Syllabus to Teach for IIT-Joint Entrance Examination, 2023-24

Chemistry

C01BC Basic Concepts

C01 CBCC Basic concepts of Chemistry — Aspire Science Higher Secondary School

Importance and scope of chemistry.
Matter and its nature.
Dalton's atomic theory
Concept of atom, molecule, element and compound
Physical quantities and their measurements in Chemistry, precision and accuracy, significant figures, S.I. Units, dimensional analysis
Laws of chemical combination
Atomic and molecular masses
Mole concept, molar mass, percentage composition, empirical and molecular formulae
Chemical equations and stoichiometry

C02SM Different States of Matter

C02 CGAS Gaseous State — Aspire Science Higher Secondary School

Classification of matter into solid, liquid and gaseous states
Concept of intermolecular interactions, melting point and boiling point.
Gaseous State: Measurable properties of gases
Gas laws - Boyle's law, Charle's law, Graham's law of diffusion, Avogadro's law, Gay Lussac's law, Dalton's law of partial pressure
Concept of Absolute scale of temperature
Ideal gas equation
Kinetic theory of gases (only postulates); Concept of average, root mean square and most probable velocities
Real gases, deviation from Ideal behaviour, compressibility factor, critical temperature and van der Waals equation

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C03 CSLD Solid State — Aspire Science Higher Secondary School

Solid State: Classification of solids: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea); Bragg's Law and its applications; Unit cell and lattices, packing in solids (fcc, bcc and hcp lattices), packing efficiency voids, calculations involving unit cell parameters, imperfection in solids; Electrical, magnetic and dielectric properties. Band theory of metals, conductors, semiconductors and insulators.

C04 CLIQ Liquid State and Solution — Aspire Science Higher Secondary School

Liquid State: Properties of liquids - vapour pressure, viscosity and surface tension and effect of temperature on them (qualitative treatment only).

C05 CCOL Colloidal State and Surface Chemistry — Aspire Science Higher Secondary School

Adsorption - Physisorption and chemisorption and their characteristics
Factors affecting adsorption of gases on solids - Freundlich and Langmuir adsorption isotherms, adsorption from solutions.
Catalysis: homogeneous and heterogeneous; activity and selectivity; enzyme catalysis
Colloidal state - distinction among true solutions, colloids and suspensions
Classification of colloids - lyophilic, lyophobic, multi molecular, macromolecular and associated colloids (micelles)
Preparation and properties of colloids - Tyndall effect, Brownian movement
Electrophoresis, dialysis, coagulation and flocculation
Emulsions and their characteristics.

C03AMS Structure of Atoms and Molecules

C06 CASX Atomic Structure

Aspire Science Higher Secondary School

Atomic number, isotopes and isobars.
Thomson and Rutherford atomic models and their limitations
Nature of electromagnetic radiation, photoelectric effect
Spectrum of hydrogen atom: Bohr model of hydrogen atom - its postulates, derivation of the relations for energy of the electron and radii of the different orbits, limitations of Bohr's model
Dual nature of matter, de-Broglie's relationship, Heisenberg uncertainty principle.
Elementary ideas of quantum mechanics, quantum mechanical model of atom, its important features, ??and ??2, concept of atomic orbitals as one electron wave functions; Variation of ??and ??2 with r for 1s and 2s orbitals
Various quantum numbers (principal, angular momentum and magnetic quantum numbers) and their significance
Shapes of s, p and d - orbitals, electron spin and spin quantum number
Rules for filling electrons in orbitals – Aufbau principle, Pauli's exclusion principle and Hund's rule, electronic configuration of elements, extra stability of half-filled and completely filled orbitals.

C07 CPCX Periodic Classificaiton

Aspire Science Higher Secondary School

Modem periodic law and present form of the periodic table
s, p, d and f block elements
Periodic trends in properties of elements: atomic and ionic radii, ionization enthalpy, electron gain enthalpy, electronegativity, valence, oxidation states and chemical reactivity

C08 CCBX Chemical Bond

Aspire Science Higher Secondary School

Kossel - Lewis approach to chemical bond formation, concept of ionic and covalent bonds.
Ionic Bonding: Formation of ionic bonds, factors affecting the formation of ionic bonds; calculation of lattice enthalpy.
Covalent Bonding: Concept of electronegativity, Fajan's rule, dipole moment; Valence Shell Electron Pair Repulsion (VSEPR) theory and shapes of simple molecules.
Quantum mechanical approach to covalent bonding: Valence bond theory – Its important features, concept of hybridization involving s, p and d orbitals; Resonance.
Molecular Orbital Theory - Its important features, LCAOs, types of molecular orbitals (bonding, antibonding), sigma and pi-bonds, molecular orbital electronic configurations of homonuclear diatomic molecules, concept of bond order, bond length and bond energy.
Elementary idea of metallic bonding.
Hydrogen bonding and its applications.

C04CR Chemical Reaction

C09 CCRX Chemical Reactions

Aspire Science Higher Secondary School

Electronic concepts of oxidation and reduction, redox reactions, oxidation number, rules for assigning oxidation number, balancing of redox reactions.

C10 CENR Energetics

Aspire Science Higher Secondary School

Fundamentals of thermodynamics: System and surroundings, extensive and intensive properties, state functions, types of processes.
First law of thermodynamics - Concept of work, heat internal energy and enthalpy, heat capacity, molar heat capacity; Hess's law of constant heat summation; Enthalpies of bond dissociation, combustion, formation, atomization, sublimation, phase transition, hydration, ionization and solution.
Introduction of entropy as state function
Second law of thermodynamics; Spontaneity of processes; dS of the universe and dG of the system as criteria for spontaneity, dGo (Standard Gibbs energy change) and equilibrium constant.
Third law of thermodynamics- Brief introduction

C11 CEQL Equilibria

Aspire Science Higher Secondary School

Meaning of equilibrium, concept of dynamic equilibrium.
Equilibria involving physical processes: Solid -liquid, liquid - gas and solid – gas equilibria,
Henry's law, general characteristics of equilibrium involving physical processes.
Equilibria involving chemical processes: Law of chemical equilibrium, equilibrium constants (Kp and Kc) and their significance, significance of dG and dGo in chemical equilibria, factors affecting equilibrium concentration, pressure, temperature, effect of catalyst; Le Chatelier's principle.
Ionic equilibrium: Weak and strong electrolytes, ionization of electrolytes, various concepts of acids and bases (Arrhenius, Bronsted - Lowry and Lewis) and their ionization, acid - base equilibria (including multistage ionization) and ionization constants; Ionization of water, pH scale, common ion effect; Hydrolysis of salts and pH of their solutions, solubility of sparingly soluble salts and solubility products, Henderson equation, buffer solutions.

C12 CKIN Chemical Kinetics — Aspire Science Higher Secondary School

Rate of a chemical reaction(average and instantaneous)
Factors affecting the rate of reactions: concentration, temperature, pressure and catalyst
Elementary and complex reactions
Order and molecularity of reactions
Rate law, rate constant and its units
Differential and integral forms of zero and first order reactions, their characteristics and half – lives
Effect of temperature on rate of reactions – Arrhenius theory, activation energy and its calculation
Collision theory of bimolecular gaseous reactions (no derivation)

C05MET Metal and Metallurgy

C13 CMLG Metallurgy — Aspire Science Higher Secondary School

Modes of occurrence of elements in nature - minerals, ores;
Steps involved in the extraction of metals - concentration, oxidation, reduction (chemical and electrolytic methods) and refining with special reference to the extraction of Al, Cu, Zn and Fe;
Thermodynamic and electrochemical principles involved in the extraction of metals.

C06FAM Families

C14 CHYD Hydrogen Family — Aspire Science Higher Secondary School

Position of hydrogen in periodic table
Isotopes, preparation, properties and uses of hydrogen
Physical and chemical properties of water and heavy water
Structure, preparation, reactions and uses of hydrogen peroxide
Hydrogen as a fuel.

C15 CALK Alkali and Alkaline Earth Metals — Aspire Science Higher Secondary School

Group - 1 and 2 Elements:
General introduction, electronic configuration and general trends in physical and chemical properties of elements
Anomalous properties of the first element of each group
Diagonal relationships: Trends in the variation of properties (such as ionization enthalpy, atomic and ionic radii), trends in chemical reactivity with oxygen, water, hydrogen and halogens
Preparation and properties of some important compounds - sodium carbonate, sodium chloride, sodium hydrogencarbonate and sodium hydroxide
Industrial uses of lime, limestone, Plaster of Paris and cement;
Biological significance of Na, K, Mg and Ca.

C16 CBOR Boron Family — Aspire Science Higher Secondary School

General Introduction to p-Block Elements (Group - 13 to Group 18 Elements):
General Introduction: Electronic configuration and general trends in physical and chemical properties of elements across the periods and down the groups
Unique behaviour of the first element in each group.
Group wise study of the p – block elements:
Group – 13: Preparation, properties and uses of boron and aluminium
Properties of boric acid, diborane, boron trifluoride, aluminium chloride and alums, reactions of aluminium with acids and alkalies.

C17 CCAR Carbon Family — Aspire Science Higher Secondary School

Group – 14:
Electronic configuration and general trends in physical and chemical properties of elements down the groups
Allotropes of carbon, tendency for catenation; Uses of oxides of carbon; Structure & properties of silicon tetrachloride, silicones, silicates, and zeolites.

C18 CNIT Nitrogen Family — Aspire Science Higher Secondary School

Group – 15:
Electronic configuration and general trends in physical and chemical properties of elements down the groups
Properties and uses of nitrogen and phosphorus;
Allotrophic forms of phosphorus
Preparation, properties, structure and uses of ammonia, nitric acid, oxides of nitrogen (structure only), phosphine and phosphorus halides, (PCl_3, PCl_5);
Structures of oxides and oxoacids of phosphorus.

C19 COXY Oxygen Family — Aspire Science Higher Secondary School

Group – 16:
Electronic configuration and general trends in physical and chemical properties of elements down the groups
Preparation, properties, structures and uses of dioxygen and ozone
Allotropic forms of sulphur
Preparation, properties, structures and uses of sulphur dioxide and sulphuric acid (including its industrial preparation)
Structures of oxoacids of sulphur

C20 CHAL Halogen Family — Aspire Science Higher Secondary School

Group – 17:
Electronic configuration and general trends in physical and chemical properties of elements down the groups
Preparation, properties and uses of chlorine and hydrochloric acid
Trends in the acidic nature of hydrogen halides
Structures of Interhalogen compounds and oxides and oxoacids of halogens

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C21 CZGE Zero Group Elements — Aspire Science Higher Secondary School

Group –18:
Electronic configuration and general trends in physical and chemical properties of elements down the groups
Occurrence and uses of noble gases; Structures of fluorides and oxides of xenon.

C22 CTRA Transition Metals — Aspire Science Higher Secondary School

Transition Elements: General introduction, electronic configuration, occurrence and characteristics
General trends in properties of the first row transition elements – physical properties, ionization enthalpy, oxidation states, atomic radii, colour, catalytic behaviour, magnetic properties, complex formation, interstitial compounds, alloy formation
Preparation, properties and uses of K2 Cr2 O7 and KMnO4.
Inner Transition Elements Lanthanoids- Electronic configuration, oxidation states and lanthanoid contraction.
Actinoids - Electronic configuration and oxidation states. Comparison with lanthanoids.

C07ENC Electro, Nuclear and Coordination Chemistry

C23 CELE Electrochemistry — Aspire Science Higher Secondary School

1. Electrolytic and metallic conduction, conductance in electrolytic solutions, specific and molar conductivities and their variation with concentration: Kohlrausch's law and its applications.
2. Electrochemical cells - Electrolytic and Galvanic cells, different types of electrodes, electrode potentials including standard electrode potential, half – cell and cell reactions, emf of a Galvanic cell and its measurement
3. Nernst equation and its applications
4. Relationship between cell potential and Gibbs' energy change;
5. Dry cell and lead accumulator
6. Fuel cells; corrosion.

C25 CCOO Coordination Chemistry — Aspire Science Higher Secondary School

Introduction to co-ordination compounds: Werner's theory; ligands, coordination number, denticity, chelation
IUPAC nomenclature of mononuclear co-ordination compounds
Isomerism
Bonding-Valence bond approach and basic ideas of Crystal field theory, colour and magnetic properties; Importance of co-ordination compounds (in qualitative analysis, extraction of metals and in biological systems).

C08BOC Basics of Organic Chemistry

C26 CPOC Purification and Characterization of Organic Compounds — Aspire Science Higher Secondary School

Purification - Crystallization, sublimation, distillation, differential extraction and chromatography - principles and their applications.
Qualitative analysis - Detection of nitrogen, sulphur, phosphorus and halogens.
Quantitative analysis (basic principles only) - Estimation of carbon, hydrogen, nitrogen, halogens, sulphur, phosphorus.
Calculations of empirical formulae and molecular formulae;
Numerical problems in organic quantitative analysis.

C27 CIOC Introduction to Organic Chemistry and Nomenclature — Aspire Science Higher Secondary School

1. Tetravalency of carbon
2. Shapes of simple molecules - hybridization (s and p);
3. Classification of organic compounds based on functional groups: - C = C - , - C h C – and those containing halogens, oxygen, nitrogen and sulphur
4. Homologous series
5. Nomenclature (Trivial and IUPAC)

C28 CIMX Isomerism — Aspire Science Higher Secondary School

Isomerism - structural and stereoisomerism.

C29 CRMX Reaction Mechanisms — Aspire Science Higher Secondary School

1. Covalent bond fission - Homolytic and heterolytic
2. Free radicals, carbocations and carbanions
3. Stability of carbocations and free radicals
4. Electrophiles and nucleophiles.
5. Electronic displacement in a covalent bond - Inductive effect, electromeric effect, resonance and hyperconjugation.
6. Types of organic reactions - substitution, addition, elimination and rearrangement

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C09HC Hydrocarbons

C30 CANE Saturated Hydrocarbons — Aspire Science Higher Secondary School

Classification, isomerism, IUPAC nomenclature
General methods of preparation, properties and reactions.
Alkanes - Conformations: Sawhorse and Newman projections (of ethane); Mechanism of halogenation of alkanes, combustion and pyrolysis.

C31 CENE Alkenes — Aspire Science Higher Secondary School

Alkenes – Nomenclature, Geometrical isomerism; Mechanism of electrophilic addition: addition of hydrogen, halogens, water, hydrogen halides (Markownikoff's and peroxide effect); Ozonolysis, polymerization and oxidation; mechanism of electrophilic addition

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C32 CYNE Alkynes — Aspire Science Higher Secondary School

Alkynes - Nomenclature, structure of triple bond (ethyne), Acidic character; Addition of hydrogen, halogens, water and hydrogen halides; Polymerization.

C10DHC Derived Hydrocarbons

C33 CHHC Haloalkanes and haloaranes — Aspire Science Higher Secondary School

Haloalkanes and Haloarenes: General methods of preparation, properties and reactions; Nature of C-X bond; Mechanisms of substitution reactions. Optical rotation. Uses and Environmental effects of chloroform, iodoform, dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons and DDT.

C34 CALC Alcohols — Aspire Science Higher Secondary School

General methods of preparation, properties, reactions and uses. ALCOHOLS, PHENOLS AND ETHERS
Alcohols: Identification of primary, secondary and tertiary alcohols; mechanism of dehydration.

C35 CALD Aldehydes and Ketones — Aspire Science Higher Secondary School

Aldehyde and Ketones: Nature of carbonyl group; Nucleophilic addition to >C=O group, relative reactivities of aldehydes and ketones
Important reactions such as – Nucleophilic addition reactions (addition of HCN, NH3 and its derivatives), Grignard reagent; oxidation; reduction (Wolff Kishner and Clemmensen); acidity of ı- hydrogen, aldol condensation, Cannizzaro reaction, Haloform reaction; Chemical tests to distinguish between aldehydes and Ketones.

C36 CMCA Monocarboxyllic acids — Aspire Science Higher Secondary School

CARBOXYLIC ACIDS Acidic strength and factors affecting it.

C38 CANC Aliphatic Nitrogen Compounds — Aspire Science Higher Secondary School

General methods of preparation, properties, reactions and uses. Amines: Nomenclature, classification, structure, basic character and identification of primary, secondary and tertiary amines and their basic character.
Diazonium Salts: Importance in synthetic organic chemistry.

C11AC Aromatic Compounds

C41 CARC Aromatic Compounds — Aspire Science Higher Secondary School

Classification, isomerism, IUPAC nomenclature
General methods of preparation, properties and reactions.
Aromatic hydrocarbons - Nomenclature, benzene - structure and aromaticity; Mechanism of electrophilic substitution: halogenation, sulphonation, nitration, Friedel – Craft's alkylation and acylation, directive influence of functional group in monosubstituted benzene. Carcinogenicity and toxicity.
Phenols: Acidic nature, electrophilic substitution reactions: halogenation, nitration and sulphonation, Reimer - Tiemann reaction.

C12BIO Biomolecules

C42 CBIO Biomolecules — Aspire Science Higher Secondary School

General introduction and importance of biomolecules.
CARBOHYDRATES - Classification: aldoses and ketoses; monosaccharides (glucose and fructose), D.L. configuration. Constituent monosaccharides of oligosaccharides (sucrose, lactose and maltose). Polysaccharides (starch, cellulose, glycogen): importance.
PROTEINS - Elementary Idea of ι- amino acids, peptide bond, polypeptides; Proteins: primary, secondary, tertiary and quaternary structure (qualitative idea only), denaturation of proteins, enzymes.
Hormones- Elementary idea (excluding structure).
VITAMINS - Classification and functions.
NUCLEIC ACIDS - Chemical constitution of DNA and RNA. Biological functions of nucleic acids.

C13CSH Chemistry in Service of Humanity

C43 CCSH Chemistry in Service of Humanity — Aspire Science Higher Secondary School

1. Chemicals in medicines - Analgesics, tranquilizers, antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamins – their meaning and common examples.
2. Polymers: General introduction and classification of polymers
General methods of polymerization-addition and condensation, copolymerization; Natural and synthetic rubber and vulcanization; some important polymers with emphasis on their monomers and uses - polythene, nylon, polyester and bakelite. ; Biodegradable and non-biodegradable polymers.
3. Chemicals in food - Preservatives, artificial sweetening agents – common examples. Elementary idea of antioxidants.
4. Cleansing agents - Soaps and detergents, cleansing action.

C44 CECX Environmental Chemistry — Aspire Science Higher Secondary School

Environmental pollution - Atmospheric, water and soil.
Atmospheric pollution - Tropospheric and Stratospheric
Tropospheric pollutants – Gaseous pollutants: Oxides of carbon, nitrogen and sulphur and hydrocarbons; their sources, harmful effects and prevention;
Green house effect and Global warming
Acid rain
Particulate pollutants: Smoke, dust, smog, fumes, mist; their sources, harmful effects and prevention.
Stratospheric pollution- Formation and breakdown of ozone,
Depletion of ozone layer - its mechanism and effects.
Water Pollution - Major pollutants such as, pathogens, organic wastes and chemical pollutants; their harmful effects and prevention.
Soil pollution - Major pollutants such as: Pesticides (insecticides,. herbicides and fungicides), their harmful effects and prevention.
Strategies to control environmental pollution. Green chemistry as an alternative tool for reducing pollution

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C46 CPOL Polymers — Aspire Science Higher Secondary School

1. Classification-Natural and synthetic
2. Methods of polymerization (addition and condensation) co-polymerization
3. Some important polymers - natural and synthetic like polythene, nylon, polyester, bakelite, rubber
4. Biodegradable and non-biodegradable polymers.

C14PRP Principles of Practicals

C45 CPRP Principles related to Practical Chemistry — Aspire Science Higher Secondary School

Detection of extra elements (N,S, halogens) in organic compounds;
Detection of the following functional groups: hydroxyl (alcoholic and phenolic), carbonyl (aldehyde and ketone), carboxyl and amino groups in organic compounds.
Chemistry involved in the preparation of the following: Inorganic compounds: Mohr's salt, potash alum.
Organic compounds: Acetanilide, pnitroacetanilide, aniline yellow, iodoform.
Chemistry involved in the titrimetric excercises - Acids bases and the use of indicators, oxalic-acid vs KMnO4, Mohr's salt vs KMnO4.
Chemical principles involved in the qualitative salt analysis: Cations - Pb2+ , Cu2+, Al3+, Fe3+, Zn2+, Ni2+, Ca2+, Ba2+, Mg2+, NH4+. Anions- CO3 2-, S2-, SO4 2-, NO2-, NO3-, Cl -, Br, I. (Insoluble salts excluded).
Chemical principles involved in the following experiments:
1. Enthalpy of solution of CuSO4
2. Enthalpy of neutralization of strong acid and strong base.
3. Preparation of lyophilic and lyophobic sols.
4. Kinetic study of reaction of iodide ion with hydrogen peroxide at room temperature.

Mathematics

M01LS Logic and Set

M01 MLOG Symbolic Logic — Aspire Science Higher Secondary School

Statements, logical operations - and, or, implies, implied by, if and only if. Understanding of tautology, contradiction, converse and contrapositive. Principle of Mathematical Induction and its simple applications.

M02 MSET Set — Aspire Science Higher Secondary School

Sets and their representation; Union, intersection and complement of sets and their algebraic properties; Power set

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M32 MPMI Principle of Mathematical Induction — Aspire Science Higher Secondary School

Principle of Mathematical Induction:
1. Process of the proof by induction, motivation the application of the method by looking at natural numbers as the least inductive subset of real numbers.
2. The principle of mathematical induction and simple applications.

M02NS Number system

M07 MQPX Quadratic Polynomial — Aspire Science Higher Secondary School

Quadratic equations 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.

M08 MCNX Complex Number and Quadratic Equations — Aspire Science Higher Secondary School

Complex numbers as ordered pairs of reals, Representation of complex numbers in the form a + ib and their representation in a plane, Argand diagram, algebra of complex numbers, modulus and argument (or amplitude) of a complex number, square root of a complex number, triangle inequality

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M27 MSEQ Sequence and Series — Aspire Science Higher Secondary School

Arithmetic and Geometric progressions, insertion of arithmetic, geometric means between two given numbers. Relation between A.M. and G.M. Sum upto n terms of special series: Sn, Sn2, Sn3. Arithmetico – Geometric progression.

M30 MLIX Linear inequalities — Aspire Science Higher Secondary School

Linear inequalities.
1. Algebraic solutions of linear inequalities in one variable and their representation on the number line.
2. Graphical solution of linear inequalities in two variables.
3. Graphical solution of system of linear inequalities in two variables.

M03RF Relation and Function

M03 MREL Relation — Aspire Science Higher Secondary School

Relation, Types of relations, equivalence relations

M04 MFUN Function — Aspire Science Higher Secondary School

Functions;. one-one, into and onto functions, composition of functions. Real - valued functions, algebra of functions, polynomials, rational, trigonometric, logarithmic and exponential functions, inverse functions. Graphs of simple functions.

M04Trig Trigonometry

M05 MTRI Trigonometry — Aspire Science Higher Secondary School

Trigonometrical identities and equations.
Trigonometrical functions.
Inverse trigonometrical functions and their properties.
Heights and Distances.

M05CG2D 2D Co-ordinate Geometry

M12 MLIN Straight Line & Pairs of Lines — Aspire Science Higher Secondary School

Cartesian system of rectangular co-ordinates in a plane, distance formula, section formula, locus and its equation, translation of axes, slope of a line, parallel and perpendicular lines, intercepts of a line on the coordinate axes.
Various forms of equations of a line, intersection of lines, angles between two lines, conditions for concurrence of three lines, distance of a point from a line, equations of internal and external bisectors of angles between two lines, coordinates of centroid, orthocentre and circumcentre of a triangle, equation of family of lines passing through the point of intersection of two lines.

M14 MCOG Conic Sections — Aspire Science Higher Secondary School

1. Standard form of equation of a circle, general form of the equation of a circle, its radius and centre, 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 a circle, equation of the tangent.
2. 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.

M06DCAL Differential Calculus

M15 MLCX Limit and Continuity — Aspire Science Higher Secondary School

Limits, continuity

M16 MDIF Derivatives — Aspire Science Higher Secondary School

Differentiability

M17 MADX Application of Derivatives — Aspire Science Higher Secondary School

Rolle's and Lagrange's Mean Value Theorems. Applications of derivatives: Rate of change of quantities, monotonic - increasing and decreasing functions, Maxima and minima of functions of one variable, tangents and normals.

M28 MDER Derivatives-II — Aspire Science Higher Secondary School

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 up to two.

M07ICAL Integral Calculus

M18 MAND Antiderivative (Indefinite Integral) — Aspire Science Higher Secondary School

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. Evaluation of simple integrals of the type

M19 MDIX Definite Integral — Aspire Science Higher Secondary School

Integral as limit of a sum. Fundamental Theorem of Calculus. Properties of definite integrals. Evaluation of definite integrals, determining areas of the regions bounded by simple curves in standard form.

M20 MDEQ Differential Equation — Aspire Science Higher Secondary School

Ordinary differential equations, their order and degree. Formation of differential equations. Solution of differential equations by the method of separation of variables, solution of homogeneous and linear differential equations of the type: $dy/dx + p(x)\, y = q(x)$

M08CGV 3D Co - ordinate Geometry and Vector

M21 MTSL 3D Straight Line — Aspire Science Higher Secondary School

Coordinate axes and coordinate planes in three dimensions.
Coordinates of a point in three dimensions.
Distance between two points and section formula. Coordinates of a point in space, distance between two points, section formula, direction ratios and direction cosines, angle between two intersecting lines. Skew lines, the shortest distance between them and its equation. Equations of a line and a plane in different forms, intersection of a line and a plane, coplanar lines.

M23 MVEC Vector — Aspire Science Higher Secondary School

Vectors and scalars, addition of vectors, components of a vector in two dimensions and three dimensional space, scalar and vector products, scalar and vector triple product.

M09DM Determinants and Matrices

M10 MDET Determinants — Aspire Science Higher Secondary School

Determinants, Properties of determinants, evaluation of determinants, area of triangles using determinants. Test of consistency and solution of simultaneous linear equations in two or three variables using determinants.

M11 MMAT Matrices — Aspire Science Higher Secondary School

Matrices, algebra of matrices, types of matrices and matrices of order two and three. Adjoint and evaluation of inverse of a square matrix using determinants and elementary transformations, Test of consistency and solution of simultaneous linear equations in two or three variables using matrices

M10PC Permutation and Combination

M09 MPCX Permutation, Combination and Binomial Theorem — Aspire Science Higher Secondary School

Fundamental principle of counting, permutation as an arrangement and combination as selection, Meaning of P (n,r) and C (n,r), simple applications. Binomial theorem for a positive integral index, general term and middle term, properties of Binomial coefficients and simple applications.

M11PS Probability and Statistics

M24 MPRO Probability — Aspire Science Higher Secondary School

Probability: Probability of an event, addition and multiplication theorems of probability, Baye's theorem, probability distribution of a random variate, Bernoulli trials and Binomial distribution.

M25 MSTA Statistics — Aspire Science Higher Secondary School

Measures of Dispersion: Calculation of mean, median, mode of grouped and ungrouped data calculation of standard deviation, variance and mean deviation for grouped and ungrouped data.

Physics

P01PWM Physical World and Measurement

P01 PUDX Unit and Dimension

Aspire Science Higher Secondary School

1.Scope and excitement of Physics;
 a. Nature of physical laws
 b. Physics, technology and society
2. Need for measurement
3. Units of measurement
 a. Systems of units
 b. SI units - fundamental and derived units
4. Length, mass and time measurements
5. Least count, Accuracy and precision of measuring instruments
6. Errors in measurement
7. Significant figures.
8. Dimensions of physical quantities
9. Dimensional analysis and its applications.

P02 PSVX Scalars and vectors

Aspire Science Higher Secondary School

1. Scalar and vector quantities
 a. Position and displacement vectors
 b. General vectors and notation
 c. Equality of vectors
 d. Multiplication of vectors by a real number
 e. Addition and subtraction of vectors
2. Relative velocity
3. Unit vectors
4. Resolution of a vector in a plane, rectangular components.
5. Scalar and Vector products of Vectors

P02LM Linear Motion

P03 PKIN Kinematics

Aspire Science Higher Secondary School

1. Frame of reference
2. Motion in a straight line: Position-time graph, speed and velocity
3. Uniform and non-uniform motion
 a. Average speed and instantaneous velocity
 b. Uniformly accelerated motion
 c. Velocity-time and position-time graphs for uniformly accelerated motion (graphical treatment).
3. Elementary concepts of differentiation and integration for describing motion.
4. Motion in a plane
5. Cases of uniform velocity and uniform acceleration
 a. Projectile motion
 b. Uniform circular motion.

P04 PPMX Projectile Motion

Aspire Science Higher Secondary School

Projectile Motion: Motion in two dimension

P05 PLOM Laws of Motion

Aspire Science Higher Secondary School

1. Force and Inertia
2. Newton's First Law of motion
3. Momentum
4. Newton's Second Law of motion
5. Impulse
6. Newton's Third Law of motion
7. Law of conservation of linear momentum and its applications
8. Equilibrium of concurrent forces

P06 PFRI Friction

Aspire Science Higher Secondary School

1. Static and Kinetic friction
2. Laws of friction, rolling friction and lubrication

P07 PWPE Work, Power & Energy — Aspire Science Higher Secondary School

1. Work done by a constant force and a variable force
2. Kinetic energies
3. Work energy theorem
4. Power
5. Notion of potential energy
6. Potential energy of a spring
7. Conservative forces
8. Conservation of mechanical energy (kinetic and potential energies)
9. Non-conservative forces

P08 PCOL Collision — Aspire Science Higher Secondary School

Elastic and inelastic collisions in one and two dimensions.

P03RMG Rotaional Motion and Gravitation

P09 PCMX Circular Motion — Aspire Science Higher Secondary School

Dynamics of uniform circular motion:
1. Centripetal force
2. Examples of circular motion: vehicle on level circular road and vehicle on banked road
3. Applications of uniform circular motion
4. Motion in a vertical circle

P10 PRMI Rotational Motion and MI — Aspire Science Higher Secondary School

1. Centre of mass of a two-particle system: centre of mass motion and momentum conservation
2. Centre of mass of a rigid body and Equilibrium of rigid bodies
3. Centre of mass of uniform rod
4. Basic concepts of rotational motion
   a. moment of a force
   b. torque
   c. angular momentum
   d. conservation of angular momentum, examples and its applications
5. Moment of inertia
6. Radius of gyration
7. Comparison of linear and rotational motions
8. Values of moments of inertia for simple geometrical objects
9. Parallel and perpendicular axes theorems and their applications
10. Rigid body rotation
11. Equations of rotational motion.

P11 PGRV Gravitation — Aspire Science Higher Secondary School

1. The universal law of gravitation.
2. Acceleration due to gravity and its variation with altitude and depth.
3. Kepler's laws of planetary motion.
4. Gravitational potential energy; gravitational potential.
5. Escape velocity.
6. Orbital velocity of a satellite.
7. Geo-stationary satellites.

P04WM Wave Motion

P12 PSHM Simple Harmonic Motion — Aspire Science Higher Secondary School

1. Periodic motion - period, frequency, displacement as a function of time.
2. Periodic functions. Simple harmonic motion (S.H.M.) and its equation; phase;
3. Oscillations of a spring – restoring force and force constant
4. Energy in S.H.M. - kinetic and potential energies
5. Simple pendulum - derivation of expression for its time period
6. Free, forced and damped oscillations
7. Resonance

P13 PWAV Waves — Aspire Science Higher Secondary School

1. Wave motion. Longitudinal and transverse waves, speed of a wave. Displacement relation for a progressive wave.
2. Principle of superposition of waves, reflection of waves
3. Standing waves in strings

P14 PSWX Sound waves — Aspire Science Higher Secondary School

1. Standing waves in organ pipes
2. Fundamental mode and harmonics
3. Beats
4. Doppler effect in sound

P05POM Properties of Matter

P15 PEPM Elastic properties of matter — Aspire Science Higher Secondary School

1. Elastic behaviour; Stress-strain relationship
2. Hooke's Law
3. Young's modulus; Bulk modulus; Shear; Modulus of rigidity; Poisson's ratio; elastic energy.

P16 PHST Hydrostatic and surface tension — Aspire Science Higher Secondary School

1. Pressure due to a fluid column; Pascal's law and its applications.
2. Surface energy and surface tension
3. Angle of contact and excess of pressure
4. Application of surface tension - drops, bubbles and capillary rise.

P17 PFDX Fluid in Motion — Aspire Science Higher Secondary School

1. Viscosity: Stokes' law
2. Terminal velocity
3. Streamline and turbulent flow
4. Critical velocity
5. Reynolds number.
6. Bernoulli's principle and its applications.

P06HT Heat and Thermodynamics

P18 PHPX Heat Phenomena — Aspire Science Higher Secondary School

1. Heat, temperature, thermal expansion of solids, liquids and gases; Anomalous expansion.
2. Specific heat capacity, Cp, Cv, calorimetry; change of state, latent heat.

P19 PTDX Thermodynamics — Aspire Science Higher Secondary School

1. Thermal equilibrium, zeroth law of thermodynamics, concept of temperature
2. Heat, work and internal energy.
3. First law of thermodynamics.
   a. Isothermal and adiabatic processes
4. Second law of thermodynamics
   a. Reversible and irreversible processes
   b. Carnot engine and its efficiency
   c. Refrigerators

P20 PHTX Heat transfer — Aspire Science Higher Secondary School

1. Heat transfer
   a. Conduction and thermal conductivity
   b. Convection
   c. Radiation
   d. Newton's law of cooling and Stefan's law
   e. Qualitative ideas of Black Body Radiation
   f. Wein's displacement law
   g. Green House effect

P21 PMPM Molecular properties of matter — Aspire Science Higher Secondary School

1. Equation of state of a perfect gas, work done on compressing a gas.
2. Kinetic theory of gases - assumptions, concept of pressure.
3. Kinetic energy and temperature:
   a. rms speed of gas molecules
   b. Degrees of freedom, Law of equipartition of energy
   c. applications to specific heat capacities of gases
   d. Mean free path
   e. Avogadro's number

P07EMS Electrostatics and Magnetostatics

P22 PEFP Electric Charge Field and Potential — Aspire Science Higher Secondary School

1. Electric charges: Conservation of charge, Coulomb's law-forces between two point charges, forces between multiple charges; superposition principle and continuous charge distribution.
2. Electric field: Electric field due to a point charge, Electric field lines, Electric dipole, Electric field due to a dipole, Torque on a dipole in a uniform electric field.
3. Electric flux: Gauss's law and its applications to find field due to infinitely long uniformly charged straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell (field inside and outside).
4. Electric potential and its calculation for a point charge, electric dipole and system of charges
5. Equipotential surfaces, Electrical potential energy of a system of two point charges and of electric diploes in an electrostatic field.
6. Conductors and insulators, free charges and bound charges inside a conductor.

P23 PCAP Capacitance and capacitors — Aspire Science Higher Secondary School

Dielectrics and electric polarization
Capacitors and capacitance
Combination of capacitors in series and in parallel
Capacitance of a parallel plate capacitor with and without dielectric medium between the plates
Energy stored in a capacitor
Van de Graaff generator

P24 PMAG Magnetostatics — Aspire Science Higher Secondary School

Concept of magnetic field and Oersted's experiment.
Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis. Torque on a magnetic dipole (bar magnet) in a uniform magnetic field
Bar magnet as an equivalent solenoid, magnetic field lines;
Earth's magnetic field and magnetic elements.
Para-, dia- and ferro- magnetic substances.
Magnetic susceptibility and permeability, Hysteresis, Electromagnets and permanent magnets.

P08CE Current Electricity

P25 PCRD Current, Resistance and DC circuits — Aspire Science Higher Secondary School

Electric current and flow of electric charges in a metallic conductor
Drift velocity and mobility; their relation with electric current
Ohm's law, Electrical resistance, Resistances of different materials, V-I characteristics of Ohmic and non-ohmic conductors, Electrical energy and power
Electrical resistivity, Colour code for (carbon) resistors
Series and parallel combinations of resistors; Temperature dependence of resistance.
Electric Cell and its Internal resistance, potential difference and emf of a cell, combination of cells in series and in parallel.
Kirchhoff's laws and their applications. Wheatstone bridge, Metre bridge.
Potentiometer: Principle and applications to measure potential difference, and for comparing emf of two cells; measurement of internal resistance of a cell.

P27 PDCM Magnetic effects of current — Aspire Science Higher Secondary School

Biot - Savart law and its application to current carrying circular loop.
Ampere's law and its applications to infinitely long current carrying straight wire and solenoid.
Force on a moving charge in uniform magnetic and electric fields.
Cyclotron.
Force on a current-carrying conductor in a uniform magnetic field.
Force between two parallel current-carrying conductors
Definition of ampere
Torque experienced by a current loop in uniform magnetic field;
Moving coil galvanometer, its current sensitivity and conversion to ammeter and voltmeter.
Current loop as a magnetic dipole and its magnetic dipole moment. Magnetic dipole moment of a revolving electron.

P09EIAC Electromagnetic induction and alternating current

P28 PEMI Electromagnetic induction — Aspire Science Higher Secondary School

Electromagnetic induction
Faraday's law
Induced emf and current
Lenz's Law
Eddy currents
Self and mutual inductance.

P29 PACX Alternating current — Aspire Science Higher Secondary School

Alternating currents
Peak and rms value of alternating current/ voltage
Reactance and impedance
LC oscillations (qualitative treatment only)
LCR series circuit, resonance
Quality factor
Power in AC circuits, watt-less current.
AC generator and transformer.

P10OPT Optics

P30 PROX Ray optics — Aspire Science Higher Secondary School

Reflection and refraction of light at plane and spherical surfaces
Mirror formula
Total internal reflection and its applications, optical fibres
Deviation and Dispersion of light by a prism
Lenses: Lens Formula, lens-maker's formula. Magnification, Power of a Lens, Combination of thin lenses in contact. Combination of a lens and a mirror
Scattering of light- blue colour of the sky and reddish appearance of the sun at sunrise and sunset.

P31 PWOX Wave optics — Aspire Science Higher Secondary School

Wave optics: wave front and Huygens' principle, Laws of reflection and refraction using Huygen's principle. Proof of laws of reflection and refraction using Huygens' principle.
Interference, Young's double slit experiment and expression for fringe width. Coherent sources and sustained interference of light.
Diffraction due to a single slit, width of central maximum.
Resolving power of microscopes and astronomical telescopes,
Polarisation, plane polarized light; Brewster's law, uses of plane polarized light and Polaroids.

P32 POIX Optical instruments — Aspire Science Higher Secondary School

Optical instruments: Human eye, image formation and accommodation, correction of eye defects (myopia and hypermetropia) using lenses.
Microscope and Astronomical Telescope (reflecting and refracting) and their magnifying powers.

P11ANR Atomic Physics and Nuclear Physics

P33 PDNR Dual Nature of Radiation — Aspire Science Higher Secondary School

Dual nature of radiation.
Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation;
Particle nature of light
Matter waves: Wave nature of particle, de Broglie relation. Davisson-Germer experiment.

P34 PAPX Atomic Physics — Aspire Science Higher Secondary School

Alpha-particle scattering experiment
Rutherford's model of atom
Bohr model, energy levels, hydrogen spectrum.

P35 PNPX Nuclear physics — Aspire Science Higher Secondary School

Composition and size of nucleus, atomic masses, isotopes, isobars; isotones.
Radioactivity:
Alpha, beta and gamma particles/rays and their properties;
Radioactive decay law.
Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number
Nuclear fission and fusion.

P12SS Solids and Semiconductors

P36 PSSX Solids and semiconductors — Aspire Science Higher Secondary School

1. Energy bands in solids (qualitative ideas only)
2. Conductors, insulators and semiconductors
3. Semiconductor diode:
 a. I-V characteristics in forward and reverse bias
 b. Diode as a rectifier
 c. I-V characteristics of LED, photodiode, solar cell and Zener diode
 d. Zener diode as a voltage regulator.
4. Junction transistor:
 a. Transistor action, characteristics of a transistor
 b. transistor as an amplifier (common emitter configuration) and oscillator.
5. Logic gates (OR, AND, NOT, NAND and NOR).
6. Transistor as a switch.

P13SCOM Space communication

P37 PEMW Electromagnetic Waves — Aspire Science Higher Secondary School

Electromagnetic waves and their characteristics.
Transverse nature of electromagnetic waves.
Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, X-rays, gamma rays).
Applications of electromagnetic waves.

P38 PCOM Principles of Communication — Aspire Science Higher Secondary School

Propagation of electromagnetic waves in the atmosphere
Sky and space wave propagation
Need for modulation, Amplitude and Frequency Modulation,
Bandwidth of signals, Bandwidth of Transmission medium
Basic Elements of a Communication System (Block Diagram only).

P14ES Experimental Skill

P39 PEXS Experimental Skill — Aspire Science Higher Secondary School

Familiarity with the basic approach and observations of the experiments and activities:
1. Vernier callipers-its use to measure internal and external diameter and depth of a vessel.
2. Screw gauge-its use to determine thickness/diameter of thin sheet/wire.
3. Simple Pendulum-dissipation of energy by plotting a graph between square of amplitude and time.
4. Metre Scale - mass of a given object by principle of moments.
5. Young's modulus of elasticity of the material of a metallic wire.
6. Surface tension of water by capillary rise and effect of detergents.
7. Co-efficient of Viscosity of a given viscous liquid by measuring terminal velocity of a given spherical body.
8. Plotting a cooling curve for the relationship between the temperature of a hot body and time.
9. Speed of sound in air at room temperature using a resonance tube.
10. Specific heat capacity of a given (i) solid and (ii) liquid by method of mixtures.
11. Resistivity of the material of a given wire using metre bridge.
12. Resistance of a given wire using Ohm's law.
13. Potentiometer –
(i) Comparison of emf of two primary cells.
(ii) Determination of internal resistance of a cell.
14. Resistance and figure of merit of a galvanometer by half deflection method.
15. Focal length of:
(i) Convex mirror
(ii) Concave mirror, and
(iii) Convex lens using parallax method.
16. Plot of angle of deviation vs angle of incidence for a triangular prism.
17. Refractive index of a glass slab using a travelling microscope.
18. Characteristic curves of a p-n junction diode in forward and reverse bias.
19. Characteristic curves of a Zener diode and finding reverse break down voltage.
20. Characteristic curves of a transistor and finding current gain and voltage gain.
21. Identification of Diode, LED, Transistor, IC, Resistor, Capacitor from mixed collection of such items.
22. Using multimeter to:
(i) Identify base of a transistor
(ii) Distinguish between npn and pnp type transistor
(iii) See the unidirectional flow of current in case of a diode and an LED.
(iv) Check the correctness or otherwise of a given electronic component (diode, transistor or IC).
