Introduction to Chemistry 1

LATEST SYLLABUS – Key Concepts / Concerns

- Chemistry – meaning and importance.
- Development of Chemistry- A historical perspective.
- Notable chemists/ scientists & their contributions to Chemistry [at least 3 scientists].
- Food & Chemistry [food preservatives – processing].
- Cosmetics & Chemistry [examples, talcum powder].
- Clothing & Chemistry [terylene] .
- Chemicals as Medicines [aspirin, paracetamol].
- Chemicals in Industries [soaps & detergents, stain removals].

Learning Outcomes:

Children will be able to:

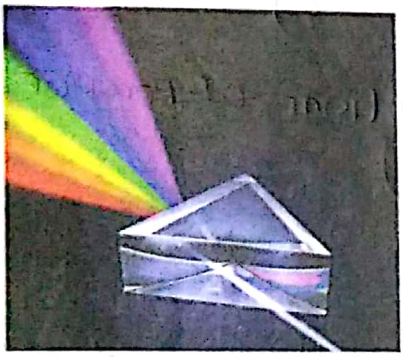
- discuss the importance of Chemistry in daily life and its role in different industries and life processes;
- list important applications of Chemistry in day to day life;
- list some industrial applications of Chemistry;
- discuss the bio-sketches of some great scientists & their works;
- appreciate the patience, perseverance, sacrifices and ethical conduct of scientists.

A. INTRODUCTION – To Chemistry

1. INTRODUCTION – Meaning of Chemistry

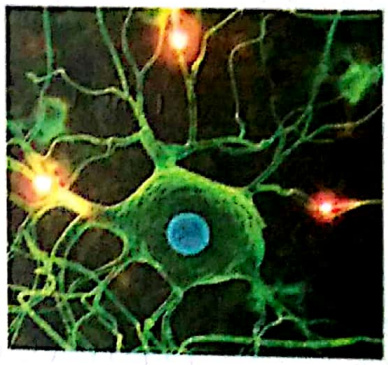
- Science is bifurcated into three main branches – Physics, Chemistry & Biology.

SCIENCE



PHYSICS

CHEMISTRY



BIOLOGY

Branches of science –

- *Physics* – deals with different forms of energy – light, sound, heat, electrical etc.
- *Chemistry* – deals with the study of substances – composition, preparation, reactions etc.
- *Biology* – deals with the study of living organisms e.g. plants [*Botany*] & animals [*Zoology*].

The two main branches of Chemistry are –

- *Inorganic Chemistry*
  - Includes study of innumerable elements & compounds – including *metals* & *non-metals*.
- *Organic Chemistry*
  - Includes study of specific carbon compounds built up mainly of – *carbon* & *hydrogen*.

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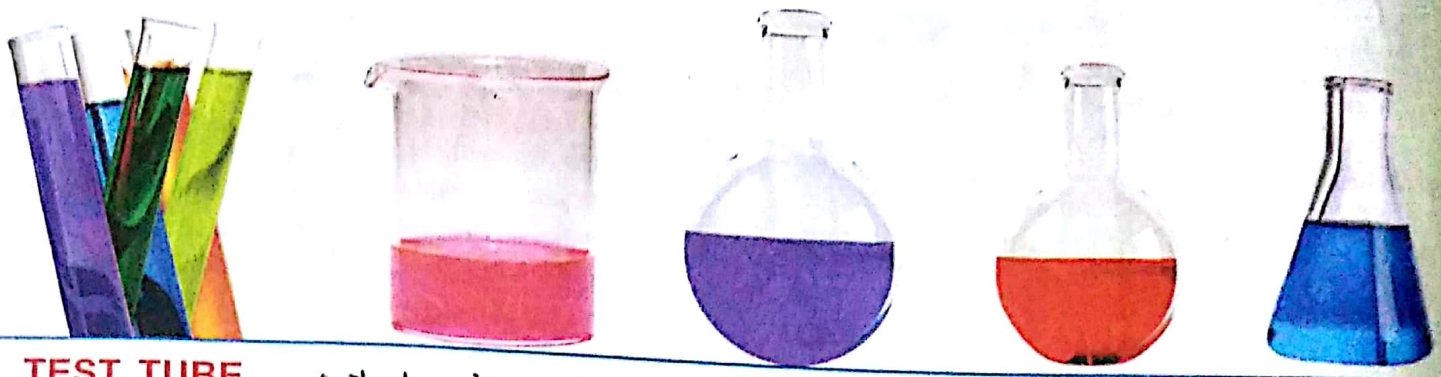
B. APPARATUS – Used in the Chemistry laboratory

a] BASIC – Glass apparatus

- Consists of test tubes, beakers, flasks and retort.



1. TEST TUBE

what is a test tube? what are the functions of a test tube

- It is a special glass tube – *with one open & one closed end.*
- It varies in size from – about 4 cms. to 15 cms.
- A hard glass test-tube made of pyrex is called a – *'boiling tube'*

FUNCTION:

Boron and silicon oxide

- For heating chemicals & studying reactions in solution.
- *A boiling tube* is resistant to chemicals & used for special purposes.

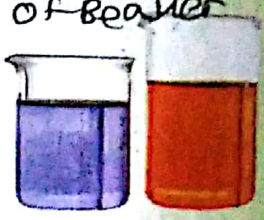
2. BEAKER

what is a Beaker? what are the functions of Beaker

- It is a glass container with a – *lip available in varied sizes.*

FUNCTION:

- It is used for holding, pouring & mixing solutions.



3. FLASKS

what is a flasks? what are the function of a flask

- They are glass apparatuses of various shapes – *for varied purposes.*

FUNCTION:

what is a round botton flask?

Round bottom flask – For gas preparation, where heating is required. Since the flask is round bottomed – *heat is uniformly distributed throughout on heating.*

what is a flat botton flask?

Flat bottom flask – For gas preparation, where heating is not required and hence – *uniform heat distribution is not necessary.*

what is a conical flask?

Conical flask – For storage of various liquids and for – *mixing of different solutions.*

what is a rotott

Retort – For carrying out distillation experiments – *which include distillation of acids.*

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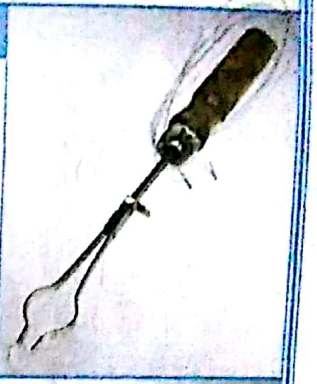
APPARATUS – Used in the Chemistry laboratory

b] HOLDERS – For basic glass apparatus

- *Test tube holder* – for holding test tubes.
- *Test tube stand* – for keeping test tubes after completion of experiment or after cleaning.
- *Retort stand* – for holding flasks, retorts and other apparatus during experiments.
- *Tripod stand & wire gauze* – for supporting glass apparatus.

1. TEST TUBE HOLDER

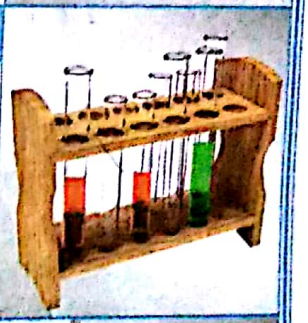


It is a metallic clamp – *fixed on a wooden handle.*

FUNCTION:

- It is used for holding a test tube when the substance – in the test tube is heated or a chemical is added.
- The wooden handle at the end being a poor conductor of heat – *makes holding the test tube holder, easy.*

2. TEST TUBE STAND

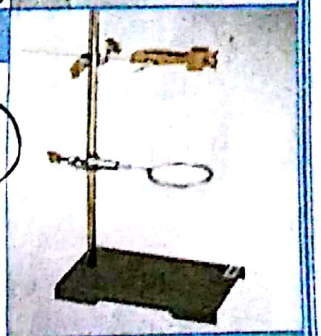


- It is a wooden or plastic stand – *with holes & upright pegs.*

FUNCTION:

- The test tubes are kept straight through the holes – which are of different sizes, to hold each test tube.
- Washed test tubes can be inverted on the pegs – *in the test tube stand.*

3. RETORT STAND

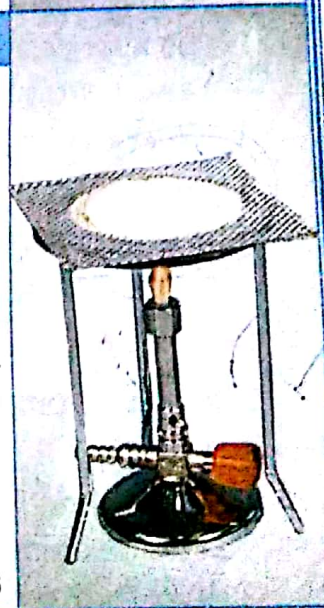


- It contains an iron rod – *with a rectangular heavy iron base.*
- A clamp is mounted on the rod – which can be raised or rotated.

FUNCTION:

- It holds the apparatus e.g. flasks – *used during chemical reactions.*
- The movable clamp can be adjusted – *upwards or downwards.*

4. TRIPOD STAND & WIRE GAUZE



Tripod stand – is made up of an equilateral iron triangle mounted on three iron legs for support & hence – *it is called a 'tripod'.*

FUNCTION:

- Supports the glass apparatus i.e. a flask or retort – *placed on it.*
- It also supports the wire gauze – *which is placed on it.*

Wire gauze – is a rectangular wire mesh with an asbestos at its centre and – is placed between the tripod stand & the glass apparatus.

FUNCTION:

- It prevents the glass apparatus – *from cracking on heating from below.*
- It initiates even distribution – *of heat to the bottom of the apparatus.*

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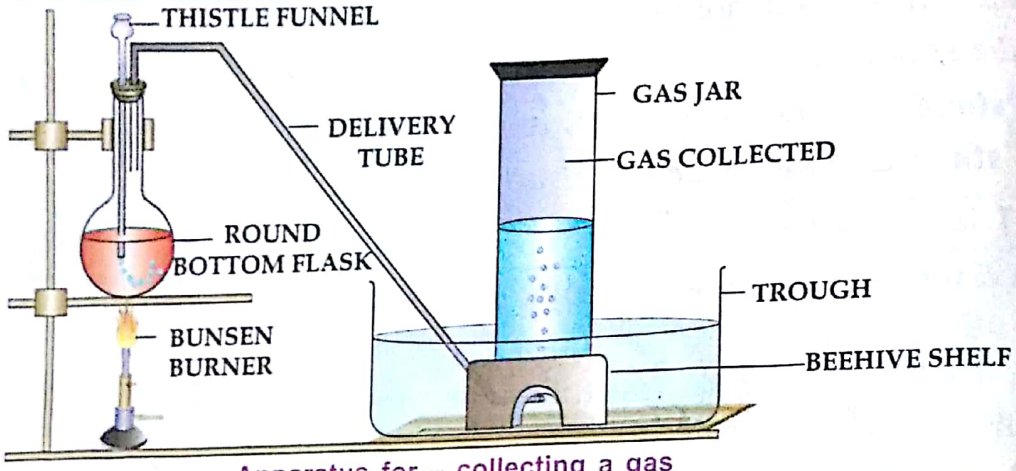
APPARATUS – Used in the Chemistry laboratory

c] OTHER ACCESSORY APPARATUS – For collecting gases



Apparatus for – collecting a gas

1. SPIRIT LAMP OR BUNSEN BURNER

Spirit lamp – consists of a glass pot filled with spirit and a neck through which passes – *a cotton wick which soaks up the spirit.*

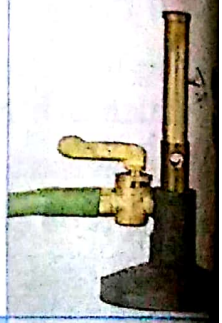
FUNCTION:

- An outdated method used for heating purposes.

Bunsen burner – consists of a burner tube, an *air regulator* & a base.

FUNCTION:

- A modern means – used for heating purposes.
- Burner tube is a long tube at the end of which – the gas burns.
- Air regulator is a metal cylinder with holes – *for regulating the flame.*
- Base is connected to a gas tap – *for inlet of the gas.*



2. THISTLE FUNNEL & DELIVERY TUBE

Thistle funnel – consists of a long glass tube with a broad inlet at the top.

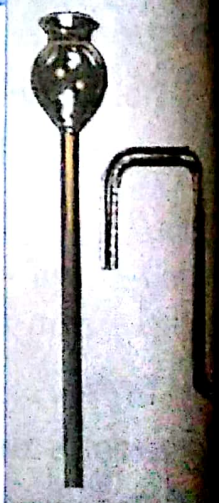
FUNCTION:

- It allows entry of the reactants – into the round bottom flask.
- It's lower end dips below the solution in the flask – otherwise the *gases formed may escape out through the thistle funnel* and not pass through the delivery tube and get collected.

Delivery tube – is a thin hollow glass tube – of various shapes.

FUNCTION:

- For transfer of gases – from one apparatus to another.
- For connecting – one piece of glass apparatus to another.



3. BEEHIVE SHELF

Clay vessel provided with two outlets – on the side and at the top.

FUNCTION:

- For collecting gases by the downward displacement of water. The beehive shelf is kept in a trough of water & the gas jar inverted over it – in which the gas is collected.

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APPARATUS – Used in the Chemistry laboratory

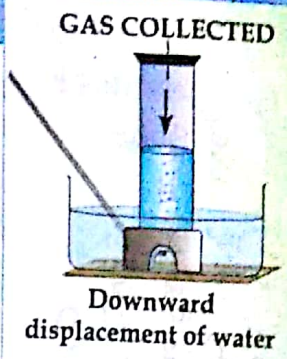
OTHER ACCESSORY APPARATUS – For collecting gases

4. GAS JAR

- It is a long glass jar which is closed at one end which serves as the base and has an – open mouth at the other end.

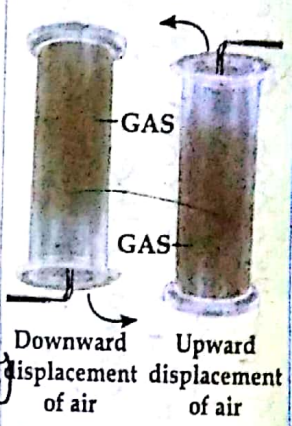
FUNCTION: For collecting gases – *by different methods.*

- *Downward displacement of water* – The gas jar is filled with water and inverted over the beehive shelf so that the water is displaced downwards & the gas is collected upwards. It is used for gases which are – *insoluble or slightly soluble in water.* e.g. nitrogen, oxygen.



Downward displacement of water

- *Downward displacement of air* – The method is used for gases – *soluble in water & lighter than air* e.g. ammonia.
- *Upward displacement of air* – The method is used for gases – *soluble in water & heavier than air.* e.g. hydrogen chloride, sulphur dioxide



Downward displacement of air Upward displacement of air

5. FUNNEL

- It is made of glass & available – *in various sizes.*

FUNCTION:

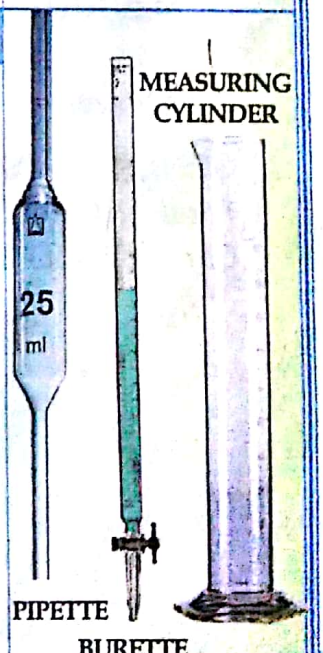
- For pouring reactants into the – thistle funnel or from one vessel to another.
- For carrying out filtration, during which – a *filter paper* made into a *conical shape* is wetted & placed inside it.

MEASURING APPARATUSES

- Glass apparatuses having – *fixed volumes for measurement.*

FUNCTION:

- *Pipette* – Measures liquids – by sucking the liquid from the top upto the marked level & closing the open end with the thumb. The measured liquid is then – *poured out by removing the thumb.*
- *Burette* – Measures liquids – by pouring the liquid from the top of the burette upto the marked level. The measured liquid is then – *removed dropwise by opening the tap below.*
- *Measuring cylinder* – Measures definite volumes of a liquid – by filling the liquid to the marked level and – *then pouring it out.*



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C.IMPORTANCE – Of Chemistry

IMPORTANCE – Of Chemistry in agriculture, various products & other use

1. AGRICULTURE

- **Fertilizers** – A substance to improve fertility & supply plant nutrients – *essential for grow*

  Example
  - *Ammonium nitrate* – widely used fertilizer.
  - *Urea* – an important source of nitrogen [non-explosive & solid in nature]
  - *Phosphatic fertilizer* – super phosphates.

  About 90% of fertilizers are in the – solid form.
  Liquid fertilizers comprise – aqueous solutions of *ammonia* or *ammonium nitr*

- **Pesticides** – Chemicals added to the soil, to kill pests. They include – Herbicides ; insecticides ; termiticides etc.
  – They protect the plants from – weeds, fungi & insects.
  – About 30% of crops are destroyed by agricultural pests.
  - *Herbicides* – Kill or inhibit growth of – unwanted plants. Eg -Parag
  - *Insecticides* – Destroy insects, which harm or destroy plants.

  Pesticides may come in contact with other living organisms & disrupt – the balance of the eco-system. Eg – DDT, BHC gammexa
  Eg – premise 75wp

Termiticides (chemical) compounds which are used to kill termiticides which destroy the crops Eg – primis 75wp

2. PRODUCTS

Knowledge of Chemistry has initiated production of – different products

- **Food** – Refined oils , butter, cheese, etc. are obtained through chemical reactions
- **Construction** – Mortar, cement, glass, etc. are various chemical compounds.
- **Clothing** – Natural fabrics such as silk are made through chemical reactions.
- **Household** – Cooking gas which is liquefied petroleum gas or LPG, food preservati specific utensils and electronic items, all involve use of Chemistry.
- **Daily usage** – Paints, dyes, perfumes, paper, ink etc. involve chemical reactions.
- **Industrial** – Metals & alloys [mixture of metals] which find application in innumer machines & metallic structures like automobiles, involve Chemistry
- **Petroleum** – Petrol, kerosene & diesel oil are products – obtained from petroleum.

3. GENERAL USES

Food & Chemistry, Cosmetics & Chemistry, Clothing & Chemistry, Chemicals as Medicines, Chemicals in Industries – are discussed later in the cha

Agriculture

Industry

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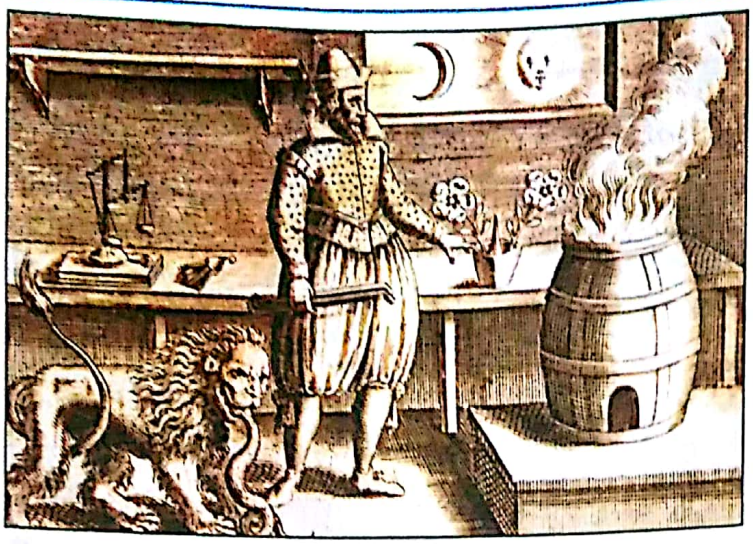
D.DEVELOPMENT OF CHEMISTRY – A historical perspective

ALCHEMISTS – A historical study



Alchemists in the medieval period

ALCHEMISTS

Alchemists – were people who were *predessors* to the – Modern Chemist.

- They were largely discredited by the scientific community – since alchemists included – *occult* & *religion* leading to scientific research.
- Alchemy & alchemists are older words for – Chemistry & chemists where – alchemists transformed or created substances through a seemingly – *magical process.*
- Nicolas Flamel an alchemist around the 14th century, claimed to transform metals into gold.

PHILOSOPHER'S STONE

- In Europe – the creation of the ***philosopher's stone*** was – vastly connected with – all transformation projects.
- Philosopher's stone in a legendary substance, capable of turning inexpensive metals like lead or mercury into – gold & silver.
  [It was not literally a stone, but a powder or potion]
- It was believed to be the – ***elixir of life*** & for a long time was the most – sought after goal in Western Alchemy.
- From the middle ages to the 17th Century the so-called philosopher's stone – held priority & alchemists were successful to a certain extent, in the development of processes, which helped later chemists to extract metals and develop – path-breaking avenues in Chemistry.
- Towards the end of the 17th Century – the scientific processes involving modern Chemistry started paving paths & Alchemy today is considered – a *pseudoscience* & Chemistry regains its rightful position as a – serious scientific field.

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Total 118 elements.

E. NOTABLE CHEMISTS/SCIENTISTS – And their contributions

NOTABLE CHEMISTS/SCIENTISTS & THEIR CONTRIBUTION TO CHEMI

Scientists	
• **Dimitri Mendeleev**  1834 – 1907	• *Dimitri Mendeleev* – was a Russian scientist born in 18 Moseley – Modern periodic table (incr • He formulated the – *Periodic Table of elements.* order of atomic number – He systematically arranged the dozens of known elem by atomic weights & could even predict the – properties of the still unknown elements. – He devised the – Periodic Table & was best known fo discovery of the – *Periodic Law.*
• **Antoine Lavoisier**  1743 – 1794	• *Antoine Lavoisier* – was a French scientist born in 1743 1778 • He recognised & named oxygen in 1778 & later – hydrogen in 1783. 1783 – He also wrote the first extensive list of elements a helped to reform chemical nomenclature. – In 1774 – he turned his attention to the phenom of combustion – with his famous experiment, in w he heated pure mercury in a swan necked ret leading to the discovery of – *oxygen.*
• **John Dalton**  1766 – 1844	• *John Dalton* – was an English scientist born in 1766. • He compiled his theory – Dalton's atomic theory in 1 • The main postulates of *Dalton's atomic theory* are that – Matter consists of particles called atoms, which are indivi & cannot be created or destroyed. – The theory was later contradicted in certain aspe by the – *Modern atomic theory.*

OTHER CHEMISTS

- **VAN HELMONT – 1630** – Discovered ***carbon dioxide*** on heating charcoal in a
- **GLAUBER – 1648-58** – First prepared ***hydrogen chloride gas*** from sod chloride & concentrated sulphuric acid & later ***nitric*** from potassium nitrate & concentrated sulphuric a
- **JOSEPH PRIESTLEY – 1770** – First prepared ***Sulphur dioxide gas*** by action of concentrated sulphuric acid on mercury.

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F. FOOD & CHEMISTRY – Food preservatives & food processing

1. FOOD PRESERVATIVES

TERM:

Food preservatives – are substances or chemicals – added to food or beverages to
- prevent decomposition by bacteria or microbes.
- reduce risk of food borne infections.
- preserve nutritional quality of food.

TYPES OF PRESERVATIVES:

The commonly used preservatives are –

Preservatives	Food items
. *Benzoic acid* . *Nitrates* . *Sulphur compounds*	– Jams, pickles, carbonated drinks. – Meat products – Beverages, wines etc.

Some preservatives may have side effects & hence study & further research is required.

Preservative for jams

Preservative for pickles

2. FOOD PROCESSING

TERM:

Food processing – involves – physical or chemical processes, to transform or change the – raw ingredients in food into – easy usable forms – of food available in markets.

Raw materials – in food **to** Marketable food products

FOOD PROCESSING – processes:

- Mincing
- Preservative addition
- Cooking
- Canning
- Pickling
- Packaging

Food processing industries include –

Sugar industry, Fish processing, Meat packaging, Tinned vegetables, snacks etc.

Marketable food products

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COSMETICS – Ingredients in cosmetics

TERM:

Cosmetics – enhance or alter the appearance or fragrance of an individual.

Cosmetics are mixtures of chemical compounds – from natural sources or from synthetic sources.

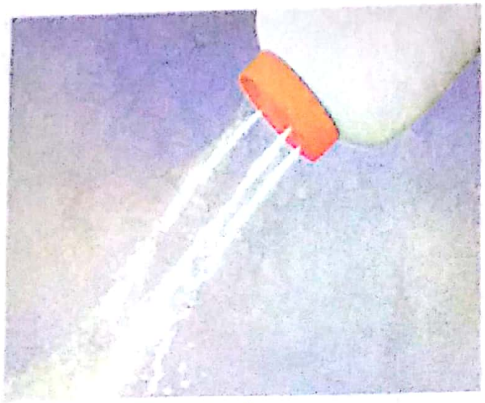
Some sources of compounds used in cosmetics include – modified natural oils & processed minerals such as – zinc oxide, iron oxide & talc.

TALC:

- Talcum powder is made from talc – a mineral made up of – *hydrated magnesium silicate.* [contains elements – magnesium silicon, oxygen].
- In its natural form – talc contains asbestos – which is removed from consumer prod
- *Talc* – absorbs moisture, cuts down on friction, keeps skin dry & prevents ra

INGREDIENTS IN COSMETICS

Chemical ingredients	
. *Water* –	It forms the basic of almost all cosmetic prod & acts as a solvent – to dissolve other – water soluble ingredients.
. *Titanium dioxide* –	It is a natural pigment powder which provi base for mineral makeup. It provides – *mild sun protection* & as a pigment gives white colouration to coloured ingredients.
. *Oxides of zinc & iron* –	They are classified as pigments i.e. colour and may provide variation in colour to the cos products. Zinc oxide also initiates – *anti-inflammatory properties* in the cosmetic.
. *Emulsifier* [oil dispersed in water] –	They are used in creams & lotions to give an even texture.
. *Preservatives* –	They extend the shelf life of a cosmetic & prevent growth of microorganisms.



Talcum powder

Cosmetics

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CLOTHING – Synthetic fabric – Terylene

TERM:

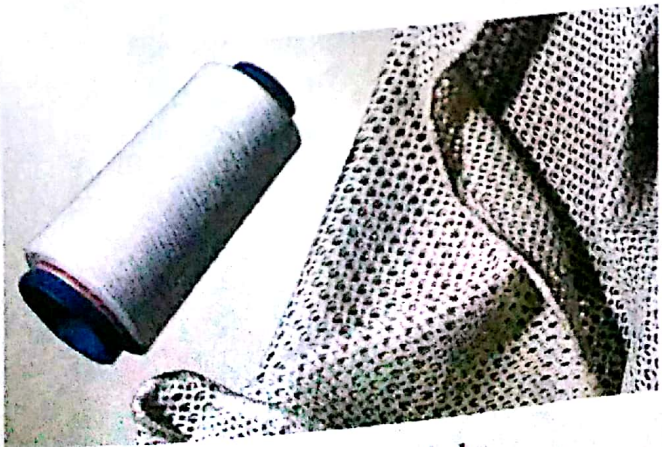
- *Clothing* – It is a material for covering the body by a fabric. Certain fabrics are made by conversion of fibres such as cotton, to synthetic fabrics.
- *Natural fibres* – such as cotton & wool were – *directly converted into clothing material.*
- *Synthetic fibres* – such as terylene, nylon & rayon – *are used in expensive clothing; carpets etc.*

TERYLENE:

- *Term* – It is a synthetic polyester fibre or fabric formed generally, by – addition of *polyester* to natural fibre – *cotton.*
  The combination makes the fabric – easy to clean & crease resistant.
- *Properties* – It is a strong fabric –
  – elastic in nature, resistant to friction,
  – suffers little loss in strength,
  – crease resistant,
  – easily washable & dries quickly.
- *Uses* – It finds use –
  – in fashion garment fabrics
  – in nonwoven carpets, rain coats, sails and
  – in making of nets, ropes, hoses etc.

OTHER SYNTHETIC FABRICS – *Include*

- *Rayon* – a regenerated cellulose fibre
  – used in – carpets when blended with wool.
  – bed sheets – when blended with cotton.
- *Nylon* – an artificial synthetic fibre
  – used in – fabrics, ropes, brushes, hooks etc.



Terylene rope

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I. CHEMICALS AS MEDICINES – Aspirin & paracetamol

MEDICINES – Aspirin & paracetamol

TERM:

- *Medicines* – are natural or synthetic substances which when taken in a living
  - affects its functioning,
  - and treats or prevents a disease.
- Chemistry allows researchers to create drugs which combat illn by interacting efficiently with the diseased body.
- Once the promising molecule is identified –
  Chemistry is required to know, which molecule is preferred for which dise

ASPIRIN

- It is a medicine – to treat pain, fever & inflammation.
- Aspirin given shortly after a heart attack, may decrease – risk of death.
- As long term use – it may reduce, blood clots in people who are at a high
- It is generally not recommended in children with infections –
  and is one of the most widely used medication – globally.
- Its side effects may include – *upset stomach, stomach ulcers etc.*

PARACETAMOL

- It is a medicine to treat – mild to moderate – pain & fever.
- It may also be used in low back pain, headaches & for dental use.
- It maybe sold in combination with – cold medications.
- It is safe at recommended doses, but too high a dose may result in – *liver p*

OTHER MEDICINES – Include

- *Antacids or sodium bicarbonate* – for acidity & upset stomach.
- *Iron supplements & vitamin B12* – for anemia [deficiency of red cells in the
- *Antibacterials* – for conjunctivitis [inflammation of the membrane covering the e

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1. CLEANSING AGENTS – Soaps & detergents

TERM – SOAP

Soaps – are substances used with water, for cleaning & washing. & are made from –

- a compound of vegetable oils or animal fats along with – sodium or potassium hydroxide and generally have perfumes or colourants, added to it.

TERM – DETERGENTS

Detergents – are synthetic water soluble cleaning agents –
that unlike soap [which are prepared from vegetable oils or fats] are prepared from –

- petroleum products along with – sodium or potassium hydroxide.

Detergents have an advantage over ordinary soap

- Hard water is one which does not lather with soap, while soft water lathers easily.
- Ordinary soap when rubbed in hard water is wasted & lather forms only – after all the insoluble salts in hard water are removed as – scum.
- Synthetic detergents – do not form scum & lather even in hard water.

Soap

Detergents

2. STAIN REMOVALS

TERM – STAIN REMOVALS

It is the process of removing a mark or a stain left by one substance –
on a specific surface – *fabric.*
Most stains are removed by dissolving – *with a solvent.*

EXAMPLES OF – Stain removers

Substance	*Stain*
Lemon juice	– contains citric acid & is used for removing – *stains from fabrics.*
Hydrogen peroxide	– a mild bleaching agent – *also effective in removing stains.*
Glycerine	– it softens stains on – *wool*
Sodium hydroxide	– it dissolves grease & oil & is preferred as a – *drain cleaner.*
Boiling water	– it softens fruit juice stains – on a fabric.

Stain on fabrics

Stain remover

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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.

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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.

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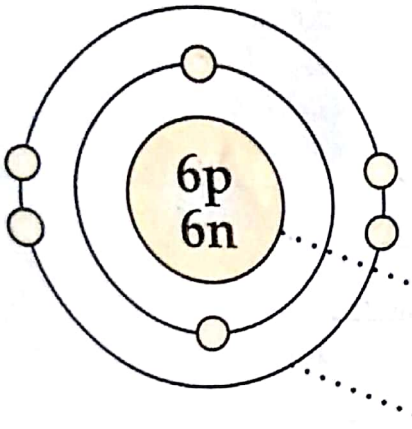
C. ELEMENTS – Term, basic unit, classification

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.

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ELEMENTS – Symbols

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.

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ELEMENTS – Symbols

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

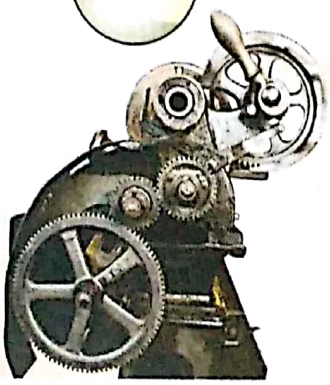
ALUMINIUM

Al

Aluminium foil

IRON [STEEL]

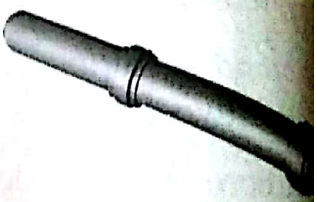
Fe



Steel machinery

LEAD

Pb



Lead pipes

COPPER

Cu

Copper utensils

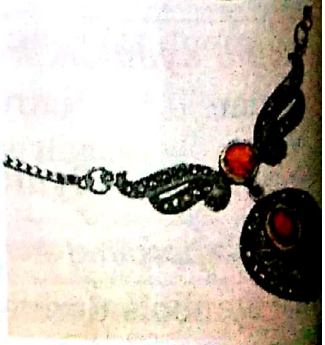
MERCURY

Hg

Mercury thermometer

SILVER

Ag



Silver jewellery

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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

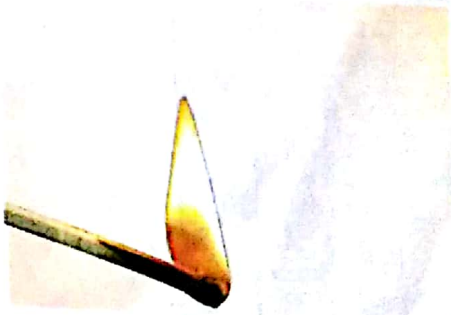
CHLORINE

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.

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ELEMENTS – Names & symbols of first twenty elements in periodic

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 man*

  This arrangement of elements was done in the form of a table called – *Periodic T*

The Periodic Table

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

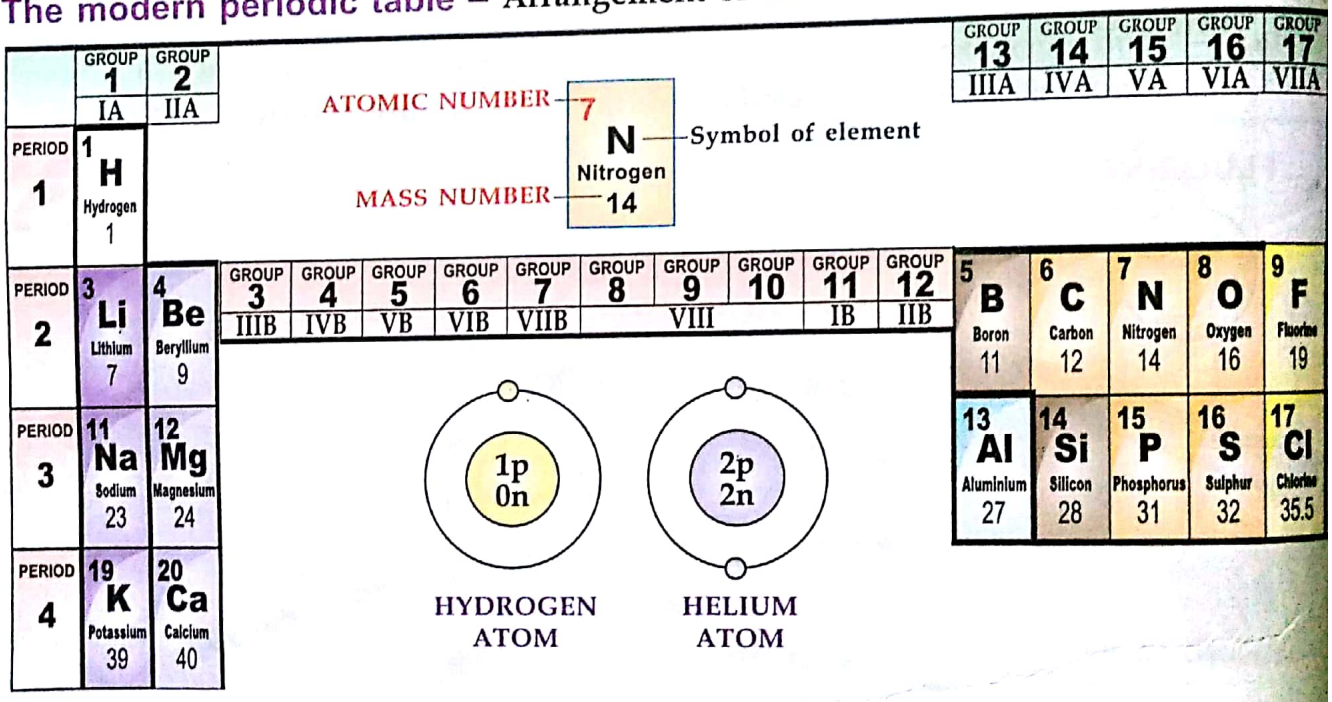
  is the number of protons or electrons [*both are equal*] in an atom of an element. e.g. –

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

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

2. THE PERIODIC TABLE

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



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
Boron	Carbon
Silcon	Nitrogen
	Oxygen
	Fluorine
	Phosphorus
	Sulphur
	Chlorine

mass no. = total no. of protons & electrons.
atomic no = total no. of electrons or protons.

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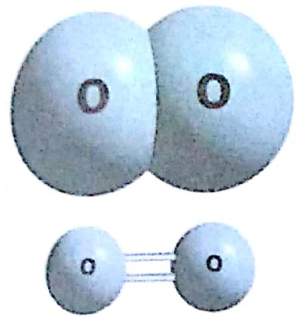
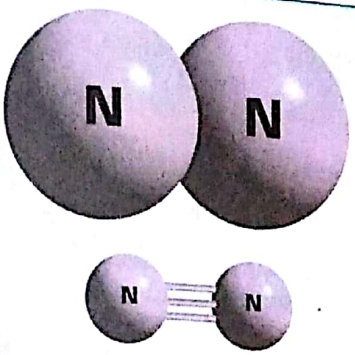
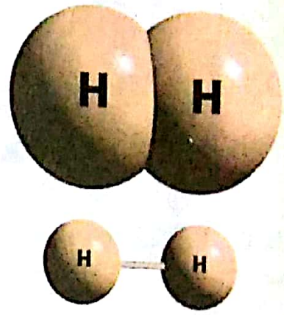
D. MOLECULES

THE TERM – Molecules

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

Atoms of the same element – forming a molecule

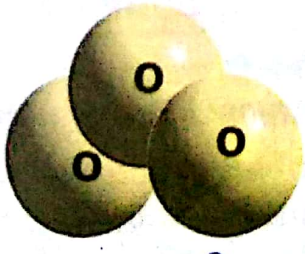
Oxygen	*Nitrogen*	*Hydrogen*
		

Diatomic molecules

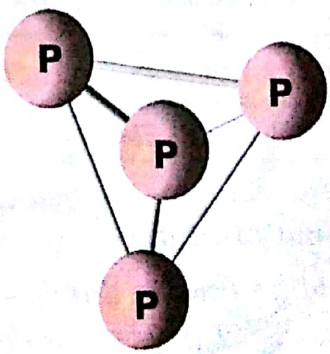
ELEMENT	MOLECULE	ATOMICITY	
HYDROGEN- H	H_2	2	**ATOMICITY**
NITROGEN - N	N_2	2	It is the number of atoms present in one molecule of the element.
OXYGEN - O	O_2	2	
CHLORINE - Cl	Cl_2	2	
BROMINE - Br	Br_2	2	
IODINE - I	I_2	2	

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]

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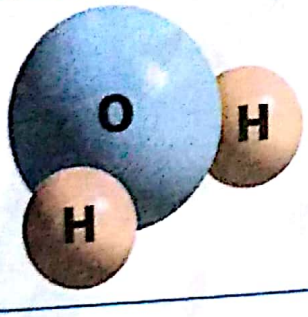
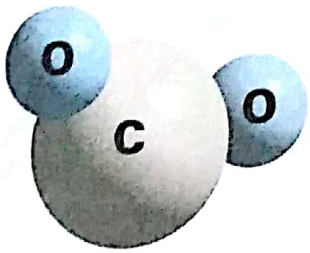
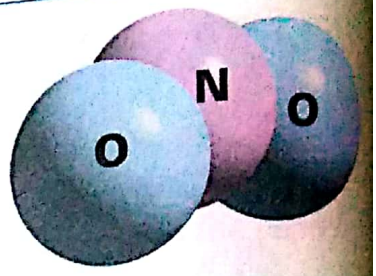
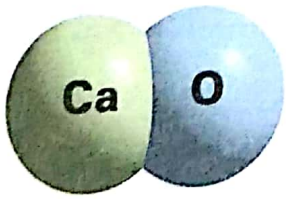
E. COMPOUNDS

THE TERM – Compounds

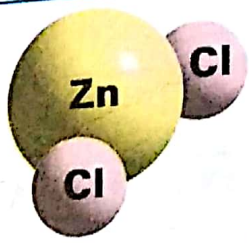
A compound is a pure substance made up of – two or more different elements combined chemically – *in a fixed proportion.*

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 ma

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 sim substances by chemical meth
3. *Have their own set of* – properties.	3. *Properties differ* – from those of their elements.

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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*]

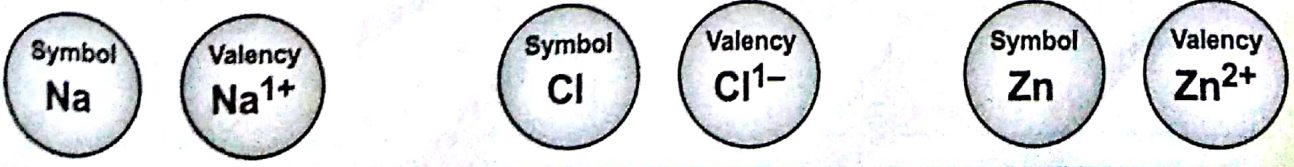
Combining capacity of an element

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].



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COMPOUNDS – Formula of compounds

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 unit and having a charge.] → positive or negative charge. or neutral charge
(extra electron) / Extra proton

SYMBOLS – of some elements		SYMBOLS – of radicals
METALS	NON-METALS	Radicals - group of atoms of elemen
• 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 [
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 [valenc
- 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+ 1 Cl 1- 1	II	Zn 2+ 1 Cl 1- 2
III	Na_1 Cl_1	III	Zn_1 Cl_2
	Formula = NaCl *[ignore 1]*		Formula = $ZnCl_2$

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IMPORTANT CHEMICAL FORMULAS

GASES

Hydrogen H_2	Nitrogen N_2	Oxygen O_2	Chlorine Cl_2	Hydrogen chloride HCl	Ammonia NH_3
Carbon monoxide CO	Carbon dioxide CO_2	Nitrogen monoxide [nitric oxide] NO	Dinitrogen oxide [nitrous oxide] N_2O	Nitrogen dioxide NO_2	Sulphur dioxide 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 *Hydrochloric acid*	HNO_3 *Nitric acid*	H_2SO_4 *Sulphuric acid*	H_2CO_3 *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 *Potassium hydroxide*	NaOH *Sodium hydroxide*	$Ca(OH)_2$ *Calcium hydroxide*	$Zn(OH)_2$ *Zinc hydroxide*

SALTS

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

Base + Acid → *Salt* + Water

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

METALLIC OXIDES & SULPHIDES

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

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REPRESENTING – A chemical reaction

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

CHEMICAL EQUATION –

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

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* -

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

- *Molecular equation* -

Fe [iron] + S [sulphur] → FeS [iron sulphide]

Fe + S : *Reactants* ; FeS : *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 + W

Molecular equation –

$NaOH + HCl\ [dil.] \rightarrow NaCl +$ H

. dil. =

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

Word equation –

Magnesium + Sulphuric acid → Magnesium sulphate+Hy

Molecular equation –

$Mg + H_2SO_4\ [dil.] \rightarrow MgSO_4 +$ H

.

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F. MIXTURES

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

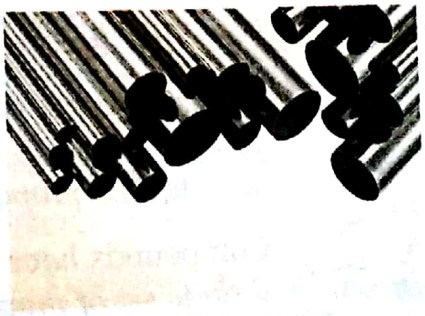
Element Sulphur + *Element* Carbon + *Compound* Potassium nitrate → *Mixture* Gun powder



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 mixtur
e.g. oil & water, salt & sand, chalk & water. [oil – water *immiscible* mixture – i.e. do not mix easil

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MIXTURES – Characteristics of mixtures & comparative stud

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 propo*

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

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

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 & s

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
  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 elem* or *compounds.* e.g.*Iron-sulphur mi*
EXISTENCE	Elements i.e. atoms – present – *on their own.*	Components in a *compound* present – *in a definite proportion.*	Components in a present – *in any proportion.*
PROPERTIES	Elements *have a* – *definite set of properties.*	Compounds *have a* – *definite set of properties.*	Mixtures *do not h* *definite set of prop*
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 can be separated b *physical methods*
EXAMPLES	*Elements* Iron, copper.	*Compounds* Iron sulphide, copper oxide.	*Mixtures* Iron + sulphur, copper + silver.

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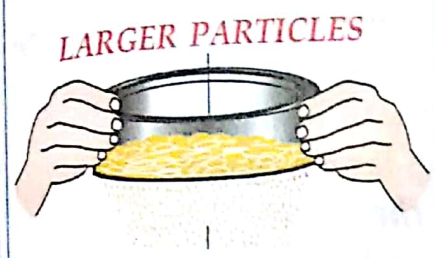
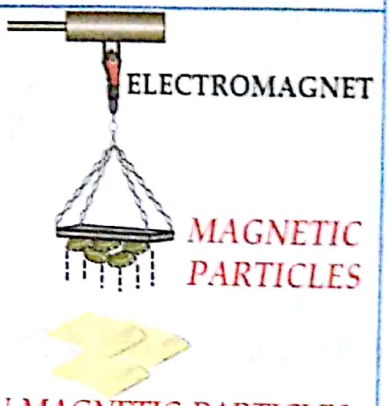
MIXTURES – Separation of mixtures

SOLID – SOLID MIXTURES

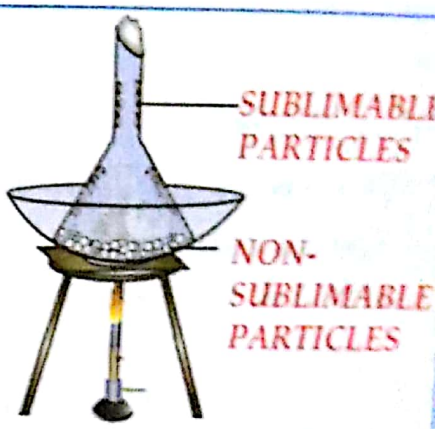
SIEVING



MAGNETIC SEPARATION

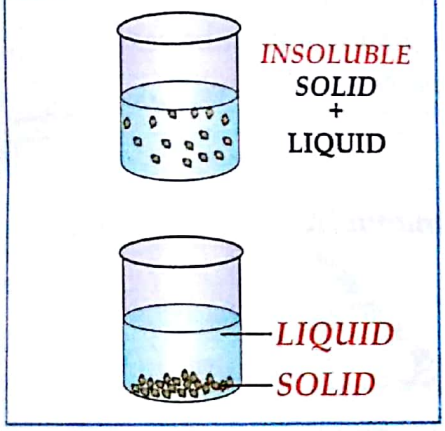


SUBLIMATION

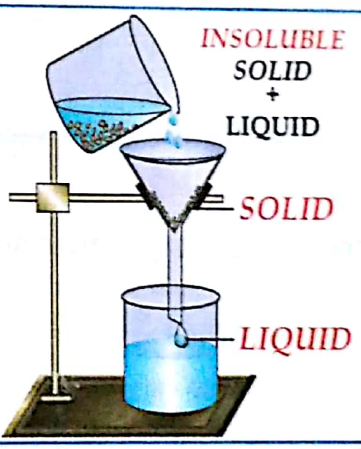


SOLID – LIQUID MIXTURES

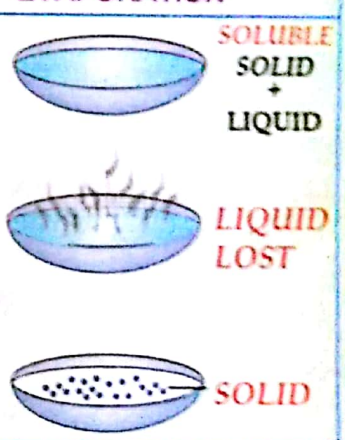
SEDIMENTATION



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.

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MIXTURES – Separation of mixtures – Seiving & magnetic sepa

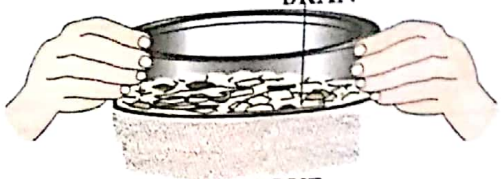
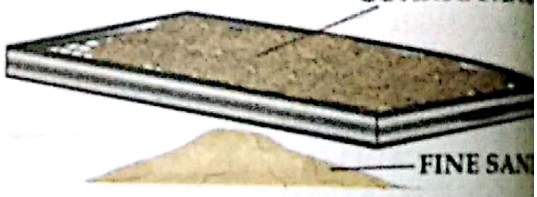
METHOD 1 – SEIVING

- **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 fro 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 sta above & the finer particles collect below it on – *shaking the sieve.*
- **EXAMPLES** – *Separation* of rice powder from soil, *different sized particles* of diamond & of

In the home	*By builders*
BRAN  WHEAT FLOUR Separation–of bran & wheat flour *Larger bran particles* - stay above *Smaller flour particles* - below	COARSE SAN  FINE SAN Separation–of particles of sand *Coarse sand* - stays above *Fine sand* - below

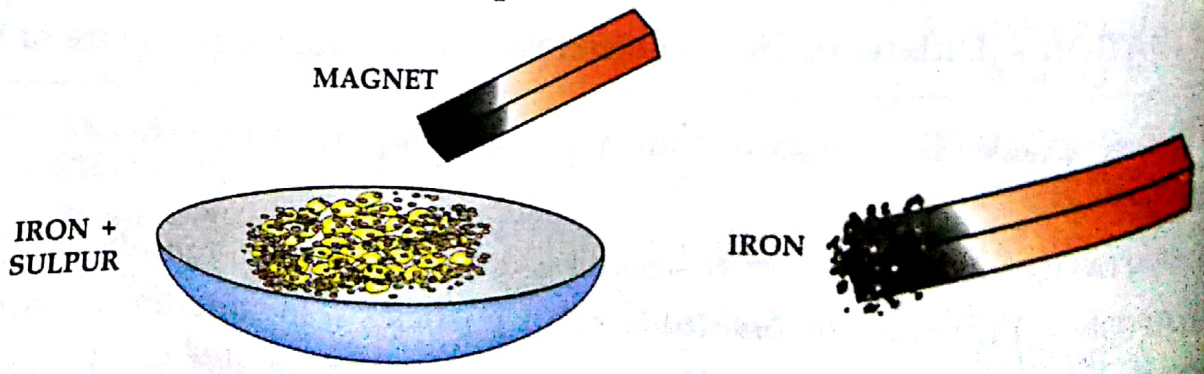
METHOD 2 – MAGNETIC SEPARATION

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

MAGNETIC PARTICLES – IRON

NON-MAGNETIC PARTICLES – SULPHU

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



SEPARATION OF IRON FROM SULPHUR

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METHOD 3 – SUBLIMATION

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

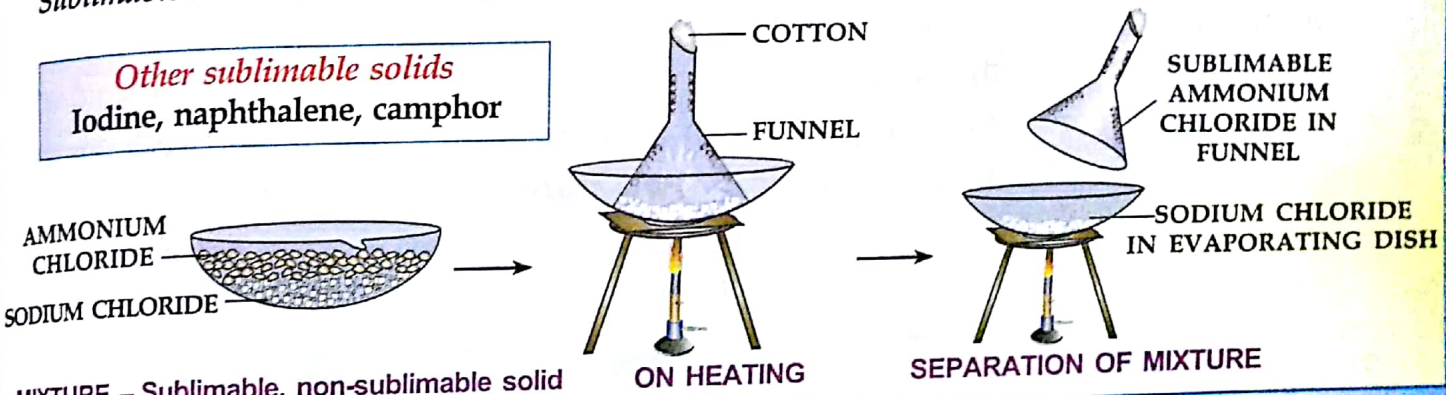
Sublimable solids – are those which sublime i.e. turn directly into vapour on heating. The vapours on cooling, give back the pure solid. The ***non-sublimable solid*** remains behind.

- **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.

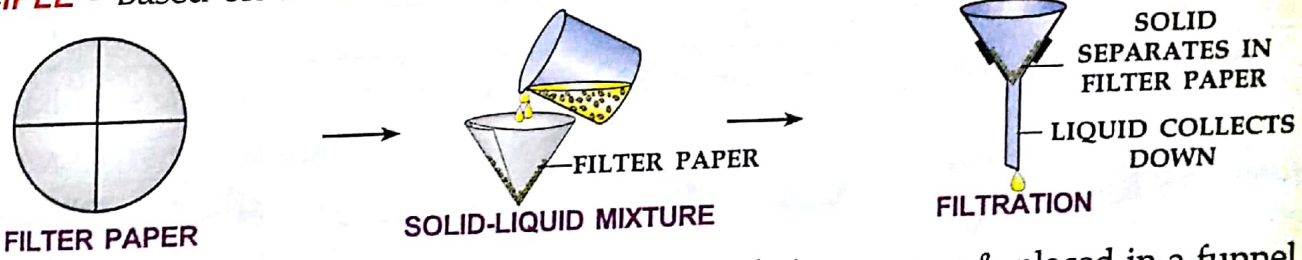
Sublimable substance : ammonium chloride. ***Non-sublimable substance :*** sodium chloride.

Other sublimable solids
Iodine, naphthalene, camphor



METHOD 4 – FILTRATION

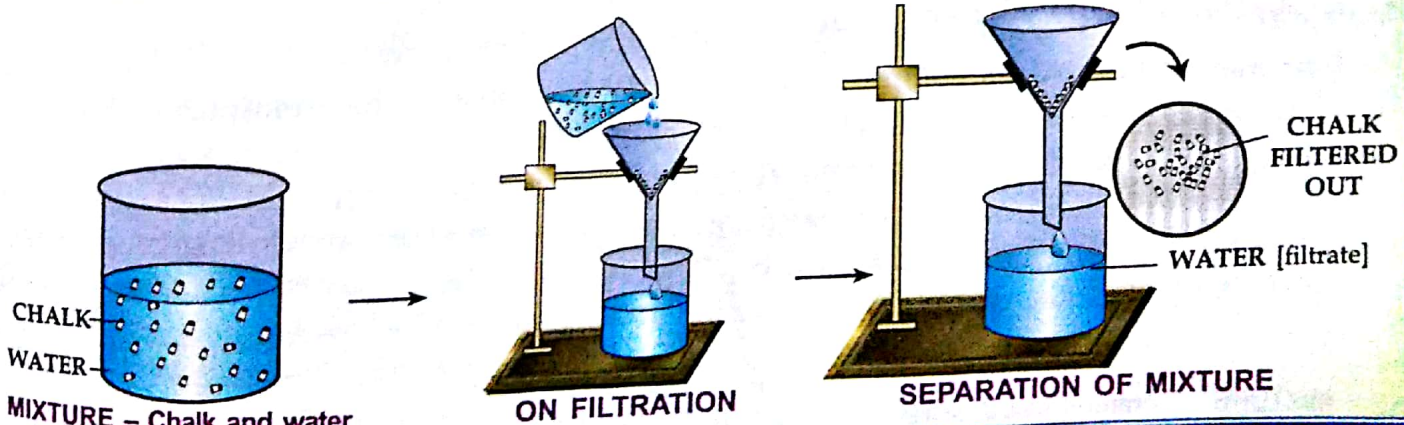
- **PRINCIPLE -** Based on the filtration of ***insoluble*** solid particles in a solid-liquid mixture.



- **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



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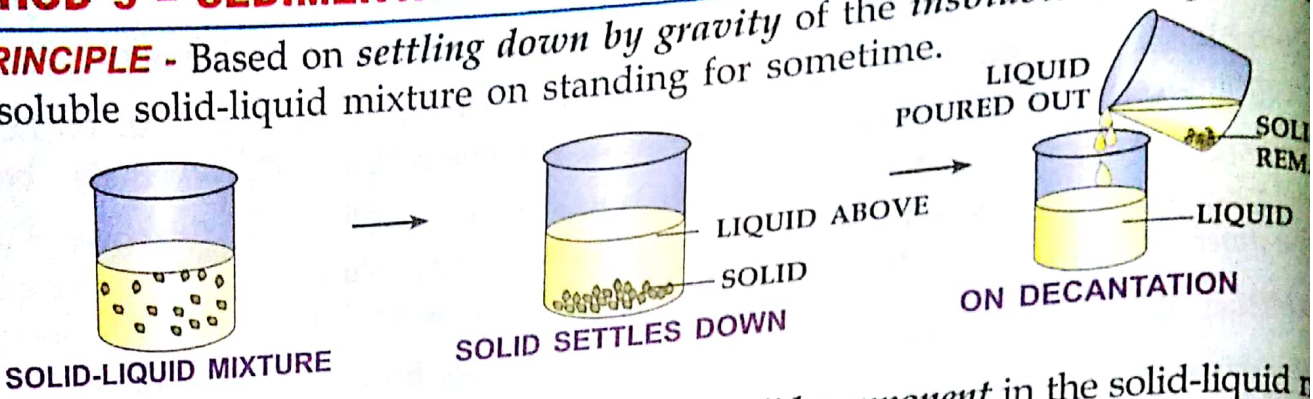
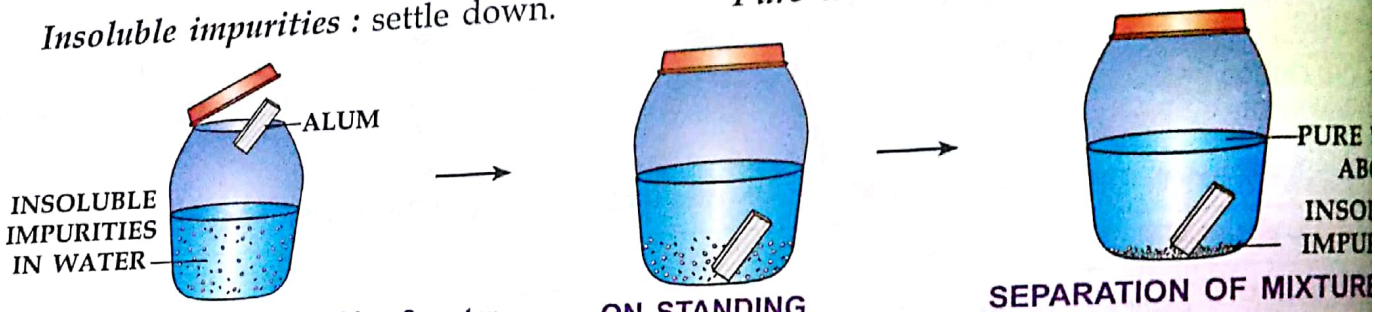
METHOD 5 – SEDIMENTATION & DECANTATION

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



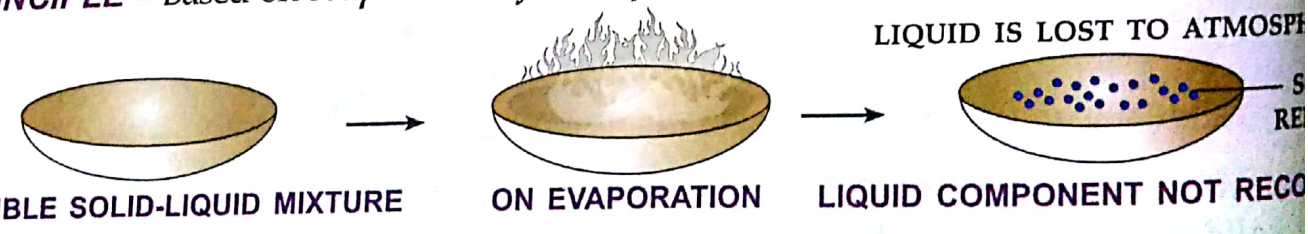
- **TECHNIQUE OF SEPARATION** – The *insoluble solid component* in the solid-liquid m *settles down* on standing in a beaker. The liquid collects above it and is poured o process of pouring out of the liquid, such that the solid remains behind is called *decan*
- **EXAMPLE** - Sedimentation of impurities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

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



METHOD 6 – EVAPORATION

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



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

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

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Matter

3

LATEST SYLLABUS – Key Concepts / Concerns

States of Matter

- Classification of matter into solid, liquid and gas on the basis of properties [shape, volume].
- Factors responsible for the existence of matter in different states.
- Arrangement of atoms/molecules in solids, liquids & gases: - intermolecular space, cohesive forces.
- There is space between the particles of matter.
- Effect of heat on matter [expansion, change of state and chemical change]

Learning Outcomes:

Children will be able to:

- discuss the properties of solids, liquids and gases;
- classify the matter into solid, liquid and gas;
- discuss the inter-conversion of one state of matter into another;
- explain the effect of heat on matter showing change of state, expansion and chemical change.

A. INTRODUCTION – Matter

THE TERM – Matter

- It is anything that can be perceived by the senses.
- It occupies space & has mass & can neither be created nor destroyed.
- It is made up of one kind of particles called – *substances*.
- One kind of matter can be distinguished from another by its – *physical & chemical properties*.

Physical properties of matter

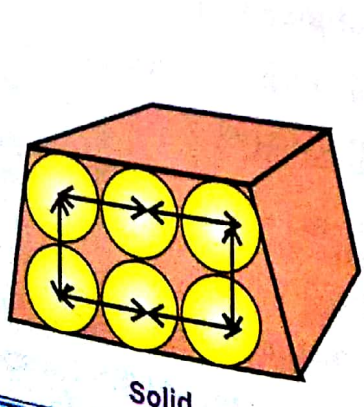
- *Colour* – all matter can be distinguished by their varied – *colours*.
- *Odour* – matter shows variation in odour or smell.
- *Solubility* – matter may vary in solubility in water or other solvents.
- *Melting & boiling point* – substances show variation in their melting & boiling poin

Chemical properties of matter

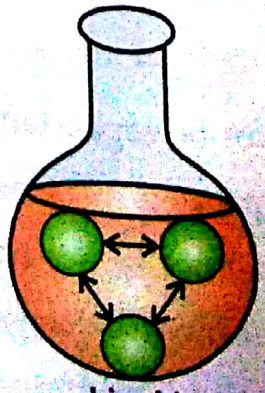
- Includes various chemical reactions of different substances – with varied chemica

States of matter

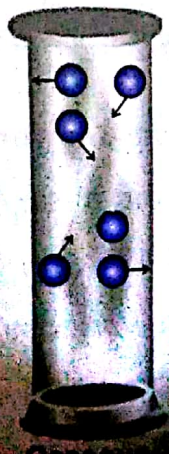
- The three main states of matter are – solids, liquid & gaseous.



Solid



Liquid



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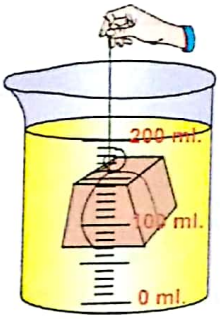
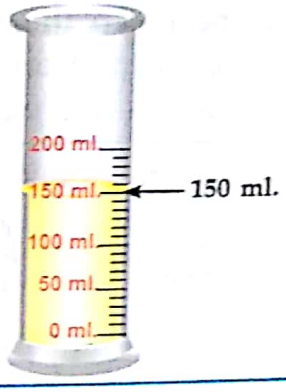
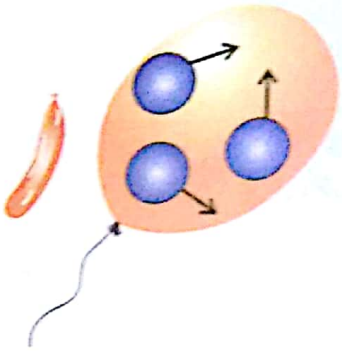
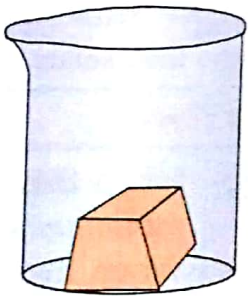
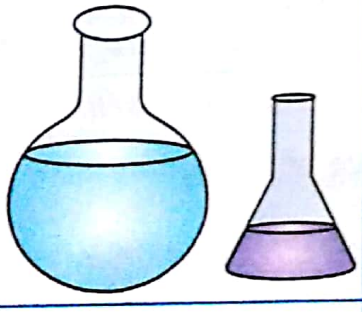
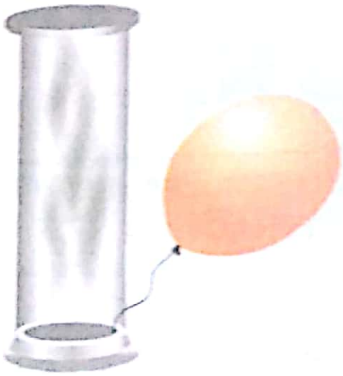
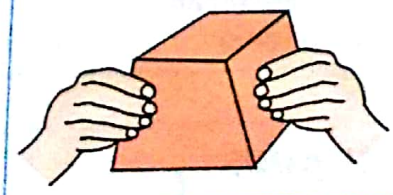
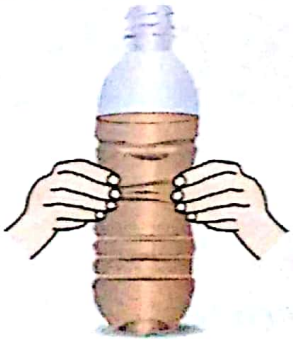
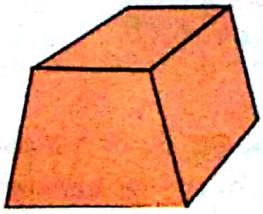
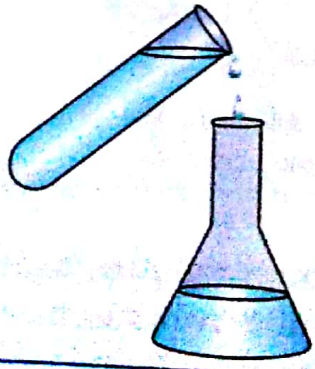
CLASSIFICATION – Of matter

CHARACTERISTIC	SOLIDS	LIQUIDS	GASES
• VOLUME	Have – *a definite volume* 	Have – *a definite volume* 	Have – *no definite volume* 
• SHAPE	Have – *a definite shape* 	Have – *no definite shape* 	Have – *no definite shape* 
• COMPRESSIBILITY	Have – *no compressibility* 	Have – *slight compressibility* 	Have – *high compressibility* 
• DIFFUSION	Have – *no diffusibility* 	Have – *slight diffusibility* 	Have – *high diffusibility* 

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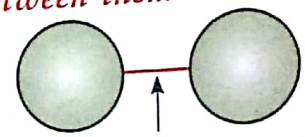
C. FACTORS – Responsible for existence of different

• MATTER

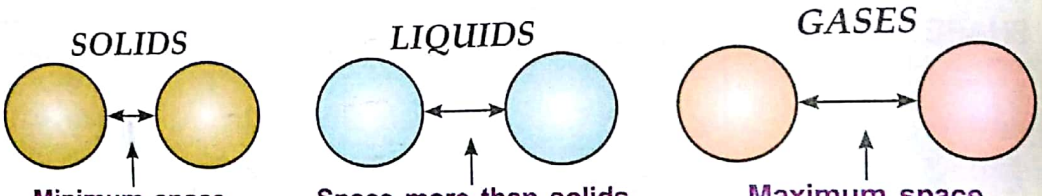
Exists in three states – solid, liquid and gaseous
- Matter in any state is composed of – particles
- The particles are arranged in a way such that there exists
  - spaces between them
  - a force of attraction between them
  - movement in the particles.

• INTERMOLECULAR SPACE

Particles have spaces between them



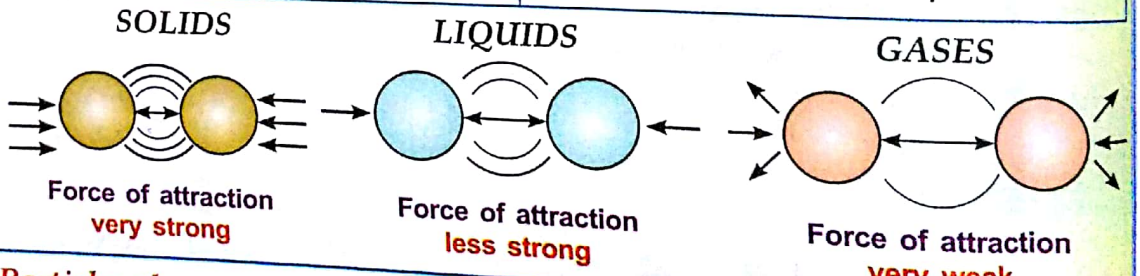
Space between particles



• INTERMOLECULAR ATTRACTION

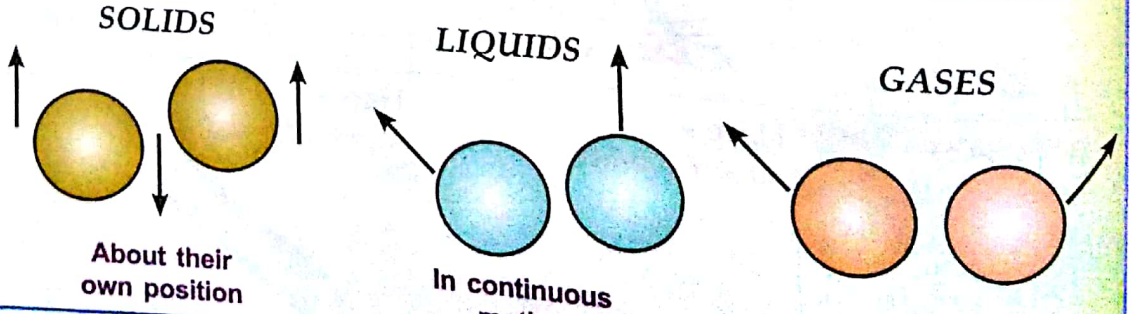
Particles attract each other with a force

Force of attraction is very strong–	when there is – *minimum space between particles.*
Force of attraction is very weak–	when there is – *maximum space between particles.*



• MOVEMENT OF PARTICLES

Particles show movement



Therefore
- *Solids* have – a definite volume, a definite shape & are rigid.
- *Liquids* have – a definite volume, no definite shape & are less rigid.
- *Gases* have – no definite volume or shape & are not rigid.

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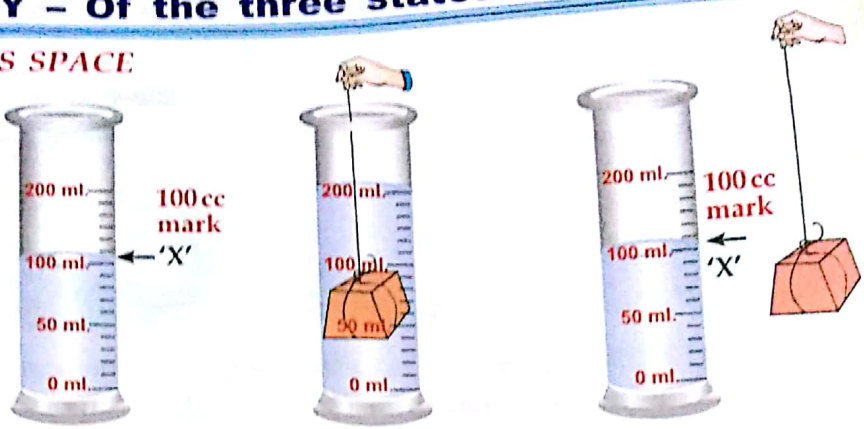
• SOLIDS

OCCUPIES SPACE



Procedure – Take a measuring cylinder & fill it to 100 cc mark with water. A 'solid' is slowly immersed inside the cylinder.

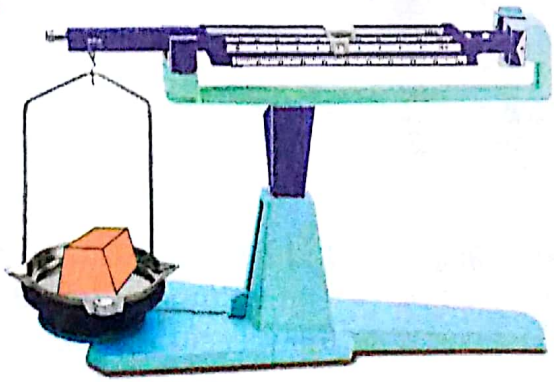
Observation – The water level rises above the 100 cc mark & if the solid is removed, then the water level comes back to the 100 cc mark.

Conclusion – The solid occupies the space of the water & thus pushes the water level up & similarly back to the original level on removing the solid.

Therefore all solids [and liquids] – occupy space.

• SOLIDS

HAVE MASS



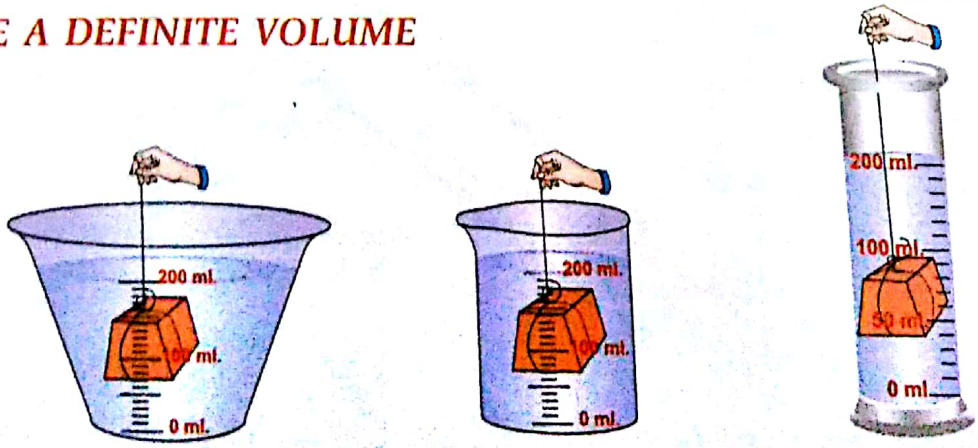
Procedure – On one side of the scale is placed – a solid.

Observation – The scale tilts to the side where the solid is placed.

Conclusion – ***Therefore all solids have – mass.***

• SOLIDS

HAVE A DEFINITE VOLUME



Procedure – A solid is taken and placed in containers of different shap

Observation – Water rises up to the same level in each case.

Conclusion – ***Therefore all solids have a – definite volume.***

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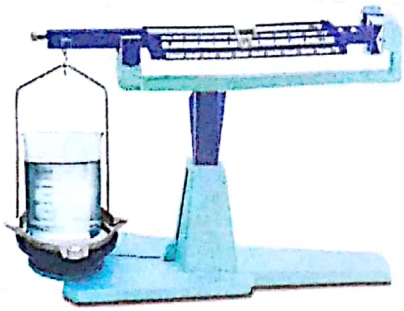
• LIQUIDS

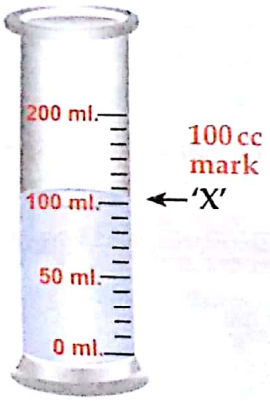
HAVE MASS

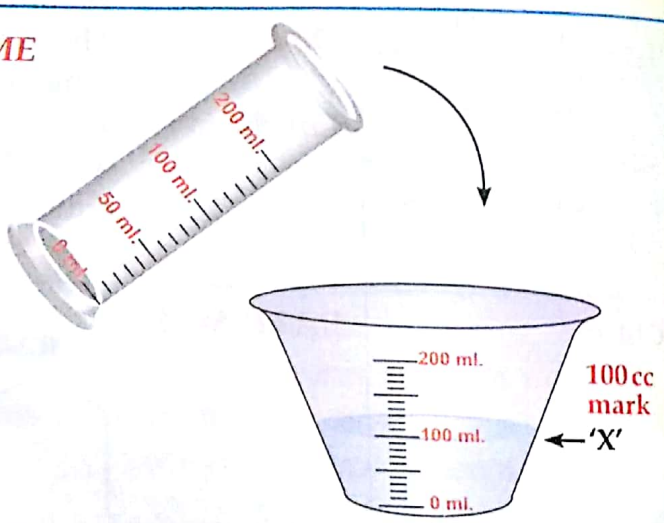


Procedure – On one side of the scale is placed – a liquid in a beaker.
Observation – The scale tilts to the side where the liquid is placed.
Conclusion – The mass of the liquid in the beaker causes the scale to tilt.
Therefore all liquids have – mass.

• LIQUIDS

HAVE A DEFINITE VOLUME

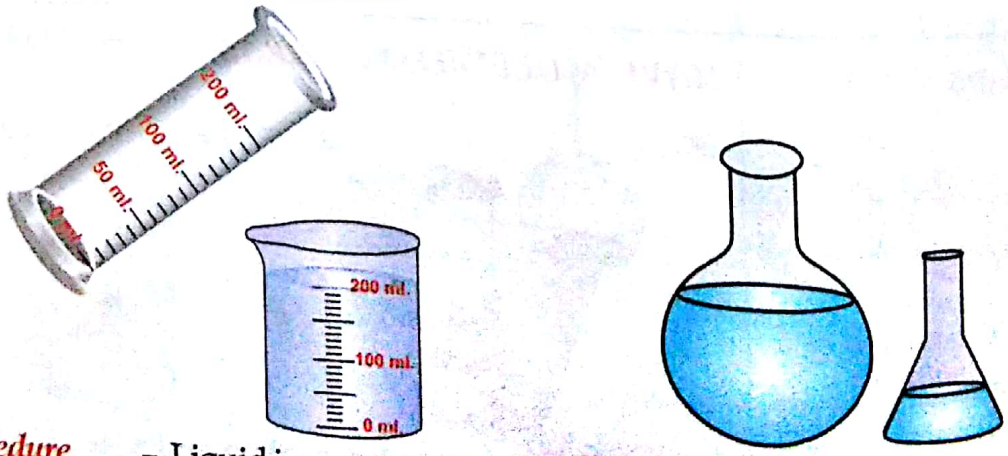




Procedure – Liquid in a measuring cylinder is poured into another container
Observation – The volume of liquid in the container, is the same as that in the measuring cylinder.
Conclusion – Liquids retain their own volume in any shaped container
Therefore all liquids have – a definite volume.

• LIQUIDS

HAVE NO DEFINITE SHAPE



Procedure – Liquid in a measuring cylinder is poured into different containers
Observation – The liquid takes up the shape of each container.
Conclusion – ***Therefore all liquids have – no definite shape.***

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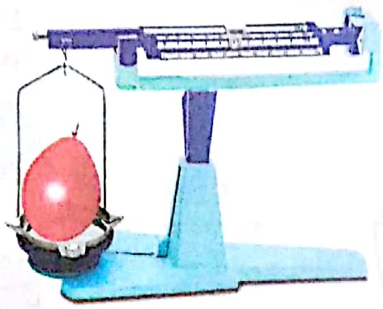
ASES

OCCUPY SPACE

Procedure – An empty glass tumbler is lowered into a beaker of water.
Observation – On tilting the tumbler to one side, bubbles of air are seen coming out from the lower end of the tumbler.
Conclusion – The air inside the tumbler is displaced and bubbles are pushed out from its lower end.
Therefore all gases – occupy space.

. GASES

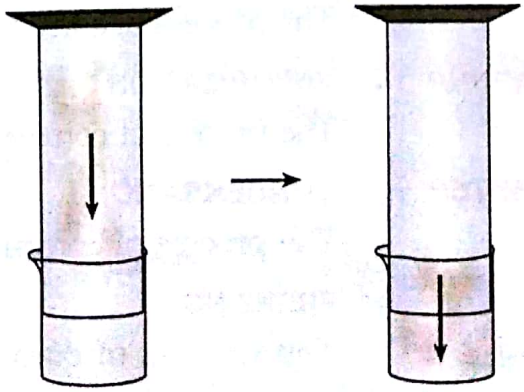
HAVE MASS



Procedure – A balloon is inflated with air & placed on one side of the scale.
Observation – The scale tilts to the side where the balloon is placed.
Conclusion – The mass of the gas i.e air in the balloon causes the scale to tilt to one side.
Therefore all gases have – mass.

. GASES

HAVE NO DEFINITE VOLUME OR SHAPE



Procedure – A gas jar filled with a coloured gas e.g. brown nitrogen dioxide, is inverted over an empty beaker.
Observation – The coloured gas, empties out from the cylinder & completely takes up the volume & shape of the beaker.
Conclusion – ***Therefore all gases have – no definite volume or shape.***

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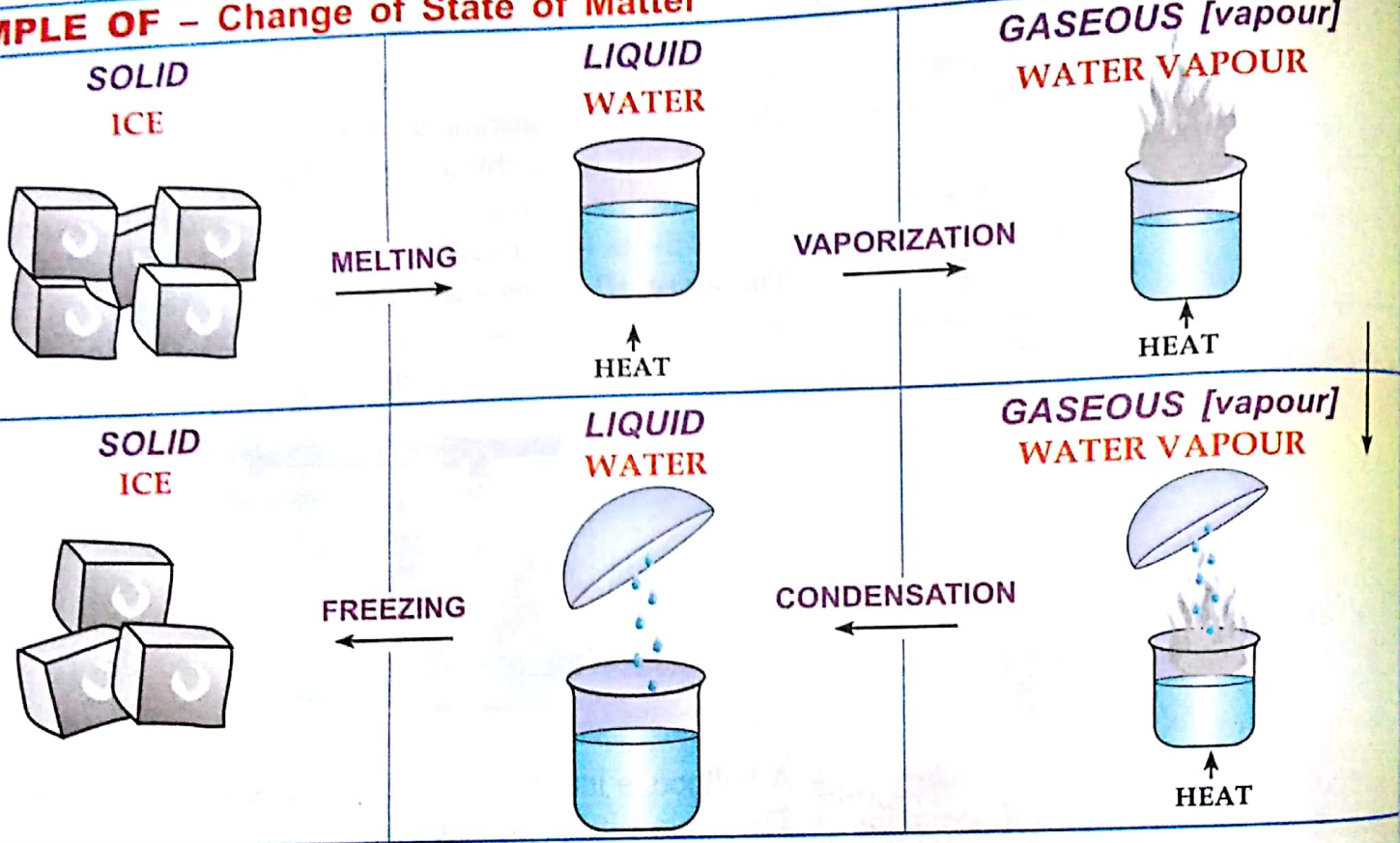
E. CHANGE OF STATE OF MATTER

THE TERM

- Matter exists in three states – *solids, liquids & gaseous* [vapour].
- *Interconversion of matter* – involves change of state of matter from – one state to another state & back to its original state.
- The change is brought about by changes in – *temperature, pressure.*

EXAMPLE OF – Change of State of Matter



TERMS INVOLVED IN – Change of State of Matter

Example	THE TERM
ICE to WATER	• **MELTING** The process of conversion of a – ***solid into a liquid*** on heating.
WATER to WATER VAPOUR	• **VAPORIZATION** The process of conversion of a – ***liquid into vapour*** on heating.
WATER VAPOUR to WATER	• **CONDENSATION** The process of conversion of – ***vapour*** [or gas] ***into a liquid.***
WATER to ICE	• **FREEZING** The process of conversion of a – ***liquid into a solid.***

Melting point - The constant temperature at which – a ***solid*** melts into a ***liquid.*** [*m.p. of ice = 0°C*]

Boiling point - The constant temperature at which – a ***liquid*** starts ***boiling.*** [*b.p. of water is 100°C*]

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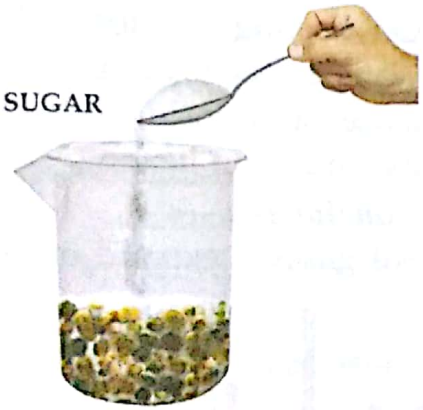
EXPERIMENT – 1

Basic mock experiment – to show that intermolecular spaces are occupied.

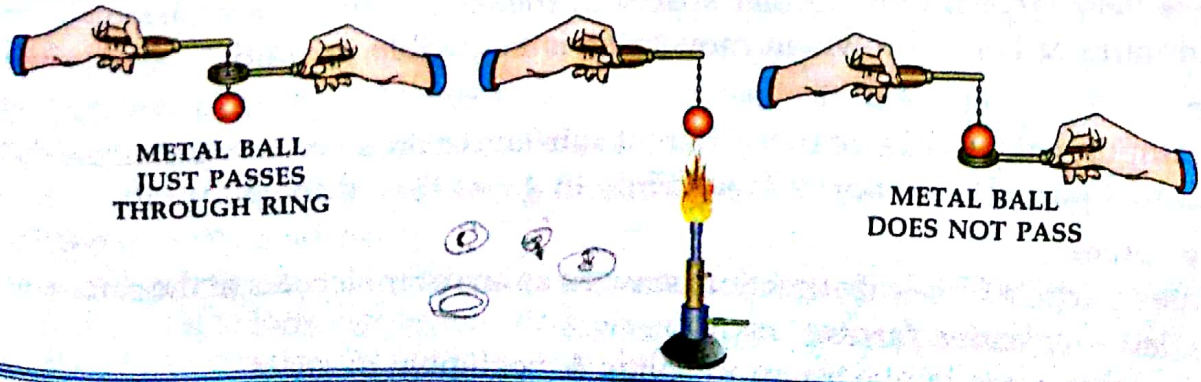
- *Experiment:* Add *sugar* to pebbles taken in a plastic beaker or *sand* to glass balls in a beaker
- *Observation:*
  The sugar or the sand goes into the – *space between the pebbles & the glass balls respectively*
- *Conclusion:* An imaginative demonstration to show that –
  intermolecular spaces between particles are occupied easily.



EXPERIMENT – 2

Experiment – to show that solids expand on heating.

- *Experiment A:*
  An iron bar is taken and its length measured accurately.
  The iron bar is then slowly heated for a certain period of time & its length again measured accurately [with a vernier calipers or otherwise]
- *Observation:* It is observed that the iron bar has increased in length on heating.
- *Experiment B:*
  A simple ball & ring apparatus is taken, which consists of a metal ball which can *just pass* – through the circular metal ring.
  The metal ball is then heated for a certain period of time.
- *Observation:* After heating, the metal ball does not pass through the ring, since on heating it has expanded in size and hence cannot pass through the ring.
- *Conclusion:* All solids expand on heating.



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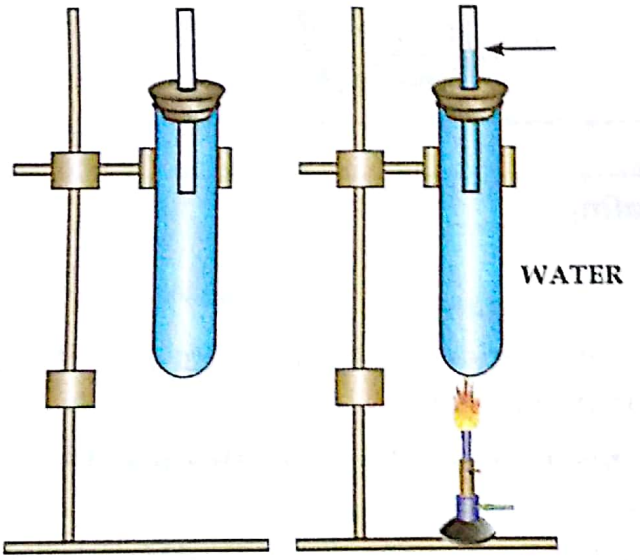
EXPERIMENT – 3

Experiment –

To show that liquids expand on heating.

- *Experiment:* Take water in a hard glass test tube & fill it upto its brim. The mouth of the test tube is fitted with a cork with a capillary at the centre of the cork .
- *Observation:*
  On heating, the water in the hard glass test tube, rises up into the capillary, since water in the hard glass test tube has expanded on heating.
- *Conclusion:*
  All liquids – expand on heating

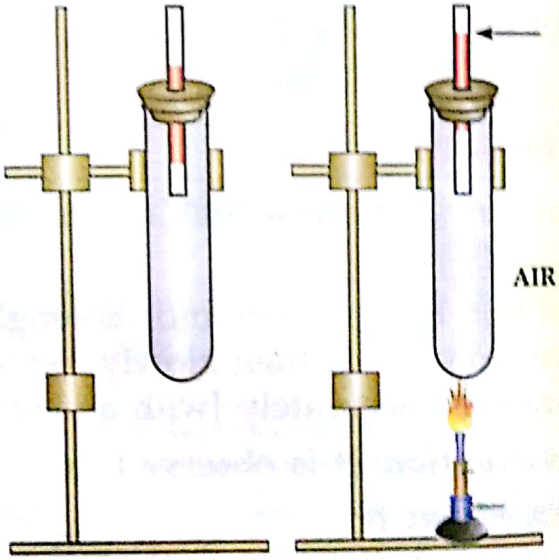


EXPERIMENT – 4

Experiment –

To show that gases expand on heating.

- *Experiment:* Take an empty hard glass test tube fitted with a cork having a capillary at its centre. Coloured water is carefully poured into the capillary.
- *Observation:*
  On heating the test tube, the coloured water is seen to rise up inside the capillary, since the air inside the empty test tube has expanded on heating.
- *Conclusion:*
  All gases – expand on heating



From three states of matter, solids, liquids & gases, solids expand the least and gases the most on heating.

INTERMOLECULAR FORCES – Brownian movement, diffusion & cohesive forces

Brownian movement

- The *random zig zag movement of particles* – suspended in air or water is called – *Brownian movement.*
- Among the three states of matter, brownian movement is maximum in gases since there is very large intermolecular spaces in them. In solids the intermolecular space is minimum & hence brownian movement is negligible in solids.

Diffusion

- Intermingling of particles of two different substances on their own is called – *diffusion.*
- In solids – particles do not diffuse, while in gases they diffuse rapidly.

Cohesive forces

- The inter-particle forces of attraction between atoms or molecules of the same substance are called – *cohesive forces.*
- The cohesive force is maximum in solids & negligible in gases.

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EXERCISE

Matter

1. Explain the term 'matter'. One kind of matter can be distinguished from another by its *physical properties* and *chemical properties*. State the main physical properties of matter.
2. The three main states of matter are – solids, liquids & gases. Compare the three states with reference to the following characteristics of matter –
   a] volume b] shape c] compressibility d] diffusion
3. Matter in any state is composed of particles. Compare the three states of matter i.e. solids, liquids & gases with reference to :
   a] intermolecular space b] intermolecular force of attraction c] movement of particles
4. Describe simple experiments to show that – *solids*
   a] occupy space b] have mass c] have a definite volume
5. Describe simple experiments to prove that – *liquids*
   a] have mass b] have a definite volume c] have no definite shape
6. Describe simple experiments to prove that – *gases*
   a] occupy space b] have mass c] have no definite volume or shape
7. Explain the term 'Interconversion of matter'. With reference to ice, water & water vapour – show diagrammatically the change of state of matter from solid to liquid to gaseous & back to its original state.
8. Explain the terms a] melting b] vaporization c] condensation d] freezing e] melting point f] boiling point.
9. State what would you *observe* if a] sugar is added to pebbles taken in a plastic beaker b] sand is added to glass balls in a beaker. What would you *conclude* from this imaginative demonstration.
10. With the help of a simple diagram how would you show that – solids expand on heating.
11. *Give reasons for the following :*
    a] Solids have a definite shape & are highly rigid, while gases have no definite shape & are least rigid.
    b] Sugar can be distinguished from talcum powder using water.
    c] Water on freezing turns into ice.
    d] A bottle of perfume on opening evolves an odour which can be sensed over a long distance.
12. *Complete the statements given below by selecting the correct word/s.*
    a] Solids and liquids have a definite _____ but gases do not. [mass, shape, volume]
    b] The space between atoms in ____ is maximum while in ___ is minimum. [solids, liquids, gases]
    c] Conversion of a vapour into a liquid is called _____ [vaporization, condensation, freezing]
    d] _____ is an example of a crystalline substance. [wax, sugar, tea]
13. *State which of the following statements are false. If false write the correct statement.*
    a] Solids are highly compressible and rigid.
    b] Atoms/molecules in gases move only about their own positions.
    c] The conversion of water to ice is called – freezing.

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OBJECTIVE TYPE QUESTIONS

Matter

40 marks

Q.1 Fill in the blanks with the correct word/s from the bracket. [10]

1. From the three states of matter, _____ [solids/ liquids/ gases] expand the least.
2. Brownian movement is maximum in _____ [gases /solids/ liquids].
3. Cohesive forces are negligible in _____ [liquids / solids/ gases].
4. Matter can change from one state to another by change in _____ [temperature or pressure / temperature only].
5. The space between atoms [molecules] of solids is _____ [minimum / maximum].
6. Intermingling of molecules is called _____ [perforation / diffusion].
7. Ice on absorption of heat converts to 'X' a process called _____ [vaporization / melting]. 'X' changes to water vapour on _____ [heating / cooling]. Water vapour changes back to 'X' on _____ [freezing / condensation]. The constant temperature at which ice changes into 'X' is called its _____ [fusion point / melting point / boiling point].

Q.2 State which of the following are physical properties of a substance. [10]

1. Chlorine gas has a – strong irritating odour.
2. Sodium nitrate is soluble in water, but calcium carbonate is not.
3. Magnesium reacts with dilute hydrochloric acid, liberating hydrogen gas.
4. Manganese dioxide, a catalyst which alters the rate of a chemical reaction, is black in colour.
5. The melting point of ice is 0°C.
6. Lead chloride reacts with barium sulphate to give a white precipitate of lead sulphate.
7. Water acidified with dilute sulphuric acid – is a good conductor of electricity.
8. Naphthalene on heating directly turns into vapour.
9. Hydrogen sulphide gas has a – strong rotten egg odour.
10. Sulphur is a yellow amorphous powder – insoluble in water.

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.3 **Match the characteristics of the three states of matter in List I with their correct answer from List II.** [10]

LIST I	LIST II
1. Are highly rigid & have a definite shape	A: Solids and gases only
2. Have no definite shape	B: Solids only
3. Have a definite volume but no definite shape	C: Liquids and gases only
4. Are highly compressible and least rigid	D: Gases only
5. Have no definite volume	E: Solids, liquids & gases
6. Have no definite shape and volume	F: Liquids only
7. Occupy space	G: Solids and liquids only
8. Are not compressible	
9. Are slightly compressible	
10. Have mass	

Q.4 Match the arrangement of atoms in the three states of matter in List I with the correct state in List II. [5]

LIST I	LIST II
1. Arrangement of atoms is far apart	A: Solids
2. Force of attraction between atoms is very strong	B: Liquids
3. Movement of atoms is in any random direction	C: Gases
4. Particles diffuse very easily	
5. Particles show movement about their own position	

Q.5 State the correct term from A, B, C, D, E or F in List II which represents the change of state of matter or its relevant property from List I [5]

LIST I	LIST II
1. Solid 'X' to a Liquid 'Y'	A: Condensation
2. Liquid 'Y' to its vapour 'Z'	B: Vaporization
3. 'Z' to 'Y'	C: Melting
4. 'Y' to 'X'	D: Freezing
5. The temperature at which 'Y' changes to 'Z'	E: Melting point
	F: Boiling point

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