1. Tick the correct answer.

A. Which of the following bears a diatomic molecule?
✓ Nitrogen (N_2)
Nitrogen exists in nature as a diatomic molecule (two atoms joined together).

B. Which of the following is a chemical change?
✓ Burning of coal
Burning is a chemical change because a new substance (carbon dioxide) is formed, and the process is irreversible.

C. Which of the following is an exothermic reaction?
✓ $CaO + H_2O \rightarrow Ca(OH)_2$
This is exothermic because heat energy is released during the reaction.

D. When a piece of granulated zinc was added into dilute HCl, what gas was produced?
✓ Hydrogen (H_2)
Reaction: $Zn + 2HCl \rightarrow ZnCl_2 + H_2\uparrow$

E. What does the symbol (⇌) represent?
✓ Reversible reaction
It shows that the reaction can proceed both forward and backward.

F. What gas will be produced if $KClO_3$ is heated?
✓ Oxygen (O_2)
Reaction: $2KClO_3 \rightarrow 2KCl + 3O_2\uparrow$

G. If limestone ($CaCO_3$) is heated, what will be the products?
✓ $CaO + CO_2$
Reaction: $CaCO_3 \rightarrow CaO + CO_2\uparrow$

2. Answer in these questions

a. What are physical and chemical changes? Explain with examples.

A **physical change** is a change in which only the physical properties such as shape, size, state, or appearance of a substance are changed and no new substance is formed. For example, melting of ice, boiling of water, and breaking of glass are physical changes.

A **chemical change** is a change in which the original substance is converted into a new substance with different properties. Such changes are usually irreversible. For example, burning of paper, rusting of iron, and digestion of food are chemical changes.

b. What is chemical reaction? What are the ways to write chemical reactions?

A **chemical reaction** is a process in which one or more substances, called reactants, undergo chemical changes to form new substances, called products.

Chemical reactions can be written in two ways:

Word equation – in which the names of substances are written in words.

Symbolic equation – in which the chemical symbols and formulae are used to represent the reaction.

c. What do you mean by word equation and symbolic equation? Give two examples of each.

A **word equation** is the representation of a chemical reaction in words, showing the names of reactants and products.

Example 1: Hydrogen + Oxygen → Water

Example 2: Carbon + Oxygen → Carbon dioxide

A **symbolic equation** is the representation of a chemical reaction using chemical symbols and formulae of the substances.Example 1: $2H_2 + O_2 \rightarrow 2H_2O$

Example 2: $C + O_2 \rightarrow CO_2$

d. What do you understand by diatomic elements? Give examples.

The elements whose molecules consist of two atoms of the same element joined together are called **diatomic elements**. These atoms always exist in pairs under normal conditions.
Examples: Hydrogen (H_2), Oxygen (O_2), Nitrogen (N_2), Chlorine (Cl_2), Fluorine (F_2), Bromine (Br_2), and Iodine (I_2).

e. Define a balanced and an unbalanced equation with an example of each.
A **balanced chemical equation** is a chemical equation in which the number of atoms of each element is equal on both sides of the equation.
Example: $2H_2 + O_2 \rightarrow 2H_2O$

An **unbalanced chemical equation** is a chemical equation in which the number of atoms of elements is not equal on both sides.
Example: $H_2 + O_2 \rightarrow H_2O$

f. Explain the terms reactant and product with examples.
The substances which take part in a chemical reaction and undergo changes are called **reactants**. The new substances formed as a result of the reaction are called **products**.
Example: In the reaction $2H_2 + O_2 \rightarrow 2H_2O$, hydrogen and oxygen are reactants, while water is the product.

g. Define reversible and irreversible reactions with an example of each.
A **reversible reaction** is a reaction in which the products can be converted back into the reactants under suitable conditions.
Example: $N_2 + 3H_2 \rightleftharpoons 2NH_3$

An **irreversible reaction** is a reaction in which the products cannot be changed back into the reactants.
Example: Burning of paper.

h. Two different chemical reactions are taking place in two beakers. If touched, the first beaker feels hot, whereas the second one feels cold. What kinds of reactions are taking place? Define them.
The reaction in the first beaker is an **exothermic reaction** because heat is released during the reaction.
The reaction in the second beaker is an **endothermic reaction** because heat is absorbed during the reaction.

i. A chef is cooking food by burning gas in a stove. Can you find exothermic and endothermic reactions?
Yes. The burning of gas in the stove is an **exothermic reaction** because it produces heat. The cooking of food by absorbing this heat is an **endothermic reaction**.

j. Our daily life would have been almost impossible if there were no chemical reactions. Justify this statement.
Our daily life depends on chemical reactions. Important life processes such as respiration, digestion of food, and photosynthesis are all chemical reactions. The burning of fuels to obtain energy and the preparation of food also involve chemical changes. Without chemical reactions, life would not exist, and survival would be impossible.

3. Differentiate between

a. Physical change and Chemical change

Physical Change	Chemical Change
1. No new substance is formed.	1. A new substance is formed.
2. It is usually reversible.	2. It is usually irreversible.
3. Only physical properties such as shape, size, and state change.	3. Both physical and chemical properties of the substance change.
4. Example: Melting of ice, breaking glass.	4. Example: Rusting of iron, burning of paper.

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b. Balanced and Unbalanced chemical equation

Balanced Chemical Equation	Unbalanced Chemical Equation
1. The number of atoms of each element is equal on both sides of the equation.	1. The number of atoms of each element is not equal on both sides.
2. It obeys the law of conservation of mass.	2. It does not obey the law of conservation of mass.
3. It represents the actual chemical reaction correctly.	3. It does not represent the actual reaction correctly.
4. Example: $2H_2 + O_2 \rightarrow 2H_2O$	4. Example: $H_2 + O_2 \rightarrow H_2O$

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c. Chemical reaction and Chemical equation

Chemical Reaction	Chemical Equation
1. It is the actual process in which reactants change into products.	1. It is the symbolic or word representation of a chemical reaction.
2. It cannot be seen directly, but its effects can be observed.	2. It can be written and studied in symbols or words.
3. It takes place naturally or under given conditions.	3. It is written by using reactants and products with arrow signs.
4. Example: Burning of fuel, rusting of iron.	4. Example: $2H_2 + O_2 \rightarrow 2H_2O$

4. Give reasons

a. Making ornament from gold is a physical change.
Because gold is only melted and given shape, but no new substance is formed.

b. Melting of ice is an example of physical change.
Because only the physical state of water changes from solid to liquid, but the chemical composition remains the same.

c. Growth of child into adult is a chemical change.
Because new substances like proteins, tissues, and hormones are formed inside the body, and the change is irreversible.

5. Balanced chemical equations

i. $2H_2 + O_2 \rightarrow 2H_2O$
ii. $C + O_2 \rightarrow CO_2$
iii. $N_2 + 3H_2 \rightarrow 2NH_3$
iv. $H_2 + Br_2 \rightarrow 2HBr$
v. $3Ca + N_2 \rightarrow Ca_3N_2$
vi. $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$
vii. $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
viii. $3Mg + N_2 \rightarrow Mg_3N_2$
ix. $2K + Cl_2 \rightarrow 2KCl$
x. $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$
xi. $4Fe + 3O_2 \rightarrow 2Fe_2O_3$
xii. $Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$
xiii. $2KClO_3 \rightarrow 2KCl + 3O_2$
xiv. $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

6. Balance the following skeletal equations

i. $2Na + Cl_2 \rightarrow 2NaCl$
ii. $2Ag + Br_2 \rightarrow 2AgBr$
iii. $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$
iv. $P_4 + 5O_2 \rightarrow 2P_2O_5$
v. $2KClO_3 \rightarrow 2KCl + 3O_2$
vi. $H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$
vii. $3Mg + N_2 \rightarrow Mg_3N_2$
viii. $2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$

7. Complete and balance

i. $HCl + NaOH \rightarrow NaCl + H_2O$
ii. $4Na + O_2 \rightarrow 2Na_2O$
iii. $2HgO \rightarrow 2Hg + O_2$
iv. $2HNO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + 2H_2O$
v. $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$
vi. $2Ca + O_2 \rightarrow 2CaO$
vii. $4Fe + 3O_2 \rightarrow 2Fe_2O_3$
viii. $HCl + NaOH \rightarrow NaCl + H_2O$