MOLE CONCEPT

1. SIGNIFICANT FIGURES

(A) Every scientific observation involves some degree of uncertainity depending upon the limitation of instrument. To repr esent scientific data, role of significant figures has its own importance.

(B) Significant figures are equal to the number of digits in numbers with last digit uncertain and rest all are certain digits i.e. all the digits of datum including the uncertain one , are called significant figures.

(C) **Rules for determination significant figure:**

(i) All non zero digits are significant.

Example : 3.14 has three significant figures

(ii) The zeros to the right of the decimal point are significant.

Example : 3.0 has two significant figures.

(iii) The zeros to the left of the first non zero digit in a number are not significant.

Example : 0.02 has one significant figure.

(iv) The zeros between two non zero digits are also significant.

Example : 6.01 has three significant figures.

(v) **Exponential form :** $N \times 10^n$. Where N show the significant figure.

Example : 1.86×10^4 has three significant figure.

(vi) **Rounding off the uncertain digit :**

(a) If the left most digit to be rounded off is more than 5 , the preceding number is increased by one.

Example : 2.16 is rounded to 2.2

(b) If the left most digit to be rounded off is less than 5 , the preceding number is retained.

Example : 2.14 is rounded off to 2.1

(c) If the left most digit to be rounded off is equal to 5 , the preceding number is not changed if it is even and increased by one if it is odd.

Example : 3.25 is rounded off to 3.2

2.35 is round off to 2.4

2. TYPES OF MIXTURE

2.1 Heterogenous mixture

A mixture in which the different constituents are not distributed uniformly is known as heterogenous mixture. eg Water

2.2 Homogenous mixture

A mixture in which the different constituents are uniformly distributed is known as homogenous mixture. eg. O_2, N_2 etc.

3. LAWS OF CHEMICAL COMBINATION

3.1 Law of conservation of mass-[Lavoisier, 1744]

(a) According to this law , matter is neither created nor destroyed in the course of chemical reaction although it may change from one form to other

(b) This law contradicts nuclear reactions where Einestein equation is applicable

(c) According to this law , sum of the masses of product formed is always equal to the sum of the masses of the reactant undergone change

Example :

$$\begin{array}{ccccc} H_2 & + & Cl_2 & \rightarrow & 2HCl \\ 2gm & & 71\ gm & & 2\,[1 + 35.5] \end{array}$$

$$\underbrace{2gm \quad 71\ gm}_{\Rightarrow\ 73\ gm} \equiv 73\ gm$$

3.2 Law of definite proportion [Proust, 1799]

(a) According to the law , the composition of a compound always remains a constant i.e. the ratio of weights of different elements in a compound ; no matter by whatever method , it is prepared or obtained from different sources, remains always a constant

Example : In H_2O ratio of weight = 1 : 8

In CO_2 ratio of weight = 3 : 8

3.3 Law of multiple proportion [John Dalton, 1804]

According to this law, when two elements A and B combine to form more than one chemical compound then different weights of A , which combine with a fixed weight of B , are in a proportion of simple whole number

MATTER

- Homogenous (Composition uniform)
  - Elements (only one type of atoms)
  - Compounds
    * only one type of molecules
    * Different type of atoms but composition is uniform
- Heterogeneous (Composition nonuniform)
  - Mixture
    * Different type molecules of composition of them is not fixed and can be sometimes separated

Example : CO & CO_2

12 : 16 & 12 : 32

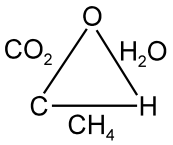
ratio = 16 : 32

= 1 : 2

3.4 Law of reciprocal proportions [Ritche,1792-94]

When two elements combines separately with third element and form different types of molecules, their combining ratio is directly reciprocated if they combine directly

Example :



C with H form methane and with O form CO_2. In CH_4 , 12 grams of C reacts with 4 grams of H whereas in CO_2 12 gram of C reacts with 32 grams of O. Therefore when H combines with O they should combine in the ratio of 4 : 32 (i.e. = 1 : 8) or in simple multiple of it. The same is found to be true in H_2O molecule. The ratio of weights of H and O in Water is 1 : 8

3.5 Gay-Lussac's [1808] law of combining volumes

This law states that under similar conditions of pressure and temperature, volume ratio of gases is always in terms of simple integers.

Ex.

$$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$$

vol. ratio 1 : 3 : 2

4. AVOGADRO'S HYPOTHESIS

According to this under similar conditions of pressure and temperature , equal volumes of gases contain equal number of molecules.

4.1 Salient features of Avogadro's hypothesis

(1) It has removed the anomaly between Dalton's atomic theory and Gay Lussac's law of volume by making a clear distinction in between atoms and molecules

(2) It reveals that common elementary gases like hydrogen , nitrogen , oxygen etc. are diatomic

(3) It provides a method to determine the atomic weights of gaseous elements

(4) It provides a relationship between vapour density and molecular weight of substances

Vapour density

$$= \frac{\text{Volume of definite amount of Gas}}{\text{Volume of same amount of Hydrogen}}$$

or Vapour density

$$= \frac{\text{Weight of n molecules of Gas}}{\text{Weight of n molecules of Hydrogen}}$$

or Vapour density

$$= \frac{\text{Weight of one molecule of Gas}}{\text{Weight of one atom of hydrogen} \times 2}$$

or Vapour density $= \dfrac{\text{Molecular weight}}{2}$

(5) It helps to determine molar volume

Molecular weight of the gas

= 2 × vapour density

$$= 2 \times \frac{\text{Weight of 1 litre of the Gas at S.T.P}}{\text{Weight of 1 litre of Hydrogen at S.T.P}}$$

$$= 2 \times \frac{\text{Weight of 1 litre of the Gas at S.T.P}}{0.089 \text{ gm}}$$

$$= \frac{2}{0.089} \times \text{Weight of 1 litre of the gas at S.T.P.}$$

= 22.4 × Weight of 1 litre of gas at S.T.P.

= Weight of 22.4 litre of the gas at S.T.P

5. ATOM, MOLECULES AND MOLECULAR FORMULA

Atom: It is the smallest particle of an element that takes part in a chemical reaction and not capable of independent existence.

Molecule : It is the smallest particle of matter which is capable of independent existence. A molecule is generaly an assembly of two or more tightly bonded atoms.

Homoatomic molecules : Molecules of an element contain one type of atoms. eg. O_2, Cl_2 etc.

Heteroatomic molecules : Molecules of compounds contain more that one type of atom. eg. H_2O, HCl etc

5.1 Atomic mass scale

(A) Oxygen as standard : The standard reference for atomic weight may be oxygen with an assigned value of 16.

Atomic weight of an element

$$= \frac{\text{Weight of 1 atom of element}}{1/16 \times \text{Weight of 1 atom of oxygen}}$$

(B) Carbon as standard : The modern reference standard for atomic weight is carbon isotope of mass number 12.

Atomic weight of an element

$$= \frac{\text{Weight of 1 atom of the element}}{1/12 \times \text{Weight of 1 atom of C-12}}$$

IMPORTANT POINTS

(1) Atomic weight is not a weight but a number.

(2) Atomic weight is not absolute but relative to the weight of the standard reference element C-12

SOLVED PROBLEMS

Ex.1 8 litre of H_2 and 6 litre of Cl_2 are allowed to react to maximum possible extent. Find out the final volume of reaction mixture. Suppose P and T remains constant throughout the course of reaction

(A) 7 litre **(B) 14 litre**
(C) 2 litre **(D) None of these.**

Sol. (B)

$H_2 + Cl_2 \rightarrow 2\ HCl$

Volume before reaction 8 lit 6 lit 0

Volume after reaction 2 0 12

$\therefore$ Volume after reaction

= Volume of H_2 left + Volume of HCl formed

= 2 + 12 = 14 lit

Ex.2 Naturally occurring chlorine is 75.53% Cl^{35} which has an atomic mass of 34.969 amu and 24.47% Cl^{37} which has a mass of 36.966 amu. Calculate the average atomic mass of chlorine -

(A) 35.5 amu **(B) 36.5 amu**
(C) 71 amu **(D) 72 amu**

Sol. (A)

Average atomic mass

$$= \frac{\text{\% of I isotope} \times \text{its atomic mass} + \text{\% of II isotope} \times \text{its atomic mass}}{100}$$

$$= \frac{75.53 \text{x} 34.969 + 24.47 \text{x} 36.96}{100} = 35.5 \text{ amu.}$$

Ex.3 Calculate the mass in gm of 2g atom of Mg-

(A) 12 gm **(B) 24 gm**
(C) 6 gm **(D) None of these.**

Sol. (D)

$\because$ 1 gm atom of Mg has mass = 24 gm

$\therefore$ 2 gm atom of Mg has mass

= 24 x 2 = 48 gm.

Ex.4 In 5 g atom of Ag (At. wt. of Ag = 108), calculate the weight of one atom of Ag -

(A) 17.93×10^{-23}gm **(B) 16.93×10^{-23} gm**
(C) 17.93×10^{23} gm **(D) 36×10^{-23} gm**

Sol. (A)

$\because$ N atoms of Ag weigh 108 gm

$\therefore$ 1 atom of Ag weigh $= \frac{108}{N}$

$= \frac{108}{6.023 \text{x} 10^{23}} = 17.93 \times 10^{-23}$ gm.

Ex.5 In 5g atom of Ag (at. wt. = 108), calculate the no. of atoms of Ag -

(A) 1 N **(B) 3N** **(C) 5 N** **(D) 7 N.**

Sol. (C)

$\because$ 1 gm atom of Ag has atoms = N

$\therefore$ 5 gm atom of Ag has atoms = 5N.

Ex.6 Calculate the mass in gm of 2N molecules of CO_2 -

(A) 22 gm **(B) 44 gm**
(C) 88 gm **(D) None of these.**

Sol. (C)

$\because$ N molecules of CO_2 has molecular mass = 44.

$\therefore$ 2N molecules of CO_2 has molecular mass

= 44 x 2 = 88 gm.

Ex.7 How many carbon atoms are present in 0.35 mol of $C_6H_{12}O_6$ -

(A) 6.023×10^{23} carbon atoms
(B) 1.26×10^{23} carbon atoms
(C) 1.26×10^{24} carbon atoms
(D) 6.023×10^{24} carbon atoms

Sol. (C)

$\therefore$ 1 mol of $C_6H_{12}O_6$ has = 6 N atoms of C

$\therefore$ 0.35 mol of $C_6H_{12}O_6$ has

= 6 × 0.35 N atoms of C

= 2.1 N atoms

= $2.1 \times 6.023 \times 10^{23} = 1.26 \times 10^{24}$ carbon atoms

Ex.8 How many molecules are in 5.23 gm of glucose ($C_6H_{12}O_6$) -

(A) 1.65×10^{22} **(B) 1.75×10^{22}**
(C) 1.75×10^{21} **(D) None of these**

Sol. (B)

$\because$ 180 gm glucose has = N molecules

$\therefore$ 5.23 gm glucose has $= \frac{5.23 \times 6.023 \times 10^{23}}{180}$

= 1.75×10^{22} molecules

Ex.9 What is the weight of 3.01×10^{23} molecules of ammonia -

(A) 17 gm **(B) 8.5 gm**
(C) 34 gm **(D) None of these**

Sol. (B)

$\because$ 6.023×10^{23} molecules of NH_3 has weight

= 17 gm

$\therefore$ 3.01 × 10^{23} molecules of NH_3 has weight

$$= \frac{17 \times 3.01 \times 10^{23}}{6.023 \times 10^{23}} = 8.50 \text{ gm}$$

Ex.10 How many significant figures are in each of the following numbers -

(a) 4.003 (b) 6.023 × 10^{23} (c) 5000

(A) 3, 4, 1 ***(B) 4, 3, 2***

(C) 4, 4, 4 ***(D) 3, 4, 3***

Sol. (C)

Ex.11 How many molecules are present in one mℓ of water vapours at STP -

(A) 1.69 × 10^{19} ***(B) 2.69 × 10^{-19}***

(C) 1.69 × 10^{-19} ***(D) 2.69 × 10^{19}***

Sol. (D)

$\because$ 22.4 litre water vapour at STP has

= 6.023 × 10^{23} molecules

$\therefore$ 1 × 10^{-3} litre water vapours at STP has

$$= \frac{6.023 \times 10^{23}}{22.4} \times 10^{-3} = 2.69 \times 10^{+19}$$

Ex.12 How many years it would take to spend Avogadro's number of rupees at the rate of 1 million rupees in one second -

(A) 19.098 × 10^{19} years

(B) 19.098 years

(C) 19.098 × 10^{9} years

(D) None of these

Sol. (C)

$\because$ 10^6 rupees are spent in 1sec.

$\therefore$ 6.023 × 10^{23} rupees are spent in

$$= \frac{1 \times 6.023 \times 10^{23}}{10^6} \text{ sec}$$

$$= \frac{1 \times 6.023 \times 10^{23}}{10^6 \times 60 \times 60 \times 24 \times 365} \text{ years}$$

= 19.098 × 10^9 year

Ex.13 An atom of an element weighs 6.644 × 10^{-23} g. Calculate g atoms of element in 40 kg-

(A) 10 gm atom ***(B) 100 gm atom***

(C) 1000 gm atom ***(D) 10^4 gm atom***

Sol. (C)

$\because$ weight of 1 atom of element

= 6.644 × 10^{-23} gm

$\therefore$ weight of 'N' atoms of element

= 6.644 × 10^{-23} × 6.023 × 10^{23} = 40 gm

$\because$ 40 gm of element has 1 gm atom.

$\therefore$ 40 x 10^3 gm of element has $\frac{40 \times 10^3}{40}$

= 10^3 gm atom.

Ex.14 Calculate the number of Cl^- and Ca^{+2} ions in 222 g anhydrous $CaCl_2$ -

(A) 2N ions of Ca^{+2} 4 N ions of Cl^-

(B) 2N ions of Cl^- & 4N ions of Ca^{+2}

(C) 1N ions of Ca^{+2} & 1N ions of Cl^-

(D) None of these.

Sol. (A)

$\because$ mol. wt. of $CaCl_2$ = 111 g

$\because$ 111 g $CaCl_2$ has = N ions of Ca^{+2}

$\therefore$ 222g of $CaCl_2$ has $\frac{N \times 222}{111}$

= 2N ions of Ca^{+2}

Also $\because$ 111 g $CaCl_2$ has = 2N ions of Cl^-

$\therefore$ 222 g $CaCl_2$ has = $\frac{2N \times 222}{111}$ ions of Cl^-

= 4N ions of Cl^- .

Ex.15 The density of O_2 at NTP is 1.429g / litre. Calculate the standard molar volume of gas-

(A) 22.4 lit. ***(B) 11.2 lit***

(C) 33.6 lit ***(D) 5.6 lit.***

Sol. (A)

$\because$ 1.429 gm of O_2 gas occupies volume = 1 litre.

$\therefore$ 32 gm of O_2 gas occupies = $\frac{32}{1.429}$

= 22.4 litre/mol.

Ex.16 Which of the following will weigh maximum amount-

(A) 40 g iron

(B) 1.2 g atom of N

(C) 1 × 10^{23} atoms of carbon

(D) 1.12 litre of O_2 at STP

Sol. (A)

(A)Mass of iron = 40 g

(B) Mass of 1.2 g atom of

N = 14 × 1.2 = 16.8 gm

(C) Mass of 1 × 10^{23} atoms of C

$$= \frac{12 \times 1 \times 10^{23}}{6.023 \times 10^{23}} = 1.99 \text{ gm.}$$

(D) Mass of 1.12 litre of O_2 at STP

$$= \frac{32 \times 1.2}{22.4} = 1.6 \text{ g}$$

Ex.17 How many moles of potassium chlorate to be heated to produce 11.2 litre oxygen -

(A) $\frac{1}{2}$ ***mol*** ***(B)*** $\frac{1}{3}$ ***mol***

(C) $\frac{1}{4}$ ***mol*** ***(D)*** $\frac{2}{3}$ ***mol.***

Sol. (B)

$2\,KClO_3 \rightarrow 2KCl + 3O_2$

Mole for reaction

∵ 3 × 22.4 litre O_2 is formed by 2 mol $KClO_3$

∴ 11.2 litre O_2 is formed by $\frac{2 \times 11.2}{3 \times 22.4}$

$= \frac{1}{3}$ mol $KClO_3$

Ex.18 Calculate the weight of lime (CaO) obtained by heating 200 kg of 95% pure lime stone ($CaCO_3$).

(A) 104.4 kg ***(B) 105.4 kg***

(C) 212.8 kg ***(D) 106.4 kg***

Sol. (D)

∵ 100 kg impure sample has pure $CaCO_3$ = 95 kg

∴ 200 kg impure sample has pure $CaCO_3$

$$= \frac{95 \times 200}{100} = 190 \text{ kg.}$$

$CaCO_3 \rightarrow CaO + CO_2$

∵ 100 kg $CaCO_3$ gives CaO = 56 kg.

∴ 190 kg $CaCO_3$ gives CaO = $\frac{56 \times 190}{100}$ = 106.4 kg.

Ex.19 The chloride of a metal has the formula MCl_3. The formula of its phosphate will be-

(A) M_2PO_4

(B) MPO_4

(C) M_3PO_4

(D) $M(PO_4)_2$

Sol. (B) $AlCl_3$ as it is $AlPO_4$

Ex.20 A silver coin weighing 11.34 g was dissolved in nitric acid. When sodium chloride was added to the solution all the silver (present as $AgNO_3$) was precipitated as silver chloride. The weight of the precipitated silver chloride was 14.35 g. Calculate the percentage of silver in the coin -

(A) 4.8 % ***(B) 95.2%***

(C) 90 % ***(D) 80%***

Sol. (B)

$\underset{108}{Ag} + 2HNO_3 \rightarrow AgNO_3 + NO_2 + H_2O$

$AgNO_3 + NaCl \rightarrow \underset{143.5}{AgCl} + NaNO_3$

∴ 143.5 gm of silver chloride would be precipitated by 108 g of silver.

or 14.35 g of silver chloride would be precipitated 10.8 g of silver.

∵ 11.34 g of silver coin contain 10.8 g of pure silver.

∴ 100 g of silver coin contain $\frac{10.8}{11.34} \times 100 = 95.2$ %.

Q.1 Mass of 1 atom of Hydrogen is -
(A) 1.66×10^{-24} g (B) 10^{-22} g
(C) 10^{-23} g (D) 10^{-25} g

Q.2 Which of the following contains the largest number of atoms -
(A) 11g of CO_2 (B) 4g of H_2
(C) 5g of NH_3 (D) 8g of SO_2

Q.3 Four containers of 2L capacity contains dinitrogen as described below. Which one contains maximum number of molecules under similar conditions.
(A) 2.5 gm-molecules of N_2
(B) 4 gm-atom of nitrogen
(C) 3.01×10^{24} N atoms
(D) 84 gm of dinitrogen

Q.4 What is correct for 10 g of $CaCO_3$ -
(A) It contains 1g-atom of carbon
(B) It contains 0.3 g-atoms of oxygen
(C) It contains 12 g of calcium
(D) None of these

Q.5 The total number of electrons present in 18 mL water (density 1 g/mL) is -
(A) 6.023×10^{23} (B) 6.023×10^{24}
(C) 6.023×10^{25} (D) 6.023×10^{21}

Q.6 4.0 g of caustic soda (mol mass 40) contains same number of sodium ions as are present in-
(A) 10.6 g of Na_2CO_3 (mol. mass 106)
(B) 58.5 g of NaCl (Formula mass 58.5)
(C) 100 ml of 0.5 M Na_2SO_4 (Formula mass 142)
(D) 1mol of $NaNO_3$ (mol. mass 85)

Q.7 No. of oxalic acid molecules in 100 ml of 0.02 N oxalic acid is -
(A) 6.023×10^{20} (B) 6.023×10^{21}
(C) 6.023×10^{22} (D) 6.023×10^{23}

Q.8 One atom of an element 'X' weighs 6.664×10^{-23} gm. The number of gram atoms in 40 kg of it is -
(A) 10 (B) 100
(C) 10000 (D) 1000

Q.9 The number of oxygen atoms present in 14.6 g of magnesium bicarbonate $[Mg(HCO_3)_2]$ is
(A) $6N_A$ (B) $0.6N_A$
(C) N_A (D) $0.5\ N_A$

Q.10 One mole of P_4 molecules contains -
(A) 1 molecule
(B) 4 molecules
(C) $1/4 \times 6.022 \times 10^{23}$ atoms
(D) 24.088×10^{23} atoms

Q.11 The total number of protons , electrons and neutrons in 12gm of $_6C^{12}$ is -
(A) 1.084×10^{25} (B) 6.022×10^{23}
(C) 6.022×10^{22} (D) 18

Q.12 The number of sodium atoms in 2 moles of sodium ferrocyanide $Na_4[Fe(CN)_6]$, is-
(A) 2 (B) 6.023×10^{23}
(C) $8 \times 6.02 \times 10^{23}$ (D) $4 \times 6.02 \times 10^{23}$

Q.13 Out of 1.0 g dioxygen, 1.0 g (atomic) oxygen and 1.0 g of ozone, the maximum number of oxygen atoms are contained in -
(A) 1.0 g of atomic oxygen.
(B) 1.0 g of ozone.
(C) 1.0 g of oxygen gas.
(D) All contain same number of atoms.

Q.14 Number of Ca^{+2} and Cl^- ion in 111 g of anhydrous $CaCl_2$ are -
(A) N_A, $2N_A$ (B) $2N_A$, N_A
(C) N_A, N_A (D) None

Q.15 2 moles of H_2 at NTP occupy a volume of
(A) 11.2 litre (B) 44.8 litre
(C) 2 litre (D) 22.4 litre

Q.16 4.48 litres of methane at N.T.P. correspond to-
(A) 1.2×10^{22} molecules of methane
(B) 0.5 mole of methane
(C) 3.2 gm of methane
(D) 0.1 mole of methane

Q.17 The weight of a substance that displaces 22.4 litre air at NTP is -
(A) Mol. wt. (B) At. wt.
(C) Eq. wt. (D) all

Q.18 Mol. wt. = vapour density × 2, is valid for -
(A) metals (B) non metals
(C) solids (D) gases

Q.19 5.6 litre of a gas at N.T.P. weighs equal to 8 gm the vapour density of gas is -
(A) 32 (B) 16
(C) 8 (D) 40.

Q.20 The maximum volume at N.T.P. is occupied by-

(A) 12.8 gm of SO_2
(B) 6.02×10^{22} molecules of CH_4
(C) 0.5 mol of NO_2
(D) 1 gm-molecule of CO_2

Q.21 Equal masses of O_2, H_2 and CH_4 are taken in a container. The respective mole ratio of these gases in container is -
(A) 1 : 16 : 2 (B) 16 : 1 : 2
(C) 1 : 2 : 16 (D) 16 : 2 : 1

Q.22 Number of moles of water in 488 gm of $BaCl_2.2H_2O$ are - (Ba = 137)
(A) 2 moles (B) 4 moles
(C) 3 moles (D) 5 moles

Q.23 16 gm of SO_x occupies 5.6 litre at STP. Assuming ideal gas nature, the value of x is -
(A) 1 (B) 2
(C) 3 (D) None of these

Q.24 The density of air is 0.001293 gm/ml at S.T.P. It's vapour density is -
(A) 143 (B) 14.3
(C) 1.43 (D) 0.143

Q.25 The percentage of nitrogen in urea is about-
(A) 38.4 (B) 46.6
(C) 59.1 (D) 61.3

Q.26 The mass of carbon present in 0.5 mole of $K_4[Fe(CN)_6]$ is -
(A) 1.8 gm (B) 18 gm
(C) 3.6 gm (D) 36 gm

Q.27 1.2 gm of Mg (At. mass 24) will produce MgO equal to -
(A) 0.05 mol (B) 40 gm
(C) 40 mg (D) 4 gm

Q.28 Insulin contains 3.4% sulphur by mass. What will be the minimum molecular weight of insulin -
(A) 94.117 (B) 1884
(C) 941 (D) 976

Q.29 The percent of N in 66% pure $(NH_4)_2\ SO_4$ sample is -
(A) 32 (B) 28
(C) 14 (D) None of these

Q.30 The chloride of a metal contains 71% chlorine by weight and the vapour density of it is 50. The atomic weight of the metal will be -
(A) 29 (B) 58 (C) 35.5 (D) 71

Q.31 The haemoglobin of most mammals contains approximately 0.33% of iron by mass. The molecular mass of haemoglobin is 67200. The number of iron atoms in each molecule of haemoglobin is-
(A) 3 (B) 4 (C) 2 (D) 6

Q.32 A compound was found to contain 5.37% nitrogen by mass. What is the minimum molecular weight of compound-
(A) 26.07 (B) 2.607
(C) 260.7 (D) None

Q.33 An element (A) (at wt = 75) and another element (B) (at. wt. = 25) combine to form a compound. The compound contains 75% (A) by weight. The formula of the compound will be -
(A) A_2B (B) A_3B
(C) AB_3 (D) AB

Q.34 The empirical formula of a compound is CH. Its molecular weight is 78. The molecular formula of the compound will be -
(A) C_2H_2 (B) C_3H_3
(C) C_4H_4 (D) C_6H_6

Q.35 An oxide of a metal (M) contains 40% by mass of oxygen. Metal (M) has atomic mass of 24. The empirical formula of the oxide is-
(A) M_2O (B) MO
(C) M_2O_3 (D) M_3O_4

Q.36 Two oxides of Metal contain 27.6% and 30% oxygen respectively. If the formula of first oxide is M_3O_4 then formula of second oxide is
(A) MO (B) M_2O
(C) M_2O_3 (D) MO_2

Q.37 The formula which represents the simple ratio of atoms in a compound is called -
(A) molecular formula
(B) structural formula
(C) empirical formula
(D) rational formula

Q.38 On analysis, a certain compound was found to contain 254 gm of iodine (at. mass 127) and 80 gm oxygen (at. mass 16). What is the formula of the compound -
(A) IO (B) I_2O
(C) I_5O_3 (D) I_2O_5

Q.39 14g of element X combine with 16g of oxygen. On the basis of this information, which of the following is a correct statement :
(A) The element X could have an atomic weight of 7 and its oxide formula XO
(B) The element X could have an atomic weight of 14 and its oxide the formula X_2O
(C) The element X could have an atomic weight of 7 and its oxide is X_2O
(D) The element X could have an atomic weight of 14 and its oxide is XO_2

Q.40 A mixture containing 100 gm H_2 and 100 gm O_2 is ignited so that water is formed according to the reaction, $2H_2 + O_2 \rightarrow 2H_2O$; How much water will be formed -
(A) 113 gm (B) 50 gm
(C) 25 gm (D) 200 gm

Q.41 0.5 mole of H_2SO_4 is mixed with 0.2 mole of Ca $(OH)_2$. The maximum number of moles of $CaSO_4$ formed is -
(A) 0.2 (B) 0.5
(C) 0.4 (D) 1.5

Q.42 How many mol Fe^{2+} ions are formed, when excess of iron is treated with 50mL of 4.0M HCl under inert atmosphere ? Assume no change in volume -
(A) 0.4 (B) 0.1
(C) 0.2 (D) 0.8

Q.43 12 litre of H_2 and 11.2 litre of Cl_2 are mixed and exploded. The composition by volume of mixture is -
(A) 24 litre of HCl
(B) 0.8 litre Cl_2 and 20.8 lit HCl.
(C) 0.8 litre H_2 & 22.4 litre HCl
(D) 22.4 litre HCl

Q.44 For the reaction : $A + 2B \rightarrow C$
5 mole of A and 8 mole of B will produce -
(A) 5 mole of C (B) 4 mole of C
(C) 8 mole of C (D) 13 mole of C

Q.45 Hydrogen and oxygen combine to form H_2O_2 and H_2O containing 5.93% and 11.2% Hydrogen respectively. The data illustrates-
(A) Law of conservation of mass
(B) Law of constant proportions
(C) Law of reciprocal proportions
(D) Law of multiple proportions

Q.46 If water samples are taken from sea, rivers, clouds, lake or snow, they will be found to contain H_2 and O_2 in the fixed ratio of 1 : 8. This indicates the law of -
(A) Multiple proportion
(B) Definite proportion
(C) Reciprocal proportion
(D) None of these.

Q.47 One of the following combinations illustrate law of reciprocal proportions-
(A) N_2O_3, N_2O_4, N_2O_5
(B) NaCl, NaBr, NaI
(C) CS_2, CO_2, SO_2
(D) PH_3, P_2O_3, P_2O_5

Q.48 The law of multiple proportions is illustrated by -
(A) Carbon monoxide and carbon dioxide
(B) Potassium bromide and potassium chloride
(C) Water and heavy water
(D) Calcium hydroxide and barium hydroxide.

Q.49 The law of conservation of mass holds good for all of the following except -
(A) All chemical reactions
(B) Nuclear reactions
(C) Endothermic reactions.
(D) Exothermic reactions.

Q.50 If law of conservation of mass was to hold true, then 20.8 gm of $BaCl_2$ on reaction with 9.8 gm of H_2SO_4 will produce 7.3 gm of HCl and $BaSO_4$ equal to -
(A) 11.65 gm (B) 23.3 gm
(C) 25.5 gm (D) 30.6 gm

Q.1 Which one of the following properties of an element is not variable ?

(A) Valency (B) Equivalent mass

(C) Atomic mass (D) All the three

Q.2 An element A is tetravalent and another element B is divalent. The formula of the compound formed from these elements will be-

(A) A_2B (B) AB

(C) AB_2 (D) A_2B_3

Q.3 The vapour density of gas A is four times that of B. If molecular mass of B is M, then molecular mass of A is -

(A) M (B) 4M

(C) $\frac{M}{4}$ (D) 2M

Q.4 Percentage of copper and oxygen in sample of CuO obtained by different methods were found to be same. This proves the law of -

(A) Constant proportion

(B) Multiple proportion

(C) Reciprocal proportion

(D) None of these

Q.5 6 gm of carbon combines with 32 gm of sulphur to form CS_2. 12 gm of C also combine with 32 gm of oxygen to form carbondioxide. 10 gm of sulphur combines with 10 gm of oxygen to form sulphur dioxide. Which law is illustrated by them -

(A) Law of multiple proportions

(B) Law of constant composition

(C) Law of Reciprocal proportions

(D) Gay Lussac's law.

Q.6 Two elements X (at mass 16) and **Y** (at mass 14) combine to form compounds **A, B** and **C**. The ratio of different masses of **Y** which combine with a fixed mass of **X** in A, B and C is 1 : 3 : 5. If 32 parts by mass of **X** combines with 84 parts by mass of **Y** in **B**, then in **C**, 16 parts by mass of **X** will combine with-

(A) 14 parts by mass of **Y**

(B) 42 parts by mass of **Y**

(C) 70 parts by mass of **Y**

(D) 84 parts by mass of **Y**

Q.7 If one mole of ethanol (C_2H_5OH) completely burns to form carbon dioxide and water, the weight of carbon dioxide formed is about -

(A) 22 gm (B) 45 gm

(C) 66 gm (D) 88 gm

Q.8 If LPG cylinder contains mixture of butane and isobutane, then the amount of oxygen that would be required for combustion of 1kg of it will be-

(A) 1.8 kg (B) 2.7 kg

(C) 4.5 kg (D) 3.58 kg

Q.9 1 gm - atom of nitrogen represents -

(A) 6.02×10^{23} N_2 molecules

(B) 22.4 lit. of N_2 at N.T.P.

(C) 11.2 lit. of N_2 at N.T.P.

(D) 28 gm of nitrogen.

Q.10 The moles of O_2 required for reacting with 6.8 gm of ammonia.

(..... NH_3 + ... O_2 $\rightarrow$ ..... NO + ... H_2O) is

(A) 5 (B) 2.5

(C) 1 (D) 0.5

Q.11 If isotopic distribution of C–12 and C–14 is 98% and 2% respectively, then the number of C–14 atoms in 12 gm of carbon is -

(A) 1.032×10^{22} (B) 3.01×10^{22}

(C) 5.88×10^{23} (D) 6.02×10^{23}

Q.12 If 3.01×10^{20} molecules are removed from 98 mg of H_2SO_4, then the number of moles of H_2SO_4 left are-

(A) 0.1×10^{-3}

(B) 0.5×10^{-3}

(C) 1.66×10^{-3}

(D) 9.95×10^{-2}

Q.13 Total number of atoms of all elements present in 1 mole of ammonium dichromate $[(NH_4)_2Cr_2O_7]$ is

(A) 14

(B) 19

(C) 6×10^{23}

(D) 114×10^{23}

Q.14 X gm of Ag was dissolved in HNO_3 and the solution was treated with excess of NaCl. When 2.87 gm of AgCl was precipitated the value of x is -

(A) 1.08 gm (B) 2.16 gm

(C) 2.70 gm (D) 1.62 gm

Q.15 What mass of calcium chloride in grams would be enough to produce 14.35 gm of AgCl.

(At. mass Ca = 40, Ag = 108) -

(A) 5.55 gm (B) 8.295 gm

(C) 16.59 gm (D) 11.19 gm

Q.16 Total no. of atoms in 44 gm of CO_2 is -
(A) 6.02×10^{23} (B) 6.02×10^{24}
(C) 1.806×10^{24} (D) 18.06×10^{22}

Q.17 If the density of water is 1 gm/cm^3, then the volume occupied by one molecule of water is approximately-
(A) 18 cm^3 (B) 22400 cm^3
(C) 6.02×10^{-23} cm^3 (D) 3.0×10^{-23} cm^3

Q.18 How many grams are contained in 1gm-atom of Na -
(A) 13 gm (B) 23 gm
(C) 1 gm (D) 1/23 gm

Q.19 1.35 gm of pure Ca metal was quantitatively converted into 1.88 gm of pure CaO. What is atomic weight of Ca -
(A) 40.75 (B) 50
(C) 60 (D) 70

Q.20 The % loss in weight after heating a pure sample of potassium chlorate (M. wt. 122.5) will be -
(A) 12.25 (B) 24.50
(C) 39.17 (D) 49.00

Q.21 The minimum quantity in gram of H_2S needed to precipitate 63.5 gm of Cu^{+2} will be nearly
(A) 63.5 gm (B) 31.75 gm
(C) 34 gm (D) 20 gm

Q.22 Mass of H_2O in 1000 kg $CuSO_4.5H_2O$ is - (Cu = 63.5)
(A) 360.5 kg (B) 36.05 kg
(C) 3605 kg (D) 3.605 kg

Q.23 Phosphine (PH_3) decomposes to produce vapours of phosphorus and H_2 gas. What will be the change in volume when 100 mL of phosphine is decomposed ?
(A) + 50 mL (B) 500 mL
(C) + 75 mL (D) – 500 mL

Q.24 In the reaction 4A + 2B + 3C $\rightarrow$ $A_4B_2C_3$, what will be the number of moles of product formed, starting from one mole of A, 0.6 mole of B and 0.72 mole of C ?
(A) 0.25 (B) 0.3
(C) 0.24 (D) 2.32

Q.25 8 gm of O_2 has the same number of molecules as-
(A) 7 gm of CO (B) 14 gm of CO
(C) 14 gm of CO_2 (D) 12 gm of CO_2

Q.26 4.4 gm of CO_2 and 2.24 litre of H_2 at STP are mixed in a container. The total number of molecules present in the container will be -
(A) 6.022×10^{23} (B) 1.2044×10^{23}
(C) 2 moles (D) 6.023×10^{24}

Q.27 Find the volume of CO_2 obtained at S.T.P. on heating 200 gm of 50% pure $CaCO_3$ -
(A) 11.2 litre (B) 22.4 litre
(C) 44.8 litre (D) None of these

Q.28 2.76 gm of silver carbonate on being strongly heated yields a residue weighing -
(A) 2.16 gm (B) 2.48 gm
(C) 2.32 gm (D) 2.64 gm

Q.29 A sample of AlF_3 contains 3.0×10^{24} F^- ions. The number of formula units in this sample are -
(A) 9.0×10^{24}
(B) 3.0×10^{24}
(C) 0.75×10^{24}
(D) 1.0×10^{24}

Q.30 Calculate the gm quantity of Na_2CO_3 which has same No. of atoms as the No. of protons present in 10 gm $CaCO_3$ -
(A) 20 gm
(B) 88.33 gm
(C) 44 gm
(D) 60 gm

Q.31 The mass of $CaCO_3$ produced when carbon dioxide is passed in excess through 500 ml of 0.5 M $Ca(OH)_2$ will be-
(A) 10 gm (B) 20 gm
(C) 50 gm (D) 25 gm.

Q.32 The mass of 70% pure H_2SO_4 required for neutralisation of 1 mol of NaOH -
(A) 49 gm (B) 98 gm
(C) 70 gm (D) 34.3 gm

Q.33 A sample of hard water is found to contain 40 mg of Ca^{+2} ion per litre. The amount of washing soda (Na_2CO_3) required to soften five litres of the sample would be -
(A) 1.06 gm (B) 5.3 gm
(C) 53 mg (D) 530 mg

Q.34 The mass of oxygen that would be required to produce enough CO, which completely reduces 1.6

kg Fe_2O_3 (at. mass Fe = 56) is-

(A) 240 gm (B) 480 gm

(C) 720 gm (D) 960 gm

Q.35 1.5 gm of divalent metal displaced 4 gm of copper (at. wt. = 64) from a solution of copper sulphate. The atomic weight of the metal is-

(A) 12 (B) 24

(C) 48 (D) 6

Q.36 Avogadro's number of Rupees can be spent in ....years if 10 lac rupees per second are spent -

(A) 1.91×10^{10} year (B) 2.91×10^{10} year

(C) 3.91×10^{10} year (D) 4.91×10^{10} year

Q.37 The amount of sulphur required to produce 100 moles of H_2SO_4 is -

(A) 3.2×10^3 gm (B) 32.65 gm

(C) 32 gm (D) 3.2 gm

Q.38 The vapour density of a mixture containing NO_2 and N_2O_4 is 38.3 at 27° C. The moles of NO_2 in 100 mole mixture is -

(A) 33.48 (B) 53.52

(C) 28.3 (D) 76.6

Q.39 Assuming that petrol is iso-octane (C_8H_{18}) and has density 0.8 gm/ml, 1.425 litre of petrol on complete combustion will consume oxygen -

(A) 50 L (B) 125 L

(C) 125 mol (D) 50 mol

Q.40 The conversion of oxygen to ozone occurs to the extent of 15% only. The mass of ozone that can be prepared from 67.2 L of oxygen at S.T.P. will be -

(A) 14.4 gm (B) 96 gm

(C) 640 gm (D) 64 gm

ANSWER KEY

LEVEL # 1

Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	A	B	D	B	B	C	A	D	B	D	A	C	D	A	B	C	A	D	B	D
Q.No.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	A	B	B	B	B	D	A	C	C	A	B	C	D	D	B	C	C	D	C	A
Q.No.	41	42	43	44	45	46	47	48	49	50										
Ans.	A	B	C	B	D	B	C	A	B	B										

LEVEL # 2

Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	C	C	B	A	C	C	D	D	C	D	A	B	D	B	A	C	D	B	A	C
Q.No.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	C	A	C	C	A	B	B	A	D	B	D	C	D	B	B	B	A	A	C	A