DAV PUBLIC SCHOOL, PTPS PATRATU

CLASS: 7 SUBJECT: Chemistry(NOTES)

LESSON: . Chemical Substances and Processes

Matter is the substance which occupies space and has mass.

Example: Ice, Water, Water vapour, etc.

Matter exists in three states—**solid, liquid and gas**. All matter is made up of small particles called atoms. Atoms combine to form molecules.

Atom is the smallest basic building block of matter. Example: Hydrogen, Oxygen, etc.

Molecule is a group of two or more atoms of same or different elements. Example: O_2 ,H_2O

Pure substance: Materials which are made of same kind of particles (atoms or molecules), are called pure substances. Example; iron, sodium chloride.

Pure substances can be further classified as 'elements' and 'compounds'.

Element: An element is a pure substance which is made up of atoms of the same kind. Example; iron, copper, etc.

A **compound** is a pure substance which is made up of molecules of the same kind. A molecule of a compound consists of atoms of two, or more, different elements that have combined in a fixed ratio. For example, carbon dioxide is a compound made up of carbon dioxide molecules. Each molecule of carbon dioxide contains one atom of carbon and two atoms of oxygen combined together.

A **mixture** contains two or more substances mixed in any proportion. The components of a mixture are not chemically combined with each other. A mixture is, therefore, not a pure substance.

Example: Air , Soil ,Lemonade, etc.

Chemical Symbols: Chemical substances are usually represented by symbols.
Elements are represented by the letters of English alphabet. For example; the chemical symbol of iron is Fe, the chemical symbol of copper is Cu.

Note: Symbols of elements are written using first alphabet of English name, First alphabet of English name with some other alphabets, First alphabet of Latin name.

The present day chemical symbols of some common elements are given below:

Name of the element	Latin Name	Symbol
Hydrogen	-	H
Magnesium	-	Mg
Aluminium	-	Al
Calcium	-	Ca
Carbon	-	C
Oxygen	-	O

Sulphur	-	S
Nitrogen	-	N
Phosphorus	-	P
Chlorine	-	Cl
Bromine	-	Br
Iodine	-	I
Copper	Cuprum	Cu
Gold	Aurum	Au
Iron	Ferrum	Fe
Lead	Plumbum	Pb
Mercury	Hydragyrum	Hg
Potassium	Kalium	K
Silver	Argentum	Ag
Sodium	Natrium	Na

Chemical Formula: The chemical formula of a substance is based on the composition of that substance. It indicates the type and number of atoms of each kind present in that substance.

The chemical formula of carbon dioxide is CO_2.Here, C is the symbol of carbon and O is the symbol of oxygen. This means that a carbon dioxide molecule is formed by the combination of one atom of carbon and two atoms of oxygen.

Writing the chemical formula:

1.To write the chemical formula of a substance, the chemical symbols of all the elements are written and the number of atoms of each element is written as a subscript to the right side of its symbol.

For example glucose contains six atoms of carbon, twelve atoms of hydrogen and six atoms of oxygen. Its chemical formula is, therefore, written as $C_6H_{12}O_6$.

Ions: Substances that are made up of positively and negatively charged particles are called ions.

Example: Na^+, CO_3^{2-}

The names and symbols of some common ions, along with their charge, are given below:

Name of the ion	Symbol
Sodium	Na^+
Magnesium	Mg^{2+}
Aluminium	Al^{3+}
Calcium	Ca^{2+}
Hydrogen	H^+
Copper	Cu^{2+}
Iron	Fe^{2+}
Zinc	Zn^{2+}
Ammonium	NH_4^+
Chloride	Cl^-
Oxide	O^{2-}

Hydroxide	OH^-
Carbonate	CO_3^{2-}
Sulphate	SO_4^{2-}
Nitrate	NO_3^-
Acetate	CH_3COO^-
Phosphate	PO_4^{3-}

2. The procedure for writing the chemical formula of a substance containing ions:

(i). Symbols of positive and negative ions are written and their charge is written on the top-right corner of the symbol.

(ii). Common factor, if any, is removed (from the numbers) in the charges of the two ions.

(iii). Charges of two ions are 'criss-crossed'; these (criss-crossed) numbers are now written at the bottom-right of the symbols of the two ions.

(A).To write the formula of sodium oxide, we write the symbol for sodium and oxide ions along with their charges.

$$Na^{1+} \qquad O^{2-}$$

There is no common factor in the numbers corresponding to their charges. We now 'criss-cross' their charges.

Na O

1 2

Na_2O_1 OR Na_2O

Hence, the chemical formula of sodium oxide is Na_2O

(B). To write the formula of aluminium nitrate, we first write the symbols for aluminium and nitrate ions along with their charges.

$$Al^{3-} \qquad NO_3^-$$

There is no common factor in the numbers corresponding to their charges. We now criss-cross their charges and write the criss-crossed numbers as subscripts against the two symbols.

Al NO_3

3 ↗ ↖ 1

Nitrate is written in bracket

Hence, the chemical formula of aluminium nitrate is $Al(NO_3)_3$

Physical Changes: No new substance is formed, and the change is often temporary or reversible.

Examples: Melting of wax, boiling water, tearing paper, cutting wood.

Chemical Changes: A new substance is formed, and the change is permanent or irreversible.

Examples: Rusting of iron, baking a cake, burning wood, digestion of food.

Chemical reaction: The process, in which a chemical change causes one substance to change into another, is called a chemical reaction.

Reactants: Substances which undergo a chemical change in a reaction are called the reactants.

Products: The new substances which are formed are called the products.

Chemical Equation: The represention of a chemical reaction, using symbols and formulae of substances, involved in the reaction, is called a chemical equation.

Writing Chemical Equation.

1. When we write a chemical equation, we put the symbols of the reactants on the left-hand side and those of the products on the right-hand side.
2. An arrow is put between them .
3. The physical state of the reactants and products is written in bracket along with their symbols. The letter 's' is used to denote solid state, 'l' for liquid, 'g' for gas and 'aq' for an aqueous solution (solution of a substance in water).

   Example: Magnesium reacts with oxygen to form Magnesium oxide.

   $2\ Mg\ (s) \quad + \quad O_2\ (g) \quad \text{------}\rightarrow \quad 2\ MgO\ (s)$

Balancing of Chemical Equations

Balanced chemical equation : A balanced chemical equation is that in which the number of atoms of each element are the same on both sides of the equation.

For balancing a chemical equation, follow these steps:

1.Do not change the formula of a chemical substance in the reaction.
2.Write a suitable coefficient (number) with the formula of that substance; in order to balance the equation.

Let us take following example:

$H_2\ (g) \quad + \quad O_2\ (g) \quad \text{-------}\rightarrow \quad H_2O(l)$

In this equation, number of hydrogen atoms on both sides is same, but number of oxygen atom is not same.

$H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

To balance the number of oxygen atoms, coefficient 2 is written with the formula of water on the right hand side of the equation.

$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

Now, to balance the number of hydrogen atoms, coefficient 2 is written with the formula of hydrogen on the left hand side of the equation. Now, the equation is balanced

→ Types of Chemical Reaction:

1. Combination Reaction

- A reaction in which ***two or more reactants combine to form a single product*** is known as a combination reaction.
- It takes the form of $X + Y \rightarrow XY$
- Example of combination reaction: $2Na + Cl_2 \rightarrow 2NaCl$

2. Decomposition Reaction

- A reaction in which a ***single compound breaks into two or more simpler compounds*** is known as a decomposition reaction.
- It takes the form of $XY \rightarrow X + Y$
- A decomposition reaction is just the opposite of a combination reaction.
- Example of a decomposition reaction: $CaCO_3 \rightarrow CaO + CO_2$

3. Displacement Reaction

- A chemical reaction in which a ***more reactive element displaces a less reactive element from its aqueous salt solution.***
- It takes the form $X + YZ \rightarrow XZ + Y$
- Example of displacement reaction: $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

4.Neutralization Reaction

An acid reacts with a base to produce salt and water.

Acid+Base→Salt+Water

Example: When hydrochloric acid (HCl) reacts with sodium hydroxide (NaOH), sodium chloride (NaCl) and water are formed**:** $\mathbf{HCl+NaOH \rightarrow NaCl+H_2O}$

WORKSHEET

Q.1.) Fill in the blanks.

1.) Substances made up of positively and negatively charged particles called ions.
2.) Chemical formula of glucose is $C_6H_{12}O_6$
3.) Substances which undergo a chemical change in a reaction are called reactants.
4.) Mixture is not pure substances.
5.) Element is a pure substance which is made up of atoms of same kind.
6.) Materials made up of same kind of particles are called pure substances.
7.) The type and number of particles of each kind present in a substance is given by its chemical formula
8). The chemical formula of water is H_2O
9). Iron gets rusted on coming in contact with oxygen and water.
10).The process that leads to a chemical change is called a chemical reaction.
11). In a neutralisation reaction, salt and water are formed.

Q.2.) Write the symbols of the following Ions.

1.) Iron
Answer – Fe^{2+}
2.) Phosphate
Answer – PO_4^{3-}
3.) Sodium
Answer – Na^+
4.) Zinc
Answer – Zn^{2+}
5.) Chloride
Answer – Cl^-

Q.3) Answer the following .

1. Explain chemical change with an example.

A chemical change is a process where substances react to form new substances with different properties. Example: Burning of paper produces ash and smoke.

2. What is a chemical reaction? Give an example.

A chemical reaction is a process where reactants change into products with new chemical properties. Example: **$HCl+NaOH \rightarrow NaCl+H_2O$**

3.Are lemonade and soil mixtures? Explain.

Yes, both are mixtures. Lemonade is a solution of water, lemon juice, and sugar, whereas soil is a mixture of various particles.

4.Give a chemical reaction to represent a Displacement reaction.

$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

5. What are elements?

The substances which are made up of same kind of atoms are called elements.

6. Give the chemical symbol of iron and chlorine.

Iron – Fe and chlorine – Cl

7. Write the chemical formulae of the following compounds:

(a) Aluminium oxide (b) Zinc acetate

(a) Al_2O_3 (b) $(CH_3COO)_2Zn$

8. Balance the following equation:
$Ca(OH)_2 + HCl \rightarrow CaCl_2 + H_2O$

$Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$

9. What does a chemical equation represent?

Chemical equation represents a chemical reaction and formulae of substances involved in the reaction.

10. What are reactants and products in a chemical equation?

Reactants: Substances which undergo a chemical change in a reaction are called the reactants.

Products: The new substances which are formed are called the products.

11. Give one example of a combination reaction.
Combination of carbon and oxygen gas to form carbon dioxide is an example of a combination reaction.

$C + O_2 \rightarrow CO_2$

12. Differentiate between a. Combination and Decomposition reaction.

Aspect	Combination Reaction	Decomposition Reaction
Definition	Two or more substances combine to form one	One substance breaks down into two or more substances
Example	A + B --> AB (e.g. $2H_2 + O_2$ --> $2H_2O$)	AB --> A + B (e.g. $2H_2O$ --> $2H_2 + O_2$)

b. Physical and chemical changes

Aspect	Physical Change	Chemical Change
Nature	No new substance formed; reversible	New substances formed; usually irreversible
Example	Melting ice	Burning paper

13. Explain neutralization reaction with an example.

Neutralization is a reaction between an acid and a base producing salt and water.
Example: HCl + NaOH --> NaCl + H2O

14.Give two differences between an element and a compound, using suitable examples.

Feature	Element	Compound
Definition	Substance made of only one type of atom	Substance made of two or more atoms chemically combined
Example	Oxygen (O2), Iron (Fe)	Water (H2O), Carbon dioxide (CO2)

15. Give chemical symbols of these elements

Potassium – K, Iron – Fe Calcium – Ca Chlorine – Cl Silver - Ag