UNIT 7

ATOMS AND MOLECULES

Points to Remember

- Two or more forms of an element having the same atomic number, but different mass number are called Isotopes ($_{17}Cl^{35}$, $_{17}Cl^{37}$).
- Atoms of different elements having the same mass number, but different atomic numbers are called Isobars ($_{18}Ar^{40}$, $_{20}Ca^{40}$).
- Atoms of different elements having the same number of neutrons, but different atomic number and different mass number are called Isotones ($_{6}C^{13}$, $_{7}N^{14}$).
- Relative atomic mass of an element is the ratio between the mass of one atom of the element to 1/12th of the mass of the atom of carbon -12.
- Average atomic mass of an element is calculated by adding the masses of its isotopes, each multiplied by their natural abundance on the Earth.
- Relative molecular mass of a molecule is the ratio between the mass of one molecule of the substance to 1/12th of the mass of the atom of carbon – 12.
- The Avogadro's law states that "equal volumes of all gases under similar conditions of temperature and pressure contain equal number of molecules".
- The vapour density is defined as "the ratio between the masses of equal volumes of a gas (or a vapour) and hydrogen under the same condition".
- Atomicity of a monoatomic element = Molecular mass / Atomic Mass.
- Molecular mass = 2 × Vapour density.

PART - A

I. Book Exercise – Choose the best answer

1. Which of the following has the smallest mass?

a) 6.023×10^{23} atoms of He
b) 1 atom of He
c) 2 g of He
d) 1 mole atoms of He

Ans : (b) 1 atom of He

2. Which of the following is a triatomic molecule?

a) Glucose
b) Helium
c) Carbon dioxide
d) Hydrogen

Ans : (c) Carbon dioxide

3. The volume occupied by 4.4 g of CO2 at S.T.P

a) 22.4 litre
b) 2.24 litre
c) 0.24 litre
d) 0.1 litre

Ans : (b) 2.24 litre

4. Mass of 1 mole of Nitrogen atom is

a) 28 amu
b) 14 amu
c) 28 g
d) 14 g

Ans : (c) 28 g

5. Which of the following represents 1 amu?

a) Mass of a C – 12 atom
b) Mass of a hydrogen atom
c) 1/12th of the mass of a C – 12 atom
d) Mass of O – 16 atom

Ans : (c) 1/12th of the mass of C – 12 atom

6. Which of the following statement is incorrect?

a) One gram of C – 12 contains Avogadro's number of atoms.
b) One mole of oxygen gas contains Avogadro's number of molecules.
c) One mole of hydrogen gas contains Avogadro's number of atoms.
d) One mole of electrons stands for 6.023×10^{23} electrons.

Ans : (d) One mole of electrons stands for 6.023×10^{23} electrons.

7. The volume occupied by 1 mole of a diatomic gas at S.T.P is

a) 11.2 litre b) 5.6 litre c) 22.4 litre d) 44.8 litre

Ans : (c) 22.4 litre

8. In the nucleus of $_{20}Ca^{40}$, there are

a) 20 protons and 40 neutrons
b) 20 protons and 20 neutrons
c) 20 protons and 40 electrons
d) 40 protons and 20 electrons

Ans : (b) 20 protons and 20 neutrons

9. The gram molecular mass of oxygen molecule is

a) 16 g b) 18 g c) 32 g d) 17 g

Ans : (c) 32 g

10. 1 mole of any substance contains _____ molecules.

a) 6.023×10^{23} b) 6.023×10^{-23} c) 3.0115×10^{23} d) 12.046×10^{23}

Ans : (a) 6.023×10^{23}

II. Book Exercise – Fill in the blanks

1. Atoms of different elements having _____ mass number, but _____ atomic numbers are called isobars. **Ans :** same, different
2. Atoms of different elements having same number of _____ are called isotones. **Ans :** neutrons
3. Atoms of one element can be transmuted into atoms of other element by _____. **Ans :** artificial transmutation
4. The sum of the numbers of protons and neutrons of an atom is called its _____. **Ans :** Mass number
5. Relative atomic mass is otherwise known as _____. **Ans :** Standard atomic weight
6. The average atomic mass of hydrogen is _____ amu. **Ans :** 1.008
7. If a molecule is made of similar kind of atoms, then it is called _____ atomic molecule. **Ans :** Homo
8. The number of atoms present in a molecule is called its _____. **Ans :** Atomicity
9. One mole of any gas occupies _____ ml at S.T.P. **Ans :** 22400
10. Atomicity of phosphorous is _____. **Ans :** 4

III. Book Exercise – Match the following

1. 8 g of O_2 - 4 moles
2. 4 g of H_2 - 0.25 moles
3. 52 g of He - 2 moles
4. 112 g of N_2 - 0.5 moles
5. 35.5 g of Cl_2 - 13 moles

Ans :

1	8 g of O_2	b	0.25 moles
2	4 g of H_2	c	2 moles
3	52 g of He	e	13 moles
4	112 g of N_2	a	4 moles
5	35.5 g of Cl_2	d	0.5 moles

IV. Book Exercise – True or false (If false give the correct statement)

1. **Two elements sometimes can form more than one compound.**
   Ans : True.
2. **Noble gases are Diatomic.**
   Ans : False. Monoatomic.
3. **The gram atomic mass of an element has no unit.**
   Ans : False. Relative atomic mass of an element has no unit.
4. **1 mole of Gold and Silver contain same number of atoms.**
   Ans : True.
5. **Molar mass of CO_2 is 42g.**
   Ans : False. 44 g.

V. Book Exercise – Assertion and Reason

Answer the following questions using the data given below:

a) A and R are correct, R explains the A.
b) A is correct, R is wrong.
c) A is wrong, R is correct.
d) A and R are correct, R doesn't explains A.

1. **Assertion: Atomic mass of aluminium is 27**
   Reason: An atom of aluminium is 27 times heavier than 1/12th of the mass of the C – 12 atom.
   Ans : (d) A and R are correct, R doesn't explains A
2. **Assertion: The Relative Molecular Mass of Chlorine is 35.5 a.m.u.**
   Reason: The natural abundance of Chlorine isotopes are not equal.
   Ans : (a) A and R are correct, R explains the A

VI. Book Exercise – Short answer questions

1. **Define: Relative atomic mass.**
   Relative atomic mass of an element in the ratio between the average mass of its isotopes to 1/12th part of the mass of a carbon–12 atoms. It is denoted as A. It is otherwise called Standard Atomic Weight.

$$\text{An} = \frac{\text{Average mass of the isotopes of the element}}{\frac{1}{12}\text{th of the mass of one carbon} - 12\text{ atom}}$$

2. **Write the different types of isotopes of oxygen and its percentage abundance.**

Isotope	Mass (amu)	% abundance
$_8O^{16}$	15.9949	99.757
$_8O^{17}$	16.9991	0.038
$_8O^{18}$	17.9992	0.205

3. **Define: Atomicity.**
   The number of atoms present in the molecule is called its Atomicity.

$$\text{Atomicity} = \frac{\text{Molecular Mass}}{\text{Atomic Mass}}$$

4. **Give any two examples for heterodiatomic molecules.**
   HCl, H_2O, NH_4.
5. **What is Molar volume of a gas?**
   One mole of any gas occupies 22.4 litre or 22400 ml at STP. The volume occupied by one mole of any gas at S.T.P is called molar volume.

6. Find the percentage of nitrogen in ammonia.

Molar mass of Ammonia = 14 + 3 = 17 g.

% of Nitrogen = $\frac{14}{17} \times 100$ = 82.35%.

VII. Book Exercise – Long answer questions

1. Calculate the number of water molecule present in one drop of water which weighs 0.18 g.

Given Mass = 0.18 g

Avogadro Number = 6.023 × 1023

Molecular Mass of water = 18 g (H2O = 2(1) + 1(16) = 2 + 16 = 18)

No. of water molecules = $\frac{\text{Avogadro number} \times \text{given man}}{\text{Molecular Mass of water}}$

$= \frac{6.023 \times 10^{23} \times 0.18 \not{g}}{18 \not{g}}$

$= \frac{6.023 \times 10^{23} \times 0.18 \times 100}{18 \times 10^{2}}$

$= \frac{6.023 \times 10^{23} \times 18}{18 \times 10^{2}}$

$= \frac{6.023 \times 10^{23} \times 10^{-2} \times \not{18}}{\not{18}}$

$= 6.023 \times 10^{23} \times 10^{-2}$

$= 6.023 \times 10^{21}$ molecules of water.

2. $N_2 + 3H_2 \rightarrow 2NH_3$.

(The atomic mass of nitrogen is 14, and that of hydrogen is 1)

1 mole of nitrogen (_____g) +

3 moles of hydrogen (_____ g) →

2 moles of ammonia (_____ g)

1 mole of nitrogen (**28** g) +

3 moles of hydrogen (**3×1** g) →

2 moles of Ammonia (**34** g)

28, 3, 34

3. Calculate the number of moles in

i) 27g of Al ii) 1.51×10^{23} molecules of NH_4Cl.

i) No. of moles = $\frac{\text{Mass}}{\text{Atomic Mass}}$

$= \frac{27g}{27g}$

= 1 mole.

ii) No. of moles = $\frac{\text{No. of molecules of } NH_4Cl}{\text{Avogadro's number}}$

$= \frac{1.51 \times 10^{23}}{6.023 \times 10^{23}}$

$= \frac{1}{4}$

= 0.25 mole.

4. Give the salient features of "Modern atomic theory".

Modern Atomic Theory:

- **An atom is no longer indivisible** (after the discovery of the electron, proton and neutron).
- Atoms of the same element may have different atomic mass (discovery of **Isotopes** $_{17}Cl^{35}$, $_{17}Cl^{37}$).
- Atoms of different elements may have same atomic masses (discovery of **Isobars** $_{20}Ar^{40}$, $_{20}Ca^{40}$).
- Atoms of one element can be transmuted into atoms of other elements. In otherwords, atom is no longer indestructible (discovery of **artificial transmutation**).
- Atoms may not always combine in a simple whole number ratio (Eg. Glucose $C_6H_{12}O_6$ C:H:O = 6:12:6 or 1:2:1 and Sucrose $C_{12}H_{22}O_{11}$ C:H:O = 12:22:11).
- Atom is the **smallest particle that take part in a chemical reaction**.
- The mass of an atom can be converted into energy (**$E=MC^2$**).

5. Derive the relationship between Relative molecular mass and Vapour density.

Relative Molecular Mass : The ratio of Mass of one molecule of gas or vapour to the mass of one atom of hydrogen.

$$\text{Relative Molecular Mass} = \frac{\text{Mass of one molecule of gas or vapour}}{\text{Mass of one atom of hydrogen}} \quad \text{.....(1)}$$

Vapour density : The ratio of mass of a certain volume of a gas or vapour to the mass of an equal volume of hydrogen, measured under the same conditions of temperature and pressure.

$$\text{Vapour Density} = \frac{\text{Mass of 1 volume of gas or vapour}}{\text{Mass of 1 volume of hydrogen}} \quad \text{.....(2)}$$

$$\text{VD} = \frac{\text{Mass of 1 volume of gas or vapour}}{\text{Mass of 1 volume of hydrogen}} \quad \text{.....(3)}$$

Applying Avogadro's law,

$$\text{VD} = \frac{\text{Mass of 1 molecule of gas or vapour}}{\text{Mass of 1 molecule of hydrogen}} \quad \text{.....(4)}$$

Hence hydrogen is diatomic

$$\text{VD} = \frac{\text{Mass of 1 molecule of gas or vapour}}{\text{Mass of 2 } \times \text{ atoms of hydrogen}} \quad \text{.....(5)}$$

$$\text{VD} = \frac{\text{Mass of 1 molecule of gas or vapour}}{2 \times \text{mass of 1 atom of hydrogen}} \quad \text{.....(6)}$$

Multiplying '2' on both sides

$$2 \times \text{VD} = \frac{\cancel{2} \times \text{Mass of 1 molecule of gas or vapour}}{\cancel{2} \times \text{Mass of 1 atom of hydrogen}} \quad \text{.....(7)}$$

$$2 \times \text{VD} = \frac{\text{Mass of 1 molecule of gas or vapour}}{\text{Mass of 1 atom of hydrogen}} \quad \text{.....(8)}$$

$$2 \times \text{VD} = \text{Relative Molecular Mass} \quad \text{.....(9)}$$

$$\text{VD} = \frac{\text{RMM}}{2} \text{ or } \frac{\text{Molecular Weight}}{2} \quad \text{.....(10)}$$

VIII. Book Exercise – HOT question

1. Calcium Carbonate is decomposed on heating in the following reaction.

$CaCO_3 \rightarrow CaO + CO_2$

i) How many moles of Calcium Carbonate are involved in this reaction?

Ans : 1 mole of Calcium carbonate.

ii) Calculate the gram molecular mass of Calcium Carbonate involved in this reaction.

Ans : GMM of $CaCO_3$ = 1 (Ca) + 1 (C) + 3 (O)
= 1 (40) + 1 (12) + 3 (16) = 1 (40) + 1 (12) + 48
= 40 + 12 + 48 = 100 g.

iii) How many moles of CO_2 are there in this equation?

Ans : 1 mole of CO_2.

IX. Book Exercise – Solve the following problems

1. How many grams are there in the following?

i) 2 moles of hydrogen molecule, H_2.

Mass = No. of moles × Molecular Mass.
Mass = 2 × (2×1) = 4 g.

ii) 3 moles of chlorine molecule, Cl_2.

Mass = No. of moles × Molecular Mass.
Mass = (35.5×2) × 3
= 71 × 3
= 213 g.

iii) 5 moles of sulphur molecule, S_8.

Mass = No. of moles × Molecular Mass.
Mass = (8×32) × 5
= 256 × 5
= 1280 g.

iv) 4 moles of phosphorous molecule, P_4.

Mass = No. of moles × Molecular Mass.
Mass = (4 × 31) × 4
= 124 × 4
= 496 g.

2. Calculate the % of each element in calcium carbonate. (Atomic mass: C-12, O-16, Ca -40).

$CaCO_3$.

Molar Mass of $CaCO_3$ = 1 (Ca) + 1 (C) + 3 (O)
= 1 (40) + 1 (12) + 3 (16)
= 40 + 12 + 48
= 100 g.

% of Ca in $CaCO_3$ $= \frac{\text{Mass of Ca}}{\text{Molar Mass of } CaCO_3} \times 100$

$= \frac{40\ \cancel{g}}{\cancel{100}\ \cancel{g}} \times \cancel{100}$

= 40%.

% of C in $CaCO_3$ $= \frac{\text{Mass of Carbon}}{\text{Molar Mass of } CaCO_3} \times 100$

$= \frac{12\ \cancel{g}}{\cancel{100}\ \cancel{g}} \times \cancel{100}$

= 12%.

% of O in $CaCO_3$ $= \frac{\text{Mass of Oxygen}}{\text{Molar Mass of Calcium}} \times 100$

$= \frac{48\ \cancel{g}}{\cancel{100}\ \cancel{g}} \times \cancel{100}$

= 48%.

3. Calculate the % of oxygen in $Al_2(SO_4)_3$. (Atomic mass: Al-12, O-16, S -32)

$Al_2(SO_4)_3$.

Molar Mass of $Al_2(SO_4)_3$ = 2 (Al) + 3 (S) + 12 (O)

= 2 (27) + 3 (32) + 12 (16)

= 54 + 96 + 192

= 342 g.

% of Oxygen in $Al_2(SO_4)_3$

$$\% \text{ of Oxygen} = \frac{\text{Mass of Oxygen}}{\text{Molecular Mass of } Al_2(SO_4)_3}$$

$$= \frac{192\ \cancel{g}}{342\ \cancel{g}} \times 100$$

= 56.14%.

4. Calculate the % relative abundance of B -10 and B -11, if its average atomic mass is 10.804 amu.

B10 and B11.

Let B10 = X%

B11 = (100 – X)%

$$\text{Average atomic mass} = 10X + \frac{11(100 - x)}{100} = 10.80$$

$10X + 11\ (100–X) = 10.80 \times 100$

$10X + 1100 – 11X = 1080$

$1100 – X = 1080$

$– X = 1080 – 1100$

$– X = – 20$

$X = 20$

B10 = 20%.
B11 = (100–X) = 80%.

Additional – Choose the best answer

1. The first scientific theory of the atom was proposed by _____.

a) John Dalton b) J.J. Thomson c) Ruther Ford d) Neils Bohr

Ans : (a) John Dalton

2. The atoms are having same atomic number but differ in their mass number is known as _____.

a) Isobars b) Isotopes c) Isotones d) None

Ans : (b) Isotopes

3. The atoms are having same mass number but differ in their atomic number is known as _____.

a) Isobars b) Isotopes c) Isotones d) None

Ans : (a) Isobars

4. The atoms are having different atomic number, different mass number but it contains same number of neutrons are called as _____.

a) Isobars b) Isotopes c) Isotones d) None

Ans : (c) Isotones

5. An Isotope of Carbon, which contains 6 protons and 6 neutrons.

a) 6 protons 6 neutrons b) 6 protons 7 neutrons c) 6 protons 8 neutrons d) 8 protons 6 neutrons

Ans : (a) 6 protons 6 neutrons

6. If the molecule is made of similar kind of atoms. Then it is called _____.

a) Homo Atomic Molecule
b) Di Atomic Molecule
c) Hetero Atomic Molecule
d) Poly Atomic Molecule

Ans : (a) Homo Atomic Molecule

7. If a molecule contains more than three atoms, then it is called _____.

a) Homo Atomic Molecule
b) Di Atomic Molecule
c) Tri Atomic Molecule
d) Poly Atomic Molecule

Ans : (d) Poly Atomic Molecule

8. Gram Atomic Mass of Carbon = _____ g.

a) 16 b) 12 c) 10 d) 8

Ans : (b) 12

9. Gram Molecular Mass of HCl is _____ g.

a) 35.5 g b) 34.5 g c) 36.5 g d) 31.5 g

Ans : (c) 36.5 g

10. The value of Avogadro number is _____.

a) 6.023×10^{23} b) 6.023×10^{22} c) 6.023×10^{21} d) 6.023×10^{-21}

Ans : (a) 6.023×10^{23}

11. One litre is equal to _____.

a) 1 dm^2 b) 1 dm^3 c) 1 cm^2 d) 1 mm^2

Ans : (b) 1 dm^3

12. Gram molar volume of gas at STP is _____.

a) 22.4 lit b) 22.5 lit c) 224 lit d) none

Ans : (a) 22.4 lit

13. Gram molecular mass of Water _____ g.

a) 18 b) 16 c) 15 d) 1.8

Ans : (a) 18

14. Vapour density = _____.

a) RMM × 2 b) RMM / 2 c) RAM × 2 d) RMM / 2

Ans : (b) RMM / 2

15. Gram atomic mass of Hydrogen _____ g.

a) 2 b) 1 c) 3 d) 4

Ans : (b) 1

16. Gram atomic mass of Nitrogen _____ g.

a) 12 b) 14 c) 28 d) 20

Ans : (b) 14

17. Atomic mass of Hydrogen is _____ amu.

a) 1.008 b) 1.006 c) 1.005 d) 1.004

Ans : (a) 1.008

18. Atomic mass of Helium is _____ amu.

a) 3.003 b) 4.003 c) 2.003 d) 1.003

Ans : (b) 4.003

19. Atomic mass of Lithium is _____ amu.

a) 7.641 b) 6.941 c) 8.451 d) 9.412

Ans : (b) 6.941

20. Atomic mass of Beryllium is _____ amu.

a) 9.012 b) 8.012 c) 7.012 d) 6021

Ans : (a) 9.012

21. Example of Triatomic molecule is _____.

a) O_2 b) O_3 c) NH3 d) none

Ans : (b) O_3

22. Gram molecular mass of Oxygen is _____ g.

a) 16 b) 30 c) 32 d) 26

Ans : (c) 32

Additional – Fill in the blanks

1. _____ is made of atoms. **Ans :** Matter
2. The first scientific theory of the atom was proposed by _____. **Ans :** John Dalton
3. An atom is _____ divisible. **Ans :** no longer
4. Atoms of the same element may have different atomic mass. These elements are called as _____. **Ans :** Isotopes
5. An example of isotopes _____. **Ans :** $_{17}Cl^{35}$.$_{17}Cl^{37}$
6. Atoms of different elements may have same atomic mass. These elements are called as _____. **Ans :** Isobars
7. An example of Isobars are _____. **Ans :** $_{18}Ar^{40}$.$_{20}Ca^{40}$
8. Atoms of one element can be _____ into atoms of other elements. In other words, atom is no longer indestructible. **Ans :** transmuted
9. Atoms may not always combine in a _____ whole number ratio. **Ans :** simple
10. Atom is the _____ that takes part in chemical reaction. **Ans :** smallest particle
11. The _____ of an atom can be converted into energy ($E=mc^2$). **Ans :** mass
12. An atom contains such as protons, neutrons and _____. **Ans :** electrons
13. _____ have considerable mass. **Ans :** Protons and neutrons
14. _____ does not have a considerable mass. **Ans :** Electrons
15. The sum of the number of protons and neutrons of an atom is called its _____. **Ans :** mass number
16. The mass of an atom is measured in _____ (amu). **Ans :** atomic mass unit
17. The mass of a proton or neutron is approximately _____. **Ans :** 1 amu
18. An _____ which contains 6 protons and 6 neutrons. **Ans :** isotope of carbon
19. _____ is unified atomic mass. **Ans :** Amu
20. Isotopic character of hydrogen is _____. **Ans :** $_1H^1$, $_1H^2$, $_1H^3$
21. Relative atomic mass of an element is the ratio between the average mass of its isotopes to $1/12^{th}$ part of the mass of a carbon–12 atom. It is otherwise called _____. **Ans :** Standard Atomic Weight
22. Relative Atomic Mass is only a ratio, so it has _____. **Ans :** no unit
23. If the atomic mass of an element is expressed in grams, it is called as _____. **Ans :** Gram Atomic Mass
24. Gram atomic Mass of _____ = 1g. **Ans :** Hydrogen
25. Gram atomic mass of _____ = 12g. **Ans :** Carbon
26. Gram atomic mass of _____ = 14g. **Ans :** Nitrogen
27. Gram atomic mass of _____ = 16g. **Ans :** Oxygen
28. Atomic mass of _____ = 1. **Ans :** Hydrogen
29. Atomic mass of _____ = 12. **Ans :** Carbon
30. Atomic mass of _____ = 14. **Ans :** Nitrogen

31. Atomic mass of _____ = 16. **Ans :** Oxygen
32. Atomic mass of _____ = 23. **Ans :** Sodium
33. Atomic mass of _____ = 24. **Ans :** Magnesium
34. Atomic mass of _____ = 32. **Ans :** Sulphur
35. The natural abundance of C-12 and C-13 are _____ . **Ans :** 98.90% and 1.10%
36. The average of the atomic mass of carbon is _____ amu. **Ans :** 12.011
37. The average of the atomic mass of Hydrogen is _____ amu. **Ans :** 1.008
38. The average of the atomic mass of Helium is _____ amu. **Ans :** 4.003
39. The average of the atomic mass of Lithium is _____ amu. **Ans :** 6.941
40. The average of the atomic mass of Beryllium is _____ amu. **Ans :** 9.012
41. The average of the atomic mass of Boron is _____ amu. **Ans :** 1.008
42. Mass of $_8O^{16}$ isotope is _____. **Ans :** 15.9949
43. % of abundance $_8O^{16}$ isotope is _____. **Ans :** 99.757
44. Mass of $_8O^{17}$ isotope is _____. **Ans :** 16.9991
45. % of abundance $_8O^{17}$ isotope is _____. **Ans :** 0.038
46. Mass of $_8O^{18}$ isotope is _____. **Ans :** 17.9992
47. % of abundance $_8O^{18}$ is _____. **Ans :** 0.205
48. Except noble gases, atoms of most of the elements are found in the combined form with itself or atoms of other elements. It is called as a _____. **Ans :** molecule
49. A molecule is a combination of two or more held together by strong chemical _____ in chemical bonds. **Ans :** forces of attraction
50. If the molecule is made of similar kind of atoms then it is called _____ molecule. **Ans :** homoatomic
51. The molecule that consist of atoms of different elements is called _____ molecule. **Ans :** hetero atomic molecule
52. The compound NH_3 is a _____. **Ans :** hetero atomic molecule
53. The number of atoms present in the molecule is called its _____. **Ans :** atomicity
54. Number of atoms are present in Monoatomic is _____. **Ans :** 1
55. Number of atoms are present in Diatomic .is _____. **Ans :** 2
56. Number of atoms are present in triatomic is _____. **Ans :** 3
57. Number of atoms are present in Polyatomic is _____. **Ans :** more than 3
58. An example of mono atomic molecule is _____. **Ans :** Helium (He)
59. An example of Di atomic molecule is _____. **Ans :** Hydrogen (H_2)
60. An example of Tri atomic molecule is _____. **Ans :** Ozone (O_3)
61. An example of poly atomic molecule is _____. **Ans :** Sulphur (S_8)
62. An example of _____ molecule is hydrogen chloride. **Ans :** hetero atomic
63. The relative molecular mass of a molecule is the ratio between the mass of one molecule of the substance to 1./12th mass of an atom _____. **Ans :** carbon – 12
64. Relative molecular mass is only a ratio. It has _____. **Ans :** no unit
65. If the molecular mass of a compound is expressed in grams it is called _____. **Ans :** gram molecular mass
66. Gram molecular mass of _____ is 18 g. **Ans :** water
67. Gram molecular mass of _____ is 44 g. **Ans :** carbon di oxide

68. Gram molecular mass of _____ is 17 g. **Ans :** ammonia

69. Gram molecular mass of _____ is 36.5 g. **Ans :** HCl

70. The _____ is obtained by adding together the relative atomic masses of all the atoms present in a molecule. **Ans :** relative molecular mass

71. Molecules are _____. **Ans :** less reactive

72. Atoms are _____. **Ans :** highly reactive

73. An atom is the _____ particle of an element. **Ans :** smallest

74. A _____ is the smallest particle of an element or compound. **Ans :** molecule

75. Atom does not have a _____. **Ans :** chemical bond

76. Atoms in a _____ are held by chemical bonds. **Ans :** molecule

77. The _____ is the amount of substance that contains as many atoms or molecules or other particles as there are atoms in exactly 12 g of the carbon–12 isotope. **Ans :** mole

78. _____ was proposed the Avogadro number. **Ans :** Amedo Avogadro

79. Amedo Avogadro is an _____. **Ans :** Italian Scientist

80. Value of Avogadro number is _____. **Ans :** 6.023×10^{23}

81. One mole of substance contains _____. **Ans :** 6.023×10^{23} molecules

82. Standard molar volume at STP = _____. **Ans :** 22.4 litres

83. STP means _____. **Ans :** Standard Temperature and Pressure

84. Standard Temperature is _____. **Ans :** 273.15 K

85. Standard Pressure is _____. **Ans :** 1.00 atm

86. One mole of an element contains 6.023×10^{-23} atoms and it is equal to its _____.
Ans : gram atomic mass

87. One mole of matter contains 6.023×10^{-23} molecules and it is equal to its _____.
Ans : gram molecular mass

88. One mole of oxygen contains 6.023×10^{-23} molecules of oxygen and its gram molecular mass is _____. **Ans :** 32 g

89. One mole of any gas occupies _____ at STP. This volume is called as molar volume.
Ans : 22.4 litre (or) 22400 ml

90. Number of moles = _____. **Ans :** Mass / Atomic mass

91. Number of moles = _____. **Ans :** Mass / Molecular mass

92. Number of moles = _____. **Ans :** Number of atoms / Avogadro number

93. Number of moles = _____. **Ans :** Number of molecules / Avogadro number

94. The _____ of a compound represents the mass of each element present in 100 g of the compound.
Ans : percentage composition

95. In 1811 Avogadro framed a _____. **Ans :** hypothesis

96. Equal volume of all gases under similar conditions of temperature and pressure contain equal number of molecules. This is called _____. **Ans :** Avogadro Hypothesis

97. V = _____ is stated that Avogadro hypothesis. **Ans :** constant × n

98. One litre = _____. **Ans :** 1 dm^3

99. One litre of hydrogen contains the _____ number of molecules as in one litre of oxygen. **Ans :** same

100. The volume of the gas is _____ to the number of molecules of the gas. **Ans :** directly proportional

101. One molecule of hydrogen is react with one molecule of chlorine to give 2 molecules of _____.
Ans : hydrogen chloride

102. Avogadro explains _____. **Ans :** Gay–Lussac's law

103. Avogadro helps in the determination of _____. **Ans :** atomicity of gases

104. Avogadro derived the _____. **Ans :** molecular formula of gases

105. Avogadro determines the relation between _____ and _____.
Ans : molecular mass, vapour density

106. Avogadro helps to determine _____ (22.4 lit at STP). **Ans :** gram molar volume of gases

107. The relative molecular mass is the ratio between the mass of one molecule of the gas or vapour to mass of _____.
Ans : one atom of hydrogen

108. _____ is defined as the ratio of mass of a certain volume of a gas or vapour to the mass of an equal volume of hydrogen, measured under the same conditions of temperature and pressure.
Ans : Vapour density

109. VD = _____. **Ans :** Relative molecular mass / 2

110. VD = _____. **Ans :** RMM / 2

111. VD = _____. **Ans :** Molecular weight / 2

112. 2 × VD = _____. **Ans :** RMM

113. Gram molar mass of _____ = 18 g. **Ans :** water

114. Gram molar mass of CO_2 = _____. **Ans :** 44 g

115. Gram molar Mass of _____ =308 g. **Ans :** $Ca_3(PO_4)_2$

116. Gram Molar mass of H_2SO_4 = _____. **Ans :** 98 g

117. Atomicity of _____ = 2. **Ans :** Chlorine

118. Atomicity of _____ = 2. **Ans :** Nitrogen

119. Atomicity of _____ = 2. **Ans :** Oxygen

120. Atomicity of _____ = 3. **Ans :** Ozone

121. Atomicity of _____ = 4. **Ans :** Phosphorous

122. Atomicity of _____ = 8. **Ans :** Sulphur

123. _____ is made up atoms. **Ans :** Matter

124. An atom is no longer _____. **Ans :** indivisible

125. E = _____. **Ans :** MC^2

126. The mass of an atom is measured in _____ (amu). **Ans :** atomic mass unit

127. Relative atomic mass is measured in _____ (amu). **Ans :** Standard Atomic Weight

128. Atomic mass of an element is expressed in terms of grams is called _____. **Ans :** Gram Atomic Mass

129. The number of atoms present in the one molecule of an element is called _____. **Ans :** Atomicity

130. Avogadro number is denoted as _____. **Ans :** N

131. STP is equal to _____, _____. **Ans :** 273.15 K, 1.00 atm

132. Atomicity is equal to _____. **Ans :** Molecular Mass / Atomic Mass

Additional – Match the following

1.

1.	**Mono atomic molecule**	**(a)**	**O_2, N_2**
2.	**Di atomic molecule**	**(b)**	**He, Ne**
3.	**Tri atomic molecule**	**(c)**	**P_4**
4.	**Tetra atomic molecule**	**(d)**	**O_3**

Ans :

1	Mono atomic molecule	b	He, Ne
2	Di atomic molecule	a	O_2, N_2
3	Tri atomic molecule	d	O_3
4	Tetra atomic molecule	c	P_4

2.

1.	**GMM of Water**	**(a)**	**36.5 g**
2.	**GMM of CO_2**	**(b)**	**18 g**
3.	**GMM of Ammonia**	**(c)**	**44 g**
4.	**GMM of HC*l***	**(d)**	**17 g**

Ans :

1	GMM of Water	b	18 g
2	GMM of CO_2	c	44 g
3	GMM of Ammonia	d	17 g
4	GMM of HC*l*	a	36.5 g

3.

1.	**Atom**	**(a)**	**chlorine**
2.	**De–broglie**	**(b)**	**argon and calcium**
3.	**Isobars**	**(c)**	**Tri atomic**
4.	**Isotopes**	**(d)**	**poly atomic**
5.	**Hydrogen**	**(e)**	**helium**
6.	**Ozone**	**(f)**	**$6.023 \times 10_{23}$**
7.	**Phosphorus**	**(g)**	**wave**
8.	**Avogadro number**	**(h)**	**indivisible**
9.	**Mono atomic**	**(i)**	**homo di atomic**
10.	**Di atomic**	**(j)**	**cl –35, cl –37**

Ans :

1	Atom	h	indivisible
2	De–broglie	g	wave
3	Isobars	b	argon and calcium
4	Isotopes	j	cl –35, cl –37
5	Hydrogen	i	homo diatomic
6	Ozone	c	tri atomic
7	Phosphorus	d	poly atomic
8	Avogadro number	f	$6.023 \times 10_{23}$
9	Mono atomic	e	helium
10	Di atomic	a	chlorine

4.

1.	**0.5 mole of SO_2**	**(a)**	**Heisenberg**
2.	**Uncertinity principle**	**(b)**	**3.0115×10^{-23}**
3.	**Atomic mass**	**(c)**	**11.2 lit**
4.	**Volume of 16 g of oxygen at STP**	**(d)**	**atomic mass unit**

Ans :

1	0.5 mole of SO_2	b	3.0115×10^{-23}
2	Uncertinity principle	a	Heisenberg
3	Atomic mass	d	atomic mass unit
4	Volume of 16 g of oxygen at STP	c	11.2 lit

Additional – Spot the error

1. **The molecule that consist of atoms of different elements is called homo atomic molecule.**

   Ans: The molecule that consist of atoms of different elements is called hetero atomic molecule.

2. **Oxygen gas does not exist in two allotropic forms they are Oxygen and ozone.**

   Ans: Oxygen gas exist in two allotropic forms they are oxygen and ozone.

3. **Ozone contains three oxygen atoms and hence it is called homo di atomic molecule.**

   Ans: Ozone contains three oxygen atoms and hence it is called homo tri atomic molecule.

4. **Hydrogen chloride is a homo diatomic molecule.**

   Ans: Hydrogen chloride is a hetero diatomic molecule.

5. **Oxygen is a second most abundant element in the earth crust.**

   Ans: Oxygen is a first most abundant element in the earth crust.

Additional – Assertion and Reason

1. **Assertion :** A molecule is a combination of two or more atoms held together by chemical forces of attraction.
   Reason : These are formed by chemical bonds.
   a. A is right R is wrong **b. A is wrong R is right**
   c. R explains A **d. R does not explain A**

   Ans : (c) R explains A

2. **Assertion :** Homoatomic molecules are made up of atoms of the same elements.
   Reason : Hcl consist of hydrogen and chlorine.
   a. A is right R is wrong **b. A is wrong R is right**
   c. R explains A **d. R does not explain A**

   Ans : (a) A is right R is wrong

3. **Assertion :** Ammonia is a molecule.
   Reason : Ammonia is a hetero atomic molecule.
   a. A is right R is wrong **b. A is wrong R is right**
   c. R explains A **d. R does not explain A**

   Ans : (b) R explains A

4. **Assertion :** one mole of any gas occupies 22.4 litres or 22400 ml at STP.
   Reason : one mole matter contains Avogadro number of particles.
   a. A is right R is wrong **b. A is wrong R is right**
   c. R explains A **d. R does not explain A**

   Ans : (d) R does not explain A

5. **Assertion :** The volume of the gas is directly proportional to the number of molecules of the gas.
   Reason : Equal volume of all gases contain equal number of molecules.
   a. A is right R is Wrong **b. A is wrong R is right**
   c. R explains A **d. R does not explain A**

   Ans : (c) R explains A

Additional – True or False (If False give the Correct Statement

1. **The sum of the number of protons and neutrons of an atom is called its atomic number.**
   Ans : False: The sum of the number of protons and neutrons of an atom is called its mass number.
2. **The molecule that consist of atoms of different elements is called hetero atomic molecule.**
   Ans : True.
3. **If a molecule contains more than three atoms then it is called triatomic molecule.**
   Ans : False: If a molecule contains more than three atoms then it is called poly atomic molecule.
4. **One mole of oxygen contains 6.023×10^{23} molecules of oxygen and its gram molecular mass is 32 g.**
   Ans : True.
5. **The percentage composition of a compound represents the mass of each element present in 100 g of the compound.**
   Ans : True.
6. **One mole of any gas contains 22400cm^3 at STP.**
   Ans : False : One mole of any gas contains 22400 ml at STP.
7. **Avogadro law does not explains Gay Lussac's law.**
   Ans : False. Avogadro law explains Gay Lussac's law.
8. **Gay lussac law helps to determine gram molar volume of all gases.**
   Ans : False: Avogadro law helps to determine gram molar volume of all gases.
9. **Relative molecular mass is equal to 4 times of vapour density.**
   Ans : False: Relative molecular mass is equal to 2 times of vapour density.
10. **Gram molecular mass of calcium phosphate is 208 g.**
    Ans : False: Gram molecular mass of Calcium Phosphate is 308 g.

Additional – Short answer questions

1. **Define Mass number.**
   The sum of the number of protons and neutrons of an atom is called its mass number.
2. **Define RAM.**
   Relative atomic mass of an element is the ratio between the average mass of its isotopes to 1/12th part of the mass of a Carbon–12 atom. It is denoted as A. It is otherwise called as Standard Atomic Weight.

$$Ar = \frac{\text{Average mass of the Isotopes of the element}}{\frac{1}{12}\text{th of the mass of one Carbon atom}}$$

3. **Define average atomic mas of an element.**
   The average atomic mass of an element in the weighed average of the masses of its naturally occuring isotopes.
   Average atomic mass = (Mass of 1st Isotope × % abundance of 1st Isotope) + (Mass of 2nd Isotope × % abundance of 2nd Isotope)
4. **Calculate the abundance of C–12 and C–13 are 98.90% and 1.10% respectively.**

$$\text{Average atomic mass of Carbon} = 12\times\left(\frac{98.9}{100}\right)+13\times\left(\frac{1.1}{100}\right)$$
$$= 12 \times 0.989 + 13 \times 0.011$$
$$= 11.868 + 0.143$$
$$= 12.011 \text{ amu.}$$

5. **Define molecule.**
   A molecule is a combination of 2 (or) more atoms held together by strong chemical forces of attraction. i.e., chemical bonds.

6. Differentiate Homo and Hetero atomic molecule.

S.No.	Homo Atomic	Hetero Atomic
1. 2.	The molecule is made of similar kind of atoms, then it is called Homo atomic molecule. eg: H_2, Cl_2, N_2	The molecule that consist of atoms of different elements is called Hetero atomic molecule. eg: NH_3, HCl

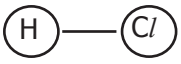
7. Define homotriatomic molecule. Give an example.

Ozone contains three oxygen atoms and hence it is called homo triatomic molecule. Eg.: O_3.

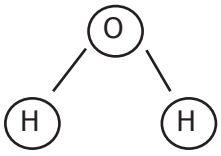
8. Define polyatomic molecule. Give an example.

If a molecule contains more than three atoms, then it is called polyatomic molecule. Eg.: P_4, S_8.

9. Draw the structure of HCl and H_2O.



HCl (Hydrogen Chloride)



Water (H_2O)

10. Define Relative Molecular Mass.

The Relative Molecular Mass of a molecule is the ratio between the mass of one molecule of the substance to 1/12th mass of an atom of Carbon–12.

11. Write the difference between atoms and molecules.

S.No.	Atom	Molecule
1.	An atom is the smallest particle of an element.	A molecule is the smallest particle of an element or compound.
2.	Atom does not exist in free state except in a noble gas.	Molecule exists in free a state.
3.	Except some of noble gas, other atoms are highly reactive.	Molecules are less reactive.
4.	Atom does not have a chemical bond.	Atoms in a molecule are held by chemical bonds.

12. Define Mole.

The mole is the amount of substance that contains as many elementary entities as there are atoms in exactly 12g of the Carbon–12 Isotope.

13. Define Avogadro number.

The actual number of atoms in 12g of Carbon–12 is determined experimentally. This is called Avogadro number and it is denoted as NA. It's value is 6.023×10^{23}.

14. How to calculate the number of moles of a substance?

- Number of moles of molecules.
- Number of moles of atoms.
- Number of moles of a gas.
- Number of moles of Ions.

15. Define Mole.

One mole of an element contains 6.023×10^{23} atoms and it is equal to its gram atomic mass. Eg.: One mole of oxygen contains 6.023×10^{23} atoms of oxygen and its Gram atomic mass is 16g.

16. Define Mole of molecules.

One mole of matter contains 6.023×10^{23} molecules and its equal to its gram molecular mass. Eg.: One mole of oxygen contains 6.023×10^{23} molecules of oxygen and its gram molecular mass is 32g.

17. Calculate the number of moles by different modes.

Number of moles = Mass / Atomic mass.
= Mass / Molecular mass.
= Number of atoms / 6.023×10^{23}.
= Number of molecules / 6.023×10^{23}.

18. Define Percent composition.

The percentage composition of the compound represents the mass of each element present is 100g of the compound.

19. State Avogadro's law.

Equal volumes of all gases under similar conditions of temperature and pressure contain equal number of molecules.

20. Define vapour density.

Vapour density is the ratio of the mass of a certain volume of gas or vapour to the mass of an equal volume of hydrogen measured under the same conditions of temperature and pressure.

Additional – Long answer questions

1. Explain Avogardo hypothesis.

The volume of any given gas must be propostional to the number of molecules in it. If 'V' is the volume, 'n' is the number of molecules of a gas, then Avogadro law is represented mathematically as follows.

$V \alpha n$

V = Constant × n.

Thus one litre (1 dm3) of hydrogen contains the same number of moecules as in one litre of oxygen. i.e., the volume of the gas is directly propostional to the number of molecules of the gas.

Explanation : Let us consider the reaction between hydrogen and chlorine to form hydrogen chloride gas.

$H_2 + Cl_2 \rightarrow 2HCl_{(g)}$
(g) (g) 2 volumes.

According to Avogadro's law, 1 volume of any gas is occupied by 'n' number of molecules.

'n' molecules + 'n' molecules → 2n molecules

if 'n' = 1 then,

1 molecule + 1 molecule → 2 molecules.

½ molecule + ½ molecule → 1 molecule.

1 molecule of hydrogen chloride gas is made up of ½ molecule of chlorine. Hence the molecules can be subdivided. This law obeys the Dalton's Atomic Theory.

2. Write the applications of Avogadro's law.

- It explains Gay – lussac's law.
- It helps in the determination of atomicity of gases.
- Molecular formula of gases can be derived from Avogadro's law.
- It determines the relation between molecular mass and vapour density.
- It helps to determine gram molar volume of all gases. (22.4 lit at STP)

SOLVED PROBLEMS

1. Boron naturally occurs as a mixture of boron-10 (5 protons + 5 neutrons) and boron-11 (5 protons + 6 neutrons) isotopes. The percentage abundance of B-10 is 20 and that of B-11 is 80. Then, the atomic mass of boron is calculated as follows :

Solution : Atomic mass of Boron $= \left(10\times\frac{20}{100}\right)+\left(11\times\frac{80}{100}\right)$

$= (10 \times 0.20) + (11 \times 0.80)$

$= 2 + 8.8$

$= 10.8$ amu.

2. Relative molecular mass of sulphuric acid (H_2SO_4) is calculated as follows: Sulphuric acid conatins 2 atoms of hydrogen, 1 atom of sulphur and 4 atoms of oxygen.

Solution : Therefore, Relative molecular mass of sulphuric acid

= (2×mass of hydrogen) + (1×mass of sulphur) + (4×mass of oxygen)

= (2 × 1) + (1 × 32) + (4 × 16)

= 98.

i.e., one molecule of H2SO4 is 98 times as heavy as $\frac{1}{12^{th}}$ of the mass of a carbon – 12.

3. Relative molecular mass of water (H_2O) is calculated as follows: A water molecule is made of 2 atoms of hydrogen and one atom of oxygen.

Solution : So, the relative molecular mass of water

= (2 × mass of hydrogen) + (1 × mass of oxygen)

= (2 × 1) + (1 × 16)

= 18.

i.e., one molecule of H2O is 18 times as heavy as $\frac{1}{12^{th}}$ of the mass of carbon – 12.

4. Find the mass percentage composition of methane (CH_4).

Solution : Molar mass of CH4 = 12 + 4 = 16 g.

Mass % carbon = $\frac{12}{16} \times 100$

= 75%.

Mass % of hydrogen = $\frac{4}{16} \times 100$

= 25%.

5. Calculation of molar mass.

Calculate the gram molar mass of the following.

i) H_2O.

Solution :

Atomic masses of H = 1, O = 16.

Gram molar mass of H_2O = (1 × 2) + (16 × 1)

= 2 + 16

Gram molar mass of H_2O = 18 g.

ii) CO_2.

Solution :

Atomic masses of C = 12, O = 16.

Gram molar mass of CO_2 = (12 × 1) + (16 × 2)

= 12 + 32

Gram molar mass of CO_2 = 44 g.

iii) $Ca_3(PO_4)_2$.

Solution :

Atomic masses of Ca = 40, P = 30, O = 16.

Gram molar mass of $Ca_3(PO_4)_2$ = (40 × 3) + [30 + (16 × 4)] × 2

= 120 + (94 × 2)

= 120 + 188

Gram molar mass of $Ca_3(PO_4)_2$ = 308 g.

6. Calculation based on number of moles from mass and volume.

i) Calculate the number of moles in 46 g of sodium?

Solution :

$$\text{Number of moles} = \frac{\text{Mass of the element}}{\text{Atomic mass of the element}}$$

$$= \frac{46}{23}$$

= 2 moles of sodium.

ii) 5.6 litre of oxygen at S.T.P

Solution :

$$\text{Number of moles} = \frac{\text{Given volume of } O_2 \text{ at S.T.P}}{\text{Molar volume at S.T.P}}$$

$$\text{Number of moles of oxygen} = \frac{5.6}{22.4}$$

= 0.25 mole of oxygen.

iii) Calculate the number of moles of a sample that contains 12.046×10^{23} atoms of iron?

Solution :

$$\text{Number of moles} = \frac{\text{Number of atoms of iron}}{\text{Avogadro's number}}$$

$$= \frac{12.046 \times 10^{23}}{6.023 \times 10^{23}}$$

= 2 moles of iron.

7. Calculation of mass from mole. Calculate the mass of the following

i) 0.3 mole of aluminium (Atomic mass of Al = 27)

Solution :

$$\text{Number of moles} = \frac{\text{Mass of Al}}{\text{Atomic mass of Al}}$$

Mass = No. of moles × atomic mass

So, mass of Al = 0.3 × 27

= 8.1 g.

ii) Calculate the number of moles in 46 g of sodium?

Solution :

Molecular mass of SO_2 = 32 + (16 × 2)

= 32 + 32 = 64.

$$\text{Number of moles of } SO_2 = \frac{\text{Given volume of } SO_2 \text{ at S.T.P}}{\text{Molar volume of } SO_2 \text{ at S.T.P}}$$

$$\text{Number of moles of } SO_2 = \frac{2.24}{22.4}$$

= 0.1 mole.

$$\text{Number of moles} = \frac{\text{Mass}}{\text{Molecular mass}}$$

Mass = No. of moles × molecular mass

Mass = 0.1 × 64

Mass of SO_2 = 6.4 g.

iii) 1.51×10^{23} molecules of water

Solution :

Molecular mass of H_2O = 18

$$\text{Number of moles} = \frac{\text{Number of molecules of water}}{\text{Avogadro's number}}$$

= $1.51 \times 10^{23} / 6.023 \times 10^{23}$

= 1/4

$= 0.25$ mole.

$$\text{Number of moles} = \frac{\text{Mass}}{\text{Molecular mass}}$$

$0.25 = \text{mass} / 18$

$\text{Mass} = 0.25 \times 18$

$\text{Mass} = 4.5$ g.

iv) 5×10^{23} molecules of glucose?

Solution :

Molecular mass of glucose $= 180$

$$\text{Mass of glucose} = \frac{\text{Molecular mass} \times \text{number of particles}}{\text{Avogadro's number}}$$

$= (180 \times 5 \times 10^{23}) / 6.023 \times 10^{23}$.

$= 149.43$ g.

8. Calculation based on number of atoms/molecules.

i) Calculate the number of molecules in 11.2 litre of CO_2 at S.T.P

Solution :

$$\text{Number of moles of } CO_2 = \frac{\text{Volume at S.T.P}}{\text{Molar volume}}$$

$= 11.2 / 22.4$

$= 0.5$ mole.

Number of molecules of CO_2 = number of moles $CO_2 \times$ Avogadro's number.

$= 0.5 \times 6.023 \times 10^{23}$.

$= 3.011 \times 10^{23}$ molecules of CO_2.

ii) Calculate the number of atoms present in 1 gram of gold (Atomic mass of Au = 198)

Solution :

$$\text{Number of atoms of Au} = \frac{\text{Mass of Au} \times \text{Avogadro's number}}{\text{Atomic mass of Au}}$$

$$\text{Number of atoms of Au} = \frac{1}{198} \times 6.023 \times 10^{23}$$

Number of atoms of Au $= 3.042 \times 10^{23}$ g.

iii) Calculate the number of molecules in 54 gm of H_2O?

Solution :

$$\text{Number of molecules} = \frac{(\text{Avogadro number} \times \text{Given mass})}{\text{Gram molecular mass}}$$

No. of molecules of water $= 6.023 \times 10^{23} \times 54 / 18.$

$= 18.069 \times 10^{23}$ molecules.

iv) Calculate the number of atoms of oxygen and carbon in 5 moles of CO_2.

Solution :

- 1 mole of CO_2 contains 2 moles of oxygen.
- 5 moles of CO_2 contains 10 moles of oxygen.

Number of atoms of oxygen = Number of moles of oxygen × Avogadro's number

$= 10 \times 6.023 \times 10^{23}$

$= 6.023 \times 10^{24}$ atoms of oxygen.

- 1 mole of CO_2 contains 1 mole of carbon.
- 5 moles of CO_2 contains 5 moles of carbon.

No. of atoms of carbon = No. of moles of carbon × Avogadro's number.

$= 5 \times 6.023 \times 10^{23}$.

$= 3.011 \times 10^{24}$ atoms of carbon.

9. Calculation based on molar volume. Calculate the volume occupied by:

i) 2.5 mole of CO_2 at S.T.P.

Solution :

$$\text{Number of moles of } CO_2 = \frac{\text{Given volume at S.T.P}}{\text{Molar volume at S.T.P}}$$

$$2.5 \text{ mole of } CO_2 = \frac{\text{Volume of } CO_2 \text{ at S.T.P}}{22.4}$$

$$\text{Volume of } CO_2 \text{ at S.T.P} = 22.4 \times 2.5$$
$$= 56 \text{ litres.}$$

ii) 3.011×10^{23} of ammonia gas molecules.

Solution :

$$\text{Number of moles} = \frac{\text{Number of molecules}}{\text{Avogadro's number}}$$
$$= 3.011 \times 10^{23} / 6.023 \times 10^{23}.$$
$$= 2 \text{ moles.}$$
$$\text{Volume occupied by } NH_3 = \text{number of moles} \times \text{molar volume}$$
$$= 2 \times 22.4$$
$$= 44.8 \text{ litres at S.T.P.}$$

iii) 14 g nitrogen gas.

Solution :

$$\text{Number of moles} = 14 / 28.$$
$$= 0.5 \text{ mole}$$
$$\text{Volume occupied by } N_2 \text{ at S.T.P} = \text{no. of moles} \times \text{molar volume}$$
$$= 0.5 \times 22.4$$
$$= 11.2 \text{ litres.}$$

10. Calculation based on % composition. Calculate % of S in H_2SO_4.

Solution :

$$\text{Molar mass of } H_2SO_4 = (1 \times 2) + (32 \times 1) + (16 \times 4)$$
$$= 2 + 32 + 64$$
$$= 98 \text{ g}$$
$$\% \text{ of S in } H_2SO_4 = \frac{\text{Mass of sulphur}}{\text{Molar mass of } H_2SO_4} \times 100$$
$$\% \text{ of S in } H_2SO_4 = \frac{32}{98} \times 100$$
$$= 32.65\%.$$

UNIT TEST - 7

Time : 1.15 Hrs. Marks : 50

I. Choose the best answer (5 × 1 = 5)

1. Which of the following is a triatomic molecule?

a) Glucose b) Helium c) Carbondioxide d) hydrogen

2. The volume occupied by 4.4 g of CO_2 at STP _____.

a) 22.4 lit b) 2.24 lit c) 0.24 lit d) 0.1 lit

3. Mass of 1 mole of Nitrogen atom is _____.

a) 28amu b) 14amu c) 28g d) 14g

4. The gram molecular mass of oxygen molecule is _____.

a) 16g b) 18g c) 32g d) 17g

5. The volume occupied by 1 mole of a diatomic gas at STP is _____.

a) 11.2 lit b) 22.4 lit c) 44.8 lit d) 5.6lit

II. Fill in the blanks

(5 × 1 = 5)

6. The first scientific theory of the atom was proposed by _____.
7. The sum of the number of protons and neutrons of an atom is called its _____.
8. The number of atoms present in the molecule is called _____.
9. _____ was proposed the Avogadro number
10. One mole of substance contains _____.

III. State whether the statements are true or false. Correct the false statement

(4 × 1 = 4)

11. The sum of the number of protons and neutrons of an atom is called its atomic number
12. The molecule that consist of atoms of different elements is called hetero atomic molecule
13. If a molecule contains more than three atoms then it is called triatomic molecule
14. One mole of oxygen contains 6.023×10^{23} molecules of oxygen and its gram molecular mass is 32 g

IV. Match the following

(4 × 1 = 4)

15.	0.5 mole of So2	(a)	heisenberg
16.	Uncertinity principle	(b)	3.0115×10^{-23}
17.	Atomic mass	(c)	11.2 lit
18.	Volume of 16g of oxygen at STP	(d)	Atomic mass unit

V. Assertion and Reasoning

(3 × 1 = 3)

Direction: In each of the following questions, a statement of Assertion is given and a corresponding statement of Reason is given just below it. Of the statements given below, mark the correct answer as

a. If both A and R are true and R is the correct explanation of A.

b. If both A and R are true but R is not the correct explanation of A.

c. If A is true but R is false.

d. If both A and R are false.

19. **Assertion:** A molecule is a combination of two or more atoms held together by chemical forces of attraction.
Reason: These are formed by chemical bonds.

20. **Assertion:** Homoatomic molecules are made up of atoms of the same elements.
Reason: Hcl consist of hydrogen and chlorine.

21. **Assertion:** Ammonia is a molecule.
Reason: Ammonia is a hetero atomic molecule.

VI. Write the answer for the following questions in word or sentence (3 × 1 = 3)

22. Define atomicity.
23. Define Average atomic mass.
24. Define atom.

VII. Find the odd one out (3 × 1 = 3)

25. $_{17}Cl^{35}$ $_{17}Cl^{37}$, $_{18}Ar^{40}$ $_{20}Ca^{40}$, $_{1}H^{1}$ $_{1}H^{2}$ $_{1}H^{3}$.
26. Fluorine, Hydrogen, Sulphur, Carbondioxide
27. Ammonia, Methane, Sulphuric acid, Phosphorus

VIII. Correct the mistakes (3 × 1 = 3)

28. The molecule that consist of atoms of different elements is called homo atomic molecule.
29. Ozone contains three oxygen atoms and hence it is called homo di atomic molecule.
30. Oxygen is a second most abundant element in the earth crust.

IX. Write the short answer for ANY 5 of the following questions. (5 × 2 = 10)

31. Define Relative atomic mass.
32. Write the different types of isotopes of oxygen and its percentage abundance.
33. Define Atomicity.
34. What is the molar volume of a gas.
35. Give any 2 examples of Homo and Hetero atomic molecules.
36. Find the percentage of nitrogen in ammonia.
37. Calculate the % of each element in calcium carbonate (Atomic mass C–12, O–16, Ca–40).

X. Write long answer for the following questions (2 × 5 = 10)

38. Calculate the number of water molecules present in one drop of water which weighs 0.18g.

[OR]

39 Give the salient features of Modern Atomic theory.

40. Derive the relationship between VD and RMM.

[OR]

41 Write the Applications of Avogadro's law.

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