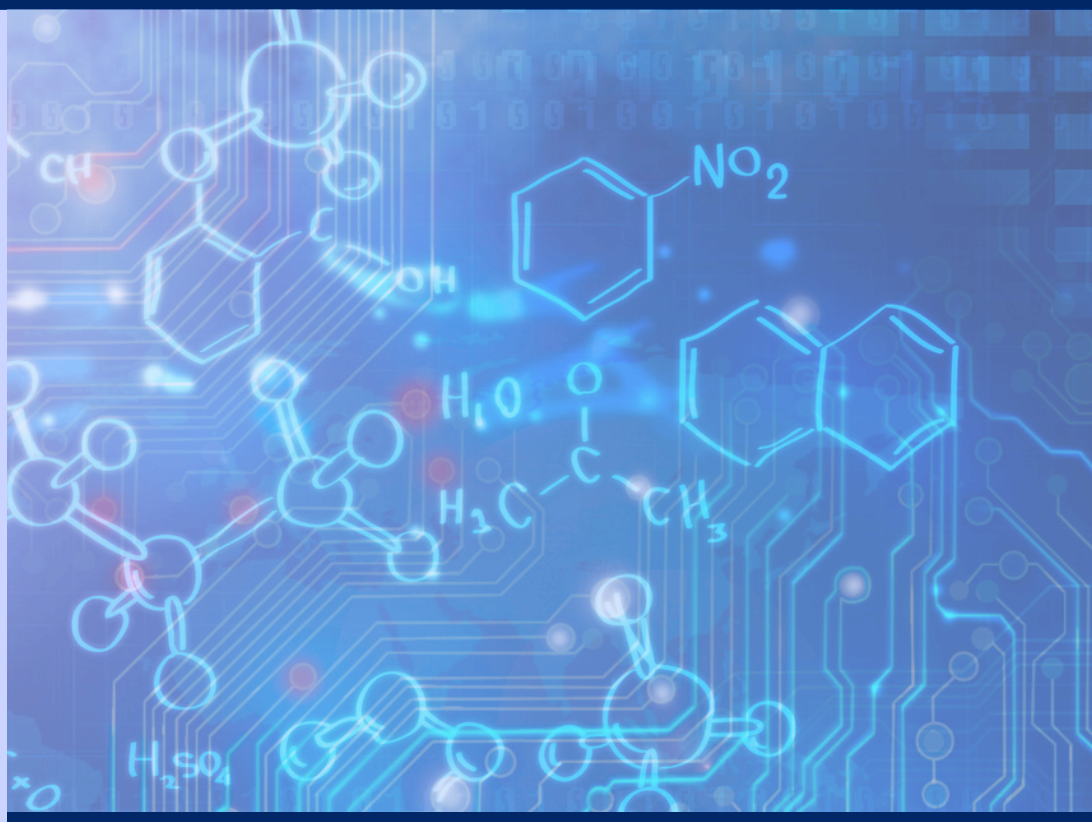
ENGLISH VOCABULARY AND GRAMMAR

for Chemistry

- Technical vocabulary
- Grammar for academic purposes
- Reading comprehension articles
- Grammar exercises



dr. Eva Boh

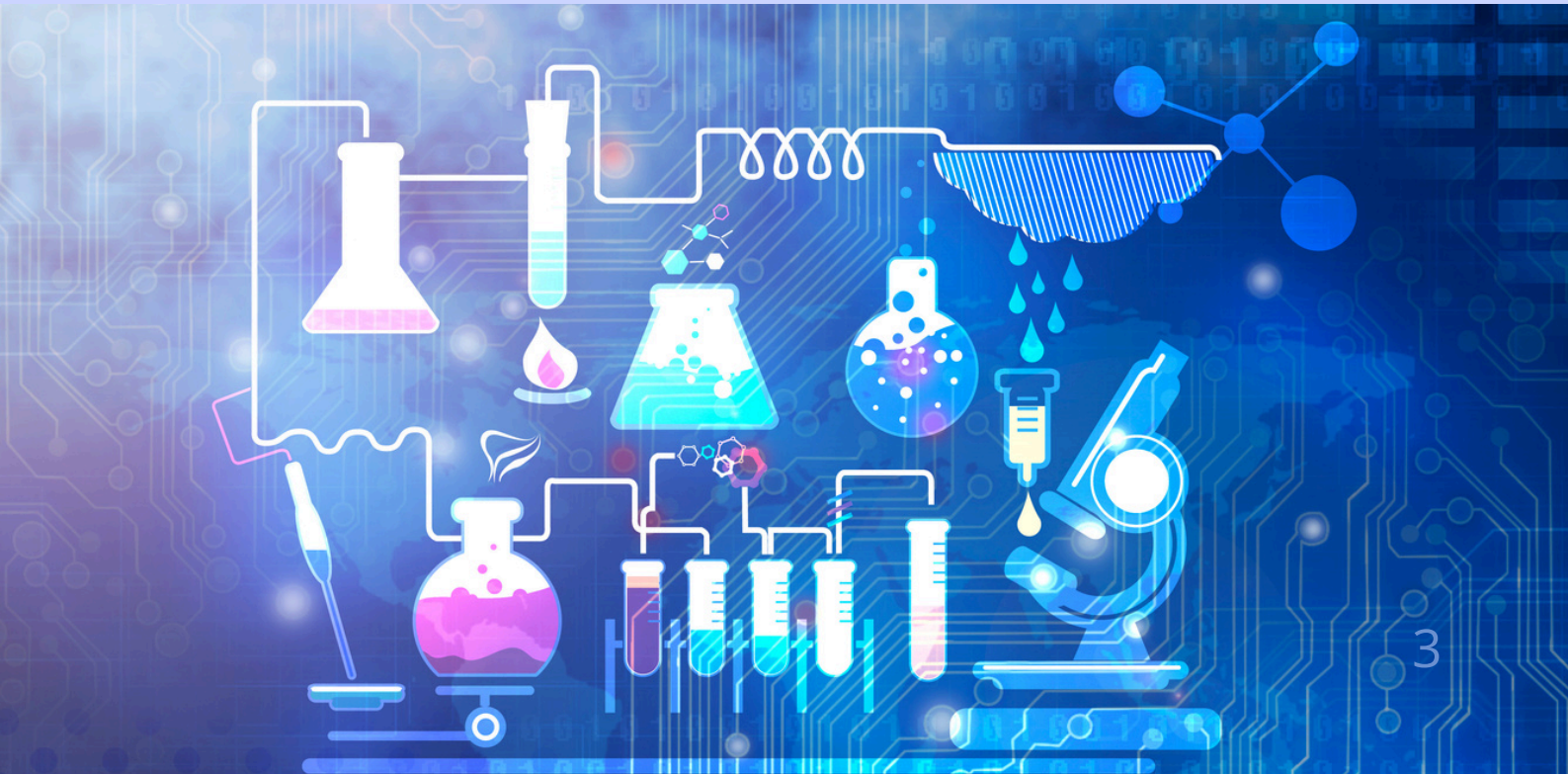
KOLOFON

English Vocabulary and Grammar for Chemistry

Avtor: dr. Eva Boh
Format: PDF
Naslov URL: https://alfabet.si/english-vocabulary-and-grammar-for-chemistry.pdf
Kraj in leto izdaje: Celje, 2025
Izdal: Alfabet, d.o.o, Celje

Kataložni zapis o publikaciji (CIP) pripravili v Narodni in univerzitetni knjižnici v Ljubljani
COBISS.SI-ID 233400323
ISBN 978-961-07-2675-3 (PDF)

CONTENTS PAGE



UNIT 1
The Scientific Method

The scientific method is a step-by-step process used by scientists to investigate questions and solve problems. In chemistry, this method helps researchers understand substances, reactions, and changes in matter.

First, a scientist makes an observation—something noticed during an experiment or in everyday life. Next, they form a hypothesis, a testable idea or prediction. To test this hypothesis, they design and carry out an experiment. During the experiment, they collect data, both qualitative (descriptive) and quantitative (numerical).

The scientist then analyzes the data to see if it supports the hypothesis. Based on this analysis, they draw a conclusion. If the results are consistent and repeatable, the hypothesis may lead to a new theory. All findings are often reviewed through peer review to ensure accuracy and reliability.

Using the scientific method helps chemists discover new materials, improve processes, and solve real-world problems.

1.1 Transalte 15 key terms related to the scientific method in chemistry.

Observation: _____
Hypothesis: _____
Experiment: _____
Variable: _____
Independent Variable: _____
Dependent Variable: _____
Control Group: _____
Replication: _____

Data Collection: _____
Qualitative Data: _____
Quantitative Data: _____
Analysis: _____
Conclusion: _____
Theory: _____
Peer Review: _____

1.2 Match the words with their correct definitions.

Words	Definitions
1.Observation 2.Hypothesis 3.Experiment 4.Variable 5.Independent Variable 6.Dependent Variable 7.Control Group 8.Replication 9.Data Collection 10.Qualitative Data 11.Quantitative Data 12.Analysis 13.Conclusion 14.Theory 15.Peer Review	A. The process of gathering facts, measurements, and information. B. A proposed explanation for a phenomenon that can be tested. C. The process of repeating an experiment to verify results. D. A group that does not receive the experimental treatment for comparison. E. A factor that can be changed or controlled in an experiment. F. Descriptive information that is not in numerical form. G. Numerical data that can be measured and expressed in numbers. H. The act of observing a phenomenon or event to gather information. I. A detailed explanation of a set of phenomena, based on repeated testing. J. A statement summarizing the outcome of an experiment, based on data analysis. K. The factor in an experiment that is changed to observe its effect. L. The factor that changes in response to the independent variable. M. The process of examining and interpreting data from an experiment. N. A group of data or results obtained by repeating an experiment. O. The evaluation of scientific work by experts in the same field.

1.3 Fill in the blanks with the correct words from the list below.

Word Bank:

observation, hypothesis, experiment, variable, independent variable, dependent variable, control group, replication, data collection, qualitative data, quantitative data, analysis, conclusion, theory, peer review.

In chemistry, scientists use the (1) _____ to investigate natural phenomena. The process begins with an (2) _____, where a scientist notices something unusual. Based on this, they form a (3) _____, which is a testable explanation. To verify it, they design an (4) _____, ensuring that only one (5) _____ is changed—the (6) _____, while measuring the (7) _____. A (8) _____ remains unchanged for comparison.
During the (9) _____ phase, scientists gather both (10) _____ (descriptive) and (11) _____ (numerical) information. The next step is (12) _____, where they interpret the results. A (13) _____ is then drawn, summarizing whether the hypothesis was correct. If an idea is tested repeatedly with successful (14) _____, it may become a (15) _____. Before publication, findings undergo (16) _____ to ensure accuracy.

Present Simple

The Present Simple is used to talk about:

·**Habits and routines: things that happen regularly.**

o Example: I go to the lab every morning.

o Example: She studies chemistry on Mondays.

·**General truths and facts: things that are always true or scientifically correct.**

o Example: Water boils at 100°C.

o Example: Hydrogen is the lightest element.

-Permanent situations: things that don't change often.

o Example: He works as a chemistry teacher.

o Example: They live near the university.

·**Schedules and timetables: often used for public transport, school, or events.**

o Example: The class starts at 8 a.m.

o Example: The lab closes at 6 p.m.

·**Instructions and directions: when giving steps or commands.**

o Example: First, you heat the solution.

o Example: Then, you add the acid slowly.

Present Continuous

·The Present Continuous is used to talk about:

Actions happening right now: for something that is happening at this moment.

o Example: The chemist is mixing two solutions.

o Example: Students are observing the color change in the reaction.

·Actions happening around now: temporary actions.

o Example: She is working on a project about acids and bases this week.

o Example: They are studying chemical bonding in class these days.

·**Changing or developing situations: to describe something that is gradually changing.**

o Example: The solution is becoming darker.

o Example: The temperature is rising quickly.

·**Planned future actions (less common in scientific English)**

o Example: We are meeting in the lab at 2 p.m.

o Example: The professor is giving a lecture on organic chemistry tomorrow.

GRAMMAR EXERCISES

1.4 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Present Simple or Present Continuous.

Dr. Lewis is a chemist who (1) _____ (study) new materials. Every day, she (2) _____ (work) in her laboratory, where she (3) _____ (analyze) different chemical reactions. Right now, she (4) _____ (heat) a liquid in a test tube while her assistant (5) _____ (record) the temperature changes.

She always (6) _____ (follow) the scientific method. First, she (7) _____ (observe) how substances react. Then, she (8) _____ (form) a hypothesis and tests it. At the moment, she (9) _____ (mix) two solutions to see if a new compound forms. The mixture (10) _____ (change) color, so she (11) _____ (write) down her observations. She (12) _____ (repeat) experiments regularly to ensure accuracy. Her research (13) _____ (help) scientists develop better materials. Even now, she (14) _____ (look) at the data to draw conclusions.
Science (15) _____ (play) a key role in everyday life!

1.5 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Present Simple or Present Continuous.

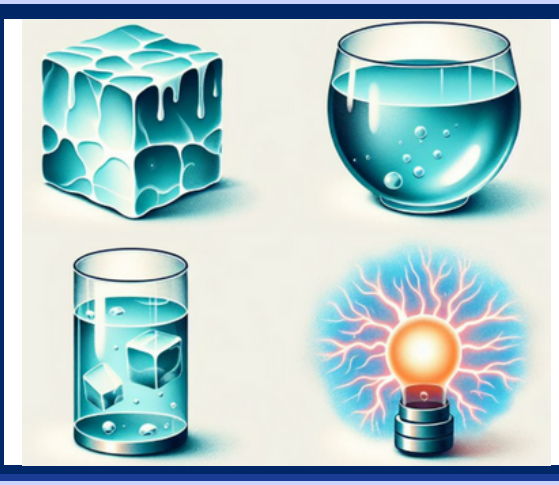
Sophia is a chemistry student who (1) _____ (love) doing experiments. Right now, she (2) _____ (work) on a project about acids and bases. She always (3) _____ (follow) safety rules in the lab. At the moment, she (4) _____ (wear) protective gloves while she (5) _____ (pour) a liquid into a beaker.

Her professor (6) _____ (observe) her carefully because experiments (7) _____ (require) precision. Usually, she (8) _____ (record) all data in her notebook, but today, she (9) _____ (use) a digital tablet instead. The solution (10) _____ (change) color, which means the reaction (11) _____ (take) place. Sophia (12) _____ (enjoy) chemistry because it (13) _____ (help) people understand the world. Right now, she (14) _____ (analyze) the results to write her report. Science (15) _____ (teach) us how things work!

1.6 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Present Simple or Present Continuous.

Dr. Carter is a chemist who (1) _____ (study) chemical reactions in different substances. Every day, she (2) _____ (conduct) experiments in her laboratory. Right now, she (3) _____ (mix) two solutions in a beaker while her assistant (4) _____ (take) notes. She always (5) _____ (check) measurements carefully before she (6) _____ (start) a new experiment. At the moment, she (7) _____ (observe) the reaction closely because the color (8) _____ (change). Her research (9) _____ (help) scientists develop safer chemicals. Today, she (10) _____ (test) a new formula that might improve battery efficiency. The reaction (11) _____ (produce) gas bubbles, so she (12) _____ (write) down her observations. Chemistry (13) _____ (play) an important role in technology. Even now, Dr. Carter (14) _____ (analyze) the data to draw conclusions. Science (15) _____ (allow) us to discover new possibilities!

UNIT 2
States of Matter



In chemistry, the states of matter—solid, liquid, gas, and plasma—describe the different forms that matter can take, each with unique properties influenced by temperature and pressure.

Solids have a definite shape and volume due to tightly packed particles that vibrate but do not move from their positions. This results in a rigid structure, as seen in ice, metals, and crystalline salts. The strong intermolecular forces in solids provide stability and resistance to deformation.

Liquids have a definite volume but take the shape of their container. The particles are less tightly packed than in solids, allowing them to flow and move past one another. This fluidity is due to weaker intermolecular forces. Common examples include water, alcohol, and mercury. Liquids exhibit properties like viscosity and surface tension, important in various chemical processes.

Gases have neither a definite shape nor volume, expanding to fill any container. The particles are far apart and move freely at high speeds, resulting in low density and high compressibility. Examples include oxygen, nitrogen, and carbon dioxide. The behavior of gases is described by the ideal gas law, relating pressure, volume, and temperature.

Plasma is a high-energy state where atoms are ionized, creating a mix of charged particles. Plasmas are found in stars, neon signs, and plasma TVs. Their behavior is influenced by electromagnetic fields, making them distinct from other states. Plasma is crucial in fields like astrophysics and fusion energy research.

Understanding these states and their transitions—such as melting, freezing, and ionization—is essential in chemistry for explaining the physical properties and behaviors of substances under different conditions.

2.1 Match the following definitions with the correct technical word from the list.

Words	Definitions
1. Intermolecular Forces 2. Viscosity 3. Surface Tension 4. Compressibility 5. Ionization 6. Crystalline 7. Amorphous 8. Sublimation 9. Condensation 10. Evaporation 11. Melting Point 12. Boiling Point 13. Plasma 14. Diffusion 15. Phase Transition	a)The process by which a solid changes directly into a gas without passing through the liquid state. b)The temperature at which a liquid changes into a gas. c)The resistance of a liquid to flow. d)The force that holds molecules together in a solid or liquid. e)The process by which a gas changes into a liquid. f)The ability of a gas to be compressed into a smaller volume. g)The temperature at which a solid changes into a liquid. h)The process by which a liquid changes into a gas at a temperature below its boiling point. i)The process by which a gas spreads out to fill a space. j)A state of matter consisting of ionized particles. k)The process by which a solid changes into a liquid. l)A solid with a regular, repeating pattern of atoms. m)A solid without a regular, repeating pattern of atoms. n)The process by which atoms or molecules gain or lose electrons. o)The change of matter from one state to another.

2.2 Translate the words.

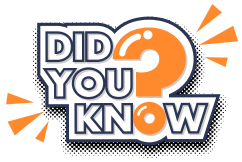
English	Translation	English	Translation
Intermolecular Forces		Condensation	
Viscosity		Evaporation	
Surface Tension		Melting Point	
Compressibility		Boiling Point	
Ionization		Plasma	
Crystalline		Diffusion	
Amorphous		Phase Transition	
Sublimation		State of matter	

2.3 Fill in the gaps with the words from the word bank.

Word Bank:
compressibility, definite, density, evaporation, ionized, mercury, metals, neon signs, recombination, sublimation.

State of Matter	Characteristics	Examples	Transitions
Solid	- _____ shape and volume - Particles closely packed - Strong intermolecular forces	Ice, _____, crystalline salts	Melting (solid to liquid), _____ (solid to gas)
Liquid	- Definite volume, takes shape of container - Particles less tightly packed - Weaker intermolecular forces	Water, _____ alcohol, _____	Freezing (liquid to solid), _____ (liquid to gas
Gas	- No definite shape or volume - Particles far apart, move freely - Low _____, high _____,	Oxygen, nitrogen, carbon dioxide	Condensation (gas to liquid), Sublimation (gas to solid)
Plasma	- High-energy state - _____, particles - Influenced by electromagnetic fields	Stars, _____, plasma TVs	Ionization (gas to plasma), _____ (plasma to gas)

2.4 Choose the correct answer for each question.



1.What is the process by which a solid changes directly into a gas without passing through the liquid state?
- A) Condensation
- B) Sublimation
- C) Evaporation
- D) Melting

2.What is the temperature at which a liquid changes into a gas?
- A) Melting Point
- B) Freezing Point
- C) Boiling Point
- D) Sublimation Point

3.What term describes the resistance of a liquid to flow?
- A) Viscosity
- B) Compressibility
- C) Diffusion
- D) Ionization

4.What are the forces that hold molecules together in a solid or liquid?
- A) Gravitational Forces
- B) Magnetic Forces
- C) Intermolecular Forces
- D) Nuclear Forces

5.What is the process by which a gas changes into a liquid?
- A) Evaporation
- B) Condensation
- C) Sublimation
- D) Melting

6.What is the ability of a gas to be compressed into a smaller volume?
- A) Viscosity
- B) Compressibility
- C) Diffusion
- D) Ionization

7.What describes a solid with a regular, repeating pattern of atoms?
- A) Amorphous
- B) Crystalline
- C) Plasma
- D) Diffuse

8.What is the process by which atoms or molecules gain or lose electrons?
- A) Ionization
- B) Evaporation
- C) Condensation
- D) Melting

Modern Materials with Fascinating State of Matter Properties

In the realm of material science, modern materials with unique state of matter properties are revolutionizing various industries. These materials exhibit extraordinary behaviors that challenge our traditional understanding of solids, liquids, and gases. Here, we explore some of the most intriguing modern materials and their fascinating properties.

1. Graphene
Graphene, a single layer of carbon atoms arranged in a hexagonal lattice, is renowned for its exceptional properties. It is incredibly strong, yet lightweight, and exhibits remarkable electrical and thermal conductivity. Graphene's flexibility and transparency make it ideal for applications in flexible electronics, transparent conductive films, and advanced composites. Its unique two-dimensional structure allows electrons to move freely, giving it properties that are not found in conventional materials.

2. Aerogels
Aerogels are ultra-light materials derived from a gel, where the liquid component is replaced with gas. Despite their low density, aerogels are excellent insulators and can support substantial weight. They have a porous structure that gives them a high surface area, making them useful in applications such as thermal insulation, oil spill cleanup, and even in space suits. Their ability to withstand extreme temperatures and their low thermal conductivity make them invaluable in various high-tech applications.

3. Shape Memory Alloys (SMAs)
Shape memory alloys are metals that can return to their original shape after being deformed, upon exposure to a specific temperature. This property is due to a reversible phase transformation between two different crystal structures. SMAs are used in medical devices, such as stents and surgical tools, as well as in actuators and robotics. Their ability to "remember" their shape and return to it makes them incredibly useful in applications requiring precise movements and adjustments.

4. Liquid Crystals
Liquid crystals are substances that exhibit properties between those of conventional liquids and solid crystals. They flow like a liquid but have some degree of ordering in their molecular arrangement. This unique state of matter is exploited in liquid crystal displays (LCDs), which are ubiquitous in screens for televisions, computers, and smartphones. The ability of liquid crystals to change their orientation in response to electric fields allows for the control of light passage, making them essential in modern display technology.

5. Metamaterials
Metamaterials are engineered materials designed to have properties not found in naturally occurring materials. They achieve this through their structure rather than their composition. Metamaterials can manipulate electromagnetic waves in unusual ways, leading to applications such as invisibility cloaks, superlenses, and advanced antennas. Their ability to control wave propagation opens up new possibilities in optics, telecommunications, and beyond.

6. Quasicrystals
Quasicrystals are structures that are ordered but not periodic. Unlike traditional crystals, which have repeating patterns, quasicrystals have a unique arrangement that never repeats. This gives them unusual properties, such as low thermal conductivity and high resistance to wear and corrosion. Quasicrystals are used in applications ranging from non-stick coatings to LED lights, where their unique properties can be exploited.

2.5 Answer the questions.

1. What is the structure of graphene?
2. How are aerogels created?
3. What unique property do shape memory alloys exhibit?
4. In what applications are liquid crystals commonly used?
5. What distinguishes metamaterials from naturally occurring materials?
6. Describe one application of quasicrystals.
7. Why are aerogels considered excellent insulators?
8. Which material is known for its exceptional electrical and thermal conductivity?
   a) Aerogels b) Graphene c) Liquid Crystals d) Quasicrystals
9. Metamaterials are primarily used to manipulate which type of waves?
   a) Sound waves b) Electromagnetic waves c) Water waves d) Seismic waves

Past Simple

The past simple tense is used to describe actions or events that happened at a specific time in the past.

1. Completed Actions in the Past

Use the past simple to talk about actions that were completed at a specific time in the past.

Examples:

- The scientist discovered a new element last year.
- They conducted the experiment yesterday.

2. Series of Completed Actions

Use the past simple to describe a series of actions that happened one after the other in the past.

Examples:

- She mixed the chemicals, heated the solution, and observed the reaction.
- The team collected the samples, analyzed the data, and published their findings.

3. Duration in the Past

Use the past simple to talk about actions that lasted for a specific period of time in the past.

Examples:

- The reaction lasted for two hours.
- They studied the compound for several months.

4. Habits in the Past

Use the past simple to describe habits or repeated actions in the past.

Examples:

- The chemist always used a Bunsen burner for heating.
- They frequently tested the pH levels of the solution.

5. Past Facts or Generalizations

Use the past simple to state facts or generalizations about the past.

Examples:

- Early chemists believed that phlogiston was a real substance.
- The laboratory had very basic equipment in the 19th century.

Present Continuous

The past continuous tense is used to describe actions or events that were ongoing at a specific time in the past.

1. Actions in Progress at a Specific Time

Use the past continuous to describe actions that were in progress at a specific moment in the past.

Examples:

- The chemist was heating the solution when the alarm went off.
- They were observing the reaction at 3 PM yesterday.

2. Interrupted Actions

Use the past continuous to describe an action that was interrupted by another action in the past.

Examples:

- She was mixing the chemicals when the beaker broke.
- They were conducting the experiment when the power went out.

3. Parallel Actions

Use the past continuous to describe two or more actions that were happening at the same time in the past.

Examples:

- While the students were preparing the samples, the professor was writing the report.
- The researchers were analyzing the data while the technicians were calibrating the equipment.

4. Background Actions

Use the past continuous to set the scene or provide background information for another action in the past.

Examples:

- The lab was buzzing with activity as the team was working on the new experiment.
- The scientist was reviewing the data while the assistant was cleaning the equipment.

GRAMMAR EXERCISES

2.6 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Past Simple or Past Continuous.

Dr. Smith (1) _____ (conduct) an experiment in the lab yesterday. While he (2) _____ (mix) the chemicals, his assistant (3) _____ (take) notes. Suddenly, the solution (4) _____ (change) color. They (5) _____ (observe) the reaction carefully when the beaker (6) _____ (explode). As they (7) _____ (clean) up the mess, Dr. Smith (8) _____ (realize) that he (9) _____ (forget) to add a crucial ingredient. While they (10) _____ (discuss) the mistake, the lab supervisor (11) _____ (enter) the room. She (12) _____ (ask) what (13) _____ (happen) and they (14) _____ (explain) the situation. Afterward, they (15) _____ (decide) to repeat the experiment the next day.

♝ 2.7 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Past Simple or Past Continuous.

Last week, Dr. Johnson (1) _____ (prepare) a new compound in the lab. While she (2) _____ (heat) the mixture, her colleague (3) _____ (record) the temperature changes. Suddenly, the mixture (4) _____ (start) to bubble. They (5) _____ (monitor) the reaction closely when the flask (6) _____ (crack). As they (7) _____ (deal) with the situation, Dr. Johnson (8) _____ (notice) that the reaction (9) _____ (produce) an unexpected gas. While they (10) _____ (analyze) the gas, the lab technician (11) _____ (arrive) with new equipment. He (12) _____ (ask) if they (13) _____ (need) any help and they (14) _____ (describe) the issue. Afterward, they (15) _____ (decide) to modify the experiment protocol.

♝ 2.8 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Past Simple or Past Continuous.

Dr. Brown (1) _____ (work) on a groundbreaking experiment last month. While she (2) _____ (prepare) the chemical solution, her assistant (3) _____ (set) up the equipment. They (4) _____ (plan) to test a new catalyst. As Dr. Brown (5) _____ (mix) the ingredients, the solution (6) _____ (begin) to change color. They (7) _____ (observe) the reaction when the temperature (8) _____ (rise) unexpectedly. While they (9) _____ (try) to stabilize the reaction, the lab (10) _____ (experience) a power outage. Dr. Brown (11) _____ (realize) that they (12) _____ (need) to act quickly. She (13) _____ (instruct) her assistant to fetch the backup generator. While he (14) _____ (run) to get it, she (15) _____ (monitor) the reaction closely. The power (16) _____ (come) back on just as the generator (17) _____ (arrive). They (18) _____ (continue) the experiment and (19) _____ (record) the data. Afterward, they (20) _____ (analyze) the results and (21) _____ (discover) a significant finding. While they (22) _____ (celebrate), Dr. Brown (23) _____ (receive) a call from a colleague. He (24) _____ (hear) about their experiment and (25) _____ (want) to collaborate. They (26) _____ (agree) to meet the next day. As they (27) _____ (discuss) the details, Dr. Brown (28) _____ (feel) optimistic about the future. They (29) _____ (know) that their discovery (30) _____ (have) the potential to change the field of chemistry.

PRESENT AND PAST TENSES

Tips for Differentiating Between Past and Present Tenses

1. **Identify Time References:** Look for words or phrases that indicate a specific time in the past or present.
   - Past: yesterday, last week, in 2020, etc.
   - Present: today, now, currently, etc.
2. **Verb Forms**: Pay attention to the form of the verb.
   - Past Simple: Regular verbs often end in -ed (e.g., walked, played).
   - Present Simple: Base form of the verb (e.g., walk, play).
3. **Context Clues**: Consider the context of the sentence to determine if the action is ongoing or completed.
   - Past Continuous: Describes actions that were ongoing in the past (e.g., was/were + verb-ing).
   - Present Continuous: Describes actions that are ongoing in the present (e.g., am/is/are + verb-ing).
4. **Adverbs and Time Expressions**: Use typical adverbs and time expressions to help identify the tense.

Typical Adverbs and Time Expressions

Present Simple

- Always
- Usually
- Often
- Sometimes
- Never
- Every day/week/month/year

Examples:

- The chemist always mixes the solution carefully.
- They usually analyze the samples in the morning.

Present Continuous

- Now
- Currently
- At the moment
- Right now
- Today

Examples:

- The chemist is mixing the solution right now.
- They are analyzing the samples at the moment.

Past Simple

- Yesterday
- Last week/month/year
- In 2020 (or any specific year)
- Ago (e.g., two days ago)
- When (used with a specific time in the past)

Examples:

- The chemist mixed the solution yesterday.
- They analyzed the samples last week.

Past Continuous

- While, when (used to describe an action that was interrupted)
- At that moment
- All day/week/month

Examples:

- The chemist was mixing the solution when the alarm went off.
- They were analyzing the samples while the power outage occurred.

2.9 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Past and Present tenses.

1. The chemist _____ (analyze) the samples every morning.
2. They _____ (conduct) an experiment right now.
3. Last week, Dr. Smith _____ (discover) a new compound.
4. While the students _____ (prepare) the solution, the professor _____ (review) the procedure.
1. The reaction _____ (take) place at room temperature.
2. She _____ (heat) the mixture when the alarm went off.
3. The lab technician _____ (always wear) safety goggles.
4. They _____ (test) the pH levels at the moment.
5. Yesterday, the team _____ (complete) the synthesis of the polymer.
6. While the chemist _____ (mix) the chemicals, the assistant _____ (record) the data.
7. The solution _____ (change) color when they added the catalyst.
8. The researchers _____ (currently study) the effects of temperature on the reaction.
9. He _____ (measure) the volume of the liquid every hour.
10. They _____ (observe) the reaction when the power outage occurred.
11. The experiment _____ (yield) interesting results last month.

2.10 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Past and Present tenses.

1. The compound _____ (crystallize) when they added the solvent.
2. The researchers _____ (currently investigate) the properties of the new material.
3. He _____ (weigh) the samples every hour.
4. They _____ (examine) the results when the power outage occurred.
5. The experiment _____ (produce) significant data last week.
6. The chemist _____ (observe) the reaction every day.
7. They _____ (synthesize) a new compound right now.
8. Last month, Dr. Lee _____ (identify) a rare mineral.

2.11 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Past and Present tenses.

1. While the students _____ (measure) the temperature, the professor _____ (explain) the process.
2. The solution _____ (react) quickly at room temperature.
3. She _____ (cool) the mixture when the alarm went off.
4. The lab technician _____ (always check) the equipment.
5. They _____ (monitor) the pressure levels at the moment.
6. Yesterday, the team _____ (isolate) the active ingredient.
7. While the chemist _____ (filter) the solution, the assistant _____ (note) the observations.

2.12 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Past and Present tenses.

Mr. Johnson is a dedicated chemistry teacher who (1) _____ (teach) his students about chemical reactions every day. Today, he (2) _____ (mix) two solutions to demonstrate a reaction. Last week, he (3) _____ (discover) a new way to explain complex concepts. While he (4) _____ (analyze) the results, he noticed something unusual.

His students (5) _____ (learn) about acids and bases this semester. At the moment, they (6) _____ (conduct) an experiment on pH levels. Yesterday, they (7) _____ (measure) the acidity of various substances. While they (8) _____ (work), Mr. Johnson explained the importance of safety.

Mr. Johnson always (9) _____ (wear) protective gear in the lab. Currently, he (10) _____ (prepare) a presentation on his findings. Last month, he (11) _____ (present) his research at a teachers' conference. While he (12) _____ (speak), the audience asked many questions.

The students (13) _____ (understand) the concept of chemical equilibrium now. Right now, they (14) _____ (test) the effects of temperature on reaction rates. Last year, they (15) _____ (complete) a project on organic chemistry.

2.13 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Past and Present tenses.

Ms. Brown is a passionate chemistry teacher who (1) _____ (teach) her students about chemical reactions every day. Today, she (2) _____ (mix) different chemicals to show a reaction. Last week, she (3) _____ (discover) a new method to illustrate complex ideas. While she (4) _____ (analyze) the experiment, she noticed something unexpected.

Her students (5) _____ (learn) about chemical bonds this semester. At the moment, they (6) _____ (conduct) an experiment on molecular structures. Yesterday, they (7) _____ (measure) the bond lengths of various molecules. While they (8) _____ (work), Ms. Brown explained the significance of precision.

Ms. Brown always (9) _____ (wear) safety goggles in the lab. Currently, she (10) _____ (prepare) a report on her findings. Last month, she (11) _____ (present) her research at a science fair. While she (12) _____ (speak), the audience showed great interest.

The students (13) _____ (understand) the concept of molecular geometry now. Right now, they (14) _____ (test) the effects of different solvents on reaction rates. Last year, they (15) _____ (complete) a project on inorganic chemistry.

2.14 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Past and Present tenses.

A team of researchers (1) _____ (study) chemical reactions every day in their lab. Today, they (2) _____ (mix) various compounds to observe the results. Last week, they (3) _____ (discover) a new catalyst. While they (4) _____ (analyze) the data, they noticed an unexpected pattern.

The researchers (5) _____ (investigate) the properties of different elements this semester. At the moment, they (6) _____ (conduct) an experiment on reaction kinetics. Yesterday, they (7) _____ (measure) the rate of a specific reaction. While they (8) _____ (work), the lead scientist explained the importance of accuracy.

The team always (9) _____ (wear) lab coats and goggles for safety. Currently, they (10) _____ (prepare) a detailed report on their findings. Last month, they (11) _____ (present) their research at an international conference. While they (12) _____ (speak), the audience was highly engaged.

The researchers (13) _____ (understand) the concept of activation energy now. Right now, they (14) _____ (test) the effects of pressure on reaction rates. Last year, they (15) _____ (complete) a project on nanotechnology.

2.15 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Past and Present tenses.

Discovery and Impact of Plasma

A team of scientists (1) _____ (study) different states of matter every day in their lab. Today, they (2) _____ (experiment) with high-energy particles. Plasma was first identified in the laboratory by Sir William Crookes in 1879, who (3) _____ (call) it "radiant matter." While he (4) _____ (analyze) the results, he observed unique properties.

Systematic studies of plasma (5) _____ (begin) with the research of Irving Langmuir and his colleagues in the 1920s. At the moment, they (6) _____ (conduct) experiments to understand its characteristics. Yesterday, they (7) _____ (measure) the temperature and density of plasma. While they (8) _____ (work), Langmuir explained the significance of their findings.

The team always (9) _____ (wear) protective gear in the lab. Currently, they (10) _____ (prepare) a detailed report on their discovery. Last month, they (11) _____ (present) their research at a scientific symposium. While they (12) _____ (speak), the audience was fascinated.

Plasma (13) _____ (consist) of highly charged particles with extremely high energy. The researchers (14) _____ (investigate) its potential uses in various fields. They (15) _____ (discover) that plasma (16) _____ (have) applications in electronics, medicine, and space exploration. While they (17) _____ (study) these applications, they (18) _____ (find) new ways to utilize plasma.

The team (19) _____ (collaborate) with other scientists worldwide. They (20) _____ (share) their findings through publications and conferences. Plasma research (21) _____ (become) a global effort. The scientists (22) _____ (continue) to explore its properties and uses.

Currently, they (23) _____ (work) on improving plasma containment methods. They (24) _____ (develop) new technologies to harness its power. The future of plasma research (25) _____ (look) promising. The team (26) _____ (believe) that plasma (27) _____ (transform) many industries.

Plasma (28) _____ (play) a significant role in modern technology. Researchers (29) _____ (use) plasma in various applications, including plasma TVs and medical treatments. The discovery of plasma (30) _____ (impact) the field of chemistry profoundly.

2.16 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Past and Present tenses.

Discovery and Use of Aerogel

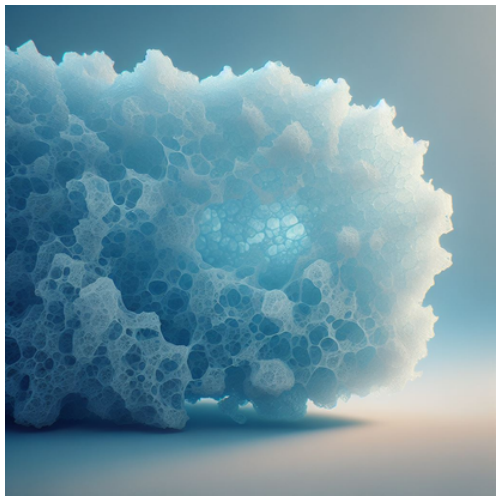
Aerogel was first created by Samuel Stephens Kistler in 1931, who (1) _____ (replace) the liquid in a gel with gas1. While he (2) _____ (analyze) the results, he observed unique properties. Systematic studies of aerogel (3) _____ (begin) with Kistler's research. At the moment, researchers (4) _____ (conduct) experiments to understand its characteristics. Yesterday, they (5) _____ (measure) the thermal conductivity of aerogel. While they (6) _____ (work), they noticed its excellent insulating properties.

The team always (7) _____ (wear) protective gear in the lab. Currently, they (8) _____ (prepare) a detailed report on their findings. Last month, they (9) _____ (present) their research at a scientific conference. While they (10) _____ (speak), the audience was fascinated.

Aerogel (11) _____ (consist) of a porous solid network with air pockets2. The researchers (12) _____ (investigate) its potential uses in various fields. They (13) _____ (discover) that aerogel (14) _____ (have) applications in electronics, medicine, and space exploration2. While they (15) _____ (study) these applications, they (16) _____ (find) new ways to utilize aerogel.

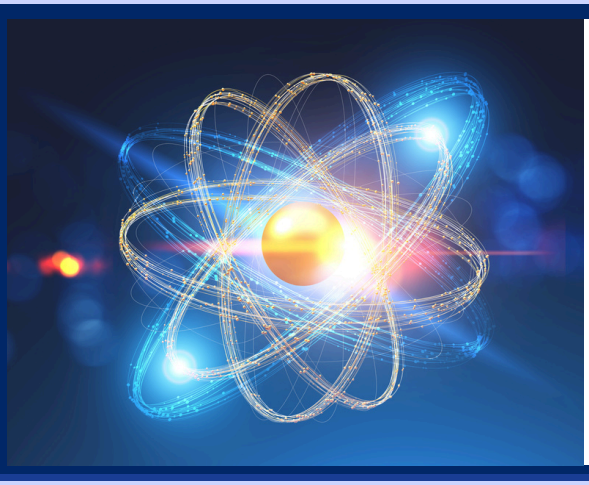
The team (17) _____ (collaborate) with other scientists worldwide. They (18) _____ (share) their findings through publications and conferences. Aerogel research (19) _____ (become) a global effort. The scientists (20) _____ (continue) to explore its properties and uses.

Currently, they (21) _____ (work) on improving aerogel production methods. They (22) _____ (develop) new technologies to harness its power. The future of aerogel research (23) _____ (look) promising. The team (24) _____ (believe) that aerogel (25) _____ (transform) many industries2.



Aerogel (26) _____ (play) a significant role in modern technology. Researchers (27) _____ (use) aerogel in various applications, including thermal insulation and medical treatments2. The discovery of aerogel (28) _____ (impact) the field of chemistry profoundly.

UNIT 3
Atoms and Molecules



Atoms and molecules are fundamental concepts in chemistry and physics, forming the basis of all matter in the universe.

Atoms are the smallest units of an element that retain the properties of that element. Each atom consists of a nucleus, containing protons and neutrons, surrounded by electrons in various energy levels or orbitals. Protons are positively charged, neutrons are neutral, and electrons are negatively charged. The number of protons in the nucleus, known as the atomic number, defines the element. For example, hydrogen has one proton, while carbon has six.

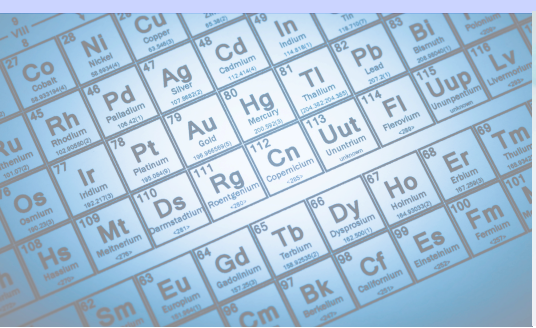
Atoms can exist independently or combine with other atoms to form molecules. The way atoms bond and interact with each other determines the properties of the resulting substances.

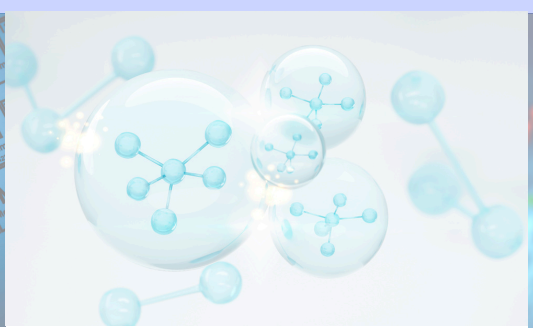
Molecules are groups of two or more atoms held together by chemical bonds. These bonds can be covalent, where atoms share electrons, or ionic, where electrons are transferred from one atom to another, resulting in oppositely charged ions that attract each other. Molecules can consist of atoms of the same element, like O_2 (oxygen gas), or different elements, like H_2O (water).

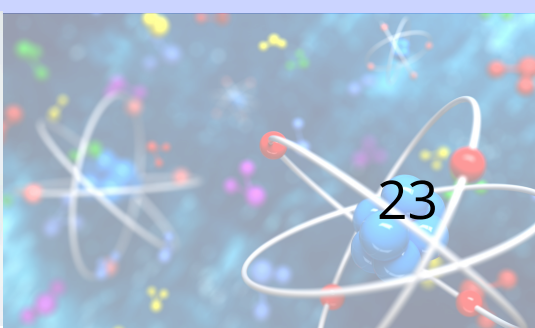
The arrangement and type of atoms in a molecule determine its chemical properties and behavior. For instance, the molecular structure of water, with its bent shape and polar covalent bonds, gives it unique properties like high surface tension and the ability to dissolve many substances.

Atoms and molecules are constantly in motion. In solids, atoms vibrate in fixed positions, while in liquids, they move more freely but remain close together. In gases, atoms and molecules move rapidly and are widely spaced.

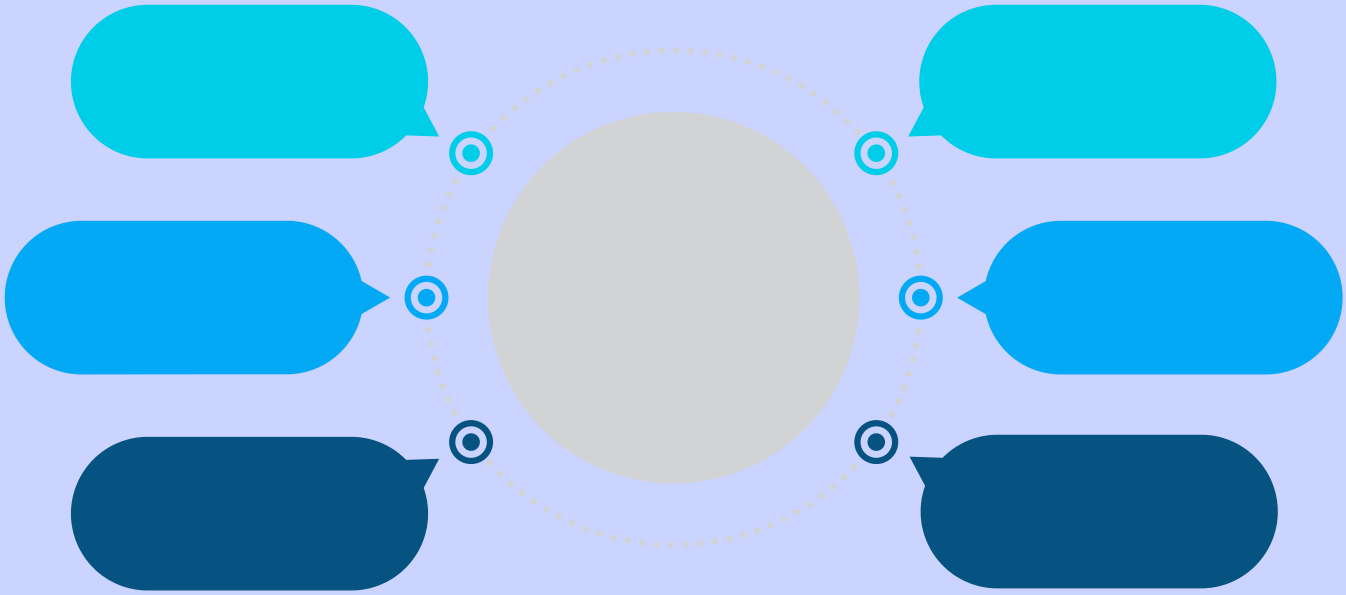
Understanding atoms and molecules is crucial for explaining chemical reactions, where bonds between atoms are broken and formed, resulting in new substances. This knowledge is applied in various fields, from developing new materials and medicines to understanding biological processes and environmental changes.







3.1 Read the text on the previous page and make a mind map.



3.2 Translate and define the words.

English	Translation	Definition
Atom		
Molecular Structure		
Nucleus		
Covalent Bond		
Ionic Bond		
Valence Electrons		
Chemical Reaction		
Compound		

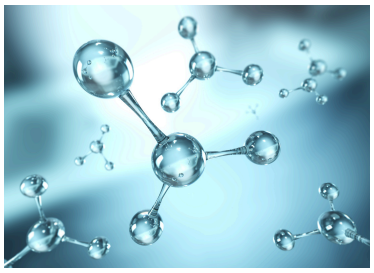
3.4 Match each term with its correct description and use the terms in the sentences.

Word bank:
atom, compound, electron, element, ion, isotope, molecule, neutron, nucleus, proton.

Sentences for Matching:

A. The positively charged particle found in the nucleus of an atom.
B. A substance made up of two or more different elements chemically bonded together.
C. The central part of an atom, containing protons and neutrons.
D. A negatively charged particle that orbits the nucleus of an atom.
E. A particle with no charge found in the nucleus of an atom.
F. A form of an element with the same number of protons but a different number of neutrons.
G. The smallest unit of a chemical element that retains its chemical properties.
H. A charged atom or molecule.
I. A pure substance consisting of only one type of atom.
J. Two or more atoms bonded together.

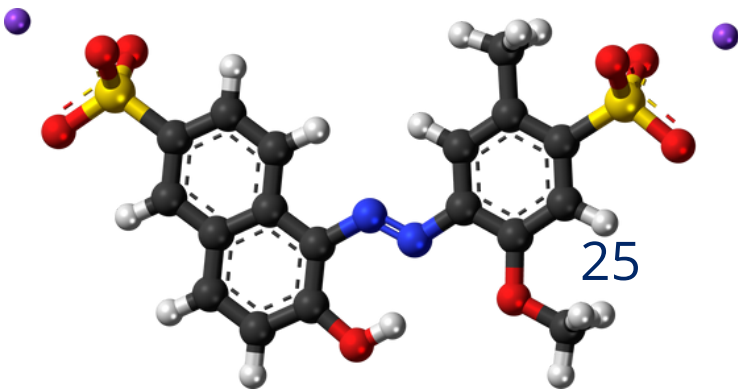
Usage in Sentences:



1. The ____ is the basic building block of matter.
2. Water is a ____ made up of hydrogen and oxygen atoms.
3. An ____ orbits the nucleus and has a negative charge.
4. The ____ is found in the nucleus and has a positive charge.
5. A ____ has no charge and is found in the nucleus.
6. The ____ is the center of an atom.
7. An ____ is a substance that cannot be broken down into simpler substances.
8. A ____ is formed when atoms of different elements bond together.
9. An ____ has the same number of protons but different numbers of neutrons.
10. An ____ is an atom or molecule with a net electric charge.

Now find these words in the word search puzzle:

E L E M E N T X P R O T O N
L N U C L E U S E L E C T R
E O I S O T O P E N E U T R
M L E C U L E I O N M O L E
E C O M P O U N D A T O M N
N E U T R O N E L E M E N T
T R O N P R O T O N I S O T



FUTURE TENSES

Future Simple

1.**Predictions:** Use the future simple tense to make predictions about the future.

- Example: Scientists will discover new elements in the next decade.
- Example: The experiment will yield significant results.

2. **Spontaneous Decisions**: Use the future simple tense for decisions made at the moment of speaking.

- Example: I will test the new chemical compound right now.
- Example: We will start the reaction immediately.

Adverbs that tyically occur with this tense are:

- Definitely: Scientists will definitely discover new elements.
- Probably: The experiment will probably yield significant results.
- Soon: We will start the reaction soon.
- Eventually: I will test the new chemical compound eventually.

Going to Future

1. **Plans and Intentions**: Use "going to" for plans or intentions that have already been decided.

- Example: We are going to conduct the experiment tomorrow.
- Example: She is going to analyze the samples next week.

2. **Evidence-Based Predictions**: Use "going to" for predictions based on current evidence.

1. Example: The solution is going to change color when we add the reagent.
2. Example: The reaction is going to produce heat.

Adverbs that tyically occur with this tense are:

1. Look! Watch out! Be careful!: Watch out, the reaction is going to explode.
2. Definitely: She is definitely going to analyze the samples next week.
3. Soon: The solution is soon going to change color when we add the reagent.
4. Clearly: The reaction is clearly going to produce heat.

Study tip

When writing academic papers in chemistry, use the future simple tense for predictions, with adverbs like "definitely" and "probably" (e.g., "Researchers will likely identify new catalysts"). Use "going to" future tense for planned experiments, with adverbs such as "certainly" and "soon" (e.g., "The team is going to investigate temperature effects next month"). This distinction enhances clarity and precision in your writing.

3.5 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Future Simple and Going to Future.

1. _____ (discover) new elements in the next decade.
2. The team _____ (analyze) the samples next week.
3. The experiment _____ (yield) significant results.
4. We _____ (conduct) the experiment tomorrow.
5. The solution _____ (change) color when we add the reagent.
6. Researchers _____ (identify) new catalysts soon.
7. She _____ (test) the new chemical compound right now.
8. The reaction _____ (produce) heat.
9. We _____ (start) the reaction immediately.
10. They _____ (investigate) the effects of temperature next month.
11. The compound _____ (exhibit) increased stability under acidic conditions.
12. Scientists _____ (likely find) a more efficient method.
13. I _____ (revise) our experimental protocol.
14. The new procedure _____ (reduce) the reaction time.
15. The lab _____ (implement) the new safety measures next week.

3.6 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Future Simple and Going to Future.

Dr. Smith is excited about the upcoming experiment. He (1) _____ (test) a new hypothesis. The team (2) _____ (conduct) the experiment tomorrow. They (3) _____ (use) advanced equipment to ensure accuracy. Dr. Smith believes the results (4) _____ (reveal) important data. The students (5) _____ (analyze) the samples next week. They (6) _____ (prepare) the lab today. The new procedure (7) _____ (reduce) the reaction time. Dr. Smith (8) _____ (present) the findings at the conference. The team (9) _____ (publish) their results in a journal. They (10) _____ (likely find) new insights. The experiment (11) _____ (start) at 9 AM. The solution (12) _____ (change) color during the reaction. They (13) _____ (record) all observations. The data (14) _____ (be) crucial for future research. The team (15) _____ (celebrate) their success.

3.7 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Future Simple and Going to Future.

The chemistry students are preparing for their final project. They (1) _____ (conduct) an experiment on chemical reactions. The project (2) _____ (start) next Monday. The students (3) _____ (use) various reagents to observe changes. They (4) _____ (record) their findings meticulously. The professor (5) _____ (evaluate) their work. The students (6) _____ (present) their results to the class. They (7) _____ (analyze) the data thoroughly. The experiment (8) _____ (reveal) interesting patterns. The students (9) _____ (write) a detailed report. They (10) _____ (submit) their report by the end of the week. The professor (11) _____ (provide) feedback. The students (12) _____ (improve) their techniques based on the feedback. They (13) _____ (celebrate) their success. The project (14) _____ (be) a significant part of their grade. The students (15) _____ (continue) their research in the next semester.

3.8 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Future Simple and Going to Future.

Sarah, a lab worker, is excited about her new project. She (1) _____ (prepare) the lab for a series of experiments. The project (2) _____ (begin) next week. Sarah (3) _____ (collect) samples from various sources. She (4) _____ (examine) the samples under a microscope. The results (5) _____ (help) her understand the chemical composition. Sarah (6) _____ (document) every step of the process. She (7) _____ (share) her findings with her team. The team (8) _____ (discuss) the implications of the results. They (9) _____ (plan) further experiments based on the initial findings. Sarah (10) _____ (write) a comprehensive report. The report (11) _____ (include) detailed observations and conclusions. The team (12) _____ (submit) the report to their supervisor. The supervisor (13) _____ (review) the report and provide feedback. Sarah (14) _____ (implement) the suggestions in the next phase of the project. The team (15) _____ (celebrate) their progress.

OTHER EXPRESSIONS FOR FUTURE

Present Simple for future

Rule: The present simple tense is used **for scheduled events or timetables.**

Examples:

1. The lab session starts at 9 AM on Monday.
2. The chemistry conference begins on the 5th of May.

Present Continuous for future

Rule: The present continuous tense is used **for planned or arranged events in the near future**.

Examples:

- We are conducting a titration experiment tomorrow.
- The professor is giving a lecture on organic chemistry next week.

GRAMMAR EXERCISES

3.9 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Future Simple, Going to Future, Present Simple and Present Continuous.

1._____ (conduct) a chromatography experiment next week.
2. The lab session _____ (start) at 8 AM tomorrow.
3. We _____ (analyze) the chemical samples this afternoon.
4. The professor _____ (give) a lecture on molecular structures next Monday.
5. The students _____ (submit) their reports by the end of the week.
6. The chemistry conference _____ (begin) on the 10th of June.
7. Sarah _____ (prepare) the reagents for the experiment tomorrow.
8. The results _____ (help) us understand the reaction mechanisms.
9. The team _____ (discuss) the findings in the meeting next Friday.
10. The lab technician _____ (calibrate) the equipment before the experiment.
11. The seminar on chemical bonding _____ (start) at 2 PM.
12. We _____ (document) every step of the synthesis process.
13. The students _____ (present) their research at the symposium next month.
14. The new research project _____ (begin) next semester.
15. The professor _____ (review) the experimental data next week.

3.10 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Future Simple, Going to Future, Present Simple and Present Continuous.

John, a chemistry researcher, is thrilled about his new experiment. He (1) _____ (organize) the lab equipment tomorrow afternoon. The experiment (2) _____ (start) next Tuesday. John (3) _____ (gather) materials from various suppliers over the weekend. On Thursday, he (4) _____ (analyze) the samples using advanced techniques. The findings (5) _____ (provide) insights into molecular structures. Each day, he (6) _____ (record) his observations carefully. Next Wednesday, he (7) _____ (present) his findings to his colleagues. The team (8) _____ (debate) the significance of the results during the meeting. They (9) _____ (design) new experiments based on the initial data. John (10) _____ (compile) a detailed report by the end of the month. The report (11) _____ (contain) comprehensive data and interpretations. The team (12) _____ (submit) the report to the head of the department next Tuesday. The head (13) _____ (examine) the report and give feedback. John (14) _____ (incorporate) the suggestions in the next phase of the experiment. The team (15) _____ (acknowledge) their achievements at the end of the semester.

3.11 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Future Simple, Going to Future, Present Simple and Present Continuous.

Tomorrow, our class (1) _____ (visit) the chemistry lab at 9 a.m. First, we (2) _____ (watch) a demonstration by Dr. Lee. He always (3) _____ (explain) new experiments on Thursdays. Later, we (4) _____ (wear) lab coats because we (5) _____ (work) with some reactive substances. After lunch, I (6) _____ (help) my lab partner with the experiment. We (7) _____ (mix) two unknown liquids, and we (8) _____ (see) what reaction happens. It sounds exciting! I think I (9) _____ (ask) Dr. Lee a lot of questions!

3.12 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Future Simple, Going to Future, Present Simple and Present Continuous.

Next Monday, I (1) _____ (give) a presentation about acids and bases. At 8:30 a.m., we (2) _____ (set up) the lab for the demonstration. The school bell (3) _____ (ring) at 9:00, and then the students (4) _____ (come) in. I (5) _____ (explain) how pH indicators work, and we (6) _____ (test) some household substances. My partner and I (7) _____ (wear) gloves and goggles, of course. I think the students (8) _____ (enjoy) it, and maybe someone (9) _____ (ask) a really interesting question!

TIME CLAUSES FOR FUTURE

1. Future time clauses are used to **describe actions that will happen in the future, often introduced by conjunctions** like "when," "as soon as," "before," "after," "until," and "while." The main clause uses the future tense, while the time clause uses the present simple.
Examples:
- When the experiment is completed, we will analyze the results.
- As soon as the new equipment arrives, we will start the synthesis process.

2. Future time clauses can also **indicate conditions that must be met** before another future action occurs. These clauses often use "if" or "unless."
Examples:
- If the chemical reaction is successful, we will proceed with further testing.
- Unless the samples are contaminated, we will publish the findings.

Present Perfect in Time Clauses for future

1. Use the present perfect to indicate that one **action will be completed before another future action begins**.
Examples:
- When we have finished the synthesis, we will test the new compound.
- After the researchers have analyzed the data, they will publish their findings.

2. Use the present perfect to show that a **condition must be met before a future action can occur**.
Examples:
- As soon as the lab has received the new reagents, we will start the experiment.
- Until the team has completed the preliminary tests, they will not proceed with the main experiment.

GRAMMAR EXERCISES

3.13 Complete the sentences by filling in the blanks with the correct form of the verb in brackets to form time clauses.

1. We'll start the experiment as soon as the teacher _____ (arrive).
2. I'll record the results after the reaction _____ (finish).
3. She won't touch the beaker until it _____ (cool) down.
4. When the acid _____ (react) with the metal, we'll observe hydrogen gas.
5. We'll clean the lab before the next class _____ (begin).
6. They won't add the base until the solution _____ (turn) blue.
7. The students will leave the lab when the supervisor _____ (check) their stations.
8. He'll submit his lab report after he _____ (analyze) the data.

3.14 Complete the sentences by filling in the blanks with the correct form of the verb in brackets to form time clauses for future.

1. We _____ (start) the reaction as soon as the solution _____ (reach) 100°C.
2. The teacher _____ (explain) the procedure before the students _____ (enter) the lab.
3. I _____ (not pour) the acid until I _____ (put on) my safety goggles.
4. When the experiment _____ (be) complete, we _____ (clean) our equipment.
5. The pH _____ (change) after the base _____ (neutralize) the acid.
6. She _____ (label) all the test tubes once she _____ (measure) the liquids.
7. We _____ (mix) the chemicals after the Bunsen burner _____ (go out).
8. They _____ (not record) the temperature until the thermometer _____ (stabilize).
9. When the crystals _____ (form), we _____ (observe) them under a microscope.
10. I _____ (start) my report as soon as we _____ (finish) the titration.
11. We _____ (compare) our results after everyone _____ (submit) their data.
12. The teacher _____ (not approve) the experiment until she _____ (check) the safety checklist.
13. Once the indicator _____ (change) color, we _____ (stop) adding the reagent.
14. The students _____ (begin) the lab write-up when the demonstration _____ (end).
15. He _____ (not open) the container until the pressure _____ (decrease).
16. The experiment _____ (begin) as soon as the chemicals _____ (arrive).
17. We _____ (measure) the temperature after the reaction _____ (start).
18. The lab assistant _____ (not give) us the results until everyone _____ (finish) the experiment.
19. I _____ (add) the acid once I _____ (check) the pH level.
20. The students _____ (observe) the reaction when the solution _____ (turn) green.
21. The teacher _____ (not allow) us to mix the chemicals until we _____ (read) the safety instructions.
22. We _____ (add) the indicator after the solution _____ (be) neutralized.
23. I _____ (not open) the bottle until the label _____ (be) checked.
24. They _____ (compare) their results once they _____ (finish) the calculations.
25. The students _____ (leave) the lab when the supervisor _____ (sign) their work.
26. I _____ (wear) gloves before I _____ (handle) the chemicals.
27. The class _____ (start) the titration once the solution _____ (reach) the correct concentration.
28. Once the experiment _____ (be) completed, we _____ (clean) the equipment.
29. The supervisor _____ (check) our results before we _____ (leave) the lab.
30. We _____ (finish) the procedure as soon as the test tube _____ (cool) down.

3.15 Complete the sentences by filling in the blanks with the correct form of the verb in brackets.

1. The class _____ (start) at 9:00 tomorrow morning.
2. We _____ (do) the experiment in the chemistry lab next week.
3. The teacher _____ (explain) the new concept at the beginning of the lesson.
4. I _____ (mix) the chemicals as soon as the supervisor _____ (arrive).
5. Our lab assistant _____ (help) us with the procedure this afternoon.
6. We _____ (measure) the pH level after the reaction _____ (finish).
7. I _____ (bring) my notebook tomorrow to write down the results.
8. They _____ (not open) the container until the pressure _____ (decrease).
9. As soon as the reaction _____ (begin), we _____ (observe) the color change.
10. The experiment _____ (take) about 45 minutes to complete.
11. I _____ (not leave) the lab until I _____ (finish) my experiment.
12. We _____ (observe) the results carefully when the chemical _____ (react) with the base.
13. Our professor _____ (give) us the results after everyone _____ (complete) the lab.
14. We _____ (wait) for the chemical to cool down before we _____ (add) more substances.
15. The laboratory _____ (close) at 6:00 p.m., so we _____ (need) to finish before then.

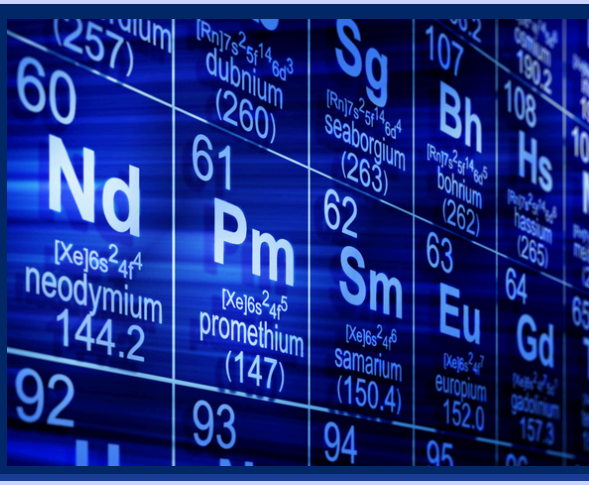
3.16 Complete the sentences by filling in the blanks with the correct form of the verb in brackets.

Tomorrow, our class (1) _____ (start) an exciting experiment in the chemistry lab. The teacher (2) _____ (explain) the procedure before we (3) _____ (begin) the experiment. I (4) _____ (work) with my partner, Sarah, who (5) _____ (be) really good at conducting experiments. We (6) _____ (have) all the materials ready, and we (7) _____ (measure) the substances right after the teacher (8) _____ (give) us the go-ahead. We (9) _____ (use) a new chemical solution, so I'm excited to see the results. Once we (10) _____ (combine) the liquids, we (11) _____ (observe) any color changes. I think the reaction (12) _____ (be) fascinating!

At 10:30, we (13) _____ (take) a short break, and after that, we (14) _____ (continue) with the second phase of the experiment. Sarah (15) _____ (write) down all the observations, while I (16) _____ (analyze) the data. We (17) _____ (finish) our experiment by noon, and then we (18) _____ (clean) up the lab before the next class (19) _____ (start). Afterward, I (20) _____ (submit) our results to the teacher, and I (21) _____ (ask) her about the next steps. I (22) _____ (be) sure that we (23) _____ (get) great results!

UNIT 4

The Periodic Table



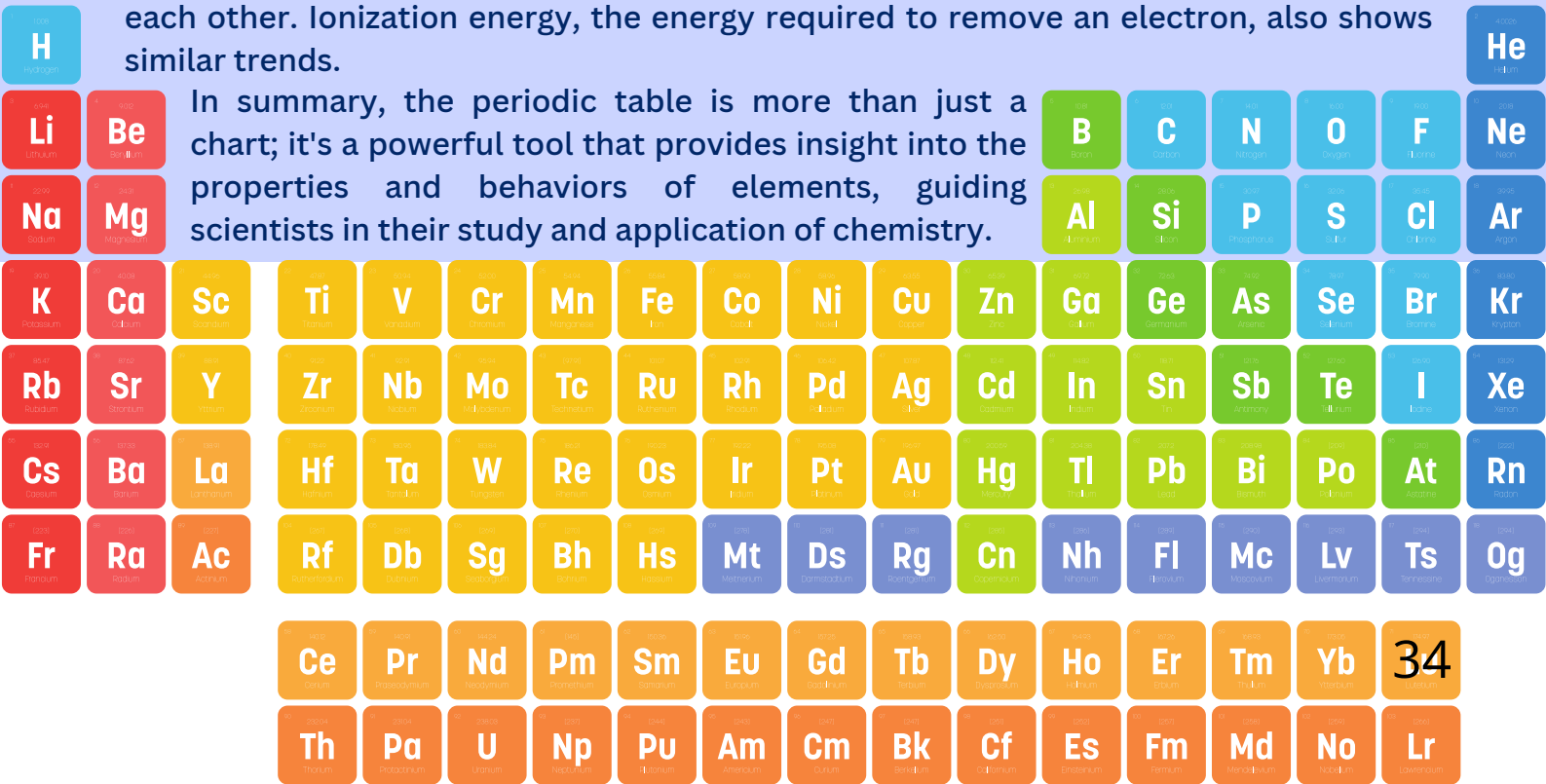
The periodic table is a fundamental tool in chemistry, organizing elements based on their atomic number, electron configurations, and chemical properties. Dmitri Mendeleev created the first version in 1869, arranging elements by increasing atomic mass and noting recurring properties.

In the modern periodic table, elements are ordered by atomic number, revealing periodic trends. Rows are called periods, and columns are groups or families. Each period corresponds to the filling of an electron shell, while groups contain elements with similar chemical behaviors due to their valence electrons.

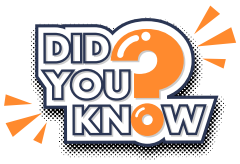
Groups are numbered 1 to 18. For example, Group 1 includes alkali metals like lithium and sodium, which are highly reactive with one valence electron. Group 17 contains halogens like fluorine and chlorine, which are reactive with seven valence electrons. Group 18 has noble gases like helium and neon, which are inert with full valence shells. Special blocks include transition metals (groups 3-12), known for various oxidation states, and the lanthanides and actinides, often shown separately, important in high-tech applications.

The periodic table helps predict element behavior in reactions, showing trends like electronegativity, ionization energy, and atomic radius. Electronegativity tends to increase across a period and decrease down a group, influencing how atoms bond with each other. Ionization energy, the energy required to remove an electron, also shows similar trends.

In summary, the periodic table is more than just a chart; it's a powerful tool that provides insight into the properties and behaviors of elements, guiding scientists in their study and application of chemistry.



4.1 Use the Internet and answer the questions.



Fun Facts About The Periodic Table

1. Which element is named after a planet?

Hint: This element is named after the Roman god of the underworld, who also has a planet named after him.

2. What is the only metal that is liquid at room temperature?

Hint: This element is often used in thermometers.

3. Which element has the highest melting point?

Hint: This element is used in light bulb filaments and has the symbol 'W'.

4. Which element is essential for life and is found in all organic compounds?

Hint: This element is the basis of organic chemistry and has the symbol 'C'.

5. Which element is named after the scientist who discovered radioactivity?

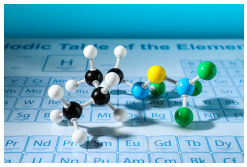
Hint: This element has the symbol 'Cm'.

7. What is the most abundant element in the Earth's crust?

Hint: This element is used to make glass and has the symbol 'Si'.

8. Which element is known as the "King of Chemicals" due to its widespread use in industry?

Hint: This element is used to make sulfuric acid and has the symbol 'S'.



4.2 Match the following definitions with the correct technical word from the list.

Words	Definitions
1. Atomic Number 2. Valence Electrons 3. Period 4. Group 5. Transition Metals 6. Lanthanides 7. Actinides 8. Electronegativity 9. Ionization Energy 10. Noble Gases	A. The energy required to remove an electron from an atom. B. Elements in the same vertical column of the periodic table, sharing similar chemical properties. C. The number of protons in the nucleus of an atom, determining the element's identity. D. Elements in the same horizontal row of the periodic table, indicating the filling of an electron shell. E. Elements found in groups 3-12, known for their ability to form various oxidation states. F. Elements with a full valence shell, making them inert and non-reactive. G. Elements often displayed separately at the bottom of the periodic table, important in high-tech applications. H. The measure of an atom's ability to attract and hold electrons. I. Electrons in the outermost shell of an atom, determining its chemical reactivity. J. Elements often displayed separately at the bottom of the periodic table, known for their radioactive properties.

4.3 Guess the word of phrase the definition describes.

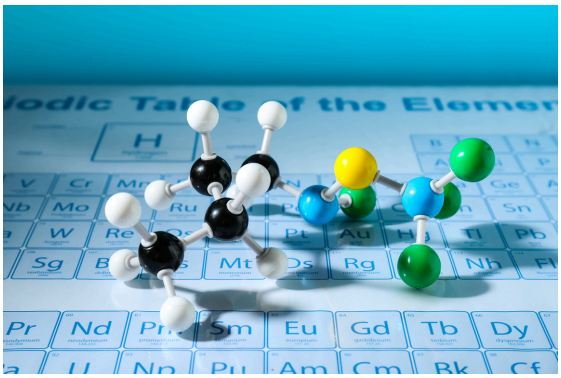
1. The smallest unit of a chemical element, consisting of a nucleus and electrons.
   - A_ _ _
2. A horizontal row in the periodic table, indicating the filling of an electron shell.
   - P_ _ _ _ _
3. A vertical column in the periodic table, where elements share similar properties.
   - G_ _ _ _
4. The measure of an atom's ability to attract and hold electrons.
   - E_ _ _ _ _ _ _ _ _ _ _ _ _
5. Elements found in groups 3-12, known for their ability to form various oxidation states.
   - T_ _ _ _ _ _ _ _ _ _ M_ _ _ _ _
6. Elements often displayed separately at the bottom of the periodic table, known for their radioactive properties.
   - A_ _ _ _ _ _ _ _
7. The energy required to remove an electron from an atom.
   - I_ _ _ _ _ _ _ _ E_ _ _ _ _
8. Electrons in the outermost shell of an atom, determining its chemical reactivity.
   - V_ _ _ _ _ _ E_ _ _ _ _ _ _ _
9. Elements with a full valence shell, making them inert and non-reactive.
   - N_ _ _ _ _ G_ _ _ _
10. Elements often displayed separately at the bottom of the
11. periodic table, important in high-tech applications.
    - L_ _ _ _ _ _ _ _ _ _

4.4 Match each element with its correct property or use.

Element	Property or use
1. Helium (He) 2. Iron (Fe) 3. Carbon (C) 4. Uranium (U) 5. Neon (Ne) 6. Gold (Au) 7. Oxygen (O) 8. Silicon (Si) 9. Chlorine (Cl) 10. Aluminum (Al)	A. Used in nuclear reactors and weapons due to its radioactive properties. B. Essential for respiration in most living organisms. C. Known for its use in computer chips and electronics. D. A noble gas used in neon signs. E. A precious metal used in jewelry and electronics. F. A lightweight metal used in aircraft and packaging. G. A non-metal essential for organic life, found in all living organisms. H. A gas used to fill balloons and airships because it is lighter than air. I. A metal used in construction and manufacturing, known for its strength. J. A disinfectant used in swimming pools and drinking water.

4.5 Complete the sentences with the correct element.

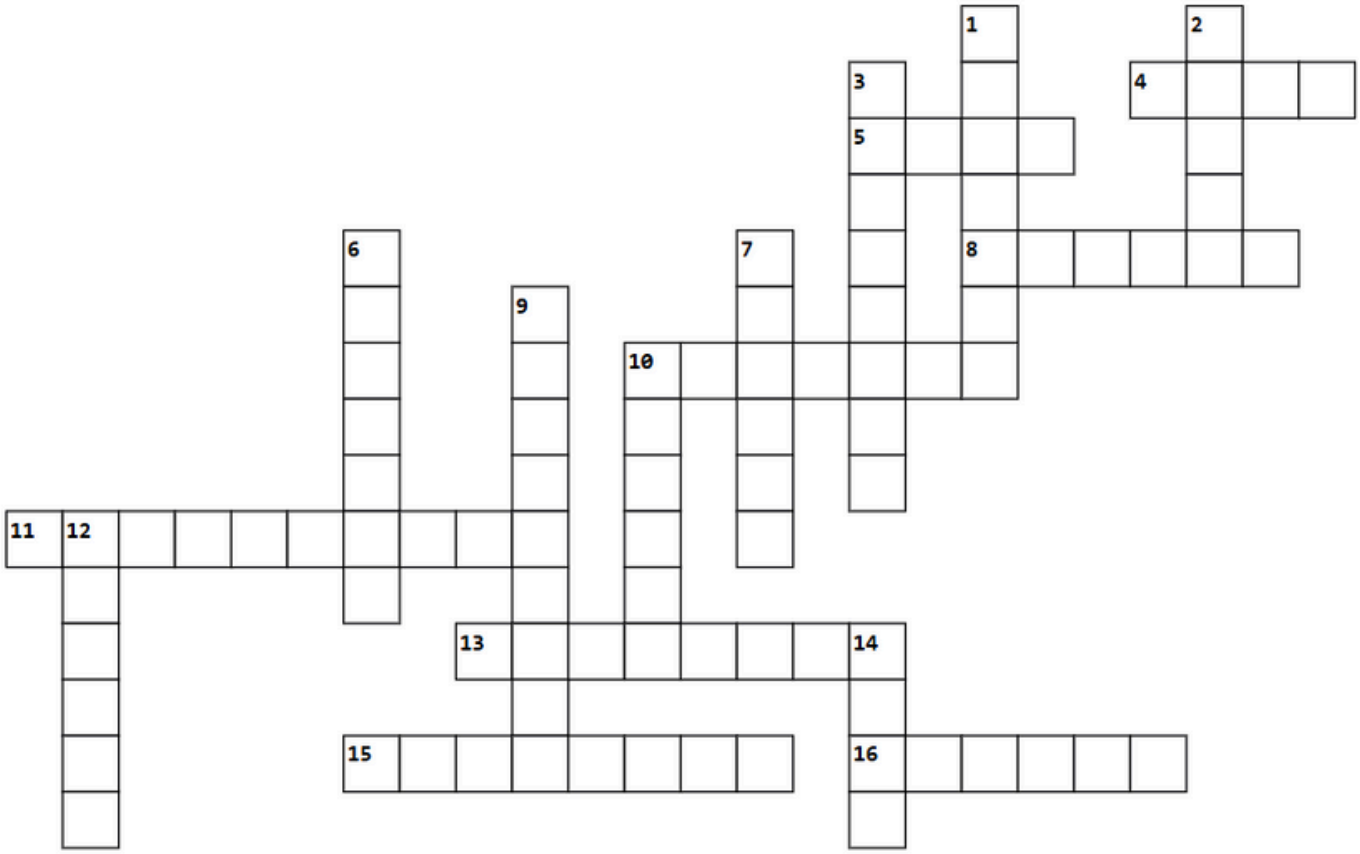
1. _____ is an alkali metal that reacts vigorously with water.
2. _____ is a heavy metal that was once commonly used in pipes and paints.
3. _____ is an essential nutrient for plant growth and is found in fertilizers.
4. _____ is a key component of bones and teeth.
5. _____ is used to galvanize steel to prevent rusting.
6. _____ is added to drinking water to help prevent tooth decay.
7. _____ is a lightweight metal used in aircraft and car parts.
8. _____ is essential for thyroid function and is added to table salt.
9. _____ is a good conductor of electricity and is used in wiring.
10. _____ is a precious metal used in jewelry and silverware.



4.6 Determine whether each statement is true or false and correct the false statements.

1. Hydrogen is the most abundant element in the universe. True or False?
2. Gold is a transition metal. True or False?
3. Helium is heavier than air. True or False?
4. Mercury is the only metal that is liquid at room temperature. True or False?
5. Carbon is found in all organic compounds. True or False?
6. Neon is used in neon signs because it is highly reactive. True or False?
7. Iron is essential for the production of hemoglobin in blood. True or False?
8. Silicon is used to make glass. True or False?
9. Chlorine is a noble gas. True or False?
10. Uranium is used in nuclear reactors. True or False?

4.7 Complete the sentences with the correct element.



Across:	Down:
4. A precious metal used in jewelry and electronics. (4 letters) 5. A heavy metal that was once commonly used in pipes and paints. (4 letters) 8. Essential for thyroid function and is added to table salt. (6 letters) 10. A key component of bones and teeth. (7 letters) 11. Essential for energy transfer in cells. (10 letters) 13. Makes up about 78% of the Earth's atmosphere. (8 letters) 15. A lightweight metal used in aircraft and car parts. (9 letters) 16. Essential for respiration in most living organisms. (6 letters)	1. Used in nuclear reactors and weapons due to its radioactive properties. (8 letters) 2. Used in glass and ceramics to improve durability. (5 letters) 3. Added to drinking water to help prevent tooth decay. (8 letters) 6. Used to make computer chips and electronics. (7 letters) 7. Known as the "King of Chemicals," used to make sulfuric acid. (6 letters) 9. An essential nutrient for plant growth and is found in fertilizers. (10 letters) 10. A good conductor of electricity and is used in wiring. (6 letters) 12. A gas used to fill balloons and airships because it is lighter than air. (6 letters) 14. A noble gas used in neon signs. (4 letters)

PRESENT PERFECT

The Present Perfect tense is used to describe actions or events that have occurred at an unspecified time before now. The exact time is not important.

Rules for Present Perfect Tense:

1. **To describe an action that happened at an unspecified time in the past**:
   - Example: Scientists have discovered new elements in the periodic table.
   - Example: Researchers have developed a new method for synthesizing compounds.
2. **To describe an action that started in the past and continues up to the present**:
   - Example: Chemists have been studying the properties of graphene for years.
   - Example: The laboratory has maintained its high standards of safety since its establishment.
3. **To describe a repeated action that has occurred several times before now**:
   - Example: The team has conducted multiple experiments to test the hypothesis.
   - Example: They have analyzed the samples several times to ensure accuracy.
4. **To describe an action that has a present result or relevance**:
   - Example: The discovery of penicillin has revolutionized medicine.
   - Example: The new catalyst has increased the efficiency of the reaction.

In academic writing the Present Perfect tense may be used in the following examples related to Chemistry:

1. **Unspecified Time in the Past**:
   - Scientists have discovered new elements in the periodic table.
   - Researchers have developed a new method for synthesizing compounds.
2. **Action Continuing Up to the Present**:
   - Chemists have been studying the properties of graphene for years.
   - The laboratory has maintained its high standards of safety since its establishment.
3. **Repeated Action**:
   - The team has conducted multiple experiments to test the hypothesis.
   - They have analyzed the samples several times to ensure accuracy.
4. **Present Result or Relevance**:
   - The discovery of penicillin has revolutionized medicine.
   - The new catalyst has increased the efficiency of the reaction.

Present Perfect Continuous

The Present Perfect Continuous tense is used to describe actions that started in the past and are still continuing or have recently stopped but have a present relevance.

PRESENT PERFECT

Rules for Present Perfect Continuous Tense:

1. **To describe an action that started in the past and is still continuing**:
   - Example: Scientists have been researching the effects of climate change on chemical reactions.
   - Example: The team has been analyzing the data from the latest experiments for weeks.
2. **To describe an action that has recently stopped but has a present relevance:**
   - Example 1: Researchers have been working on developing a new polymer, and they just presented their findings.
   - Example 2: Chemists have been studying the reaction mechanisms, and their results are now published.

Key Differences between the Present Perfect Simple and Continuous tense:

- **Result vs. Duration**: Present Perfect Simple focuses on the result, while Present Perfect Continuous focuses on the duration.
- **Completion vs. Continuation**: Present Perfect Simple is used for completed actions, while Present Perfect Continuous is used for actions that are still continuing or have recently stopped.
- **Specific vs. Ongoing**: Present Perfect Simple can indicate specific instances (how many times), while Present Perfect Continuous emphasizes ongoing or repeated actions.

GRAMMAR EXERCISES

4.8 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Present Perfect and Present Perfect Continuous.

1. _____ (discover) a new element in the periodic table.
2. The researchers _____ (analyze) the chemical composition for hours.
3. The laboratory _____ (publish) several papers on nanotechnology this year.
4. Chemists _____ (study) the reaction mechanisms since last month.
5. The team _____ (complete) the synthesis of the new compound.
6. Scientists _____ (work) on improving the efficiency of solar cells.
7. The experiment _____ (yield) promising results so far.
8. Researchers _____ (investigate) the properties of graphene for years.
9. The professor _____ (teach) organic chemistry at the university for over a decade.

♟ 4.9 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Present Perfect and Present Perfect Continuous.

This week, our chemistry class has been working on a project about reaction rates.

We (1) _____ (study) how temperature affects chemical reactions. Our team (2) _____ (conduct) multiple experiments since Monday. I (3) _____ (take) detailed notes every day. Sarah and Liam (4) _____ (measure) the temperature changes using a digital thermometer. We (5) _____ (already / complete) three out of five planned trials. The solutions (6) _____ (change) color more quickly at higher temperatures.

We (7) _____ (observe) this pattern since the beginning. Our teacher (8) _____ (check) our results regularly to make sure everything is accurate.

Some groups (9) _____ (not / get) consistent results, so they are repeating their tests.

We (10) _____ (also / use) different catalysts to see how they influence the speed of reaction. I (11) _____ (never / see) such a strong reaction before!

Liam (12) _____ (analyze) the data for over two hours now. We (13) _____ (just / print) the graphs for our lab report. The whole class (14) _____ (work) really hard on this project.

Hopefully, we (15) _____ (achieve) accurate and reliable results by the end of the week.

♟ 4.10 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Present Perfect and Present Perfect Continuous.

For the past few weeks, our chemistry club (1) _____ (work) on a project about biodegradable plastics.

We (2) _____ (try) different natural materials to create eco-friendly polymers.

So far, we (3) _____ (test) starch, gelatin, and even banana peels!

Our team leader, Maya, (4) _____ (gather) results from each trial.

She (5) _____ (already / create) a chart showing all the reaction times.

Some of the mixtures (6) _____ (not / harden) properly, so we had to modify the process.

I (7) _____ (focus) on measuring the elasticity of each sample.

Meanwhile, Lucas (8) _____ (monitor) the pH levels of the solutions all morning.

We (9) _____ (find) that acidic environments slow down the polymerization.

Our samples (10) _____ (sit) in the drying oven for over six hours now.

We (11) _____ (just / check) the consistency of the latest batch.

The results (12) _____ (improve) gradually with each experiment.

Everyone (13) _____ (put) a lot of effort into making this work.

The science teacher (14) _____ (be) impressed with our creativity so far.

By next week, we hope we will have developed a working prototype.

4.11 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Present Perfect and Present Perfect Continuous.

Our science class (1) _____ (investigate) different methods of water purification. Over the last two weeks, we (2) _____ (test) filters made from sand, charcoal, and cotton. I (3) _____ (record) the clarity levels of the water before and after each test. Some students (4) _____ (research) how chemical treatments like chlorine affect bacteria. So far, we (5) _____ (discover) that charcoal filters are the most effective. Several groups (6) _____ (struggle) with clogged filters during their trials. We (7) _____ (collect) samples from different sources, including tap, pond, and rainwater. The teacher (8) _____ (warn) us not to touch untreated samples without gloves. I (9) _____ (never / see) such murky water before we started! Emma and Raj (10) _____ (analyze) the bacterial content under a microscope for over an hour. We (11) _____ (just / finish) preparing our final water quality reports. Some teams (12) _____ (compare) the results with professional purification tablets. We (13) _____ (learn) a lot about real-world chemistry applications. Our results (14) _____ (improve) since we began using multiple filtration stages. By the end of the month, we hope we will have designed a simple and affordable filter model.

4.12 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Present Perfect and Present Perfect Continuous.

Dr. Smith and her team of chemists _____ (1) _____ (work) on a groundbreaking project for the past two years. They _____ (2) _____ (focus) on developing a new type of biodegradable plastic. This plastic _____ (3) _____ (show) promising results in preliminary tests. Recently, the team _____ (4) _____ (discover) a new catalyst that speeds up the degradation process. They _____ (5) _____ (test) this catalyst in various conditions to ensure its effectiveness. So far, the results _____ (6) _____ (be) very encouraging. Dr. Smith _____ (7) _____ (present) their findings at several international conferences. The scientific community _____ (8) _____ (express) great interest in their work. Many researchers _____ (9) _____ (reach out) to collaborate on further studies. The team _____ (10) _____ (collect) data from different experiments to analyze the environmental impact of the new plastic. They _____ (11) _____ (find) that it breaks down much faster than traditional plastics. This discovery _____ (12) _____ (have) a significant impact on reducing plastic waste. In addition to their research, the team _____ (13) _____ (conduct) workshops to educate the public about the benefits of biodegradable plastics. They _____ (14) _____ (receive) positive feedback from participants. Dr. Smith _____ (15) _____ (hope) that their work will lead to a cleaner and more sustainable future.

UNIT 5

Laboratory Equipment

Laboratory equipment has evolved significantly over the centuries, reflecting advancements in science and technology. Early laboratories, dating back to the alchemists of the Middle Ages, were rudimentary and often consisted of basic tools like crucibles, mortars and pestles, and simple furnaces. These early scientists sought to transform base metals into gold and discover the elixir of life, laying the groundwork for modern chemistry.

The 17th and 18th centuries saw the rise of more sophisticated equipment with the advent of the scientific revolution. Pioneers like Robert Boyle and Antoine Lavoisier introduced the use of precise balances, glassware such as flasks and beakers, and early forms of the Bunsen burner. These tools allowed for more controlled and repeatable experiments, leading to significant discoveries in chemistry and physics.

The 19th and 20th centuries brought further advancements with the development of specialized instruments like spectrometers, microscopes, and centrifuges. These innovations enabled scientists to explore the atomic and molecular levels of matter, revolutionizing fields such as biochemistry and molecular biology. Today, modern laboratories are equipped with highly advanced technology. Automated systems, high-performance liquid chromatography (HPLC), nuclear magnetic resonance (NMR) spectrometers, and mass spectrometers are standard in many labs. Computers and software play a crucial role in data analysis and experimental design, enhancing accuracy and efficiency.

Safety has also become a paramount concern, with modern labs featuring fume hoods, safety showers, and personal protective equipment (PPE) to protect researchers. The integration of digital technology and robotics has further transformed laboratories, enabling high-throughput screening and real-time data collection.

5.1 Match each piece of lab equipment with its correct description. Then, use each term in a sentence to demonstrate your understanding.

Lab equipment	Definition
1. Beaker 2. Erlenmeyer Flask 3. Bunsen Burner 4. Graduated Cylinder 5. Pipette 6. Test Tube 7. Crucible 8. Mortar and Pestle 9. Volumetric Flask 10. Watch Glass	A. A container used for heating substances, typically made of porcelain. B. A narrow, cylindrical container used to measure precise volumes of liquids. C. A flat, circular piece of glass used to hold small amounts of substances. D. A piece of equipment used to transfer small amounts of liquid accurately. E. A container with a wide mouth and flat bottom, used for mixing and heating liquids. F. A piece of equipment used to grind solid substances into powder. G. A container with a narrow neck and flat bottom, used for mixing and heating liquids. H. A small, cylindrical container used to hold small amounts of liquid for experiments. I. A piece of equipment used to heat substances using a gas flame. J. A container used to prepare solutions with precise volumes.

Use each term in a sentence to demonstrate your understanding.

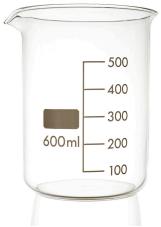
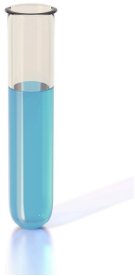
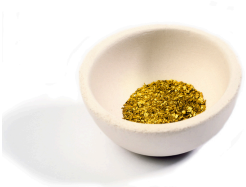
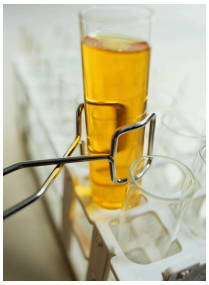
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____



5.2 Match the words from the word bank with pictures and translate them.

Word bank:

balance, beaker, bunsen burner, burette, clamp, crucible, erlenmeyer flask, funnel, graduated cylinder, mortar and pestle, pipette, stirring rod, test tube, thermometer, volumetric flask, watch glass

1 	2 	3 	4 
5 	6 	7 	8 
9 	10 	11 	12 
13 	14 	15 	16 

5.3 Describe the lab and the equipment in the picture.

The lab in the picture has _____

PAST PERFECT

The past perfect tense is used to describe actions that were completed before another action in the past.

Rules for Past Perfect Tense

1. **To indicate an action that was completed before another action in the past**:
   - Example: The scientist had completed the experiment before the lab assistant arrived.
   - Example: By the time the professor entered the lab, the students had already prepared the solutions.
2. **To show an action that happened before a specific time in the past**:
   - Example: The chemist had analyzed the samples by 5 PM yesterday.
   - Example: The research team had finished the synthesis process before the deadline last week.
3. **To express a condition in the past that led to a result**:
   - Example: The reaction had stopped because the temperature had dropped too low.
   - Example: The experiment had failed because the chemicals had not been mixed properly.
4. **To describe an action that was completed before another action in a narrative**:
   - Example: After the technician had calibrated the equipment, the experiment proceeded smoothly.
   - Example: Once the scientist had recorded the data, she began analyzing the results.

GRAMMAR EXERCISES

5.4 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Past Perfect and Past Simple.

1. After the chemist _____ (analyze) the data, she _____ (write) the report.
2. The reaction _____ (stop) because the scientist _____ (turn off) the Bunsen burner.
3. By the time the lab assistant _____ (arrive), the experiment _____ (already start).
4. The professor _____ (explain) the procedure after the students _____ (complete) the experiment.
5. Once the technician _____ (calibrate) the equipment, the experiment _____ (proceed) smoothly.

5.5 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Past Perfect and Past Simple.

1. The research team _____ (finish) the synthesis before the deadline _____ (pass).
2. The solution _____ (change) color after the reagent _____ (add).
3. The students _____ (clean) the lab after they _____ (conduct) the experiment.
4. The scientist _____ (record) the results before she _____ (leave) the lab.
5. The experiment _____ (fail) because the chemicals _____ (not mix) properly.
6. The scientist _____ (discover) the error after she _____ (conduct) the experiment.
7. The lab assistant _____ (prepare) the samples before the professor _____ (arrive).
8. By the time the technician _____ (fix) the equipment, the experiment _____ (already begin).
9. The chemist _____ (measure) the pH level after the solution _____ (cool).
10. Once the students _____ (complete) the experiment, they _____ (write) their observations.
11. The reaction _____ (occur) because the chemicals _____ (mix) correctly.
12. The professor _____ (teach) the concept after the students _____ (perform) the experiment.
13. The solution _____ (evaporate) after the scientist _____ (heat) it.
14. The research team _____ (analyze) the data before they _____ (publish) their findings.
15. The experiment _____ (succeed) because the technician _____ (follow) the instructions precisely.
16. The chemist _____ (discover) the error after she _____ (conduct) the experiment.
17. The lab assistant _____ (prepare) the samples before the professor _____ (arrive).
18. By the time the technician _____ (fix) the equipment, the experiment _____ (already begin).
19. The scientist _____ (measure) the pH level after the solution _____ (cool).
20. Once the students _____ (complete) the experiment, they _____ (write) their observations.
21. The reaction _____ (occur) because the chemicals _____ (mix) correctly.
22. The professor _____ (teach) the concept after the students _____ (perform) the experiment.
23. The solution _____ (evaporate) after the scientist _____ (heat) it.

5.6 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Past Perfect and Past Simple.

Dr. Smith was excited about the new experiment. She (1) _____ (plan) it for weeks and finally, the day had come. Before starting, she (2) _____ (ensure) that all the equipment was ready. The lab assistant (3) _____ (arrive) early and (4) _____ (set up) the apparatus.

Once everything was in place, Dr. Smith (5) _____ (begin) the experiment. She (6) _____ (mix) the chemicals carefully, following the procedure she (7) _____ (design). After she (8) _____ (add) the final reagent, she (9) _____ (observe) a color change, indicating that the reaction (10) _____ (occur).

However, halfway through the experiment, the temperature (11) _____ (drop) unexpectedly. Dr. Smith (12) _____ (realize) that the thermostat (13) _____ (malfunction). She quickly (14) _____ (adjust) the settings and (15) _____ (continue) with the experiment.

By the end of the day, Dr. Smith (16) _____ (collect) all the data she needed. She (17) _____ (analyze) the results and (18) _____ (find) that the experiment (19) _____ (succeed). The team (20) _____ (celebrate) their achievement, knowing that their hard work (21) _____ (pay off).

5.7 Complete the story by filling in the blanks with the correct form of the verb in brackets. Use only Past Perfect and Past Simple.

ChemTech Innovations was preparing for a major product launch. The team (1) _____ (develop) the new chemical compound for months and finally, the day had come. Before the launch, they (2) _____ (ensure) that all the marketing materials were ready. The CEO (3) _____ (arrive) early and (4) _____ (review) the final preparations.

Once everything was in place, the team (5) _____ (begin) the presentation. They (6) _____ (explain) the benefits of the new compound, following the strategy they (7) _____ (design). After they (8) _____ (present) the product, they (9) _____ (observe) positive reactions from the audience, indicating that the launch (10) _____ (succeed).

However, halfway through the event, the projector (11) _____ (fail) unexpectedly. The IT specialist (12) _____ (realize) that the software (13) _____ (crash). He quickly (14) _____ (fix) the issue and (15) _____ (continue) with the presentation.

By the end of the day, the team (16) _____ (collect) all the feedback they needed. They (17) _____ (analyze) the responses and (18) _____ (find) that the product (19) _____ (be well received). The company (20) _____ (celebrate) their success, knowing that their hard work (21) _____ (pay off).

UNIT 6

Organic Chemistry

Organic chemistry is a branch of chemistry that focuses on the study of carbon-containing compounds. This field is vast and encompasses a wide range of substances, including those found in living organisms and synthetic materials. Carbon's unique ability to form stable bonds with other elements, particularly hydrogen, oxygen, nitrogen, and other carbon atoms, allows for the creation of an immense variety of compounds.

One of the fundamental concepts in organic chemistry is the structure of molecules. Organic chemists study how atoms are arranged in space and how this arrangement affects the properties and reactivity of the molecules. This includes understanding functional groups, which are specific groupings of atoms within molecules that have characteristic properties and reactions.

Organic chemistry plays a crucial role in many industries. For example, in pharmaceuticals, organic chemists design and synthesize new drugs to treat diseases. In agriculture, they develop pesticides and fertilizers to improve crop yields. Additionally, organic chemistry is essential in the production of plastics, dyes, and other materials.

The study of organic reactions, such as addition, substitution, and elimination reactions, is also a key aspect of this field. These reactions allow chemists to transform simple molecules into more complex ones, enabling the synthesis of a wide array of useful compounds.

6.1 Fill in the blanks with the correct term from the word bank. Then, use each term in a sentence to demonstrate your understanding.

Word bank:

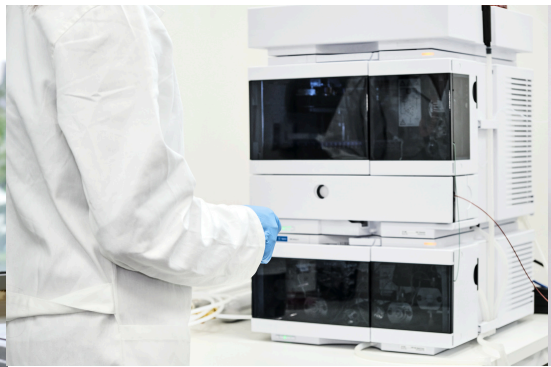
hydrocarbon, functional group, isomer, alkane, alkene, alkyne, aromatic compound, polymer, stereochemistry, nucleophile

Definitions:

1. A compound consisting entirely of hydrogen and carbon atoms. _____
2. A specific grouping of atoms within a molecule that has characteristic properties and reactions. _____
3. Compounds with the same molecular formula but different structural arrangements. _____
4. A hydrocarbon with only single bonds between carbon atoms. _____
5. A hydrocarbon with at least one double bond between carbon atoms. _____
6. A hydrocarbon with at least one triple bond between carbon atoms. _____
7. A compound containing a benzene ring or similar structure. _____
8. A large molecule made up of repeating subunits. _____
9. The study of the spatial arrangement of atoms in molecules. _____
10. A chemical species that donates an electron pair to form a chemical bond. _____

Sentences:

1. _____: Methane is a simple _____ used as a fuel.
2. _____: The hydroxyl group is a common _____ in alcohols.
3. _____: Butane and isobutane are _____ with different structures.
4. _____: Propane is an _____ commonly used in gas grills.
5. _____: Ethylene is an _____ used in the production of plastics.
6. _____: Acetylene is an _____ used in welding torches.
7. _____: Benzene is an _____ with a distinct ring structure.
8. _____: Polyethylene is a _____ used in plastic bags.
9. _____: _____ is important in drug design to ensure the correct 3D arrangement of atoms.
10. _____: A hydroxide ion acts as a _____ in many organic reactions.



6.2 Complete the story by filling in the blanks with the correct form of the verb in brackets.

Yesterday, while we (1) _____ (prepare) the lab equipment, the teacher (2) _____ (explain) the experiment.
We (3) _____ (already / study) chemical reactions for two weeks.
I (4) _____ (mix) the solutions when the beaker suddenly cracked!
Luckily, no one (5) _____ (get) hurt.
We (6) _____ (clean) the mess when the principal (7) _____ (walk) in.
Today, we (8) _____ (repeat) the experiment with better glassware.
Our teacher (9) _____ (monitor) us closely since the accident.
Next time, we (10) _____ (double-check) everything before starting.

6.3 Complete the story by filling in the blanks with the correct form of the verb in brackets.

This week, we (1) _____ (explore) how acids and bases react.
Our group (2) _____ (observe) a strong reaction when we added baking soda to vinegar.
We (3) _____ (not / expect) the foam to rise that quickly!
I (4) _____ (take) notes while my partner (5) _____ (record) the reaction on her tablet. So far, we (6) _____ (conduct) five successful tests.
We (7) _____ (test) lemon juice next, which (8) _____ (contain) citric acid.
By Friday, we (9) _____ (submit) our full report.
Hopefully, the teacher (10) _____ (be) impressed with our work.

6.4 Complete the story by filling in the blanks with the correct form of the verb in brackets.

Today in class, we (1) _____ (perform) an electrolysis experiment with salt water.
While we (2) _____ (connect) the electrodes, the teacher (3) _____ (explain) how the ions move. I (4) _____ (never / see) gas bubbles form so quickly!
We (5) _____ (study) electrolysis for two lessons now. One student (6) _____ (accidentally / knock) over a beaker, but nothing spilled. Next week, we (7) _____ (try) the same process using copper sulfate. Right now, we (8) _____ (write) a short report about our findings. Hopefully, we (9) _____ (understand) it all better by the test.
Our teacher (10) _____ (already / give) us some tips to prepare.

UNIT 7
Work Safety

Ensuring safety in the laboratory is crucial to prevent accidents and protect everyone involved. Chemical safety involves understanding the properties and hazards of chemicals used in experiments. Proper labeling and storage of chemicals are essential to avoid dangerous reactions. Always wear appropriate personal protective equipment (PPE) such as gloves, goggles, and lab coats to minimize exposure to harmful substances.

Hazard symbols play a vital role in chemical safety by providing quick visual warnings about the dangers associated with specific chemicals. These symbols include the skull and crossbones for toxic substances, the flame for flammable materials, and the exclamation mark for irritants. The corrosive symbol indicates substances that can damage skin and materials, while the environmental hazard symbol warns of chemicals that can harm aquatic life.

Familiarizing yourself with these symbols and their meanings helps in identifying potential risks and taking necessary precautions. Additionally, always follow proper disposal procedures for chemical waste to prevent environmental contamination. Regular training and adherence to safety protocols ensure a safe working environment in the lab, reducing the likelihood of accidents and promoting a culture of safety. Remember, safety in the lab is everyone's responsibility.

7.1 Fill in the blanks with the correct term from the word bank.

Word bank:
Personal Protective Equipment (PPE), Fume Hood, MSDS (Material Safety Data Sheet), Corrosive, Flammable, Toxic, Irritant, Emergency Shower, Eye Wash Station, Spill Kit

1. Before handling any chemical, always check the _____ for safety information.
2. When working with volatile substances, use the _____ to prevent inhalation of harmful fumes.
3. If a chemical splashes into your eyes, immediately use the _____.
4. Wear _____ such as gloves and goggles to protect yourself from chemical exposure.
5. In case of a chemical spill, use the _____ to clean it up safely.
6. _____ substances can cause severe burns or damage to materials.
7. _____ substances can catch fire easily and should be kept away from heat sources.
8. If you come into contact with a _____ substance, it may cause inflammation or discomfort.
9. _____ substances can cause harm or death if inhaled, ingested, or absorbed.
10. If a large amount of chemical spills on your body, use the _____ to rinse it off quickly.

7.2 Decide if the statements are true or false.

Statements:

1. True or False: Wearing an apron in the lab helps protect your clothing from chemical spills.
2. True or False: Carcinogens are substances that can cause cancer.
3. True or False: Biohazard symbols indicate the presence of flammable materials.
4. True or False: Decontamination is the process of removing hazardous substances from equipment or surfaces.
5. True or False: Explosive materials can cause a violent reaction when mixed with other chemicals.
6. True or False: Gloves are not necessary when handling reactive substances.
7. True or False: Inhalation of fumes can be avoided by working in a well-ventilated area.
8. True or False: Containment is the process of keeping hazardous materials within a controlled area.
9. True or False: Flammable materials can catch fire easily.
10. True or False: Reactive substances are safe to mix with other chemicals without precautions.

7.3 Choose the correct answer.

1. Which piece of equipment should you use to protect yourself from chemical splashes?
   - A) Fume Hood
   - B) Personal Protective Equipment (PPE)
   - C) Spill Kit
2. What should you consult to find detailed information about the hazards of a chemical?
   - A) Emergency Shower
   - B) MSDS (Material Safety Data Sheet)
   - C) Eye Wash Station
3. If you accidentally spill a chemical, what should you use to clean it up safely?
   - A) Spill Kit
   - B) Fume Hood
   - C) Personal Protective Equipment (PPE)
4. Which device is used to remove harmful fumes from the lab environment?
   - A) Eye Wash Station
   - B) Emergency Shower
   - C) Fume Hood
5. What should you use if a chemical splashes into your eyes?
   - A) Eye Wash Station
   - B) MSDS (Material Safety Data Sheet)
   - C) Spill Kit

5. What should you use if a chemical splashes into your eyes?
   - A) Eye Wash Station
   - B) MSDS (Material Safety Data Sheet)
   - C) Spill Kit
6. Which term describes substances that can catch fire easily?
   - A) Corrosive
   - B) Flammable
   - C) Toxic
7. What should you use to rinse off chemicals if a large amount spills on your body?
   - A) Emergency Shower
   - B) Eye Wash Station
   - C) Fume Hood
8. Which term describes substances that can cause severe burns or damage to materials?
   - A) Irritant
   - B) Toxic
   - C) Corrosive
9. Which term describes substances that can cause harm or death if inhaled, ingested, or absorbed?
   - A) Flammable
   - B) Toxic
   - C) Irritant

10. Which term describes substances that cause inflammation or discomfort upon contact with skin or mucous membranes?
    - A) Corrosive
    - B) Irritant
    - C) Flammable

ANSWER KEY

1.1
1.Observation – Opazovanje
2.Hypothesis – Hipoteza
3.Experiment – Eksperiment / Poskus
4.Variable – Spremenljivka
5.Independent Variable – Neodvisna spremenljivka
6.Dependent Variable – Odvisna spremenljivka
7.Control Group – Kontrolna skupina
8.Replication – Ponovitev
9.Data Collection – Zbiranje podatkov
10.Qualitative Data – Kvalitativni podatki
11.Quantitative Data – Kvantitativni podatki
12.Analysis – Analiza
13.Conclusion – Zaključek
14.Theory – Teorija
15.Peer Review – Strokovni pregled

1.2
1.H – Observation
2.B – Hypothesis
3.C – Experiment
4.E – Variable
5.K – Independent Variable
6.L – Dependent Variable
7.D – Control Group
8.N – Replication
9.A – Data Collection
10. F – Qualitative Data
11. G – Quantitative Data
12. M – Analysis
13. J – Conclusion
14. I – Theory
O – Peer Review

1.3
1. Scientific Method
2. Observation
3. Hypothesis
4. Experiment
5. Variable
6. Independent Variable
7. Dependent Variable
8. Control Group
9. Data Collection
10. Qualitative Data
11. Quantitative Data
12. Analysis
13. Conclusion
14. Replication
15. Theory
16. Peer Review

1.4
1.studies (Present Simple)
2.works (Present Simple)
3.analyzes (Present Simple)
4.is heating (Present Continuous)
5.is recording (Present Continuous)
6.follows (Present Simple)
7.observes (Present Simple)
8.forms (Present Simple)
9.is mixing (Present Continuous)
10.is changing (Present Continuous)
11.is writing (Present Continuous)
12.repeats (Present Simple)
13.helps (Present Simple)
14.is looking (Present Continuous)
15.plays (Present Simple)

ANSWER KEY

1.5

1. loves (Present Simple)
2. is working (Present Continuous)
3. follows (Present Simple)
4. is wearing (Present Continuous)
5. is pouring (Present Continuous)
6. observes (Present Simple)
7. requires (Present Simple)
8. records (Present Simple)
9. is using (Present Continuous)
10. is changing (Present Continuous)
11. is taking (Present Continuous)
12. enjoys (Present Simple)
13. helps (Present Simple)
14. is analyzing (Present Continuous)
15. teaches (Present Simple)

1.6

1. studies (Present Simple)
2. conducts (Present Simple)
3. is mixing (Present Continuous)
4. is taking (Present Continuous)
5. checks (Present Simple)
6. starts (Present Simple)
7. is observing (Present Continuous)
8. is changing (Present Continuous)
9. helps (Present Simple)
10. is testing (Present Continuous)
11. produces (Present Simple)
12. is writing (Present Continuous)
13. plays (Present Simple)
14. is analyzing (Present Continuous)

allows (Present Simple)

2.1

1. Sublimation - The process by which a solid changes directly into a gas without passing through the liquid state.
2. Boiling Point - The temperature at which a liquid changes into a gas.
3. Viscosity - The resistance of a liquid to flow.
4. Intermolecular Forces - The force that holds molecules together in a solid or liquid.
5. Condensation - The process by which a gas changes into a liquid.
6. Compressibility - The ability of a gas to be compressed into a smaller volume.
7. Melting Point - The temperature at which a solid changes into a liquid.
8. Evaporation - The process by which a liquid changes into a gas at a temperature below its boiling point.
9. Diffusion - The process by which a gas spreads out to fill a space.
10. Plasma - A state of matter consisting of ionized particles.
11. Melting - The process by which a solid changes into a liquid.
12. Crystalline - A solid with a regular, repeating pattern of atoms.
13. Amorphous - A solid without a regular, repeating pattern of atoms.
14. Ionization - The process by which atoms or molecules gain or lose electrons.
15. Phase Transition - The change of matter from one state to another.

ANSWER KEY

2.2

1.Intermolecular Forces: Medmolekularne sile
2.Viscosity: Viskoznost
3.Surface Tension: Površinska napetost
4.Compressibility: Stisljivost
5.Ionization: Ionizacija
6.Crystalline: Kristaliničen
7.Amorphous: Amorfen
8.Sublimation: Sublimacija
9.Condensation: Kondenzacija
10.Evaporation: Izhlapevanje
11.Melting Point: Tališče
12.Boiling Point: Vrelišče
13.Plasma: Plazma
14.Diffusion: Difuzija
15.Phase Transition: Fazni prehod

2.4

1. B) Sublimation
2. C) Boiling Point
3. A) Viscosity
4. C) Intermolecular Forces
5. B) Condensation
6. B) Compressibility
7. B) Crystalline
8. A) Ionization

2.3

State of Matter	Characteristics	Examples	Transitions
Solid	- Definite shape and volume - Particles closely packed - Strong intermolecular forces	Ice, metals, crystalline salts	Melting (solid to liquid), Sublimation (solid to gas)
Liquid	- Definite volume, takes shape of container - Particles less tightly packed - Weaker intermolecular forces	Water, alcohol, mercury	Freezing (liquid to solid), Evaporation (liquid to gas)
Gas	- No definite shape or volume - Particles far apart, move freely - Low density, high compressibility	Oxygen, nitrogen, carbon dioxide	Condensation (gas to liquid), Sublimation (gas to solid)
Plasma	- High-energy state - Ionized particles - Influenced by electromagnetic fields	Stars, neon signs, plasma TVs	Ionization (gas to plasma), Recombination (plasma to gas)

ANSWER KEY

2.5
1.Single layer of carbon atoms in hexagonal lattice.
2.Liquid component of gel replaced with gas.
3.Returns to original shape when heated.
4.Used in LCDs for screens.
5.Engineered structure, unique properties.
6.Non-stick coatings, LED lights.
7.Porous structure, low thermal conductivity.
8.Graphene.
Electromagnetic waves.

2.6
1.conducted
2.was mixing
3.was taking
4.changed
5.were observing
6.exploded
7.were cleaning
8.realized
9.had forgotten
10.were discussing
11.entered
12.asked
13.had happened
14.explained
15.decided

2.7
1.prepared
2.was heating
3.was recording
4.started
5.were monitoring
6.cracked
7.were dealing
8.noticed
9.was producing
10.were analyzing
11.arrived
12.asked
13.needed
14.described
15.decided

2.8
1.was working
2.was preparing
3.was setting
4.planned
5.was mixing
6.began
7.were observing
8.rose
9.were trying
10.experienced
11.realized
12.needed
13.instructed
14.was running
15.was monitoring
16.came
17.arrived
18.continued

ANSWER KEY

19.recorded
20.analyzed
21.discovered
22.were celebrating
23.received
24.had heard
25.wanted
26.agreed
27.were discussing
28.felt
29.knew
30.had

2.9
1.analyzes
2.are conducting
3.discovered
4.were preparing, was reviewing
5.takes
6.was heating
7.always wears
8.are testing
9.completed
10.was mixing, was recording
11.changed
12.are currently studying
13.measures
14.were observing
15.yielded

2.10
1.crystallize
2.investigate
3.weigh
4.examine
5.produce
6.observe
7.synthesize
8.identify

2.11
1.measure, explain
2.react
3.cool
4.check
5.monitor
6.isolate
7.filter, note

2.12
1.studies
2.is mixing
3.discovered
4.was analyzing
5.are learning
6.are conducting
7.measured
8.were working
9.wears
10.is preparing
11.presented
12.was speaking
13.understand
14.are testing
15.completed

ANSWER KEY

2.13
1.teaches
2.is mixing
3.discovered
4.was analyzing
5.are learning
6.are conducting
7.measured
8.were working
9.wears
10.is preparing
11.presented
12.was speaking
13.understand
14.are testing
15.completed

2.14
1.study
2.are mixing
3.discovered
4.were analyzing
5.are investigating
6.are conducting
7.measured
8.were working
9.wear
10.are preparing
11.presented
12.were speaking
13.understand
14.are testing
completed

2.15
1.study
2.are experimenting
3.called
4.was analyzing
5.began
6.are conducting
7.measured
8.were working
9.wear
10.are preparing
11.presented
12.was speaking
13.consists
14.are investigating
15.discovered
16.has
17.were studying
18.found
19.collaborate
20.share
21.became
22.continue
23.are working
24.are developing
25.looks
26.believe
27.will transform
28.plays
29.use
30.impacted

3.1
Students' own answers

ANSWER KEY

3.2

Atom - Atom: The smallest unit of matter that retains the properties of an element.
Molecular Structure - Molekularna struktura: The arrangement of atoms within a molecule.
Nucleus - Jedro: The central part of an atom, containing protons and neutrons.
Covalent Bond - Kovalentna vez: A chemical bond where two atoms share pairs of electrons.
Ionic Bond - Ionska vez: A bond formed between ions with opposite charges.
Valence Electrons - Valencni elektroni: Electrons in the outermost shell of an atom.
Chemical Reaction - Kemijska reakcija: A process that rearranges the molecular structure of substances.
Compound - Spojina: A substance formed from two or more chemically bonded elements.

3.3

B) Atom
B) Oganesson
D) 99.9%
B) 1836
A) Technetium
B) Greek for "uncuttable"

3.4

1. Atom - G
2. Molecule - J
3. Electron - D
4. Proton - A
5. Neutron - E
6. Nucleus - C
7. Element - I
8. Compound - B
9. Isotope - F
10. Ion – H

3.5

1. will discover
2. is going to analyze
3. will yield
4. are going to conduct
5. is going to change
6. will identify
7. will test
8. is going to produce
9. will start
10. are going to investigate
11. is going to exhibit
12. will likely find
13. will revise
14. will reduce
15. is going to implement

3.6

1. will test
2. are going to conduct
3. will use
4. will reveal
5. are going to analyze
6. are going to prepare

ANSWER KEY

7. will reduce
8. will present
9. are going to publish
10. will likely find
11. will start
12. is going to change
13. are going to record
14. will be
15. are going to celebrate

3.7

1. will conduct
2. is going to start
3. are going to use
4. will record
5. will evaluate
6. are going to present
7. will analyze
8. is going to reveal
9. will write
10. are going to submit
11. will provide
12. are going to improve
13. will celebrate
14. is going to be
15. will continue

3.8

1. will prepare
2. is going to begin
3. will collect
4. will examine
5. will help
6. will document
7. will share
8. will discuss
9. will plan
10. will write
11. will include
12. will submit
13. will review
14. will implement
15. will celebrate

3.9

1. are going to conduct
2. starts
3. are analyzing
4. is giving
5. will submit
6. begins
7. is preparing
8. will help
9. will discuss
10. is calibrating
11. starts
12. will document
13. are going to present
14. is going to begin
15. will review

3.10

1. is organizing
2. is going to start
3. will gather
4. is analyzing
5. will provide
6. records
7. will present
8. will debate

9. will design
10. will compile
11. contains
12. will submit
13. will examine
14. will incorporate
15. will acknowledge

3.11
1. is visiting
2. are going to watch
3. explains
4. will wear
5. are going to work
6. am going to help
7. are going to mix
8. will see
9. will ask

3.12
1. am giving
2. are going to set up
3. rings
4. will come
5. will explain
6. are going to test
7. are wearing
8. will enjoy
9. will ask

3.13
1. arrives
2. has finished
3. has cooled
4. reacts
5. begins
6. has turned
7. has checked
8. has analyzed

3.14
1. will start, reaches
2. will explain, enter
3. will not pour, put on
4. is, will clean
5. will change, neutralizes
6. will label, has measured
7. will mix, goes out
8. will not record, stabilizes
9. form, will observe
10. will start, finish
11. will compare, have submitted
12. will not approve, checks
13. changes, will stop
14. will begin, ends
15. will not open, decreases
16. will begin, arrive
17. will measure, starts
18. will not give, have finished
19. will add, have checked
20. will observe, turns
21. will not allow, have read
22. will add, has been
23. will not open, has been
24. will compare, have finished
25. will leave, has signed
26. will wear, handle
27. will start, reaches
28. has been, will clean
29. will check, leave
30. will finish, cools

ANSWER KEY

3.15
1. starts
2. are doing
3. will explain
4. will mix, arrives
5. is helping
6. will measure, finishes
7. will bring
8. will not open, decreases
9. begins, will observe
10. will take
11. will not leave, finish
12. will observe, reacts
13. will give, have completed
14. will wait, add
15. closes, need

3.16
1. starts
2. will explain
3. begin
4. will work
5. is
6. have
7. will measure
8. gives
9. are going to use
10. combine
11. will observe
12. will be
13. will take
14. will continue
15. is writing
16. will analyze
17. will finish
18. will clean
19. starts
20. will submit
21. will ask
22. am
23. will get

4.1
1. Plutonium (Pu)
2. Mercury (Hg)
3. Tungsten (W)
4. Carbon (C)
5. Curium (Cm)
6. Silicon (Si)
7. Sulfur (S)

4.2
1. Atomic Number - C
2. Valence Electrons - I
3. Period - D
4. Group - B
5. Transition Metals - E
6. Lanthanides - G
7. Actinides - J
8. Electronegativity - H
9. Ionization Energy - A
10. Noble Gases – F

4.3
1. Atom
2. Period
3. Group
4. Electronegativity
5. Transition Metals
6. Actinides
7. Ionization Energy
8. Valence Electrons
9. Noble Gases
10. Lanthanides

ANSWER KEY

4.4

1. Helium (He) - H
2. Iron (Fe) - I
3. Carbon (C) - G
4. Uranium (U) - A
5. Neon (Ne) - D
6. Gold (Au) - E
7. Oxygen (O) - B
8. Silicon (Si) - C
9. Chlorine (Cl) - J
10. Aluminum (Al) – F

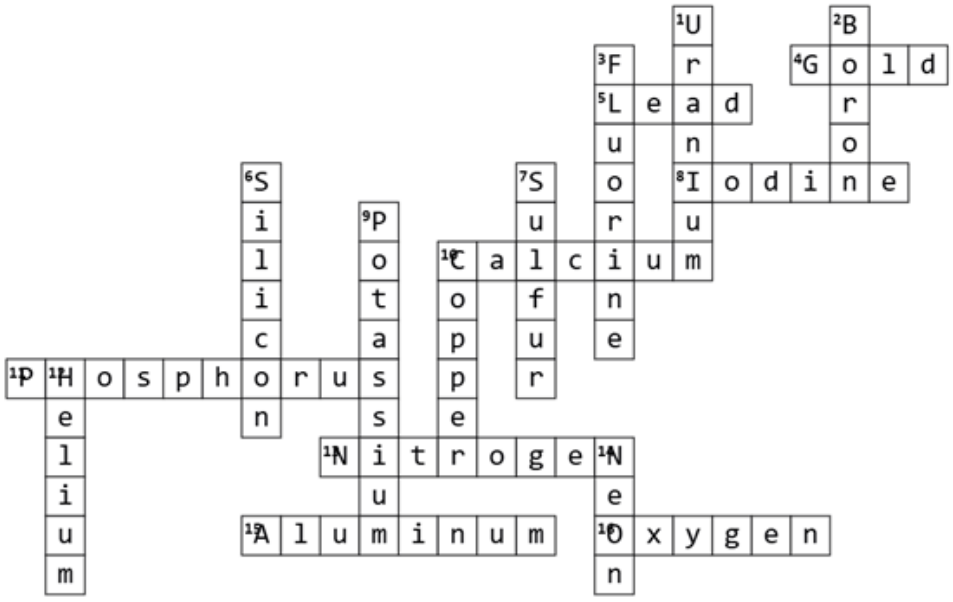
4.5

1. Sodium
2. Lead
3. Potassium
4. Calcium
5. Zinc
6. Fluorine
7. Magnesium
8. Iodine
9. Copper
10. Silver

4.6

1. True
2. False (Gold is a precious metal, not a transition metal)
3. False (Helium is lighter than air)
4. True
5. True
6. False (Neon is used in neon signs because it is inert and emits light when electrified)
7. True
8. True
9. False (Chlorine is a halogen)
10. True

4.7



ANSWER KEY

4.8
1. have discovered
2.have been analyzing
3.has published
4.have been studying
5.have completed
6.have been working
7.has yielded
8.have been investigating
9. has been teaching

4.9
1. have been studying
2. have conducted
3. have been taking
4. have been measuring
5. have already completed
6. have changed
7. have been observing
8. has checked
9. haven't got
10. have also been using
11. have never seen
12. has been analyzing
13. have just printed
14. have been working
15. have achieved

4.10
1. have been working
2. have been trying
3. have tested
4. has been gathering
5. has already created
6. haven't hardened
7. have been focusing
8. has been monitoring
9. have found
10. have been sitting
11. have just checked
12. have improved
13. have put
14. has been

4.11
1. have been investigating
2. have tested
3. have been recording
4. have been researching
5. have discovered
6. have been struggling
7. have been collecting
8. has warned
9. have never seen
10. have been analyzing
11. have just finished
12. have been comparing
13. have learned
14. have improved

4.12
1. have been working
2.have been focusing
3.has shown
4.have discovered
5.have been testing
6.have been
7.has presented
8.has expressed
9.have reached out

10.have been collecting
11.have found
12.has had
13.have been conducting
14.have received
15. has hoped

5.1
1. Beaker - E
2.Erlenmeyer Flask - G
3.Bunsen Burner - I
4.Graduated Cylinder - B
5.Pipette - D
6.Test Tube - H
7.Crucible - A
8.Mortar and Pestle - F
9.Volumetric Flask - J
10. Watch Glass - C
Sentences:
1. Beaker: The scientist used a beaker to mix the chemical solutions.
2.Erlenmeyer Flask: The Erlenmeyer flask was perfect for swirling the mixture without spilling.
3.Bunsen Burner: The Bunsen burner was used to heat the substance to a high temperature.
4.Graduated Cylinder: She measured 50 milliliters of water using the graduated cylinder.
5.Pipette: The pipette allowed for precise transfer of the liquid reagent.
6.Test Tube: The test tube contained the sample for the experiment.
7.Crucible: The crucible was used to heat the metal until it melted.
8.Mortar and Pestle: He ground the solid into a fine powder using the mortar and pestle.
9.Volumetric Flask: The volumetric flask was used to prepare a solution with an exact concentration.
10. Watch Glass: The watch glass held the small amount of substance for observation.

5.2
1. Beaker - Čaša
2.Erlenmeyer Flask - Erlenmajerica
3.Bunsen Burner - Bunsenov gorilnik
4.Graduated Cylinder - Merilni valj
5.Pipette - Pipeta
6.Test Tube - Epruveta
7.Crucible - Lonček
8.Mortar and Pestle - Terilnica in pestilo
9.Volumetric Flask - Merilna bučka
10.Watch Glass - Urno steklo
11.Funnel - Lijak
12.Thermometer - Termometer
13.Balance - Tehtnica
14.Burette - Bireta
15.Clamp - Klešče
16. Stirring Rod - Mešalna palica

5.3
Students' own answers.

ANSWER KEY

5.4
1. had analyzed, wrote
2.had stopped, turned off
3.arrived, had already started
4. had explained, completed
had calibrated, proceeded

5.5
1. had finished, passed
2.had changed, was added
3.cleaned, had conducted
4.had recorded, left
5.had failed, had not been mixed
6.had discovered, conducted
7.had prepared, arrived
8.fixed, had already begun
9.had measured, cooled
10.had completed, wrote
11.had occurred, mixed
12.had taught, performed
13.had evaporated, heated
14.had analysed, published
15.had succeeded, followed
16.had discovered, conducted
17.had prepared, arrived
18.fixed, had already begun
19.had measured, cooled
20.had completed, wrote
21.had occurred, mixed
22.had taught, performed
23. had evaporated, heated

5.6
1. had planned
2.had ensured
3.arrived
4.set up
5.began
6.mixed
7.had designed
8.had added
9.observed
10.had occurred
11.dropped
12.realized
13.had malfunctioned
14.adjusted
15.continued
16.had collected
17.analyzed
18.found
19.had succeeded
20.celebrated
21. had paid off

5.7
1. had developed
2.had ensured
3.arrived
4.reviewed
5.began
6.explained
7.had designed
8.had presented
9.observed
10.had succeeded
11.failed
12.realized
13.had crashed
14.fixed
15.continued
16.had collected
17.analyzed
18.found
19.had been well received
20.celebrated
21. had paid off

ANSWER KEY

6.1

1. Hydrocarbon
2. Functional group
3. Isomers
4. Alkane
5. Alkene
6. Alkyne
7. Aromatic compound
8. Polymer
9. Stereochemistry
10. Lewis base

Sentences:

1. Hydrocarbon: Methane is a simple hydrocarbon used as a fuel.
2. Functional group: The hydroxyl group is a common functional group in alcohols.
3. Isomers: Butane and isobutane are isomers with different structures.
4. Alkane: Propane is an alkane commonly used in gas grills.
5. Alkene: Ethylene is an alkene used in the production of plastics.
6. Alkyne: Acetylene is an alkyne used in welding torches.
7. Aromatic compound: Benzene is an aromatic compound with a distinct ring structure.
8. Polymer: Polyethylene is a polymer used in plastic bags.
9. Stereochemistry: Stereochemistry is important in drug design to ensure the correct 3D arrangement of atoms.
10. Lewis base: A hydroxide ion acts as a Lewis base in many organic reactions.

6.2

1. were preparing
2. was explaining
3. have already studied
4. was mixing
5. got
6. were cleaning
7. walked
8. are repeating
9. has been monitoring
10. will double-check

6.3

1. have been exploring
2. observed
3. didn't expect
4. was taking
5. was recording
6. have conducted
7. are going to test / are testing
8. contains
9. will submit
10. will be

6.4

1. are performing
2. were connecting
3. was explaining
4. have never seen
5. have been studying
6. accidentally knocked
7. will try
8. are writing
9. will understand
10. has already given

ANSWER KEY

7.1

1. MSDS (Material Safety Data Sheet)
2. Fume Hood
3. Eye Wash Station
4. Personal Protective Equipment (PPE)
5. Spill Kit
6. Corrosive
7. Flammable
8. Irritant
9. Toxic
10. Emergency Shower

7.2

1. True
2. True
3. False- Biohazard symbols indicate the presence of biological hazards.
4. True
5. False- Explosive materials can cause an explosion if not handled properly.
6. False- Gloves are necessary when handling reactive substances..
7. True
8. True
9. True
10. False- Reactive substances can cause a violent reaction when mixed with other chemicals

7.3

1. B) Personal Protective Equipment (PPE)
2. B) MSDS (Material Safety Data Sheet)
3. A) Spill Kit
4. C) Fume Hood
5. A) Eye Wash Station
6. B) Flammable
7. A) Emergency Shower
8. C) Corrosive
9. B) Toxic
10. B) Irritant