geometry :** Recall of Cartesian system of Rectangular co-ordinates in a plane, distance formula, area of a triangle, condition for the collinearity of three points and section formula, centroid and in-centre of a triangle, locus and its equation, translation of axes, slope of a line, parallel and perpendicular lines, intercepts of a line on the coordinate axes.

The straight line and pair of straight lines
Various forms of equations of a line, intersection of lines, angles between two lines, conditions for concurrency of three lines, distance of point from a line, coordinates of orthocentre and circumcentre of triangle, equation of family of lines passing through the point of intersection of two lines, homogeneous equation of second degree in x and y, angle between pair of lines through the origin, combined equation of the bisectors of the angles between a pair of lines, condition for the general second degree equation to represent a pair of lines, point of intersection and angle between two lines represented by $S = O$ and the factors of S.

Circles and system of Circles
Standard form of equation of a circle, general form of the equation of a circle, its radius and centre, equation of a circle in the parametric form, equation of a circle when the end points of a diameter are given, points of intersection of a line and a circle with the centre at the origin and condition for a line to be tangent to the circle, length of the tangent, equation of the tangent, equation of a family of circles through the intersection of two circles, condition for two intersecting circles to be orthogonal.

Conic Section
Sections of cones, equations of conic sections (parabola, ellipse and hyperbola) in standard forms, condition for $y = mx + c$ to be a tangent and point(s) of tangency.

13. **Three dimensional Geometry :** Coordinates of a point in space, distance between the points; Section formula, direction ratios and direction cosines, angle between two intersecting lines, equations of a line and a plane in different forms; intersection of a line and a plane, coplanar lines, equation of a sphere, its centre and radius. Diameter form of the equation of a sphere.

IV. VECTORS

14. **Vector Algebra :** Vectors and Scalars, addition of vectors, components of a vector in two dimensions and three dimensional space, scalar and vector products, vector triple product. Application of vectors to plane geometry.

V. STATISTICS

15. **Measures of Central Tendency and Dispersion :** Calculation of Mean, median and mode of grouped and ungrouped data. Calculation of standard deviation, variance and mean deviation for grouped and ungrouped data.

16. **Probability :** Probability of an event, addition and multiplication theorems of probability and their applications; Conditional probability; Probability distribution of a random variable; Binomial distribution and its properties.

VI. TRIGONOMETRY

17. Trigonometrical ratios, identities and equations. Inverse trigonometric functions and their properties. Properties of triangles, solution of triangles. Heights and Distances.

VII. STATICS AND DYNAMICS

18. **Statics :** Resultant of Coplanar forces; moments and couples. Equilibrium of three concurrent forces.

19. **Dynamics :** Speed and velocity, average speed, instantaneous speed, acceleration and retardation, resultant of two velocities, relative velocity and its simple applications. Motion of a particle along a line, moving with constant acceleration. Motion under gravity. Laws of motion, Projectile motion.

Key Topics in Physics for Class XI and XII

1. **Units and Measurement :** Units for measurement, system of units – S.I., fundamental and derived units. Dimensions and their applications.

2. **Description of Motion in one dimension :** Motion in a straight line, uniform motion, its graphical representation. Uniformly accelerated motion, and its applications.

3. **Description of Motion in Two and Three dimensions :** Scalars and vectors, vector addition, multiplication of a vector by a real number, zero-vector and its properties. Resolution of vectors. Scalar and vector products, uniform circular motion and its applications, projectile motion.

4. **Laws of Motion :** Force and inertia – Newton's Laws of motion. Conservation of linear momentum, rocket propulsion. Inertial frames of references. Static and kinetic friction, laws of friction, rolling friction.<O:P

5. **Work, Energy and Power :** Concept of work, energy and power, Energy – kinetic and potential. Conservation of energy. Elastic collision in one and two dimensions. Different forms of energy.

6. **Rotational Motion and Moment of Inertia :** Centre of mass of a two-particle system. Centre of mass of a rigid body, general motion of a rigid body, nature of rotational motion, torque, angular momentum, conservation of angular momentum and its applications. Moment of Inertia and its physical significance, parallel and perpendicular axes theorem, expression of moment of inertia for ring, disc and sphere.

7. **Gravitation :** Acceleration due to gravity, one and two-dimensional motion under gravity. Universal law of gravitation, variation in the acceleration due to gravity of the earth. Planetary motion, artificial satellite – geostationary satellite, gravitational potential energy near the surface of earth, gravitational potential and escape velocity.

8. **Properties of Matter :** Inter-atomic and inter-molecular forces, states of matter
   (A) Solids : Elastic properties, Hook's law, Young's modulus, bulk modulus, modulus of rigidity.
   (B) Liquids : Cohesion and adhesion. Surface energy and surface tension. Flow of fluids, Bernoulli's theorem and its applications. Viscosity, Stoke's Law, terminal velocity.
   (C) Ideal gas laws.

9. **Oscillations :** Periodic motion, simple harmonic motion and its equation of motion, energy in S.H.M., Oscillations of

a spring and simple pendulum.

10. **Waves :** Wave motion, speed of a wave, longitudinal and transverse waves, superposition of waves, progressive and standing waves, vibration of strings and air-columns, beats, resonance. Doppler effect in sound.

11. **Heat and Thermodynamics :** Thermal expansion of solids, liquids and gases and their specific heats, relationship between C_p and C_v for gases, first law of thermodynamics, thermodynamic processes. Second law of thermodynamics, Carnot cycle, efficiency of heat engines.

12. **Transference of heat :** Modes of transference of heat. Thermal conductivity. Black body radiations, Kirchoff's law, Wien's law, Stefan's law of radiation and Newton's law of cooling.

13. **Electrostatics :** Charges and their conservation, Coulomb's law, S.I. unit of charge, dielectric constant, electric field, lines of force, field due to dipole and its behavior in a uniform electric field, electric flux, Gauss's law in simple geometries. Electric potential, potential due to a point charge. Conductors and insulators, distribution of charge on conductors. Capacitance, parallel plate capacitor, combination of capacitors, energy of capacitor, van de graf generator.

14. **Current Electricity :** Current as a rate of flow of charges, sources of energy, cells-primary and secondary, grouping of cells resistance of different materials, temperature dependence, specific resistance, Ohm's law, Kirchoff's law, series and parallel circuits. Wheatstone Bridge, measurement of voltages and currents, potentiometer.

15. **Thermal and Chemical Effects of currents :** Heating effects of current, electric power, simple concept of thermo electricity – (Seeback effect and its explanation), thermocouple, Chemical effects of current and laws of electrolysis.

16. **Magnetic Effects of Currents :** Oersted's experiment, Biot-Savert's law (magnetic field due to a current element), magnetic field due to a straight wire, circular loop and solenoid, force on a moving charge in a uniform magnetic field (Lorentz force), forces and torques on currents in a magnetic field, force between two current carrying wires, moving coil galvanometer, ammeter and voltmeter.

17. **Magnetostatics :** Bar magnet, magnetic field, lines of force, torque on a bar magnet in a magnetic field, earth's magnetic field, tangent galvanometer, vibration magnetometer, para, dia and ferro-magnetism, magnetic induction, magnetic susceptibility.

18. **Electromagnetic Induction and Alternating Currents :** Induced e.m.f., Farady's Law, Lenz's Law, self and mutual induction, alternating currents, impedance and reactance, power in a.c. circuits, LCR series combination, resonant circuits. Transformer, simple motor, and A.C. generator.

19. **Ray Optics :** Sources of light, luminous intensity, luminous flux, illuminance and photometry(elementary idea). Reflection and refraction of light at plane and curved surfaces, total internal reflection, optical fibre; deviation and dispersion of light by a prism; Lens formula, magnification and resolving power; microscope and telescope.

20. **Wave Optics :** Wave nature of light; Interference – Young's double slit experiment. Diffraction – diffraction due to a single slit. Elementary idea of polarization, Doppler effect of light.

21. **Electromagnetic waves :** Electromagnetic oscillations, Electromagnetic wave spectrum from gamma to radio waves – their uses and propogation properties of the atmosphere w.r.t. electromagnetic spectrum.

22. **Electrons and Photons :** Discovery of electrons, cathode rays, charge on an electron, e/m for an electron, photoelectric effect and Einstein's equation of photoelectric effect.

23. **Atoms, Molecules and Nuclei :** Rutherford model of the atom, Bohr's model, energy quantizations, hydrogen spectrum; Atomic masses, size of the nucleus; Radioactivity; rays and their properties – alpha, beta and gamma decay; half life and mean life of radio-active nuclei, Binding energy, mass energy relationship, nuclear fission and nuclear fusion.

24. **Solids and Semi-Conductor Devices :** Energy bands in solids, conductors, insulators and semi-conductors, PN junction, diodes, diode as rectifier, junction transistor, transistor as an amplifier.

Key Topics in Chemistry for Class XI and XII

1. **Atoms, Molecules and Chemical Arithmetic :** Measurement in chemistry (significant figures, SI unit, Dimensional analysis). Chemical classification of matter (mixtures, compounds and elements, and purification). Law of chemical combination and Dalton's Atomic theory. Atomic Mass (mole concept, determination of chemical formulae). Chemical equation (balancing of chemical equation and calculations using chemical equations).

2. **Elements, their Occurrence and extraction :** Earth as a source of elements, elements in biology, extraction of metals (mettallurgical process, production of concentrated ore, production of metals and their purification). Mineral wealth of India. Qualitative test of metals.

3. **States of Matter Gaseous state :** (measurable properties of gases, Boyle's Law, Charle's Law and absolute scale of temperature, Avogadro's hypothesis, ideal gas equation, Dalton's law of partial pressure). Kinetic molecular theory of gases (the microscopic model of gas, deviation form ideal behaviour). The solid state (classification of solids, X-ray studies of crystal lattices and unit cells, packing of constituent particles in crystals). Liquid state (Properties of liquids, Vapour pressure, Surface tension, Viscosity).

4. **Atomic Structures Constituents of the atom :** (Discovery of electron, Rutherford model of the atom). Electronic structure of atoms (nature of light and electromagnetic waves, atomic spectra, Bohr's model of Hydrogen atom, Quantum mechanical model of the atom, electronic configurations of atoms, Aufbau principle). Dual nature of matter and radiation. The uncertainty principle. Orbitals and Quantum numbers. Shapes of orbitals. Electronic configuration of atoms.

5. **Chemical Families – Periodic Properties :** Mendeleev's Periodic Table, Modern Periodic Law, Types of elements (Representative elements-s & p block elements, inner transition elements – d-block elements, inner transition elements – f-block elements). Periodic trends in properties. (Ionization energy, electron affinity, atomic radii, valence, periodicity in properties of compounds).

6. **Chemical Bonding and Molecular structure :** Chemical bonds and Lewis structure shapes of molecules (VSEPR theory). Quantum theory of the covalent bond (Hydrogen and some other simple molecules, carbon compounds, hybridization, Boron and Beryllium compounds). Coordinate covalent bond (Ionic bond as an extreme case of polar covalent bond, ionic character of molecules and polar molecules. Bonding in solid state (Ionic, molecular and covalent solids, metals). Hydrogen bond, Resonance.
    Molecules: Molecular orbital method. Formation of H_2, O_2, N_2, F_2 on the basis of MOT. Hybridisation, Dipole moment and structure of molecules.

7. **The Solid State :** Structure of simple ionic compounds. Close-packed structures. Ionic-radii, Silicates (elementary ideas). Imperfection in solids (point defects only). Properties of solids, Amorphous solids.
    The Gaseous state : Ideal gas equation-Kinetic theory (fundamentals only)

8. **Solutions :** Types of solutions, Vapour-pressure of solutions and Raoult's law. Colligative properties. Non-ideal solutions and abnormal molecular masses. Mole concept-stoichemistry, volumetric analysis-concentration unit.<O:P

9. **Chemical Energetics and Thermodynamics :** Energy changes during a chemical reaction, Internal energy and Enthalpy (Internal energy, Enthalpy, Enthalpy changes, Origin of Enthalpy change in a reaction, Hess's Law of constant heat summation, numericals based on these concepts). Heats of reactions (heat of neutralization, heat of combustion, heat of fusion and vaporization). Sources of energy (conservation of energy sources and identification of alternative sources, pollution associated with consumption of fuels. The sun as the primary source). First law of thermodynamics: Internal energy, Enthalpy, application of first law of thermodynamics. Second law of thermodynamics : Entropy, Free energy, Spontaneity of a chemical reaction, free energy change and chemical equilibrium, free energy available for useful work.

10. **Chemical Equilibrium :** Equilibria involving physical changes (solid-liquid, liquid-gas equilibrium involving dissolution of solid in liquids, gases in liquids, general characteristics of equilibrium involving physical processes). Equilibria involving chemical systems (the law of chemical equilibrium, the magnitude of the equilibrium constant, numerical problems). Effect of changing conditions of systems at equilibrium (change of concentration, change of temperature, effect of catalyst-Le Chateliar's principle). Equilibria involving ions (ionization of electrolytes, weak and strong electrolytes, acid-base equilibrium, various concepts of acids and bases, ionization of water, pH, solubility product, numericals based on these concepts).

11. **Redox Reactions and Electrochemistry :** Oxidation and reduction as an electron transfer process. Redox reactions in aqueous solutions-electrochemical cells. EMF of a galvanic cell. Dependence of EMF on concentration and temperature (nearest equation and numerical problems based on it). Electrolysis, Oxidation numbers (rules for assigning oxidation number, redox reactions in terms of oxidation number and nomenclature). Balancing of oxidation-reduction equations. Electrolytic conduction. Voltaic cell, Electrode potential and Electromotive force, Gibb's free energy and cell potential. Electrode potential and Electrolysis.

12. **Rates of Chemical Reactions and Chemical Kinetics :** Rate of reaction, Instantaneous rate of reaction and order of reaction. Factors affecting rates of reactions (factors affecting rate of collisions encountered between the reactant molecules, effect of temperature on the reaction rate, concept of activation energy, catalysis). Effect of light on rates of reactions. Elementary reactions as steps to more complex reactions. How fast are chemical reactions?Rate expression. Order of a reaction (with suitable examples). Units of rates and specific rate constants. Order of reaction and effect of concentration. (study will be confined to first order only). Temperature dependence of rate constant – Fast reactions (only elementary idea). Mechanism of reaction (only elementary idea). Photochemical reactions.

13. **Chemistry of Hydrocarbons :** Alkanes (structure, isomerism, conformation). Stereo Isomerism and chirality (origin of chirality, optical rotation, racemic mixture) Alkenes (isomerism including cis-trans). Alkynes. Arenes (structure of benzene, resonance structure, isomerism in arenes). Sources of hydrocarbons (origin and composition of coal and petroleum; Hydrocarbons from coal and petroleum cracking and reforming, quality of gasoline-octane number, gasoline additives). Laboratory preparation of alkanes (preparation from unsaturated hydrocarbons, alkyl halides and carboxylic acids). Laboratory preparation of alkenes (preparation from alcohols, alkyl halides). Laboratory prepration of alkynes (preparation from calcium carbide and accetylene). Physical properties of alkanes(boiling and melting points, solubility and density). Reactions of hydrocarbons (oxidation, addition, substitution and miscellaneous reactions).

14. **Purification and Characterisation of Organic Compounds :** Purification (crystallization, sublimation, distillation, differential extraction, chromatography). Qualitative analysis (analysis of nitrogen, sulphur, phosphorus and halogens). Quantitative analysis (estimation of carbon, hydrogen, nitrogen, halogens, sulphur, phosphorus and oxygen). Determination of molecular mass (Victor Mayer's method, volumetric method). Calculation of empirical formula and molecular formula. Numerical problems in organic quantitative analysis, modern methods of structure elucidation.

15. **Organic Chemistry Based on Functional Group :** (Halides and Hydroxy compounds) Nomenclature of compounds containing halogen atoms and hydroxyl groups : haloalkanes, haloarenes; alcohols and phenols. Correlation of physical properties and uses. Preparation, properties and uses of following. Polyhalogen compounds : Chloroform, Idoform Polyhydric compounds, Ethane 1, 2-diol; Propane-1,2,3 triol. Structure and reactivity – (a) Induction effect, (b) Mesomeric effect, (c) Electrophiles and Nucleophiles, (d) Types of organic reaction.

16. **Organic Chemistry Based on Functional Group II :** (Ethers, aldehydes, ketones, carboxylic acids and their derivatives). Nomenclature of ethers, aldehydes, ketones, carboxylic acids and their derivatives. Sacylhalides, acid anhydrides, amides and esters). General methods of preparation, correlation of physical properties with their structures, chemical properties and uses. (Note : Specific compounds should not be stressed for the purpose of evaluation)

17. **Organic Chemistry Based on Functional Group-II :** (Cyanides, isocyanides, nitrocompounds and amines) Nomenclature and classification of amines, cynadies, isocyanides, nitro compounds and their method of preparation; correlation of physical properties with structure, chemical reactions and uses.

18. **Chemistry of Non-metals –** (Hydrogen, Oxygen and Nitrogen) Hydrogen (position in periodic table, occurrence, isotopes, properties, reactions and uses) Oxygen (occurrence, preparation, properties and reactions, uses, simple oxides; ozone) Water and hydrogen peroxide (structure of water molecule and its aggregates, physical and chemical properties of water, hard and soft water, water softening, hydrogen peroxides, preparation, properties, structure and uses). Nitrogen(Preparation, properties, uses, compounds of Nitrogen – Ammonia, Oxides of Nitrogen, Nitric Acid – preparation, properties and uses).

19. **Chemistry of Non-metals – II :** (Boron, Carbon, Silicon, phosphorus, sulphur, halogens and the noble gases). Boron (occurrence, isolation, physical and chemical properties, borax and boric acid, uses of boron and its compounds). Carbon, inorganic compounds of carbon (oxides, halides, carbides), elemental carbon. Silicon (occurrence, preparation and properties, oxides and oxyacids of phosphorus, chemical fertililzers). Sulphur (occurrence and extraction, properties and reactions, oxides: Sulphuric acid – preparation, properties and uses, sodium thiosulphate). Halogens (occurrence, preparation, properties, hydrogen halides, uses of halogens). Noble gases (discovery, occurrence and isolation, physical properties, chemistry of noble gases and their uses).

20. **Chemistry of lighter Metals :** Sodium and Potassium (occurrence and extraction, properties and uses, important compounds – NaCl, Na2CO$_3$, NaHCO$_3$, NaOH, KCI, KOH). Magnesium and calcium (occurrence and extraction, properties and uses, important compounds MgCl$_2$, MgSO$_4$, CaO, Ca(OH)$_2$, CaCO$_3$, CaSO$_4$, plaster of paris). Aluminium (occurrence, extraction, properties and uses, compounds – AlCl$_3$, alums). Cement. Biological role of Sodium, Potassium, Magnesium and Calcium.

21. **Heavy Metals :** Iron (Occurrence and extraction, compounds of iron, oxides, halides, sulphides, sulphate, alloy and steel). Copper, silver and gold (occurrence and extractions, properties and uses, compound – sulphides, halides and sulphates, photography). Zinc and Mercury (occurrence and extraction, properties and uses, compound-oxides, halides; sulphides and sulphates). Tin and Lead (occurrence and extraction, properties and uses, compounds – oxides, sulphides, halides).

22. **Chemistry of Representative Elements :** Periodic properties – Trends in groups and periods (a) Oxides-nature (b) Halides-melting points (c) Carbonates and sulphates – solubility. The chemistry of s and p block elements, electronic configuration, general characteristics properties and oxidation states of the following :-
Group 1 elements – Alkali metals
Group 2 elements – Alkaline earth metals
Group 13 elements – Boron family

Group 14 elements – Carbon family
Group 15 elements – Nitrogen family
Group 16 elements – Oxygen family
Group 17 elements – Halogen family
Group 18 elements – Noble gases and Hydrogen

23. **Transition Metals including Lanthanides :** Electronic configuration: General characteristic properties, oxidation states of transition metals. First row transition metals and general properties of their compounds-oxides, halides and sulphides. General properties of second and third row transition elements (Groupwise discussion). Preparation, properties and uses of Potassium dichromate, Potassium permaganate. Inner Transition Elements: General discussion with special reference to oxidation states and eamthanide contraction.

24. **Coordination Chemistry and Organo Metallics :** Coordination compounds, Nomenclature : Isomerism in coordination compounds; Bonding in coordination compounds, Werner's coordination theory.

25. **Nuclear Chemistry :** Nature of radiation from radioactive substances. Nuclear reactions; Radioactive disintegration series; Artificial transmutation of elements; Nuclear fission and Nuclear fusion: Isotopes and their applications: Radio carbon-dating.

26. **Synthetic and Natural Polymers :** Classification of Polymers, natural and synthetic polymers (with stress on their general methods of preparation) and important uses of the following : Teflon, PVC, Polystyrene, Nylon-66, terylene Environmental pollution – pollutants – services – check and alternatives.

27. **Surface Chemistry :** Surfaces : Adsorption Colloids – (Preparation and general properties), Emulsions, Micelles Catalysis : Homogeneous and heterogeneous, structure of catalyst.

28. **Bio Molecules and Biological Processes :** The Cell Carbohydrates : Monosaccharides, Disaccharides, Polysaccharides Amino Acides and Peptides – Structure and classification. Proteins and Enzymes – Structure of Proteins, Role of enzymes. Nucleic Acids – DNA and RNA Biological functions of Nucleic acids – Protein synthesis and replication Lipids – Structure, membranes and their functions.

29. **Chemistry in Action :** Dyes, Chemicals and medicines (antipyretic, analgesic, antibiotics & tranquilesers), Rocket propellants.<O:P (Structural formulae non-evaluative)

Key Topics in Biology for Class XI and XII

1. **General Biology :** Biology and its branches; relationships with other sciences; scientific methods in Biology; historical break-throughs; scope of Biology and career options; role of Biology in dispelling myths and misbeliefs; characters of living organisms, (elementary idea of metabolism, transfer of energy at molecular level, open and closed system, homoeostasis, growth and reproduction, adaptation, survival, death).

2. **Systematics and Classification :** Variety of living organisms; Systematics; need, history and types of classifications (ar-tificial, natural, phylogenetic); biosystematics; binomial nomenclature; Two kingdom sys-tem, Five kingdom system, their merits and demerits, status of bacteria and virus; botanical gardens and herbaria; zoological parks and museums. Salient features of various plant groups; classification of angiosperms up to series level (Bentham and Hooker's system). Salient features of non-chordates up to phylum level and chordates up to class level).

3. **Animal Kingdom :** Classification of animal kingdom, characteristics of different phyla and their example. Morphology of Animals - Salient features of earthworm, cockroach and rat; tissue sys-tems, structure and function of tissues - epithelial, connective, muscular and nervous.

4. **Plant Kingdom :** Classification of plants groups, their characteristics and examples.

5. **Cell Biology :** Cell as a basic unit of life — discovery of cell, cell theory, cell as a self-contained unit; prokaryotic and eukaryotic cell; unicellular and multicellular organisms; tools and techniques (compound microscope, electron microscope and cell fraction-ation); Ultrastructure of prokaryotic and eukaryotic cell - cell wall, cell membrane - unit membrane concept (fluid mosaic model); membrane transport; cellular movement (exocytosis, endocytosis); cell organelles and their functions - nucleus, mitochondria, plastids, endoplasmic reticulum, Golgi complex, lysosomes, microtubules, centriole, vacuole, cytoskeleton, cilia and flagella, ribosomes. Molecules of cell; inorganic and organic materials — water, salt, mineral ions, carbohy-drates, lipids, amino acids, proteins, nucleotides, nucleic acids (DNA and RNA); Enzymes (properties, chemical nature and mechanism of action); vitamins, hormones and steroids. Cell cycle : significance of cell division; amitosis, mitosis and meiosis; karyotype analysis.

6. **Genetics :** Continuity of life - heredity, variation; Mendel's laws of inheritance; chromosomal basis of inheritance; other patterns of inheritance - incomplete dominance, multiple allelism, quantitative inheritance. Chromosomes - bacterial cell and eukaryotic cell; parallelism between genes and chro-mosomes; genome, linkage and crossing over; gene mapping; recombination; sex chro-

mosomes; sex determination; sex linked inheritance; mutation and chromosomal aberra-tions; Human genetics - methods of study, genetic disorders. DNA as a genetic material - its structure and replication; structure of RNA and its role in protein synthesis; Gene expression - transcription and translation in prokaryotes and eukaryotes; regulation of gene expression, induction and repression - housekeeping genes; nuclear basis of differentiation and development; oncogenes. Basics of Recombinant DNA technology; cloning; gene bank; DNA fingerprinting; genomics - principles and applications, transgenic plants, animals and microbes.

7. **Human Biology :** Nutrition and its types; nutrients - food and vitamins; Intracellular and extracellular digestion; digestive system of invertebrate (cockroach); digestive system and process in humans (digestion, ingestion, absorption, assimilation, egestion); role of enzymes and hormones in digestion; malnutrition and undernutrition; disorders related to nutrition. Gaseous exchange in animals (earthworm, cockroach); respiration in humans - respiratory organs, mechanism; breathing and its regulation : transport of gases through blood; common respiratory disorders - prevention and cure. Circulation of body fluids - open system in cockroach; closed system in humans, blood and its composition, structure and pumping action of human heart; pulmonary and systemic circulation; heart beat and pulse; rhythmicity of heart-beat, blood related disorders - hypertension, atheroma and arteriosclerosis; ECG; pacemaker; lymphatic system, im-munity and immune system. Nitrogenous waste elimination - ammonetelism, ureotelism, uricotelism; excretory system of cockroach and humans; composition and formation of urine; role of kidney in osmoregulation, kidney failure; dialysis, kidney transplantation; role of ADH; role of liver in excretion. Locomotion and movements; human skeleton - axial and appendicular including cranium and rib cage bones; Joints and their types; bone, cartilage and their disorders (arthritis, osteoporosis); mechanism of muscle contraction; red and white muscles in movements. Nervous coordination in cockroach and humans; human nervous system - structure and functions of brain and spinal cord, transmission of nerve impulse; reflex action; sensory receptors; structure and function of sense organs - eye, ear, nose and tongue. Human endocrine system; hormones and their functions; hormonal imbalance and diseases; role of hormones as messengers and regulators; hypothalamo - hypophysial axis; feedback controls. Types of reproduction - a general account (asexual and sexual); human male and female reproductive systems; Reproductive cycle in human female, gametogenesis; Fertilization - physical and chemical events; development of zygote upto 3 germinal layers and their derivatives; extra-embryonic membranes; general aspects of placenta. Cellular growth - growth rate and growth curve; hormonal control of growth; mechanism and types of regeneration; ageing - cellular and extracellular changes; theories of ageing.

8. **Angiosperm Botany :** Morhpology - root, stem and leaf, their structure and modification; Inflorescence, flower, fruit, seed and their types; Description of Poaceae, Liliaceae, Fabaceae, Solanaceae, Brassicaceae and Asteraceae. Internal structure of plants - Tissues (meristematic and permanent); tissue systems; anatomy of root, stem and leaf of monocot and dicot; secondary growth. Cell as a physiological unit; water relations - absorption and movement (diffusion, osmosis, plasmolysis, permeability, water potential, imbibition); theories of water translocation - root pressure, transpiration pull; transpiration - significance, factors af-fecting rate of transpiration; mechanism of stomatal opening and closing (Potassium ion theory). Mineral nutrition - functions of minerals, essential major elements and trace elements; deficiency symptoms of elements; translocation of solutes, nitrogen and nitrogen metabolism with emphasis on biological nitrogen fixation. * Photosynthesis - significance, site of photosynthesis (functional aspect of chlorophyll structure); photochemical and biosynthetic phases; electron transport system; photophospho-rylation (cyclic and non-cyclic); C 3 and C 4 Pathway; photorespiration; factors affecting photosynthesis; mode of nutrition (autotrophic, heterotrophic - saprophytic, parasitic and insectivorous plants), chemosynthesis. Mechanism of respiration - glycolysis, Krebs cycle, pentose pathway, anaerobic respira-tion; respiratory quotient; compensation point; fermentation.

Modes of reproduction in flowering plants - vegetative propagation (natural and artificial), significance of vegetative propaga-tion; micropropagation; sexual reproduction - develop-ment of male and female gametophytes; pollination (types and factors); double fertilisation, incompatibility, embryo development, parthenogenesis and parthenocarpy. * Characteristics of Plant growth; growth regulators (phytohormones) - Auxins, gibberellins, cytokinins, ethylene, ABA; seed germination - mechanism and factors affecting germina-tion, role of growth regulators in seed dormancy; senescence; abscission; stress factors (salt and water) and growth; plant movement - geotropism, phototropism, turgor growth movements (tropic, nastic and nutation), process of flowering - photoperiodism, vernalisation.

9. **Ecology and Environment :** Organisms and their environment; factors - air, water, soil, biota, temperature and light; range of tolerance; ecological adaptation. Levels of organisation - population, species, community, ecosystem and biosphere; Eco-logical interactions - symbiosis, mutualism, commensalism, parasitism, predation and competition. Ecosystem - structure and functions; productivity; energy flow; ecological efficiencies; decomposition and nutrient cycling; major blomes - forests, grasslands and deserts. Ecological Succession - types and mechanism. Natural resources - types, use and misuse of natural resources. Environ-mental pollution - kinds, sources and abatement of air, water, soil and noise pollution. Global environmental changes; Greenhouse gases, global warming, sea level rise and ozone layer depletion. Biotic resources - terrestrial and aquatic including marine resources; bio-diversity -benefits and assessment; threats, endangered species, extinctions; conservation of bio-diversity (biosphere reserves and other protected areas); National and International efforts - both governmental and non-governmental; environmental ethics and legislation.

10. **Application of Biology :** Population, environment and development; Population growth and factors - (natality, mortality, immigration, emigration, age and sex ratio); impact of population growth; reproductive health; common problems of adolescence (Drugs, Alcohol and Tobacco); social and moral implications; mental and addictive disorders; Risks of indiscriminate use of drugs and antibiotics; population as a resource. * Food production, breeding, improved varieties, biofertilizers, plant tissue culture and its applications; Brief account of some common crop and animal diseases; biopesticides; genetically modified food; bio-war, biopiracy; biopatent; biotechnology and sustainable agriculture. * Recent advances in vaccines; organ transplantation; immune disorders; modern techniques in disease diagnosis; Elementary knowledge of Haemoglobin estimation and estimation of sugar and urea in blood, TLC, DLC, ESR, lipid profile, ELISA and VIDAL tests; AIDS, STD, cancer (types, causes, diagnosis, treatment); biotechnology in therapeutics - hor-mones, interferon and immuno modulations. * Basic concepts of ECG, normal ECG, EEG, CT Scan, MRI and ultrasound.

11. **Evolution :** Origin and evolution of Life - Oparin-Haldane theory, Miller Experiment; theories of evolution; evidences of evolution; sources of variations (mutation, recombination, genetic drift, migration, natural selection); concept of species; speciation and isolation (geographical and reproductive); origin of species.