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CBSE

CLASS-11th

THE CENTRAL BOARD OF SECONDARY EDUCATION

CHEMISTRY-I

SIERRA INNOVATIONS

CONTENT

CHAPTER 1–SOME BASIC CONCEPTS OF CHEMISTRY

Content

Importance of Chemistry

1) Many types of drugs, fairness products, medicines and many more things which we use in daily life are because of chemistry.
2) Drugs effective in cancer therapy – Cisplatin and Taxol.
3) Drug used for AIDS patients-AZT (azidothymidine).

Nature of Matter

Matter

It is defined as "Anything that has mass, occupies space and can be felt by any one or more senses is called matter".

Physical classification of matter

On the basis of physical properties matter can be classified into five states as discussed below

1) Solid
2) Liquid
3) Gas
4) Plasma (highest energetic state of matter)
5) BEC (Bose - Einstein condensate)

But we usually study only first three because of their vast existence in our environment.

Properties of matter

1) Solid

It possesses definite shape and definite volume which means it cannot be compressed on applying pressure on it.

- Fixed shape and volume
- Intermolecular space is very low
- Intermolecular forces are very strong
- They have rigidity (resistance to change in shape)
- Rocks, metal, wood, Iron, copper sulphate, bricks etc..

2) Liquid

A liquid possess definite volume but do not have definite shape.

- They have fix volume
- They occupy shape of its container
- Intermolecular space is moderate
- Intermolecular forces are moderate
- They are fluid in nature (capability to flow)
- Examples of liquid; water at 27C, oil, milk alcohol etc.

3) Gas

It does not have either a definite shape or definite volume but it can take the shape of the vessel in which it is placed.

- They don't have definite shape and volume
- They have the nature as same as the nature of fluid.
- Intermolecular forces are very low and space is very high
- Example – nitrogen, oxygen, carbon dioxide, steam etc.

Chemical classification of matter

Matters are classified in two groups- **mixture** and **pure substances**.

1) Mixture

The composition of two or more substances is known as mixture.

There are two types of mixture as follows;

a) Homogeneous mixture

When components of mixture are completely or uniformly mix with each other.

Ex.-water and sugar, water and salt

- ➢ They required distillation, Fractional distillation, Evaporation or crystallization etc ways for separation.

b) Heterogeneous mixture

When components of mixture are not mixed uniformly and can be distinguished easily.

Ex. - water and sand, oil and water etc.

- They can separated by hand-picking, separating funnel, evaporation or boiling etc.

2) Pure substances

These are made from single component or constituents are combined in fixed ratio.
Ex.- Copper, Iron, Gold, sulphur, hydrogen etc.

There are two types of pure substances as follows;

a) Elements

It can neither be broken into nor built from simpler substances by ordinary chemical and physical methods.
Ex - gold, silver, copper, chlorine, silicon etc.

b) Compound

When two or more elements are combined in fixed ratio they form compounds and these compounds can be decomposed into elements by suitable chemical methods.
Ex- water (H_2O), Glucose ($C_6H_{12}O_6$) etc.

There are two types of compound as follows:-

- **Inorganic compounds** – these are obtained from non – living sources such as minerals, rocks etc. Ex – marble, gypsum, common salt etc.
- **Organic compound** – these compounds are generally obtained from animals and plants and carbon is present in these compounds as the main constituent.
  Ex – oil, fat, carbohydrates etc.

<u>Properties of matter and its measurement</u>

Matter posses two types of properties – Physical and Chemical property. They can be measured in their respective terms.

Fundamental units

These are those units which can neither be derived from one another nor they can be further resolved into any other units.

System of units

There are some systems to measure physical quantities -

- CGS System (centimetre-gram-second)
- SI system
- fps system
- Metric system
- English system and more system across the world.

The international system of units (SI)

1) In French – Le Systeme International d'Unites
2) Established by CGPM (Conference Generals des Poids at Measures) in its 11th conference.
3) The SI system has seven basic units-

Basic physical quantities	**Symbol for quantity**	**Name of SI unit**	**Symbol for SI units**
Length	l	metre	m
Mass	m	kilogram	Kg
Time	t	second	s
Electric current	I	ampere	A
Thermodynamics temperature Luminous intensity	T I_v	kelvin candela	K cd
Amount of substance	n	mole	mol

Mass, Weight and Volume

Mass - It is defined as amount of matter in a substance.
Weight - It is defined as the amount of force exerted by gravity on a substance.
Volume - the space occupied by any matter is known as volume of that matter.

Density

The amount of mass per unit volume of any matter is known as density of that matter.
Density= mass/volume
SI unit of density - Kg/m^3
CGS unit – g/cm^3
Relation between CGS and SI unit of density-
Density (SI unit) = 1000 × density (CGS unit)

Temperature

The degree or measure of coldness or hotness of a body is known as its temperature.
Relation between Fahrenheit and Celsius scale –

$$F = \left[\frac{9}{5} \times ({}^{0}C)\right] + 32$$

Relation in Kelvin and Celsius scale –

$$K = ({}^{0}C) + 273.15$$

Significant Numbers

The total number of digits in a number including the last digit whose value is uncertain is called **significant figures**. These are the meaningful digits which are known with certainty plus one which is uncertain.

Ex.-in volume 11.2 ml
11 are certain and 2 are uncertain and the uncertainty would be ±1.

Rules for determining significant figures

Note:

- **All non-zero digits are significant.**
- **Zeroes between nonzero digits are significant.**
- **A trailing zero or final zero in the decimal portion only is significant.**

Following are the significant figures rules that govern the determination of significant figures:

1. Those digits which are non-zero are significant.
   For example, in 6575 cm there are four significant figures and in 0.543 there are three significant figures.
2. If any zero precedes the non-zero digit then it is not significant. The preceding zero indicates the location of the decimal point, in 0.005 there is only one and the number 0.00232 has 3 figures.
3. If there is a zero between two non-zero digits then it is also a significant figure. For example; 4.5006 have five significant figures.
4. Zeroes at the end or on the right side of the number are also significant. For example; 0.500 has three significant figures.
5. Counting the number of objects for example 5 bananas 10 oranges have infinite figures as these are inexact numbers.

Accuracy

It is defined as "the degree to which the result of a measurement, calculation, or specification conforms to the correct value or a standard".
As in previous example the value 1.99m is precise and accurate to 2 but the value 1.97m is not accurate because it is too far from true value 2.

Precision

It refers to the closeness of various measurements for the same quantity.
Ex- let a rope has 2m length but when it is measured by different candidates, their measures are 1.97, 1.96, 1.98, 1.99 etc.

Here 1.99 is more precise than all values because this is closer to 2.

Rule for addition and subtraction of values

The significant place after decimal is decided by the one who has least values on right side of decimal.

Ex- if we add the numbers

```
   12.11
  +18.0
  +1.012
  +31.122
-------------------
   62.244
```

62.244 But this will be rounded to **62.2** because digits after decimal is decided by 18.0 as it have only one digit 0 after decimal.

Rule for multiplication and division of values

The number of significant digits in the final result of multiplication or division is decided by the value having least significant number.

Ex- $2.5 \times 1.25 = 3.125$ but this is not the final result.

Final result is decided by 2.5 as it has only 2 significant digits.

So the answer is **3.1**

Rules for rounding off the digits

1) If rightmost digit is more than 5 then preceding value is increased by 1.
   Ex- 1.286 converted to 1.29
2) If rightmost digit is less than 5 then preceding value is remains same.
   Ex- 1.334 converted to 1.33
3) If rightmost digit is equal to 5 and preceding value is
   a) Even- preceding value remains same.
      Ex - 1.25 converted to 1.2
   b) Odd-preceding value is increased by 1.
      Ex- 1.35 converted to 1.4

Laws of chemical combination

There are many laws who govern the combination of elements and compound.

1) Law of conservation of mass

This law states that "the total mass of the reactant is equal to total mass of the product".

- This law is given by Antoine Lavoisier.

- This law is also called as law of **indestructibility of matter**.

2) Law of constant proportion (Law of definite composition)

It states that "a pure compound is always contains exactly the same proportion by of elements by weight" and this law is given by Joseph Proust.

Ex:- CO_2 is formed when 12 g of C and 32 g of O is combined.
H_2O is formed when 2 g of H and 16 g of O is combined.

Note: The chemical compound must be pure. If it has some impurity, then the law is not applicable.

3) Law of multiple proportion

This law is given by Dalton.

According to the **Law of multiple proportions** "one element combined to other element in different ratio by mass to form different compound".

Ex- H_2O – H(2g) combined with O (16g).
H_2O_2 -H(2g) combined with O (32g).
CO, CO_2 etc.

4) Gay lussac's law of gaseous volume

It is given by the renowned scientist Gay lussac.

It states that "at the same temperature and pressure, the gases are combined in simple ratio by volume to produced new compounds".

Ex- H_2 + 1/2 O_2 ---> H_2O
(100 ml) (50 ml) (100 ml)

In simple ratio term

1:1/2:1 or 2:1:2

5) Avogadro's law

This law states that "the equal volume of all gases at same temperature and pressure should contain equal number of molecules".

6) Dalton's atomic theory

The different postulates of the theory are;

- The matter consists of individual atoms (elements).
- All atoms of given elements have identical properties, including identical mass.
- Atoms of different elements differ in mass.
- Atom is the smallest portion of matter which can take part in chemical combination.
- The compounds are formed when atoms of different elements combined in fixed ratio.

- Atoms are neither be created nor destroyed. They only rearranged in a chemical reaction.

Limitations of the Theory

- It could explain the laws of chemical combinations based on weight but not on volume. Thus, it could give no explanation for the Gay lussac's law.
- It could not give a clear distinction between an atom and molecule.
- It failed to explain why atoms of different elements differs in mass, size and valency.
- It could not give an explanation as to why atoms of the same or different elements combine to form molecules.

Isotopes – It is defined as the same element with different atomic mass.
Ex- C-12, C-14 etc,

Isobars – It is defined as the different elements with same atomic masses.
Ex- Argon and Calcium

Avogadro's Hypothesis

It states that "under similar conditions of temperature and pressure, equal volumes of all gases contain equal number of molecules.

Avogadro's Hypothesis and Dalton's atomic theory

According to this hypothesis "Equal volumes of all gases under similar conditions of temperature and pressure contain equal number of atoms". This hypothesis is also known as **Berzelius hypothesis**.

Application of Avogadro's law

1. Determination of Atomicity of elementary gases.

Atomicity is defined as "the number of atom present in one molecule of the element".

2. Determination of the relationship between molar mass and vapour density of a gas.

The vapour density if defined as "the ratio between the mass of a certain volume of gas to the mass of the same volume of hydrogen under similar conditions of pressure and temperature".

$$\text{Vapour density} = \frac{\text{mass of V ml of gas}}{\text{mass of V ml of hydrogen}}$$

Mass related terms

Atomic mass – The actual mass of any atom is known as its atomic mass. This is very small (have magnitude of 10^{-24} g).

Atomic mass unit – the relative mass with respect to one twelfth mass of C-12 atom.

Mass of hydrogen = 1.6736×10^{-24} g

1 amu = 1/12 mass of C-12 atom = 1.6605×10^{-24} g

Mass of hydrogen in amu $= \frac{1.6736 \times 10^{-24}}{1.6605 \times 10^{-24}}$

= 1.008 amu

Now, amu is replaced with '**u**' termed as **unified mass**.

Average atomic mass

Let the mass of isomers of any element is m_i

a) When abundance ratio $\mathbf{r_i}$ is given

Average atomic mass = $\Sigma \mathbf{m_i r_i} \;/\; \Sigma \mathbf{r_i}$

= ($m_1r_1+m_2r_2+$ ------) / (r_1+r_2+ -----)

b) When abundance percentage **pi** is given

Average atomic mass = ($m_1p_1 + m_2p_2+$ ----) / 100

Molecular mass

It is defined as the "Sum of atomic masses of all elements present in a molecule".

Formula mass

The molecular mass of one formula unit is called formula mass.

Ex- formula mass unit of NaCl is (58.5 u $)_n$.

Mole concept and Molar mass

a) Mole is unit to measure amount of substances.

b) 1 mole contains 6.022×10^{23} particles.

c) N_A(Avogadro constant) = 6.022×10^{23}

d) **Molar mass** - The weight of one mole of any substance in gram is called **molar mass**.

e) **n**(number of moles) = $\frac{\text{given mass of substance}}{\text{Molar mass of substance}}$.

Percentage composition = $\frac{(\text{mass of element in compound} \times 100)}{\text{molar mass of compound}}$.

Empirical formula

It represents the simplest whole number ratio of various atoms present in a compound.

Ex- CH_2 is empirical formula of C_2H_2 .

Molecular formula

It shows the exact number of atoms present in a molecule of compound.

Steps to calculate empirical formula of compound (when percentage composition is given)

1) First convert mass percent to gram i.e. if composition is 20% then take it as 20 g.
2) Then convert it into number of moles for each element.
3) Divide moles of each element by smallest one.
4) Write down the empirical formula by mentioning the numbers after element's symbol. Ex - CH_2 etc.
5) Molecular formula = n × empirical formula

   Where, $n = \frac{\text{molar mass of compound}}{\text{empirical formula mass}}$

Stoichiometry and stoichiometric calculations

We can obtain much information from a balanced equation to calculate unknown values.

Ex. - CH_4 (g) + $2O_2$ → CO_2 (g) + $2H_2O$ (g)

This balanced equation tell us-

a) **1 mole,1 molecule,22.7 L or 16 g** of CH_4 react with **2 moles,2 molecule, 45.4L or 32g** of O_2 to give **1 mole ,1 molecule ,22.7L or 44g** of CO_2 and **2 moles ,2 molecules,45.4L or 36 g** of water.

Molecular weight = 2 × Vapour density

Limiting reagent – The component in reactant which is consumed first, limits the amount of product formed is known as **limiting reagent.**

Concentration terms in solutions

1) Mass percent

$$\text{Mass percent} = \frac{\text{Mass of solute} \times 100}{\text{Mass of solution}}$$

2) Mole fraction

Let there are two components in solution, A and B having moles n_1 and n_2 then

Mole fraction of A = $n_1 / (n_1 + n_2)$
Mole fraction of B = $n_2 / (n_1 + n_2)$

3) Molarity

$$\text{Molarity(M)} = \frac{\text{moles of solute}}{\text{volume of solution (in litre)}}$$

4) Molality

$$\text{Molality(m)} = \frac{\text{moles of solute}}{\text{mass of solvent (in kg)}}$$

5) Normality

$$\text{Normality(N)} = \frac{\text{weight of solute}}{\text{equivalent weight of solute}} \times \frac{1000}{\text{Volume of solution(in ml)}}$$

Points to remember

- The total number of digits in a number is called the significant figures.
- All digits are significant except zeroes at the beginning of the number.
- Zeroes to the right of a decimal point are significant.
- The volume of the solution changes with temperature while the mass doest note change. Therefore, molarity of solution changes with temperature whereas, Molality does not change.
- Molality of solution is regarded better for expressing the concentration of solution compared with molarity.
- Relation between Molarity and Molality
$$\frac{\text{Molarity}}{\text{molality}} = \frac{\text{mass of solvent in kg}}{\text{volume of solution in litres}}$$
- All substances contain matter, which can exist in three states – solid, liquid or gas.
- Matter can also be classified into elements, compounds or mixtures. An element contains particles of only one type, which may be atoms or molecules.
- The compounds are formed where atoms of two or more elements combine in a fixed ratio to each other.
- The measurements of quantities in chemistry are spread over a wide range of 10^{-31} to 10^{+23}.

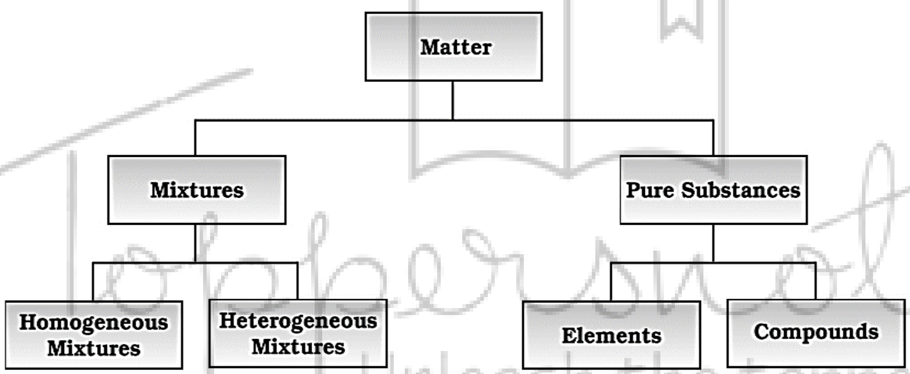
- The uncertainty is taken care of by specifying the number of significant figures, in which the observations are reported.
- The combination of different atoms is governed by basic laws of chemical combination — these being the Law of Conservation of Mass, Law of Definite Proportions, Law of Multiple Proportions, Gay Lussac's Law of Gaseous Volumes and Avogadro Law.
- The atomic mass of an element is expressed relative to ^{12}C isotope of carbon, which has an exact value of 12u.
- The number of atoms, molecules or any other particles present in a given system is expressed in the terms of Avogadro constant (6.022×10^{23}). This is known as 1 mol of the respective particles or entities.

1 Mark Questions

Ques1. Differentiate solids, liquids & gases in terms of volume & shapes.
Ans.

Properties	Solids	Liquids	Gases
Volume	Definite	Definite	Not definite
Shape	Fixed	Not fixed, take the shape of the container.	Not fixed, take the shape of the container.

Ques2. How is matter classified at macroscopic level?



Ans.

Classification of matter

Ques3. Write down the difference between homogeneous and heterogeneous mixtures.
Ans. In a homogeneous mixture components completely mix with each other and its composition is uniform throughout.
Examples of homogeneous mixtures are sugar solution and air.
While in heterogeneous mixture the composition is not uniform throughout and sometimes different components can be observed.
Example of heterogeneous mixtures is mixture of salt and sugar.

Ques4. Explain the difference between elements and compounds.
Ans. An element consists of only one type of particles. These particles may be atoms or molecules.
A compound consists of two or more atoms of different elements.

Ques5. What is the SI unit of density?

Ans. The SI Unit of density is kg/m^3.

Ques6. What is the SI unit of volume? What is the other common unit which is not an SI unit of volume?

Ans. The SI unit of volume is m3 whereas liter (L) is the other common unit which is not an SI unit.

Ques7. Write the relation between ^0F and ^0C.

Ans. $F = (9/5)\,^0C + 32$.

Ques8. Write 232.508 and 0.00016 in scientific notation.

Ans. 2.32508×10^2 and 1.6×10^{-4}.

Ques9. What is difference between precision and accuracy?

Ans. Precision means the closeness of various measurements for the same quantity. Accuracy is the agreement of a particular value to the true value of the result.

Ques10. What do you understand by significant figures?

Ans. Significant figure refers to the number of important single digits (0 to 9 inclusive) in the coefficient of expression in the scientific notation. The number of significant figures in the expression indicates the confidence or precision with which an engineer or scientist indicates a quantity.

Ques11. How many significant figures are present in (a) 100 (b) 8.256

Ans. (a) 1 (b) 4

Ques12. State law of conservation of mass.

Ans. "Matter can neither be created nor destroyed". This is called 'Law of Conservation of Mass.

Ques13. State law of definite proportions.

Ans. Law of definite proportions states that a given compound always contains exactly the same proportion of elements by weight.

Ques14. State law of multiple proportions.

Ans. According to this law, if two elements can combine to form more than one compound, the masses of one element that combine with a fixed mass of the other element, are in the ratio of small whole numbers.

Ques15. State Gay Lussac's Law of Gaseous Volumes.

Ans. When gases combine or are produced in a chemical reaction they do so in a simple ratio by volume, provided all gases are at the same temperature and pressure.

Ques16. State Avogadro's Law.

Ans. Avogadro proposed that equal volumes of all gases at the same temperature and pressure should contain equal number of molecules.