آغا خان یونیورسٹی ایگزامینیشن بورڈ

AGA KHAN UNIVERSITY EXAMINATION BOARD

Higher Secondary School Certificate Examination Syllabus

CHEMISTRY

CLASSES XI-XII

(based on National Curriculum 2006)

Published by
Aga Khan University Examination Board
Bungalow # 233 / E.I.Lines,
Daudpota Road, Karachi, Pakistan.

November 2004
Latest Revision June 2012

Higher Secondary School Certificate Examination Syllabus

CHEMISTRY

CLASSES XI-XII

This subject is examined in both May and September Examination sessions

S. No.	Table of Contents	Page No.
	Preface	5
1.	Aims/Objectives of the National Curriculum (2006)	7
2.	Rationale of the AKU-EB Examination Syllabus	9
3.	Topics and Student Learning Outcomes of the Examination Syllabus	12
4.	Scheme of Assessment	66
5.	Teaching-Learning Approaches and Classroom Activities	72
6.	Recommended Text and Reference Material	73
7.	Definition of Cognitive Levels and Command Words	73
	Annex A: HSSC Scheme of Studies	77
	Annex B: List of Practical Activities	82

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PREFACE

In pursuance of National Education Policy (1998-2010), the Curriculum Wing of the Federal Ministry of Education has begun a process of curriculum reform to improve the quality of education through curriculum revision and textbook development (Preface, National Curriculum documents 2000 and 2002).

AKU-EB was founded in August 2003 with the same aim of improving the quality of education nationwide. As befits an examination board it seeks to reinforce the National Curriculum revision through the development of appropriate examinations for the Secondary School Certificate (SSC) and Higher Secondary School Certificate (HSSC) based on the latest National Curriculum and subject syllabus guidance.

AKU-EB has a mandate by Ordinance CXIV of 2002 to offer such examination services to English and Urdu medium candidates for SSC and HSSC from private schools anywhere in Pakistan or abroad, and from government schools with the relevant permissions. It has been accorded this mandate to introduce a choice of examination and associated educational approach for schools, thus fulfilling a key objective of the National Curriculum of Pakistan: "Autonomy will be given to the Examination Boards and Research and Development cells will be established in each Board to improve the system" (ibid. para. 6.5.3 (ii)).

AKU-EB is committed to creating continuity of educational experience and the best possible opportunities for its students. In consequence it offered HSSC for the first time in September, 2007 to coincide with the arrival of its first SSC students in college or higher secondary school. Needless to say this is not an exclusive offer. Private candidates and students joining AKU-EB affiliated schools and colleges for HSSC Part 1 are eligible to register as AKU-EB candidates even though they have not hitherto been associated with AKU-EB.

This examination syllabus exemplifies AKU-EB's commitment to national educational goals.

- It is in large part a reproduction, with some elaboration, of the Class XI and XII National Curriculum of the subject.

- It makes the National Curriculum freely available to the general public.

- The syllabus recommends a range of suitable textbooks already in print for student purchase and additional texts for the school library.

- It identifies areas where teachers should work together to generate classroom activities and materials for their students as a step towards the introduction of multiple textbooks, another of the Ministry of Education's policy provisions for the improvement of higher secondary education (ibid. para. 6.3.4).

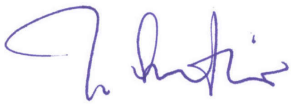
This examination syllabus brings together all those cognitive outcomes of the National Curriculum statement which can be reliably and validly assessed. While the focus is on the cognitive domain, particular emphasis is given to the application of knowledge and understanding, a fundamental activity in fostering "attitudes befitting useful and peaceful citizens and the skills for and commitment to lifelong learning which is the cornerstone of national economic development" (Preface to National Curriculum documents 2000 and 2002).

To achieve this end AKU-EB has brought together university academicians, teacher trainers, writers of learning materials and above all, experienced teachers, in regular workshops and subject panel meetings.

AKU-EB provides copies of the examination syllabus to subject teachers in affiliated schools to help them in planning their teaching. It is the syllabus, not the prescribed textbook which is the basis of AKU-EB examinations. In addition, the AKU-EB examination syllabus can be used to identify the training needs of subject teachers and to develop learning support materials for students. Involving classroom teachers in these activities is an important part of the AKU-EB strategy for improving the quality of learning in schools.

The Curriculum Wing of the Federal Ministry of Education has recently released new subject specifications and schemes of study to take effect in September, 2008. These documents are a major step forward towards a standards-related curriculum and have been welcomed by AKU-EB. Our current HSSC syllabuses have been revised to ensure conformity with the new National Curriculum 2006.

We stand committed to all students who have embarked upon the HSSC courses in facilitating their learning outcomes. Our examination syllabus document ensures all possible support.



Dr. Thomas Christie
Director,
Aga Khan University Examination Board
July 2009

1. Aims/Objectives of the National Curriculum (2006)[1]

Aims

This two-year study of chemistry aims to develop in all students:

- A scientific understanding of the physical world.
- Cognitive, affective, and psychomotor abilities appropriate to the acquisition and use of chemical knowledge, understanding, attitude, and skills.
- An appreciation for the products and influences of science and technology, balanced by a concern for their appropriate application.
- An understanding of the nature and limitations of scientific activity.
- An ability to apply the understanding of chemistry to relevant problems (including those from everyday real-life) and to approach those problems in rational ways
- Respect for evidence, rationality and intellectual honesty.
- The capacities to express themselves coherently and logically, both orally and in writing and to use appropriate modes of communication characteristic of scientific work.
- The ability to work effectively with others.

Objectives:

A statement of objectives relevant to each of the general aims is listed below. The sequence is in no particular order.

Understanding the physical world:
Students should understand the scientific concepts inherent in the theme for each chapter and be able to:

- State, exemplify, and interpret the concepts.
- Use appropriately, fundamental terms and classification related to the concepts.
- Cite, explain or interpret scientific evidence in support of the concepts.

Using appropriate cognitive, affective and psychomotor abilities:
Students should show ability to:

- Formulate questions that can be investigated by gathering first or second – hand data.
- Find relevant published background information.
- Formulate hypotheses and make predictions from them.
- Plan an investigation and carry out the planned procedure.
- Use appropriate and relevant motor skills in carrying out investigations.
- Observe phenomena and describe, measure and record these as data.

[1] Government of Pakistan (2006), *National Curriculum; Chemistry Classes XI-XII, Islamabad,* Ministry of Education (Curriculum Wing)

- Classify, collate and display data.
- Construct and or interpret visual representations of phenomena and relationships (diagrams, graphs, flowcharts, physical models).
- Analyze data and draw conclusions.
- Evaluate investigative procedures and the conclusions drawn from such investigations.

Understanding the nature and limitations of scientific activity:
For each facet of scientific activity selected for study, students should:

- Describe and exemplify it.
- Use appropriately any fundamental terms and classification related to it.
- Recognise that the problem-solving nature of science has limitations.
- Acknowledge that people engaged in science, a particularly human enterprise, have the characteristics of people in general.

Appreciating influences of science and technology
Student should:

- Recognise that the technology resulting from scientific activity influences the quality of life and economic development through or by improvements in medical / health care nutrition and agricultural techniques.
- Explain that these influences may be the result of unforeseen consequences, rapid exploitation, or rapid cultural changes.
- Realize that advances in technology require judicious applications.

Respecting evidence, rationality and intellectual honesty:
Student should:

- Display respect for evidence, rationality and intellectual honesty given the number of emotive issues in the area of chemistry.

Showing capacities to communicate:
Students should:

- Comprehend the intention of a scientific communication, the relationship among its parts and its relationship to what they already know.
- Select and use the relevant parts of a communication.
- Translate information fro communications in particular modes (spoken, written, tables, graphs flowcharts, diagrams) to other modes.
- Structure information using appropriate modes to communicates.

Working with others:
Students should actively participate in group work and:

- Share the responsibility for achieving the group.
- Show concern for the fullest possible involvement of each group member.

2. Rationale of the AKU-EB Examination Syllabus

2.1 General Rationale

2.1.1 In 2007, the Curriculum Wing of the Federal Ministry of Education (MoE) issued a revised part-wise Scheme of Studies. All subjects are to be taught and examined in both classes XI and XII. It is therefore important for teachers, students, parents and other stakeholders to know:

(a) that the AKU-EB Scheme of Studies for its HSSC examination (Annex A) derives directly from the 2007 Ministry of Education Scheme of Studies;
(b) which topics will be examined in Class XI and in Class XII;
(c) at which cognitive level or levels (Knowledge, Understanding, Application and other higher order skills) the topics and sub-topics will be taught and examined;

2.1.2 This AKU-EB examination syllabus addresses these concerns. Without such guidance teachers and students have little option other than following a single textbook to prepare for an external examination. The result is a culture of rote memorization as the preferred method of examination preparation. The pedagogically desirable objectives of the National Curriculum which encourage "observation, creativity and other higher order thinking [skills]" are generally ignored. AKU-EB recommends that teachers and students use multiple teaching-learning resources for achieving the specific objectives of the National Curriculum reproduced in the AKU-EB examination syllabuses.

2.1.3 The AKU-EB examination syllabuses use a uniform layout for all subjects to make them easier for teachers to follow. Blank sheets are provided in each syllabus for writing notes on potential lesson plans. It is expected that this arrangement will also be found helpful by teachers in developing classroom assessments as well as by question setters preparing material for the AKU-EB external examinations. The AKU-EB aims to enhance the quality of education through improved classroom practices and improved examinations.

2.1.4 The Student Learning Outcomes (SLOs) in Section 3 start with command words such as list, describe, relate, explain, etc. The purpose of the command words is to direct the attention of teachers and students to specific tasks that candidates following the AKU-EB examination syllabuses are expected to undertake in the course of their subject studies. The examination questions will be framed using the same command words or the connotation of the command words, to elicit evidence of these competencies in candidates' responses. The definitions of command words used in this syllabus are given in Section 7. It is hoped that teachers will find these definitions useful in planning their lessons and classroom assessments.

2.1.5 The AKU-EB has classified SLOs under the three cognitive levels, Knowledge (K), Understanding (U) and Application of knowledge and skills (A) in order to derive multiple choice questions and constructed response questions on a rational basis from the subject syllabuses ensuring that the intentions of the National Curriculum should be met in full. The weighting of marks to the Multiple Choice and Constructed Response Papers is also derived from the SLOs, command words and cognitive levels. In effect the SLOs derived from the National Curriculum determine the structure of the AKU-EB subject examination set out in Section 4 and 5.

2.1.6 Some topics from the National Curriculum have been elaborated and enriched for better understanding of the subject and/or to better meet the needs of students in the twenty-first century.

2.2. Specific Rationale of the AKU-EB Chemistry Examination Syllabus

2.2.1 The National Education Policy (1998-2010) outlines the following objectives for higher secondary education:

a. To prepare the students well for the pursuit of professional and specialized education;

b. To make available such teaching and learning materials that will make learning rewarding and attractive.

c. To introduce a system of evaluation that emphasizes learning of concepts and discourages rote memorization.

2.2.2 In line with National Education Policy, the AKU-Examination Board syllabuses in science subject focus on the following:

a. Broadening student's conceptual understanding through opportunities for enhancing their scientific skills, inquiry and experimentation.

b. Allocating marks for each cognitive level of learning such as knowledge, understanding and application. The importance of content has been clearly elaborated as student learning outcomes.

c. Reducing overloading and repetition. There is a need to look at the syllabus critically with due consideration to the fundamental concepts of secondary level science.

3. Topics and Student Learning Outcomes of the Examination Syllabus

Part–I (Class XI)

Topic		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 Avogadro's number;	*		
		1.1.2	define moles concept with the help of Avogadro's number;	*		
		1.1.3	calculate the number of moles of substances;			*
		1.1.4	interpret a balanced chemical equation in terms of interacting moles, representative particles, masses and volume of gases at STP (22.4 L);			*
1.2	Mole Calculation	1.2.1	calculate mole ratios from a balanced equation for use as conversion factors in stoichiometric problems;			*
1.3	Formulae and Percentage Composition	1.3.1	calculate % (percentage) by mass of elements in compounds;			*
		1.3.2	deduce empirical and molecular formula of compounds;			*
1.4	Excess and Limiting Reagent	1.4.1	deduce the limiting reagent in reactions;			*
		1.4.2	calculate maximum amount of product produced and amount of any unreacted excess reagent, knowing the limiting reagent in a reaction;			*
1.5	Chemistry as a Quantitative Science	1.5.1	list down the significance of chemistry as quantitative science in daily life;	*		

[2] K = Knowledge, U = Understanding, A= Application (for explanation see Section 7: Definition of command words used in Student Learning Outcomes and in Examination Questions).

NOTES

				K	U	A
1.6	Theoretical and Actual Yield	1.6.1	distinguish between actual yield, percentage 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 with reference to the discovery of electron and proton;		*	
2.2	Application of Bohr's Model	2.2.1	summarize Bohr's atomic theory;		*	
		2.2.2	calculate the radius and energy of revolving electrons in orbits using the concept of Bohr's model;			*
		2.2.3	explain spectral line of hydrogen atom;		*	
		2.2.4	calculate wave numbers of photons of various spectral series by using the concept of Bohr's theory;			*
		2.2.5	discuss the defects of Bohr's atomic model;		*	
2.3	Plank's Quantum Theory	2.3.1	explain the relation between energy, frequency and wave length using Plank's theory;		*	
2.4	X-Rays and Atomic Numbers	2.4.1	describe Moseley's experiment with reference to X-rays;		*	
		2.4.2	state Moseley's law and its significance;	*		
		2.4.3	explain the production, properties and types of X-rays;		*	
		2.4.4	list the uses of X-rays;	*		
2.5	Heisenberg's Uncertainty Principle and Quantum Numbers	2.5.1	describe the concepts of orbital on the basis of uncertainty principle;		*	
		2.5.2	compare orbit and orbital;		*	
		2.5.3	apply the concept of quantum number to specify the position and distribution of electrons;			*

NOTES

				K	U	A
2.6	Dual Nature of Electron	2.6.1	explain the dual nature of electron with reference to de-Broglie equation;		*	
2.7	Electronic Configuration	2.7.1	state the rules of electronic configuration (Aufbau, Hund's, and Pauli's exclusion);	*		
		2.7.2	show correct electronic configuration of elements based on above rules.			*
3. Theories of Covalent Bonding and Shape of Molecules		**Candidates should be able to:**				
3.1	Bond Characteristics	3.1.1	define bond energy;	*		
		3.1.2	relate bond energy with bond strength;		*	
		3.1.3	define bond length;	*		
		3.1.4	explain ionic character of covalent bond;		*	
		3.1.5	predict the nature of bonding on the basis of electronegativity;			*
		3.1.6	describe the change in bond length of heteronuclear molecules due to the difference of electronegativity values of bonded atoms;		*	
		3.1.7	explain dipole moment;		*	
		3.1.8	predict geometry and dipole moment of different molecules on the basis of molecular theory;			*
3.2	Shape of Molecules	3.2.1	state the postulate of valence shell electron pair repulsion (VSEPR) theory;	*		
		3.2.2	describe the shape of simple covalent molecules using VSEPR theory;		*	
3.3	VBT, MOT and Hybridization	3.3.1	explain and compare VBT and MOT;		*	
		3.3.2	predict the electronic configuration, bond order and magnetic properties of homonuclear diatomic molecules with the help of MOT;			*
		3.3.3	explain hybridization and describe the shapes of simple molecules using orbital hybridization (sp, sp^2, sp^3);		*	

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				K	U	A
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 compounds;		*	
		3.4.3	compare directional and non-directional nature of ionic and covalent bonds.		*	
4. States of Matter I: Gases		**Candidates should be able to:**				
4.1	Kinetic Molecular Theory of Gases	4.1.1	list down the postulate of kinetic molecular theory (KMT) of gases;	*		
		4.1.2	state and explain the gas laws (Boyle's, Charles's, Avogadro's, Dalton's law of partial pressure and Graham's law of diffusion/effusion);		*	
		4.1.3	explain the gas laws with reference to Kinetic Molecular Theory;		*	
4.2	Absolute Temperature Scale on the Basis of Charles's Law	4.2.1	explain absolute zero on the basis of Charles's law;		*	
		4.2.2	convert temperature into different scales;			*
4.3	Ideal Gas Equation	4.3.1	derive ideal gas equation;		*	
		4.3.2	calculate the values of ideal gas constant in different units;			*
		4.3.3	apply ideal gas equation for the calculation of mass, pressure, volume, temperature and density of a gas;			*
		4.3.4	calculate the gram molecular mass of a gas from density measurement of gases at STP;			*
		4.3.5	explain how pressure affects scuba divers at varying depths;		*	
4.4	Deviation from Ideal Behaviour	4.4.1	explain deviation of gases from their ideal behaviour;		*	

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				K	U	A
4.5	Vander Waal's Equation	4.5.1 4.5.2	derive Vander Waal's equation; explain pressure and volume correction for non-ideal gases;		* *	
4.6	Liquefaction of Gases	4.6.1 4.6.2	explain the general principle of liquefaction of gases; discuss Linde's method for the liquefaction of gases;		* *	
4.7	Fourth State of Matter: Plasma	4.7.1 4.7.2	define and explain the formation of plasma; describe the characteristics and applications of plasma.		* *	
5. States of Matter II: Liquids		**Candidates should be able to:**				
5.1	Kinetic Molecular Interpretation of Liquid	5.1.1	describe the following terms: diffusion, compression, expansion, motion of molecules, intermolecular forces, and kinetic energy in liquids using kinetic molecular theory;		*	
5.2	Intermolecular Forces	5.2.1 5.2.2 5.2.3 5.2.4	explain applications of dipole-dipole forces, hydrogen bonding and London forces; explain physical properties of liquids such as evaporation, vapour pressure, boiling point, viscosity and surface tension; explain the properties of water (high surface tension, high specific heat, low vapour pressure, high heat of vaporisation, high boiling point and anomalous behaviour of water when its density shows maximum at $4^{\circ}C$ using the concept of hydrogen bonding); compare the volatility of different liquids at same temperature based on intermolecular forces;		* * * *	

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				K	U	A
5.3	Energetic of Phase Changes	5.3.1 5.3.2 5.3.3	define molar heat of fusion, heat of vaporization, molar heat of sublimation; relate energy changes with changes in intermolecular forces; describe dynamic equilibrium between different physical states of matter;	*	 * *	
5.4	Liquid Crystals	5.4.1 5.4.2 5.4.3	explain the formation of liquid crystals; differentiate liquid crystals from pure liquids and crystalline solids; state the uses of liquid crystals (as temperature sensors, in thermometers, skin thermography, electrical circuits and devices, chromatographic separations, and as display screens).	 *	* * 	
6. States of Mater III: Solids		**Candidates should be able to:**				
6.1	Kinetic Molecular Interpretation of Solids	6.1.1	describe simple properties of solids e.g. diffusion, compression, expansion, motion of molecules, intermolecular forces and kinetic energy with reference to kinetic molecular theory;		*	
6.2	Types of Solids	6.2.1 6.2.2 6.2.3 6.2.4	distinguish between crystalline and amorphous solid; differentiate between isomorphism and polymorphism; relate polymorphism with allotropy; describe transition temperature with examples;		* * * *	
6.3	Properties of Solids	6.3.1	describe different properties of crystalline solids e.g. symmetry, melting point, anisotropy, cleavage plane, crystal growth, geometrical shape and habit of crystals;		*	

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				K	U	A
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 crystal lattice;		*	
6.5	Types of Crystalline Solid	6.5.1	differentiate among different types of crystalline solids (ionic, molecular, metallic and covalent);		*	
		6.5.2	list examples of crystalline and amorphous solids along with their uses in daily life.	*		
7. Chemical Equilibrium		**Candidates should be able to:**				
7.1	Reversible Reaction and Dynamic Equilibrium	7.1.1	define reversible reaction;	*		
		7.1.2	define equilibrium reaction;	*		
		7.1.3	determine equilibrium expression for different given reactions;		*	
		7.1.4	relate equilibrium expressions to concentration, partial pressure, number of moles and mole fraction;		*	
		7.1.5	determine expression for reaction quotient;		*	
7.2	Factors Affecting Equilibrium	7.2.1	state Le-Chatelier's 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	recognise the equilibrium state from the given value of Kc;		*	
		7.2.4	relate the equilibrium constant with ratio between concentration of products and reactants;		*	
7.3	Industrial Application of Le-Chatelier's Principle	7.3.1	apply Le-Chatelier's principle in different situations;			*
		7.3.2	discuss the effect of catalyst, temperature, pressure, volume and concentration on the equilibrium state of given reversible reactions;		*	

NOTES

				K	U	A
7.4	Solubility Product and Precipitation Reactions	7.4.1 7.4.2 7.4.3 7.4.4	define solubility product; distinguish between solubility and solubility product; explain why some substances are more soluble and some are less soluble; calculate concentration of ions of slightly soluble salts;	* 	 * * 	 *
7.5	Common Ion Effect	7.5.1 7.5.2	define common ion effect; discuss common ion effect and its application.	*	 *	
8. Acids, Bases and Salts		**Candidates should be able to:**				
8.1	Acids, Bases and Amphoteric Substances	8.1.1 8.1.2 8.1.3	define acids, bases and amphoteric compounds; explain the significance of acid base reactions in daily life (food preservation, allergic reactions, importance of iodine in salt, gastric acidity, curdling of milk); calculate molarity, molality and strength of given sample solutions based on acid-base titration;	*	 *	 *
8.2	Lowry - Bronsted Concept of Acids and Bases	8.2.1	define acids and bases according to Lowry – Bronsted theory;	*		
8.3	Conjugate Acids and Bases	8.3.1 8.3.2	define conjugate acid and conjugate base; compare the strength of conjugate acids and bases;	*	 *	

NOTES

				K	U	A
8.4	Strengths of Acids and Bases	8.4.1	explain the ionization constant of water (K_w);		*	
		8.4.2	compare the strength of acids and bases using pH and pOH;		*	
		8.4.3	derive the dissociation constants of acid, base and water (K_a, K_b and K_w);		*	
		8.4.4	calculate the H_3O^+ concentration by using the given Ka and molar concentration of weak acid;			*
		8.4.5	explain the term 'levelling effect';		*	
8.5	Lewis Concept of Acids and Bases	8.5.1	define Lewis acids and bases along with examples;	*		
		8.5.2	classify the given compounds (e.g. NH_3, $AlCl_3$, BF_3, etc.) as Lewis acids or bases;		*	
8.6	Buffer Solution	8.6.1	define 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 with the help of equations the buffer action to maintain pH of solutions ;		*	
8.7	Hydrolysis and 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;		*	

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				K	U	A
9. Chemical Kinetics		**Candidates should be able to:**				
9.1	Chemical Kinetics	9.1.1	define chemical kinetics;	*		
9.2	Rate and Order of Reaction	9.2.1	explain the relation of 'speed-of-reaction' with time;		*	
		9.2.2	define the terms, 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	determine the rate law for the given reaction;		*	
		9.2.5	deduce the order of reaction using the method of initial rate;			*
9.3	Collision Theory, Transition State and Activation Energy	9.3.1	relate activation energy and activated complex to the rate of reaction;		*	
		9.3.2	calculate the initial rate using concentration data of given reactions;			*
		9.3.3	draw an energy diagram that represents the activation energy and show the effect of catalyst;			*
		9.3.4	explain the effect of concentration, temperature and surface area on reaction rate by using collision theory;		*	
9.4	Catalysis	9.4.1	explain how a homogeneous and a heterogeneous catalyst works;		*	
		9.4.2	explain the effect of catalyst on the rate of reaction;		*	
		9.4.3	explain the significance of enzymes in daily life (such as biological catalysts or in removing stains from fabrics).		*	

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				K	U	A
10. Solution and Colloids		**Candidates should be able to:**				
10.1	Concentration Units	10.1.1	calculate the different concentration units of solutions (percentage composition, molarity, molality, mole fraction, ppm, ppb, ppt) from the given data;			*
10.2	General Properties of Solution and Solubility	10.2.1	distinguish between hydrophilic and hydrophobic molecules;		*	
		10.2.2	predict the nature of solutions in liquid phase in the given examples (w.r.t. miscible, immiscible, partially miscible solution);			*
		10.2.3	interpret the solubility graph on the basis of temperature for different solutions;			*
10.3	Raoult's Law	10.3.1	state Raoult'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 Raoult's law from the given data;			*
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 between osmotic pressure and reverse osmosis;		*	
10.5	Colloid, Suspension and Solution	10.5.1	describe the properties of colloids, suspension and solution;		*	
		10.5.2	explain the types of colloids;		*	
		10.5.3	compare the characteristics of colloids and suspension that distinguish these from solution;		*	
		10.5.4	classify the given substances as solutions, colloids or suspensions.		*	

NOTES

			K	U	A
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, internal energy, work and enthalpy;	*		
11.2 First Law of Thermodynamics	11.2.1	state and explain the first law of thermodynamics with the help of daily life examples;		*	
	11.2.2	relate change in internal energy of system with thermal energy at constant volume and pressure;		*	
	11.2.3	calculate internal energy and work done of a system by applying the first law of thermodynamics;			*
11.3 Hess's Law	11.3.1	state and explain Hess's law of heat summation;		*	
	11.3.2	construct simple energy cycles by using Hess's law for any given reactions;			*
	11.3.3	calculate standard heat of formation and heat of reaction by using Hess's law;			*
	11.3.4	explain working of a calorimeter (glass and bomb calorimeter);		*	
	11.3.5	calculate the heat of reaction in a calorimeter from the given experimental data;			*
11.4 Born-Haber Cycle	11.4.1	explain reaction pathway diagram in terms of enthalpy changes of the reactions (of ionic compounds) using Born-Haber's cycle;		*	
	11.4.2	calculate lattice energy and enthalpy of formation of ionic compounds from given set of appropriate data;			*
11.5 Heat Capacity	11.5.1	describe the terms, heat capacity, specific heat capacity and molar heat capacity.		*	

NOTES

				K	U	A
12. Electrochemistry		**Candidates should be able to:**				
12.1	Oxidation - Reduction Concept	12.1.1	define the terms, reduction, oxidation, oxidation number, reducing agent and oxidizing agent;	*		
		12.1.2	determine oxidation number of an atom in pure substance or in a compound;		*	
		12.1.3	determine reducing and oxidizing agent by using oxidation –number change method;		*	
		12.1.4	balance the equation using oxidation number method;			*
		12.1.5	recognise 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 cells as a source of energy);		*	
		12.1.8	perform oxidation-reduction titrations and related calculations;			*
12.2	Electrode, Electrode Potential and Electrochemical Series	12.2.1	define cathode, anode, electrode potential, Standard Hydrogen Electrode (S.H.E.) 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 reactions occurring within lead storage batteries;		*	
		12.3.4	explain production of electrical energy in a fuel cell;		*	
		12.3.5	define standard electrode potential;	*		
12.4	Faraday's Law	12.4.1	state and explain Faraday's first and second law ;		*	
		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.			*

NOTES

Part–II (Class XII)

Topic	Student Learning Outcomes		Cognitive Level		
			K	U	A
13. s- and p-Block Elements	**Candidates should be able to:**				
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	determine 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, electronegativity, electron affinity, electrical conductivity, melting and boiling points) of elements within groups and periods in the periodic table;		*	
	13.1.5	describe the reaction of period 3 elements with water, oxygen and chlorine;		*	
	13.1.6	describe the reaction of oxides and chlorides of period 3 elements with water;		*	
	13.1.7	describe physical properties (such as bonding, conductivity of liquid and solubility) and acid-base behaviour of oxides and chlorides of period 3 elements;		*	
13.2 Group 1	13.2.1	describe oxidation states and trends in physical properties in group 1 (such as ionization energy, electronegativity, atomic radius, melting and boiling point);		*	
	13.2.2	describe the chemical reaction of group 1 elements with water, oxygen and chlorine;		*	
	13.2.3	explain effect of heat on nitrates, carbonates and hydrogen carbonates of group 1 elements;		*	

NOTES

				K	U	A
13.3	Group 2	13.3.1	describe oxidation states and trends in physical properties in group 2 elements (such as ionization energy, electronegativity, 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 in solubility of hydroxides, sulphates and carbonates of group 2 elements;		*	
		13.3.4	discus the trends in thermal stability of 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 variation in oxidation states and trends in physical properties of group 4 elements (such as ionization energy, electronegativity, atomic radius, metallic character, melting and boiling point);		*	
		13.4.2	describe the reaction of water with chlorides of carbon, silicon and lead;		*	
		13.4.3	compare the structure and stability of chlorides of carbon, silicon and lead;		*	
		13.4.4	describe the structure of CO_2 and SiO_2;		*	
		13.4.5	discuss the acid-base behaviour of oxides of group 4 elements;		*	
13.5	Group 7	13.5.1	discuss oxidation states and trends in physical property of group 7 elements (such as atomic radius, electronegativity, electron affinity, bond energy, melting and boiling point);		*	
		13.5.2	discuss bond enthalpies and acidic strength of hydrogen halide;		*	
		13.5.3	compare the strength of halide ions as reducing agents;		*	
		13.5.4	explain the significance of following elements in daily life (iodine prevents from goitre, fluoride prevents tooth decay, use of steel, tin, aluminium and glass for canning purposes in beverage and food industry).		*	

NOTES

			K	U	A
14. d- and f- Block Elements (Transition)					
14.1 General Feature of Transition Elements	14.1.1	describe the general features of transition elements (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;		*	
	14.2.2	explain anomalous behaviour of chromium and copper with respect to electronic configuration;		*	
	14.2.3	show the electronic configuration of given elements and ions of d – block;			*
14.3 Chemistry of Some Specific Transition Elements	14.3.1	describe important reactions (redox reaction) and uses of vanadium, chromium, copper, manganese and iron as catalyst;		*	
14.4 Coordination Compounds	14.4.1	explain shapes, origin, colour and nomenclature of coordination compounds;		*	
	14.4.2	relate the coordination number of ions to the crystal structure of the compound of which they are a part;		*	
	14.4.3	describe properties of alloys with reference to the metals that compose them;		*	
	14.4.4	describe the reaction of $K_2Cr_2O_7$ with oxalic acid and Mohr's salts;		*	
	14.4.5	describe the reaction of $KMnO_4$ with $FeSO_4$, oxalic acid and Mohr's salts;		*	
	14.4.6	explain the reaction of Hexaaquacopper(II)ion with iodide and determine the concentration of copper ion in the solution.		*	

NOTES

			K	U	A
15. Organic Compounds	**Candidates should be able to:**				
15.1 Sources of Organic Compounds (Living and Non-Living)	15.1.1	explain general properties, diversity and magnitude of organic compounds;		*	
15.2 Coal as a Source of Organic Compound	15.2.1	explain the destructive distillation of coal;		*	
	15.2.2	explain the use of coal as a source of both aliphatic and aromatic hydrocarbons;		*	
15.3 Classification of Organic Compound	15.3.1	classify organic compounds on structural basis;		*	
15.4 Functional Group and Homologous Series	15.4.1	define functional groups and homologous series;	*		
	15.4.2	recognise a molecule's functional group.		*	
16. Hydrocarbons	**Candidates should be able to:**				
16.1 Nomenclature, Shape of Molecules and Resonance	16.1.1	describe the nomenclature and shapes of molecule focusing on sigma and pi carbon-carbon bonds (alkane, alkene, cycloalkane, alkynes, benzenes and substituted benzene);		*	
	16.1.2	explain the phenomenon of resonance and stability of benzene;		*	
16.2 Alkanes	16.2.1	explain unreactive nature of alkanes towards polar reagents;		*	
	16.2.2	explain homolytic and heterolytic fission, free radical initiation, propagation and termination;		*	

NOTES

				K	U	A
16.3	Free Radical Substitution Reaction	16.3.1	describe the mechanism of free radical substitution with reference to methane and ethane;		*	
16.4	Oxidation of Organic Compounds	16.4.1	recognise and complete the redox reaction of organic compounds (hydrocarbons);		*	
16.5	Isomerism	16.5.1	describe isomerism, stereo-isomerism and structural isomerism with suitable examples;		*	
		16.5.2	explain what is meant by chiral centre and show that such a centre gives rise to optical isomerism;		*	
		16.5.3	determine chiral centres in given structural formula of a molecule;		*	
16.6	Alkenes	16.6.1	describe the reactivity of alkenes exemplified by ethene;		*	
		16.6.2	describe the preparation of ethene from dehydration of alcohol and dehydrohalogenations of alkyl halide using chemical equations;		*	
		16.6.3	describe the reactions of ethene (hydrogenation, hydration, hydrohalogenation, halogenation, halohydration, epooxidation, ozonolysis and 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 acidic strength of alkynes (w.r.t. its reaction with metals);		*	
		16.7.4	explain the chemistry of alkynes by hydrogenation, hydrohalogenation, hydration, bromination and ozonolysis);		*	

NOTES

				K	U	A
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:**				
17.1	Alkyl halides	17.1.1	apply IUPAC system for naming alkyl halides;			*
		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 alkyl 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 nucleophilic substitution (SN) reaction;		*	
		17.2.2	compare SN1 and SN2 reaction;		*	
		17.2.3	deduce the mechanism of SN reaction for the given alkyl halide using chemical equations;			*
		17.2.4	recognise nucleophile (base), substrate and leaving group in the given reactions;		*	
		17.2.5	discuss carbocation 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	deduce the mechanism of elimination reaction in the given alkyl halide using chemical equations;			*
		17.3.4	compare substitution reaction and elimination reaction;		*	

NOTES

				K	U	A
17.4	Organo-Metallic Compounds (Grignard Reagent)	17.4.1	describe the preparation and reactivity of Grignard's reagent;		*	
		17.4.2	describe chemical reaction of Grignard's reagent with aldehydes, ketones, esters and carbon dioxide;		*	
17.5	Amines	17.5.1	apply IUPAC system for naming amines;			*
		17.5.2	discuss physical properties of amines (melting point, boiling point 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;		*	
		17.5.6	describe chemical reaction of amines (alkylation with RX, reaction with aldehydes and ketones);		*	
		17.5.7	describe preparation of amides and diazonium salts;		*	
		17.5.8	describe isomerism in alkyl halides and amines.		*	

NOTES

			K	U	A
18. Alcohols, Phenols and Ethers	**Candidates should be able to:**				
18.1 Alcohols	18.1.1	apply IUPAC system for naming different alcohols;			*
	18.1.2	describe the physical properties and structure of alcohol;		*	
	18.1.3	distinguish among primary, secondary and tertiary alcohols using Lucas reagent test;		*	
	18.1.4	differentiate between methanol and ethanol using iodoform test (haloform reaction);		*	
	18.1.5	describe the preparation of alcohol by reduction of aldehydes, ketones, carboxylic acids and esters using chemical equations;		*	
	18.1.6	discuss the acidic character of alcohol (as exemplified by ethanol);		*	
	18.1.7	describe the chemistry of alcohol by preparation of ethers, esters, oxidative cleavage of 1-2-diols;		*	
	18.1.8	define thiols (RSH);	*		
	18.1.9	describe the uses of alcohol (disinfectant and antiseptic);		*	
18.2 Phenols	18.2.1	apply IUPAC system for naming different phenols;			*
	18.2.2	discuss the physical properties, structure and acidic behaviour of phenol;		*	
	18.2.3	describe the preparation of phenols from the given compounds (benzene sulphonic acid, chlorobenzene, acidic oxidation of cumene and hydrolysis of diozomium salts) using chemical equations;		*	
	18.2.4	discuss the reactivity of phenol (electrophilic aromatic substitution, reaction with Na metal and oxidation);		*	
	18.2.5	differentiate between alcohols and phenols;		*	
	18.2.6	explain isomerism in alcohols and phenols;		*	
18.3 Ethers	18.3.1	identify common and IUPAC names of different ethers from their formula;	*		
	18.3.2	describe the physical and chemical properties of ethers;		*	
	18.3.3	describe the preparation of ethers by the following methods (Williamson synthesis, reaction of alkyl halides with dry silver oxide, reaction of alcohols with excess H_2SO_4) using chemical equations;		*	
	18.3.4	recognise the use of ether in medicine (for anaesthesia).		*	

NOTES

				K	U	A
19. Carbonyl Compound I: Aldehydes and Ketones		**Candidates should be able to:**				
19.1	Nomenclature and Structure	19.1.1 19.1.2	apply IUPAC system for naming aldelydes and ketones; 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 Aldehydes and Ketones	19.3.1	describe the preparation of aldehydes and ketones (by ozonolysis of alkene, hydration of alkyne, oxidation of alcohol, Friedal Craft acylation of aromatics) using chemical equations;		*	
19.4	Reaction of Aldehydes and Ketones	19.4.1 19.4.2 19.4.3 19.4.4	discuss the role of ά – hydrogen for comparing the reactivity of aldehydes and ketones; describe acid and base catalysed nucleophilic addition reaction of aldehydes and ketones; discuss the chemistry of aldehydes and ketones by their reduction to hydrocarbons, alcohols, by using carbon nucleophiles, nitrogen nucleophiles and oxygen nucleophiles; describe the oxidation reactions of aldehydes and ketones;		* * * *	
19.5	Isomerism	19.5.1 19.5.2	draw all possible isomers of given aldehydes and ketones; describe glucose and fructose as examples of aldehydes and ketones;		 *	*
19.6	Uses and Effects	19.6.1 19.6.2	list the uses of formaldehyde vapours in adhesives, varnish, paints, foam insulations, permanent press clothing; describe the health hazards associated with the exposure to formalin.	*	 *	

NOTES

				K	U	A
20. Carbonyl Compound 2: Carboxylic Acid and Functional Derivatives		**Candidates should be able to:**				
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 20.2.2	describe the structure and physical properties (solubility, melting point and boiling point) of carboxylic acid; 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	describe the preparation of carboxylic acid by Grignard's reagent, hydrolysis of nitriles, oxidation of primary alcohol, aldehydes and alkyl benzene using chemical equations;		*	
20.5	Reactivity	20.5.1 20.5.2	describe the reactivity of carboxylic acid; compare the reactivity in different derivatives of carboxylic acid;		* *	
20.6	Reaction of Carboxylic Acid	20.6.1 20.6.2 20.6.3	describe the preparation of acyl halides, acid anhydrides, esters and amides; describe the inter-conversion reactions of the above mentioned carboxylic acid derivatives ; describe reaction of the above mentioned carboxylic acid derivatives ;		* * *	
20.7	Isomers	20.7.1 20.7.2	describe isomerism in carboxylic acids (chain and functional); draw all possible isomers of carboxylic acid from the given formula;		*	 *

NOTES

			K	U	A
20.8 Uses	20.8.1	list carboxylic acids present in fruits, vegetables and other natural products;	*		
	20.8.2	list the uses of carboxylic acids (in plastic, leather, rubber, soap industries and as preservatives in food and food products,).	*		
21. Biochemistry	**Candidates should be able to:**				
21.1 Carbohydrates, Proteins and Lipids	21.1.1	explain the basis of classification of carbohydrates, proteins and lipids;		*	
	21.1.2	describe structure-function relationship of carbohydrates, proteins and lipids;		*	
	21.1.3	explain role of carbohydrates in health and disease;		*	
	21.1.4	explain the nutritional importance of proteins and lipids;		*	
	21.1.5	explain different types of lipids (simple, compound, derived or associated including steroids);		*	
	21.1.6	explain how milk proteins can be precipitated by lowering the pH (using lemon juice);		*	
21.2 Enzymes	21.2.1	describe the role of enzymes as biological catalyst (for example in digestion of food);		*	
	21.2.2	explain the factors that affect enzyme activity;		*	
	21.2.3	explain the role of enzymes as inhibitors;		*	
21.3 Nucleic Acids	21.3.1	identify the structural components of DNA and RNA;	*		
	21.3.2	describe the role of DNA in terms of storing genetic information;		*	
	21.3.4	describe the role of RNA in terms of protein synthesis;		*	
21.4 Minerals 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 as hormones (insulin, cholesterol) to regulate human health.		*	

NOTES

			K	U	A
22. Industrial Chemistry	**Candidates should be able to:**				
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 and petrochemical industries;	*		
22.2 Safety Measurement	22.2.1	list some safety measures and precautions that should be followed in process industries;	*		
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 processes in petrochemical technology (polymerization with its examples);		*	
	22.4.3	recognise from 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 processes of addition and condensation polymerization;		*	
	22.5.2	describe the formation and uses of PVC and nylon;		*	
22.6 Synthetic Adhesive	22.6.1	describe types and applications of synthetic adhesives;		*	
22.7 Cosmetics	22.7.1	describe preparation and applications of various cosmetics like nail varnish, nail polish remover, hair dyes and lipsticks.		*	

NOTES

				K	U	A
23. Environmental Chemistry		**Candidates should be able to:**				
23.1	Chemistry of Troposphere and Stratosphere	23.1.1	describe the various chemical reactions occurring in the atmosphere (w.r.t. formation of acid rain, ozone, ammonium nitrates and sulphates and carbon dioxide);		*	
		23.1.2	discuss the release of oxides of C, S, N and VOCs which are associated with combustion of hydrocarbon based fuel;		*	
		23.1.3	outline problems associated with the release of pollutants (e.g. acid rain and hazardous inorganic and organic compounds like peroxyacetyl nitrate (PAN) ;	*		
		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 to the use of CFCs;	*		
		23.1.7	explain greenhouse 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, total dissolved solids (TDS) meter, titration method);		*	
		23.2.2	explain the methods of treatment for water purification (raw water treatment, sewage treatment, zeolite process and reverse osmosis);		*	
23.3	Green Chemistry	23.3.1	describe green chemistry and its significance;		*	

NOTES

			K	U	A
24. Analytical Chemistry	**Candidates should be able to:**				
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	describe 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	outline the basic principles of IR spectroscopy (such as purpose, absorption of IR radiations, molecular rotation, molecular vibrations, vibrational coupling);	*		
	24.1.6	recognise benzene, acetone, carboxylic acid and ethanol from given IR spectra;		*	
	24.1.7	outline in simple terms the basic principles of proton NMR spectroscopy [such as purpose, nuclear spin, splitting of nuclear energy levels, chemical shift and spin-spin coupling (peak splitting patterns)];	*		
	24.1.8	explain instrumentation and working of a mass spectrometer (MS);		*	
	24.1.9	outline the use of MS in determination of relative isotopic masses;	*		
	24.1.10	explain atomic emission and atomic absorption spectrum;		*	
	24.1.11	discuss the use of MS in determination of drug abuse in forensic sciences.		*	

NOTES

4. Scheme of Assessment

Class XI

Table 1: Number of Student Learning Outcomes by Cognitive Level

Topic No.	Topics	No. of Sub-Topics	SLOs			Total
			K	U	A	
1.	Stoichiometry	6	3	1	8	12
2.	Atomic Structure	7	3	10	4	17
3.	Theories of Covalent Bonding and Shapes of Molecules	4	3	10	3	16
4.	States of Matter I: Gases	7	1	12	4	17
5.	States of Matter II: Liquids	4	2	9	0	11
6.	States of Matter III: Solids	5	2	8	0	10
7.	Chemical Equilibrium	5	5	10	2	17
8.	Acids, Bases and Salts	7	7	11	2	20
9.	Chemical Kinetics	4	2	8	3	13
10.	Solution and Colloids	5	2	7	6	15
11.	Thermochemistry	5	2	6	5	13
12.	Electrochemistry	4	4	8	5	17
	Total	**63**	**36**	**100**	**42**	**178**
	Percentage		**20**	**56**	**24**	**100**

Table 2: Allocation of Marks for the Multiple Choice Questions (MCQs), Constructed Response Questions (CRQs) and Extended Response Questions (ERQs)

Topic No.	Topics	No. of Sub-Topics	Marks			Total
			Multiple Choice Questions	Constructed Response Questions	Extended Response Questions	
1.	Stoichiometry	6	9	9	7	25
2.	Atomic Structure	7				
8.	Acids, Bases and Salts	7				
3.	Theories of Covalent Bonding and Shapes of Molecules	4	3	6	0	9
4.	States of Matter I: Gases	7	6	7	0	13
5.	States of Matter II: Liquids	4				
6.	States of Matter III: Solids	5				
7.	Chemical Equilibrium	5	2	8	0	10
9.	Chemical Kinetics	4	2	4	0	6
10.	Solution and Colloids	5	8	6	8	22
11.	Thermochemistry	5				
12.	Electrochemistry	4				
	Total	**63**	**30**	**40**	**15**	**85**
	Practical					15
	Total					**100**

Table 3: Paper Specifications

<table>
<tr><th>Topic No.</th><th>Topic</th><th colspan="3">Marks Distribution</th><th>Total Marks</th></tr>
<tr><td>1.</td><td>Stoichiometry</td><td colspan="3" rowspan="3">MCQs 9 @ 1 Mark
CRQ 1 @ 4 Marks
CRQ 1 @ 5 Marks
*ERQ 1 @ 7 Marks
Choose any ONE from TWO</td><td rowspan="3">25</td></tr>
<tr><td>2.</td><td>Atomic Structure</td></tr>
<tr><td>8.</td><td>Acids, Bases and Salts</td></tr>
<tr><td>3.</td><td>Theories of Covalent Bonding and Shapes of Molecules</td><td colspan="3">MCQs 3 @ 1 Mark
CRQs 2 @ 3 Marks</td><td>9</td></tr>
<tr><td>4.</td><td>States of Matter I: Gases</td><td colspan="3" rowspan="3">MCQs 6 @ 1 Mark
CRQ 1 @ 3 Marks
CRQ 1 @ 4 Marks</td><td rowspan="3">13</td></tr>
<tr><td>5.</td><td>States of Matter II: Liquids</td></tr>
<tr><td>6.</td><td>States of Matter III: Solids</td></tr>
<tr><td>7.</td><td>Chemical Equilibrium</td><td colspan="3">MCQs 2 @ 1 Mark
CRQs 2 @ 4 Marks</td><td>10</td></tr>
<tr><td>9.</td><td>Chemical Kinetics</td><td colspan="3">MCQs 2 @ 1 Mark
CRQ 1 @ 4 Marks</td><td>6</td></tr>
<tr><td>10.</td><td>Solutions and Colloids</td><td colspan="3" rowspan="3">MCQs 8 @ 1 Mark
CRQs 2 @ 3 Marks
*ERQ 1 @ 8 Marks
Choose any ONE from TWO</td><td rowspan="3">22</td></tr>
<tr><td>11.</td><td>Thermochemistry</td></tr>
<tr><td>12.</td><td>Electrochemistry</td></tr>
<tr><td></td><td>Total</td><td>MCQs
30</td><td>CRQs
40</td><td>ERQs
15</td><td>85</td></tr>
<tr><td></td><td>Practical</td><td colspan="3"></td><td>15</td></tr>
<tr><td></td><td>Total Marks</td><td colspan="3"></td><td>100</td></tr>
</table>

* Extended response questions (ERQs) will require answers in more descriptive form. The answers will be in a paragraph rather than a word or a single sentence.

Class XII

Table 4: Number of Student Learning Outcomes by Cognitive Level

Topic No.	Topics	No. of Sub-Topics	SLOs			Total
			K	U	A	
13.	s-and p-Block Elements	5	2	22	0	24
14.	d- and f- Block Elements (Transition)	4	0	10	1	11
15.	Organic Compound	4	1	5	0	6
16.	Hydrocarbons	8	0	19	0	19
17.	Alkyl Halides and Amines	5	0	17	6	23
18.	Alcohol, Phenols and Ethers	3	2	15	2	19
19.	Carbonyl Compound 1. Aldehydes and Ketones	6	1	8	3	12
20.	Carbonyl Compound 2. Carboxyl Acid and Functional Derivative	8	2	9	3	14
21.	Biochemistry	4	1	13	0	14
22.	Industrial Chemistry	7	3	9	0	12
23.	Environmental Chemistry	3	2	8	0	10
24.	Analytical Chemistry	1	3	8	0	11
	Total	**58**	**17**	**143**	**15**	**175**
	Percentage		**10**	**81**	**9**	**100**

Table 5: Allocation of Marks for the Multiple Choice Questions (MCQs), Constructed Response Questions (CRQs) and Extended Response Questions (ERQs)

Topic No.	Topics	No. of Sub-Topics	Marks			Total
			Multiple Choice Questions	Constructed Response Questions	Extended Response Questions	
13.	s-and p-Block Elements	5	5	10	0	15
14.	d- and f- Block Elements (Transition)	4				
17.	Alkyl halides and Amines	5	3	4	0	7
18.	Alcohol, Phenol and Ether	3	4	5	0	9
16.	Hydrocarbons	8	7	8	8	23
19.	Carbonyl compound 1. Aldehydes and Ketones	6				
20.	Carbonyl Compound 2. Carboxyl acid and functional derivative	8				
15.	Organic Compound	4	8	9	7	24
21.	Biochemistry	4				
22.	Industrial Chemistry	7				
23.	Environmental Chemistry	3				
24.	Analytical Chemistry	1	3	4	0	7
	Total	**58**	**30**	**40**	**15**	**85**
	Practical					15
	Total					**100**

Table 6: Paper Specifications

Topic No.	Topic	Marks Distribution			Total Marks
13.	s-and p-Block Elements	MCQs 5 @ 1 Mark CRQs 2 @ 5 Marks			15
14.	d- and f- Block Elements (Transition)				
17.	Alkyl Halides and Amines	MCQs 3 @ 1 Mark CRQ 1 @ 4 Marks			7
18.	Alcohol, Phenol and Ethers	MCQs 4 @ 1 Mark CRQ 1 @ 5 Marks			9
16.	Hydrocarbons	MCQs 7 @ 1 Mark CRQs 2 @ 4 Marks *ERQ 1 @ 8 Marks Choose any ONE from TWO			23
19.	Carbonyl compound 1. Aldehydes and Ketones				
20.	Carbonyl Compound 2. Carboxyl acid and functional derivative				
15.	Organic Compounds	MCQs 8 @ 1 Mark CRQ 1 @ 4 Marks CRQ 1 @ 5 Marks *ERQ 1 @ 7 Marks Choose any ONE from TWO			24
21.	Biochemistry				
22.	Industrial Chemistry				
23.	Environmental Chemistry				
24.	Analytical Chemistry	MCQs 3 @ 1 Mark CRQ 1 @ 4 Marks			7
	Total	**MCQs 30**	**CRQs 40**	**ERQs 15**	**85**
	Practical				15
	Total Marks				**100**

* Extended response questions (ERQs) will require answers in more descriptive form. The answers will be in a paragraph rather than a word or a single sentence.

4.1 Tables 1 and 4 summarize the number and nature of SLOs in each topic in classes XI and XII. This will serve as a guide in the construction of the examination paper. It also indicates that more emphasis has been given to Understanding (56% and 81%), Application and higher order skills (24% and 09%) to discourage rote memorization. Tables 1 and 4 however do not translate directly into marks.

4.2 There will be two examinations, one at the end of Class XI and one at the end of Class XII.

4.3 In each class, the theory paper will be in two parts, paper I and paper II. Both papers will be of duration of 3 hours.

4.4 Paper I theory will consist of 30 compulsory, multiple choice items. These questions will involve four response options.

4.5 Paper II theory will carry 55 marks and consist of a number of compulsory, structured questions and a number of extended response questions. Each extended response question will be presented in an either/or form.

4.6 Practical examination will be conducted separate from the theory paper. It will be based on the list of practical activities listed in the examination syllabus.

4.7 All constructed response questions will be in a booklet which will also serve as an answer script.

4.8 Practicals to assess performance skills will carry 15 marks in class XI and 15 marks in class XII.

4.9 It is essential for each school to equip its laboratories with chemicals, instruments, apparatus, specimens etc. according to the requirements of the practicals. Each school will be responsible to make sure that each student is provided the opportunity to do the practicals.

List of practicals is attached as annex B.

5. Teaching-Learning Approaches and Classroom Activities

To promote effective teaching and learning a teacher has to play an effective and vital role as a facilitator, guide, supervisor, advisor etc. Work plan to be worked out beforehand for the speculated period. Lesson should be pre-planned keeping in view the set objectives. Theoretical concepts must be augmented by relevant practical activities. Teaching aids should be developed and tested beforehand. Classroom environment must be conducive, absorbing and friendly. Evaluation, assessment and measurement must be a regular feature for the scheme of work. Lesson evaluation should be formative and summative and to be done beforehand. Field trips to be pre planned. Short-term projects to be designed with perfection, and should be executed effectively. Lab should be properly equipped to cater to the needs of given set of practical.

Following activities/ strategies can be implemented to make learning interesting:

1. Concept of Celebration Day
   Celebration of Mole day on 23 October of every year at 6.02 P.M. Charts, models, debates and other activities related to the theme can be organised.

2. Group based assignments especially on numerical problems.

3. Experiments and demonstration on atomic structure/ gas laws/ solution and solubility/ colligative properties/ redox reactions and batteries

4. Models of bonding/ shape of molecules can be shown for concept building,

5. ICT integration
   - simulation of bond formation
   - gas law
   - Graph plot ….. chemical kinetics

6. Field trips
   - Steel mill
   - Cement factory
   - Textile industry

7. Project on environment / pollution / chemical

8. Experiments: functional group-reaction and spectroscopy

6. Recommended Text and Reference Material

Recommended Books

1. *Chemistry for Class XI* (2010). Punjab Textbook Board, Lahore.
2. *Chemistry for Class XII* (2010). Punjab Textbook Board, Lahore.
3. Mushtaq Ahmed Sheikh, (2005). *Chemistry Practical Notebook for Class XI:* Star Publishers.
4. Mushtaq Ahmed Sheikh, (2007). *Chemistry Practical Notebook for Class XII:* Star Publishers.

Reference Books

1. Mathews, Philip. (1996). *Advanced Chemistry (Physical and Industrial)*. UK: Cambridge Press.
2. Clugston M. and Flemming R. *Advanced Chemistry*. Oxford University Press.
3. Julian L. Robert, J. Leland Hollenberg, James M. Postma. (1975). *Chemistry in the Laboratory*. USA: W H Freeman.

Recommended Websites:

1. http://www.ausetute.com.au/index.html
2. http://www.chemguide.co.uk/
3. http://www.mhhe.com/physsci/chemistry/carey/student/olc/index.htm
4. http://teaching.shu.ac.uk/hwb/chemistry/tutorials/
5. http://chemteacher.chemeddl.org/services/chemteacher/
6. http://www.books-about-california.com/Pages/Experimental_Organic_Chemistry/Ex_Organic_Chem_main.htm

7. Definition of Cognitive Levels and Command Words

7.1. Definition of Cognitive Levels

Knowledge

This requires knowing and remembering facts and figures, vocabulary and contexts, and the ability to recall key ideas, concepts, trends, sequences, categories, etc. It can be taught and evaluated through questions based on: who, when, where, what, list, define, identify, label, tabulate, quote, name, state, etc.

Understanding

This requires understanding information, grasping meaning, interpreting facts, comparing, contrasting, grouping, inferring causes/reasons, seeing patterns, organizing parts, making links, summarizing, solving, identifying motives, finding evidence, etc. It can be taught and evaluated through questions based on: why, how, show, demonstrate, paraphrase, interpret, summarize, explain, prove, identify the main idea/theme, predict, compare, differentiate, discuss, chart the course/direction, report, solve, etc.

Application

This requires using information or concepts in new situations, solving problems, organizing information and ideas, using old ideas to create new ones, generalizing from given facts, analyzing relationships, relating knowledge from several areas, drawing conclusions, evaluating worth, etc. It can be taught and evaluated through questions based on: differentiate, analyse, show relationship, propose an alternative, prioritize, give reasons for, categorize, illustrate, corroborate, compare and contrast, create, design, formulate, integrate, rearrange, reconstruct/recreate, reorganize, predict consequences etc.

7.2 Definition of Command Words:

Knowledge

Define:	Only a formal statement or equivalent paraphrase is required. No examples need to be given.
Identify:	Give the name or identifying characteristics of; describe with specific examples how a given term or concept is applied in daily life.
List / Enlist:	Requires a number of points, generally each of one word, with no elaboration. Where a given number of points are specified, this should not be exceeded.
Outline:	Implies briefness, i.e. restricting the answer to giving essentials.
State:	Implies concise answer with little or no supporting argument, for example a numerical answer that can be obtained by inspection.

Understanding

Compare:	List the main characteristics of two entities clearly identifying similarities or differences or both.
Describe:	State in words (using diagrams where appropriate) the main points of the topic. It is often used with reference either to particular phenomena or specific experiments. In the former instance, the term usually implies that the answer should include reference to (visual) observations associated with the phenomena.
Determine:	Often implies that the quantity concerned cannot be measured directly but is obtained by calculation, substituting measured or known values of other quantities into standard formula, e.g. relative molecular mass.
Differentiate/ Distinguish:	Identify those characteristics which always or sometimes differentiate two categories.
Discuss:	Give a critical and logical account of the points involved in the topic.
Derive:	Manipulate a mathematical relationship(s) to give a new equation or relationship.
Explain:	Make an idea, situation or problem clear by describing it in detail revealing relevant data or facts.
Recognise:	Involves looking at a given example and stating what it most probably is.
Relate:	Describe how things depend upon, follow from or are part of another.
Summarise:	Identify/review the main points, relevant factors and/or arguments so that these are explained in a clear and concise manner.

Application

Apply:	Use knowledge or principle to solve problems.
Balance:	Equalise the number of atoms on the reactant side to the number of atoms on the product side.

Calculate / Solve:	Used when a numerical answer is required. In general, working should be shown, especially where two or more steps are involved.
Classify	State a basis for categorization of a set of related entities and assign examples to categories.
Convert:	Change or adapt from one system or units to another.
Construct / Draw:	Make a simple freehand sketch or diagram. Care should be taken with proportions and the clear labelling of parts.
Deduce:	By recall but by making a logical connection between other pieces of information. Such information may be wholly given in the question or may depend on answer extracted in an early part of the question.
Detect:	Examine systematically a situation or a problem in order to come to a rational conclusion.
Estimate:	Make an approximate quantitative judgement.
Interpret:	Clarify both explicit meaning and implications of the given information.
Observe:	Pay attention to details which characterize a specimen, reaction or change taking place; to examine and note scientifically;
Perform:	Carry out an action, undertaking, or procedure, often with great skill or care.
Predict:	Implies that the candidates are not expected to produce the required answer.
Purify:	Implies a practical activity in which the candidates are expected to apply an approved methodology with appropriate safety precautions.
Prepare:	To bring something into existence such as making up of various objects in the laboratory.
Show	Demonstrate with evidence i.e. by physical manipulation or experiment how one thing is related to another.
Separate:	To divide into components or parts.
Standardize:	To determine unknown concentration of a given solution by titrating it against a solution of known molarity.

Annex A

HSSC Scheme of Studies[3]

AKU-EB as a national board offers SSC and HSSC qualifications for both English and Urdu medium schools. The revised HSSC Scheme of Studies issued by the Curriculum Wing was implemented from September 2007. The marks allocated to subjects in the revised National Scheme of Studies have been followed.

HSSC I-II (Classes XI-XII) subjects on offer for examination

HSSC Part-I (Class XI) Science Group (Pre-Medical)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I **OR** Pakistan Culture-I [a]	100	-	100	Urdu English
Physics-I	85	15	100	English
Chemistry-I	85	15	100	English
Biology-I	85	15	100	English
Total:	**455**	**45**	**500**	

HSSC Part-II (Class XII) Science Group (Pre-Medical)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	100	-	100	English
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	-	100	Urdu English
Islamiyat **OR** Ethics [b]	50	-	50	English / Urdu
Pakistan Studies	50	-	50	English / Urdu
Physics-II	85	15	100	English
Chemistry-II	85	15	100	English
Biology-II	85	15	100	English
Total:	**555**	**45**	**600**	

a. Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.
b. For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

[3] Government of Pakistan September 2007. *Scheme of Studies for SSC and HSSC (Classes IX-XII).* Islamabad: Ministry of Education, Curriculum Wing.

HSSC Part-I (Class XI) Science Group (Pre-Engineering)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I **OR** Pakistan Culture-I [a]	100	-	100	Urdu English
Physics-I	85	15	100	English
Chemistry-I	85	15	100	English
Mathematics-I	100	-	100	English
Total:	**470**	**30**	**500**	

HSSC Part-II (Class XII) Science Group (Pre-Engineering)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	100	-	100	English
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	-	100	Urdu English
Islamiyat **OR** Ethics [b]	50	-	50	English / Urdu
Pakistan Studies	50	-	50	English / Urdu
Physics-II	85	15	100	English
Chemistry-II	85	15	100	English
Mathematics –II	100	-	100	English
Total:	**570**	**30**	**600**	

a. Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.
b. For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

HSSC Part-I (Class XI) Science Group (Science General)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I Pakistan Culture-I [a]	100	-	100	Urdu English
Any one subject combinations of the following:				
Physics-I Mathematics-I *Statistics-I	85 100 85	15 - 15	300	English English English
Economics-I Mathematics-I *Statistics-I	100 100 85	- - 15	300	English / Urdu English English
Economics-I Mathematics-I Computer Science-I	100 100 75	- - 25	300	English / Urdu English English
Physics-I Mathematics-I Computer Science-I	85 100 75	15 - 25	300	English English English
Mathematics-I *Statistics-I Computer Science-I	100 85 75	- 15 25	300	English English English
Total:			**500**	

HSSC Part-II (Class XII) Science Group (Science General)

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	100	-	100	English
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	-	100	Urdu English
Islamiyat **OR** Ethics [b]	50	-	50	English / Urdu
Pakistan Studies	50	-	50	English / Urdu
Any one subject combinations of the following:				
Physics-II Mathematics-II *Statistics-II	85 100 85	15 - 15	300	English English English
Economics-II Mathematics-II *Statistics-II	100 100 85	- - 15	300	English / Urdu English English
Economics-II Mathematics-II Computer Science-II	100 100 75	- - 25	300	English / Urdu English English
Physics-II Mathematics-II Computer Science-II	85 100 75	15 - 25	300	English English English
Mathematics-II *Statistics-II Computer Science-II	100 85 75	- 15 25	300	English English English
Total:			**600**	

a. Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.

b. For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

***These subject is offered ONLY in the May examination.**

HSSC Part-I (Class XI) Commerce Group

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-I	100	-	100	English
Urdu Compulsory-I **OR** Pakistan Culture-I [a]	100	-	100	Urdu English
Principles of Accounting-I	100	-	100	English
Principles of Economics	75	-	75	English
Principles of Commerce	75	-	75	English
Business Mathematics	50	-	50	English
Total:	**500**	**-**	**500**	

HSSC Part-II (Class XII) Commerce Group

Subjects	Marks			Medium
	Theory	Practical	Total	
English Compulsory-II	100	-	100	English
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	-	100	Urdu English
Islamiyat **OR** Ethics [b]	50	-	50	English / Urdu
Pakistan Studies	50	-	50	English / Urdu
Principles of Accounting-II	100	-	100	English
Commercial Geography	75		75	English
*Computer Studies **OR** Banking	60 **OR** 75	15 -	75	English
Business Statistics	50	-	50	English
Total:	**600**		**600**	

a. Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.
b. For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

***This subjects are offered <u>ONLY</u> in the May examination.**

HSSC Part-I (Class XI) Humanities Group

Subjects	Marks	Medium
English Compulsory-I	100	English
Urdu Compulsory-I **OR** Pakistan Culture-I [a]	100	Urdu English
Any three of the following Elective Subjects	300	
1. Civics-I	(100	English / Urdu
2. Computer Science-I (75+25 practical)	each)	English
3. Economics-I		English / Urdu
4. *Education-I		English / Urdu
5. *Geography-I (85+15 practical)		English / Urdu
6. *Islamic Studies-I		English / Urdu
7. *Islamic History-I		English / Urdu
8. Literature in English-I		English
9. Mathematics-I		English
10. *Psychology-I (85+15 practical)		English / Urdu
11. *Statistics-I (85+15 practical)		English
12. *Sociology-I		English / Urdu
13. Urdu Literature-I		Urdu
14. *Fine Arts-I		English
Total:	**500**	

HSSC Part-II (Class XII) Humanities Group

Subjects	Marks	Medium
English Compulsory-II	100	English
Urdu Compulsory-II **OR** Pakistan Culture-II [a]	100	Urdu English
Islamiyat **OR** Ethics [b]	50	English / Urdu
Pakistan Studies	50	English / Urdu
Any three of the following Elective Subjects	300	
1. Civics-II	(100	English / Urdu
2. Computer Science-II (75+25 practical)	each)	English
3. Economics-II		English / Urdu
4. *Education-II		English / Urdu
5. *Geography-II (85+15 practical)		English / Urdu
6. *Islamic Studies-II		English / Urdu
7. *Islamic History-II		English / Urdu
8. Literature in English-II		English
9. Mathematics-II		English
10. *Psychology-II (85+15 practical)		English / Urdu
11. *Statistics-II (85+15 practical)		English
12. *Sociology-II		English / Urdu
13. Urdu Literature-II		Urdu
14. *Fine Arts-II		English
Total:	**600**	

a. Foreign students may opt for Pakistan Culture in lieu of Urdu Compulsory, subject to the Board's approval.
b. For non-Muslim candidates in lieu of Islamiyat.

Note: Pakistan Studies, Islamiyat / Ethics will be taught in Classes XI and XII, but the examination will be conducted at the end of Class XII.

***These subjects are offered <u>ONLY</u> in the May examination.**

Annex B

List of Practical Activities

Class XI

S. No.	SLO No.	OBJECTIVE	EQUIPMENT	CHEMICAL
		TOPIC 1: INTRODUCTION TO STOICHIOMETRY		
1.	1.4.2	Estimate the amount of Ba^{+2} in the given solution of $BaCl_2$ gravimetrically.	Analytical balance, oven, funnel, wash bottle, Whatman filter paper No. 42, glass rod, beakers, desiccators, pipette, burner, match box, safety goggles	Distilled water, potassium chromate solution, barium chloride solution
		TOPIC 5: STATES OF MATTER II: LIQUIDS		
2.	5.1.1	Separate the given mixture of inks by paper chromatography.	Whatman filter paper No. 1, glass cylinder with a glass support, rubber bung, capillary tubes, lead pencil	Developing solvents (water – alcohol mixture/ n-butanol, ethanol and ammonia), mixture of inks (blue, green, red)
		TOPIC 7: CHEMICAL EQUILIBRIUM		
3.	7.5.2	Purify a given sample of sodium chloride by passing HCl gas. (Application of common ion effect)	Beaker 500ml, funnel, round-bottom flask, glass tubing, wire gauze, thistle funnel, burner, stirrer, graduated cylinder and physical/ digital balance	Distilled water, common salt, concentrated H_2SO_4

S. No.	SLO No.	OBJECTIVE	EQUIPMENT	CHEMICAL
		TOPIC 8: ACIDS, BASES AND SALTS		
4.	8.1.3	Determine the exact molarity of the given solution of H_2SO_4 and the volume of this acid required to prepare 500 cm^3 of 0.02 M acid by volumetric method.	Burette, pipette, funnel, conical flasks, beakers, iron stand with clamp	Phenolphthalein/ methyl orange, 0.1M NaOH/ Na_2CO_3, 0.2 M H_2SO_4 distilled water
5.	8.1.3	Determine the percentage of NaOH in the given solution (such as a mixture of NaCl and NaOH or a sample of soap solution) by volumetric method.	Burette, pipette, funnel, conical flasks, beakers, iron stand with clamp	Phenolphthalein, 0.1M NaOH, 0.1M HCl, distilled water, solution containing 8 g of a mixture of NaCl and NaOH/ 250cm^3 solution of 10 g soap.
6.	8.1.3	The given solution contains 6 g of Na_2CO_3 dissolved per dm^3. Determine the percentage purity of the sample solution by volumetric method.	Burette, pipette, funnel, conical flasks, beakers, iron stand with clamp	Methyl orange, 0.1M Na_2CO_3, 0.1M HCl, distilled water, solution of 6 g of Na_2CO_3 in 1 litre.
7.	8.1.3	Determine the value of X by volumetric method in the given sample of 6.3 g of $(COOH)_2 . XH_2O$ dissolved per dm^3.	Burette, pipette, funnel, conical flasks, beakers, iron stand with clamp	Phenolphthalein, 0.1M NaOH, 0.1M $(COOH)_2 .2H_2O$, distilled water
8.	8.1.3	Determine the solubility of oxalic acid at room temperature volumetrically.	Burette, pipette, funnel, conical flasks, beakers, iron stand with clamp	Phenolphthalein, 0.1M NaOH, 0.1M $(COOH)_2.2H_2O$, distilled water
		TOPIC 11:THERMOCHEMISTRY		
9.	11.3.5	Determine the heat of neutralization of NaOH and HCl.	Calorimeter with stirrer, thermometer, balance (physical/ digital	1M NaOH, 1M HCl, distilled water

S. No.	SLO No.	OBJECTIVE	EQUIPMENT	CHEMICAL
		TOPIC 12: ELECTROCHEMISTRY		
10.	12.1.8	Standardize the given solution of $KMnO_4$ and calculate the volume of $KMnO_4$ required for preparing 1 dm^3 of 0.01M $KMnO_4$ solution volumetrically.	Burette, pipette, funnel, conical flasks, beakers, iron stand with clamp, Bunsen burner/ spirit lamp, test tube	0.1M $FeSO_4$ solution/ 0.05M oxalic acid, 0.02M $KMnO_4$solution, dilute H_2SO_4, distilled water
11.	12.1.8	Determine the amount of iron in the given sample volumetrically.	Burette, pipette, funnel, conical flasks, beakers, iron stand with clamp, test tube	0.05M $FeSO_4$ solution, 0.01M $KMnO_4$ solution, dilute H_2SO_4, distilled water
12.	12.1.8	Determine the percentage composition volumetrically of a solution mixture of $K_2C_2O_4$ and K_2SO_4.	Burette, pipette, funnel, conical flask, beakers, iron stand with clamp, test tube	Solution mixture of $K_2C_2O_4$ and K_2SO_4, 0.01M $KMnO_4$ solution, dilute H_2SO_4, distilled water
13.	12.1.8	Determine the solubility of Mohr's salt at room temperature volumetrically.	Burette, pipette, funnel, conical flasks, beakers, iron stand with clamp, test tube	0.05M Mohr's salt solution, 0.01M $KMnO_4$ solution, dilute H_2SO_4, distilled water

Class XII

S. No.	SLO No.	OBJECTIVE	EQUIPMENT	CHEMICAL
		TOPIC 13: s-AND p- BLOCK ELEMENTS		
1.	13.1.7, 13.1.8, 13.2.3, 13.3.2, 13.3.3, 13.4.5 and 13.5.2	Detect the following cations: NH_4^+, Mg^{2+}, Al^{3+}, Ca^{2+}, Ni^{2+}, Co^{2+}, Fe^{2+}, Fe^{3+}, Cu^{2+}, Zn^{2+}, Ba^{2+}, Pb^{2+}. Detect the following anions: CO_3^{2-}, NO_3^-, NO_2^-, SO_4^{2-}, SO_3^{2-}, Cl^-, Br^-, I^-, CrO_4^{2-}. Perform tests for the following gases: NH_3, CO_2, Cl_2, H_2, O_2, SO_2.	Test tubes, test tube holder, test tube rack, delivery tube, measuring cylinder, match box, wooden splint, Bunsen burner, safety goggles, glass rod, filter paper, litmus paper	Sodium hydroxide, ammonium hydroxide, dilute acids, barium, lead, silver salt solutions, Al foil, lime water and other necessary chemical solutions for the identification of these ions and gases
		TOPIC 14: d- and f- BLOCK ELEMENTS		
2.	14.3.1	Prepare pure sample of copper amine complex (tetra amine cupric sulphate, $Cu(NH_3)_4SO_4$.	Beaker, watch glass, glass rod/ stirrer, filter paper, funnel	2.5 g copper sulphate, concentrated ammonia, H_2SO_4, ethyl alcohol
3.	14.4.2	Prepare nickel dimethyl glyoxime.	Test tubes, test tube holder, test tube rack, measuring cylinder, Bunsen burner, safety goggles, filter paper, funnel	Dimethyl glyoxime solution, nickel salt solution, distilled water and NH_4OH

S. No.	SLO No.	OBJECTIVE	EQUIPMENT	CHEMICAL
		TOPIC 15: ORGANIC COMPOUNDS		
4.	15.1.1	Detect elements in an organic compound (nitrogen, sulphur and halogen).	Test tubes, test tube holder, test tube rack, safety goggles, Bunsen burner, tripod stand, wire guaze, china dish, dropper	**For Lassaigne's solution:** Sodium metal, organic compound containing N, S and Halogen, distilled water.
				For N: Lassaigne's solution, sodium hydroxide, freshly prepared $FeSO_4$, dilute H_2SO_4.
				For S: Lassaigne's solution, acetic acid, lead acetate, sodium nitroprusside solution *For combined test of N and S can also use $FeCl_3$
				For Halogen: Lassaigne's solution, $AgNO_3$, concentrated HNO_3, NH_4OH
		TOPIC 17: ALKYL HALIDES AND AMINES		
5.	17.5.3	Identify the amine functional group.	Test tubes, test tube rack, test tube holder, measuring cylinder, balance, filter paper, funnel	Hinsberg test: benzenesulfonyl chloride, sodium hydroxide, HCl
6.	17.5.7	Prepare azo dye from amine.	Test tubes, test tube rack, test tube holder, measuring cylinder, balance, filter paper, funnel	Amine, phenol, hydrochloric acid, ice, sodium nitrite, alcohol, distilled water

S. No.	SLO No.	OBJECTIVE	EQUIPMENT	CHEMICAL
		TOPIC 18: ALCOHOLS, PHENOLS AND ETHERS		
7.	18.1.4	Prepare iodoform.	Test tubes, test tube holder, test tube rack, Bunsen burner, safety goggles	Alcohol, sodium hydroxide, water, solution of iodine in potassium iodide
8.	18.2.2	Identify the phenol function group.	Test tubes, test tube holder, test tube rack, measuring cylinder, safety goggles.	Litmus solution, ferric chloride solution
		TOPIC 19: CARBONYL COMPOUNDS I - ALDEHYDES AND KETONES		
9.	19.1.2	Identify the aldehyde and ketone functional group.	Beakers, test tubes, measuring cylinders, Bunsen burner, match box, funnel, filter papers	Fehling's solution, Tollen's reagent, Benedict solution
10.	19.4.2	Prepare glucosazone.	Beakers, test tubes, measuring cylinder, balance, Bunsen burner, match box, funnel, filter paper	Glucose solution, phenyl hydrazine solution, glacial acetic acid, distilled water
		TOPIC 20: CARBONYL COMPOUNDS II - CARBOXYLIC ACIDS AND FUNCTIONAL DERIVATIVES		
11.	20.2.1	Identify the carboxylic acid functional group.	Test tubes, beakers, balance, measuring cylinders, funnel, filter paper	Dilute sodium hydroxide, saturated potassium bicarbonate
		TOPIC 21: BIOCHEMISTRY		
12.	21.1.2	Detect protein urea denaturation.	Test tubes, beakers, conical flask, pipette	Urea, egg white
13.	21.1.3	Detect glucose as reducing sugar in urine sample of diabetic patients/ any glucose containing compound.	Test tubes, beaker conical flask, pipette	Benedict Reagent, Fehling's Solution.
14.	21.1.5	Determine the iodine number of oil.	Test tubes, beakers, conical flask, pipette	Iodine solution, oil
15.	21.2.1	Observe the digestion of starch with salivary amylase.	Test tubes, beakers, conical flask, pipette, slides.	Freshly prepared starch solution, iodine solution