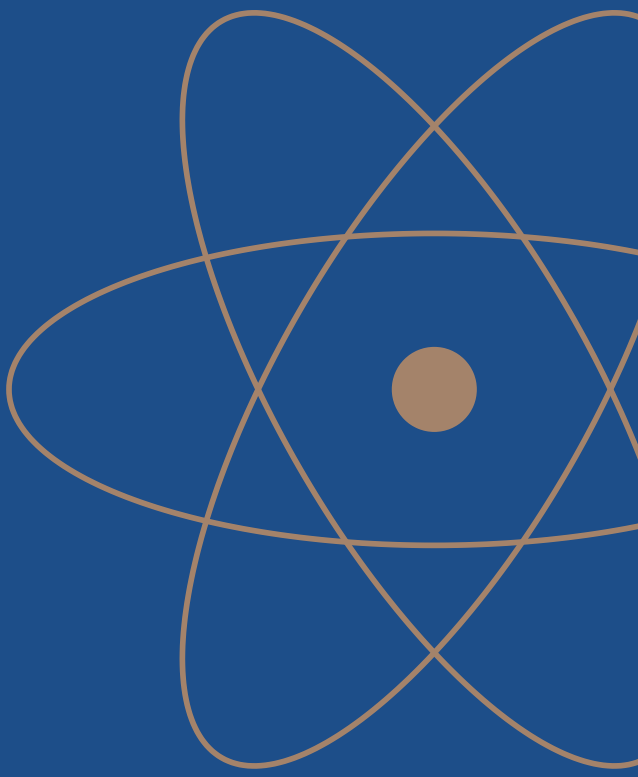
EXAM READY CHEMISTRY

Exam Ready Chemistry

GRADE 9

Study Guide, Worked Examples and Practice Tests for the Grade 9 Examination



- ✓ 5 units with clear key ideas, worked examples and “Watch out!” boxes
- ✓ 100 worked examples and 160+ practice questions at three levels
- ✓ 100 unit-quiz questions and 3 full mock exams (60 MCQ each)
- ✓ Diagnostic test · Key Facts Sheet · Top 20 Mistakes · teacher notes

Follows the units and order of the Ethiopian Grade 9 Chemistry textbook

ERMIAS WEDAJE TEGBARU

Exam Ready Chemistry

Grade 9 · Study Guide, Worked Examples and Practice Tests

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First edition, 2026

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This is an independent study guide. It follows the units and order of the Ethiopian Grade 9 Chemistry student textbook, but it is not published or endorsed by the Ministry of Education. All explanations, examples and questions are original. Keep your textbook and your teacher's notes beside this book.

The answers were calculated and checked before printing, but no book is free of errors. If you find a mistake or disagree with an answer, please tell the author on Telegram (@Ermias_Wedaje) and it will be reviewed for the next edition.

How to Use This Book

Each unit follows the same pattern, so you always know where to look.

Key ideas
The rules and facts of the section, short and clear.

Worked examples
Step-by-step solutions. Cover the solution and try first.

⚠ Watch out!
The mistakes students make most often, and the right way.

Practice
Level 1 Basic · Level 2 Standard · Level 3 Challenge.

Unit quiz
20 multiple-choice questions in the style of the national examination.

For the Teacher
Timing, starters, misconceptions, activities and assessment.

For students

- Begin with the Diagnostic Test. It shows which units need the most work.
- Read the key ideas, then study each example with the solution covered.
- Do Level 1 and Level 2 practice for every section; try Level 3 when you are ready.
- Take each quiz in 30 minutes, mark it, and redo every question you got wrong.
- In the last weeks, learn the Key Facts Sheet and the Top 20 Mistakes page, and sit the three mock exams. Their answer keys show which unit each question comes from.

For teachers

- Each unit follows the textbook sections, so the book can sit beside your lessons.
- The “For the Teacher” page gives timing, starters, misconceptions and activities.
- The quizzes and mock exams can be used as class tests; every answer has a short reason.

For parents

- Ask your child to explain one worked example to you each day. Teaching is the best way to learn.
- Look at the quiz score after each unit, and celebrate progress, not only high marks.

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Page numbers are the numbers shown at the foot of each page (and in the online reader).

Diagnostic Test · Where Should I Start?

14 questions · 15 minutes. Take this test before you start the book. There are two questions on each unit. Your score only shows you where to spend your time.

1. Chemistry is the study of
   A. rocks only
   B. stars only
   C. matter and its changes
   D. living cells only

2. The branch that studies compounds without carbon-hydrogen chains (minerals, metals) is
   A. biochemistry
   B. nuclear chemistry
   C. organic chemistry
   D. inorganic chemistry

3. The SI unit of mass is the
   A. tonne
   B. kilogram
   C. gram
   D. pound

4. The SI unit of temperature is the
   A. degree Celsius
   B. calorie
   C. kelvin
   D. degree Fahrenheit

5. The idea of atoms was first proposed by
   A. Democritus
   B. Thomson
   C. Rutherford
   D. Dalton

6. The law that a compound has fixed mass ratios is the law of
   A. gravity
   B. multiple proportions
   C. definite proportions
   D. conservation of mass

7. Early classification by Dobereiner grouped elements in
   A. blocks
   B. periods
   C. octaves
   D. triads

8. Mendeleev left gaps and predicted
   A. new laws of motion
   B. new colours
   C. new acids
   D. undiscovered elements

9. A chemical bond is the force that
   A. separates atoms
   B. holds atoms together
   C. makes atoms larger
   D. removes protons

10. Hydrogen follows the
    A. triple rule
    B. duplet rule
    C. none
    D. octet rule only

11. Soap is made by
    A. saponification of fats or oils with alkali
    B. cooling water
    C. melting sand
    D. burning wood only

12. An ion with 16 protons and 18 electrons has charge
    A. -1
    B. +1
    C. +2
    D. -2

Unit 1 · Chemistry and Its Importance

By the end of this unit you will be able to:

- define chemistry and describe its scope and branches
- relate chemistry to other sciences
- describe the role of chemistry in agriculture, medicine, food and construction
- describe common chemical industries in Ethiopia and their effects

Before you start — check yourself. (a) What is matter? (b) Give one chemical used at home. (c) Name one change that makes a new substance.
Answers: (a) anything that has mass and occupies space (b) salt or soap (c) burning wood

Key words: chemistry · matter · organic chemistry · inorganic chemistry · physical chemistry · analytical chemistry · biochemistry · fertiliser · pollution · industry

How this unit is examined

Question types that appear again and again in Ethiopian model examinations:

- Definition, Scope and Branches of Chemistry
- Chemistry and Other Sciences
- Role of Chemistry in Society
- Chemical Industries in Ethiopia

1.1 Definition, Scope and Branches of Chemistry

Key ideas

- **Chemistry** is the science that deals with the **properties, composition and structure of substances, the transformations they undergo, and the energy released or absorbed** during these changes. **Matter** is anything that has mass and occupies space.
- **Branches: organic chemistry** (carbon compounds, e.g. fuels, plastics, medicines), **inorganic chemistry** (all other elements and compounds, e.g. metals, salts), **physical chemistry** (energy, rates and laws of change), **analytical chemistry** (identifying and measuring substances) and **biochemistry** (chemistry of living things).
- **Scope:** agriculture, medicine, food production, building and construction, energy, clothing, environment; understanding the natural world, preparing for careers and informed citizenship.
- **Chemical vs physical change:** a chemical change makes a new substance (burning wood, rusting, cooking); a physical change does not (melting ice, dissolving sugar).

Example 1.1 — Define

Define chemistry.

Solution. The science of the properties, composition and structure of substances and their changes.

Example 1.2 — Match

Branch for: (a) carbon compounds, (b) chemistry of the body, (c) measuring how much of a substance is present.

Solution. (a) organic; (b) biochemistry; (c) analytical.

Example 1.3 — Change

Chemical or physical: rusting, melting ice, burning wood, dissolving sugar.

Solution. Chemical: rusting, burning. Physical: melting, dissolving.

Example 1.4 — Exam Booster · Scope

Name three areas where chemistry is applied.

Solution. Agriculture, medicine and food production.

Example 1.5 — Exam Booster · Matter

What is matter?

Solution. Anything that has mass and occupies space.

⚠ Watch out!

× Wrong	✓ Right
Chemistry studies only living things.	It studies all matter.
Dissolving sugar is a chemical change.	It is a physical change.
Organic chemistry means chemistry of metals.	It is the chemistry of carbon compounds.

Practice 1.1

Level 1 — Basic

1. Define chemistry.
2. Name a branch.
3. Burning is which change?

Level 2 — Standard

4. What is matter?
5. Branch of life chemistry?

6. Melting is which change?

Level 3 — Challenge

7. Explain the scope of chemistry.
8. Describe the five branches.

1.2 Chemistry and Other Sciences

Key ideas

- Chemistry is called the **central science** because it links the others. **Chemistry and biology:** metabolic processes in living things (**biochemistry**: photosynthesis, digestion). **Chemistry and physics:** structure of atoms, energy changes (**chemical physics**). **Chemistry and geology:** composition and distribution of minerals and rocks (**geochemistry**).
- **Chemistry and medicine:** design and manufacture of drugs (**medicinal chemistry**, pharmacology). **Chemistry and mathematics:** calculations of amounts, concentrations and rates; **chemistry and environmental science:** pollution and waste treatment.
- **Example:** photosynthesis (biology) is also a chemical reaction: $6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$.
- **Careers:** chemist, pharmacist, doctor, chemical engineer, food technologist, geologist, laboratory technician.

Example 1.6 — Link

Name the sub-discipline joining chemistry and biology.

Solution. Biochemistry.

Example 1.7 — Link

Which science studies the abundance of chemical compounds in rocks?

Solution. Geochemistry (geology and chemistry).

Example 1.8 — Example

Why is photosynthesis a topic of both biology and chemistry?

Solution. It is a living process that is a chemical reaction.

Example 1.9 — Exam Booster · Career

Give two careers that use chemistry.

Solution. Pharmacist and chemical engineer.

Example 1.10 — Exam Booster · Drug

Which discipline designs and synthesises drugs?

Solution. Medicinal chemistry.

Unit 2 · Measurements and Scientific Methods

By the end of this unit you will be able to:

- use SI units, prefixes and derived units in chemistry
- write numbers in scientific notation and count significant figures
- distinguish accuracy from precision
- apply the scientific method and laboratory safety

Before you start — check yourself. (a) What is the SI unit of mass? (b) Write 3,000 in scientific notation. (c) What is a hypothesis?

Answers: (a) kilogram (b) 3×10^3 (c) a testable explanation

Key words: SI unit · density · significant figures · scientific notation · accuracy · precision · hypothesis · theory · law · safety

How this unit is examined

Question types that appear again and again in Ethiopian model examinations:

- SI Units and Derived Quantities
- Scientific Notation and Significant Figures
- Accuracy, Precision and Laboratory Apparatus
- Scientific Method and Laboratory Safety

2.1 SI Units and Derived Quantities

Key ideas

- The **International System (SI)** uses **seven base units**; those used most in chemistry: **length – metre (m)**, **mass – kilogram (kg)**, **time – second (s)**, **temperature – kelvin (K)** and **amount of substance – mole (mol)**. Derived units come from base units: **volume** (m^3; common unit litre, L; 1 L = 1000 mL = 1000 cm^3 = 1 dm^3), **density** (kg/m^3 or g/cm^3), **pressure** and **energy**.
- **Prefixes:** kilo (k) 10^3; centi (c) 10^{-2}; milli (m) 10^{-3}; micro (μ) 10^{-6}; nano (n) 10^{-9}.
- **Density = mass ÷ volume.** Example: a metal piece of mass 54 g and volume 20 cm^3 has density 54 ÷ 20 = **2.7 g/cm^3**. **Temperature:** K = °C + 273; so 25°C = 298 K.
- **Unit conversion** (factor-label): 250 mL = 250 ÷ 1000 = 0.25 L; 2.5 kg = 2500 g.

Example 2.1 — Calc

A metal has mass 54 g and volume 20 cm^3. Find its density.

Solution. 54 ÷ 20 = 2.7 g/cm^3.

Unit 3 · Structure of the Atom

By the end of this unit you will be able to:

- trace the development of atomic theory
- state the fundamental laws of chemical reactions
- describe protons, neutrons and electrons
- calculate protons, neutrons, electrons, isotopes and average atomic mass
- write electron configurations of the first 20 elements

Before you start — check yourself. (a) What is an atom? (b) Name the three subatomic particles. (c) Which particle has a negative charge?
Answers: (a) the smallest particle of an element (b) proton, neutron, electron (c) electron

Key words: atom · proton · neutron · electron · nucleus · atomic number · mass number · isotope · energy level · valence electrons

How this unit is examined

Question types that appear again and again in Ethiopian model examinations:

- Atomic Theories and Fundamental Laws
- Subatomic Particles and the Nucleus
- Atomic Number, Mass Number and Isotopes
- Electron Configuration

3.1 Atomic Theories and Fundamental Laws

Key ideas

- **Early ideas:** Greek philosophers (Empedocles, Plato, Aristotle) believed in four elements (earth, air, water, fire); **Democritus** (5th century BC) proposed indivisible particles called **atoms** (Greek atomos = indivisible).
- **Laws: Law of conservation of mass** (Lavoisier): mass is neither created nor destroyed in a chemical reaction. **Law of definite proportions** (Proust): a compound always contains the same elements in the same mass ratio (water is always 1 g H : 8 g O). **Law of multiple proportions** (Dalton): when two elements form more than one compound, the masses of one element combining with a fixed mass of the other are in small whole-number ratios (CO and CO_2).
- **Dalton's atomic theory (1803):** matter is made of tiny indivisible atoms; atoms of an element are identical; atoms of different elements differ; compounds form by combining atoms in fixed whole-number ratios; atoms are rearranged, not created or destroyed, in reactions. Later discoveries showed atoms are divisible and isotopes exist.
- **Example (conservation of mass):** 12 g of carbon burns with 32 g of oxygen to give 44 g of CO_2.

Unit 4 · Periodic Classification of Elements

By the end of this unit you will be able to:

- describe early attempts to classify elements
- describe Mendeleev's table and the modern periodic law
- locate elements by group, period and block
- describe periodic trends and properties of alkali metals, halogens and noble gases

Before you start — check yourself. (a) How many elements are in period 2? (b) Name an alkali metal. (c) Name a noble gas.
Answers: (a) 8 (b) sodium (c) neon

Key words: periodic table · group · period · atomic number · metal · non-metal · atomic radius · ionisation energy · electronegativity · noble gas

How this unit is examined

Question types that appear again and again in Ethiopian model examinations:

- Early Classification and Mendeleev
- The Modern Periodic Table
- Periodic Trends
- Groups: Alkali Metals, Halogens and Noble Gases

4.1 Early Classification and Mendeleev

Key ideas

- **Döbereiner (1829): triads** – groups of three elements with similar properties where the atomic mass of the middle one is about the average of the others (Li, Na, K: 7, 23, 39; (7 + 39) ÷ 2 = 23). **Newlands (1864): law of octaves** – every eighth element showed similar properties (like musical notes), but it failed beyond calcium.
- **Mendeleev (1869):** arranged elements in **increasing atomic mass** in rows and columns so that elements with similar properties fall in the same column; **left gaps** for undiscovered elements and **predicted their properties** (eka-aluminium = gallium, eka-silicon = germanium). Some placements broke the atomic-mass order (Te and I).
- **Moseley (1913):** showed that properties depend on **atomic number**, giving the **modern periodic law:** *the properties of elements are a periodic function of their atomic numbers.*
- **Example:** Mendeleev predicted eka-silicon with atomic mass about 72; germanium (72.6) was discovered later and matched.

Key Facts Sheet

Learn these by heart. Cover the right-hand side and say each fact from memory.

Unit 1 · Chemistry and its importance

Chemistry: study of matter and its changes

Branches: organic, inorganic, physical, analytical, biochemistry

Element: one kind of atom ; compound: chemically combined

Chemical change forms a new substance

Ethiopian industries: cement, sugar, leather, textiles, glass

Green chemistry reduces pollution

Unit 2 · Measurements

SI: kg, m, s, K, mol

Density = mass / volume

K = °C + 273

kilo 10^{3} ; centi 10^{-2} ; milli 10^{-3}

Leading zeros are not significant

Accuracy = closeness to true value ; precision = repeatability

Unit 3 · Structure of the atom

Proton +1 ; neutron 0 ; electron −1

Atomic number Z = protons

Mass number A = protons + neutrons

Neutrons = A − Z

Isotopes: same Z, different A

Shells hold 2, 8, 8, 2 (first 20 elements)

Unit 4 · Periodic table

Ordered by atomic number

18 groups, 7 periods

Period number = shells ; group = valence electrons

Radius decreases across, increases down

Ionisation energy increases across, decreases down

Group 1 alkali, 17 halogens, 18 noble gases

Unit 5 · Chemical bonding

Octet rule: eight valence electrons

Ionic: metal + non-metal, transfer

Covalent: non-metals, sharing

Metallic: ions + sea of electrons

Ionic compounds conduct when molten or dissolved

H_2O single ; O_2 double ; N_2 triple

Mock Examination 1

60 multiple-choice questions · 90 minutes · one mark each. A scientific calculator is allowed. Circle one answer. Mark with the answer key at the back and use the unit number to see where to revise.

1. Chemistry is the study of
   A. rocks only
   B. stars only
   C. matter and its changes
   D. living cells only

2. Matter is anything that
   A. has colour
   B. is alive
   C. has mass and occupies space
   D. has energy only

3. The branch of chemistry dealing with carbon compounds is
   A. analytical chemistry
   B. inorganic chemistry
   C. physical chemistry
   D. organic chemistry

4. The branch that studies compounds without carbon-hydrogen chains (minerals, metals) is
   A. biochemistry
   B. nuclear chemistry
   C. organic chemistry
   D. inorganic chemistry

5. The branch that identifies and measures substances is
   A. organic chemistry
   B. analytical chemistry
   C. inorganic chemistry
   D. biochemistry

6. Chemistry of living organisms is
   A. biochemistry
   B. organic only
   C. geochemistry
   D. physical chemistry

7. The branch that studies energy changes and rates of reactions is
   A. analytical chemistry
   B. physical chemistry
   C. biochemistry
   D. organic chemistry

8. Chemistry is called the central science because it
   A. studies only plants
   B. has no link to other sciences
   C. studies only stars
   D. links physics, biology and other sciences

9. Biochemistry links chemistry with
   A. astronomy only
   B. geography only
   C. history
   D. biology

10. Geochemistry links chemistry with
    A. geology
    B. music
    C. economics
    D. biology only

11. Medicinal chemistry helps to make
    A. roads only
    B. drugs
    C. clocks
    D. bricks only

12. Fertilizers improve
    A. rock hardness
    B. sound
    C. crop yield
    D. water speed

13. The SI unit of mass is the
    A. tonne
    B. kilogram
    C. gram
    D. pound