CHAPTER 2

ELEMENTS, COMPOUNDS & MIXTURES

LATEST SYLLABUS – Key Concepts / Concerns

- Element [a substance made up of identical atoms].
  - Use of symbols as short hand notations of writing names of elements. - Origin of symbols of elements.
  - Names & symbols of first 20 elements. - Molecules of elements contain atoms of the same element [O_2, N_2, H_2].
- Compound [two or more than two elements combine in fixed definite proportions to form a compound. Original properties of the constituent elements are lost and a substance with new properties is formed].
  - Molecules of compounds contain atoms of different elements. [H_2O, CO_2, NO_2, CaO, $ZnCl_2$].
- Mixture [components of more than one substance combine in any proportion, *original properties of the components are retained*].
- Difference between mixtures & compounds [on the basis of *proportion of combination of components & their properties*].
- Separation techniques of mixtures into their components:
  - Sieving - Sedimentation - Decantation - Filtration - Evaporation - Magnetic Separation.

Learning Outcomes:

Children will be able to:

- define elements as made up of identical atoms;
- classify elements as metals & non-metals on the basis of their properties;
- define compound and mixture and discuss the points of difference between the two;
- use symbols of elements & molecular formulae of the compounds to represent their names as short hand notations;
- separate different components of samples of some mixtures;
- discuss the reasons for opting for a particular technique for separation of components of the mixture.

UNIT 1 – ELEMENTS & COMPOUNDS

A. INTRODUCTION – ELEMENTS, COMPOUNDS & MIXTURES

SUBSTANCES

- **PURE SUBSTANCES**
  - **ELEMENTS**
    - METAL
    - NON-METAL
  - **COMPOUNDS**
- **IMPURE SUBSTANCES**
  - **MIXTURES**

Iron

Sulphur

Iron sulphide

Iron & sulphur mixture

- **ELEMENT** – made up of
  - IDENTICAL ATOMS ONLY
    - cannot be broken into two or more simpler substances.
- **COMPOUND** – made up of
  - TWO OR MORE DIFFERENT ELEMENTS
    - can be broken down into elements by chemical means.
- **MIXTURE** – made up of
  - TWO OR MORE SUBSTANCES
    - mixed in any proportion & substances retain their properties.

B. PHYSICAL PROPERTIES – Of substances

SUBSTANCES – Characteristic properties – of gases, solids & liquids

The important **physical properties** of substances are:

COLOUR	ODOUR	NATURE	DENSITY	SOLUBILITY	MELTING & BOILING POINT

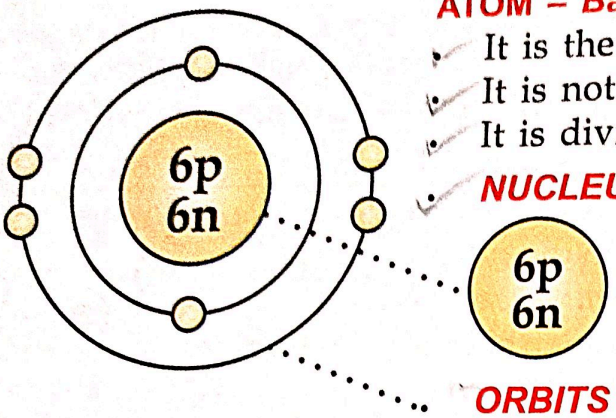
COLOUR	COLOURLESS	Oxygen, hydrogen, carbon dioxide, nitrogen, hydrogen chloride, ammonia, sulphur dioxide
	COLOURED	Chlorine – *greenish yellow,* Nitrogen dioxide – *reddish brown.*
ODOUR	ODOURLESS	Oxygen, hydrogen, carbon monoxide, carbon dioxide, nitrogen.
	HAVE ODOUR	*Pungent, choking odour.* Hydrogen chloride, chlorine, ammonia, sulphur dioxide
NATURE	POISONOUS	Chlorine, sulphur dioxide, ammonia, carbon monoxide.
	NON-POISONOUS	Oxygen, hydrogen, carbon dioxide, nitrogen, hydrogen chloride.
DENSITY	LIGHTER – than air	Hydrogen [lightest gas known], ammonia.
	HEAVIER – than air	Carbon dioxide, chlorine, sulphur dioxide.
	ALMOST AS HEAVY	Oxygen, carbon monoxide, nitrogen, hydrogen chloride.
SOLUBILITY IN WATER	HIGHLY – soluble	Hydrogen chloride, ammonia, sulphur dioxide.
	FAIRLY – soluble	Carbon dioxide, chlorine.
	SLIGHTLY – soluble	Oxygen, hydrogen, carbon monoxide, nitrogen.
MELTING & BOILING POINT	MELTING POINT	Temperature at which solids – just melt & change over to liquid.
	BOILING POINT	Temperature at which liquids – just boil & change over to vapour.
MALLEABILITY & DUCTILITY	MALLEABILITY	Ability of a substance to be – hammered into sheets e.g. metals.
	DUCTILITY	Ability of a substance to be – drawn into wires e.g. metals.

C. ELEMENTS – Term, basic unit, classification

1. TERM – Element

- An element is a pure substance – *made up of identical atoms.*
- An element cannot be broken down – into two or more simpler substances by – *any physical or chemical methods.*
- It is mainly classified into – Metals, Non-metals, Metalloids & Noble gases.

2. BASIC UNIT OF AN ELEMENT – Atom



ATOM – *Basic unit of an element*

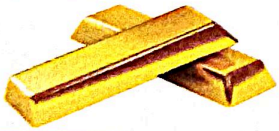
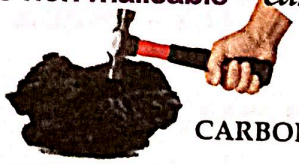
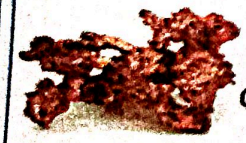
- It is the *smallest particle of an element.*
- It is not capable of independent existence.
- It is divisible as seen today into –
- **NUCLEUS –** in the centre of the atom which contains
  - *Protons* – positively charged particles.
  - *Neutrons* – particles carrying no charge.
- **ORBITS –** surround the nucleus in which revolve
  - *Electrons* – negatively charged particles.

ELEMENTS MADE UP OF IDENTICAL ATOMS

ELEMENT – *IRON*	Contains one type of atoms i.e. iron atoms.
– *SULPHUR*	Contains one type of atoms i.e. sulphur atoms.

3. CLASSIFICATION – Of elements

Elements are classified into – • *Metals* • *Non-metals* • *Metalloids* • *Noble gases*

METALLIC ELEMENTS	NON-METALLIC ELEMENTS
Have lustre – *shine.*  GOLD SHINES	Do not have lustre.  SULPHUR DOES NOT SHINE
Are malleable – *can be beaten into sheets.*  ALUMINIUM 	Are non-malleable – *cannot be beaten into sheets.*  CARBON 
Are ductile – *can be drawn into wires.*  COPPER 	Are non-ductile – *cannot be drawn into wires.*  PHOSPHORUS 
Are good conductors – *of heat & electricity.*	Are poor conductors – *of heat & electricity.*

- *Metalloids* – elements which show properties of both – *metals & non-metals.* e.g. boron.
- *Noble gases* – unreactive, inert elements present – *in traces in air.* e.g. helium, neon, argon.

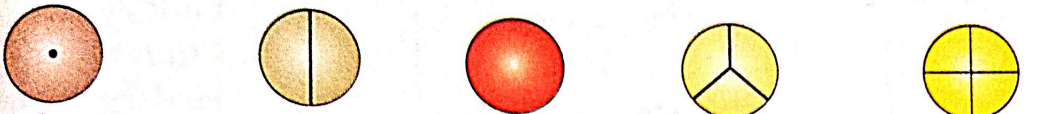
1. TERM – Symbols of elements

Denotes –	An atom – of an element
Is the short form –	Abbreviated name – of an element
Distinguishes –	One element from – another element.
Is characteristic –	Of that element only.

2. REPRESENTATION – Of symbols

JOHN DALTON – 1807 – Suggested – *figurative symbols* for atoms of elements.

• ***Figurative symbols***



Hydrogen Nitrogen Oxygen Phosphorus Sulphur

John Dalton [1807]

– Method discarded –

Since it was tedious and non-practical.

BERZELIUS – 1814 – Suggested representing elements with – *symbols.*

a] First letter of the name of element

Hydrogen	Carbon	Sulphur	Nitrogen
Symbol: H	*Symbol:* C	*Symbol:* S	*Symbol:* N

Berzelius [1814]

– Method not approved completely –

Since two elements can have the same first letter – e.g.

Carbon Calcium

b] First two letters of the name of element

Helium	Cobalt
Symbol: He	*Symbol:* Co

– Method approved –

Since certain symbols could be written in this manner.

c] Deriving symbols from their Latin names

Cuprum	Natrum	Plumbum
Symbol: Cu	**Symbol:** Na	**Symbol:** Pb

Cu = Copper

Na = Sodium

Pb = Lead

– Method approved –

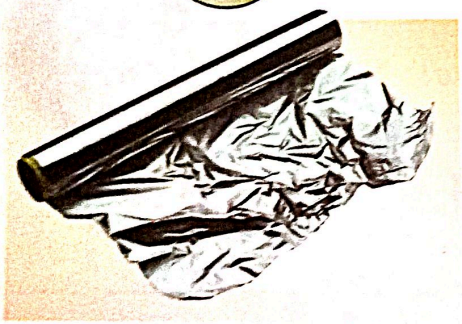
Since symbols derived from Latin names are widely used.

1. SYMBOLS OF ELEMENTS – Metallic elements

METALS	SYMBOL	LATIN NAME
1. POTASSIUM	K	Kalium
2. SODIUM	Na	Natrium
3. CALCIUM	Ca	Calx
4. MAGNESIUM	Mg	Magnesia
5. ALUMINIUM	Al	Alumen
6. ZINC	Zn	Zinken
7. IRON	Fe	Ferrum
8. LEAD	Pb	Plumbum
9. COPPER	Cu	Cuprum
10. MERCURY	Hg	Hydragyrum
11. SILVER	Ag	Argentum
12. PLATINUM	Pt	–
13. GOLD	Au	Aurum

ALUMINIUM

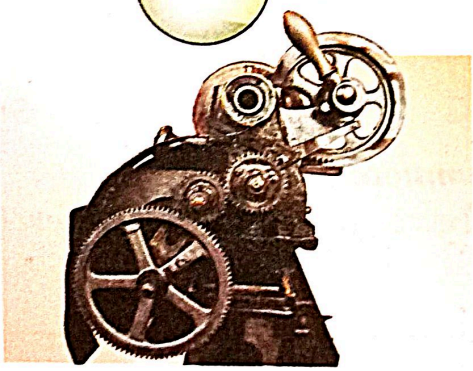
Al



Aluminium foil

IRON [STEEL]

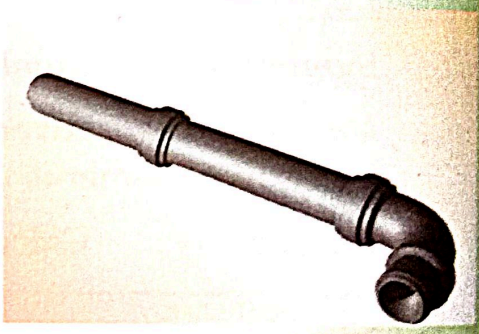
Fe



Steel machinery

LEAD

Pb



Lead pipes

COPPER

Cu

Copper utensils

MERCURY

Hg

Mercury thermometer

SILVER

Ag

Silver jewellery

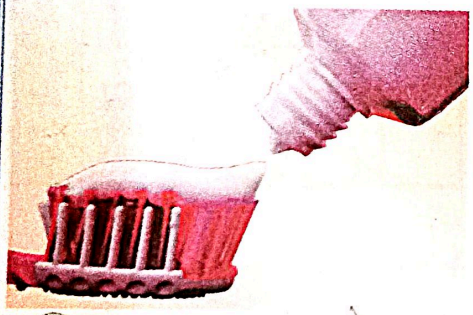
2. SYMBOLS OF ELEMENTS – Non-metallic elements & noble gases

NON-METALS	SYMBOL	STATE [at room temp.]
1. HYDROGEN	H	Gas
2. NITROGEN	N	Gas
3. OXYGEN	O	Gas
4. FLUORINE	F	Gas
5. CHLORINE	Cl	Gas
6. BROMINE	Br	Liquid
7. IODINE	I	Solid
8. CARBON	C	Solid
9. SULPHUR	S	Solid
10. SILICON	Si	Solid
11. PHOSPHORUS	P	Solid

Non-metals – *Hydrogen, nitrogen, oxygen* – are elements present in the atmosphere.
Fluorine, chlorine, bromine, iodine – are highly reactive *halogens*.

FLUORINE

F



Fluorine in tooth paste

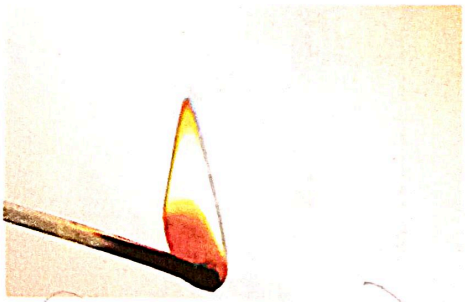
CHLORINE

Cl

Chlorine added to swimming pools

PHOSPHORUS

P



Phosphorus in matchstick

NOBLE GASES	SYMBOL	STATE
1. HELIUM	He	Gas
2. NEON	Ne	Gas
3. ARGON	Ar	Gas
4. KRYPTON	Kr	Gas
5. XENON	Xe	Gas
6. RADON	Rn	Gas

Noble gases – Inert, unreactive, non-metallic elements – present in traces in the atmosphere.

ELEMENTS – Names & symbols of first twenty elements in periodic table

1. ELEMENTS – In the periodic table

- **Number of elements** – Till date about – *118 elements have been discovered.*
- **Need for Classification of elements**

Scientists found a need for arranging all the elements in a – *systematic, simple manner.*
This arrangement of elements was done in the form of a table called – *Periodic Table.*

The Periodic Table

- *It is a table in which elements are arranged in* – increasing order of their – **atomic numbers.**
- *Atomic number of an element* –

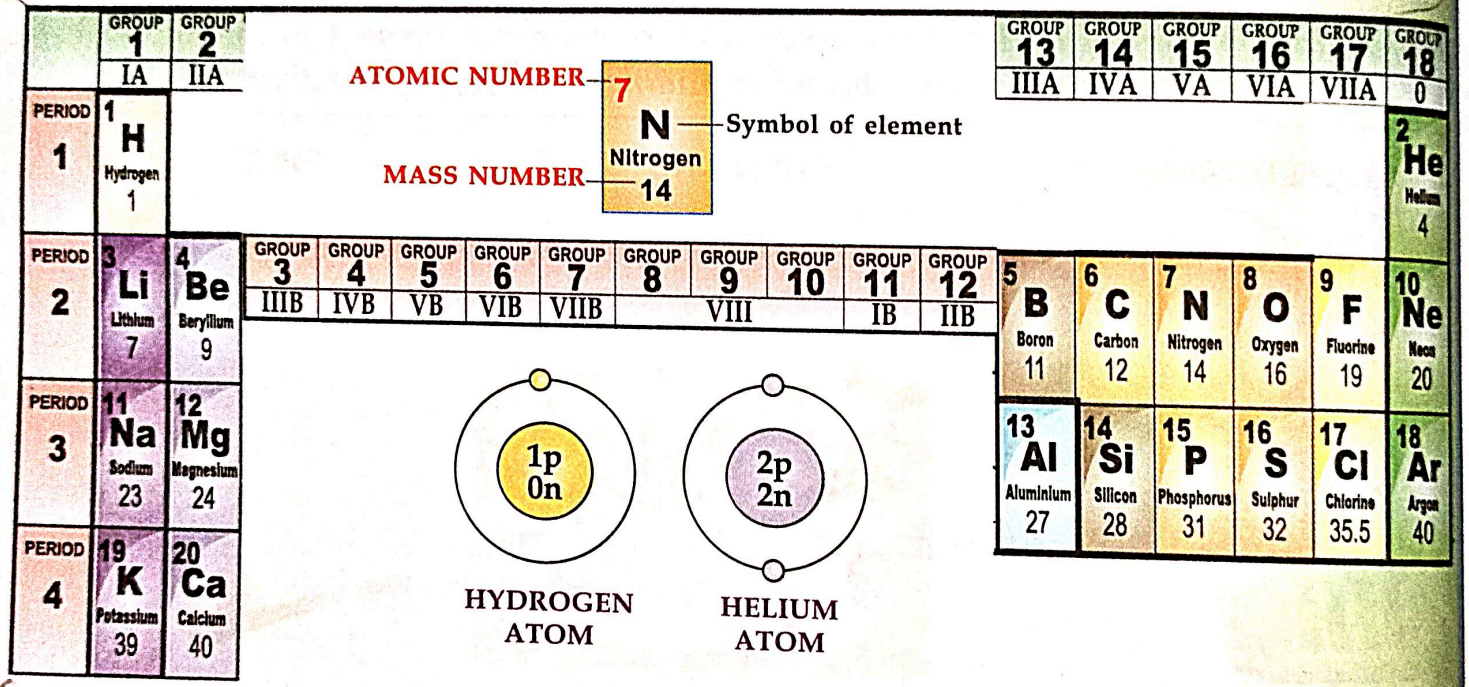
is the number of protons or electrons [*both are equal*] in an atom of an element. e.g. –

Hydrogen atom – has one electron – has atomic number one – is placed **first in the periodic table.**

Helium atom – has two electrons – has atomic number two – is placed **second in the periodic table.**

2. THE PERIODIC TABLE

The modern periodic table – Arrangement of elements from atomic numbers 1 to 20.



Elements – certain elements in the Modern Periodic Table – categorized into *metals, non-metals, metalloids & noble gases.*

METALS
Lithium
Beryllium
Sodium
Magnesium
Potassium
Calcium
Aluminium

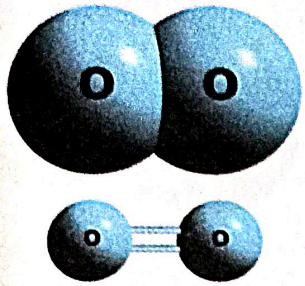
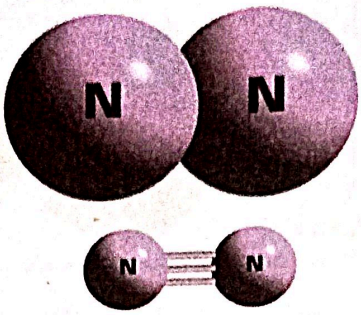
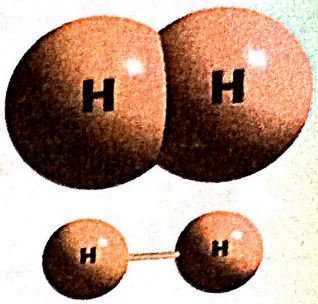
METALLOIDS	NON-METALS	NOBLE GASES
Boron	Carbon	Helium
Silcon	Nitrogen	Neon
	Oxygen	Argon
	Fluorine	
	Phosphorus	
	Sulphur	
	Chlorine	

D. MOLECULES

THE TERM – Molecules

Atoms of the –
- *same element* or
- *different elements* – combine to form a – *'molecule'.*

Atoms of the same element – forming a molecule

Oxygen	*Nitrogen*	*Hydrogen*
		

Diatomic molecules

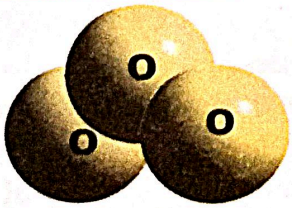
ELEMENT	MOLECULE	ATOMICITY
HYDROGEN- H	H_2	2
NITROGEN - N	N_2	2
OXYGEN - O	O_2	2
CHLORINE - Cl	Cl_2	2
BROMINE - Br	Br_2	2
IODINE - I	I_2	2

ATOMICITY

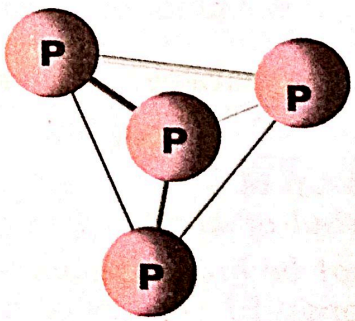
It is the number of atoms present in one molecule of the element.

Triatomic molecules & polyatomic molecules

ELEMENT	MOLECULE	ATOMICITY
OZONE -O	O_3	3
PHOSPHORUS - P	P_4	4



Ozone – O_3



Phosphorus – P_4

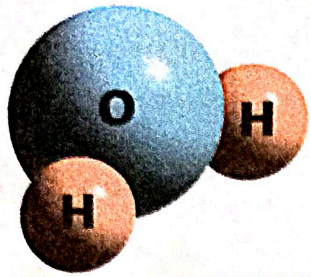
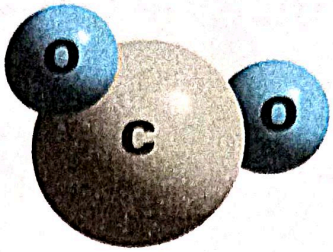
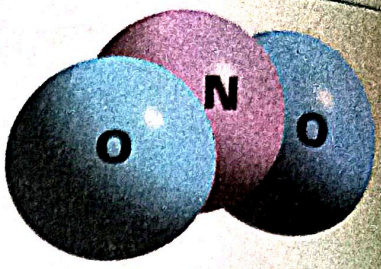
Atoms of different elements – form molecules of compounds. e.g. water [H_2O]

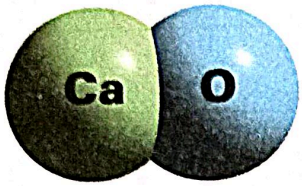
E. COMPOUNDS

THE TERM – Compounds

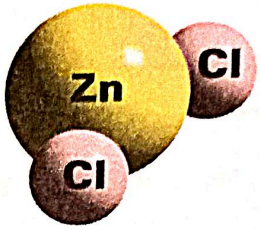
A compound is a pure substance made up of – two or more different elements combined chemically – *in a fixed proportion.*

Atoms of different elements – forming a compound

Water	Carbon dioxide	Nitrogen dioxide
		



Calcium oxide



Zinc chloride

Charactertistics of compounds

a] ELEMENTS IN A COMPOUND – *Are present in a definite proportion.*

e.g. 2 *atoms* of hydrogen – combines with *1 atom* of oxygen to give – *1 molecule of water* [compound].

b] COMPOUNDS – *Have a definite set of properties*

e.g. The properties of the compound *water* – are different from – the properties of the elements – *hydrogen* & *oxygen* in water.

c] ELEMENTS IN A COMPOUND – *Cannot be separated by physical methods*

e.g. In the compound – iron sulphide [FeS] – *Iron* cannot be separated from its compound *iron sulphide* - using a magnet.

Comparison between – Elements & compounds

ELEMENTS	COMPOUNDS
1. Made up of – *one kind of atoms.*	1. Made up of – *two or more kinds of atoms.*
2. *Cannot be broken down* – into simpler substances by physical or chemical methods.	2. *Can be broken down* – into simpler substances by chemical methods.
3. *Have their own set of* – properties.	3. *Properties differ* – from those of their elements.

COMPOUNDS – Formula of compounds

1. THE TERM – Chemical formula

Representation of a compound – by means of – *symbols.*
It denotes in a compound – the *number of atoms of each element* present.

Substance	Symbols	No. of atoms of each element present	Chemical formula
Sodium chloride	Na[*sodium*], Cl [*chlorine (chloride)*]	1 atom of – Na, 1 atom of – Cl	$NaCl$
Water	H [*hydrogen*], O [*oxygen (oxide)*]	2 atoms of –H, 1 atom of – O	H_2O
Carbon dioxide	C [*carbon*], O [*oxygen (oxide)*]	1 atom of – C, 2 atoms of – O	CO_2
Nitrogen dioxide	N [*nirogen*], O [*oxygen (oxide)*]	1 atom of – N, 2 atoms of – O	NO_2
Calcium oxide	Ca [*calcium*], O [*oxygen (oxide)*]	1 atom of – Ca, 1 atom of – O	CaO
Zinc chloride	Zn [*zinc*], Cl [*chlorine (chloride)*]	1 atom of – Zn, 2 atoms of – Cl	$ZnCl_2$

2. WRITING – A chemical formula of a compound

For writing a chemical formula – the following should be known.

i] SYMBOLS ii] THE COMBINING CAPACITY OF AN ELEMENT WITH HYDROGEN [*Valency*]

Combining capacity of an element

Chlorine	+	**Hydrogen**	→	**Hydrogen chloride**	**'HCl'**
1 atom		1 atom		1 molecule	
Oxygen	+	**Hydrogen**	→	**Water**	**'H_2O'**
1 atom		2 atoms		1 molecule	

– Elements thus have different combining capacities
In the above examples –
One atom of chlorine combines with – *1 atom of hydrogen* – but
One atom of oxygen combines with – *2 atoms of hydrogen.*
∴ Oxygen has twice the combining capacity of – chlorine [*with hydrogen*].
– The combining capacity is also called its – *valency.*
∴ **Valency of chlorine = 1; valency of oxygen = 2.**

Valency – will be taught in further classes

It is seen above that the chemical formula of *sodium chloride* is – $NaCl$ but the chemical formula of *zinc chloride* is – $ZnCl_2$ and not ZnCl.
For understanding the difference in the above formulas – let us study a few symbols of some elements & of a few radicals – alongwith their combining capacity [valency].

Symbol	Valency	Symbol	Valency	Symbol	Valency
Na	Na^{1+}	Cl	Cl^{1-}	Zn	Zn^{2+}

WRITING – A chemical formula of a compound

Revising – Symbols of elements [or radicals] and some simple combining capacities – for writing the chemical formula of some basic compounds.

Revising – Symbols of metals, non-metals & radicals

[*Radical* – is a group of atom of different elements (or single element) behaving as a single unit and having a charge.]

SYMBOLS – of some elements		SYMBOLS – of radicals
METALS	NON-METALS	Radicals - group of atoms of elements
• K [*potassium*]	• Cl [*chlorine*]	• NO_3 [*nitrate*]
• Na [*sodium*]	• Br [*bromine*]	• OH [*hydroxide*]
• Ca [*calcium*]	• I [*iodine*]	• SO_3 [*sulphite*]
• Mg [*magnesium*]	• O [*oxygen*]	• SO_4 [*sulphate*]
• Zn [*zinc*]	• S [*sulphur*]	• CO_3 [*carbonate*]
• Al [*aluminium*]	• C [*carbon*]	

A simple chart of some combining capacity of elements [valency]

METALLIC ELEMENTS [Positive valencies]			NON-METALLIC ELEMENTS [Negative valencies]	
Valency 1	Valency 2	Valency 3	Valency 1	Valency 2
K $[K^{1+}]$	Ca $[Ca^{2+}]$	Al $[Al^{3+}]$	Cl $[Cl^{1-}]$	O $[O^{2-}]$, ; S $[S^{2-}]$,
Na $[Na^{1+}]$	Zn $[Zn^{2+}]$			
			Radicals	*Radicals*
			NO_3 $[NO_3^{1-}]$	SO_4 $[SO_4^{2-}]$
			OH $[OH^{1-}]$	CO_3 $[CO_3^{2-}]$

For writing a chemical formula – some basic steps are

- Write the symbol of the element [radical] – with its combining capacity [valency]
- Interchange the combining capacity of the element [radical] i.e. valency
- Write the interchanged number and hence the formula.

Step		Step	
I	Na^{1+} Cl^{1-}	I	Zn^{2+} Cl^{1-}
II	Na^{1+} Cl^{1-} → 1 1	II	Zn^{2+} Cl^{1-} → 1 2
III	Na_1 Cl_1	III	Zn_1 Cl_2
	Formula = NaCl *[ignore 1]*		Formula = $ZnCl_2$

IMPORTANT CHEMICAL FORMULAS

GASES

Hydrogen	Nitrogen	Oxygen	Chlorine	Hydrogen chloride	Ammonia
H_2	N_2	O_2	Cl_2	HCl	NH_3

Carbon monoxide	Carbon dioxide	Nitrogen monoxide [nitric oxide]	Dinitrogen oxide [nitrous oxide]	Nitrogen dioxide	Sulphur dioxide
CO	CO_2	NO	N_2O	NO_2	SO_2

ACIDS

Acids are chemicals which are – *sour* in taste and derived from –

a] *Plants* e.g. citric acid [from oranges],

b] *Minerals* e.g. hydrochloric acid [HCl] – from mineral sodium chloride

HCl	HNO_3	H_2SO_4	H_2CO_3
Hydrochloric acid	*Nitric acid*	*Sulphuric acid*	*Carbonic acid*

BASES

Bases are chemicals which are – *bitter* in taste.

They are *hydroxides [or oxides]* of *metals.*

e.g. sodium hydroxide – NaOH [hydroxide of metal - Sodium (Na)]

KOH	NaOH	$Ca(OH)_2$	$Zn(OH)_2$
Potassium hydroxide	*Sodium hydroxide*	*Calcium hydroxide*	*Zinc hydroxide*

SALTS

Salts are chemicals formed on reaction of – a *base* with an *acid.*

Base + Acid → *Salt* + Water

KNO_3	NaCl	$CaCO_3$	NH_4Cl
Potassium nitrate	*Sodium chloride*	*Calcium carbonate*	*Ammonium chloride*

METALLIC OXIDES & SULPHIDES

ZnO	CaO	MgS	CaS
Zinc oxide	*Calcium oxide*	*Magnesium sulphide*	*Calcium sulphide*

REPRESENTING – A chemical reaction

Chemical equations will be studied in higher classes – but a basic idea is given below:

CHEMICAL EQUATION –

- **A chemical equation** – is a *shorthand form* representing – the result of a chemical change.

REPRESENTING A CHEMICAL EQUATION –

- *Reaction* - A simple reaction between –
  iron – [metal] & sulphur – [non-metal] – on heating the two reactants.
- *Reactants* - The substances which –
  take part in the chemical reaction i.e. iron & sulphur
- *Product/s* - The substances which –
  are formed as a result of the chemical reaction. i.e. iron sulphide
- *Word equation* -

$$\text{Iron} + \text{Sulphur} \xrightarrow{\Delta} \text{Iron sulphide}$$

- *Molecular equation* -

$$\underset{\text{[iron]}}{\text{Fe}} + \underset{\text{[sulphur]}}{\text{S}} \rightarrow \underset{\text{[iron sulphide]}}{\text{FeS}}$$

Reactants — *Product/s*

[→] *The arrow indicates the direction of the reaction.*
[Δ] *Indiacates heat i.e. iron & sulphur are heated to give the product iron sulphide.*

OTHER EXAMPLES

a] *Reaction* – A simple reaction between –
sodium hydroxide [NaOH] & dilute hydrochloric acid [HCl].

Word equation –

Sodium hydroxide + Hydrochloric acid → Sodium chloride + Water

Molecular equation –

$$NaOH + HCl\ [\text{dil.}] \rightarrow NaCl + H_2O$$

. dil. = dilute

a] *Reaction* – A simple reaction between –
magnesium [Mg] & dilute sulphuric acid [H_2SO_4].

Word equation –

Magnesium + Sulphuric acid → Magnesium sulphate + Hydrogen

Molecular equation –

$$Mg + H_2SO_4\ [\text{dil.}] \rightarrow MgSO_4 + H_2\ [g]$$

. [g] = gas

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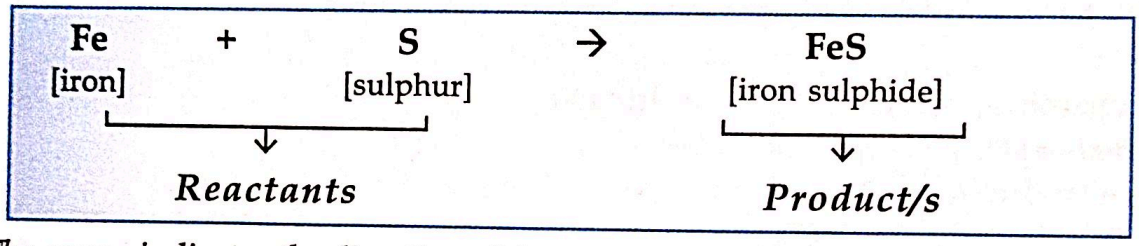

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ACTIVITIES & DEMONSTRATIONS

Elements, Compounds & Mixtures

As per the new latest Middle School Chemistry Syllabus

Unit 1 – Elements & compounds

Pedagogy/Transactional Strategies

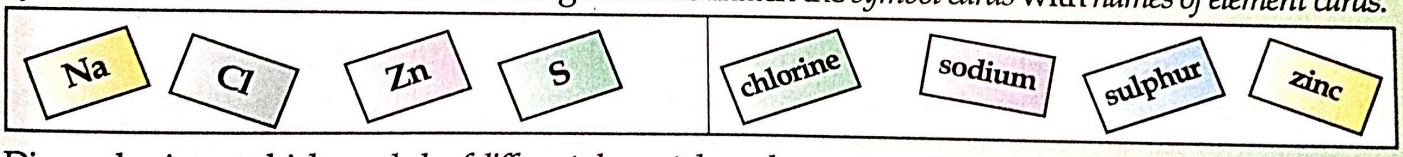
- Showing samples of iron powder, sulphur powder and zinc granules.
- Taking examples of certain elements e.g. iron and discussing with children that it is made up of only one type of atoms i.e. iron atoms. Likewise, discussing other examples of elements also.
- Introducing symbols and emphasising that every element has a symbol. Showing the periodic table and drawing children's attention towards the symbols of elements.
- Explaining the basis on which symbols of the elements have been given, qualitative meaning of symbols which represent the name & one/two atom(s) of an element. Giving examples also.
- Using the molecular model kit to show the models of some atoms & molecules [O_2, N_2, H_2].
- Discussing that the molecules of compounds are made up of atoms of different elements in a fixed proportion. Examples of H_2O, CO_2, NO_2, CaO, $ZnCl_2$, etc.

Suggested Learning Resources

- Different samples of some metal and non-metals.
- Literature related to language of Chemistry.
- Periodic table of elements with names and symbols of elements.
- Molecular model kit. If molecular kit is not available, balls and sticks models can be used. Models of some compounds using the kit.

Demonstrations & Discussions – By the Teacher

- The students maybe shown *samples of different substances* – including *metals* e.g. iron powder, zinc granules, copper wire, a piece of aluminium etc. and some *non-metals* including sulphur powder, carbon [charcoal] particles etc. The students maybe taught to differentiate between metals & non-metals & discussions maybe held on the differences in properties of the two.
- Students maybe told that an element e.g. iron or sulphur are made up of only one type of atoms i.e. iron made up of only iron atoms.
- *The periodic table* maybe shown to the students & the names & symbols of each element from atomic numbers 1 to 20 maybe discussed with the students.
- Symbols & names of elements – making students match the *symbol cards* with *names of element cards.*



- Discuss basis on which *symbols of different elements* have been given & the *qualitative meaning of symbols.*
- Molecular model kits maybe used to show models of molecules e.g. O_2, N_2 & H_2.
- If molecular kit is not available – models of some compounds using ball & stick model maybe used to discuss the molecules of compounds such as – carbon dioxide, water, calcium oxide.

EXERCISE

Elements, Compounds & Mixture

Unit 1 – Elements & compounds

1. Classify substances into pure & impure substances in the form of a chart or tabulation.
2. Differentiate between the terms – elements, compounds & mixtures.
3. The important physical properties of substances are colour, odour, nature, density & solubility in water. Name – a] two coloured gases [with their colours] b] a gas with a pungent, choking odour which is lighter than air c] a poisonous gas almost as heavy as air.
4. Complete the statement – an element is a pure substance made up of _____ [identical/different] atoms.
5. Draw a labelled diagram of an atom including its nucleus, orbits & their contents.
6. Elements are classified into – ***Metals – Non-metals – Metalloids – Noble gases.***
   State which of A, B, C, D is a – i] Metallic element ii] Non-metallic element, iii] Metalloid, iv] Noble gas.
   A : Is non-malleable, non-ductile & a poor conductor of electricity _____
   B : Has lustre, is malleable and ductile & a good conductor of heat _____
   C : Is unreactive and inert and present in traces in air _____
   D : Shows properties of both metals and non-metals _____
7. An atom of an element is denoted by a ***'symbol'***. Explain the meaning of the term *'symbol'*. State a reason for representing the following elements by their symbols.
   a] Hydrogen by 'H', b] Helium by 'He', c] Copper by 'Cu'.
8. Match the **metallic elements** – with their correct symbols
   Metallic elements – a] Potassium b] Sodium c] Calcium d] Magnesium e] Zinc f] Aluminium g] Iron h] Lead i] Copper j] Mercury k] Silver l] Platinum m] Gold
   Symbols – 1. Ca 2. Zn 3. Pb 4. Hg 5. Cu 6. Au 7. K 8. Fe 9. Al 10. Na 11. Mg 12. Pt 13. Ag
9. Match the **non-metallic elements** – with their correct symbols
   Non-metallic elements – a] Carbon b] Chlorine c] Oxygen d] Phosphorus e] Hydrogen f] Nitrogen g] Iodine h] Bromine i] Fluorine j] Silicon k] Sulphur
   Symbols – 1. O 2. I 3. Si 4. C 5. Cl 6. P 7. F 8. H 9. S 10. Br 11. N
10. Match the **noble gases** – with their correct symbols
    Noble gases – a] Helium b] Neon c] Argon d] Krypton e] Xenon f] Radon
    Symbols – 1. Ar 2. Xe 3. Rn 4. He 5. Kr 6. Ne
11. Give a reason why elements are tabulated in a table called the *'Periodic table'*.
12. Give the names and symbols of the first twenty elements of the periodic table. Differentiate them into metals, non-metals, metalloids & noble gases.
13. Explain the term – molecules. Give three examples of atoms of the same element forming a molecule. State the atomicity of the same.
14. Give one example of – a] a triatomic molecule b] a polyatomic molecule.
15. Explain the term – compounds. Give the example of a compound containing – a] hydrogen & oxygen b] carbon & oxygen c] nitrogen & oxygen d] calcium & oxygen.

16. State two characteristics of water which prove that it is a – compound.

17. Explain the term '*chemical formula*'. State what a chemical formula denotes.

18. Give the symbols and the number of atoms of each element present in – a] sodium chloride b] water c] carbon dioxide d] zinc chloride.

19. For writing a chemical formula – 'symbols' & combining capacity of an element with hydrogen i.e. 'valency' should be known. Explain the term – combining capacity of an element i.e. valency.

20. State what are *radicals*. Give the names of the radicals – a] NO_3 b] OH c] SO_4 d] CO_3

21. Match the *symbols of – metallic elements* – with their correct combining power or capacity.
a] K b] Zn c] Al d] Na e] Ca
Combining power or capacity – A: 3; B: 2; C: 1. [positive valencies]

22. Match the *symbols of – non-metallic elements* – with their correct combining power or capacity.
a] O b] S c] Cl
Combining power or capacity – A: 3; B: 2; C: 1. [negative valencies]

23. Match the *symbols of – radicals* – with their correct combining power or capacity [valency].
a] OH b] SO_4 c] NO_3 d] CO_3
Combining power or capacity – A: 3; B: 2; C: 1. [negative valencies]

24. Write the *formula of the compound* formed – given *symbols* & combining power or capacity [valency] *of each element* in the compound.
a] K^{1+} Cl^{1-} b] Na^{1+} Cl^{1-} c] Ca^{2+} $NO_3{}^{1-}$

25. Match the **formulas of the following – gases** – with their correct names
Gases – a] H_2 b] N_2 c] O_2 d] Cl_2 e] HCl f] NH_3 g] CO h] CO_2 i] SO_2 j] NO k] NO_2
Names – 1. Ammonia 2. Nitrogen dioxide 3. Oxygen 4. Hydrogen 5. Nitrogen 6. Chlorine 7. Carbon monoxide 8. Sulphur dioxide 9. Nitrogen monoxide 10. Carbon dioxide 11. Hydrogen chloride

26. Match the **formulas of the following – acids** – with their correct names
Acids – a] HCl b] HNO_3 c] H_2SO_4 d] H_2CO_3
Names – 1. Carbonic acid 2. Sulphuric acid 3. Hydrochloric acid 4. Nitric acid;

27. Match the **formulas of the following – bases** – with their correct names
Bases – a] NaOH b] KOH c] $Ca(OH)_2$ d] $Zn(OH)_2$
Names – 1. Potassium hydroxide 2. Zinc hydroxide 3. Calcium hydroxide 4. Sodium hydroxide

28. Complete the statements with the correct words.
a] *Acids* – are chemicals which are _____ in taste & derived from plants & _____.
b] *Bases* – are chemicals which are *hydroxides* [or oxides] of _____ eg. sodium hydroxide.
c] *Salts* – are chemicals formed on reaction of a base with an _____ giving *salt* & water.

29. In the chemical word equation :- Zinc + Sulphuric acid → Zinc sulphate + Hydrogen
a] State the *reactants* & *products* of the above reaction. What does the arrow indicate.
b] The *molecular equation* is : $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2[g]$. State what [g] represents.

OBJECTIVE TYPE QUESTIONS

Elements, Compounds & Mixtures

Unit 1 – Elements & compounds

40 marks

Q.1 Complete the statements given below by filling in the blank with the correct word/s. [10]

1. An element is a pure substance which cannot be broken down by physical or _____ methods.
2. The basic unit of an element is a /an _____. [molecule / atom / ion]
3. Atom contains _____ [neutron / nucleus], with positively charged _____ [protons / neutrons].
4. Element _____ [silver / copper / carbon] has the symbol derived from its Latin name 'argentum'.
5. From the elements – He, Br, Pt & O; the element which is metallic is _____, an inert element is _____, forms a triatomic molecule is _____, is liquid at room temperature is _____
6. From the elements *nitrogen, chlorine, bromine,* the element present in the atmosphere is ___

Q.2 Match the statements in List I – 1 to 10 with their correct answers in List II – A to J. [10]

1. Fluorine & chlorine
2. A diatomic molecule
3. A molecule containing the elements hydrogen and oxygen
4. A metalloid – showing properties of both metals & non-metals
5. The term used for the substances which take part in the chemical reaction
6. The term which represents a substance by means of symbols
7. The term used for substances formed as a result of a chemical reaction
8. A compound containing one atom of zinc & two atoms of chlorine
9. The chemical name for nitrogen monoxide
10. A polyatomic molecule

A: Nitrogen
B: Boron
C: Reactants
D: Chemical formula
E: Halogens
F: Water
G: Nitric oxide
H: Products
I: Phosphorus
J: Zinc chloride

Q.3 Select the correct answer from the choice in brackets. [10]

1. The symbol of – mercury [Mg / Hg / Ag]
2. The type of element – phosphorus [metallic / non-metallic / noble gas]
3. The type of molecule – bromine [monoatomic / diatomic / triatomic]
4. A compound [nitrogen / ozone / zinc chloride]
5. The unreactive non-metallic element [chlorine / argon / sulphur]
6. The negatively charged particles in an atom [protons / neutrons / electrons]
7. The element which is malleable [sulphur / carbon / iron]
8. An impure substance [element / mixture / compound]
9. An element which is a poor conductor of heat [copper / carbon / aluminium]
10. A group of atoms of elements [ion / radical / combining power]

Q.4 Match the compounds in List I – 1 to 20 with their correct formulas in List II – A to T. [10]

1. *Hydrochloric acid*	2. *Potassium hydroxide*	3. *Sulphuric acid*	4. *Zinc hydroxide*
5. *Sodium chloride*	6. *Nitric acid*	7. *Calcium hydroxide*	8. *Carbonic acid*
9. *Sodium hydroxide*	10. *Copper sulphate*	11. *Potassium chloride*	12. *Calcium carbonate*
13. *Magnesium sulphide*	14. *Zinc sulphate*	15. *Aluminium hydroxide*	16. *Sodium carbonate*
17. *Calcium sulphide*	18. *Magnesium oxide*	19. *Zinc oxide*	20. *Ammonium chloride*

A. $NaCl$	B. $NaOH$	C. KCl	D. $Ca(OH)_2$
E. CaS	F. $CuSO_4$	G. $CaCO_3$	H. NH_4Cl
I. HCl	J. ZnO	K. HNO_3	L. H_2CO_3
M. MgS	N. MgO	O. KOH	P. $ZnSO_4$
Q. Na_2CO_3	R. H_2SO_4	S. $Al(OH)_3$	T. $Zn(OH)_2$

THE TERM – Mixture

- **A mixture is an impure substance – made up of – *two or more elements or compounds* – mechanically mixed together in – *any proportion.***

Examples of mixtures

- Of two elements

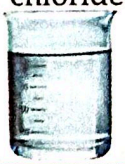
Element Iron + *Element* Sulphur → *Mixture* Iron + Sulphur



- Of two compounds

Compound Potassium chloride + *Compound* Water → *Mixture* Potassium chloride solution





- Of elements & compound

Element Sulphur + *Element* Carbon + *Compound* Potassium nitrate → *Mixture* Gun powder

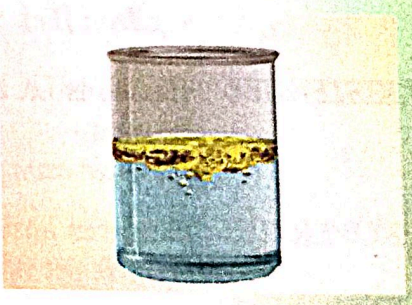


Other examples of mixtures

- Solution of – sugar, honey, milk. • Petrol • Air • Stainless steel


MILK


STAINLESS STEEL


OIL & WATER

Homogeneous mixtures

Mixtures which have – ***same composition & properties*** – throughout the mixture. e.g. alcohol & water, salt & water, sugar & water. [sugar – water *miscible* mixture – i.e. mix easily]

Heterogeneous mixtures

Mixtures which have – ***different composition & properties*** – throughout the mixture. e.g. oil & water, salt & sand, chalk & water. [oil – water *immiscible* mixture – i.e. do not mix easily]

MIXTURES – Characteristics of mixtures & comparative study

CHARACTERISTICS – Of mixtures

a] COMPONENTS IN A MIXTURE ARE – *Present in a varying proportions.*

Element-iron + *Element*-sulphur — *Mixture*-iron & sulphur



The mixture of iron & sulphur – may contain iron & sulphur in – ***varying proportions.***

b] MIXTURES – *Have no definite set of properties*

Components i.e. elements or compounds in a mixture – retain their original properties.

Element	+	*Element*	*Mixture*
iron		sulphur	iron & sulphur

- Element – iron reacts with dil. hydrochloric acid to give hydrogen.
- Element – sulphur dissolves in carbon disulphide.
- **The two properties of each element** – ***are retained*** in the mixture of iron & sulphur.

c] COMPONENTS IN A MIXTURE CAN – *Be separated by physical methods.*

Element	+	*Element*	*Mixture*
iron		sulphur	iron & sulphur

- **A mixture of the two elements iron & sulphur** – ***can be separated*** by using a magnet i.e. a physical method, since iron is attracted to the magnet.

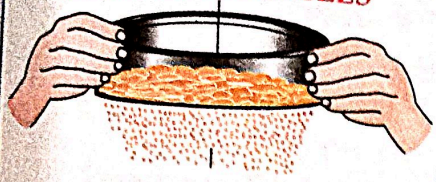
COMPARATIVE STUDY – Of elements, compounds & mixtures

	ELEMENTS	*COMPOUNDS*	*MIXTURES*
TERM	Pure substance Made up of – *–one kind of atoms only.* e.g.*Iron [Fe], Sulphur [S]*	Pure substance Made up of – *– two or more different elements.* e.g.*Iron sulphide [FeS]*	Impure substance Made up of – *– two or more elements* or *compounds.* e.g.*Iron-sulphur mixture*
EXISTENCE	Elements i.e. atoms – present – *on their own.*	Components in a *compound* present – *in a definite proportion.*	Components in a *mixture*- present – *in any proportion.*
PROPERTIES	Elements *have a* – *definite set of properties.*	Compounds *have a* – *definite set of properties.*	Mixtures *do not have a* – *definite set of properties.*
SEPARATION	Elements occur on their own & can be separated by – *chemical & physical methods.*	Elements in a compound can be separated by – *chemical methods only.*	Components in a mixture can be separated by – *physical methods only.*
EXAMPLES	*Elements* Iron, copper.	*Compounds* Iron sulphide, copper oxide.	*Mixtures* Iron + sulphur, copper + silver.

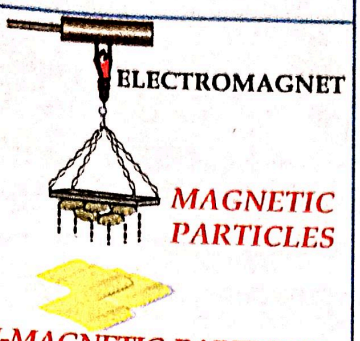
MIXTURES – Separation of mixtures

SOLID – SOLID MIXTURES

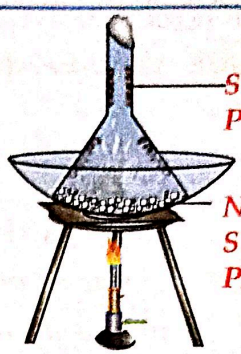
SIEVING



MAGNETIC SEPARATION

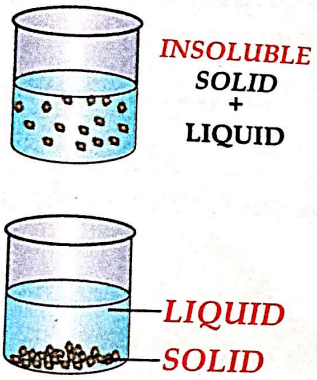


SUBLIMATION

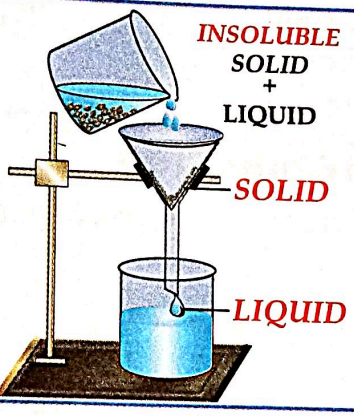


SOLID – LIQUID MIXTURES

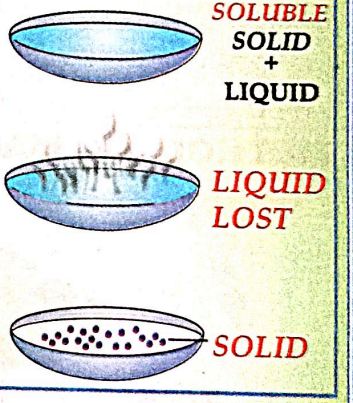
SEDIMENTATION



FILTRATION



EVAPORATION



PRINCIPLE INVOLVED – In Separation of solid-solid mixtures

Based on

a] **SIEVING** – Difference in – size of solid particles.

b] **MAGNETIC SEPARATION** – Difference in – magnetic & non-magnetic nature of particles.

c] **SUBLIMATION** – Difference in – sublimable & non-sublimable nature of solids.

PRINCIPLE INVOLVED – In Separation of solid-liquid mixtures

Based on

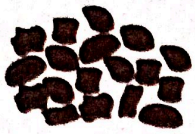
a] **SEDIMENTATION & DECANTATION** – Settling down by gravity of ***insoluble*** solid particles.

b] **FILTRATION** – Filtration of ***insoluble*** solid particles – in solid-liquid mixture.

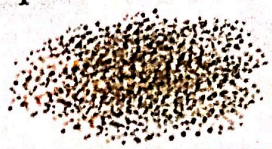
c] **EVAPORATION** – Evaporation of liquid component in ***soluble*** solid-liquid mixture.

METHOD 1 – SEIVING

- **PRINCIPLE** - Based on the difference in *size* of the solid particles.



LARGE SIZED PARTICLES

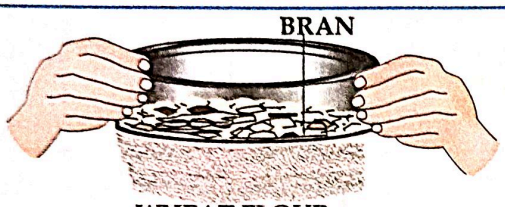
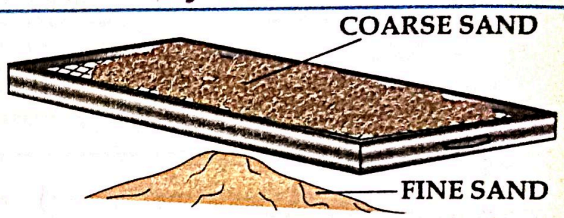


SMALL SIZED PARTICLES

- **TECHNIQUE OF SEPARATION** - The large sized particles are separated from the small or finer particles by passing the mixture through – ***a sieve.***

The sieve – the sieve has a wooden frame, with a metal mesh at its base. The mixture is added from the top of the sieve, when the larger particles stay above & the finer particles collect below it on – ***shaking the sieve.***

- **EXAMPLES** – *Separation* of rice powder from soil, *different sized particles* of diamond & of sand.

In the home	*By builders*
	
Separation-of bran & wheat flour *Larger bran particles* - stay above *Smaller flour particles* - below	**Separation-of particles of sand** *Coarse sand* - stays above *Fine sand* - below

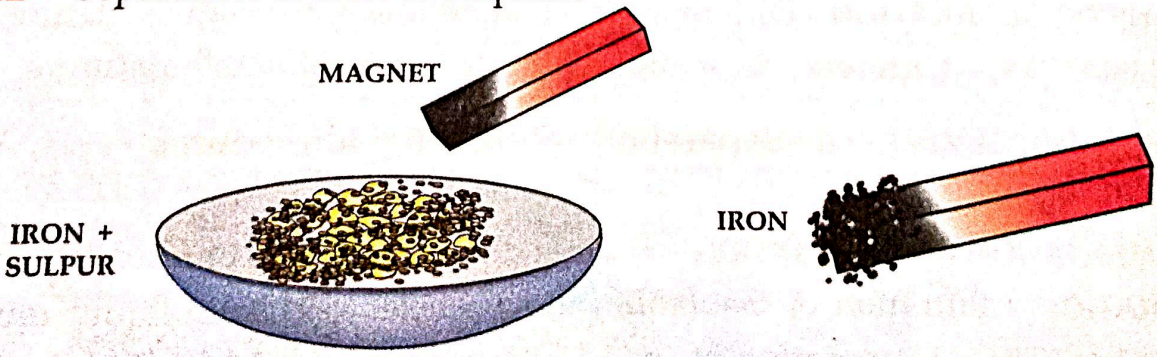
METHOD 2 – MAGNETIC SEPARATION

- **PRINCIPLE** - Based on the difference in *magnetic* and *non-magnetic* nature of particles.

MAGNETIC PARTICLES – IRON

NON-MAGNETIC PARTICLES – SULPHUR

- **TECHNIQUE OF SEPARATION** - The ***magnetic particles*** such as iron are separated from the ***non-magnetic particles*** such as sulphur – by utilizing the magnetic properties of iron. The iron gets attracted to the magnet and separates from the ***non-magnetic substance.***
- **EXAMPLE** – Separation of iron & sulphur.



SEPARATION OF IRON FROM SULPHUR

METHOD 3 – SUBLIMATION

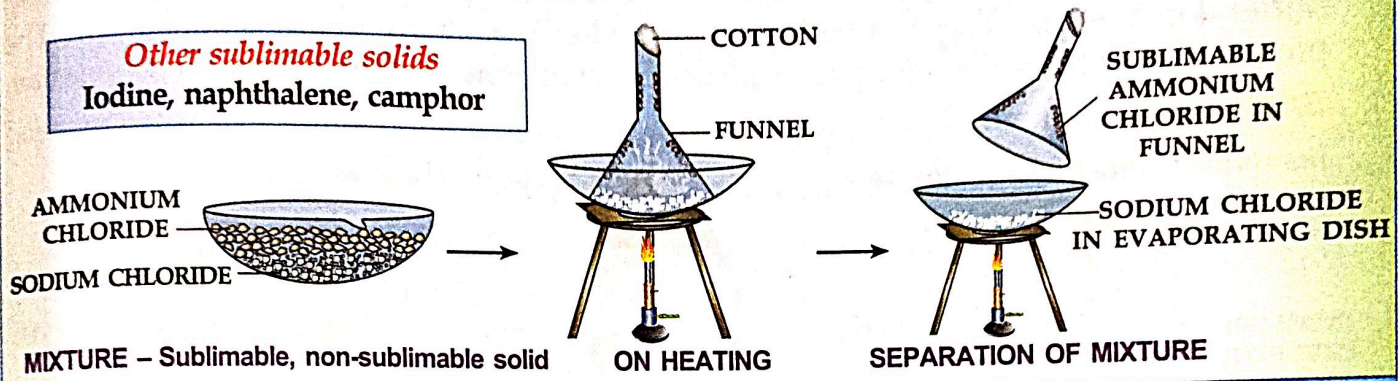
- **PRINCIPLE -** Based on the difference in ***sublimable*** and ***non-sublimable*** nature of solids.

Sublimable solids – are those which sublime i.e. turn directly into vapour on heating. The vapours on cooling, give back the pure solid. The ***non-sublimable solid*** remains behind.

- **TECHNIQUE OF SEPARATION –** The mixture is heated in an evaporating dish covered with a funnel plugged at one end with cotton. The ***sublimable solid*** sublimes & the vapours condense on the *inner side of the funnel*. The ***non-sublimable solid*** remains behind in the evaporating dish.
- **EXAMPLE -** Separation of ammonium chloride and sodium chloride in the laboratory.

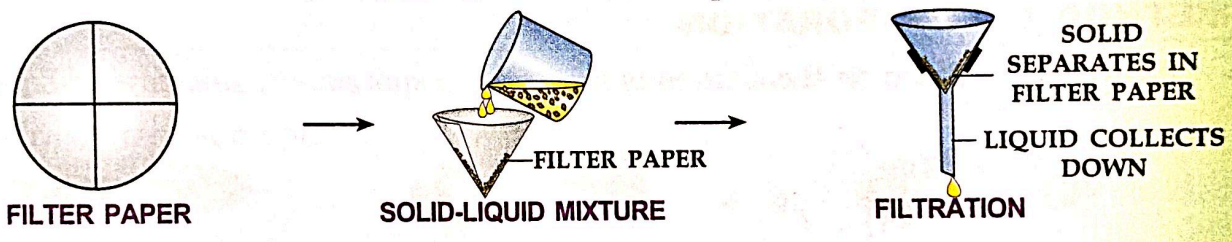
Sublimable substance : ammonium chloride. ***Non-sublimable substance*** : sodium chloride.

Other sublimable solids
Iodine, naphthalene, camphor



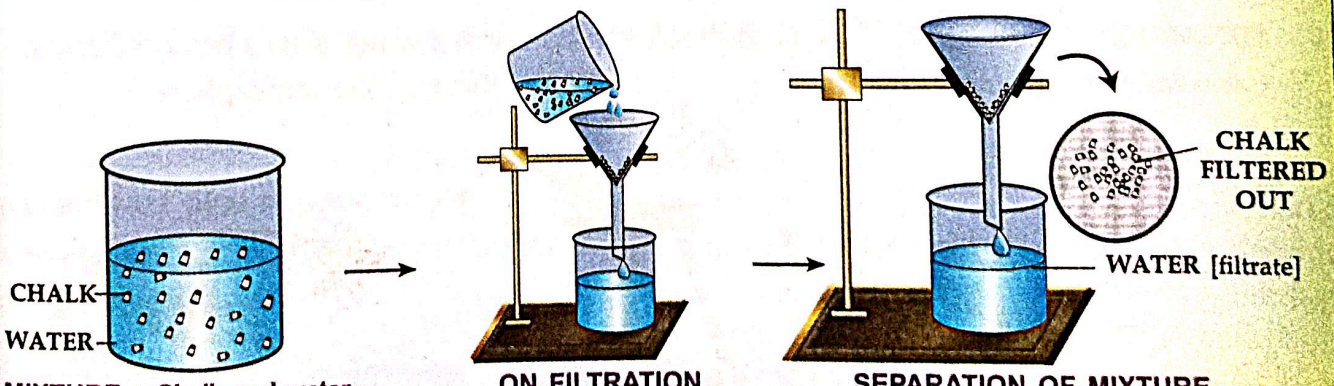
METHOD 4 – FILTRATION

- **PRINCIPLE -** Based on the filtration of ***insoluble*** solid particles in a solid-liquid mixture.



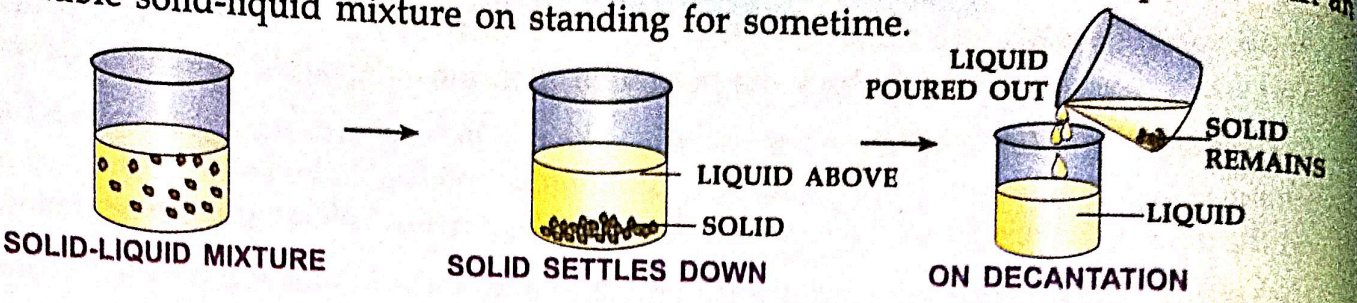
- **TECHNIQUE OF SEPARATION –** A filter paper is made into a cone & placed in a funnel. The ***solid particles*** remain behind on the – ***filter paper*** while the ***liquid collects below.***
- **EXAMPLE -** Filtration of chalk particles in water.

Filtered out solid : chalk particles ***Liquid collected below*** : water



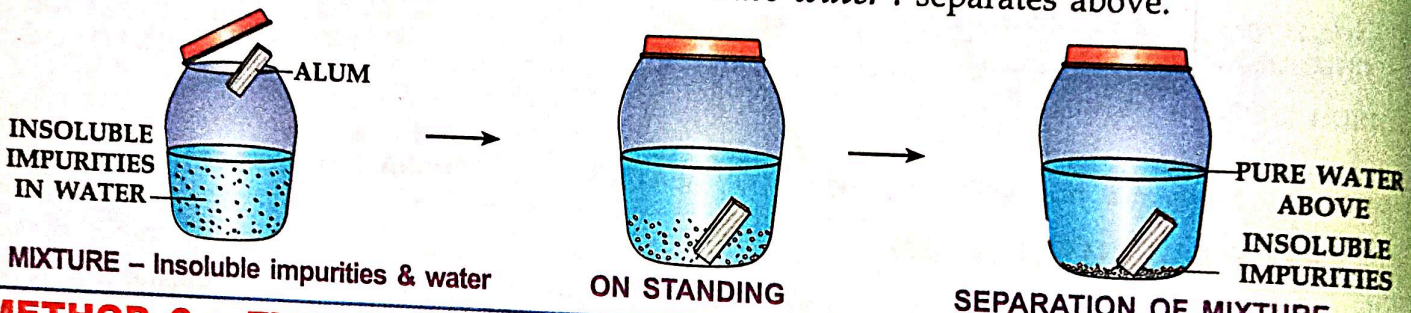
METHOD 5 – SEDIMENTATION & DECANTATION

- **PRINCIPLE -** Based on ***settling down by gravity*** of the ***insoluble*** solid particles in an insoluble solid-liquid mixture on standing for sometime.



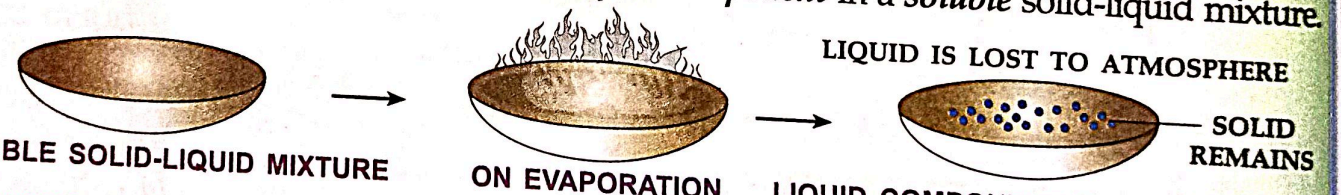
- **TECHNIQUE OF SEPARATION –** The ***insoluble solid component*** in the solid-liquid mixture ***settles down*** on standing in a beaker. The liquid collects above it and is poured out. The process of pouring out of the liquid, such that the solid remains behind is called ***decantation.***
- **EXAMPLE -** Sedimentation of impurities in drinking water. [Alum hastens the process]

Insoluble impurities : settle down. ***Pure water :*** separates above.



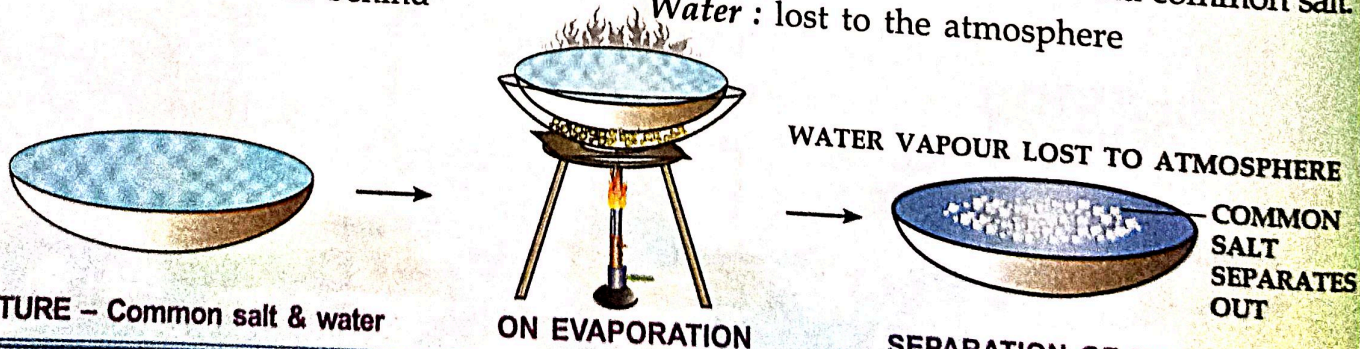
METHOD 6 – EVAPORATION

- **PRINCIPLE -** Based on ***evaporation of the liquid component*** in a ***soluble*** solid-liquid mixture.



- **TECHNIQUE OF SEPARATION –** The soluble solid can be separated from its liquid component by allowing the liquid component to evaporate either on its own or by heating. During evaporation, the ***liquid component*** is ***lost to the atmosphere*** & the ***solid remains behind.***
- **EXAMPLE -** Evaporation of a common salt solution or sea water leaves behind common salt.

Common salt : remains behind ***Water :*** lost to the atmosphere



ACTIVITIES & DEMONSTRATIONS

Elements, Compounds & Mixtures

As per the new latest Middle School Chemistry Syllabus

Unit 2 – Mixtures

Pedagogy/Transactional Strategies

- Taking examples of some mixtures such as solution of sugar, honey, milk & pointing out that the concentration of the components of the mixture can be different.
- Differentiating between mixtures & compounds by taking examples to emphasise that in compounds, elements are combined in fixed proportion and properties of the compounds are quite different from those of the elements formed. Example of $C+O_2 \rightarrow CO_2$
- Discussing details of the activity of the formation of FeS by heating Fe and S.
- Providing opportunities to children to perform simple activities:
  - ***Filtration*** – [sand and water] ▫ ***Sedimentation*** (link to purification of water)
  - ***Decantation*** [Tea brewing] ▫ ***Sublimation*** [Iodine crystals/ammonium chloride], Naphthalene balls, Camphor. ▫ Evaporation (Salt water) ▫ ***Sieving*** [Rice powder/soil structure]
  - ***Magnetic separation*** [Iron & sulphur]
- Discussing reasons for preferring a particular technique over another.

Suggested Learning Resources

- Some samples of mixtures & compounds.
- Iron powder, sulphur & iron sulphide to show different properties of iron sulphide. Iron gets attracted towards magnet, sulphur is yellow in colour and floats over water. But iron sulphide has altogether different properties.
- Separation: filter paper, sieve, bar magnet, iodine, ammonium chloride, salt, tea leaves.

Demonstrations & Discussions – By the Teacher

- Discuss with the students examples of mixtures of – two elements, two compounds, elements & compounds. Take examples of mixtures of solutions of sugar, milk, honey, chalk & water, salt & sand and differentiate the mixtures into homogeneous & heterogeneous.
- Differentiate *mixtures from compounds* using suitable examples such as – potassium chloride & an aqueous solution of potassium chloride.
- Discuss the formation of *iron sulphide* by heating iron & sulphur. Explain that iron sulphide is a compound while iron & sulphur mixed together is a mixture. Move a magnet over the mixture, showing the iron powder being attracted towards the magnet. Repeat the same for the compound iron sulphide & explain why the iron in the compound is not attracted to the magnet.
- Simple methods of separation maybe shown to the students such as – a] Separation of sand from water using a funnel, a filter paper and a beaker. b] Taking a beaker of water & adding some sand to it. On leaving the beaker aside, the settling down of the sand can be deemed as *sedimentation* & the pouring out of the water above as *decantation.* c] A salt water solution taken in an evaporating dish & heated carefully leaves behind the salt. Explain the term evaporation in this experiment. d] A sieve to separate rice powder from soil particles may be demonstrated.

EXERCISE

Elements, Compounds & Mixtures

Unit 2 – Mixtures

1. Explain the term mixtures. Give an example of mixtures of – a] two elements b] two compounds c] elements and compounds.
2. Differentiate between homogeneous & heterogeneous mixtures with suitable examples.
3. With reference to the mixture of iron and sulphur, state the main characteristics of mixture.
4. Tabulate a comparative chart – to differentiate between elements, compounds & mixtures. Differentiate them with reference to – a] the term b] existence c] properties d] separation of components.
5. State the *principle involved* in separation of solid-solid mixtures by – a] sieving b] magnetic separation c] sublimation.
6. State the *principle involved* in separation of solid-liquid mixtures by – a] sedimentation & decantation b] filtration c] evaporation.
7. Explain the term 'sieving'. State the structure of a sieve and explain the separation of different sized particles by sieving.
8. State what is meant by 'magnetic separation of two mixtures'. Explain how iron particles can be separated from sulphur particles.
9. Give a reason why sublimable & non-sublimable substances can be separated easily, but two sublimable substances cannot.
10. Explain the technique for separating – *insoluble* solid particles in a solid-liquid mixture.
11. Differentiate between the terms – sedimentation & decantation with a suitable experimental technique.
12. Explain how a solid component is separated – in a *soluble* solid-liquid mixture.
13. Draw a neat labelled diagram for separation of the following mixtures.
    a] Coarse sand from fine sand
    b] A magnetic particle from a non-magnetic particle
    c] Naphthalene from sodium chloride
    d] Chalk & water using a filter paper
    e] Sand & water without using a filter paper
    f] Common salt from a solution of common salt & water
14. State the technique involved in separating the following:
    a] Iodine crystals & potassium chloride
    b] Iron & chalk powder
    c] Potassium chloride from an aqueous solution of potassium chloride
    d] Rice powder from soil particles
    e] Iron filings from pieces of copper wire
    f] Large diamonds from very small diamonds

OBJECTIVE TYPE QUESTIONS
Elements, Compounds & Mixtures
Unit 2 – Mixtures

20 marks

Q.1 Match the statements in List I with the correct answer in List II. [5]

LIST I	LIST II
1. Purification of water by adding alum	A: Sublimation
2. Sea water leaving behind common salt	B: Sieving
3. Separation of camphor & potassium chloride	C: Filtration
4. Separation of charcoal from a charcoal-water mixture	D: Sedimentation
5. Separation of bran & wheat flour	E: Evaporation

Q.2 State whether the following statements are true or false. If false write – the correct statement [5]

1. Components in a mixture are present in a definite proportion.
2. Mixtures have no definite set of properties.
3. Components in a mixture can be separated by physical & chemical methods.
4. Sodium chloride and water – is an example of a mixture of elements & compounds.
5. Heterogeneous mixtures have different composition & properties throughout the mixture.

Q.3 Name the following. [5]

1. A black non-metallic component of the mixture – gunpowder
2. A physical method of separating iron from an iron-sulphur mixture.
3. The component of the *soluble* solid-liquid mixture, which is lost to the atmosphere on heating.
4. The component of a naphthalene-sodium chloride mixture, which remains in the evaporating dish when heated together, covered with a funnel.
5. A mixture of two immiscible liquids.

Q.4 Give reasons for the following. [5]

1. Naphthalene & camphor cannot be separated by sublimation.
2. Sodium chloride cannot be separated out from its aqueous solution by filtration.
3. Two varieties of wheat flour cannot be separated by sieving.
4. Sulphur and charcoal powder cannot be separated by magnetic separation.
5. Both components of a *soluble* solid-liquid mixture cannot be recovered by evaporation.