stance or by checking its boiling points is case of a liquid substance.

- **Types of pure substances**
  (i) **Element:** An element is a substance which can not be split up into two or more simpler substances by usual chemical methods of applying heat, light or electric energy. e. g. hydrogen, oxygen, sodium, chlorine etc.
  (ii) **Compound:** A compound is a substance made up of two or more elements chemically combined in a fixed ratio by weight e.g. H_2O (water), NaCl (sodium chloride) etc.

MIXTURE

- A mixture is a substance which consists of two or more elements or compounds not chemically combined together. e.g. Air is a mixture of nitrogen, oxygen, inert gases, water vapour, carbon dioxide etc.

Types of Mixtures

(i) **Homogeneous mixture:** It has a uniform composition throughout and its components can not be distinguished visually. e.g. a well mixed sample of vinegar.
(ii) **Heterogeneous mixture:** It is one that is not uniform throughout. Different samples of a heterogeneous mixture may have different composition. e.g. a mixture of salt and pepper.

Methods of Separation of the Constituents of Mixtures

(i) Decantation or Sedimentation

This separation technique is applicable for a mixture containing one liquid and the other solid component. Sedimentation is the process by which insoluble heavy particles in a liquid, are allowed to settle down.

(ii) Filteration

This technique is used when a mixture contains two components, of which only one is soluble in a particular solvent. For separation the mixture is

shaken with the solvent and then filtered. The soluble component passes through the filter paper as **filtrate** and the insoluble solid component is retained on the filter paper called **residue.**

(iii) Evaporation

This technique is applied to separate a non-volatile soluble salt from its mixture in volatile liquid. On heating, the volatile liquid evaporates leaving behind the soluble salt.

(iv) Sublimation

This process is used to separate a mixture containing two components, one of which can form a sublimate i.e., direct change of solid to vapour state on heating, while the other do not.

(v) Magnetic separation

This method is applied to separate a mixture containing one magnetic component and the other non- magnetic components.

(vi) Separating funnel

This method is applicable to recover one of the components from aqueous solution of the mixture by extracting the mixture with a suitable solvent. The solvent should be immiscible with water but should dissolve one of the components of the mixture.

(vii) Crystallisation or Recrystallisation

This is one of the most commonly used techniques for purification of solid organic compounds. It is based on the difference in the solubilities of the compund and the impurities in a suitable solvent. The impure compound is dissolved in a suitable solvent in which it is sparingly soluble at room temperature but appreciably soluble at higher temperature. The solution is concentrated to get nearly a saturated solution. When saturated solution is cooled, crystals of pure substance will separate out which are removed by filtration.

(viii) Distillation

This technique is commonly applied for the separation of a mixture of liquid components having a

large difference in boiling point. The lower boiling point component vapourises first and its vapours are condensed by using water condenser and collected

(ix) Chromatography

Chromatography is based on the difference in adsorption of different substances on the surface of a solid medium. The technique of separating the components of a mixture in which separation is achieved by the differential movement of individual components through a stationary phase under the influence of a mobile phase.

SOLUTION

It is a homogeneous mixture of two or more substances whose composition can be varied. e. g. solution of common salt in water

- The component of solution that is dissolved and present in smaller quantities in a solution is known as solute. e.g. **common salt** in case of solution of common salt in water and **ammonia** in case of solution of ammonia in water.
- The component of solution in which solute is dissolved is known as solvent. It is always present in larger amount in a solution. e.g. water in case of the solution of common salt or ammonia in water.
- A solution in which no more solute can be dissolved at the same temperature is called *Saturated solution.*
- A solution in which more solute can be dissolved at the same temperature is called unsaturated solution.

Properties of Solutions

(i) It is a homogeneous mixture.

(ii) The particles of solution are smaller than 1nm (10^{-9}m) in diameter and can not be seen by naked eye.

(iii) Particles of solution do not **scatter** a beam of light passing through solution i.e. they do not show **Tyndall** effect.

(iv) The components of a solution can not be separated by filtration.

(v) The particles of a solution do not settle when left undisturbed.

Types of Solution

Solution are of the following types depending upon the state of solute and solvent.

Type		Solute	Solvent	Example
(i)	gas in gas	gas	gas	Air
(ii)	liquid in gas	liquid	gas	chloroform vapours mixed with nitrogen
(iii)	solid in gas	solid	gas	camphor vapours in nitrogen
(iv)	gas in liquid	gas	liquid	aerated drinks, oxygen dissolved in water
(v)	liquid in liquid	liquid	liquid	vinegar ethanol dissolved in water
(vi)	solid in liquid	solid	liquid	solution of sugar in water solution of common salt in water
(vii)	gas in solid	gas	solid	solution of hydrogen in palladium
(viii)	solid in solid	solid	solid	Brass (70% Cu, 30% Zn) In it Zn is solute.
(ix)	liquid in solid	liquid	solid	Amalgam of mercury with sodium.

- *Concentration of a solution* is the amount of solute present in a given amount (mass or volume) of a solution or the amount of solute dissolved in a given mass or volume of a solvent.

$$\text{Concentration} = \frac{\text{Amount of solute}}{\text{Amount of solvent}}$$

The various ways of expressing the concentration of a solution, are : (i) *Mass percentage* and (ii) *Volume percentage*

(i) **Mass percentage:** It is the amount of solute in grams dissolved per 100g of solution.

$$\text{Mass \%} = \frac{\text{Mass of solute (in grams)}}{\text{Mass of solution (in grams)}} \times 100$$

(ii) **Volume percentage:** It is the mass of solute in grams present per 100 ml of solution.

$$\text{Volume \%} = \frac{\text{Mass of solute (in grams)}}{\text{Volume of solution (in ml)}} \times 100$$

Solubility : It is defined as the amount of solute dissolved in 100g of solvent to form a saturated solution.

SUSPENSION

It is a non-homogeneous mixture in which *solids are dispersed in liquids.* The particles in a suspension are of a size larger than 10^{-5}cm (or 10^{-7} m) in diameter and can be seen with naked eye, e.g. muddy water.

Properties of a Suspension

(i) It is a heterogeneous mixture.

(ii) The particle size is larger than 10^{-5}cm (100 nm) in diameter.

(iii) Particles in a suspension can be seen by naked eye.

(iv) Particles of a suspension **scatter** a beam of light passing through it and it makes the path visible. i.e. they show **Tyndall effect**.

(v) Particles of a suspension settle down when suspension is left undisturbed i.e. suspension is *unstable.*

(vi) Components of a suspension can be separated by process of filtration.

COLLOID

is a *heterogeneous mixture*. The size of particles of a colloid is intermediate between *true solutions* and *suspensions* (i.e between 1nm and 100 nm). The particles of a colloid can not be seen with naked eye.

Properties of Colloids

(i) Colloid is a *heterogeneous mixture*.

(ii) The size of colloidal particles lies between 1nm and 100 nm.

(iii) Colloidal particles can not be seen with naked eye.

(iv) Colloidal particles *scatter* a beam of light passing through a colloidal solution and make its path visible i.e. they show **Tyndall effect**.

(v) Colloidal particles can not be separated from the mixture by the process of filtration. However they can be separated by **centrifugation** process.

(vi) Colloidal particles carry charge and move in zig-zag motion. (*Brownian movement*)

- Since colloidal solution is heterogeneous mixture it consists of two *phases*. These are

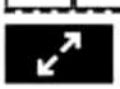
(i) *dispersed phase* (colloidal particles)

(ii) *dispersion medium* (The medium in which colloidal particles are dispersed.)

Different Types of Colloidal Solution

Eight different types of colloidal solution on the basis of state of dispersed phase and dispersion medium are

S.No.	Dispersed phase	Dispersion medium	Name of colloidal solution	Example
1	Gas	liquid	foam	soap, lather, whipped cream, soda water
2	Gas	solid	solid foam	pumice stone, foam, rubber, bread.
3	Liquid	gas	aerosol	mist, fog, cloud, insecticide spray



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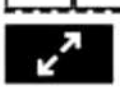

4	Liquid	liquid	emulsion	milk, emulsified oil, medicines, rubber latex.
5	Liquid	solid	gels	jelly, butter, cheese.
6	Solid	gas	solid aerosols	boot polish, aerosol smoke, dust, storm, volcanic dust,haze.
7	Solid	liquid	sols	paints, starch dispersed in water, gold sol, muddy water.
8	Solid	solid	solid	alloys, coloured glass, gem, stones, ruby, glass, minerals.

EMULSIONS

Emulsions are colloidal solutions in which both the dispersed phase and dispersion medium are liquids. Emulsions are broadly classified into two types.

(i) Oil in Water Emulsion : In this type of emulsion oil is the dispersed phase, while water is the dispersion medium. Examples are milk and vanishing cream.

(ii) Water in Oil Emulsion : In this type of colloidal system water is the dispersed phase and oil acts as the dispersion medium. Examples of water in oil emulsions are butter, cold cream, cod liver oil and margarine (in which a soyabean product is the emulsifying agent).

Application of Colloidal Solution

Some important applications are:

(i) *To stop bleeding from a cut*: For this purpose we apply alum or ferric chloride solutions on the cuts.

(ii) Medicines in colloidal form can be easily absorbed by body.

(iii) Cleansing action of soap.

(iv) Formations of delta when river comes in contact with sea water.

(v) *Blue colour of sky*: It is due to the scattering of sunlight by fine dust particles present in atmosphere.

CHANGES

Physical Change

During such a change no new substances is formed and there is no change in the chemical properties of the substances. There is only a change in physical state of the substance and such a change can be easily reversed by a slight change of conditions. Thus it is a temporary change, e.g. change of ice in water, melting of wax etc.

Chemical Change

Such a change is accompanied by change in chemical properties and formation of new substances. Such a change can not be easily reversed and so it is a permanent change, e.g. burning of paper, burning of wood, burning of candle etc.

In addition to formation of new substances, a chemical reaction may be accompanied by one or more of the following chemical changes:

(i) Evolution of gas.

$$\underset{\text{Zinc}}{Zn} + \underset{\substack{\text{Sulphuric}\\\text{acid}}}{H_2SO_4} \longrightarrow \underset{\substack{\text{Zinc}\\\text{Sulphate}}}{ZnSO_4} + \underset{\text{Hydrogen}}{H_2}$$

(ii) Change of colour.

$$\underset{\text{Lead nitrate}}{Pb(NO_3)_2} \xrightarrow{\text{Heat}} \underset{\text{Lead oxide}}{PbO} + \underset{\substack{\text{Nitrogen}\\\text{dioxide}\\\text{(Brown fumes)}}}{NO_2} + \underset{\text{Oxygen}}{O_2}$$

(iii) Formation of precipitate.

$$\underset{\text{Silver nitrate}}{AgNO_3} + \underset{\substack{\text{Sodium}\\\text{chloride}}}{NaCl} \longrightarrow \underset{\substack{\text{Silver}\\\text{chloride}}}{AgCl} + \underset{\substack{\text{Sodium}\\\text{nitrate}}}{NaNO_3}$$

(iv) Heat, light or any other radiation may be absorbed or evolved.

The reactions, during which heat energy is absorbed are called **endothermic reaction**.

Examples :

$$\underset{\text{Nitrogen}}{N_2} + \underset{\text{Oxygen}}{O_2} \xrightarrow{\text{Heat}} \underset{\text{Nitric oxide}}{NO}$$

The reactions, during which heat energy is released are called **exothermic reactions**.

Examples :

$$\underset{\text{Carbon}}{C} + \underset{\text{Oxygen}}{O_2} \longrightarrow \underset{\text{Carbon dioxide}}{CO_2} + \text{Heat}$$

(v) Sound may be produced.

When a pinch of baking soda is added to vinegar, carbon dioxide gas with a hissing sound is produced.

$$\underset{\text{Vinegar}}{2CH_3COOH} + \underset{\text{Baking soda}}{Na_2CO_3} \longrightarrow \underset{\text{Carbon dioxide}}{CO_2} + H_2O + 2CH_3COONa$$

(vi) Change of smell may occur or a new smell may be given off. When we leave cooked food containing fats and oils outside (not refrigerated), it gets spoiled and gives foul smell.

Exercise

DIRECTIONS : This section contains multiple choice questions. Each question has 4 choices (a), (b), (c) and (d) out of which only one is correct.

1. Select the one that is not a matter.
   (a) feeling of hot
   (b) smoke
   (c) humidity
   (d) water
2. Which is incorrect statement?
   (a) Matter is continuous in nature.
   (b) Of the three state of matter, the one that is most compact is solid state.
   (c) In solid state interparticles space (i.e., empty space) is minimum.
   (d) The density of solid is generally more than that of a liquid.
3. Select the one that when used would be considered as best condition for liquification of a gas.
   (a) Increasing the temperature.
   (b) Decreasing the pressure.
   (c) Increasing the pressure and decreasing the temperature.
   (d) Decreasing the pressure and increasing the temperature.
4. Select the correct order of evaporation for water, alcohol, petrol and kerosene oil :
   (a) water > alcohol > kerosene oil > petrol
   (b) alcohol > petrol > water > kerosene oil
   (c) petrol > alcohol > water > kerosene oil
   (d) petrol > alcohol > kerosene oil > water.
5. Which one is a sublime substance?
   (a) Table salt
   (b) Sugar
   (c) Iodine
   (d) Potassium Iodide
6. The process of change of liquid state into gaseous state at constant temperature is known as
   (a) boiling
   (b) melting
   (c) fusion
   (d) evaporation
7. Which one is a surface phenomenon?

(a) Evaporation
(b) Boiling
(c) Both (a) and (b)
(d) None of these

8. Which of the following processes is known as fusion?
(a) Change of liquid to solid
(b) Change of solid to liquid
(c) Change of liquid to vapour
(d) Change of gaseous state to solid state

9. The evaporation of a liquid can best be carried out in a
(a) flask
(b) china dish
(c) test-tube
(d) beaker

10. The one, in which interparticle forces are strongest, is
(a) sodium chloride
(b) hydrogen
(c) ether
(d) carbon dioxide

11. The melting point temperature of the solid state of a substance is 40°C. The freezing point temperature of the liquid state of the same substance will be
(a) 35°C
(b) 40°C
(c) 45°C
(d) can't predict

12. Which one will help to accelerate the process of evaporation of a liquid kept in an open china dish?
(a) Keeping dish in open
(b) Blowing air into the liquid
(c) Keeping the dish under a running fan
(d) All of the above

13. When a gas is compressed keeping temperature constant, it results in
(a) increase in speed of gaseous molecules
(b) increase in collision among gaseous molecules
(c) decrease in speed of gaseous molecules
(d) decrease in collision among gaseous molecules

14. Which of the following in an element ?
(a) Marble
(b) Graphite

(c) Washing stone
(d) Stone

15. An atom is
(a) The smallest particle of matter known
(b) The smallest particle of a gas
(c) The smallest indivisible particle of an element that can take part in a chemical change
(d) Radioactive emission

16. Which of the following is a compound ?
(a) Stainless steel
(b) Brass
(c) Iron sulphide
(d) Diamond

17. Select the one that has a definite boiling point
(a) true solution
(b) compound
(c) colloid
(d) All of these

18. We can see the particles of a colloidal solution with
(a) naked eyes
(b) the help of ultramicroscope
(c) the help of microscope
(d) None of these

19. Which of the following will yield a mixture ?
(a) Crushing of marble tile
(b) Breaking of ice-cubes
(c) Addition of sodium metal to water in a china dish
(d) Agitating a detergent with water in a washing machine.

20. On passing through a colloidal solution, the beam of light gets .....
(a) reflected
(b) refracted
(c) scattered
(d) absorbed

21. The cause of Brownian movement is
(a) convection current
(b) heat changes in liquid state
(c) impact of molecules of dispersion medium on colloidal particles.
(d) attractive forces between particles of dispersed phase and dispersion medium.

22. Brass is an example of
(a) compound

(b) element
(c) homogeneous mixture
(d) heterogeneous mixture

23. Air is regarded as mixture because
(a) its pressure may vary
(b) its temperature may vary
(c) its volume changes with change in temperature/pressure
(d) its composition may vary

24. The size of colloidal particles usually lies in the range
(a) $10^{-5} - 10^{-7}$ cm
(b) $10^{-7} - 10^{-9}$ cm
(c) $10^{-3} - 10^{-5}$ cm
(d) $10^{-2} - 10^{-6}$ cm

25. Oil and water can form a stable dispersion with the help of a third substance commonly called
(a) emulsifier
(b) dispersant
(c) protective colloid
(d) None of these

26. The blue colour of water in the sea is due to
(a) absorption of other colour except blue by water molecules
(b) scattering of blue light by sol particles
(c) refraction of blue light by impurities present in sea water
(d) reflection of blue sky by sea water

27. Tails of comets are visible due to
(a) Tyndall Effect
(b) Reflection
(c) Brownian movement
(d) None of these

28. Why is helium preferred over hydrogen for use in airships ?
(a) Helium has a low density
(b) Helium has a high density
(c) Helium is chemically less reactive
(d) Helium is chemically more reactive

29. Which one of the following mixtures is homogeneous?
(a) Starch and sugar
(b) Methanol and water
(c) Graphite and charcoal
(d) Calcium carbonate and calcium bicarbonate

30. During summer, water kept in an earthen pot becomes cool because of the phenomenon of
    (a) diffusion
    (b) transpiration
    (c) osmosis
    (d) evaporation
31. A few substances are arranged in the increasing order of 'forces of attraction' between their particles. Which one of the following represents a correct arrangement?
    (a) Water, air, wind
    (b) Air, sugar, oil
    (c) Oxygen, water, sugar
    (d) Salt, juice, air
32. The boiling points of diethyl ether, acetone and n-butyl alcohol are 35°C, 56°C and 118°C respectively. Which one of the following correctly represents their boiling points in kelvin scale?
    (a) 306 K, 329 K, 391 K
    (b) 308 K, 329 K, 392 K
    (c) 308 K, 329 K, 391 K
    (d) 329 K, 392 K, 308 K
33. In which of the following conditions, the distance between the molecules of hydrogen gas would increase?
    (i) Increasing pressure on hydrogen contained in a closed container
    (ii) Some hydrogen gas leaking out of the container
    (iii) Increasing the volume of the container of hydrogen gas
    (iv) Adding more hydrogen gas to the container without increasing the volume of the container
    (a) (i) and (iii)
    (b) (i) and (iv)
    (c) (ii) and (iii)
    (d) (ii) and (iv)
34. Which of the following statements are true for pure substances?
    (i) Pure substances contain only one kind of particles
    (ii) Pure substances may be compounds or mixtures

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    (d) (ii) and (iv)
34. Which of the following statements are true for pure substances?
    (i) Pure substances contain only one kind of particles
    (ii) Pure substances may be compounds or mixtures

(iii) Pure substances have the same composition throughout

(iv) Pure substances can be exemplified by all elements other than nickel

(a) (i) and (ii)
(b) (i) and (iii)
(c) (iii) and (iv)
(d) (ii) and (iii)

35. A mixture of sulphur and carbon disulphide is
(a) heterogeneous and shows Tyndall effect
(b) homogeneous and shows Tyndall effect
(c) heterogeneous and does not show Tyndall effect
(d) homogeneous and does not show Tyndall effect

36. Tincture of iodine has antiseptic properties. This solution is made by dissolving
(a) iodine in potassium iodide
(b) iodine in vaseline
(c) iodine in water
(d) iodine in alcohol

37. A student, carefully observed the colloidal of starch in water, human blood and cow milk. On the basis of observations, he made certain conclusions given below. Choose the wrong conclusion about colloidal solution
(a) Translucent
(b) Components can be separated by ordinary filteration.
(c) Heterogenous and stable
(d) Show tyndal effect

38. There are four test tubes A, B, C and D half filled with water. A considerable quantity of sugar, milk, egg white and common salt was added in them respectively with stirring the contents of each tube.
True solution will be obtained in
(a) Only A
(b) Only D
(c) Both B and C
(d) Both A and D

39. Choose the incorrect statement about true solution

(a) Its components can not be separated by filteration.
(b) It is opaque and unstable.
(c) Its particles can not be seen through naked eye.
(d) It does not show tyndal effect.

40. Barium sulphate ($BaSO_4$) dispersed in water used diagnostic X-rays is a
(a) Colloid
(b) Solution
(c) Suspension
(d) Foam

41. The example of solution of liquid in gas is
(a) Dry air
(b) Sugar in water
(c) Mercury in gold
(d) Moist air.

42. The component of a solution which is present in larger amount is referred to as
(a) Solute
(b) Solvent
(c) Both (a) and (b)
(d) Neither (a) nor (b)

43. You have prepared four different mixtures in water using1. Charcoal powder, 2. Chalk powder, 3. Slaked lime and4. Detergent powder. If you filter these mixtures through a filter paper, there will be no residue left after filtration in the case of
(a) charcoal powder
(b) chalk powder
(c) slaked lime
(d) detergent powder.

44. Non-reacting gases have a tendency to mix with each other. This phenomenon is known as
(a) chemical reaction
(b) diffusion
(c) effusion
(d) explosion

45. A gas can be compressed to a fraction of its volume. The same volume of a gas can be spread all over a room. The reason for this is that

(a) the volume occupied by molecules of a gas is negligible as compared to the total volume of the gas.
(b) gases consists of molecules which are in a state of random motion
(c) gases consist of molecules having very large inter-molecular space which can be reduced or increased under ordinary conditions
(d) None of these

46. Which has the least energetic molecules?
(a) Solids
(b) Liquids
(c) Gases
(d) Plasmas

47. The process used to separate oil and water is
(a) distillation
(b) sublimation
(c) separating funnel
(d) chromatography

48. A mixture of common salt, sulphur, sand and iron filings is shaken with carbon disulphide and filtered through a filter paper. The filtrate is evaporated to dryness in a china dish. What will be left in the dish after evaporation?
(a) Sand
(b) Sulphur
(c) Iron filings
(d) Common salt

49. A mixture of $ZnCl_2$ and $PbCl_2$ can be separated by
(a) distillation
(b) crystallization
(c) sublimation
(d) adding acetic acid

50. White gold is used in jewelry and contains two elements, gold and palladium. A jeweler has two different samples that are both identical in appearance and have a uniform composition throughout. What can be said about the samples?
(a) They are homogeneous mixtures and be classified as metallic alloys.
(b) The materials are heterogeneous mixtures and can be classified by their components
(c) The samples have variable compositions and are classified as metallic solutions.

(d) The samples are heterogeneous mixtures that can be separated using magnetic properties.

51. Which flow chart correctly describes a homogeneous material?
   (a) Unknown — density — 3 layers
   (b) Unknow — filtration — two substances
   (c) Unknown — magnet — two substances
   (d) Unknown — boiling — one temperature

52. Magnetism is most beneficial for separating
   (a) gases and non-metallic liquids
   (b) magnetic solids and solids such as sulfur
   (c) non-metallic solids and solids such as sulfur
   (d) non-magnetic solids from non-magnetic liquids

53. Distillation is a good separation technique for
   (a) solids
   (b) liquids
   (c) solid alloys
   (d) gases

54. Solubility is a good separation technique for
   (a) pure metals
   (b) noble gases
   (c) different salts
   (d) metallic alloys

55. 40 g of common salt is dissolved in 320 g of water. The mass percentage of salt is
   (a) 11.1%
   (b) 12.5%.
   (c) 15%
   (d) 10%

56. Select the correct alternative(s).
   (i) Melting of ice is a physical change.
   (ii) A physical change is due to change in physical properties of a substance.
   (iii) A physical change is always irreversible in nature.
   (iv) Burning of candle is an example of physical change.
   (a) (i) & (ii)
   (b) (i) & (iv)
   (c) (i), (ii) & (iv)
   (d) (ii) & (iii)

57. Pick out physical changes from the following
   (i) rusting of iron
   (ii) dissolving salt in water

(iii) change of water to ice
(iv) cooking of food
(a) (i) & (ii)
(b) (ii) & (iii)
(c) (i), (ii) & (iii)
(d) (iii) & (iv)

58. Water is boiling in open fry pan represents which type of change?
(a) Physical and irreversible
(b) Chemical and irreversible
(c) Physical and reversible
(d) Chemical and reversible

59. Chemical change is always accompanied by
(i) production of sound
(ii) heat and light
(iii) change in mass
(iv) change in colour
(a) (i) (ii) & (iii)
(b) (ii) & (iv)
(c) (i) only
(d) (i) , (ii) & (iv)

60. The gas you use in kitchen is called liquified petroleum gas (LPG). In the cylinder, it exists as a liquid. When it comes out of the cylinder, it becomes a gas (process A), then it burns (process B). Choose the correct statement.
(a) Process A is a chemical change.
(b) Process B is a chemical change.
(c) Both processes A and B are chemical changes.
(d) None of these processes is a chemical change.

61. Anaerobic bacteria digest animal waste and produce biogas (change A). The bio gas is burnt as fuel (change B). Choose the correct staement.
(a) Change A is a chemical change.
(b) Change B is a chemical change.
(c) Both changes A and B are chemical changes.
(d) None of these changes is a chemical change.

62. Which of the following is a chemical change?
(a) Dent produced on car body by cricket ball
(b) Streching of rubber band
(c) Brinjals and apples become dark on exposure to atmosphere
(d) Formation of salts by collecting sea water in shallow pits

Hints & SOLUTIONS

1. **(a)**
2. **(a)**
3. **(c)**
4. **(d)**
5. **(c)** Solid iodine gets directly converted into vapours.
6. **(a)**
7. **(a)** Boiling is a bulk phenomena
8. **(b)**
9. **(b)**
10. **(a)** As sodium chloride is ionic solid.
11. **(b)**
12. **(d)**
13. **(b)** On compression number of molecules of a gas per unit volume increases thereby increasing intermolecular collision.
14. **(b)**
15. **(c)**
16. **(c)** Iron sulphide (Fe_2S_3) is a compound of Iron and sulphur
17. **(b)**
18. **(c)**
19. **(d)**
20. **(c)** This is due to scattering of light by colloidal particles called Tyndall effect.
21. **(c)**
22. **(c)**
23. **(d)**
24. **(a)**
25. **(a)**
26. **(b)**
27. **(a)**
28. **(c)** Though H_2 has a lower density and is cheaper but Helium is preferred in filling of balloons and air ships since it is non-inflammable. Thus, on safety grounds He is used in preference to H_2 in airships.
29. **(b)** A mixture of methanol (a liquid) and water (a liquid) is homogeneous.
30. **(d)**
31. **(c)**
32. **(c)**
33. **(c)** Increase of pressure and addition of more H_2 both decreases intermolecular distance.

34. **(b)**
35. **(d)**
36. **(d)**
37. **(b)**
38. **(d)** Both sugar and salt are completely miscible with water.
39. **(b)** True solutions are transparent and stable.
40. **(c)**
41. **(d)** Moist air contains H_2O vapours dispersed in air.
42. **(b)** 43. **(d)**
44. **(c)** Effusion is the process in which individual molecules flow through a hole without collisions between molecules.
45. **(c)**
46. **(a)** As order of energy for different states of matter is following Bose-Einstein < Solids < Liquids < Gases < plasmas condensate.
47. **(c)** As oil being less denser than water it forms upper layer. Thus mixture of oil and water can be separated by using separating funnel.
48. **(b)** Sulphur will left behind. As in given mixture only sulphur gets dissolved in carbon disulphide.
49. **(b)**
50. **(a)** As they have uniform composition throughout they are considered as homogeneous mixture. Both samples are mixture of two metals (gold and palladium) thus are alloys.
51. **(d)** Homogeneous liquid have a particular boiling point.
52. **(b)** Magnetism is useful for separation of magnetic and non-magnetic substances.
53. **(b)** Distillation is a separation techniques used for separation of miscible liquids having different boiling point.
54. **(c)** Different salts have different solubility in a particular solvent. Thus on this basis mixture of different salts can be separated.
55. **(a)**
56. **(a)** Physical changes are those in which the physical properties are altered and melting of ice is a physi-

cal change. Some physical changes are irreversible while most of them are reversible. Burning of candle is a chemical change as the components lost in air can not be recovered. Candle is made up of carbon and hydrogen which react with oxygen to form carbon dioxide and water which is lost in air.

57. **(b)** Rusting of iron and cooking of food is a chemical change because the properties of rust are different from those of iron and the properties of cooked food are different from raw vegetables, etc.

58. **(a)** As on boiling water gets converted into steam which is a physical change but this steam is lost in to atmosphere as the pan is open. Thus the lost steam can not be condensed back to water therefore change is irreversible.

59. **(d)** A chemical change produces heat, light, sound and the products are of different colour than the reactants.

60. **(b)** This is because process A involves change of state from liquid to gas and is a physical change. While process B involves change of a gas into heat and light, which is a chemical change.

61. **(c)** This is because both changes A and B involves formation of new substances.

62. **(c)** Brinjals and apples becomes dark due to chemical changes rest all options represents physical changes only.

Chapter 2

Atomic Structure

INTRODUCTION

Law of Conservation of Mass

This law was stated by **Lavoisier** in 1744. It states that "In all physical and chemical changes, the total mass of reactants is equal to total mass of products."

Law of Constant Proportions (or Constant Composition)

This law was first stated by **Proust** in 1797. According to the law "a *chemical compound* is always found to be made up of the *same elements* combined together in the *same proportions* by weight" e.g. the ratio of hydrogen and oxygen in pure water is always 1 : 8 by weight. This law is also called **law of definite proportions.**

Law of Multiple Proportions

Whenever two elements form more than one compound, the different masses of one element that combine with the same mass of the other element are in the ratio of small whole numbers. This law was given by Dalton in 1804. For example, sulfur and oxygen form two different compounds which we call sulfur dioxide and sulfur trioxide.

DALTON'S ATOMIC THEORY

Postulates of Dalton's Atomic Theory

(i) Matter is made up of extremely small indivisible particles called **atoms**.

(ii) Atoms of the same substance are identical in all respects i.e., they possess same *size, shape, mass, chemical properties* etc.

(iii) Atoms of different substances are different in all respects i.e., they possess different size, shape, mass etc.

(iv) Atom is the smallest particle that takes part in a chemical reaction.

(v) Atoms of different elements may combine with each other in a fixed simple, whole number ratio to form **compound atoms**.

(vi) Atoms can neither be created nor destroyed i.e., atoms are indestructible.

Atom

It is the smallest particle of an element which can take part in a chemical change. It may or may not be capable of independent existence.

[Atoms, the building blocks of all matter]

Drawbacks of Dalton's Atomic Theory

(i) According to Dalton's atomic theory, atoms were thought to be indivisible. But, it is now known that under circumstances, atoms can be further divided into still smaller particles called electrons, protons and neutrons.

(ii) Dalton's atomic theory said that all the atoms of an element have exactly the same mass. But, it is now known that atoms of the same element can have slightly different masses.

(iii) Dalton's atomic theory said that atoms of different elements have different masses. But, it is now known that even atoms of different elements can have the same mass.

(iv) It could explain the laws of chemical combination by mass but failed to explain the law of gaseous volumes.

Symbols

The abbreviation used for lengthy names of elements are termed as their symbols. The symbol of an element is the **first letter** or the first and another letter of English name or Latin name of the element. While writing a symbol, the first letter is always **capital** and the second is always **small.**

Examples :

Element	English Name	Symbol
Hydrogen	Hydrogen	H

Oxygen	Oxygen	O
Carbon	Carbon	C
Calcium	Calcium	Ca

Symbol derived from Latin Names

Element	Latin Name	Symbol
Sodium	Natrium	Na
Potassium	Kalium	K
Iron	Ferrum	Fe
Copper	Cuprum	Cu

Molecule

It is the smallest particle of an element or compound that is capable of independent existence and shows all the properties of that substance.

Valency

The electrons present in the outermost shell of an atom are known as **valence electrons**. These electrons determine the valency of an atom.

Valency is equal to the number of valence electrons.

In case the number of valence electrons is close to its full capacity. Then,

$$\text{Valency} = 8 - \text{valence electrons}$$

If outermost shell is completely filled then valency is **zero**.

Valency is the combining capacity of an atom.

- The number of atoms present in a molecule of an element or a compound is known as its atomicity. e.g.

Element / Compound	Formula of a molecule	Atomicity
Hydrogen	H_2	2

Oxygen	O_2	2
Chlorine	Cl_2	2
Ozone	O_3	3
Water	H_2O	3
Ammonia	NH_3	4

- **Ion :** It is an electrically charged atom or group of atom. It is formed by the loss or gain of electrons by an atom. Ions are of two types :
  (i) **Cation :** It is positively charged ion and is formed by the loss of electron from an atom e.g. H^+, Na^+, Ca^{2+}, Al^{3+}, NH_4^+ etc.
  (ii) **Anion :** It is negatively charged ion and is formed by the gain of electrons by an atom, e.g. Cl^-, O^{2-}, C^-, F^-, CO_3^{2-}, PO_4^{3-} etc.

Table : Some common simple and Poly-Atomic Ions

Valency	Name	Symbol	Non-metallic	Symbol	Polyatomic	Symbol
I.	Sodium	Na^+	Hydrogen	H^+	Ammo-nium	$(NH_4)^+$
	Potassium	K^+	Hydride	H^-	Hydroxide	$(OH)^-$
II.	Copper (II) or Cupric	Cu^{2+}	Sulphide	S^{2-}	Carbonate	$(CO_3)^{2-}$
	Magnesium	Mg^{2+}	Oxide	O^{2-}	Sulphate	$(SO_4)^{2-}$
III.	Aluminium	Al^{3+}	Nitride	N^{3-}	Phosphate	$(PO_4)^{3-}$

FORMULA OF SIMPLE AND MOLECULAR COMPOUNDS

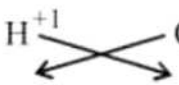
Binary compounds are those compounds which are made up of two different elements e.g. NaCl, KBr, CaO etc. Following rules are to be followed for writing the formula.

(i) The valencies or charges on the ions must be balanced.

(ii) For a compound made up of a **metal** and a **non-metal**, the symbol of metal is written first.

While writing the name of such a compound the name of metal is written first e.g. Calcium oxide, CaO (Ca is metal, O is non-metal)

(iii) In compounds formed with polyatomic ions, the ion is enclosed in a bracket before writing the number to indicate the ratio. While writing the formula for **molecular compounds.** We write the constituent elements and their valencies are shown on their top. Then by criss-cross these valencies are shown below the combining atoms emitting the positive or negative sign e.g.



by criss-cross H_1Cl_1

- The atomic mass of an element is the numerical number which indicates how many times an atom of an element is heavier than $\frac{1}{12}$ of mass of an atom of carbon-12. *For example,* the atomic mass of magnesium (Mg) is 24 which indicates that one atom of magnesium is 24 times heavier than $\frac{1}{12}$ of a carbon-12 atom. The a.m.u. is abbreviated as 'u'. It is equal to mass of one atom of C-12.

Element	Atomic Mass (U)
Hydrogen (H)	1.0
Carbon (C)	12.0
Nitrogen (N)	14.0
Oxygen (O)	16.0
Sodium (Na)	23.0
Magnesium (Mg)	24.0
Chloride (Cl)	35.5

While writing the name of such a compound the name of metal is written first e.g. Calcium oxide, CaO (Ca is metal, O is non-metal)

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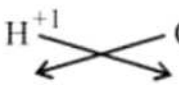

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