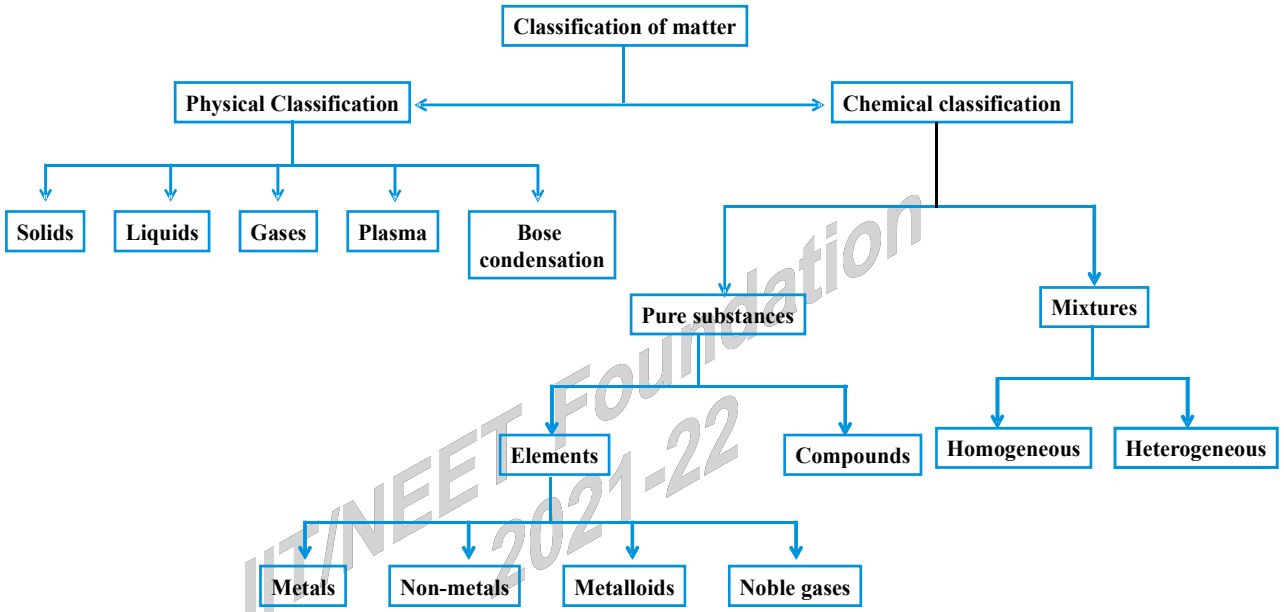
ELEMENTS ,MOLECULES AND COMPOUNDS

In previous chapter (Matter in our surroundings) , we learnt about the physical classification of Matter in this chapter we shall discuss about chemical classifiction of matter

Classification of matter



§§ The chemical classification of matter:

The chemical classification of matter is into two types

1) Pure substances 2) Mixtures

A) Pure substances

It is a homogeneous material which contains particles of only one kind. All these particles will have a definite set of properties. Therefore all elements are pure substance & all compounds are also pure substances.

But there are some substances which appear as pure substances but are not pure substances. For example tap water, milk, honey, medicines & fruit juice.

1) A clear tap water is not a pure substance. It contains some dissolved salts and air. Due to the presence of dissolved salts water has taste.

2) Milk is not a pure substance because it contains fats, carbohydrates salts, vitamins, proteins and water in different proportions

3)Honey is not a pure substance because it contains a number of chemical molecules of other substances in addition to sugar. Fruit juice is not a pure substance as it contains sugar, mineral salts and a number of organic compounds.

Medicines are prepared by mixing different substances in different proportions.

The substances containing particles of only one kind are called **pure substances.**
Examples: Iron, Silver, Oxygen, Carbon dioxide, Sodium Chloride etc.

✪ **Pure substances are further divided into elements and compounds.**

§§ Elements

Definition: Substances, which cannot be broken further into any other substances by any physical or chemical means, are called **'Elements'.**

Example : Hydrogen, oxygen, nitrogen, copper, zinc, tin, lead, mercury, etc. are all elements as they cannot be subdivided into simpler parts by any **chemical means.** A substance made up of the atoms with same atomic number is called an **element.**

¶¶ Characteristics of an element:

i) *Nature:* An element is a pure and homogeneous substance.
ii) *Melting and Boiling points:* It has characteristic melting and boiling points.
iii) *Separation of components:* An element cannot be broken down into simpler substances, by any physical or chemical means.
iv) *Nature of Atoms:* An element is made up of same kind of atoms. Different elements are made up of different kinds of atoms.
v) *Chemical Reaction:* An element may chemically react with other element(s), to form compound(s). For example, hydrogen combines with oxygen, to form water, and with chlorine to form hydrogen chloride.

§§ Existence of elements

1) Majority of the elements are solids.
Ex :- i) Sodium (Na) ii) Carbon (C) iii) Lead iv) Potassium

2) Only two elements are liquids at room temperature.
Ex :- i) Mercury (Hg) ii) Bromine (Br)

3) Eleven elements are gases at room.
Ex :- i) Hydrogen (H) ii) Oxygen (O) iii) Chlorine (Cl)

4) All noble elements are gases.
Ex :- of Noble gases are : i) Helium (He) ii) Neon (Ne) iii) Argon (Ar)
iv) Krypton (Kr) v) Xenon (Xe) vi) Radon (Rn)

Elements are represented by symbols. Symbols are used for convenience and for easy learning.Short hand notation of an element is called **symbol**

Symbols of elements with single letter: First letter (in capital) only used.

Name of Element	Symbol	Name of Element	Symbol
Hydrogen	H	Potssium	K
Boron	B	Flourine	F
Carbon	C	Iodine	I
Nitrogen	N	Phosphorus	P
Oxygen	O	Sulphur	S

Symbols of elements with two letter: First letter is capital and second letter is always small.

Name of Element	Symbol	Name of Element	Symbol
Helium	He	Zinc	Zn
Lithium	Li	Copper	Cu
Beryllium	Be	Managanese	Mg
Sodium	Na	Bromine	Br
Magnesium	Mg	Tin	Sn
Aluminium	Al	Neon	Ne
Silicon	Si	Argon	Ar
Chlorine	Cl	Krypton	Kr

Symbols of elements derived from latin names

Name of Element	Latin Name	Symbol
Sodium	Natrium	Na
Potassium	Kalium	K
Iron	Ferrum	Fe
Copper	Cuprum	Cu
Silver	Argentum	Ag
Gold	Aurum	Au
Tin	Stannum	Sn
Antimony	Stibium	Sb
Mercury	Hydrargynum	Hg
Lead	Plumbum	Pb
Tungsten	Wolfarm	W

Some elements are named after the scientist		
Element	**Scientist Name**	**Symbol**
Curium	Madam Curie	Cm
Einsteinium	Albert Einstein	Es
Fermium	Enrico Fermi	Fm
Nobelium	Alfred Nobel	No
Mendelevium	Mendeleev	Md
Bohrium	Neils Bohr	Bh
Rutherford	Rutherford	Rf

Some elements are named after the countries and the laboratories

Name of Element	Country and Laboratory	Symbol
Berkelium	City of Berkely	Bk
Californium	University of California	Cf
Polonium	Poland	Po
Americium	America	Am
Ruthenium	Russia	Ru
Germanium	Germany	Ge

Some elements are named after the Planets		
Element	**Name of the Planet**	**Symbol**
Uranium	Uranus	U
Neptunium	Neptune	Np
Plutonium	Pluto	Pu

§§ Classification of Elements:

i) Metals ii) Non-metals iii) Metalloidiv) Noble gases

i) Metals :

An element is a metal, if it has the following characteristics :

i) It has a lustre, i.e., it has a metallic glow.
ii) It is a good conductor of heat and electricity.
iii) It is ductile, i.e., it can be drawn into wires.
iv) It is malleable, i.e., it can be beaten into sheets.
v) It is solid at room temperature.
vi) It has a high melting point and high boilding point.
viii) It produces a sonorous sound on being hit.

✪ **Exception:** Mercury and Gallium are liquid metals at 30°C. Zinc is not malleable and ductile at room temperature. Sodium, Potassium, Calcium, Lead do not have high melting points.

LIST OF COMMON METALS IN VARIOUS LANGUAGES

Name in English	Name in Language Other than English	Symbol
Sodium	Natrium (Latin)	Na
Potassium	Kalilum (Latin)	K
Iron	Ferrum (Latin)	Fe
Copper	Cuprum (Latin)	Cu
Silver	Argentum (Latin)	Ag
Tin	Stannum (Latin)	Sn
Gold	Aurum (Latin)	Au
Mercury	Hydrargynum (Latin)	Hg
Lead	Plumbum (Latin)	Pb
Tangsten	Wolfram (German)	W

NOTE: Remember first letter in a symbol is always capital and second letter always small.

ii) Non-metals:

An element is a non-metal, if it has the following characteristics :

i) It has no lustre, i.e., it cannot be polished.
ii) It is a bad conductor of heat and electricity.
iii) It is not ductile, i..e., it cannot be drawn into wires.
iv) It is non malleable i.e., it cannot be beaten into sheets.
v) It is a gas or a brittle solid at room temperature.
vi) It has low melting point and low boiling point.
vii) It does not produce a sonorous sound on beating hit.

✪ **Exception :**

1. **Graphite** (an allotrope of carbon) has a lustre and is a good conductor of heat and electricity.
2. **Bromine** is a liquid non-metal.

LIST OF COMMON NON-METALS WITH SYMBOLS AND FORMULA

State	Colour	Symbol	Formula
Gas	Colourless	H	H_2
Gas	Colourless	N	N_2
Gas	Colourless	O	O2
Gas	Colourless	F	F_2
Liquid	Red	Br	Br_2
Solid	Greyish Brown	I	I_2
Solid	Grey	C	C_{60}
Solid	Waxy yellow	P	P_4
Solid	Yellow	S	S_8
Solid	Grey	Si	Si

iii) Metalloids:

Elements which exhibits some properties of metals and some properties of non-metals are called **metalloids.**

Example: Boron (B), Silicon (Si), Germanium (Ge), Arsenic (As), Antimony (Sb) Tellurium (Te) and Polonium (Po)

iv) Noble Gases :

These elements are found in air in the form of gas in very small amounts, therefore, sometimes are called **rare gases.**

They are called noble gases, because they do not react chemically with any known element.Table given below shows a list of noble gases.

LIST OF NOBLE GASES

Noble gases	Helium	Neon	Argon	Krypton	Xenon	Radon
Symbol	He	Ne	Ar	Kr	Xe	Rn

Note: Helium is the second lightest element after hydrogen.

Radon is given out by the radioactive emission from earth.

Table shows the list of major elements present in Earth's crust.

MAJOR ELEMENTS IN EARTH'S CRUST

Element	Percentage by weight
Oxygen	49.85
Silicon	26.03
Aluminium	7.28
Iron	4.12
Calcium	3.18
Sodium	2.33
Potassium	2.33
Magnesium	2.11
Hydrogen	0.97
Titanium	0.41
Other elements	1.39

§§ **Atomicity of an Element:** Number of atoms present in one molecule of an element is called Atomicity .

Generally, elements exist as single atoms. However, sometimes two or more atoms of an element combine with one another to form a compound atom or molecule. Depending upon the number of atoms present in its molecule, the elements can be classified as under :

1. **Monoatomic elements:** The molecule of a monoatomic element contains only one atom, e.g., copper (Cu), silver (Ag), noble gases (Ne, Ar).
2. **Diatomic elements:** The molecule of a diatomic element contains two atoms, e.g., hydrogen (H_2); Oxygen (O_2), nitrogen (N_2) etc.,
3. **Polyatomic elements:** The molecule of a poly atomic element contains more than two atoms eg., Ozone (O_3), Phosphorous (P_4) Sulphur (S_8), boron (B_{12}) and carbon (C_{60})

Definition of Atomicity: The number of atoms present in one molecule of an element is called its atomicity.

¶¶ **Existance of elements in different states amd nature**

1. 104 elements occur as solids.
2. 11 elements occur as gases
3. 2 elements occur as liquids.
4. 93 elements occur as metals.
5. 11 elements occur as non-metals.
6. 6 elements occur as noble gases.
7. 7 elements occurs as metalloids.

TEACHING TASK

I) Single Correct Choice Type:

1. If we divide a pure substance, then ultimately there can be a small cluster which may or may not exist independently and yet retain all the properties of the chemical substance is called.
1) An atom 2) A molecule
3) An element 4) None of these.

2. Which of the following is a pure substance?
1) Milk 2) Honey 3) Cheese 4) Iron

3. Ag is the symbol for the element
A) Arsenic B) Gold C) Aluminium D)Silver

4. H ydragyrum and Wolfram are the latin names for the elements
A) Tungsten and Tin B) Tin and Tungsten
C) Mercury and Tungsten D)Silver

5. A symbol of an element has

A) Qualitative significance only B) Quantative significance only

C) Both A and B D) None

6. The molecular formula for Phosphorus is

A) P B) P_4 C) P_2 D) none

7. The symbol for the element Astatine is

A) As B) At C) Ai D) An

8. The symbol for the elements Magenesium and Silicon are

A) Mg and Si B)Mg and Sa C)Mn and Si D)Mg and Si

9. Element can be broken by which process

A) Heating B) Cooling C) Sunlight D) None

10. Liquid metal from the following

A) Mercury B) Iron C) Gold D) Sodium

11. Latin name for sodium

A) Kalium B) Natrium C) Sodium D) Cuprum

12. The short had representation of an element is called a

A) Element B) Symbol C) Formula D) Equation

13. Select the non-metals group from the following:

1) Na, K, A/ 2) Ge, Te, Po 3) Sn, Ba, Pt 4) H_2, N_2, O_2

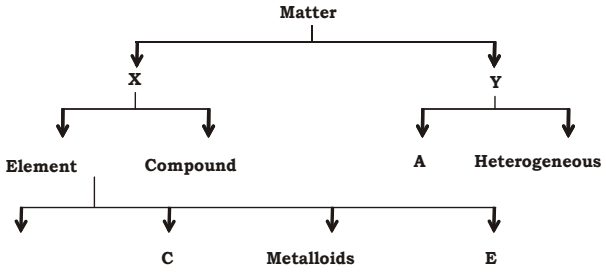
14. Which of the following elements are chemically inert?

1) All metals 2) All non-metals 3) All metalloids 4) Noble gases

15. Which of the following is the most abundant element in the earth's crust?

1) Oxygen 2) Carbon 3) Silicon 4) Nitrogen

16.



1) X → Pure substance, Y → Mixtures, A → Homogeneous mixtures, C → Non- metals, E → Noble gases.

2) X → Non-metals, Y → Mixtures, A → Homogeneous mixtures, C → pure substance, E → Noble gases.

3) X → Homogeneous mixtures, Y → Mixtures, A → Noble gases, C → pure

substance, E → Non-metals.

4) X → Pure substance, Y → Mixtures, A → Noble gases, C → Homogeneous mixtures, E → Non-metals.

17. Classify the following elements into metals, non-metals, noble gases: Na, N, Ne, Mg, F, Ar, Ca, Cl, Kr

METALS	NON-METALS	NOBLE GASES
1) Na, N, Ne, Mg, F, Ar Ca, Cl,		Kr
2) Na, Mg,Ca	N, F, Cl	Ne, Ar, Kr
3) Na, N, Mg	Ne, F, Ar Ca, Cl,	Kr
4) None		

II) Multi Correct Choice Type:

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which **ONE or MORE** is correct. Choose the correct options*

18. Which of the following statement(s) is/are false?

1) A pure substance is heterogeneous in nature.
2) The composition of a pure substance can be altered by any physical means.
3) A pure substance has definite set of properties.
4) A pure substance contains a fixed number of particles.

19. Which of the following is /are the latin names of element?

1) Plumbum 2) Kalium 3) Argentum 4) Aurum

20. Identify which of the following is / are metals :

1) Mercury 2) Vanadium 3) Calcium 4) Sodium

21. For which of the following elements atomicity is same

1) Hydrogen 2) Oxygen 3) Nitrogen 4) Chlorine

III) Reasoning Type:

- *This section contains certain number of questions. Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct Choose the correct option.*

22. ***Statement I :*** The substance containing particles of only are kind are called "pure substances".

Statement II : An element cannot be broken down into simple substance, by any physical or chemical means.

23. ***Statement I :*** Generally non-metals are bad conductors of heat and electricity.

Statement II **:** Bromine is a liquid non-metal.

24. ***Statement I :*** The molecule of a monoatomic element contains only one atom.

Statement II : The number of atoms present in one molecule of an element is called its atomicity.

IV) Comprehension Type:

- *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which **ONLY ONE i**s correct. Choose the correct option.*

A symbol represents short form of an element.the scientist who suggested a method of representing elements using the english letters (capitals as well as small) is J.J. Berzelius.

25. Identify the element which is named after the planet [ ]

1) Nitrogen 2) Neon 3) Neptunium 4) Nickel

26. An element named after the name of country "America" is

1) Californium 2) Americium 3) Ruthenium 4) Germanium

27. Identify the correct symbol for the element Palladium, Selenium and Curium are:

	Palladium	Selenium	Curium
1)	P	Sc	C
2)	Pt	S	Ca
3)	Pb	Sg	Cl
4)	Pd	Se	Cm

IV) Matrix Match Type:

*This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

28.

Column-I	**Column-II**
a) Elements with symbols derived from latin names	1) Mendelevium
b) Elements named after scientists	2) Natrium
c) Elements named after countries	3) Neptunium
d) Elements named after planets	4) Ruthenium

A) A-4,B-3,C-2,D-1 B) A-2,B-1,C-4,D-3

C) A-3,B-1,C-2,D-4 D) A-1,B-4,C-3,D-3

29.

Column-I ***Elements***	**Column-II** ***Latin Names***
a) Mercury	1) Ferrum
b) Lead	2) Aurum
c) Tin	3) Plumbum
d) Iron	4) Hydragyrum
	5) Stannum

30.

Column-I	**Column-II**
Non-metal	***Colour***
a) Iodine	1) Yellow
b) Carbon	2) Waxy Yellow
c) Phosphorous	3) Grey
d) Sulphur	4) Greyish brown
	5) Red

KEY

1	2	3	4	5	6	7	8	9	10
A	4	D	C	C	B	B	A	D	A
11	12	13	14	15	16	17	18	19	20
2	4		4	1	1	2	2,4	1,2,3,4	1,2,3,4
21	22	23	24	25	26	27	28	29	30
1,2,3,4	2	2	2	3	1	4	a-2,b-1,c-4,d-3	a-4,b-3,c-5,d-1	a-4,b-3,c-2,d-1

LEARNER'S TASK

BEGINNERS (Level - I)

1. The atomicity of which among the following is the maximum

A) Helium B) flourine C) Ozone D) Sulphur

2. Which of the following gas is filled in electric bulbs

A) Oxygen B) Nitrogen C) Argon D) Krypton

3. Which of the following statements is /are false

A) the symbol of carbon monoxide is CO B) The symbol of copper is Cu

C) The symbol of Calcium is CA D) The symbol of carbon is C

4. Which of the following elements release harmful radiations

A) O B) Ni C) Rn D) I

5. Which of the following symbol of an element is derived from latin name

A)Bohrium B)Polonium C)Uranium D) P-otassium

6. which of the following is symbol of silver

A)Ag B)Ga C)Au D)Cd

7. Identify a pure substance from the following

A)Brick B) Wood C)Milk D)Iron

8. Which of the following are correct fror non metal

A) non lustre B) non ductile

C) Bad conductor of heat and electricity D) All of the above

9. Noble gases can be indetify exactly by following properties

A) Non-metal B) Gas C) Non-reactive D) Non-conductor

10. An element is made of

A) Two kinds of atoms B) Many kinds of atoms

C) One kind of atoms D) All kind of atoms

11. Which of the following are called coinage metals

A) Cu, Ag, Au B) Zn, Ag, Au C) Cu, Na, Au D) Cu, Ag, Pt

12. Name the the scientist who suggested a method of representing elements using the english letters

A) John dalton B) Berzelius C) A chaptal D) Priestly

13. Select liquid metal from the following

A) Bromine B) Mercury C) Silver D) Gold

14. Which one of the following is the most abundent element occur in the earth crust

A) Nitrogen B)Oxygen C)Hydrogen D)Helium

15. He, Ne, Ar, Kr, Xe, Rn are known as :

1) Trace elements 2) Rare gases

3) Inert gases 4) All the above

16. Bromine is a :

1) Liquid metal 2) Liquid non-metal

3) Liquid metalloid 4) None of the above

17. The approximate number of metalloids are:

1) 7 2) 33 3) 92 4) 104

18. Elements are classified into:

i) Metals ii) Non-metals iii) Metalloids iv) Noble gases

1) i, ii, iii 2) i, ii, iv 3) i, iii, iv 4) i, ii, iii and iv

19. Which of the following is not the characteristics of non-metals?

1) Non-lustrous 2) Bad conductor

3) Non-ductile 4) None

20. Which of the following non-metals is a good conductor of electricity?

1) Carbon (Graphite) 2) Nitrogen

3) Fluorine 4) None of the above

21. Which of the gases are colourless?

1) Hydrogen 2) Nitrogen 3) Oxygen 4) All the above

ACHIEVERS (Level - II)

Answer the following:

1. Write about the classsificaion of pure substances

2. Name the elements which are liquids at room temperature

3. Write three examples of Non-Metallic solids

4. Does all the metals can be drawn into thin sheets and wires ? Justify

5. Write four differences between Metals and Non-Metals

6. Fill the following blanks

Name of Element	Latin Name	Symbol
Sodium	_____	Na
Potassium	Kalium	_____
Iron	_____	Fe
Copper	Cuprum	Cu
_____	Argentum	_____
Gold	Aurum	Au
Tin	_____	Sn
Antimony	_____	Sb
Mercury	_____	Hg
Lead	Plumbum	_____
_____	Wolfarm	W

EXPLORERS (Level - III)

II) Multi Correct Choice Type:

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which **ONE or MORE** is correct. Choose the correct options*

22. Which of the following statement(s) is/are true?

1) Graphite is a non-metal.

2) Mercury is the liquid metal at room temperature.

3) Iodine is a solid.

4) Bromine is a liquid non-metal at room temperature.

23. Which of the following is/are characteristic(s) of metal?

1) They are malleable.

2) They are ductile.

3) They have lustre.

4) They have high melting point and boiling point.

III) Reasoning Type:

- *This section contains certain number of questions. Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct Choose the correct option.*

a) Both A and R are correct and R is correct explanation of A.

b) Both A and R are correct and R is not correct explanation of A.

c) A is correct and R is incorrect. d) A is incorrect and R is correct.

24. ***Statement I:*** Metals are ductile and malleable.

Statement II: Metalloids exhibit both metallic and non-metallic properties.

25. ***Statement I :*** Mercury and Gallium are liquid metal at 30^0C

Statement II : Sodium, Potassium, Calcium, Lead do not have high melting points.

IV) Comprehension Type:

- *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which **ONLY ONE i**s correct. Choose the correct option.*

Generally elements exists in single atom, sometimes two or more atoms of an element combine with one another to form compound atom or molecule.

26. Identify which of the following is monoatomic element?

1) Ozone 2) Phosphorous

3) Nitrogen 4) Silver

27. The molecule of contain two atoms called :

1) Monoatomic 2) Both 1 & 4 3) Diatomic 4) Polyatomic

28. Identify which of the following is polyatomic element :

1) Phosphorous 2) Boron 3) Sulphur 4) All the above

V) Matrix Match Type:

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

29.

Column-I	**Column-II**
Element	***Symbol***
a) Hydrogen	1) Al
b) Aluminium	2) Ca
c) Calcium	3) F
d) Flourine	4) H
	5) He

30.

Column-I	**Column - II**
a) Pure substances	1) Element
b) Platinum	2) Ag
c) Silver	3) Iron, silver, oxygen, etc.,
d) Calcium	4) Ca
	5) Pt

§§ **Molecule:**

The smallest unit of a pure substance which always exists independently and can retain all the chemical and physical properties of that substance is called molecule.Molecules exist as groups (or) clusters of atoms.These clusters (or) molecules can be of two kinds :-

§§ **Molecules of elements :**

The molecules of an element contain two similar atom chemically bonded together, for example ozone gas has 3 oxygen atoms combined together , so ozone exists in the form of O_3. A recently discovered form of carbon, called Buckminster fullerene has molecular formula C_{60}.

§§ **Molecules of compounds :**

The molecules of a compound contain two or more different types of atoms chemically bonded together. For example : the molecule sulphur dioxide (SO_2) contain one atom of sulphur chemically bonded with two atom of oxygen.

¶¶ ***Examples of molecules of different elements :-***

Molecules of Same kind of atoms	*Molecules of different kinds of atoms*
1) (H) (H) molecule of hydrogen	1) (H) (Cl) Molecule of Hydrogen Chloride
2) (O) (O) molecule of oxygen	2) (C) (O) Molecule of Carbondioxide
	3) (H) (O) (H) molecule of Water
	4) (Na) (Cl) Molecule of Sodiumchloride

The molecules of elements contain atoms of only one kind.

The number of atoms in a molecule of an element is known as atomicity of the element. For example -The atomicity of the noble gases is 1, that of hydrogen, nitrogen, oxygen etc. is 2 each and of ozone is 3. Thus, noble gases, hydrogen and ozone are respectively monoatomic, diatomic and triatomic molecules.

Examples:

§§ **Symbols of Molecules of some kind of elements**

Elements	*Symbol of molecule*	*Number of atoms in one molecule (Atomicity)*
1. Hydrogen	H_2	2
2. Nitrogen	N_2	2
3. Oxygen	O_2	2
4. Fluorine	F_2	2
5. Chlorine	Cl_2	2
6. Bromine	Br_2	2
7. Iodine	I_2	2
8. Ozone	O_3	3
9. Phosphorus	P_4	4
10. Sulphur	S_8	8

§§ COMPOUND :

A pure substance, which is composed of **two or more elements, combined chemically in a definite ratio,** such that it can be broken into elements only by **chemical means** is called **compound.**

The two or more elements present in a compound are called **constituents or components** of the compound. For example, **water** is a compound of hydrogen and oxygen, combined together in the **ratio of 1 : 8 by weight.** The water can be broken into its **constituents** only by **electro-chemical method,** i.e., by passing electric current through it.The compounds can be further classified as acids, bases and salts. Sulphuric acid, nitric acid, hydrochloric acid, formic acid, etc. are the compounds which can be classified as acids.Sodium hydroxide, potassium hydroxide, zinc hydroxide and calcium hydroxide can be classified as bases. Ammonium chloride, zinc sulphate, lead nitrate and calcium carbonate can be classified as salts.

✪ **It must be pointed out that salts are formed by the chemical reaction between acids and bases.**

§§ Formula of a compound:

By combining the elements in different combinations, we can make an endless number of compounds.

Each compound is represented by a formula. Following information is given by the formula of a compound :

i) It tells which elements are present in a compound.

ii) It tells the number of atoms of each element present in a compound.

§§ Definition of formula:

A symbolic representation of one molecule of a compound representing the number of atoms of various elements present in it, is called **formula of compound.**

How to read information in the formula of a compound?

i) The symbols in a formula can be prefixed or suffixed by a numeral. When the numeral is written on the **left hand side before the formula,** it represents **number of molecules of the compound** and, hence the **number of atoms present in each molecule.**

For examples :

a) When we write 2S, 3Cl or 4Al, it means two atoms of sulphur, three atoms of chlorine or four atoms of aluminium respectively.

b) When we write 2NaCl, 4ZnO, etc., it means two molecules of sodium chloride (which contain two atoms of sodium and two atoms of chlorine), four molecules of zinc oxide (which contain four atoms of zinc and four atoms of oxygen) respectively.

ii) When the numeral is written on the **right bottom side of the symbol,** it represents the **number of atoms in one molecule** of a compound. Following examples will make it clear:

Example : Water is a compound whose one molecule is made up of two atoms of hydrogen and one atom of oxygen and hence its chemical formula is H_2O.

◆ While writing the formula of an ionic compound the metal is written on the left hand side while the non-metal is written on the right hand side. The name of the metal remains as such but that of the non-metal is changed to have the ending 'ide'.

Example : MgO is named as magnesium oxide, KCl is named potassium chloride etc.

◆ **Molecular compounds**, formed by the combination between two different non-metals, are written in such a way that the less electronegative element is written on the left hand side while the more electronegative element is written on the right hand side. In naming molecular compounds, the name of the less negative non-metal is written as such but the name of the more electronegative element is changed to have the ending **'ide'**.

Example : H_2S is named as hydrogen sulphide.

When there are more than one atoms of an element are present in the formula of the compound, then the number of atoms are indicated by the use of appropriate prefixes (Mono for : 1, di for 2, tri for 3. tetra for 4 atoms etc.) in the name of the compound.

Example : CO_2 is named as carbon di oxide, CCl_4 is named as carbon tetra chloride.

The prefixes are needed in naming those binary compounds in which the two non-metals form

more than one compounds (by having different number of atoms).

Example : Two non-metal, nitrogen and oxygen, combine to form different compound like nitrogen monoxide (NO), nitrogen di-oxide (NO_2), Nitrogen tri oxide (N_2O_3) etc.

◆ But, if two non-metals form only one compound, then prefixes are not used in naming such compounds.

Example : Hydrogen and sulphur combine to form only one compound H_2S, So, H_2S is named as hydrogen sulphide and not hydrogen monosulphide.

Formulae of some important common compounds

Name of Some important Compounds	Common Name	Formula
Sodium Hydroxide	Caustic Soda	NaOH
Calcium Oxide	Quick Lime	CaO
Calcium Hydroxide	Slacked Lime	$Ca(OH)_2$
Calcium Carbonate	Lime Stone	$CaCO_3$
Sodium Chloride	Common Salt	NaCl
Copper Sulphate	Blue Vitriol	$CuSO_4$
Sodium Carbonate	Washing Soda	$Na_2CO_3.10H_2O$
Sodium Bicarbonate	Baking Soda	$NaHCO_3$

Formulae of some common gaseous compounds :

Name of Gaseous Compound	Formula
Carbon Dioxide	CO_2
Caron Monoxide	CO
Sulphur Dioxide	SO_2
Nitrogen Dioxide	NO_2
Steam (Water Vapour)	H_20

Formulae of some common metal oxides

The compounds of metals with oxygen are called metal oxides.

Name of Metallic Oxide	Formula
Magnesium Oxide	MgO
Calcium Oxide	CaO
Zinc Oxide	ZnO
Copper Oxide	CuO
Lead Oxide	PbO
Iron Oxide	FeO
Mercuric Oxide	HgO
Lithium Oxide	Li_2O

Formulae of some common metal sulphides

The compounds of metals with sulphur are called metal sulphides.

Name of Metallic Oxide	Formula
Magnesium Sulphide	MgS
Calcium Sulphide	CaS
Zinc Sulphide	ZnS
Copper Sulphide	CuS
Lead Suphide	PbS
Iron Sulphide	FeS

§§ **IONS :** An ion is a positively or negatively charged atom (or group of atoms)

These are two type of ions :

(1) cations (2) anions

(1) **Cations :** A positively charged ion is known as cation. For example : Sodium ion:Na^+, Magnesium ion: Mg^{2+}

A cation is formed by the loss of one or more electrons by an atom

For example : sodium atom, loses one electron to form a sodium ion Na^+

$Na \xrightarrow{-1e^-} Na^+$ sodium ion

Sodium atom (A cation)

(2) **Anions :** A negatively charged ion is known as anion. Cl^- (chloride ion), O^{-2} (oxide ion) etc.

An anions is formed by the gain of one or more electrons by an atom. For example a chlorine atom gains one electron to form a chloride ion Cl^-.

I $Cl \xrightarrow{+e^-} Cl^-$

Chlorine atom Chloride ion (An anion)

TEACHING TASK

I) Single Correct Choice Type:

1. Which of the following statement is correct

1) Common name of Sodium Hydroxide is Caustic Soda

2) Formula of Quick Lime is $Ca(OH)_2$

3) Chemical name of Washing Soda is Sodium Carbonate

4) All the above

2. Which of the following Formulas are correctly matched

1) Carbon Dioxide CO

2) Caron Monoxide CO_2

3) Sulphur Dioxide SO_3

4) Nitrogen Dioxide NO_2

3. Which of the following information is given by the formula of a compound :

A)It tells which elements are present in a compound.

B)It tells the number of atoms of each element present in a compound.

C)Both A and B

D)None

4. Which of the following is not a compound?

1) Marble 2) Washing soda

3) Quick lime 4) Coal

5. Identify the metals present in the following compounds

(i) Sodium sulphate (ii) Calcium nitrate (iii) Aluminium chloride

1) (i) $\rightarrow$ Na (ii) $\rightarrow$ Ca, (iii) $\rightarrow$ Al 2) (i) $\rightarrow N_2$, (ii) $\rightarrow Cl_2$, (iii) $\rightarrow O_2$

3) (i) $\rightarrow$ Po, (ii) $\rightarrow$ C, (iii) $\rightarrow$ Ag 4) (i) $\rightarrow O_2$, (ii) $\rightarrow N_2$, (iii) $\rightarrow Cl_2$

6. Identify the elements present in the given compounds?

(i) CCl_4 (ii) NH_3 (iii) SO_2

1) (i) $\rightarrow$ Calcium,Chromium (ii) $\rightarrow$ Ammonia,Helium, (iii) $\rightarrow$ Sodium,Ozone

2) (i) $\rightarrow$ Carbon, Chlorine, (ii) $\rightarrow$ Nitrogen, Hydrogen, (iii) $\rightarrow$ Sulphur, Oxygen

3) (i) $\rightarrow$ Copper, Cobalt, (ii) $\rightarrow$ Neon, Helium, (iii) $\rightarrow$ Selenium, Ozone

4) (i) $\rightarrow$ Chlorine, Cobalt, (ii) $\rightarrow$ Nickel, Hydrogen, (iii) $\rightarrow$ Silicon, Oxygen.

7. Identify the metal chloride from the following:

1) HC*l* 2) S_2Cl_2 3) NaC*l* 4) A*l*S

II) Reasoning Type:

- *This section contains certain number of questions. Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct Choose the correct option.*

8. ***Statement I :*** One molecule of sulphur dioxide has one atom sulphur and two atoms of oxygen.

Statement II : The compound of metal with sulphur are metal sulphides.

1. Both statement I and II are correct and statement II is correct explanation of statement I.
2. Both statement I and II are correct and statement II is not correct explanation of statement I.
3. Statement I is correct and statement II is incorrect.
4. Statement I is incorrect and statement II is correct.

V) Matrix Match Type:

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

*If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

9.

Column-I	**Column-II**
a) Sodium Hydroxide	1) $AgNO_3$
b) Calcium carbonate	2) KNO_3
c) Potassium nitrate	3) NaCl
d) Silver nitrate	4) $CaCO_3$
	5) NaOH

10.

Column-I	**Column-II**
a) Nitrogen dioxide	1) CH_4
b) Steam	2) CO_2
c) Carbon monoxide	3) CO
d) Methane	4) H_2O
	5) NO_2

KEY

1	2	3	4	5	6	7	8	9	10
D	D	C	1	2	3	4	2	a-5,b-4,c-2,d-1	a-5,b-4,c-3,d-1

LEARNER'S TASK

BEGINNERS (Level - I)

I) Single Correct Choice Type:

1. Water is a_____.

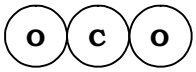
1) Element 2) Compound 3) Mixture 4) None of these.

2. Identify which of the following is / are compounds:

1) H_2SO_4 2) $AlCl_e$ 3) HgS 4) All the above

3. When the molecule of a pure substance contains two or more atoms of different elements combined together in a definite ratio, then it is said to be

1) An atom of molecule 2) A molecule of a compound
3) An element 4) None of these

4. 

represents:

1) A molecule. 2) A compound 3) A mixture. 4) All of these

5. The molecules of which of the following substances will contain the same kind of atoms?

1) Oxygen 2) Water
3) Carbon dioxide 4) Sulphur dioxide

6. The process of breaking down of a chemical compound into its elements by chemical means, is called:

1) Analysis 2) Synthesis 3) Cracking 4) None of the above.

ACHIEVERS (Level - II)

Answer the following:

1. O_2 is a molecue or a compound why?

2. Write any three differences between molecule and compound

3. What information does the the formula of a compound give

4. Write the chemical name and formula of the following

A) Washing soda
B) Baking Soda
C) Slaked Lime
D) Lime stone

5. Fill the following blanks

Name of Some important Compounds	Common Name	Formula
_____	Caustic Soda	NaOH
Calcium Oxide	_____	CaO
_____	_____	$Ca(OH)_2$
Copper Sulphate	_____	$CuSO_4$
_____	_____	$Na_2CO_3.10H_2O$
Sodium Bicarbonate	_____	$NaHCO_3$

EXPLORERS(Level - III)

II) Multi Correct Choice Type:

- *This section contains multiple choice questions. Each question has 4 choices (A), (B), (C),(D), out of which **ONE or MORE** is correct. Choose the correct options*

7. Which one of the following is not a characteristic of compound?

1) Elements unite chemically in a fixed proportion.
2) Constituents are present in a fixed ratio by weight.
3) Compounds are always homogeneous.
4) During its formation energy changes take place.

III) Reasoning Type:

- *This section contains certain number of questions. Each question contains Statement – 1 (Assertion) and Statement – 2 (Reason). Each question has 4 choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct Choose the correct option.*

8. ***Statement I :*** H_2CI is the formula for hydrochloric acid.
Statement II : The representation of a molecule of a substance (element or compound) in terms of symbols and subscript numbers is known as the formula.

9. ***Statement I :*** Formula of compound tells the elements present in a compound.
Statement II : A pure chemical compound is homogenous in nature.

1. Both statement I and II are correct and statement II is correct explanation of statement I.
2. Both statement I and II are correct and statement II is not correct explanation of statement I.
3. Statement I is correct and statement II is incorrect.
4. Statement I is incorrect and statement II is correct.

IV) Comprehension Type:

- *This section contains paragraph. Based upon each paragraph multiple choice questions have to be answered. Each question has 4 choices (A) , (B) ,(C) and (D) out of which **ONLY ONE i**s correct. Choose the correct option.*

The symbolic representation of one molecule of a compound representing the number of atoms of various elements present in it, is called formula of compound.

10. Washing soda has a formula

1) $Na_2CO_3.7H_2O$ 2) $Na_2CO_3.H_2O$
3) $Na_2CO_3.10H_2O$ 4) Na_2CO_3

11. Baking powder is

1) $NaHCO_3$ 2) Na_2CO_3 3) $KHCO_3$ 4) K_2CO_3

12. Which one of the following is not the correct formula?

1) H_2S 2) $NaHSO_4$ 3) SiO_2 4) $NaCI_2$

V) Matrix Match Type:

- *This section contains Matrix-Match Type questions. Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in **Column–I** have to be matched with statements (p, q, r, s) in **Column–II**. The answers to these questions have to be appropriately bubbled as illustrated in the following example.*

  *If the correct matches are A-p,A-s,B-r,B-r,C-p,C-q and D-s,then the correct bubbled 4*4 matrix should be as follows:*

13.

Column-I	**Column-II**
a) Metal oxide	1) $NaHCO_3$
b) Metal sulphide	2) NO_2
c) Baking soda	3) PbS
d) Nonmetallic oxides	4) CO_3
	5) ZnO

KEY

1	2	3	4	5	6	7	8	9	10
B	D	B	B	A	A	1,2,3,4	4	2	C
11	12	13							
A	4	a-5,b-3,c-1,d-2,4							