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Some Basic Concepts of Chemistry

Dalton's atomic theory:-

Every element is Composed of small indivisible particle called atoms. Atoms of some elements are identical but differ in Properties, mass and size of atoms of other elements. Atoms of different elements combine in simple ratio to form compounds. The relative no. and kind of atoms are always the same in a given compound.

Atoms cannot be created or destroyed.

Atom: The smallest particle of an element that takes part in a chemical reaction.

Molecule: The smallest particle of an element or compound that can have a stable Existence.

Formula:- Group of symbols of elements which represents one molecule of a substance.

Atomic mass: Atomic mass of elements is the ratio mass of one atom of an element to $\frac{1}{12}th$ part of the mass of the carbon-12.

$$\text{Atomic mass of an element} = \frac{Mass\ of\ one\ atom\ of\ the\ element}{Mass\ of\ one\ atom\ of\ carbon-12} \times 12$$

Atomic mass unit:- $(amu)\frac{1}{12}th$ mass of carbon-12. It is equal to $1.66\times10^{-24}g$.

$$\text{Atomic mass of an element} = \frac{Mass\ of\ one\ atom\ of\ element}{1amu}$$

$$\text{The actual mass of an atom of element} = Atomic\ mass\ in\ amu = 1.66\times10^{-24}g$$

Gram atomic mass (or) Gram atom: Atomic mass Expressed in grams. It is the absolute mass in grams of $6.02\times10^{23}\ atoms$ of any element.

$$\text{No. of gram atoms} = \frac{Mass\ of\ element\ in\ grams}{Atomic\ mass\ of\ the\ element\ in\ grams}$$

Vapour density: The ratio of the dinsities of the gas and hydrogen under similar conditions of temp. and pressure.

$$\text{Vapour density} = \frac{Density\ of\ gas}{Density\ of\ hydrogen}$$

$$V.D = \frac{mass\ of\ certain\ volume\ of\ the\ gas}{Mass\ of\ same\ volume\ of\ temp\ and\ pressure}$$

$$V.D = \frac{mass\ of\ n\ molecules\ of\ gas}{Mass\ of\ n\ molecules\ of\ hydrogen}$$

$$= \frac{Mass\ of\ 1\ molecule\ of\ gas}{Mass\ of\ 1\ molecule\ of\ hydrogen} = \frac{Molecular\ mass\ of\ gas}{Molecular\ mass\ of\ hydrogen}$$

$$= \frac{Molar\ mass}{2}$$

Hence $2 \times V.D = Molar\ mass$

Dulong and petits law: -

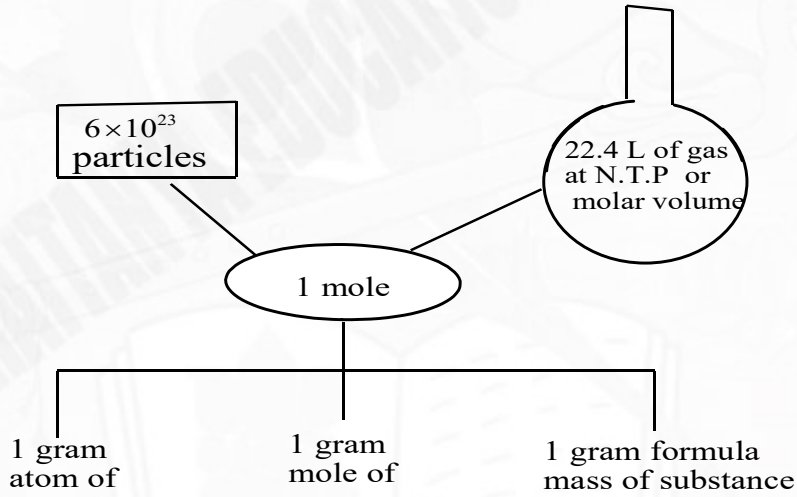
Atomic mass $\times$ *specific heat* $= 6.4$

Atomic mass can be determined by multiplying equivalent mass with valency.

$$Valency = \frac{Approximate\ atomic\ mass}{Equivalent\ mass}$$

Exact atomic mass $= Valency \times equivalent\ mass$

Mole concept and molar mass:-



percentage of composition of elements in compounds and calculation of emperical and molecular formuale:

- Percentage composition of a compound represents weight of each and Every element in that compound per 100 grams of that compounds
- % element in a compound $= \frac{\text{At.Wt}_{(element)} \times \text{No. of such elements in one species}}{\text{Formula Wt. of the compound}} \times 100$

Eg: Glucose $(C_6H_{12}O_6)$

$$\%C = \frac{12 \times 6 \times 100}{180}, \quad \%H = \frac{1 \times 12 \times 100}{180}$$

$$\%O = \frac{16 \times 6 \times 100}{180},$$

$$\% \text{ Group in a compound} = \frac{\text{Group Wt} \times \text{No. of such groups in one species} \times 100}{\text{Formula Wt. of the compound}}$$

Eg: $Na_2SO_4.10H_2O$, $\%H_2O = \frac{18\times10\times100}{322}$

- **% calculation from weight:**

If X grams of metal oxide contains Y grams of metal, then % of metal $= 100 \times \frac{Y}{X}$

- The Formula which represents the simple ratio of the atoms of different elements in one molecule of the substance is called empirical formula
- The formula which represents the exact no. of atoms of each element present in one molecule of the substance is called molecular formula

Compound	Molecular Formula	Emperical formula
Glucose	$C_6H_{12}O_6$	CH_2O
Benzene	C_6H_6	CH
Diboran	B_2H_6	BH_3
Acetic acid	CH_3COOH	CH_2O

- Molecular formula and empirical formula will be same for some of the compounds. Example. methane
- Relation between empirical formula and molecular formula is $M.F = E.F \times n$

Where $\boxed{n = \frac{Mol.wt.}{Emp.formula\ \ wt.}}$

CALCULATION OF PERCENTAGE OF ELEMENTS (C, H, N, X, S, P & O) IN THE ORGANIC COMPOUNDS

- % of carbon (Liebig's method) $= \frac{22}{44} \times \frac{wt.\ of\ CO_2}{\text{Wt. of organic compound}} \times 100$
- % of Hydrogen (Liebig's method) . $= \frac{2}{18} \times \frac{wt.\ of\ H_2O}{\text{Wt. of organic compound}} \times 100$
- % of Nitrogen (Dumas method) . $= \frac{28}{22,400} \times \frac{Volume\ of\ N_2\ at\ STP\ in\ CC}{\text{Wt. of organic compound}} \times 100$
- % of Nitrogen (Kjeldahl's method) . $= \frac{1400 \times eq_{NH_3(liberated)}}{\text{Wt. of organic compound}}$
- % of Sulphur (Carius method) . $= \frac{32}{233} \times \frac{wt.\ of\ BaSO_4}{\text{Wt. of organic compound}} \times 100$

- % of Chlorine (Carius method) . $= \frac{35.5}{143.5} \times \frac{wt.\ of\ \ AgCl}{\text{Wt. of organic compound}} \times 100$
- % of Bromine (Carius method) . $= \frac{80}{188} \times \frac{wt.\ of\ \ AgBr}{\text{Wt. of organic compound}} \times 100$
- % of Iodine (Carius method) . $= \frac{127}{235} \times \frac{wt.\ of\ \ AgI}{\text{Wt. of organic compound}} \times 100$
- % of Phosphorus (Carius method) . $= \frac{62}{222} \times \frac{wt.\ of\ \ Mg_2P_2O_7}{\text{Wt. of organic compound}} \times 100$
- % of phosphorus (ammonium phosphomolybdate method) $= (NH_4)_3\ PO_4.12MoO_3)$

  $= \frac{31}{1877} \times \frac{Wt_{(\text{Ammonium phosphor molybdate})}}{Wt_{(\text{organic compound})}} \times 100$
- % of oxygen =100-[percentage weights of all the remaining element in the given compound.
- % of oxygen $(I_2O_5$ method$) = \frac{16}{44} \times \frac{Wt_{(CO_2)}}{Wt_{(organic\ compound)}} \times 100$
- **DIFFERENT METHODS FOR THE MOECULAR WEIGHT CALCULATION**

I) Vapour density method: $M.W = 2 \times V.D$

II) Victor Mayer's method: applicable to volatile organic substances $M.W = \frac{Wt \times RT}{PV}$

III) Silver salt method:

It is used for determining molecular mass of carboxylic acid. Carboxylic acids from insoluble salts which upon

heating decompose to leave a residue of metallic **silver**, then this residue is filtered, dried and estimated.

$$\frac{W_{\text{silversalt}}}{E+107} = \frac{W_{silver}}{108}$$

$$EW_{(org.\ acid)} = \frac{Wt_{Ag-salt} \times 108}{Wt_{Ag}} - 107$$

$$M.W_{(org\ acid)} = E.W_{(org.\ acid)} \times Basicity$$

Choroplatinate salt method:

A Known mass of organic base is treated with chloroplatinic acid to form chloroplatinate salt. These salts on heating

Decompose to give metallic platinum. Ammonium salt of the acid is treated with silver nitrate to obtain the silver

Salt of the acid.

$$\frac{W_{Chloroplatinate\ salt}}{2B+410} = \frac{w_{platinum}}{195}$$

$$EW_{(org.base)} = \frac{1}{2}\left[\frac{Wt_{Pt-salt}\times 195}{Wt_{Pt}} - 410\right]$$

$$M.W_{(org\ base)} = E.W_{(org.base)} \times Acidity$$

CHEMICAL EQUATIONS AND STOICHIOMETRY

1. Balancing of a chemical equation

Principle of atom conservation

- The number and type of atoms on both sides of a chemical reaction should be the same. If is used in balancing a chemical reaction

Ex:- $Fe_2O_3 + 3CO \longrightarrow 3CO_2 + 2Fe$

2Fe L.H.S =2 Fe on R.H.S

6 oxygen = 6 oxygen

$KClO_{3_{(g)}} \longrightarrow KCl_{(s)} + O_2(g)$

Ex: Potassium perchlorate — Potassium chloride — Dioxygen

Applying POAC for k atoms

Moles of K atoms in $KClO_3$ =Moles of k atoms in KCl

$\because$ 1 mole $KClO_3$ contains 1 mole of K. 1 mole KCl contains one mole K.

POAC works on the principle of conservation of mass

- A chemical equation is balanced by hit and trial method (or) also called trial and error method.

A chemical equation is balanced as follows

Ex: -Combustion of butane $(C_4H_{10}(g))$

Step-I write down the correct formula of the reactants and products indicating the letter (g), (s) and (l) in the brackets

$C_4H_{10}(g) + O_2(g) \longrightarrow CO_2(g) + H_2O(l)$

Step-II Balance the number of c atoms $C_4H_{10}(g) + O_2(g) \longrightarrow 4CO_2(g) + H_2O(l)$

Step-III Balance the number of 'c' atoms $C_4H_{10}(g) + O_2(g) \longrightarrow 4CO_2(g) + H_2O(l)$

Step-IV Balance the H-atoms $C_4H_{10}(g) + O_2(g) \longrightarrow 4CO_2(g) + 5H_2O(l)$

Step-V Balance the number of oxygen atoms

$$C_4H_{10} + \frac{13}{2} + O_2(g) \longrightarrow 4CO_2(g) + 5H_2O(l)$$

(or)

$$2C_4H_{10} + 13O_2(g) \longrightarrow 8CO_2(g) + 10H_2O(l)$$

Step-VI Verify the number of each element is balanced in the final equation

2. Limiting reagent:- The reactant which is completed into product is called limiting reagent. The reactant which is left un reacted is called excess reactant

Calculation:- Divided given moles of each reactant by their stoichiometric coefficient the one with least ratio is limiting reagent.

Heat of combustion:- Complete combustion of hydrocarbon can be represented by the following reaction.

$$C_xH_y + \left(x + {}^{y}\!/_{4}\right)O_2 \longrightarrow xCO_2\ {}^{y}\!/_{2}\ H_2O$$

1 mole of C_xH_y required for complete combustion $\left(\frac{x+y}{4}\right)$ moles of O_2.

3. **Percentage yield:-** $\%\ \text{yield} = \frac{Actual\ \ yield}{Theoritical\ \ yield} \times 100$

4. **Percentage Purity:-** $\%\ \text{Purity} = \frac{\text{Actual mass of pure substance}}{\text{Total mass of product}} \times 100$

5. **Atom econamy:-** $\%\ \text{atom economy} = \frac{\text{mass of desired product}}{\text{Total mass of product}} \times 100$

Concentration of solution

Solute + solvent $\Rightarrow$ Solution

* The homogeneous mixture of solute and solvent is called true solution
* The quantity of solute in a given quantity of solution is called concentration methods to express Concentration of solution

methods to express concentration of solution

- Physical method
  - $(w/w)\% = \frac{wt\ of\ solute}{wt\ of\ solution} \times 100$
  - $(w/v)\% = \frac{wt\ of\ solute}{volume\ of\ solution} \times 100$
  - $(v/v)\% = \frac{vol\ of\ solute}{volume\ of\ solution} \times 100$
  - $ppm = \frac{No.of\ parts\ of\ solute}{Total\ parts\ of\ solution} \times 10^6$ (parts per million)
- Chemical methods
  - $Molarity(M)$
  - $Molality(m)$
  - $Mole\ fraction(X)$
  - $Normality(N)$

a) Molarity(M) $= \dfrac{No.of\ Moles\ of\ solute(n)}{vol\ of\ solution\ in\ litres\left(V_{lit}\right)}$

$$M = \frac{n}{V_{lit}} \Rightarrow \left(MV_{lit} = n\right)$$

$$M = \frac{wt}{G.M.wt} \times \frac{1000}{V_{ml}}$$

b) Molality(M) $= \dfrac{No.of\ moles\ of\ solute\left(n\right)}{Weight\ of\ solvent\ in\ Kg\left(s\right)}$

$$m = \frac{n}{W_{Kg}} \quad \left(mW_{Kg} = n\right)$$

c) Mole fraction (X)

$$X_{solute} = \frac{n_1}{n_1 + N_2} \quad X_{solvent} = \frac{N_2}{n_1 + N_2}$$

$$X_{solute} + X_{solvent} = 1$$

$$Normality\left(N\right) = \frac{no.ofgram\ equivalents\ of\ solute(n.e)}{volume\ of\ solution\ litres\left(V_{lit}\right)}$$

$$N = \frac{n.e}{V_{lit}} \quad \left(NV_{lit} = n.e\right)$$

$$N = \frac{wt}{Gr.Ewt} \times \frac{1000}{V_{ml}}$$

$$\frac{\text{Relation b / w Molarity}\left(M\right)\text{ \& molality}\left(m\right)}{\left(M\right)}$$

$$m = \frac{1000M}{1000d - MM1}$$

$d = density\ of\ solution\ in\ gm\ /\ ml$

$M^1 = G.M.wt\ of\ solute$

$$\frac{\text{Re}lation\ b\ /\ w\ Molarity\left(M\right)\&\ Molefraction\left(x\right)}{M = \dfrac{X_B \times d \times 1000}{\left(X_A M_A + X_B M_B\right)}}$$

$X_B = mole\ fraction\ of\ solute$

$X_A = mole\ fraction\ of\ solvent$

$M_B = M.wt\ of\ solute$

$M_A = M.wt\ of\ solvent$

Relation b/w molality &mole fraction (X)

$$m = \frac{X_B \times 1000}{X_A M_A}$$

Relation b / w N & M = Normality(N) Molarity(M) $\times$ *valency* (Z)

$$N = M \times Z$$

Significant figures:-

→ Significant figures are meaningful digits which are known with certainity.

→ The un certainty is indicated by writing the certain digits and the last uncertain digit.

Rules:-

1) All non-zero digits are significant
   Ex: - 1) In 285 cm, there are 3-significant figures
   Ex:- 2) 0.25ml, there are 2-significant figures
2) Zeros proceeding to first non-zero digit are not significant
   Ex: - 1) 0.03; It has one significant figure
   Ex: - 2) 0.0052; It has 2-significant figures
3) Zeros between 2-non zero digits are significant
   Ex: -2.005 has 4-significant figures
4) Zeros at the end or right of a number are significant provided they are on the right side of the decimal point.
   Ex: 0.200; has 3-significant figures
5) The terminal zeros are not significant if there is no decimal point
   Ex: 100 has only one significant
   100. has 3-significant figures
   100.0; has 4-significant figures
6) Counting numbers of objects have infinite significant figures
   Ex: 30 eggs; 30.00000 → *Infinite significant*
   (Or)
   3 balls; 3.0000 → Infinite significant
7) In numbers written scientific notation. All digitgs are significant
   Ex: 1) 4.01×10^2 has 3-significant figures
   Ex: 2) 8.256×10^{-3} has 4-significanifigures

Addition and subtraction:-

In addition and subtraction, multiplication and division the final result should be reported to the same number of decimal places, as present in the quantity with the minimum number of decimal places.

Ex:1) 2.6kg
3.44 kg

6.0

Final result is 6.0 kg

Ex:- 2) 35.648
22.12
_____
13.528

Final result is 13.53

Multiplication and Division:-

Rules-1: If the right most digit to be removed is more than 5, the proceeding number is In Creased by one

Ex: 2.487

We have to remove 7, we have to round it 2.49

Rule-2: If the right most digits to be removed are less than 5, the proceeding number is not Changed

Ex: 7.923

We have to remove 3, we have to round to 7.92.

Rule 3:- If the right most digits to be removed is 5, then

i) The preceding number is not changed if it is an even number

Ex: 7.45 should be round off to 7.4

ii) The preceding number is increased by one if it is an odd number

Ex: - 6.35 should be round off to 6.34

Exercise : I
(Straight Objective Including PYQ's)

Atoms, molecules and matter

(Matter and its nature) Pure substances, Dalton's atomic theory, Atomic and molecular masses, Mole concept and molar mass, Percentage composition & Empirical and molecular formulae

1. Amongst the following statements, that which was not proposed by Dalton was:
   a) Chemical reactions involve reorganization of atoms. These are neither created nor destroyed in a chemical reaction.
   b) All the atoms of a given element have identical properties including identical mass. Atoms of different elements differ in mass.
   c) When gases combine or reproduced in a chemical reaction they do so in a simple ratio by volume, provided all gases are at the same T&P.
   d) Matter consists of indivisible atoms.
2. The average molar mass of chlorine is 35.5g/mol. The ratio of ^{35}Cl to ^{37}Cl in naturally occurring chlorine is close to
   a) 4:1 b) 3:1 c) 2:1 d) 1:1
3. Study the following table

Compound	mass of the compound (in gr)
1. CO_2	4.4
2. NO_2	2.3
3. H_2O_2	6.8
4. SO_2	1.6

   Which two compounds have least mass of oxygen?
   a) II and IV b) I and III c) I and II d) III and IV
4. The percentage of Se in peroxidise enzyme is 0.5% by mass(atomic mass of Se=78.4 amu) .Then the minimum molecular mass of enzyme which contains not mole than one Se atom is
   a) $1.568\times10^4 amu$ b) $1.568\times10^7 amu$
   c) $1.568\times10^3 amu$ d) $1.568\times10^6 amu$
5. In order to oxidize a mixture of 1 mole of each of $FeC_2O_4, Fe_2(C_2O_4)_3, FeSO_4$ and $Fe_2(SO_4)_3$ in acidic medium, the number of moles of $KmnO_4$ required is____
   a) 2 b) 1.5 c) 3 d) 1
6. The minimum amount of $O_2(g)$ Consumed per gram of reactant is for the reaction (given atomic mass. $Fe=56, O=16, Mg=24, P=31, C=12, H=1$)
   a) $4Fe_{(S)}+3O_{2(g)}\rightarrow 2Fe_2O_{3\ (s)}$ b) $2\ Mg_{(s)}+O_{2(g)}\rightarrow 2MgO_{(s)}$
   c) $P_{4(s)}+5O_2(g)\rightarrow P_4O_{10(s)}$ d) $C_2H_{8(g)}+5O_{2(g)}\rightarrow 3CO_{2(g)}+4H_2O_{(l)}$

7. 25 g of an unknown hydrocarbon upon burning produces 88 g of CO_2 and $9g$ of H_2O. This unknown hydrocarbon contains.
   a) 20 g of Carbon and 5g of hydrogen b) 22 g of Carbon and 3 g of hydrogen.
   c) 24 g of Carbon and 1 g of hydrogen d) 18 g of Carbon and 7 g of hydrogen.
8. For the following reaction, the mass of water produced from 445 g of $C_{57}H_{110}O_6$ is
   $2C_{57}H_{110}O_{6(s)} + 163O_{2(g)} \rightarrow 114CO_{2(g)} + 110H_2O_{(l)}$
   a) 490g b) 495g c) 445g d) 890g
9. The ratio of masses of oxygen and nitrogen in a particular gas mixture is 1:4. The ratio of number of their molecules is
   a) 3:16 b) 1:4 c) 7:32 d) 1:8
10. **The average molar mass of chlorine is** $35.5\,g\,mol^{-1}$. the ratio of ^{35}Cl *to* ^{37}Cl in naturally occurring chlorine is close to:
    a) 4:1 b) 3:1 c) 2:1 d) 1:1
11. The ratio of mass percent of C and H of an organic compound $(C_XH_YO_z)$ is 6:1, If one molecule of the above compound $(C_XH_YO_Z)$ contains half as much oxygen as required to burn one molecule of compound C_XH_Y Completely to CO_2 and H_2O. The empirical formula of compound $C_XH_YO_z$ is:
    a) $C_3H_6O_3$ b) C_2H_4O c) $C_3H_4O_2$ d) $C_2H_4O_3$
12. The most abundant elements by mass in the body of a healthy human adult are: **Oxygen** (61.4%): Carbon(22.9%),Hydrogen(10.0%),and Nitrogen(2.6%). Two weight which a
    75kg person would gain if all 'Hatoms are replace by ^{2}H' atoms is
    a) 15Kg b) 37.5Kg c) 7.5Kg d) 10Kg
13. What quantity $(in\,ml)$ of a 45% acid solution of a monoprotic strong acid must be mixed with a 20%
    solution of the some acid to produce 800ml. of a 29.875% acid solution?
    a) 320 b) 325 c) 316 d) 330
14. At 300 K and 1 atm. 15ml of a gaseous hydrocarbon requires 375 ml. air containg 20% O_2 by volume for complete combustion. After combustion the gases occupy 330 ml. Assuming that the water formed is in liquid form and the volume were measured at the same temperature and pressure. The formula of the hydrocarbon is.
    a) C_4H_8 b) C_4H_{10} c) C_3H_6 d) C_3H_8
15. in carius method of estimation of halogens. 250mg. of an organic compound gave 141 mg of $AgBr$.
    The percentage of bromine in the compound is: $(at\,mass\,Ag = 108, Br = 80)$
    a) 48 b) 60 c) 24 d) 36

16. A gaseous compound of nitrogen and hydrogen contains 12.5% (by mass of hydrogen. The density of the compound relative to hydrogen is 16. The molecular formula of the compound is
a) NH_2 b) N_3H c) NH_3 d) N_2H_4

17. The amount of $BaSO_4$ formed upon mixing 100ml. of 20.8% $BaCl_2$ solution with 50 ml. of 9.8%
H_2SO_4 solution will be $(Ba=137.Cl=35.5, S=32, H=1 and\ O=16)$
a) 23.3 g b) 11.65 g c) 30.6 g d) 33.2 g

18. A gaseous hydrocarbon gives upon combustion 0.72 g of water and 3.08 g of CO_2. The empirical formula
of the hydrocarbon is:
a) C_2H_4 b) C_3H_4 c) C_6H_5 d) C_7H_8

19. A transition metal M forms a volatile chloride which has a vapour density of 94.8, If it contains 74.75% of
Chlorine. The formula of the metal chloride will be
a) MCl_3 b) MCl_2 c) MCl_4 d) MCl_5

20. in a compound C, H and N atoms are present in 9:1:3.5 by weight. Molecular weight of compound is 108.
Molecular formula of compound is
a) $C_2H_6N_2$ b) C_3H_4N c) $C_6H_8N_2$ d) $C_9H_{12}N_{3^+}$

21. Complete combustion of 1.80 g of an oxygen containing compound (C_xH_yOz) gave 2.64 g of CO_2
and 1.08 g of H_2O. The percentage of oxygen in the organic compound is:
a) 50.33 b) 53.33 c) 51.63 d) 63.53

22. The percentage composition of various elements in a compound is as follow

Element	Mass Percentage
C	62
H	10.4
O	27.6

The empirical formula of compound is
a) CH_2O b) C_2H_4O 3) CH_3O 4) C_3H_6O

23. A hydrocarbon contain 85.7% and 14.3% H by mass. The molecular mass of the compound is 42. The
Molecular formula of hydrocarbon is
a) CH_2 b) C_3H_6 c) CH_3 d) C_3H_8

24. What is the empirical formula of an oxide of element (E) containing 40% element by mass? (Atomic mass
$E=32$)
1) EO_2 2) EO 3) EO_3 4) E_2O_3

Chemical equations and calculations

Law of chemical combination, Chemical Equations And Stoichiometry, Concentration of solutions (or cocentration terms) , Physical quantities and their measurements (SI units and CGS units, Uncertaintyin measurements

25. Consider the reaction

$4HNO_3 + 3KCl \longrightarrow Cl_2 + NOCl + 2H_2O + 3KNO_3$

The amount of HNO_3 required to produce 110.0g of KNO_3 is (given: Atomic masses of H, O, N & K are 1, 16, 14 & 9, respectively)

a) $32.2g$ b) $69.4g$ c) $91.5g$ d) $162.5g$

26. $C_{(s)} + O_2 \longrightarrow CO_2 + 400KJ$
$(g) \quad (g)$

When coal of purity 60% is allowed to burn in presence of insufficient oxygen, 60% of carbon is converted into 'CO' and the remaining is converted into 'CO_2'.

The heat generated when 0.6 Kg of coal is burnt is_____

a) 1600 KJ b) 3200 KJ c) 4400 KJ d) 6600 KJ

27. So_2Cl_2 on reaction with excess of water results into acidic mixture.

$So_2Cl_2 + 2H_2O \longrightarrow H_2So_4 + 2HCl$

16 moles of $NaOH$ is required for the complete neutralization of the resultant acidic mixture. The number of moles of So_2Cl_2 used is

a) 16 b) 8 c) 4 d) 2

28. How many grams of 80% pure marble stone on calcinations can gives 14 grams of quick Lime

a) 20g b) 40g c) 60g d) 31.25g

29. When 159.59 of $CuSo_4$ solution is reacted with KI then the liberated Iodine required 100ml of 1M $Na_2S_2O_3$ for complete reaction then what is the percentage purity of Cu in $CuSo_4$ solution

a) 10% b) 20% c) 5% d) 40%

30. Consider the following reaction $\underset{(g)}{N_2} + \underset{(g)}{3H_2} \longrightarrow 2NH_3$ which condition will make H_2, a limiting reagent under all cases (where W is weight of substance)

a) $\frac{WN_2}{WH_2} < \frac{14}{3}$ b) $\frac{WN_2}{WH_2} > \frac{14}{3}$

c) $\frac{WN_2}{WH_2} = 1$ d) N_2 Will always be present as limiting reagent

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

31. $(g) \quad (g) \qquad (g)$ Consider the above reaction
$20g \quad 5g$

The limiting reagent of the reaction and number of moles of NH_3 formed respectively are

a) H_2, 1.42 molesb) H_2, 0.71 moles c) N_2, 1.42 moles d) H_2, 0.71 moles

32. For a reaction $\underset{(g)}{N_2}+\underset{(g)}{3H_2}\longrightarrow\underset{(g)}{2NH_3}$ identify dehydrogenate (H_2) as a limiting reagent in the following reaction mixtures

a) $56g\ of\ N_2+10g\ H_2$ b) $35g\ N_2+8g\ of\ H_2$

c) $28g\ of\ N_2+6g\ H_2$ d) $14g\ of\ N_2+4g\ of\ H_2$

33. The minimum amount of $\underset{(g)}{O_2}$ consumed per gram of reactant is for the reaction [Given atomic mass $Fe=56,\ O=16,\ Mg=24,\ P=31,\ C=12,\ h=1$]

a) $\underset{(s)}{4Fe}+\underset{g}{3o_2}\longrightarrow\underset{(s)}{2Fe_2O_3}$ b) $\underset{(s)}{P_4}+\underset{g}{5O_2}\longrightarrow\underset{(s)}{P_4O_{10}}$

c) $\underset{(g)}{C_3H_8}+\underset{(g)}{5O_2}\longrightarrow\underset{(g)}{3Co_2}+\underset{(\ell)}{4H_2O}$ d) $\underset{(s)}{2Mg}+\underset{(g)}{O_2}\longrightarrow\underset{(s)}{2MgO}$

34. Complete combustion of 1.80g of an oxygen containing compound $(C_xH_yO_z)$ gave 2.64g of Co_2 & 1.08g of H_2O the percentage of oxygen in the organic compound is

a) 50.33 b) 53.33 c) 51.63 d) 63.53

35. For the following reaction the mass of water produced from 445g of $C_{57}H_{10}O_6$ is

$\underset{(s)}{2C_{57}H_{110}O_6}+\underset{(g)}{163O_2}\longrightarrow\underset{(g)}{114CO_2}+110H_2O(l)$

a) 490g b) 445g c) 495(g) d) 890(g)

36. The amount of sugar $(C_{12}H_{22}O_{11})$ required to prepare 2L of its 0.1M aqueous solutions

a) $136.8g$ b) 17.1g c) 68.4 g d) 34.2 g

37. The PPM level of F^- in a 500 g sample of a tooth paste containing 0.2 g F^- is

a) 400 b) 1000 c) 250 d) 200

38. The concentrated sulphuric acid that is peddled commercially is 95% H_2SO_4 by weight. If the density of

This commercial acid is $1.834\,gcm^{-3}$, the molarity of this solution is

a) $17.8M$ b) $12.0M$ c) 10.5M d) 15.7M

39. 8 g of $NaOH$ is dissolved in 18 g of H_2O. Mole fraction of $NaOH$ in solution and molality (in mol kg^{-1}) of the solution respectively are

a) 0.2, 22.20 b) 0.2, 11.11 c) 0.167, 11.11 d) 0.167,22.20

40. The density of 3M solution of sodium chloride is 1.25 g ml^{-1}. The molality of the solution will be (molar mass Nacl=58.5 g mL^{-1})

a) 260m b) 2.18 c) 2.79m d) 3.00m

41. A commercially sold conc HCl is 35% HCl by mass, of the density of this commercial acid is 1.46g/ml, the morality of this solution is.

a) 10.2 M b) 12.5 M c) 14.0M d) 18.2M

42. A solution of two components containing n_1 Moles of the 1^{st} component and n_2 moles of the 2^{nd} component is prepared. M_1 And M_2 are the molecular weights of component 1 and 2 respectively. If'd' is the density of the solution in $g\,mL^{-1}$, C_2 is the morality and n_2 is the mole fraction of the 2^{nd} component, then C_2 can be expressed as

a) $C_2 = \dfrac{1000x_2}{M_1 + x_2(M_2 - M_1)}$ b) $C_2 = \dfrac{dx_2}{M_2 + x_2(M_2 - M_1)}$

c) $C_2 = \dfrac{1000dx_2}{M_1 + x_2(M_2 - M_1)}$ d) $C_2 = \dfrac{dx_1}{M_2 + x_2(M_2 - M_1)_7}$

43. 10mL of 2M $NaoH$ solution is added to 200mL of 0.5 M of $NaoH$ solution. What is the final concentration?

a) 0.57M b) 5.7M c) 11.4M d) 1.14M

44. The molecular formula of a commercial resin used for exchanging ions in water softening is $C_8H_7SO_3^{\ominus}Na^{\oplus}$ $(Mol.Wt.206)$. What would be the maximum uptake of Ca^{+2} ions by the resin when expressed in mole per gram resin?

a) $\dfrac{2}{309}$ b) $\dfrac{1}{412}$ c) $\dfrac{1}{103}$ d) $\dfrac{1}{206}$

45. The molality of a urea solution in which 0.0100 g of urea, $\left[(NH_2)CO\right]$ is added to $0.3000dm^3$ of water at STP is

(a) $5.55\times10^{-4}m$ (b) $33.3M$ (c) $3.33\times10^{-2}m$ d) $0.555m$

46. Using the rules for significant figures, the correct answer for the expression $\dfrac{0.02858\times0.112}{0.5702}$ Will be

a) 0.005613 b) 0.00561 c) 0.0056 d) 0.006

Exercise : II

(Numerical / Integer Value based Questions Including PYQ's)

Atoms, molecules and matter

(Matter and its nature) Pure substances, Dalton's atomic theory, Atomicand molecular masses, Mole concept and molar mass, Percentage composition & Empirical and molecularformulae

1. Chlorophyl extracted from the crushed green leves was dissolved in water to make 2L solution of Mg of concentration 48 ppm.
   The number of atoms of Mg in this solution is $x\times10^{20}$ atoms. The value of xis ____ (Nearest Integer) (Given: Atomic mass of Mg is 24g/mole $N_A=6.02\times10^{23}mole^{-1}$)
2. The number of atoms in 8g of sodium is $x\times10^{23}$. The value of x is ____(Nearest integer) $\left(Given: N_A=6.02\times10^{23}mol^{-1}\right)$. (Atomic mass of $Na=23u$)
3. An average person needs about 1000kJ energy per day. The amount of glucose (Molar mass. 180g/mol) needed to meet this energy requirement is____g.
4. The $NaNO_3$ weighed out to make 50 ml of an aqueous solution Containing 70 mg Na^+ per ml is___g (Rounded off to the nearest integer)
   $[Given: Atomic\,weight\,in\,g/mol - Na=23, N=14, 0=16]$
5. Complete Combustion of 3g of ethane gives $x\times10^{22}$ Molecules of water. The Value of x is ____
   (Round off to the nearest integer)
   [Use: $N_A=6.023\times10^{23}$; Atomic mass in $amu: c=12; O=16, H=1$]
6. A reaction of 0.1 mole of benzyl amine with bromo methane gave 23 g of benzyl trim ethyl ammonium bromide. The number of moles of bromo methane consumed in this reaction are $n\times10^{-1}$, when $n=$ ___ (Round off to the nearest integer) .[Given Atomic masses : C=12U, H=1U,N=14U, Br=80U]
7. The mass of NH_3 in grams produced when $2.8kg$ of N_2 Quantitatively react with 1 kg of H_2 is _____.
8. A complete combustion of 750 g of an organic compound provides 420 g of CO_2 and 210 g of H_2O.
   The percentage composition of carbon and hydrogen in organic compound is 15.3 and____respectively. (Round of to the nearest integer)
9. What is the molecular formula of a compound is S_xCl_y that contains 47.4% S and 52.6% Cl? The molecular
   Mass of the compound as determined experimentally is 135g mol^{-1}. The sum of $x+y$ is.
10. Haemoglobin contains 0.33% of Fe by weight. If 1 molecule of Haemoglobin contains two Fe atoms, the
    molecular weight of Haemoglobin is $x\times10^3$ the value of x is.(atomic weight of iron is 56)

11. 0.132g of an organic compound gave 50ml of N_2 at NTP. The weight percentage of nitrogen in the compound is close to_____.
12. What is the mass percent of carbon in carbon dioxide?
13. One gram of a metallic chloride was found to contain 0.835g of chlorine. Its vapour density is 85.5. If Molecular formula is M_xCl_y, then what is value of $(x+y)$?
14. The ratio of the mass percentages of 'C & H'and 'C & O' of a saturated acyclic organic compound'X' are 4:1 and 3:4 respectively. Then , the moles of oxygen gas required for complete compustion of two moles of organic compound 'X' is _____.

Chemical equations and calculations

Law of chemical combination, Chemical Equations And Stoichiometry, Concentration of solutions (or concentration terms) , Physical quantities and their measurements (SI units and CGS units, Uncertainty in measurements

15. Complete combustion of 750g of an organic compound provides 420g of Co_2 & 210g of H_2O. The percentage composition of carbon & hydrogen in organic compound is 15.3_____respectively.
16. The minimum number of moles of O_2 required for complete combustion of 1 mole of propane and 2 moles of butane is_____
17. The mass of ammonia in grams produced when 2.8 kg of dinitrogen quantitatively reacts with 1 kg of dehydrogenate is_____ .
18. Blister copper is produced by reaction of copper oxide with copper sulphide
    $2Cu_2O+Cu_2S\longrightarrow 6Cu+SO_2$
    When $2.86\times10^3 g$ of Cu_2O and $4.77\times10^3 g$ of Cu_2S are used for reaction, the mass of copper produced is_____g(nearest integer)
    (Atomic mass of $Ca=63.5\ a.m.u$) $(S=32\ a.m.u)$ $(O=16\ a.m.u)$
19. _____grams of 3-hydroxy prop anal $(M.W=74)$ must be dehydrate to produce 7.8g of acrolein $(M.W=56)$ (rounded off to the nearest integer)
20. A 20 ml solution containing 0.2g impure H_2O_2 reacts completely with $0.316g$ of $KMnO_4$ in acid solution. The purity of H_2O_2 (in %) is_____
21. If the concentration of glucose $(C_6H_{12}O_6)$ in blood is $0.72\,gL^{-1}$, the Molarity of glucose in Blood is _____$\times10^{-3}M$ $(Nearest\,int\,eger)$
22. A $100ml$ solution was made by adding 1.43 g of $Na_2CO_3.\ xH_2O$, The normality of the solution is 0.1N. The value of x is_____
23. $10.3mg$ of O_2 is dissolved into a litre of sea water of density $1.09\,g/ml$. The concentration of O_2 .in ppm is ____
24. The mole fraction of glucose $(C_6H_{12}O_6)$ in an aqueous binary solution is 0.1. The Mass percentage of water in it, to the nearest integer is_____

25. 6.023×10^{22} *molecules* are present in $10\,g$ of a substance 'x'. The molarity of a solution containing $5g$ of substance 'x' in $2L$ solution is _____$\times10^{-3}$.
26. 1L aqueous solution of H_2SO_4 Contains 0.02mmol H_2SO_4,50% of this solution is diluted With deionized water to give 1L solution(A). In solution (A) , 0.01mmole of H_2SO_4 are added. Total mmol of H_2SO_4 in the final solution is $x\times10^{-x}$ *mmols* Then x is_____.
27. The number of significant figures in 0.00340 is/are _____
28. The number of Significant figures in 50000.020×10^{-3} is /are_____

Exercise : III

(More than One Answer Type Questions Including PYQ's)

Atoms, molecules and matter

(Matter and its nature) Pure substances, Dalton's atomic theory, Atomicand molecular masses, Mole concept and molar mass, Percentage composition & Empirical and molecularformulae

1. Acetic acid and glucose have same
   a) empirical formula
   b) weight composition of elements
   c) ratio of masses of individual elements
   d) number of gramatoms of each element per mole
2. A certain compound has the molecular formula M_4O_6 having 57.2% of M. Thus.
   a) atomic mass of M is 32
   b) M may contain six valence electrons
   c) M is an electropositive metal
   d) M can be a non-metal
3. 80% carbon is present in an alkane by weight. The possible conclusions are
   a) The empirical formula of the compound is CH_3
   b) The minimum number of carbons in the molecule is 2
   c) The compound has gram atoms of C & H in 4:1 ratio
   d) This composition suits to all alkanes
4. The molar mass of haemoglobin is about 65000 g mol^{-1}. Every haemoglobin contains 4 iron atoms. Thus.
   a) iron content in haemoglobin is 0.35% by mass
   b) 1 mole of haemoglobin contains 56g iron
   c) 1 mole of haemoglobin contains 224g iron
   d) if iron content is increased to 0.56%, molar mass of haemoglobin would be higher than 65000g mol^{-1}
5. A dibasic acid containing C, H and O was found to contain $C = 26.7\%$ and $H = 2.2\%$. The vapour density of its diethyl ester was found to be 75. The molecular formula of the acid is
   a) CH_2O_2
   b) $C_2H_2O_4$
   c) $C_3H_3O_4$
   d) $C_2H_4O_4$

Chemical equations and calculations

Law of chemical combination, Chemical Equations And Stoichiometry, Concentration of solutions (or concentration terms) , Physical quantities and their measurements (SI units and CGS units, Uncertainty in measurements

6. In the formation reaction of NH_3 from N_2 and H_2, $140\ g$ and $40g$ H_2 were mixed select the options which is not correct
   a) Maximum mass of NH_3 which can be formed is 180g.
   b) If % yield of reaction is 80% then H_2 consumed will be 32g
   c) Some $N_2(g)$ will be left after the reaction
   d) If NH_3 formed is $85g$ then% yield will be 50%
7. One mole barium chloride and 1 mole Na_3PO_4 are mixed in aqueous medium
   a) $BaCl_2$ acts as limiting reagent
   b) Na_3PO_4 acts as limiting reagent
   c) Half mole of $Ba_3(PO_4)_2$ is formed
   d) 0.33 moles of $Ba(PO_4)_2$ is formed
8. If 0.80 mole of MnO_2 and 146g of HCl react $MnO_2+4HCl\longrightarrow MnCl_2+Cl_2+2H_2O$ then
   a) 0.80 mole of Cl_2 is formed
   b) 0.80 mole of HCl is formed
   c) MnO_2 is completely reacts
   d) MnO_2 is the limiting reagent
9. 10ml N_2 is reacted with 20ml H_2 to from NH_3. The correct statement is/are.
   a) 13.3 ml NH_3 if formed
   b) 20ml NH_3 is formed
   c) 3.4 ml N_2 is left after the completion of the reaction
   d) 16.7ml NH_3 of mixture is left after the completion of the reaction
10. Which of the following is/are independent of temperature ?
    a) Molarity b) molality c) Mole fraction d) Normality
11. A given solution of H_2SO_4 is labeled as 49% (w/w). Then correct statement regarding the Solution is $(d=1.3g/m)$
    a) $m=\frac{500}{51}$ b) $N=\frac{1000}{51}$ c) $\%w/V=(49\times1.3)\%$ d) 6.5
12. Solution(s) containing 40 gm $NaOH$ is/are
    a) 50 gm of 80% $(w/w)NaOH$
    b) 50 gm of 80% $(w/v)\ NaOH\left[d_{soln}=1.2gm/ml\right]$
    (c) 50 gm of 20 M $NaOH\left[d_{soln}=1gm/ml\right]$ d) 50 gm of 5M $NaOH$

13. 100ml solution contains 12 mg $MgSO_4$. The concentration of solution is

(a) $10^{-3}M$ (b) $2\times10^{-3}N$ (C) $120\,ppm$ (d) $10^{-3}m$

14. 30ML of $CH_3OH\left(d=0.8g/cm^3\right)$ is mixed with 60ml of $C_2H_5OH\left(d=0.92g/cm^3\right)$ at 25^0C to form a solution of density 0.88g/cm^3. Select the correct option

a) Molarity and molality of resulting solution are 6.33 and 13.59 respectively
b) The mole fraction of solute and molarity are 0.385 and 13.59 respectively
c) Molarity and % change in volume are 13.59 and zero respectively
d) molefraction of solvent and molality are 0.615 and 13.59 respectively.

15. 1ml of 1M solution is mixed with 999 ml of pure water.

a) $10^{-3}M$ Solution is formed
b) The mass of solute per ml decreases by 1000 times
c) The quantity of solute decreases in the solution
d) 10 ml of resultant solution contains 10^{-5} moles of solute

16. The molar concentration of $HCL(aq.)$ is $10^5\,10^{-5}$ M. Which of the following statement is? Correct.

$\left(d_{solution}=1gm/cc\right)$

(A) The mole fraction of HCL $\cong 1.8\times10^{-7}$
(B) The concentration of HCL in ppm is 3.65 ppm.
(C) The molality of HCL solution is approximately $10^{-5}m$
(D) The $(W/V)\%$ of solution is $3.65\times10^{-5}\%$

EXERCISE : IV

(Matrix Matching/Paragraph Type Questions Including PYQ's)

This section contains 4 questions.the statements Each question contains statement given in two. Columns Which have to be matched . The statements In column I are lablled. A,B,C and D, Which the statements In column II are labeled p,q,r,s and t, Any given statement in Column I can have correct matching with one OR More statement (s) in Column II.

1. Match the following

Column-1	**Column-II**
(A) Number of carbon atoms in 1 g molecules of CO_3	(p) 0.5 *No*
(B) Number of molecules in 48 g O_2	(q) N_0
(C) No. of molecules in 11.2 L H_2 STP	(r) 3 N_0
(D) No, of Hydrogen atoms in 1 mole of NH_3	(s) $1.5N_0$
	$(N_0 = Avogadro's\ Number)$

a) $A(q),B(s),C(p),D(r)$ b) $A(s),B(q),C(p),D(r)$

c) $A(s),B(q),C(r),D(p)$ d) $A(p),B(r),C(q),D(s)$

(A) No of C-atoms in 1 g molecule of $CO_2 = N_0$

(B) No of molecules in 48 g of $o_2 = \frac{48}{32} \times N_0 = 1.5N_0$

(C) No of molecules in 11.2 L $H_2\ at\ STP = \frac{N_0}{2} = 0.5\,N_0$

(D) No. of H-atoms in 1 mole of $NH_3 = 3 \times N_0 = 3N_0$

2. Match the following

Column-I	**Column-II**
(A) $2H_2 + O_2 \rightarrow 2H_2O$ 3g + 22.66 g	(p) 25.5 product is formed
(B) $N_2 + 3H_2 \rightarrow 2NH_3$ 24.5g 5.5g	(q) $0.25\,g\ of\ a\ reac\tan t\ is\ left$
(C) $H_2 + Cl_2 = 2HCl_2$ 1.4g 40g	(r) $H_2\ is\ the\ \lim iting\ reagent$
D. $C + 2H_2 \rightarrow CH_4$ 20g 6.375gms	(s) $41.12\,gms\ \ product$

a) $A(q),B(p),C(s),D(r)$ b) $A(p),B(q),C(s),D(r)$

c) $A(p),B(r),C(s),D(q)$ d) $A(r),B(q),C(p),D(s)$

3. Match the following

Column-I	**column-II (% by mass of oxygen)**
(A) $Na_2S_2O_3$	(p) $\approx 30\%$
(B) $KMnO_4$	(q) $\approx 39\%$
(C) Na_3PO_4	(r) $\approx 57\%$
(D) $MgCO_3$	(s) $\approx 40.5\%$

a) $A(s),B(p),C(q),D(r)$ b) $A(s),B(p),C(r),D(q)$

c) $A(p),B(s),C(q),D(r)$ d) $A(r),B(q),C(s),D(p)$

4. Match the following

Column-I	**Column-II**
(A) 1 g molecule of chlorine gas	(P) 14 L of STP
(B) 1 g equivalent of Br_2 gas	(q) 22.4 L at STP
(C) 32 g of $CH_4(g)$	(r) 80 g
(D) $40\,g\,SO_2(g)$	(s) 44.8 L STP

a) $A(r),B(q),C(s),D(p)$ b) $A(r),B(q),C(p),D(s)$

c) $A(s),B(p),C(r),D(q)$ d) $A(q),B(r),C(s),D(p)$

5. Match the following

Column-I (Concentration of aqueous solution)	**Column-II** (Density of given solutions is 1.2 g/ml)
(A) 2M $NaOH$ solution	(p) 16 gm solute in 240gm solution
(B) 8% $\left(\frac{w}{V}\right)KOH$ solution	(Q) 60 gm solute in 240 gm solution
(C) 25% $\left(\frac{w}{W}\right)CaCO_3$ solution	(R) 8 gm solute in 100 ml solution
(D) $X_{C_2H_3OH}=\frac{1}{11}$	(s) 30 gm solute in 100 gm solution
	(T) 1 mole solute in 400 gm solution

a) $A\to(P,R);B\to(P,R);C\to(Q,S,T);D\to(S,Q)$

b) $A\to(S,Q);B\to(P,R);C\to(Q,S,T);D\to(P,R)$

c) $A\to(S,Q);B\to(Q,S,T);C\to(P,R);D\to(P,R)$

d) $A\to(S,Q);B\to(P,R);C\to(P,R);D\to(Q,S,T)$

6. Match the following

Column-I	Column-II
(A) 120 g CH_3COOH in 1 L solution	(P) M=25
(B) 120 gm glucose dissolved in 1 L sol $(d_{sol}=1.2gm/ml)$	(Q) 10% w/w solution
(C) $X_{NH_2CONH_2}=1/31(aqueous\,solution)$	(R) 12%W/V solution
(D) $19.16(w/v)S_2So_4\,solution \rightarrow (d_{sol}=1.2gm/ml)$	(s) m=1.85
	(T) M=0.617

a) $A\rightarrow(p);B\rightarrow(q,r,t);C\rightarrow(q,s);D\rightarrow(p,q,r,s)$

b) $A\rightarrow(p,q,r,s);B\rightarrow(q,r,t);C\rightarrow(q,s);D\rightarrow(p)$

c) $A\rightarrow(p);B\rightarrow(q,s);C\rightarrow(q,r,t);D\rightarrow(p,q,r,s)$

d) $A\rightarrow(p);B\rightarrow(p,q,r,s);C\rightarrow(q,r,t);D\rightarrow(q,s)$

COMPREHENSION-I

AVOGRODRO'S law states that under similar condition of T and P, equal volumes of gases contain equal number of particles. Experiments show that at one atmosphere pressure and at a temperature 273 K (i.e.at STP) one mole of any gas occupies a volume approximately 22.4 litre. There fore number of moles any sample of gas can be found by comparing its volume at S.T.P with 22.4. 1 mole of species contains 6.03×10^{23} particles which is denoted by symbol N_A. Number of atoms present in 1 gm-atom of an elements or number of molecules present in 1 gm-molecule of any substance is equal to N_A. Hence it is number of particles present in one mole of the substance .

Choose the correct answer:

7. if N_{AV} is avogadro's number's number, then 10 amu will be equal to _____gram.

a) $10N_{AV}$ b) $\frac{N_{AV}}{10}$ c) $\frac{10}{N_{AV}}$ d) N_{AV}

8. At S.T.P 11.2 L of CO_2 contains

a) 1 mol b) 2 mol c) 0.5 mol d) 3 mol

9. The no.of gram atoms of oxygen present in 0.2 mole of $H_2S_2O_8$ is

a) 0.2 b) 8 3d) 1.6 d) 0.8

Comprehension-II

Atom of same elements having same atomic number and different atomic mass are known as isotopes. If atomic masses of two isotopes of an element are A_1 and A_2 and they exist in the

ratio $P_1 : P_2$, then average atomic mass $A_{avg} = \frac{A_1P_1 + A_2P_2}{P_1 + P_2}$

Choose the correct answer :

10. which isotopes can be used of decide the scale of atomic mass ?
    a) ${}_6C^{12}$ b) ${}_7N^{15}$ c) ${}_{11}Na^{24}$ d) ${}_6C^{14}$
11. If % abundance of two isotopes of carbon ${}_6C^{12}$ and ${}_6C^{14}$ are 90% and 10% respectively then
    number of C-12 atoms in 12 grams of sample will be approximately
    a) $0.44N_A$ b) $0.88N_A$ c) $0.22N_A$ d) $0.11\ N_A$
12. If average atomic mass of Cl is 35.5. Chlorine exist in nature in the form of two isotopes ${}_{17}Cl^{35}$
    and ${}_{17}Cl^{37}$. Then ratio in which they exist in nature will be
    a) 1:1 b) 3:1 c) 2:1 d) 3:2

Comprehension-III

All chemical reactions take place under certain laws out of which three laws are given here
(a) **Law of conservation of mass:** According to ohms law total mass of reactions to equal to total mass of products
(b) **Law of constant composition:** According to this law a chemical compound is always found to be made up of same elements corrected together to fixed proportion by weight.
(c) **Law of multiple proportion**: According to this law when two elements are combined to form two or more chemical compounds the weight of the one of the elements which combine which a fixed weight
of another bear a simple whole number ratio to one another.**Choose the correct answer:**

13. 3 g of hydrocarbons on combustion with 11.2 g of oxygen produces 8.8 g CO_2 and $5.4gH_2O$.
    The data illustrates
    (a) Law of conservation of mass (b) Law of multiple proportions
    (c) Law of definite proportions (c) Law of reciprocal proportions
14. The percentage of carbon and oxygen in samples of CO_2 obtained by different methods were
    to be found to be the same. This illustrates
    (a) Law of conservation of mass (b) Law of constant proportions
    (c) Law of definite proportions (d) Law of reciprocal proportions

Comprehensive-IV

On being heated oxygen 5.72 g of red metallic divides A was converted to 6.38 gram black metallic

Oxides B when 4.77 grams B was presented stream of H_2 gas 3.81 g of metal m mass forwared

(Given atomic weight of metal in 6.3 gm)

chose the correct answer

15. The formula of red metallic oxide A is
    a) MO b) MO_2 c) M_2O d) M_2O_3
16. The formula of black metallic oxide is
    a) MO b) M_2O_5 c) M_2O_3 d) M_2O
17. The eqauivalent weight of metal M in B is
    a) 118.9 b) 65.4 c) 63.5 d) 31.8

Comprehension-V

38 ml of a gaseous mixture consisting of a gaseous organic compound A and just sufficent amount of oxygen required for complete combuston gives 16 ml of CO_2. 24 ml water vapour and 8 ml of N_2. The volumes are measured at same temperatures and pressure.

Choose the correct answer

18. Volume of O_2 required complete composition?
    a) 8 *ml* b) 28 *ml* c) 74 *ml* d) 22 *ml*
19. The molecular formula of compound will be
    a) CH_3N b) C_2H_3N c) $C_2H_3N_2$ d) $C_4H_{+2}N_2$

Exercise : V

(Assertion – Reason / Statement – I & II Type Questions Including PYQ's)

This section contains 15 questions. Each question contains STATEMENT-1 (Assertion) amd STATEMENT-2 (Reason) Each question has 4 choice (a) ,(b) ,(c) and (d) out of which ONLY ONE is correct.

(a) State ment (a) is true,Statement-2 is True; Statement-2 is correct explanation for statement

(b) Statement-1 is True, Statement-2 is True; Statement -2 is not correct explanation for Statemetnt-1

(c) Statement-1 is True; Statement-2 is false.

(d) Statement-1 is false, Statement-2 is True.

1. STATEMENT-1: One mole of an ideal gas have volume of 22.4 litre at 273.15K and 1 atm.
   STATEMENT-2: Under identical condition, equal weight of gases have sameVolume.
2. STATEMENT-1: H_3PO_4 is tribasic acid.
   STATEMENT-2: in H_3PO_4 only H-atoms are replaceable.
3. STATEMENT-1: 18 g of water vapour and 18 g of ice will not contain the same number of molecules.
   STATEMENT-2: Number of molecules are independent of temperature and pressure.
4. STATEMENT-1: Atomic mass of Mg is 24.
   STATEMENT-2: An atom of magnesium is 24 times heavier than $\frac{1}{12}th$ of the mass of carbon atom$\left(C^{12}\right)$.
5. STATEMENT-1: Atomic weight of an atom can never be in fraction.
   STATEMENT-2: Average atomic weight of chlorine is 35.5.
6. STATEMETN-1: Law of conservation of mass is generally applicable to all the chemical reactions.
   STATEMENT-2: Law of constant composition is not valid for non stiochometric compound like $Fe_{0.93}O$.
7. STATEMENT-1: Solvent have always same physical state as that of solution.
   STATEMENT-2: Solution contains more than one solvent.
8. STATEMETN-1: Molality is equal to molarity. If density of solution is one.
   STATEMENT-2: Molality does not depend on the temperature.
9. STATEMETN-1: On dilution, molarity of solution changes.
   STATEMENT-2: Number of moles of solute in a solution does not changes on dilution.
10. STATEMENT-1: Equivalent weight of an acid is always less than its molecular weight.

STATEMENT-2: Equivalent weight of acid $= \frac{Molecular\ weight}{n-factor}$

11. STATEMENT-1: In any chemical reaction, total No. of molecules are conserved .
    STATEMENT-2: Atom can neither be created nor be destroyed.
12. STATEMENT-1: In a chemical reaction, total mass remains constant.
    STATEMENT-2: Ina chemical reaction, total no of moles always remain constant.

13. STATEMENT-1: compound having same general formula may have different empirical formula.
    STATEMENT-2: Compound having same empirical formula may have different general formula.
14. STATEMENT-1: 18 ml of H_2O and 18 ml of CO_2 at 277 K have same no.of moles.
    STATEMENT-2: Density of H_2O is more than C_2O
15. STATEMETN-1: In 32 g of O_2, two gram atom of oxygen atom are present
    STATEMENT-2: Molecular weight of O_2 is 32 grams.

16. STATEMENT-1: Modality of pure ethanol is lesser than pure water.
    STATEMENT-2: As density of ethanol is lesser than density of water.
    $[Given = d_{ethanol} = 0.789 gm/ml : d_{water} = 1 gm/mole]$
    (A) STATEMENT-1 is true,STATEMENT-2 is correct and STATEMETN-2 is correct explanation.
    (B) STATEMETN-1: is true, STATEMENT-2 is true and STATEMENT-2 is not the correct explanation statement-1
    (C) STATEMENT -1 is false ,STATEMENT-2 is true.
    (D) STATEMENT-1 is true, STATEMENT-2 is false
17. STATEMENT-1: Molarity and molality have almost same value for a very dilute 0
    STATEMENT-2: In all very dilute solution the moss of solvent (in gms) is equal solution (in ml)
    (A) Statement-1: is true, Statement-2 is true and statemet-2 is correct explanation.
    (B) Statemetn:-2: is true,Statement-2 is true and statement-2 is not the correct Statement-1.
    (C) Statement-1 is true, Statemetn-2 is false,
    (D) Statement-1 is false, Statemetnt-2 is false
18. STATEMENT-1: The mass fraction of solution in a solution is always greater than its mole fraction.
    Statemetn-2: Mole fraction of solvent in an aqueous solution of ethanol must be greater than that of solute

(A) Statement-1: is true, Statement-2 is true and statement -2 is correct explanation of Statement-1.

(B) statement-1 is true, statement -2 is true and Statement -2 is not correct the correct explanation Statement-I

(C) Statement-I is true, statement-2 is false

(D) Statement-1 is false, statement-2 is true.

19. **Assertion(A) :** The empirical mass of ethane is half of its molecular mass.
Reason(R) : The empirical formula represents the simplest whole number ratio of various atoms present in a
Compound

i) Both A and R are true and R is the correct explanation of A.

ii) A is true but R is false

iii) A is false but R is true

iv) Both A and R are false

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

20. **Assertion(A) :** Ratio of empirical formula mass and molecular formula mass must be a natural number
Reason(R) : $M.F = (E.F) \times n$

i) Both A and R are true and R is the correct explanation of A. ii) A is true but R is false

iii) A is false but R is true. iv) Both A and R are false

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

21. **Assertion(A) :** The ratio of molecular formula mass and empirical formula mass must be a natural number**Reason(R) :** The empirical formula can never be the same as the molecular formula

i) Both A and R are true and R is the correct explanation of A. ii) A is true but R is false

iii) A is false but R is true. iv) Both A and R are false

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

22. Statement-I: The percentage of nitrogen in urea is 46.6% because
Statement-II: Urea is a covalent compound.

a) Statement-I is true, Statement-II is true; Statement-2 is a correct explanation for Statement-I

b) Statement-I is True, Statement-II is true; Statement-2 is NOT a correct explanation for Statement-I

c) Statement-I is true, Statement-II is false

d) Statement-I is false, Statement-II is true