Chapter 1: Fundamentals of Chemistry

Topics and Sub-topics	SLO No.	Student Learning Outcomes
1.1 Chemistry and its Branches	**1.1.1**	define 'chemistry' and its various branches: a. analytical chemistry, b. astrochemistry, c. biochemistry, d. environmental chemistry, e. geochemistry, f. industrial chemistry, g. inorganic chemistry, h. nuclear chemistry, i. organic chemistry, j. physical chemistry, k. polymer chemistry;
	1.1.2	explain the significance of the branches of chemistry mentioned in SLO 1.1.1;
1.2 History of Chemistry	**1.2.1**	describe the contribution of Jabir Ibn Hayyan and Al-Razi in chemistry during the Islamic Golden Age (8th to 14th centuries);
	1.2.2	define the term 'scientific paradigm';
	1.2.3	explain the following examples of 'scientific paradigm' in chemistry: a. Phlogiston theory, b. Plum pudding model;
1.3 Basic Definitions, Comparisons, Valencies, and Chemical Formulae	**1.3.1**	define the following terms: a. atoms, b. elements, c. compounds, d. mixtures, e. molecules;
	1.3.2	differentiate between: a. atoms and molecules, b. atoms and ions, c. molecules and molecular ions, d. ions and free radicals;
	1.3.3	differentiate among elements, compounds and mixtures;
	1.3.4	classify the chemical species into elements, mixtures, compounds, ions, molecular ions and free radicals;
	1.3.5	define the term 'valency';
	1.3.6	determine valencies of common elements and ions (radicals) independently or in compounds;
	1.3.7	determine the formula of a compound based on the valencies of elements and ions (radicals).

Exam Specification

Chapter	Chapter Name	MCQs	CRQs	Total Marks
1.	Fundamentals of Chemistry	5	Total 3 Marks (1 CRQ)	8

Use this chapter breakdown to plan revision time. With 8 total marks riding on this chapter, every SLO below is examinable, do not skip any section.

1.1 Introduction to Chemistry

SLO 1.1.1: What Is Chemistry? — Branches of Chemistry

> ***Definition:*** *Chemistry is the branch of science that studies matter — its composition (what it is made of), its properties (how it behaves), and its transformations (how it changes into other substances).*

Everything around you — the air you breathe, the water you drink, the phone in your hand, and even your own body — is made of matter. Chemistry helps us understand what this matter is made of at the smallest level (atoms and molecules) and predicts how it will behave and change under different conditions. Because matter is involved in literally everything, Chemistry is often called the "central science" — it connects Physics, Biology, Geology, and Medicine.

Example: Rusting of iron is a chemical change in which iron reacts with oxygen and moisture in air to form iron oxide (rust). Studying this single example draws on several branches of Chemistry at once — Physical Chemistry (rate of the reaction), Inorganic Chemistry (the metal and its oxide), and Environmental Chemistry (the effect of humidity and pollutants on corrosion).

Branches of Chemistry

Because "matter" covers an enormous range of substances and processes, Chemistry is divided into specialised branches. Each branch focuses on a particular type of substance, method, or application.

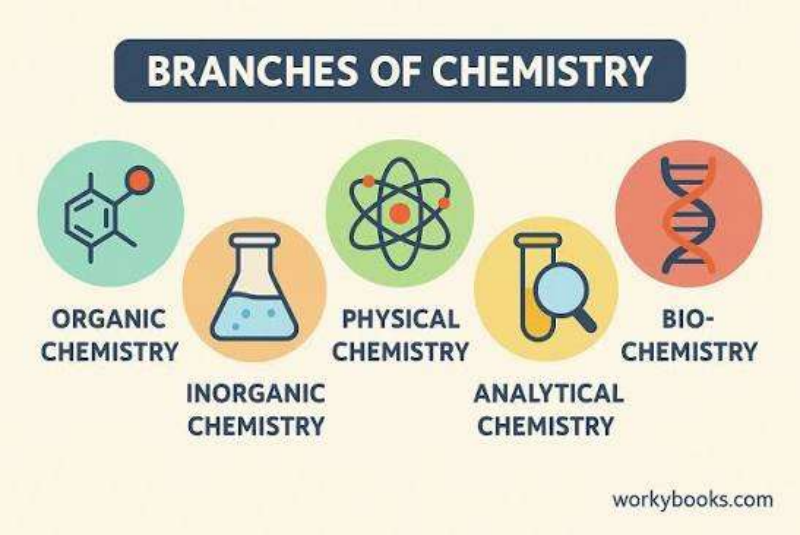

Figure 1.1 — The five core branches of Chemistry

Branch	Focus	Everyday Example
Organic Chemistry	Studies carbon-containing compounds and their reactions.	Fuels, plastics, drugs
Inorganic Chemistry	Deals with all elements and compounds other than most carbon compounds.	Metals, minerals, salts
Physical Chemistry	Explains chemical behaviour using the principles of physics and mathematics.	Reaction rates, energy changes
Analytical Chemistry	Identifies substances and determines their composition and quantity.	Purity testing, forensic analysis

Branch	Focus	Everyday Example
Nuclear Chemistry	Investigates changes in atomic nuclei, including radioactivity.	Radiotherapy, nuclear power
Biochemistry	Explores the chemical processes occurring in living organisms.	Digestion, DNA, enzymes
Industrial Chemistry	Applies chemical principles to the large-scale manufacture of useful products.	Fertilisers, cement, textiles
Environmental Chemistry	Examines chemical processes in the environment and their impacts on ecosystems.	Air/water pollution control
Polymer Chemistry	A sub-discipline focused on the structure, synthesis, and properties of polymers and macromolecules.	Rubber, nylon, polythene
Geochemistry	The study of the chemical composition of the Earth and other planets and the processes that shape them.	Rock and soil composition
Astrochemistry	Studies the abundance and reactions of atoms, molecules, and ions in space, including how they interact with radiation in gas clouds, stars, and planets.	Composition of stars and comets

Exam Point: AKUEB frequently asks you to match a branch of Chemistry to a short scenario (e.g., "a chemist studying the composition of Martian soil belongs to which branch?" → Geochemistry/Astrochemistry). Learn the definitions, not just the names.

SLO 1.1.2: Why Do These Branches Matter? (Importance of Chemistry)

Chemistry is not just an academic subject — its branches work together to solve real problems that affect human life and the planet. Some of the major contributions of Chemistry include:

Medicines and materials: Chemists design new drugs to cure diseases and develop new materials such as lightweight alloys, biodegradable plastics, and smart fabrics.

Food and water quality: Chemistry provides methods to test food for contamination, purify drinking water, and preserve food for longer shelf life.

Energy and manufacturing: Chemical processes generate energy (batteries, fuels) and improve efficiency in manufacturing industries such as cement, textiles, and fertiliser production.

Protecting ecosystems and health: Environmental chemists monitor pollution levels and design methods to treat waste, protecting both ecosystems and human health.

Understanding life and the universe: Biochemistry explains life processes at the molecular level, while astrochemistry helps scientists understand the composition of stars, planets, and comets.