Topics and Student Learning Outcomes of the Examination Syllabus

Part–I (Class XI)

Topics	Student Learning Outcomes	Cognitive Level[2]		
		K	U	A
1. Stoichiometry	**Candidates should be able to:**			
1.1 Mole and Avogadro's number	1.1.1 define moles and Avagadro's Number;	*		
	1.1.2 define moles concept with the help of Avagadro's Number;	*		
	1.1.3 calculate the number of moles of substance;			*
	1.1.4 interpret balance chemical equation in terms of interacting moles, representative particle, masses and volume of gases at STP (22.4 L);			*
1.2 Mole calculation	1.2.1 calculate mole ratio from balance equation for use as conversion factors in stoichiometric problems;			*
1.3 Percentage composition	1.3.1 calculate % (percentage) by mass of elements in compounds;			*
1.4 Excess and Limiting reagent	1.4.1 identify limiting reagent in reactions;			*
	1.4.2 calculate maximum amount of product produced and amount of any excess reagent, knowing the limiting reagent in reaction;			*
	1.4.3 calculate the gram molecular mass of a gas from density measurement of gases at STP;			*

[2] K = Knowledge, U = Understanding, A= Application (for explanation see section 8: Definition of command words used in Student Learning Outcomes and in Examination Questions).

			K	U	A
1.5 Chemistry as a Quantitative Science	1.5.1	list down the significance of chemistry as quantitative science in daily life;	*		
1.6 Theoretical and Actual yield	1.6.1	differentiate between actual yield, % age yield and theoretical yield;		*	
	1.6.2	calculate the percentage yield of a product in a given reaction.			*
2. Atomic Structure	**Candidates should be able to:**				
2.1 Discharge tube experiment	2.1.1	explain the construction, working of discharge tube and also its consequences;	*	*	
2.2 Application of Bohr's model	2.2.1	summarize the Bohr's atomic theory;		*	*
	2.2.2	concept of Bohr's model to calculate the radius and energy in the orbits;			*
	2.2.3	explain spectrual line of Hydrogenatom;		*	
	2.2.4	by using the concept of Bohr's theory calculate wave numbers of photons of various spectral series.			*
	2.2.5	discuss the defects of Bohr's atomic model		*	
2.3 Plank's quantum theory.	2.3.1	using Plank's theory interpreter relation between energy frequency and wave length;		*	
2.4 X-Rays and Atomic Numbers	2.4.1	describe the Moseley's experiment with reference to X-rays;	*	*	
	2.4.2	explain the production, properties and types of X-rays;	*	*	
	2.4.3	explain the uses of x-rays;		*	
2.5 Quantum number and orbitals / Hersen berg	2.5.1	describe the concepts of orbitals on the basis of uncertainty principal;	*		
	2.5.2	compare orbit and orbital;		*	
	2.5.3	apply the concept of quantum number for the position of electron/for distribution of electrons;			*

2.6 Dual nature of electron	2.6.1	explain the dual nature of electron with reference to De-borgliy equation;	*		
2.7 Electronic configuration	2.7.1	state the following rules of Electronic configuration (sufban, Hurd's, and Pauli's exclusion);	*		
	2.7.2	write correct electronic configuration based on above rules.		*	*
3. Theories of Covalent bonding and Shape of Molecules	**Candidates should be able to:**				
	3.1.1	discuss the postulate of VSEPR;	*		
3.1 Shape of Molecular Resonance	3.1.2	use VSEPR theory to describe the shape of simple covalent molecular;	*		
	3.1.3	explain the phenomenon of resonance with reference to Sp^2 hybrid orbital;		*	
	3.2.1	compare V.B.T and M.O.T;		*	
3.2 VBT and hybridization	3.2.2	predict the shapes of molecules with the help of M.O.T;			*
	3.2.3	explain hybridization (sp, sp^2, sp^3, dsp^3);		*	
3.3 Bond Characteristics	3.3.1	define bond energy;	*		
	3.3.2	relate bond energy with bond strength;		*	
	3.3.3	define bond length;	*		
	3.3.4	explain ionic character of covalent bond;		*	
	3.3.5	predict the nature of bonding on the basis of electro negativity;		*	
	3.3.6	describe the change in bond length of hetronuclear molecules due to the difference of E.N in bonded atoms		*	
	3.3.7	explain dipole moment;			
	3.3.8	predict geometry dipole moment of different molecules on the basis of moleculer theory;		*	*
3.4 Effect of bonding on physical and chemical properties	3.4.1	explain the solubility of ionic and covalent compounds on the nature of bonding;		*	
	3.4.2	explain chemical properties of ionic and covalent compound;		*	
	3.4.3	compare directional and non-directional nature of ionic and covalent bond.		*	

4. States of Matter: Gases		Candidates should be able to:		K	U	A
4.1	Kinetic Molecular Theory of gases	4.1.1	list down the postulate of Kinetic Molecular Theory (K.M.T) of Gases;	*		
		4.1.2	state and explain the Gas laws;	*		
		4.1.3	describe the gas laws with reference to Kinetic Molecular Theory (K.M.T);	*		
4.2	Absolute Temperature scale on the basis of Charles's law	4.2.1	explain absolute zero on the basis of Charles's laws;	*		
		4.2.2	convert the temperature into different scales;	*		
4.3	Avogadro's law	4.3.1	state and explain the significance of Avogadro. Law;		*	
4.4	Ideal Gas Equation	4.4.1	derive ideal gas equation;	*		
		4.4.2	apply ideal gas equation for calculation of gas co-efficient;			*
		4.4.3	explain the significance of ideal gas equation;		*	
		4.4.4	explain the significance of different units of ideal gas constant;			*
4.5	Deviation from ideal behaviour.	4.5.1	explain why gases deviate from their ideal behaviour;		*	
		4.5.2	explain the significance of ideal gas equation(using example of pressure cooker and scuba diver);		*	
4.6	Vander Waal's Equation	4.6.1	derive Vander Waal's equation;	*		
		4.6.2	explain pressure and volume correction for non ideal gases;		*	
4.7	Liquefaction of gases	4.7.1	explain the general principle of liquefaction of gases;		*	
		4.7.2	discuss Linde's method for the liquefication of air;		*	
4.8	Fourth State of water plasma	4.8.1	define and explain (properties) of plasma and plasma formation.	*	*	

5. States of Matter II liquids		Candidates should be able to:		K	U	A
5.1	Kinetic molecular interpretation of liquid	5.1.1	using kinetic molecular theory explain the term diffusion, compression expansion ,motion of molecular, intermolecular forces, kinetic energy in liquids;	*	*	
5.2	Intermolecular forces	5.2.1	explain applications of dipole-dipole forces, hydrogen bonding and London forces;			*
		5.2.2	explain physical properties of liquids such as evaporation ,vapour pressure ,boiling point, viscosity and surface tension;		*	
		5.2.3	use the concept of hydrogen bonding to explain the following properties of water; high surface tension, high specific heat, low vapour pressure, high heat of vapourisation and high boiling point, anomalous behaviour of water when its density shows maximum at $4^{\circ}C$;			*
		5.2.4	compare the volatility of different liquids at same temperature based on inter molecular forces;			*
5.3	Energetic of phase charge	5.3.1	define molar heat of fusion, heat of vaporization, molar heat of sublimation;	*		
		5.3.2	relate energy change and intermolecular forces;		*	
		5.3.3	describe dynamic equilibrium between different physical states of matter;		*	
5.4	Liquid Crystals	5.4.1	explain the formation of liquid crystal;		*	
		5.4.2	differentiate liquid crystals from pure liquids and crystalline solid;		*	
		5.4.3	explain anomalous behaviour of water according to hydrogen bonding;		*	
		5.4.4	state the uses of liquid crystals (wrist watches and calculator).	*		

6. States of Mater III Solids	Candidates should be able to:		K	U	A
6.1. Kinetic molecular interpretation of solids	6.1.1	describe simple properties of solid e.g. diffusion, compression, expansion, motion of molecular spaces between inter molecular forces and kinematics energy with reference to Kinetic molecular theory;		*	
6.2. Types of solids	6.2.1	differentiate between crystalline and amorphous solid;		*	
	6.2.2	differentiate between isomorphism and polymorphism;		*	
	6.2.3	relate polymorphism and allotropy;		*	
	6.2.4	define transition temperature;	*		
6.3. Properties of solids	6.3.1	describe different properties of crystalline solid e.g., symmetry, melting point, anisotropy, cleavage plane, crystal growth, geometrical shape, habit of crystals;		*	
6.4. Crystal Lattice	6.4.1	define unit cell and lattice energy;	*		
	6.4.2	explain energy changes in the formation of sodium chloride crystals lattice;		*	
	6.4.3	predict the energy changes for the formation of $MgCl_2$ and $CaCl_2$ by the given I.P and E.A value;			*
6.5. Types of Crystalline Solid	6.5.1	differentiate between different types of crystalline solid (ionic, molecular, metallic, covalent);			*
	6.5.2	list example of crystalline amorphous solid along with their uses in daily life.	*		

7. Chemical Equilibrium		Candidates should be able to:		K	U	A
7.1	Reversible reaction and Dynamic Equilibrium	7.1.1	define reversible reaction;	*		
		7.1.2	define equilibrium reaction;	*		
		7.1.3	write equilibrium expression for different given reaction;	*		
		7.1.4	relate the equilibrium expressions in terms of concentration, partial pressure, no of moles and mole fraction;			*
		7.1.5	give expression for reaction quotient;		*	
7.2	Factor affecting the Equilibrium	7.2.1	define Le-Chatelier principle;	*		
		7.2.2	explain the conditions favourable for equilibrium (concentration, temperature, pressure, catalyst) to focus the high yield of industrial products;		*	
		7.2.3	recognize the equilibrium state from the given value of Kc;		*	
		7.2.4	relate the equilibrium constant with ratio between concentration product and reactant;		*	
7.3	Industrial application of Le-Chateller's Principle	7.3.1	apply Le-Chatler's principle on different example;			*
		7.3.2	discuss the effect of temperature, pressure and concentration on the equilibrium state of given reversible reactions;			*
7.4	Solubility product and Precipitation reactions	7.4.1	define the solubility product;	*		
		7.4.2	differentiate between solubility and solubility product;		*	
		7.4.3	explain why some substances are more soluble and some are less soluble;		*	
7.5	Common Ion Effect	7.5.1	define the common ion effect;	*		
		7.5.2	discuss common ion effect and its application.		*	

8. Acid, Base and Salts	Candidates should be able to:		K	U	A
8.1 Acids, Bases and Amphoteric Substances	8.1.1	define acid, bases and amphoteric compounds;	*		
	8.1.2	explain the significance of acid base reaction in daily life (Food preservation, allergic reactions, importance of iodine in salt, gastric acidity, curdling of milk);		*	
	8.1.3	perform acid base titration to calculate molarity, molality and strength of given sample solutions;			*
8.2 Lowery - Bronsted Definitions of Acids and Bases	8.2.1	define acids and base on the bases Lowery – Bronsted theory;	*		
8.3 Conjugate Acid and Base	8.3.1	define conjugate acid and conjugate base;	*		
	8.3.2	compare the strength of conjugate acids and bases;		*	
8.4 Strengths of Acids and Bases	8.4.1	explain the ionization constant of water (Kw);		*	
	8.4.2	compare the strength of acid and base on the bases of pH and pOH;			*
	8.4.3	derive the dissociation constants of acid, base and water (Ka, Kb and Kw);	*		
	8.4.4	calculate the H_3O^+ concentration by using the given Ka and molar concentration of weak acid;			*
8.5 Lewis Concept of Acid and Base	8.5.1	define Lewis acids and Lewis bases along with examples;	*		
	8.5.2	identify Lewis acid and base from given compounds (e.g. NH_3, $AlCl_3$, BF_3);			*

			K	U	A
8.6 Buffer Solution	8.6.1	define the buffer solution;	*		
	8.6.2	state the importance of buffer in daily life;	*		
	8.6.3	describe the preparation of different types of buffer;		*	
	8.6.4	explain the buffer action to maintain pH of solution (with the help of equations);		*	
	8.6.5	explain levelling effect;		*	
8.7 Hydrolysis / Hydration	8.7.1	define hydrolysis;	*		
	8.7.2	explain the types of salt on the basis of hydrolysis;		*	
	8.7.3	differentiate between hydrolysis and hydration;		*	
	8.7.4	calculate concentration of ions of slightly soluble salts.			*
9. Chemical Kinetics	**Candidates should be able to:**				
9.1 Chemical Kinetics	9.1.1	define chemical kinetics;	*		
9.2 Rate of Reaction and Activation Energy	9.2.1	explain the relation of speed of reaction with the time;		*	
	9.2.2	define the terms like rate of reaction, rate equation, order of reactions, rate constant and rate determining step;	*		
	9.2.3	explain the significance of the rate determining step on the overall rate of a multistep reaction;			*
	9.2.4	write the rate law for the given reaction;			*
	9.2.5	relate activation energy and activated complex with the rate of reaction;		*	
	9.2.6	calculate the initial rate using concentration data of given reaction;			*
	9.2.7	draw an energy diagram that represents the activation energy and show the effect of catalyst;		*	
	9.2.8	deduce the order of reaction using the method of initial rate;			*

			K	U	A
9.3 Collision theory and transition state	9.3.1	explain the effects of concentration, temperature and surface area on reaction rate by using collision theory;		*	
9.4 Catalysis	9.4.1	explain how homogeneous and heterogeneous catalyst work;		*	
	9.4.2	explain effect of catalyst on the rate of reaction;		*	
	9.4.3	explain the significance of enzymes in daily life (Biological catalyst, removing stains from fabrics).		*	
10. Solution and Colloids	**Candidates should be able to:**				
10.1 General properties of solutions	10.1.1	list the characteristics of colloids and suspension that distinguish these from solution;	*		
	10.1.2	differentiate hydrophilic and hydrophobic molecules;		*	
	10.1.3	predict the nature of solution in liquid phase in the given examples (w.r.t miscible, immiscible, partially miscible solution);			*
	10.1.4	identify the solutions, colloids and suspensions in given examples;			*
	10.1.5	interpret the solubility graph on the basis of temperature for different solutions;			*
	10.1.6	draw and interpret the solubility curves from given experimental data;			*
10.2 Concentration Units	10.2.1	calculate the different concentration units (molarity, molality, mole fraction, ppm, ppb, ppt) from the given data;			*
10.3 Roult's Law	10.3.1	state Roult's law (all three definitions);	*		
	10.3.2	identify volatile and non volatile components of solution by plotting graph;			*
	10.3.3	draw a graph using Roult's law from the given data;			*

			K	U	A
10.4 Colligative properties	10.4.1	define colligative properties of liquids with examples;	*		
	10.4.2	explain lowering of vapour pressure, elevation of boiling point and depression of freezing point;		*	
	10.4.3	calculate molar mass of a substance using ebullioscopic and cryoscopic methods;			*
	10.4.4	differentiate osmotic pressure and reverse osmosis;		*	
10.5 Colloids	10.5.1	write down the properties of colloids;	*		
	10.5.2	explain the types of colloids.		*	
11. Thermochemistry	**Candidates should be able to:**				
11.1 Thermodynamics	11.1.1	define thermodynamics;	*		
	11.1.2	define the terms, system, surrounding, state function, heat, heat capacity, internal energy, work, and enthalpy;	*		
11.2 First law of thermodynamic	11.2.1	state and explain the first law of thermodynamic with the help of daily life examples;	*		
	11.2.2	relate change in internal energy of system with thermal energy at constant temperature and pressure;		*	
	11.2.3	calculate internal energy and work done of a system by applying the 1st law of thermodynamics;			*

			K	U	A
11.3 Hess's Law	11.3.1	state and explain Hess's law of heat summation;			*
	11.3.2	construct simple energy cycle by using Hess's law from the given reactions;	*		
	11.3.3	calculate standard heat of formation and heat of reaction by using Hess's law;		*	
	11.3.4	calculate the heat of reaction using experimental data ($Cm\Delta t=q$);			*
	11.3.5	explain working of a calorimeter;		*	
11.4 Born-Haber cycle	11.4.1	explain Born-Haber cycle(by using pathway diagram and explain in terms of enthalpy changes of the reaction);			*
11.5 Heat Capacity	11.5.1	explain the following terms; heat capacity, specific heat capacity and molar heat capacity.		*	

12. Electrochemistry	Candidates should be able to:	K	U	A
12.1 Oxidation - Reduction concept	12.1.1 define terms like reduction, oxidation, oxidation number, reducing agent, oxidizing agent;	*		
	12.1.2 determine oxidation number of an atom in pure substance or in a compound;			*
	12.1.3 identify reducing and oxidizing agent by using oxidation –number change method;			*
	12.1.4 balance the equation using oxidation number change method;			*
	12.1.5 identify oxidation and reduction half reaction;			*
	12.1.6 balance the equation using half reaction method;			*
	12.1.7 explain the uses of redox reactions in daily life (protection of metal surfaces from corrosion and other harmful agents, solar cell as a source of energy);		*	
12.2 Electrode Potential and Electrochemical Series	12.2.1 define cathode, anode, electrode potential, Standard Hydrogen Electrode and electrochemical series;	*		
12.3 Types of electrochemical cells	12.3.1 define cell potential;	*		
	12.3.2 determine the potential of electrochemical cell from the given data;			*
	12.3.3 describe reaction occurring within a lead storage batteries;		*	
	12.3.4 explain production of electrical energy in a fuel cell;		*	
	12.3.5 define in standard electrode potential;	*		
12.4 *Faraday's law*	12.4.1 state and explain the Faraday's law (1st and 2nd);		*	
	12.4.2 calculate the quantity of charge passed in an electrochemical cell during electrolysis;			*
	12.4.3 calculate the mass or volume of substance liberated during electrolysis.			*

Part–II (Class XII)

13. s-and p-Block Elements	Candidates should be able to:	K	U	A
13.1 Period (Na to Ar)	13.1.1 identify the demarcation of the periodic table into s, p, d and f-blocks;		*	
	13.1.2 identify group, period and block of given elements by using electronic configuration;			*
	13.1.3 list down the elements in period 3;	*		
	13.1.4 explain the periodicity of physical properties (like atomic radius, Ionization energy, electro negativity, electron affinity, electrical conductivity, melting and boiling points);		*	
	13.1.5 describe the anomalous behaviour in periodic trend of different elements in 3rd periods;		*	
	13.1.6 describe the reaction of period 3 elements with water, oxygen and chlorine;		*	
	13.1.7 describe the reaction of oxides, hydroxides and chloride of period 3 elements with water;		*	
	13.1.8 describe the physical properties of period 3 element (such as solubility and behaviours of oxides);		*	
13.2 Group 1	13.2.1 describe oxidation state and trend of physical properties in group 1 (such as Ionization energy, electro-negativity, atomic radius, melting and boiling point);		*	
	13.2.2 describe the chemical reaction of group 1 elements with H_2O, Oxygen and chlorine;		*	
	13.2.3 explain effect of heat on nitrates, carbonates and hydrogen carbonates of group 1 elements;		*	

			K	U	A
13.3 Group 2	13.3.1	describe oxidation state and trend of physical properties in group 2 elements (such as Ionization energy, electro-negativity, atomic radius, melting and boiling point);		*	
	13.3.2	describe the chemical reaction of group 2 elements with water, oxygen and nitrogen;		*	
	13.3.3	discuss the trend on solubility of hydroxides, sulphates and carbonates of group 2 elements;		*	
	13.3.4	discus the trends in thermal stability of the nitrates and carbonates of group 2 elements;		*	
	13.3.5	differentiate Beryllium from other members of its group;		*	
13.4 Group 4	13.4.1	describe oxidation state and trend of physical properties of group 4 elements (Ionization energy, electro-negativity, atomic radius, metallic character, melting and boiling property);		*	
	13.4.2	explain the variation of oxidation state in group 4 element;		*	
	13.4.3	describe the reaction of water with chlorides of carbon, silicon and lead;		*	
	13.4.4	compare the structure and stability of chlorides of carbon, silicon and lead;		*	
	13.4.5	describe the structure of CO_2 and SiO_2;		*	
	13.4.6	discuss the acid base behaviour of oxide of group 4 elements;		*	
13.5 Group 7	13.5.1	discuss the oxidation state and trend of physical property of group 7 elements (atomic radius, electro negativity, electron-affinity, meting and boiling point, bond energy);		*	
	13.5.2	discuss the bond enthalpies and acidity in hydrogen halide;		*	
	13.5.3	compare the strength of halide ion as a reducing agent;		*	
	13.5.4	explain the significance of following elements in daily life (Iodine in Goitre, Fluoride toxicity and deficiency, use of steel, tin, aluminium and glass in beverage and food industry).		*	

14. d- and f- Block Elements (Transition)	**Candidates should be able to:**	**K**	**U**	**A**
14.1 General feature of transition element	14.1.1 describe the general features of transition element. (colour, variable oxidation states, use as catalyst);		*	
14.2 *Electronic Structure*	14.2.1 describe the electronic structure of elements and ions of d-block element;		*	
	14.2.2 explain anomalous behaviour of chromium and copper with respect to electronic configuration;		*	
	14.2.3 write down electronic configuration of given elements and ions of d – block elements;			*
14.3 *Chemistry of some specific transition element*	14.3.1 describe the important reactions (redox reaction) and uses of Vanadium, Chromium, Copper, Manganese and Iron (as catalyst);		*	
14.4 Co-ordination Compound	14.4.1 explain shapes, origin, colour and nomenclature of Co-ordination compounds;			*
	14.4.2 relate the co-ordination number of ion through the crystal structure of a compound of which they are apart;		*	
	14.4.3 describe properties of alloys with reference to its composite metal atom;		*	
	14.4.4 describe the reaction of $K_2Cr_2O_7$ with oxalic acid and Mohr Salts;		*	
	14.4.5 describe the reaction of $KMnO_4$ with $FeSO_4$, oxalic acid and Mohr Salts;		*	
	14.4.6 calculate concentration of Fe(II) ions with in a solution by titration with $KMnO_4$;			*
	14.4.7 explain the reaction of Hexaaquacopper(II)ion with iodide and determine the concentration of copper ion in the solution.			*

15. Organic Compounds	**Candidates should be able to:**	**K**	**U**	**A**
15.1 Sources: Fossils, fuel, coal, petroleum and natural gas.	15.1.1 explain diversity and magnitude of organic compounds and their general properties;		*	
15.2 Coal as a source of organic compound	15.2.1 explain the destructive distillation of coal;		*	
15.3 *Classification of organic compound*	15.3.1 classify the organic compound on structural basis; 15.3.2 explain the use of coal as a source of both aliphatic and aromatic compounds;		* *	
15.4 Detection of element in organic compound	15.4.1 give the methods to detect the elements present in organic compound. (C, H, N, S, Halogen);	*		
15.5 Functional Group and Homologous series	15.5.1 define the Functional Group and homologous series.	*		
16. Hydrocarbons	**Candidates should be able to:**			
16.1 Nomenclature and Shapes of molecule	16.1.1 describe the nomenclature and shapes of molecule (alkane, alkene, cyclo-alkane, alkynes, benzenes and substituted benzene);		*	
16.2 Alkanes and Cycloalkanes	16.2.1 explain unreactive nature of alkanes and cycloalkanes exemplified by ethane and cyclopropane; 16.2.2 explain homolytic and hetrolytic fission,free radical initiation,propagation and termination;	 *		*
16.3 Free radical substitution reaction	16.3.1 describe the mechanism of free radical substitution with reference to methane and ethane;		*	

			K	U	A
16.4 Oxidation of organic compounds	16.4.1	identify and complete the redox reaction of organic compound;		*	*
16.5 Isomerism	16.5.1	explain what is meant by chiral centre and show that such a centre gives rise to optical isomerism.		*	
	16.5.2	identify chiral centres in given structural formula of a molecule			*
16.6 Alkenes	16.6.1	explain the term sigma and pi carbon-carbon bonds with reference to ethene molecule;		*	
	16.6.2	describe the reactivity of alkene exemplified by ethane;		*	
	16.6.3	explain the terms with suitable example: (isomerism, stereo isomerism and structural isomerism);		*	
	16.6.4	give the preparation: ethene from dehydration of alcohol and dehydro halogenations of alkyl halide;			*
	16.6.5	describe the reactions of ethene (hydrogenation, Hydration, Hydrohalogenation, halogenation, halohydration, epooxidation, Ozonolysis, polymerization);			*
16.7 Alkynes	16.7.1	compare the reactivity of alkynes with alkanes, alkenes and arenes (Aromatic compounds);		*	
	16.7.2	describe the preparation of alkynes using elimination reaction;			*
	16.7.3	explain the acidity of alkynes (w.r.t its reaction with metal);		*	
	16.7.4	explain the chemistry of alkynes by hydrogenation, hydrohalogenation, hydration, bromination, ozonolysis);		*	
16.8 Benzene and Substituted Benzene	16.8.1	compare the reactivity of benzene with alkene and alkane;		*	
	16.8.2	describe the mechanism of electrophilic substitution reaction of benzene;		*	
	16.8.3	discuss the chemistry of benzene and methyl benzene by nitration, sulphonation, halogenation, Friedal craft alkylation and acylation.			*

17. Alkyl halides and Amines	Candidates should be able to:	K	U	A
17.1 Alkyl halides	17.1.1 name alkyl halides using IUPAC system for naming;	*		
	17.1.2 discuss physical properties and reactivity of different alkyl halides on the basis of bond energy;		*	
	17.1.3 draw the structure of different alky halides by the given formula;			*
	17.1.4 describe the preparations of alkyl halide by the reaction of alcohol with HX, $SOCl_2$, PX_3 and by radical halogenations of alkane;		*	
17.2 *Nucleophilic substitution reaction*	17.2.1 describe the mechanism of SN reaction;		*	
	17.2.2 compare SN1 and SN2 reaction;		*	
	17.2.3 write down the mechanism of SN reaction for the given alkyl halide;			*
	17.2.4 identify Nucleophile (base), substrate and leaving group from the given reaction;		*	
	17.2.5 discuss carbo-cation and its stability;		*	
17.3 *Elimination Reaction*	17.3.1 describe the mechanism of different types of elimination reaction;		*	
	17.3.2 compare E1 and E2 reaction;		*	
	17.3.3 write down the mechanism of elimination reaction in the given alkyl halide;			*
	17.3.4 compare substitution reaction and elimination reaction;		*	
17.4 Organo-metallic Compounds (Grignard reagent)	17.4.1 describe the preparation and reactivity of grignard reagent;		*	
	17.4.2 describe chemical reaction of grignard reagent with aldehyde, ketones, esters and CO_2;		*	

		K	U	A
17.5 Amines	17.5.1 name amines applying IUPAC system;		*	
	17.5.2 discuss physical properties of amines (M.P, B.P and solubility);			*
	17.5.3 draw the structure of Amines (Primary, secondary and tertiary) from the given formula;		*	
	17.5.4 explain basicity of amines (basic character);			*
	17.5.5 describe preparation of amines by alkylation of NH_3, by alkyl halide and reduction of nitrile, nitro and amide functional groups;		*	
	17.5.5 describe chemical reaction of amines (alkylation with RX, reaction with aldehyde and ketones);		*	
	17.5.6 describe preparation of amides and diazonium salts;		*	
	17.5.7 describe isomerism in alkyl halides and amines;		*	
	17.5.8 describe the test to detect nitrogen in the given organic compound.		*	
18. Alcohol, Phenols and Ethers	**Candidates should be able to:**			
18.1 Alcohols	18.1.1 name different alcohols using IUPAC system;	*		
	18.1.2 describe the physical properties and structure of alcohol;		*	
	18.1.3 discuss the preparation of alcohol by reduction of aldehyde, ketone, carboxylic acid and esters;			*
	18.1.4 discuss the acidic character of alcohol (as exemplified by ethanol);		*	
	18.1.5 describe the chemistry of alcohol by preparation of ether, esters, oxidative cleavage of 1-2-diols;		*	
	18.1.6 define thiols (RSH);	*		
	18.1.7 describe the use of alcohol (disinfectant and antiseptic);		*	

			K	U	A
18.2 Phenols	18.2.1	apply IUPAC system for naming phenols;			*
	18.2.2	discuss physical properties, structure and acidic behaviour of phenol;		*	
	18.2.3	prepare phenols from the given compound in the form of equation (benzene sulphonic acid, chlorobenzene, acidic oxidation of cumene and hydrolysis of diozomium salts;			*
	18.2.4	discuss the chemistry of phenol (electrophilic aromatic substitution, reaction with Na metal and oxidation);		*	
	18.2.5	differentiate between alcohols and phenol;		*	
	18.2.6	explain isomerism in alcohol and phenol;		*	
18.3 Ether	18.3.1	apply IUPAC system for naming ether from the given formula;			*
	18.3.2	describe the physical and chemical properties of ether;		*	
	18.3.3	give chemical equation for the preparation of ether (Williamson Synthesis, reaction of alcohol and excess H_2SO_4);	*		
	18.3.4	explain the use of ether in medicine (for anaesthesia).		*	

19. Carbonyl Compound I: Aldelyde and ketones	Candidates should be able to:	K	U	A
19.1 Nomenclature / Structure	19.1.1 write the IUPAC nomenclature of aldelydes and ketones;			*
	19.1.2 draw the structure of given aldehydes and ketones;			*
19.2 Physical Properties	19.2.1 explain the physical properties of aldehydes and ketones;		*	
19.3 Preparation of Aldehyde and Ketone	19.3.1 write chemical equations for the preparation of aldehydes and ketones (by ozonolysis of alkene, hydration of alkyne, oxidation of alcohol, Friedal Craft acylation of aromatics;			*
19.4 Reaction of Aldehyde and Ketone.	19.4.1 discuss the role of ά – hydrogen for comparing the reactivity of aldehyde and ketones;		*	
	19.4.2 describe acid / base catalysed nucleophilic addition reaction of aldehyde and ketones;		*	
	19.4.3 discuss the chemistry of aldeyde and ketons by their reduction to hydrocarbon, alcohols, by using carbon nucleophiles, nitrogen nucleophiles and oxygen neucleophiles;		*	
	19.4.4 describe the oxidation reactions of aldelyde and ketones;		*	
19.5 Isomerism	19.5.1 draw all possible isomers of given aldehydes and ketones;			*
	19.5.2 describe glucose and fructose as example of aldeydes and ketones;		*	
19.6 Use	19.6.1 list down the use of formaldehyde vapours in adhesives, varnishes, paints, foam insulations, permanent press clothing;	*		

20. Carbony l Compound 2: Carboxylic acid and functional derivatives	**Candidates should be able to:**		**K**	**U**	**A**
20.1 Nomenclature	20.1.1	apply IUPAC system for naming carboxylic acid and their derivatives;			*
20.2 Structure and Physical Properties	20.2.1	describe the structure and physical properties (solubility M.P and B.P) of carboxylic acid;		*	
	20.2.2	draw the structure of given compounds of carboxylic acids and their derivatives;			*
20.3 Acidity	20.3.1	discuss the acidic behaviour of carboxylic acid (on the basis of alpha carbon) and derivatives of carboxylic acid;		*	
20.4 Preparation of Carboxylic Acid.	20.4.1	give chemical equation for the preparation of carboxylic acid by Grignard Reagent, hydrolysis of nitriles, oxidation of primary alcohol, aldehydes and alkyl benzene;	*		
20.5 Reactivity	20.5.1	describe the reactivity of carboxylic acid;		*	
	20.5.2	compare the reactivity in different derivatives of carboxylic acid;		*	
20.6 Reaction of Carboxylic Acid.	20.6.1	give the equations for the preparation of following (acyl halides, acid anhydrides, esters, amides);			*
	20.6.2	write the inter-conversion reactions of carboxylic acids derivatives (mentioned above);			*
	20.6.3	describe reaction of carboxylic acid derivatives (mentioned above);		*	

		K	U	A
20.7 Isomers	20.7.1 describe isomerism in carboxylic acids (chain and functional);		*	
	20.7.2 draw all possible isomers of carboxylic acid (given formula);			*
20.8 Uses	20.8.1 list carboxylic acids present in fruits, vegetables and other natural products;	*		
	20.8.2 list the use of carboxylic acid (as preservatives in food and food products, leather industry).	*		
21. Biochemistry	**Candidates should be able to:**			
21.1 Carbohydrates, Protein and lipids	21.1.1 explain the basis of classification of carbohydrates and protein;		*	
	21.1.2 describe structure-function relationship of carbohydrates, protein and lipids;		*	
	21.1.3 explain role of carbohydrate in health and disease;		*	
	21.1.4 explain the nutritional important of protein and lipids;		*	
	21.1.5 explain different types of lipids (simple, conjugate, steroids);		*	
	21.1.6 explain the effect of lowering of pH (by using lemon juice) on the process of precipitation of milk protein;		*	
21.2. Enzymes	21.2.1 describe the role of enzymes as biological catalyst (in conversion of food);		*	
	21.2.2 explain the factors effecting the enzymes activity;		*	
	21.2.3 explain the role of enzymes as inhibitors;		*	
21.3 Nucleic acid	21.3.1 identify the structural components of DNA and RNA;	*		
	21.3.2 state the role of DNA in terms of genetic informations;	*		
	21.3.4 explain the role of RNA in terms of protein synthesis;		*	
21.4 Mineral of biological significance	21.4.1 describe the role of Fe, Ca, P and Zn in nutrition;		*	
	21.4.2 explain the role of biochemical compounds (insulin, cholesterol) to regulate human health.		*	

22. Industrial Chemistry	Candidates should be able to:	K	U	A
22.1 Introduction	22.1.1 discuss the importance of chemical industries in the economy of Pakistan;		*	
	22.1.2 list the raw materials available in Pakistan for various chemical industries pharmaceutical, textile, petrochemicals);	*		
22.2 Safety measurement	22.2.1 discuss the safety measurement for industrial process according to ISO certification for the given industry (as mentioned above);		*	
	22.2.2 identify risks associated with the manufacturing of chemicals (as mentioned above);		*	
22.3 Dyes and Pesticides	22.3.1 discuss the importance of dyes and pesticides;		*	
22.4 Petro-chemicals	22.4.1 describe the fractional distillation and refining of petroleum;		*	
	22.4.2 describe the basic building block process in petrochemical technology (polymerization with its examples);		*	
	22.4.3 identify in the given equation the petrochemicals and chemicals derived from them (monomer and polymer);		*	
	22.4.4 list some major petrochemicals;	*		
22.5 Synthetic Polymers (PVC and nylon)	22.5.1 describe the chemical process of addition and condensation polymerization;		*	
	22.5.2 describe the formation and Uses of PVC and nylon;		*	
	22.5.3 describe preparation and application of various cosmetics like shampoos, sun blocks and fairness creams;		*	
22.6 Synthetic Adhesive	22.6.1 describe types and application of synthetic adhesive;		*	
22.7 Cosmetics	22.7.1 describe preparation and applications of various cosmetics like nail varnish, nail polish remover and lipsticks.		*	

23. Environmental Chemistry	Candidates should be able to:	K	U	A
23.1 Chemistry of Troposphere and Stratosphere	23.1.1 write down the various chemical reactions occurring in the atmosphere (w.r.t depletion of ozone);	*		
	23.1.2 discuss the release of oxide of C, S, N and VOCs which are associated with combustion of hydrocarbon based fuel;		*	
	23.1.3 outline problems associated with release of pollutants (e.g. acid rain and hazardous inorganic and organic compound like PAN (Peroxy Acetylic Nitrate);	*		
	23.1.4 describe causes and impacts of urban smog;		*	
	23.1.5 describe the role of CFCs in destroying ozone in the stratosphere;		*	
	23.1.6 list possible alternatives for the use of CFCs;	*		
	23.1.7 explain green house effect and global warming as resulting in climate change;		*	
23.2 Water pollution and Water treatment	23.2.1 explain the various techniques / methods of water analysis (using pH meter, TDS meter, titration method);		*	
	23.2.2 explain the methods of treatment for water purification (filtration, sewage treatment, Zeolite process, Reverse Osmosis);		*	
23.3 Green Chemistry	23.3.1 describe green chemistry and its significance;		*	
	23.3.2 write some micro wave reactions (green chemistry) with their industrial applications.		*	

24. Analytical Chemistry	Candidates should be able to:	K	U	A
24.1 Classical and modern methods of analysis	24.1.1 compare the classical and modern methods of analysis (w.r.t structural analysis of compounds);		*	
	24.1.2 discuss the procedure of combustion analysis of hydrocarbon;		*	
	24.1.3 define spectroscopy and discuss its application in analytical chemistry;	*		
	24.1.4 explain the different regions of electromagnetic spectrum (according to wavelength);		*	
	24.1.5 explain the basic principle of IR Spectroscopy;		*	
	24.1.6 identify benzene, acetone, carboxylic acid and ethanol from given IR spectra;		*	
	24.1.7 predict whether a given molecule will absorb in the UV / visible region;	*		
	24.1.8 outline in simple terms the principles of proton NMR spectroscopy;	*		
	24.1.9 explain instrumentation and working of mass spectroscopy. (MS);	*		
	24.1.10 outline the use of MS in determination of relative isotopic masses;		*	
	24.1.11 explain atomic emission and atomic absorption spectrum;		*	
	24.1.12 discuss the use of MS in determination of drug abuse in forensic sciences.		*	