

Solution

Mass of HCl

No. of HCl molecules = xN_A

Molar mass

$$\frac{10}{36.5} \times 6.02 \times 10^{23}$$

Molar mass

$$= 1.65 \times 10^{23} \text{ molecules}$$

Q10. How many grams of Mg will have the same number of atoms as 6 grams of C have?

Data

$$\text{Mass of Carbon} = 6 \text{ g}$$

Atomic mass of Carbon = 12 g/mol

$$\text{Mass of Mg} = ?$$

Solution

$$\text{No. of moles of Carbon} = \frac{\text{Given Mass of Carbon}}{\text{Atomic mass of Carbon}}$$

$$= \frac{6}{12}$$

$$= 0.5 \text{ mole}$$

$$\text{Number of Carbon atoms} = 0.5 \times N_A$$

$$= 0.5 \times 6.02 \times 10^{23}$$

$$= 3.01 \times 10^{23} \text{ atoms}$$

$$\text{Number of atoms of Mg} = \frac{\text{mass}}{\text{molar mass}} \times N_A$$

$$3.01 \times 10^{23} = \frac{\text{mass}}{24} \times 6.02 \times 10^{23}$$

$$\text{Mass of Mg} = 12 \text{ g}$$

So, 12 g of Mg will have same No. of atoms as 6g of carbon have

Short Answer Questions

Q1. Define Science.

Ans. The knowledge that provides understanding of this world and how it works, is called science.

Q2. Define industrial chemistry and analytical chemistry.

Ans. i) Industrial Chemistry:

The branch of that deals with the manufacture of chemical compounds on commercial scale, is called industrial chemistry. It deals with the manufacturing of fertilizers, textile, soap, agricultural products paints and paper etc.

ii) Analytical Chemistry:

It is the branch of which deals with the separation and analysis of a sample to identify its components. The separation is carried out prior to qualitative and quantitative analysis. In this branch different techniques and instruments used for analysis are also studied.

Q3. How can you differentiate between organic and inorganic chemistry? Ans.

Organic chemistry	Inorganic chemistry
Organic chemistry is the study of covalent compounds of carbon and hydrogen (hydrocarbons) and their derivatives.	Inorganic chemistry deals with the study of all elements and their compounds except those of compounds of carbon and hydrogen (hydrocarbons) and their derivatives.

Q4. Give the scope of bio chemistry.

Ans. The scope of **biochemistry** is very vast. Its applications are in the fields of medicines, food, science and agriculture etc.

Q5. How does homogeneous mixture differ from heterogeneous mixture? Ans.

Homogeneous mixture	Heterogeneous mixture
Mixture that have uniform composition throughout are called homogeneous mixtures e.g. air	Heterogeneous mixture is that in which composition is not uniform throughout e.g. soil.

Q6. What is the relative atomic mass? How it is related to gram?

Ans. The relative atomic mass of an element is the average mass of atoms of that element

as compared to $\frac{1}{12}$ th the mass of one atom of carbon-12 isotope. Its unit is called

12

atomic mass unit with symbol "amu". One atomic mass unit is —th the mass of one 12 atom of carbon-12. When this atomic mass unit is expressed in grams, it is:

$$1 \text{ amu} = 1.66 \times 10^{-24} \text{ g}$$

Q7. Define empirical formula with example.

Ans. The simplest type of formula which shows the simplest whole number ratio of atoms present in a compound is called empirical formula. e.g. glucose has simplest ratio 1:2:1 of carbon, hydrogen and oxygen respectively. Hence its empirical formula is CH₂O.

Q8. State three reasons why do you think air is a mixture and water a compound.

- Ans. i) Water is a compound because it is formed by chemical combination of hydrogen and oxygen whereas air is formed by simple mixing of different gases.
- ii) Water has fixed ratio between masses of hydrogen and oxygen, whereas in air ratio between masses of component gases is not fixed.
- iii) Water has definite melting and boiling points whereas air does not have any fixed melting and boiling point.

Q9. Explain why are hydrogen and oxygen considered elements whereas water a compound.

Ans. Hydrogen and oxygen are elements because in these substances same type of atoms with same atomic number are present whereas water is made up of hydrogen and oxygen atoms having different atomic numbers.

Hydrogen and oxygen cannot be decomposed into simpler substances by chemical means whereas water can be decomposed into hydrogen and oxygen by electrolysis.

Q10. What is the significance of the symbol of an element?

Ans. Symbol is the international recognition of an element. With the help of symbol scientists form the formulae of different compounds. Symbol also helps to write and understand chemical equation for different chemical reactions. The periodic table is based on symbols of different elements. We should say without symbols Chemistry would not be easy to understandable.

Q11. State the reasons. Soft drink is a mixture and water is a compound.

Ans. Cold drink is a true solution of sugar and water in which CO₂ is dissolved through pressure. We can separate these components by physical methods. It does not have definite melting and boiling point. Therefore cold drink is a mixture. Water is formed by chemical combination

of hydrogen and oxygen.



We cannot separate these two gases by physical methods. It has definite freezing and boiling points. Therefore water is a compound.

Q12. Classify the following into elements compound and mixture.

(i) He and H (ii) CO and Co (iii) Water and milk

(iv) Gold and brass (v) Iron and steel Ans.

Element	Compound	Mixture
He, H, co, Gold and Iron	CO, Water	Milk, Brass and Steel

Q13. Define atomic mass unit. Why is it needed?

Ans. The unit for relative atomic mass is called atomic mass unit. Its symbol is "amu".

One atomic mass unit is $\frac{1}{12}$ th the mass of one atom of carbon-12.

The mass of an atom is too small to be determined practically. So to determine the atomic mass of various elements atomic mass unit is needed.

Q14. State the nature and name of the substance formed by combining the following:

Ans.

Substance	Nature	Name
Zinc + Copper	Alloy (mixture)	Brass
Water + sugar	Solution (mixture)	Aqueous solution of sugar
Aluminium + Sulphur	Compound	Aluminium sulphide
Iron + Chromium + Nickel	Alloy (mixture)	Stainless steel

Q15. Differentiate between molecular mass and formula mass. Which of the following will be molecular formula?

H₂O, NaCl, KI, H₂SO₄

Ans. The sum of atomic masses of all the atoms present in one molecule of a molecular mass e.g. molecular mass of water is 18 amu. The sum of atomic masses of all atoms present in one formula unit of a substance is called formula mass e.g. formula mass of sodium chloride is 58.5 amu. H₂O and H₂SO₄ are molecular formula of molecular compounds water and sulphuric acid respectively. Q16. Which one has more atoms: 10g of Al or 10g of Fe?

Ans.

(i) Given mass of Al 10g

Molar mass of Al = 27g mol⁻¹

No. of atoms in 10g of Al

No. of moles x N_A

Given mass _____.

Molar mass

1 Og x 6.02×10^{23} atoms
27 gmol

$$\begin{aligned}
 \text{(ii) Given mass of Fe} &= 2.23 \times 10^{23} \text{ atoms} \\
 \text{Molar mass of Fe} &= 10 \text{ g} \\
 \text{No. of atoms in 10g of Fe} &= 56 \text{ gmol}^{-1} \\
 &= \frac{10}{56} \times 6.02 \times 10^{23} \text{ atoms}
 \end{aligned}$$

Therefore 10g of Al contains more atoms as compared to 10g of Fe.

Q17. Which one has more molecules: 9g of water or 9g of sugar.

Ans.

$$\text{(i) Molar mass of water (H}_2\text{O)} = 18 \text{ gmol}^{-1}$$

Given mass of water (H₂O)

$$\text{Given mass of water (H}_2\text{O)} = 9\text{g}$$

$$\begin{aligned}\text{No. of molecules in 9g of water} &= \frac{\text{Mass of water}}{\text{Molar mass}} \times N_A \\ &= \frac{9}{18} \times 6.02 \times 10^{23} \text{ molecules} \\ &= 3.01 \times 10^{23} \text{ molecules}\end{aligned}$$

$$\text{(ii) Molar mass of sugar (C}_{12}\text{H}_{22}\text{O}_{11}) = 342\text{gmol}^{-1}$$

$$\text{Given mass of sugar} = 9\text{g}$$

$$\begin{aligned}\text{No. of molecules in 9g of sugar} &= \frac{9}{342} \times 6.02 \times 10^{23} \text{ molecules} \\ &= 1.584 \times 10^{22} \text{ molecules}\end{aligned}$$

Therefore 9g of water contains more molecules than 9g of sugar.

Q18. Which has more formula units: 1g of NaCl or 1g of KCl.

ns.

$$\text{(i) Formula mass of NaCl} = 58.5\text{gmol}^{-1}$$

$$\text{Given mass} = 1\text{g}$$

$$\text{No. of formula units in 1g of NaCl} = \frac{\text{Given mass}}{\text{Formula mass}} \times N_A = \frac{1}{58.5} \times 6.02 \times 10^{23}$$

$$= 1.029 \times 10^{22} \text{ formula units}$$

$$\text{(ii) Formula mass of KCl} = 74.5\text{gmol}^{-1}$$

$$\text{Given mass} = 1\text{g}$$

$$\text{No. of formula units in 1g of KCl} = \frac{1}{74.5} \times 6.02 \times 10^{23}$$

$$= 8.080 \times 10^{21} \text{ formula units}$$

Therefore 1g of NaCl contains more formula units than 1g of KCl.

-Ans.

Q19. Differentiate between homoatomic and heteroatomic molecules with examples.

Ans. Difference between homoatomic and heteroatomic-molecules:

Homoatomic molecules	Heteroatomic molecules
A molecule containing same type of atoms is called homoatomic molecule e.g. Hydrogen Oxygen (O ₂), Ozone (O ₃) and sulphur (S ₈) are homoatomic molecules.	A molecule consisting of different type of atoms is called heteroatomic molecule e.g. NH ₃ , H ₂ O and CO ₂ are heteroatomic molecules.

Q20. In which one of the following the number of hydrogen atoms is more? 2 moles of HCl or 1 mole of NH₃ Ans.

No. of moles of hydrogen in 1 mole of HCl 1 mole

No. of moles of hydrogen in 2 moles of HCl — 2 moles

Whereas no. of moles of hydrogen in 1 mole of NH₃ — 3 moles

Hence 1 mole of NH₃ contains 3 moles of hydrogen will have more hydrogen atoms than 2 moles of hydrogen present in 2 moles of HCl.

Q21. What is Chemistry?

Ans. The branch of science which deal with the composition, structure, properties and reactions of matter is called Chemistry.

Q22. Define Physical Chemistry.
Ans. The branch of chemistry that deals with the relationship between the composition and physical properties of matter along with the change in them is called Physical Chemistry.

Q23. Define Bio Chemistry.

Ans. It is the branch of chemistry in which we study the structure, composition and chemical reactions of substances found in living organisms.

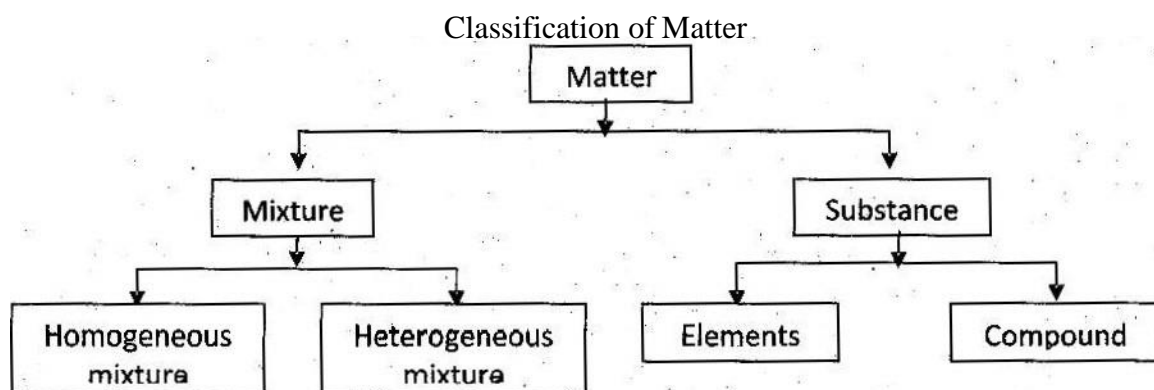
Q24. What is nuclear chemistry?

Ans. Nuclear chemistry is the branch of chemistry that deals with the reactivity, nuclear process and properties. The main concern of this branch is with the energy of atom and its uses in daily life.

Q25. What is environmental chemistry?

Ans. The branch of chemistry that deals with the components of the environment and the effects of the human activities on the environment.

Q26. What is matter? Show classification of matter.
Ans. Anything that has mass and occupies space is called matter- Matter can exist in any of the three physical states; solid, liquid or gas.



Q27. What is valency?

Ans. The combining capacity of an element with other elements is called valency. For example valency of carbon is 4.

Q28. What is meant by variable valency?

Ans. Some elements show more than one combining power (valency) that is called variable valency. For example, in ferrous sulphate (FeSO_4) the valency of iron is 2 whereas in ferric sulphate $\text{Fe}_2(\text{SO}_4)_3$ the valency of iron is 3.

Q29. What is a radical?

Ans. An atom or a group of atoms that have some charge and keeps in contact during a chemical reaction is called a radical e.g. Hydronium $1-130+$ and carbonate. cog-2 Q30. What is atomic number and mass number?

Ans. The number of protons present in the nucleus of an atom of an element is called its atomic number. It is represented by symbol 'Z'. e.g. carbon atom has 6 protons its atomic number (Z) is 6. The sum of protons and neutrons present in the nucleus of an atom of an element is called mass number or nucleon number. It is represented by symbol 'A'. e.g. carbon atom has 6 protons and 6 hence its mass number (A) is 12.

Q31. What is molecular formula? How molecular formula is derived from empirical formula?

Ans. The formula of molecular substances that shows actual number of atoms of each element present in a molecule of that substance is called molecular formula e.g. molecular formula of benzene is C_6H_6 .

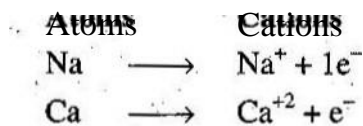
Molecular formula is derived from empirical formula by the following relationship: Molecular formula = (Empirical formula) $_n$

Where n is 1, 2, 3 and so on. e.g. molecular formula of benzene C_6H_6 is derived from the empirical formula CH where the value of n is 6.

Q32. What is ion? What are its types?

Ans. Ion: An atom or group of atoms having a charge on it is called ion. There are two types of ions i.e. cation and anion.

Cation: An atom or group of atoms having positive charge on it is called cation. Cation are formed when an atom loses electrons from its outermost shell. e.g.



Anion: An atom or group of elements that has negative charge on it, is called anion, Anion is formed by the gain or addition of electrons to an atom.

e.g. Cl^- and O^{2-}

Q33. Differentiate between atom and ion.

Ans. Difference between Atoms and Ions

	Atom	Ion
	It is the smallest particle of an element.	It is the smallest unit of an ionic compound.
ii.	It can or cannot exist independently and can take part in a chemical reaction.	It cannot exist independently and is surrounded by oppositely charged ions.
iii.	It is electrically neutral.	It has a net charge (either negative or positive) on it.

Q34. Differentiate between molecule and molecular ion.

Ans. Difference between Molecule and Molecular Ion

	Molecule	Molecular Ion
	It is the smallest particle of a compound which can exist independently and shows all the properties of that compound.	It is formed by gain or loss of electrons by a molecule.
ii.	It is always neutral.	It can have negative or positive charge.
iii.	It is formed by the combination of atoms.	It is formed by the ionization of a molecule.
iv.	It is a stable unit.	It is a reactive species.

Q35. Define free radicals? How they are generated?

Ans. Free radicals are atoms or group of atoms possessing an odd (unpaired) electron. It is represented by putting a dot over the symbol of an element e.g. $\text{H}\cdot$, $\text{Cl}\cdot$, $\cdot\text{C}$. Free radicals are generated by the homolytic (equal) breakage of the bond between two atoms when they absorb heat or light energy.

Q36. Differentiate between ions and free radicals.

Ans. Difference between Ions and Free Radicals

	Ions	Free Radicals
i.	These are the atoms which bear some charge	These are the atoms that have odd number of electrons

ii.	They exist in solution or in crystal lattice	They can exist in solutions as well in air
iii.	Their formation is not affected by the presence of light	They may form in the presence of light

Q37. What is Avogadro's number?

Ans. Avogadro's number is a collection of 6.02×10^{23} particles. It is represented by symbol 'NA'. Hence, the 6.02×10^{23} number of atoms, molecules or formula units are called Avogadro's number that is equivalent to one 'mole' of respective substance.

Q38. Define a mole.

Ans. A mole is defined as the amount (mass) of a substance that contains 6.02×10^{23} number of particles (atoms) molecules or formula units). It is abbreviated as 'mol' e.g.

carbon atoms = 1 mole of carbon. It can be defined as the atomic mass, molecular mass or formula mass of a substance expressed in grams is called mole. e.g. Atomic mass of carbon expressed as 12g = 1 mole of carbon.

(239. Write the composition of following mixtures.

- (i) Air (ii) Soil (iii) Milk (iv) Brass

Ans. Air:

Air is a mixture of oxygen, carbon dioxide, noble gases and moisture.

Soil:

Soil is a mixture of sand, clay, mineral salts, water and air.

Milk:

Milk is a mixture of calcium, water, sugar, fat, proteins, mineral salts and Vitamins.

Brass:

Brass is a mixture Of copper and zinc metals

What is empirical formula of acetic acid (CH₃COOH)? Find its molecular mass.

Ans. Empirical formula of acetic acid is CH₂O Molecular Mass of CH₃COOH

$$12 + 3 + 12 + 16 + 16 + 1 = 60 \text{ amu}$$

Q41. How many atoms of sodium are present in 3 moles of sodium and what is the mass of it?

Ans. No. of atoms of sodium are present in 3 moles = $3 \times 6.02 \times 10^{23}$
 $= 1.806 \times 10^{24}$

The mass of 3 moles of sodium is = 69g

Multiple Choice Questions

1. Industrial chemistry deals with the manufacturing of compounds:

- (a) in the laboratory
- (b) on micro scale
- (c) on commercial scale
- (d) on economic scale

2. Which one of the following can be separated by physical means?

- (a) Mixture
- (b) Element
- (c) Compound
- (d) Radical

3. The most abundant element occurs in the oceans is:

- (a) Oxygen
- (b) Hydrogen
- (c) Nitrogen
- (d) Silicon

4. Which one of the following element is found in most abundance in the earth's crust?

- (a) Oxygen
- (b) Aluminium
- (c) Silicon
- (d) Iron

5. The third abundant gas found in the earth's crust is:

- (a) Carbon monoxide
- (b) Oxygen
- (c) Nitrogen
- (d) Argon

6. One amu (atomic mass unit) is equivalent to:

(a) 1.66×10^{-24} mg (b) 1.66

(c) 1.66×10^{-24} kg (d) 1.66×10^{-23} g

7. Which of the following are triatomic molecule except:

- (a) H_2
- (b) O_3
- (c) H_2O
- (d) CO_2

8. The mass of one molecule of water is:

- (a) 18 amu
- (b) 18 g
- (c) 18 mg
- (d) 18 kg

9. The molar mass of H_2SO_4 is:

- (a) 98g
- (b) 98amu
- (c) 9.8g
- (d) 9.8amu

10. Molar mass is usually expressed in grams.

Which one of the following is molar mass of O_2 in amu?

- (a) 32 amu
- (b) 53.12×10^{-24} amu
- (c) 1.92×10^{-25} amu
- (d) 192.64×10^{-25} amu

II. How many numbers of moles are equivalent to 8 grams of CO_2 ?

- (a) 0.15
- (b) 0.18