ATOMS AND MOLECULES

Atoms

Smallest particle which takes part in a chemical reaction, e.g. H, O, Na, Fe, Ag, Au, Ba, etc.,

It may or may not exist freely

It is the smallest unit of elements

Molecules

It is made up of two or more atoms

It is smallest unit of compound

It is capable of free existence

Atomicity of Molecules

Number of atoms present in a molecule

- Mono atoms [Single atom] → He, Ne, Ar, Kr, Xe, Rn, Na
- Diatomic [Made of 2 atoms] → O_2, N_2, H_2, Br_2, I_2, Cl_2, F_2, etc
- Triatomic → O_3, H_2O, H_2S, CO_2, CS_2, SO_2
- Tetra atomic → P_4, NH_3, PH_3 PCl_3, NF_3, SO_3
- Penta- atomic → CH_4 CCl_4, $SiCl_4$ SiF_4
- Hexa- atomic → CH_3OH, PCl_5, C_2H_4,
- Hepta- atomic → SF_6, P_2O_5,
- Octa- atomic → S_8, C_2H_6, C_2H_5O,

Mole Concept

1 mole = 6.022×10^{23} particles

- No. of Moles = $\frac{Mass}{Molar\ Mass}$
- Mass of 1 atom = $\frac{Molar\ Mass}{6.022 \times 10^{23}}$

Molar Mass = Total mass of all atoms in molecule

Atomic Mass = Mass of 1 atom x 6.022×10^{23}

Mass (g) = Mass of 1 mol x number of moles

Number of molecules = No. of moles x 6.022×10^{23}

*Ions

Atoms or group of atoms having charge

- Cations (+ve charge) Al^{3+}, Mg^{2+}
- Polyatomic Ions
- Anions (- ve charge) Cl^-, Br^- CO_3^{2-},
- Cations NH_4^+
- Anions

BF_4^-, SO_4^{2-}, CO_4^{3-}, CO_3^{2-}, NO_3^-, NO_3^{2-}

Relative Atomic Mass

No. of times given atom is heavier than 1/12th mass of of $^{12}_{6}C$ atom.

Law of Conservation of Mass

It states that matter can neither be created nor be destroyed in a chemical reaction. It means that the total mass of reactants must be equal to the total mass of products. That is why we balance each and every chemical reaction.

Law of Constant Proportions, [Law of Definite proportion]

It states that in a pure chemical compound, the elements are always combined in fixed [definite] proportions by mass, e.g. water, prepared from any source contains hydrogen and oxygen in the ration of 2 : 16 (i.e. 1 : 8 by mass). If 18g of H_2O is decomposed we will get 2 g of H_2 and 16 g of O_2. Similarly, in NH_3 nitrogen and hydrogen are in the ration of 14 : 3 by mass, whatever method or source is used for preparation of NH_3

Dalton's Atomic Theory

a) All matter is made up of atoms
b) Atoms are tiny, indivisible and indestructive ultimate particles
c) Atoms of a given element are identical in mass and chemical properties.
d) Atoms of different elements have different masses and chemical properties
e) Atoms combine in the ratio of small whole number to form compounds.
f) Atoms are neither created nor destroyed.

Relative Molecular Mass

No. of times given molecule is heavier that 1/12th mass of 1 atom of $^{12}_{6}C$ atom.

Unified Mass

Mass of 1/12th of 1 atom of $^{12}_{6}C$

Molecular formula

Formula which contains exact number of atoms, e.g. $C_6H_{12}O_6$, C_6H_6

Empirical formula

Formula which contains simple ratio of atoms of elements CH_2O, CH, OH, BH_3

Ionic compounds

Consist of ions, e.g. Na^+Cl^-, K^+Cl^-, $CaCl_2$, AlF_3

Covalent compounds

Do not forms, ions, e.g. CCl_4, Ch_4, $H_{12}O_6$ C_2H_6, $C_{12}H_{22}O_{11}$

Symbols of elements

First letter of name as symbol There are 12 such elements.
Hydrogen (H), Boron (B), Carbon (C), Nitrogen (N), Oxygen (O), Sulphur (S), Fluorine (F), Iodine (I), Phosphorus (P), Vanadium (V), Yttrium (Y), Uranium (U).

The symbols of the following elements are the first two letters of their full names, The first letter of a symbol is always written in capital, the second letter, if any, is a smaller letter.

	Name of Elements	Symbol		Name of Elements	Symbol
1	Beryllium	Be	23	Xenon	Xe
2	Lithium	Li	24	Barium	Ba
3	Helium	He	25	Lanthanum	La
4	Neon	Ne	26	Tantalum	Ta
5	Aluminium	Al	27	Osmium	Os
6	Silicon	Si	28	Bismuth	Bi
7	Argon	Ar	29	Polonium	Po
8	Calcium	Ca	30	Francium	Fr
9	Scandium	Sc	31	Radium	Ra
10	Titanium	Ti	32	Actinium	Ac
11	Cobalt	Co	33	Cerium	Ce
12	Nickel	Ni	34	Praseodymium	Pr
13	Gallium	Ga	35	Europium	Eu
14	Germanium	Ge	36	Dysprosium	Dy
15	Selenium	Se	37	Holmium	Ho
16	Bromine	Br	38	Erbium	Er
17	Krypton	Kr	39	Lutetium	Lu
18	Molybdenum	Mo	40	Thorium	Th
19	Rhodium	Rh	41	Americium	Ar
20	Indium	In	42	Nobelium	No

The symbols of the following elements comprise the first and the third letters of their full names:

	Name of Elements	Symbol
1	Magnesium	Mg
2	Chlorine	Cl
3	Chromium	Cr
4	Manganese	Mn
5	Zinc	Zn
6	Arsenic	As
7	Rubidium	Rb
8	Strontium	Sr
9	Zirconium	Zr
10	Technetium	Tc
11	Rhenium	Re
12	Astatine	At
13	Samarium	Sm
14	Gadolinium	Gd
15	Neptunium	Np
16	Plutonium	Pu
17	Cadmium	Cd
18	Caesium	Cs
19	Hafnium	Hf

The symbol of the following elements comprise the first and the fourth letters of their full names

Name of Elements	Symbols
1. Einsteinium	Es
2. Fermium	Fm
3. Neodymium	Nd
4. Niobium	Nb
5. Platium	Pt
6. Promethium	Pm
7. Terblum	Tb
8. Thallium	Ti
9. Berkelium	Bk

The following symbols are derived from Latin names of elements

Name of Elements	Latin Names	Symbols
1. Copper	Cuprum	Cu
2. Iron	Ferrum	Fe
3. Lead	Plumbum	Pb
4. Mercury	Hydrargyrum	Hg
5. Potassium	Kalium	K
6. Silver	Argentum	Ag
7. Tin	Stannum	Sn
8. Antimony	Stibium	Sb
9. Sodium	Natrium	Na
10. Gold	Aurum	Au
11. Tungsten	Wolfram	W

List of Common Electropositive Radicals

Monovalent	Divalent	Trivalent	Tetravalent	
Hydrogen, H^+	Cupric, Cu^{2+}	Aluminium, Al^{3+}	Stannic, Sn^{4+}	Sulphur, S^{4+} in SO_2
Sodium, Na^+	Barium, Ba^{2+}	Ferric, Fe^{3+}	Plumbic, Pb^{4+}	Manganese in $MnO_2 Mn^{4+}$
Potassium, K^+	Calcium, Ca^{2+}	Chromium, Cr^{3+}	Platinum, Pl^{4+}	
Cuprous, Cu	Mercuric, Hg^{2+}	Auric, Au^{3+}	Carbon, C^{4+}	
Mercurous, Hg^+	Cobalt, Co^{2+}	Arsenious, As^{3+}	Nitrogen in NO_2	
Silver, Ag^+	Stannous, Sn^{2+}	Bismuth, Bi^{3+}	And N_2O_4, N^{4+}	
Ammonium, NH_4^+	Nickel, Ni^{2+}	Boron, B^{3+}	Silicon, Si^{4+}	
Aurous, Au^+	Ferrous, Fe^{2+}	Antimonous, Sb^{3+}	**Pentavalent**	
Lithium, Li^+	Magnesium, Mg^{2+}	Phosphorus, P^{3+}	Arsenic, As^{5+}	
Rubidium, Rb^+	Manganese, Mn^{2+}	Nitrogen in N_2O_3, N^{3+}	Antimonic, Sb^{5+}	
Caesium, Cs^+	Cadmium, Cd^{2+}	Gallium, Ga^{3+}	Phosphorus, P^{5+}	
Nitrogen, in $N_2O(N^{1+})$	Strontium, Sr^{2+}	Scandium, Sc^{3+}	Vanadium, V^{5+}	
	Zinc, Zn^{2+}		Nitrogen in $N_2O_5 N^{5+}$	
	Plumbous, Pb^{2+}			
	Beryllium, Be^{2+}			
	Nitrogen in NO, N^{2+}			
	Palladium, Pd^{2+}			

List of Common Electronegative Radicals

Monovalent	Divalent	Trivalent	Tetravalent
Fluoride, F^-	Carbonate, CO_3^{2-}	Phosphate, PO_4^{3-}	Carbide, C^{4-}
Chloride, Cl^-	Sulphide, S^{2-}	Arsenate, AsO_4^{3-}	Ferrocyanide, $[Fe(CN)_6]^{4-}$
Superoxide, O_2^-	Sulphite, SO_3^{2-}	Phosphite, PO_3^{3-}	Silicide, , Si^{4-}
Bromide, Br^-	Sulphate, SO_4^{2-}	Arsenite, AsO_3^{3-}	Pyrophosphate ion, $P_2O_7^{4-}$
Iodide, I^-	Thiosulphate, $S_2O_3^{2-}$	Borate, BO_3^{3-}	
Hydride, H^-	Oxide, O^{2-}	Phosphide, P^{3-}	
Cyanide, CN^-	Peroxide, O_2^{2-}	Nitride, N^{3-}	
Acetate, CH_3COO^-	Chromate, CrO_4^{2-}	Ferricyanide, $[Fe(CN)_6]^{3-}$	
Sulphocyanide	Dichromate, $Cr_2O_7^{2-}$	Boride, B^{3-}	
Or (thiocyanate) SCN^-	Oxalate, $C_2O_4^{2-}$	Arsenate, AsO_4^{3-}	
Nitrite, NO_2^-	Manganate, MnO_4^{2-}		
Nitrate, NO_3^-	Silicate, SiO_3^{2-}		
Hydrogen Sulphate, HS^-	Stannite, SnO_2^{2-}		
Hydrogen Sulphate, HSO_3^-	Stannate, SnO_3^{2-}		
Hydrogen Sulphate, HSO_4^-	Zincate, ZnO_2^{2-}		
Hydrogen carbonate, HCO_3^-	Plumbite, PbO_2^{2-}		
Chlorate, ClO_3^-	Plumbate, PbO_3^{2-}		
Bromate BrO_3^-	Hydrogen Phosphate, HPO_4^{2-}		
Iodate, IO_3^-			
Hypochorite, ClO^-			
Hypobromate, BrO^-			
Hypoiodite, lO^-			
Hypophosphite, $H_2PO_2^-$			
Perchlorate ClO_4^-			
Permanganate, MnO_4^-			
Cyanate, CNO^-			
Isocyanate, NCO^-			
Isothiocyanate, NCS^-			
Meta-aluminate, AlO_2^-			
Hypophosphate, $H_2PO_4^-$			
(Dihydrogen Phosphate)			

MODERN PERIODIC TABLE

METALS | **METALLOIDS** | **Non-Metals**

The Zigzag line seperates the metals from the non metals

PERIODS	1	GROUPS → 2	GROUP NUMBERS 3	4	5	6	7	8	9	10	11	12	GROUP NUMBER 13	14	15	16	17	18
1	1 H Hydrogen 1.0																	2 He Helium 4.0
2	3 Li Lithium 6.9	4 Be Berillium 9.0											5 B Boron 10.8	6 C Carbon 12.0	7 N Nitrogen 14.0	8 O Oxygen 14.0	9 F Fluorine 19.0	10 Ne Neon 20.2
3	11 Na Sodium 23.0	12 Mg Megnesium 24.3											13 Al Aluminium 27.0	14 Si Silicon 28.1	15 P Phosphorus 31.0	16 S Sulpher 32.1	17 Cl Chlorine 35.5	18 Ar Argon 39.9
4	1 9 K Potassiam 39.1	20 Ca Calcium 40.1	21 Sc Scandium 45.0	22 Ti Titanium 47.8	23 Va Vanadium 50.9	24 Cr Chromium 52.0	25 Mn Manganese 54.9	26 Fe Iron 55.9	27 Co Cobalt 58.9	28 Ni Nickel 58.7	29 Cu Copper 63.5	30 Zn Zinc 65.4	31 Ga Gallium 69.7	32 Ge Germanium 72.6	33 As Arsenic 74.9	34 Se Selenium 79.0	35 Br Bromine 79.9	36 Kr Krypton 83.3
5	37 Rb Rubidium 85.5	38 Sr Strontium 87.6	39 Y Yitrium 88.9	40 Zr Zirconium 91.2	41 Nb Niobium 92.9	42 Mo Molybdenum 95.9	43 Pc Pechnetiym 99	44 Ru Rothenium 101.1	45 Rh Rhodium 102.3	46 Pd Palladium 106.4	47 Ag Silver 107.9	48 Cd Cadmium 112.4	49 In Indium 114.8	50 Sn Tin 118.7	51 Sb Antimony 121.8	52 Te Tellurnium 127.6	53 I Iodine 126.9	54 Xe Xenon 131.3
6	55 Cs Caesium 132.9	56 Ba Barium 137.3	57 La Lantharum 138.9	72 Hf Hafnium 178.5	73 Ta Tantanlum 181.0	74 W Tungsten 183.9	75 Re Rhenium 186.2	76 Os Osmium 190.2	77 Ir Irdium 192.2	78 Pt Platinum 195.1	79 Au Gold 197.0	80 Hg Mercury 200.6	81 Tl Thallium 204.4	82 Pb Lead 207.2	83 Bi Bismuth 209.0	84 Po Polonium 210	85 At Astatani 210	86 Rn Radon 222
7	87 Fr Francium 223	88 Ra Radium 226	89 Ac Actinium 227	104 Rf Rutherodium 261	105 Db Dubnium 262	106 Sg Seaborgium 271	107 Bh Bohrium 272	108 Hs Hassium 270	109 Mt Meitnerium 228	110 Ds Darmstadtium 281	111 Rg Roentgenium 280	112 Cn Coternicium 285	113 Nh Nihonium 284	114 Fl Flerovium 289	115 Mc Moscovium 288	116 Lv Livermorium 293	117 Ts Tennessine 294	118 Og Oganession 294

104 Rf Ernest Rutherod, Physicist
105 Db Dubna, Russia where the element is first synthesized
106 Sg Glenn T. Seaborg, Chemist
107 Bh Neils Bohr's theory, Physicist
108 Hs Hesse, German state where the element is first synthesized
109 Mt Lise Meitner, Physicist
110 Ds GSI Helmhotiz Centre for Heavy Ion Research, Darmstaltt, Germany.
111 Rg Wilhelm Roentgen, Physicist, Discovered X – rays.
112 Cn Nicolaus Copernicus, Astronomer.
113 Nh The Japnese name for Japan, Nihon where the element is first synthesised
114 Fl Georgy Flyoror, Physicist
115 Mc Moscow oblast, Russia where the element is first synthesized
116 Lv Lawrence Livemore National Laboratory, Livemore, California
117 Ts Tennessee, United States
118 Og Yuri oganessian, Physicist.

*LANTHONOIDES	58 Ce Cerium 140.1	59 Pr Praseodymium 140.9	60 Ne Neodymium 144.2	61 Pm Promethium 145	62 Sm Samarium 150.4	63 Eu Europium 152.0	64 Gd Gadolinium 157.3	65 Tb Terbium 158.9	66 Dy Dysprosium 162.5	67 Ho Homium 164.9	68 Er Erbium 167.3	69 Tm Thulium 168.9	70 Yb Yiterbium 173.0	71 Lu Lutetium 175.5
*ACTONOIDES	90 Th Thorium 232.0	91 Pa protaqctiniu m 231	92 U Uranium 238.1	93 Np Neptulium 237	94 Pu Plupotonium 242	95 Am Americium 243	96 Cm Curium 247	97 Bk Berkelium 245	98 Cf Californium 251	99 Es Einstenium 254	100 Fm Fermium 253	101 Md mendelevium 256	102 No Nobelium 254	103 Lr Lawrencium 257

Know the Terms

Law of conservation of Mass

It state that matter can neither be created nor be destroyed in a chemical reaction. It means that the total mass of reactants must be equal to the total mass of products. That is why we balance each and every chemical reaction.

This law can be verified by the following experiment

Experiment : To prove experimentally that there is no change in mass during a chemical reaction.

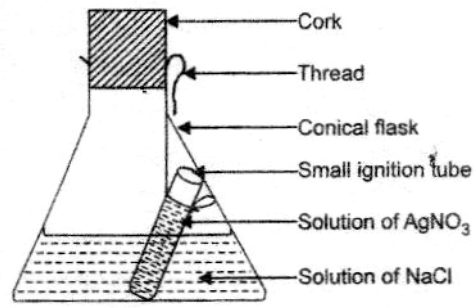
Materials Required : Physical balance, conical flask, small ignition tube, thread, cork to fit the flask, silver nitrate and sodium chloride.

Procedure : Prepare solution of silver nitrate in water and take it in the ignition tube.

- Prepare solution of sodium chloride in water and take it in the conical flask.
- Hang the ignition tube in the flask carefully so that the solutions do not get mixed. Put the cork on the conical flask as shown in figure
- Weight the flask with the contents carefully
- Now tilt and shake the flask so that both the solutions get mixed\
- Weigh again.

Observation : White precipitate of silver chloride is formed in the flask because chemical reaction has taken place. The mouth of flask should be covered so that the contents of solution do not spill out. The mass of flask does not change.

Conclusion : Mass of reactants remains equal to mass of products. Hence the law of conservation of mass is proved.



Experimental set up to prove law of conservation of mass

Activity / Project - 2

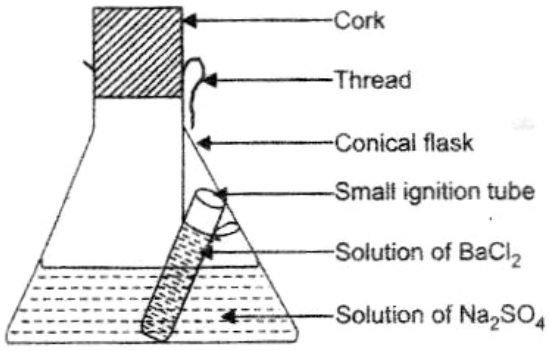
Topic Covered : Demonstration Based Worksheet

Objectives : To enable the students to –

- Observe and understand that the total mass of products and reactants in a chemical reaction is the same.
- Draw inference / appreciate that mass doesn't change in a chemical reaction.
- Understant the law of conservation of mass, i.e. the mass can neither be created nor be destroyed.

Procudure : Prepare the solution of barium chloride in water and take it in an ignition tube.

- Prepare solution of sodium sulphate in water and take it in a conical flask.
- Hang the ignition tube in the flask carefully so that the solutions do not get mixed, put the cork on the conical flask as shown in figure.
- Weigh the flask with the contents carefully.
- Now tilt and shake the flask so that both the solutions get mixed.
- Weigh the flask again.



Experimental set up to prove law of conservation of mass

Grade I X

Lesson : 3 Atoms and Molecules

Objective Type Questions

I. Multiple choice questions

1. 4.48 L of CH_4 at STP is equal to

   a) 1.2 x 10^{22} molecules of CH_4 b) 0.5 mol of CH_4

   c) 3.2 g of CH_4 d) 0.1 mol of CH_4

2. Which of the following illustrates the law of conservation of mass?

   a) 12g of C reacts with 32 g of 0_2 to form 44 g of $C0_2$

   b) 1.70 g of $AgNO_3$ reacts with 0.01 mol of HCl to form 1.435 g of AgCl and 0.63 g of HNO_3

   c) 12 g of C is heated in vacuum and cooling there is no change in mass

   d) 100 g of ice forms 100 g water liquid on melting.

3. If isotopic distribution of C-12 and C-14 are 98% and 2% respectively, then number of C-14 atoms in 12g of carbon is

   a) 1.032 x 10^{22} b) 1.032 x 10^{23} c) 3.88 x 10^{22} d) 1. 032 x 10^{22}

4. An element has 8% of sulphur. What will be the minimum molecular weight of the compound?

   a) 100 b) 200 c) 300 d) 400

5. Identify the correct symbol of Gold.

   a) Go b) Gd c) Ge d) Au

6. Identify the correct one from the following statements

   a) Elements can be changed into simpler substances.

   b) Compound has variable composition

   c) The mixture has properties similar to its components.

   d) Brass is a compound of Copper and Zinc

7. The combining capacity of an element is called.

a) Valency b) Atomicity c) Atomic number d) Valence electron

8. 18 g of water is electrolysed. The weight of oxygen formed will be.

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

9. Which is not represented by 1 mole of nitrogen gas?

a) 6.023 x 10^{23} nitrogen molecules b) 22.4 L of N_2 at STP

c) 6.023 x 10^{23} nitrogen atoms d) 28 g of nitrogen.

10. The balancing of chemical equation is based on

a) Law of combining volume b) Law of conservation of mass

c) Law of constant proportion d) Avogadro's Law

11. 1.5 g of hydrocarbon on combustion in excess of oxygen produces 4.4 g of CO_2 and 2.7 g of H_20, the data illustrates

a) Law of conservation of mass b) Law of constant proportion

` c) Law of multiple proportion d) Both (a) and (b)

12. Which of the following is correct statement

a) Na_2S is Sodium sulphide, Na_2S0_3 is Sodium sulphite and Na_2S0_4 is Sodium sulphate

b) Na_2S is Sodium sulphite, Na_2S0_3 is Sodium sulphide and Na_2S0_4 is Sodium sulphate

c) Na_2S is Sodium sulphite, Na_2S0_3 is Sodium sulphate and Na_2S0_4 is Sodium sulphide

d) Na_2S is Sodium sulphide, Na_2S0_3 is Sodium sulphate and Na_2S0_4 is Sodium thiousulphate.

13. The formula of Ammonium phosphate is

a) $(NH_4)_3 PO_4$ b) $(NH_4)_3 PO_3$ c) $(NH_4)_3 P$ d) $(NH_4) PO_4$

14. Molecular weight of $CuSO_4 . 5H_2O$ is equal to

[Cu = 63.5 u, S=32 u, O = 16 u, H = 1 u]

a) 249.5 u b) 159.5 u c) 159.5 x 90 u d) 159.5 + 10+16u

15. 2 moles of H molecules at STP occupy volume of

a) 22.4 L b) 11.2 L c) 44.8 L d) 2L

16. How many moles of electrons weigh equal to one kilogram? [Mass of 1 e = 9.1 x 10^{-31} kg.

a) 6.022 x 10^{23} b) $\frac{1}{9.108}$ x 10^{31} c) $\frac{6.022}{9.108}$ x 10^{22} d) $\frac{1\ X\ 10^{8}}{9.1\ x\ 6.022}$

17. Arrange the following in decreasing order of mass

i. 10^{23} molecules of H_2 ii) 0.1 mol of H_0O

iii. 0.01 mole of atoms of Nitrogen iv) 2.24 L of O_2 at STP

a) IV, II, I, III b) IV, I, II, III c) IV, III, I, II d) IV, I, III, II

18. Arrange the following in increasing order of number of molecules.

I. O.5 mol of H_2 II. 4.0 g of H_2 III. 18g of H_2O IV. 2.2g CO_2

(a) II > III > I > IV (b) IV < I < III < II

(C) I < II < III < IV (d) IV < III < I < II

19 How many atoms are present in 52 u of He?

(a) 13 atoms (b) 13 X 6.022 X 10^{23} atoms

(C) 52 X 6.022 X 10^{23} atoms (d) 4 X 6.022 X 10^{23} atoms

20. The mass of sodium in 5.85g of NaCl is

(a) 2.3 g (b) 3.5 g (c) 5.8 g (d) 0.23 g

21. The mass of magnesium oxide formed by burning 1.2 g of Mg in excess of oxygen is

(a) 0.2 g (b) 2.0 g (c) 4.0 g (d) 1.0 g

22. Which of the following contains maximum number of atoms?

(a) 2.0 moles of S_8 (b) 6.0 moles of S (c) 2.0 moles of SO_2 (d) 44.8 L of SO_2 at STP

23. A sample of AIF_3 contains 3.0 X 10^{24} F^- ions. The number of formula units of this sample is

(a) 3.0 X 10^{24} (b) 1.0 X 10^{24} (c) 9.0 X 10^{24} (d) 3.0 X 10^{23}

24. Out of 1.0 g oxygen gas, 1.0 g of oxygen atoms and 1.0 g of ozone, the maximum number of atoms are contained in

(a) 1.0 g of atomic oxygen (b) 1.0 g of oxygen

(c) 1.0 g of ozone (d) All contain same number of atoms

25. Which pair of species contains same percentage of carbon?

(a) CH_3COOH and $C_6H_{12}O_6$ (b) $C_6H_{12}O_6$ and $C_{12}H_{22}O_{11}$

(c) CO_2 and CH_4 (d) CH_4 and C_2H_6

26. The mass of 18 ml of water (H_2O) at 4^0 C is equal to

(a) 18 g (b) < 18 g (c) > 18 g (d) 4 g

27. If the density of water is 1 g cm^{-3} then the volume occupied by one molecule of water is approximately

(a) $18cm^3$ (b) $22400cm^3$ (c) 6.023 X $10^{-23}cm^3$ (d) 2.9 X $10^{-23}cm^3$

28. The number of atoms present in 0.5 mol of nitrogen atoms is same as in

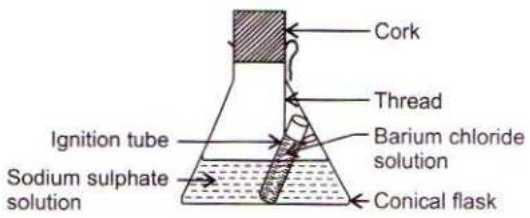
(a) 12 g of C (b) 24 g of Mg (c) 8 $g\ of\ O$ (d) 32 $g\ of\ S$

29. NaOH (aq) + $HNO_3\ (aq)$ ⟶ $NaNO_3\ (aq)$ + H_2O(l) in this reaction Nitric acid acts as

(a) 12 g of C (b) 24 g of Mg (c) 8 $g\ of\ O$ (d) 32 $g\ of\ S$

30. Activity:

- Prepare solution of barium, chloride in water and take it in an ignition tube.
- Prepare solution of sodium sulphate in water and take it in a conical flask.
- Hang the ignition tube in the flask carefully so that the solutions do not get mixed. Put the cork on the conical flask as shown in figure.
- Weigh the flask with the contents carefully.
- Now tilt and shake the flask so that both the solutions get mixed.
- Weigh again.



Which law is verified by this activity?

a) Las of conservation of mass b) Law of constant composition

c) Law of multiple proportion d) both a and b

31. Which of the following correctly represents 360 g of water?

i) 2 moles of H_2O ii) 20 moles of water

iii) 6.022 x10^{23} molecules of water iv) 1.2044 x 10^{25} molecules of water

a) (i) b. i) and iv) c. ii) and iii) d. ii and iv

32. Which of the following statements is not true about an atom?

a) Atoms are not able to exist independently

b) Atoms are the basic units from which molecules and ions are formed

c) Atoms are always neutral in nature

d) Atoms aggregate in large numbers to form the matter that we can see, feel or touch

33. The chemical symbol for nitrogen gas is

a) Ni b) N_2 c) N^+ d) ii) and iv

34. The chemical symbol for sodium is

a) So b) Sd c) NA d) Na

35. Which of the following would weigh the highest?

a) 0.2 mole of sucrose (C_{12} H_{22} O_{11}) b) 2 moles of CO_2

c) 2 moles of C_a CO_3 d) 10 moles of H_2O

36. Which of the following has maximum number of atoms?

a) 18 g H_2O b) 18 g O_2 c) 18 g CO_2 d) 18 g CH_4

37. Which of the following contains maximum number of molecules?

a) 1g CO_2 b) 1g N_2 c) 1g H_2 d) 1g CH_4

1.c	2.b	3. a	4. d	5. d	6. c	7. a	8. a	9.c	10. b
11. a	12. a	13. a	14. a	15. a	16. d	17. a	18. b	19. a	20. a
21. b	22. a	23. b	24. b	25. a	26. a	27. d	28. c	29. a	30. a
31. d	32. a	33. b	34. d	35. c	36. d	37. a			

I. Match the column

38. Match the column I with Column II

Column I	Column II
i) Quick lime	A) NaOH
ii) Baking soda	B) CaO
iii) Washing soda	C) $Ca(OH)_2$
iv) Lime water	D) $NaHCO_3$
v) Caustic soda	E) $Na_2CO_3.10H_2O$

i) B ii) D iii) E iv) C v) A

II. Match the column

39. Match the following:

Elements	Symbols
i) Sodium	(A) Ag
ii) Mercury	(B) Hg
iii) Lead	(C) Na
iv) Silver	(d) Pb

i) C ii) B ii) D iv) A

I. Fill in the blanks

40. An _____ is a positively or negatively charged atoms.

41. The _____ of an ion is equal to the charge on the ion

40. ion	41. valency

I. True or False

42. 32 g of O_2 has volume equal to 22.4 L at STP.

43 0.2 mol of oxygen atom weighs equal to 3.2 g

44. 52 u of He contains 13 atoms.

42. True	43. True	44. True

Direction (Q 45 to Q 49) : In the following Question, the Assertion and Reason have been put forward. Read the statements carefully and choose the correct alternative from the following:

a) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion

b) The Assertion and the Reason are correct but the Reason is not the correct explanation of the Assertion.

c) Assertion is true but the Reason is false

d) The statement of the Assertion is false but the Reason is true.

45. Assertion : The standard unit for expressing the mass of a atom is 'u'

Reason : 'u' is also called unified mass.

b) The Assertion and the Reason are correct but the Reason is not the correct explanation of the Assertion.

46. Assertion : Zinc is essential element for life and Cadmium is extremely toxic.

Although both belong to same group in periodic table.

Reason: Zinc is useful as it is integral part of most of the enzymes. Cadmium present in cigarette smoke, it accumulates in kidney and causes its malfunctioning. It replaces some of zinc in enzymes and thus prevents them from working.

a) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion

47. Assertion: The mass of 1 atom of hydrogen is 1.66 x 10^{-24}g.

Reason : 1 mass of 1 atom is 1 u

b) The Assertion and the Reason are correct but the Reason is not the correct explanation of the Assertion.

48. Assertion : Water obtained by every source contains hydrogen and oxygen in the ratio of 1:8 by mass.

Reason : On electrolysis of H_2O volume of hydrogen obtained is double than that of oxygen.

b) The Assertion and the Reason are correct but the Reason is not the correct explanation of the Assertion.

49. Assertion : 52 u of He contains 13 atoms.

Reason : 4 u is mass of one atom of He

a) Both the Assertion and the Reason are correct and the Reason is the correct explanation of the Assertion

50. What is an atom ?

The smallest particle which may or may not exist in free state in nature but takes part in a chemical reaction.

51. What is a molecule?

It is made up of atoms. It exists in nature in free state.

52. Define atomicity.

Atomicity is the number of atoms present in a molecule.

53. How many atoms are present in one molecule of ozone?

Three atoms are present in 1 molecule of ozone because it is triatomic

54. Give an example of (a) triatomic (b) polyatomic molecule of elements.

a) O_3 (Ozone) b)S_8 (Sulphur) or P_4 (Phosphorus)

55. Define the law of constant proportion

A compound prepared by any method contains the same elements in the fixed ratio by mass is the law of constant proportion.

56. What is the ratio between masses of (a) hydrogen and oxygen in H_2O (b) nitrogen and hydrogen in NH_3? [Atomic mass of H=1 u, =16 u, N= 14 u]

a) H_2O b) NH_3

2: 16 14 : 3 by mass

1: 8 by mass

57. What is the ratio between masses of carbon and oxygen in CO_2?

[Atomic mass of C=12 u, O=16u]

CO_2

12: 32

3: 8 BY mass.

58. As per the law of definite proportions carbon and oxygen combine in a ratio of 3: 8. Compute the mass of oxygen gas that would be required to react completely with 6 g carbon.

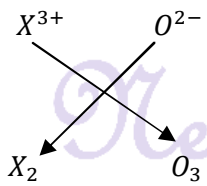
3g of carbon combines with 8 g of oxygen

$\therefore$ 6 g of carbon will combine with $= \frac{8}{3} \times 6 = 16$ g of oxygen.

59. Name the anion and cation which constitute the molecule of magnesium oxide.

Mg^{2+} is cation O^{2-} is anion

60. An element X has a valency 3. Write the formula of its oxide.



61. Name the international organisation which approves the name given to the elements

IUPAC, International Union of Pure and Applied Chemistry.

62. The oxide of aluminium has a chemical formula AI_2O_3. State the valency of Al

The valency of Al =3

63. Write the symbol for following elements.

a) Iron **b) Potassium**

a) Iron-Fe b) Potassium-K

64. Calculate formula unit mass of sugar ($C_{12}\ H_{22}\ O_{11}$)

Formula unit mass of $C_{12}\ H_{22}\ O_{11}$

= 12C + 22H + 11O

= 12 x 12+ 22x1 +11 x 16

= 144 + 22 + 176 = 342 u.

65. Give the difference between a cation and an anion?

Cations are positively charged particles having protons more than electrons

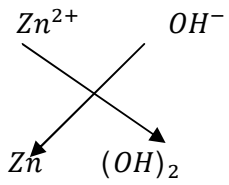
Anions are negatively charges particles having electrons more than protons.

66. Write the names of the following compounds

a) $A1_2\ (SO_4)_3$ **b) NH_4OH**

a) Aluminium sulphate b) Ammonium hydroxide

67. Write the chemical formula of the compound zinc hydroxide.



$Zn\ (OH)_2$ is the formula of zinc hydroxide.

68. Find the formula unit mass of $NaHCO_3$

[Atomic mass of Na = 23u, H = 1 u, C = 12 u, O = 16 u.

Formula unit mass of $NaHCO_3$

= 1Na + 1 H + 1C + 30

= 23 +1 +12 +3 x16

= 23 +1 + 12 + 48 = 84 u

69. Calculate the formula unit mass of Na_2CO_3

[Atomic mass of Na = 23u, C = 12 u, O = 16 u.

Formula unit mass of Na_2CO_3

= 2Na + 1C + 3O

= 2 x 23 + 1 x 12 + 3 x 16

= 46 + 12 + 48 = 106 u

70. Write the names of the compounds

a) Ag_2O **b) Cu S**

a) Ag_2O is called silver oxide.

b) CuS is called copper (II) sulphide

71. What is the formula of ammonium chloride?

NH_4Cl

72. How many atoms are there in one gram of hydrogen?

1 gram of hydrogen contains 6.022 x 10^{23} atoms.

73. How many atoms are present in 0.012 kg of C-12? What is the name given to this constant?

6.022 x 10^{23} atoms are present . It is called Avogadro's constant.

74. What is meant by Avogadro's constant?

Avogadro's constant Is equal to 6.022 x 10^{23} particles.

75. Select an element that is:

a) More ductile **b) liquid at room temperature**

a) Gold b) Mercury

76. State the law of constant proportions.

Law of constant proportions (Law of definite proportion): This law states that in a pure chemical compound, the elements are always combined, the elements are always combined in fixed (definite) proportions (ratio) by mass.

77. Show that water illustrates the law of constant proportions.

Water, prepared from any source contains hydrogen and oxygen in the ration of 2 : 16 (i.e. 1: 8 by mass) . If 18 g of H_2 O is decomposed we will get 2 g of H_2 and 16g of O_2

78. Define atomic mass unit.

Atomic mass unit is defined as $\frac{1}{12}$ th of the mass of 1 atom of C- 12. It is called unified mass 'u' these days.

79. Hydrogen and oxygen combine in the ratio 1: 8 by mass to form water. What mass of oxygen gas would be required to react completely with 4 g of hydrogen gas?

1 g of H_2 reacts with 8 g of O_2

4 g of H_2 reacts with 8 x 4 = 32 g of O_2

80. Give one word for the following :

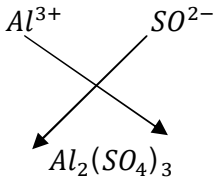
a) Positively charged ion **b) A group of atoms carrying a charge.**

a) Cation b) Polyatomic ion

81. Mention any two important rules for writing a chemical formula

a) Write valency or charge on atoms or radicals

b) Criss – cross the valency, e.g.



82. Calculate the formula unit mass of $CaCl_2$ [Atomic amss of Ca = 40u, Cl = 35.5u)]

Forumula unit mass of $CaCl_2$

= 1Ca + 2Cl = 40 x 1 + 2 x 35.5

= 40 +71 = 111u

I. SHORT ANSWER TYPE QUESTIONS

83. (a). How would you differentiate between a molecule of an element and a molecule of a compound? Write one example of each type.

(b). Write the chemical formula of baking sode [CBSE 2012]

(a) Molecule of an element contains the same kind of atoms. E.g. P_4 is a molecule of element which contains all four atoms of phosphorus.

Molecule of a compound contains two or more kinds of atoms. E.g. $.H_2O$ is a molecule of compound which contains 2 atoms of hydrogen and 1 atom of oxygen.

(b) $NaHCO_3$ is the chemical formula of baking soda.

84. Define atomicity. Give an example of each of monatomic, diatomic, tetra-atomic and polyatomic molecules.

Atomicity is defined as number of atoms present in a molecule. He is monoatomic. $.H_2$ is diatomic, $.P_4$ is tetra-atomic and $.S_8$ is polyatomic molecules.

85. Classify the following compounds as diatomic, triatomic and polyatomic molecules:

HCl,H_2, H_2O *and* NH_3

Diatomic : HCl, H_2

Triatomic : H_2O

Polyatomic : NH_3

86. The percentage of three elements, calcium, carbon and oxygen in a sample of calcium carbonate is given as:

Calcium = 40%; Carbon = 12%; Oxygen = 48%

If the law of constant proportion is true, what weight of these elements will be present in 1.5g of another sample of calcium carbonate?

[Atomic mass of Ca=40u, C=12u, O=16u]

The other compound will also contains the same percentage of elements.

Calcium = 40%; Carbon = 12%; Oxygen = 48%

100g of $CaCo_3$ contains 40g of Ca

1.5g of $CaCo_3$ contains $\frac{40}{100} X$ 1.5 = 0.6g of Calcium

100g of $CaCo_3$ contains 12g of Carbon

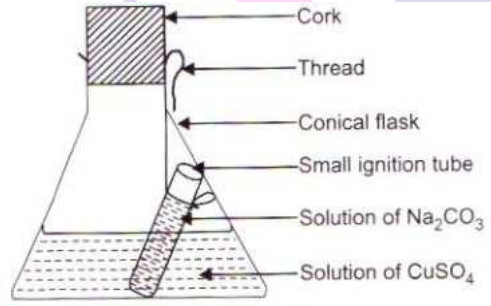
1.5g of $CaCo_3$ contains $\frac{12}{100} x$ 1.5 = 0.18g of Carbon

Also, 100g of $CaCo_3$ contains 48g of oxygen.

1.5 g of $CaCo_3$ contains $\frac{48}{100} x$ 1.5 = 0.72g of Oxygen

87. How will you prove experimentally the law of conservation of mass

- Take copper sulphate solution and dissolve it in water in a conical flask.
- Now take solution of sodium carbonate in the ignition tue and hang it carefully so that the two do not get mixed. Put a cork on the flask.



Experimental set up to prove law of conservation of mass

- Weight the flask with its content carefully,
- Now tilt and shake the flask so that the solutions of copper sulphate and sodium carbonate get mixed
- Weigh again
- The chemical reaction takes place in flask.
- Put cork on the mouth of the flask so that reactants and products do not spill out of flask.
- The mass of flask and its contents remain the same before as well as after the reaction that proves the law of conservation of mass.

88. (a)When 5g of calcium is burnt in 2g of oxygen then 7g of calcium oxide is produced. What mass of calcium oxide will be produced when 5 g of calcium is burnt in 20g of oxygen. Which law of chemical combination will govern your answer? State the law.

(b) Write the chemical formula of calcium oxide.

(a) $2Ca + O_2 \rightarrow 2CaO$

80g of Ca reacts 32g of oxygen

5g of Ca reacts $\frac{32}{80}X5 = 2g\ of\ oxygen.$

5g of Ca will react only with 2g of oxygen out of 20g of oxygen and 18g of O_2 will remain unreacted.

Law of definite proportion : It state the compound formed by any method will contain the same element with the fixed ratio by mass.

(b) CaO is the formula of calcium oxide.

89 (i) Write the full form of IUPAC.

(ii. Hydrogen and oxygen combine in the ration of 1 : 8 by mass to form water. What mass of oxygen gas would be required to react completely with 3g of hydrogen gas [CBST 2016]

(i) International Union of Pure and Applied Chemistry

(ii) 1g of H_2 combines with 8g of oxygen. 3g of H_2 combines with 8 x 3 = 24 g of oxygen.

90. Write the formulae of

(a) Magnesium hydroxide

(b) Hydrogen sulphide

(c) Potassium chloride

(d) Calcium oxide

(e) Barium chloride

(f) Sodium Carbonate

(a) Mg^{2+} OH^-

$Mg(OH)_2$

b) H^+ S^{2-}

H_2S

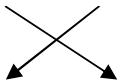
c) K^+ Cl^-

KCl

d) Ca^{2+} O^{2-}

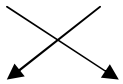
CaO

e) Ba^{2+} Cl^{-}



$BaCl_2$

d) Na^{+} $CO_3{}^{2-}$



Na_2CO_3

91. a) Define atomic mass unit

b) Distinguish between molecular mass and molar mass

c) Give an example for the following.

i) Diatomic

ii) Triatomic molecule of compounds

a) It is defined as $\frac{1}{12}$ th of the mass of 1 atom of C-12

b) Molecular mass is the mass of molecule. Molar mass is the mass of 6.22 x 10^{23} molecules

c) i) HCl is diatomic molecule of compound

ii) H_2O is triatomic molecule of compound.

92. An element 'X' forms an oxide with formula X_2O_3

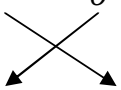
a) State the valency of X

b) Write the formula of

i) Chloride of X, ii) Sulphate of X.

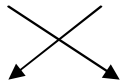
a) X has valency equal to 3

$\because$ X^{3+} O^{2-}



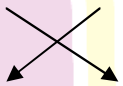
X_2O_3

b) i) X^{3+} CL^{-}



XCl_3

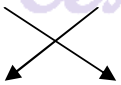
ii) X^{3+} $SO_3{}^{2-}$



$X_2\ (SO_4)_3$

93. Using criss-cross , method write the chemical formulate of copper chloride, calcium` sulphate and sodium phosphate

i) Cu^{2+} CL^{-}

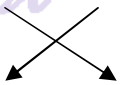


$CuCl_2$

ii) Ca^{2+} $SO_4{}^{2-}$

$CaSO_4$

iii) Na^{+} $PO_4{}^{3-}$



Na_3PO_4

94) a) What are polyatomic ions?

b) Write the formulae and names of the compounds formed by combination of

i) Fe^{3+} and $SO_4{}^{2-}$ **ii) $NH_4{}^{+}$ and $CO_3{}^{2-}$**

a) Those icons which contain two or more than two atoms are called polyatomic ions.

b) i) Fe^{3+} and $SO_4{}^{2-}$

$Fe_2(SO_4)_3$

Iron (III) sulphate

ii) $NH_4{}^{+}$ $CO_3{}^{2-}$

$(NH_4)_2CO_3$

Ammonium carbonate

95. Write the formulae of :

a) Sodium chloride **b) Aluminium oxide**

c) Ammonium sulphate

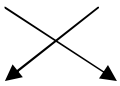
a) Na^{+} Cl^{-}

NaCl

b) Al^{3+} O^{2-}

Al_2O_3

c) $NH_4{}^{+}$ $SO_4{}^{2-}$



$(NH_4)_2SO_4$

96. a) Define polyatomic ion

b) Write the name of the compound $(NH_4)_2SO_4$ and mention the ions present in it.

a) Those icons which contain two or more than two atoms are called polyatomic ions.

b) Ammonium sulphate. $NH_4{}^{+}$ and $SO_4{}^{2-}$ ions are present in it.

97. Calculate the number of moles present in

a) 60 g of calcium

b) 3.011 x 10^{23} number of oxygen atoms.

[Given that Ca = 40 u ; Avogadro number N_a = 6.022 x 10^{23} per mole]

a) Number of moles of Ca = $\frac{Given\ mass\ of\ Calcium}{Molare\ mass\ of\ Calcium}$

$= \frac{60}{40}$ = 1.5 moles

b) Number of moles = $\frac{Given\ number\ of\ molecules}{6.022 \times 10^{23}}$

$= \frac{3.011\ x\ 10^{23}}{6.022 \times 10^{23}}$ = 0.5 moles

98. Calculate the number of molecules of phosphorus (P_4) present in 248 g of solid phosphorus

[Given Atomic mass of phosphorus = 31. Ou.

N_A = 6.022 x 10^{23} per mole]

Number of molecules of P_4

$= \frac{Given\ mass}{Molar\ mass}$ x 6.022 x 10^{23}

$= \frac{248}{31\ X\ 4}$ = 6.022 x 10^{23} = 2 x 6.022 x 10^{23}

= 12.044 x 10^{23} = 1.2044 x 10^{24} molecules

99. If hydrogen and oxygen in a ratio of 1: 8 by mass respectively to form water molecule. Explain how many moles of water will be formed using 10 moles of hydrogen gas and 5 moles of oxygen gas?

$2H_2$ (g) + O_2 (g) $2H_2$ O (l)

2 moles of H_2 reacts with 1 mole of O_2 to moles of O_2 to form 2 moles H_2O

∴ 2 moles of H_2 reacts with 5 mole of O_2 to moles of O_2 to form 10 moles of water.

100. Ravi prepared a solution of sodium chloride by mixing 5.85 g of salt in 1 litre of water. Find

a) Molar mass of sodium chloride

b) Number of moles of sodium chloride dissolved

[Atomic masses of sodium and chlorine are 23 u and 35.5 u respectively].

c) Concentration of the sodium chloride solution.

a) Molar mass of NaCl = 23 + 35.5

= 58.5 g mol^{-1}

b) Number of moles of NaCl =

$= \frac{Mass\ of\ Nacl}{Molare\ mass\ of\ Nacl} = \frac{5.85}{58.5}$ = 0.1 mol

c) Concentration of solution

$= \frac{Mass\ of\ solute}{mass\ of\ solution}$ x 100

$= \frac{5.85}{5.85+1000}$ x 100 $= \frac{5.85}{1005.85}$ x 100 = 0.58%

101 (a) Define the term mole

(b) Calculate the no. Of

(i) atoms

(ii) molecules in 124 grams of phosphorus, P_4

[Given atomic mass of P = 31.0 u

N_A = 6.023 x $10^{23} mol^{-1}$]

(a) Mole is defined as counting unit and is equal to 6.022 x 10^{23} particles,

(b) (i) No of atoms

$= \frac{\text{Mass of phosphorus}}{\text{Molar mass of phosphorus}}$ x Atomicity x 6.022 x 10^{23}

$= \frac{124}{124}$ x 6.022 - 10^{23}

= 24.088 x 10^{23} = 2.4088 x 10^{24} atoms

(ii) No. Of molecules

$= \frac{\text{Mass of phosphorus}}{Molar\ mass}$

$= \frac{124}{124}$ x 6.022 - 10^{23}

= 6.022 x 10^{23} molecules

102. Calculate the number of atoms in 120 g of calcium and 120 g of iron. Which one has more number of atoms and how much is the difference?

[Given atomic mass of Calcium = 40 u, Iron = 56 u]

1 mole of Ca = 40 g

No. of atoms of calcium

= No. Of moles x 6.022 x 10^{23}

$= \frac{Given\ mass}{Molar\ mass}$ x 6.022 x 10^{23}

$= \frac{120}{40}$ x 6.022 x 10^{23}

= 18.066 x 10^{23} atoms

= 1.8066 x 10^{23} atoms

= 18.066 x 10^{23} atoms

No. Of atoms of iron

$= \frac{Given\ mass}{Molar\ mass}$ x 6.022 x 10^{23}

$= \frac{120}{56}$ x 6.022 x 10^{23}

$= \frac{72.264\ X\ 10^{24}}{56}$

$= 1.29\ X\ 10^{24}$

Calcium has more number of atoms

Difference in number of atoms

$= 1.81x\ 10^{24} - 1.29 \times 10^{24}$

$= 10^{24}\ (1.81 - 1.29)$

$= 0.52 \times 10^{24} = 5.2 \times 10^{24}$ atoms

103. a) Calculate the number of molecules in 50 g of $CaCO_3$

b) Calculate the mass of 0.5 moles of nitrogen gas.

c) Calculate the number of moles in 50 g of NaCl.

[Atomic mass of Ca = 40 u, c= 12u, O = 16 u N = 14u, Na = 23 u, Cl = 35.5 u, $N_A = 6.022 \times 10^{23}\ mol^{-1}$]

a) Molecular mass $CaCO_3$

$= 40 + 12 + 3 \times 16 = 40 + 12 + 48$

$= 100$ g

$\because$ 100 g $CaCO_3$ contains 6.022×10^{23} molecules

$\therefore$ 50 g $CaCO_3$ contains $\frac{6.022 \times 10^{23}}{100} \times 50$

$= 3.011 \times 10^{23}$ molecules

b) 1 mole of N_2 gas = 28 g

$\therefore$ 0.5 mole of N_2 gas = $0.5 \times 28 = 14$ g

c) Molecular mass of NaCl = 23 + 35.5 = 58.5 g

$\because$ 58.5 g NaCl = 1 mole

$\therefore$ 50 g NaCl $= \frac{1}{58.5} \times 50$ moles

$= 0.855$ mole

104. a) Define one mole. How is it related to Avogadro's constant

b) Find the number of sodium ion in one mole of sodium sulphate

a) 1 mole is defined as equal to 6.022 x 10^{23} particles. It is also equal to molar mass in grams.

1 mole = Avogadro's constant

= 6.022 x 10^{23}

1 mole of Na_2SO_4 contains 2 moles of Na^+

2 moles of Na^+ = 2 x 6.022 x 10^{23}

= 12.044 x10^{23} = 1.2044 x 10^{24} Na^+ ions

105. a) Which among the following has more number of molecules :

1 g of hydrogen (H_2) or 1 g of methane (CH_4)?

(Atomic mass of H =1 u, C = 12 u)

b) Calculate the number of particles in 46 g of Na atoms.

(Atomic mass of Na = 23 u)

a) 1 g of H_2 contains number of molecules

$= \frac{1}{2}$ x 6.022 x 10^{23}

3.011 x 10^{23}

1 g of CH_4 contains number of molecules

$= \frac{1}{16}$ x 6.022 x 10^{23}

$= \frac{60.22}{16}$ x 10^{23} = 3.76 x 10^{23} molecules

∴ 1 g of H_2 contains more number of molecules

b) Atomic mass of Na atom = 23 g

∵ 23 g Na atom contains 6.022 x 10^{23} particles

∴ 46 g Na atom will contain

$$\frac{60.22\ X\ 10^{23}\ x\ 46}{1623}$$

= 12.044 x 10^{23} particles

106. The atomic mass of Calcium is 40 u. What will be the number of Calcium atoms in 0.4 u of Calcium?

40u of calcium contains 1 atom

0.4 u of calcium contains $\frac{1}{40}$ x 0.4 = 10^{-2}

I. LONG ANSWER TYPE QUESTIONS

107. a) Calculate the number of oxygen atoms in 0.40 mole of $Na_2CO_3 . 10 H_2O$

b) If one mole of sulphur weighs 32 grams. What is the mass (in grams) of 1 atom of sulphur?

c) Identify the correct formula for ammonium sulphate from the following formula.

$(NH_4)(SO_4)_3$, $(NH_4)_2SO_4$, $NH_4(SO_4)_2$

a) 1 mole of $Na_2CO_3 . 10 H_2O$ contains 13 x 6.022 x 10^{23} atoms of oxygen.

∴ 0.10 moles of $Na_2CO_3 . 10 H_2O$ will contain = 0.10 x 13 x 6.022 x 10^{23}

= 7.83 x 10^{23} atoms of oxygen.

b) 1 mole of sulphur = 32 g

Also 1 mole of sulphur

= 6.022 x 10^{23} atoms

Now = 6.022 x 10^{23} atoms of sulphur weigh

= 32 g

∴ 1 atom of sulphur weighs

= $\frac{32}{6.022 \times 10^{23}}$ g = 5.31 x 10^{-23} g

c) $(NH_4)_2SO_4$

108. a) Write chemical formulae of all the compounds that can be formed by the combination of the following ions.

Ca^{2+} , K^{+}, Fe^{3+}, Cl^{-}, $SO_4{}^{2-}$

b) Molar mass of nitrogen is 14 u. What will be the mass of one atom of nitrogen in grams?

a) Ca^{2+} Cl^{-} → $CaCl_2$

b) Ca^{2+} $SO_4{}^{2-}$ → $CaSO_4$

c) K^{+} Cl^{-} → KCl

K^{+} $SO_4{}^{2-}$ → $K_2\ SO_4$

Fe^{3+} Cl^{-} → $FeCl_3$

Fe^{3+} $SO_4{}^{2-}$ → $Fe_2\ (SO_4)_3$

b) 1 mole of nitrogen atoms = 14 g

1 mole of nitrogen atoms

= 6.022 x 10^{23} atoms

6.022 x 10^{23} atoms of nitrogen weigh

= 14 g

1 atom of nitrogen weigh

$= \frac{14}{6.022 \text{ x } 10^{23}}$ = 2.324 x 10^{-23} g

109. Verify by calculating the following:

a) Number of molecules in 100 g of NH_3 is more than 100 g of N_2 [Atomic mass of N = 14 u, H = 1 u]

b) 60 g of carbon and 60 g of magnesium elements have a molar ratio 2: 1 [Atomic mass of C = 12 u, Mg = 24 u]

No. Of moles of NH_3

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

$= \frac{100}{14+3} = \frac{100}{17}$ = 5.88 moles

= Number of molecules

= Number of moles x 6.022 x 10^{23}

= 5.88 x 6.022 x 10^{23}

= 35.4 x 10^{23}

= 3.54 x 10^{23} molecules

Number of moles of N_2 = $\frac{Given\ mass}{Molar\ mass}$

= $\frac{100}{2\ X\ 14}$ = $\frac{100}{28}$ = 3.57 moles

Number of N_2 molecules

= Number of moles x 6.022 x 10^{23}

= 3.57 x 6.022 x 10^{23}

= 21.5 x 10^{23} = 2.15 x 10^{24} molecules

Therefore the number of molecules in 100 g of NH_3 is more

b) Number of moles = $\frac{Given\ mass}{Molar\ mass}$

$\frac{60}{12}$ = 5 moles

Number of moles of Mg = $\frac{Given\ mass}{Molar\ mass}$

$\frac{60}{24}$ = 2.5 moles

Ratio = 5: 2.5

$\Longrightarrow$ Ratio = 2: 1.

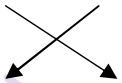
NCERT EXEMPLAR Questions

1. **Which of the following represents a correct chemical formula? Name it.**

   a) CaCl **b) $BiPO_4$**

   c) $NaSO_4$ **d) NaS**

   b) $BiPO_4$ is correct formula Bi^{3+} PO_4^{3-}

   $BiPO_4$

   Bismuth phosphate is the name of the compound.

2. **Write the molecular formula for the following compounds.**

   a) Copper (II) bromide **b) Aluminium (III) nitrate**

   c) Calcium (II) phosphate **d) Iron (III) sulphide**

   e) Mercury (II) chloride **f) Magnesium (II) acetate**

   a) $CuBr_2$ b) $Al(NO_3)_3$ c) $Ca_3(PO_4)_2$

   d) Fe_2S_3 e) $HgCl_2$ $(CH_3COO)_2Mg$

3. **Write the molecular formulae of all the compound that can be formed by the combination of following ions:**

   Ca^{2+}, Na^+, Fe^{3+}, Cl^-, SO_4^{2-}, PO_4^{3-}

   Cu^{2+} Cl^- → $CuCl_2$

   Cu^{2+} SO_4^{2-} → $CuSO_4$

   Cu^{2+} PO_4^{3-} → $Cu_3(PO_4)_2$

   Na^+ Cl^- → $NaCl$

   Na^+ SO_4^{2-} → Na_2SO_4

   Na^+ PO_4^{3-} → Na_3PO_4

   Fe^{3+} Cl^- → $FeCl_3$

   Fe^{3+} SO_4^{2-} → $Fe_2(SO_4)_3$

   Fe^{3+} PO_4^{3-} → $FePO_4$

4. Write the cations and anions present (if any) in the following compounds:

a) CH_3 **COONa** **b) NaCl** **c)** H_2 **d)** NH_4NO_3

a) CH_3 COO^- (Anion) and Na^+ (Cation)

b) Na^+ (Cation) Cl^- (Anion)

c) H_2 (No Cation and No Anion)

d) NH_4^+ (Cation) NO_3^- (Anion)

5. Give the formulae of the compounds formed from the following sets of elements.

a) Calcium and fluorine **b) Hydrogen and hydrogen**

c) Nitrogen and hydrogen **d) Carbon and Chlorine**

e) Sodium and oxygen **f) Carbon and oxygen**

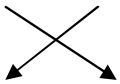
a) Ca^{2+} F^-

CaF_2

b) H^+ S^{2-}

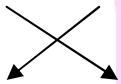
H_2S

c) N^{3-} H^{1+}



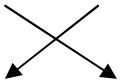
NH_3

d) C^{4+} Cl^{1-}



CCl_4

e) Na^+ O^{2-}



Na_2O

f) C^{4+} O^{2-}

CO_2

6. Which of the following symbols of elements are incorrect? Give their correct symbols

a) Cobalt CO **b) Carbon c** **c) Aluminium AL** **d) Helium He**

e) Sodium So

Elements	Correct symbols
a) Cobalt	Co
b) Carbon	C

c) Aluminium Al

d) Helium He

e) Sodium Na

7. Give the chemical formulae for the following compounds and compute the ratio by mass of the combining elements in each one of them.

a) Ammonia **b) Carbon monoxide**

c) Hydrogen chloride **d) Aluminium fluoride**

d) Magnesium sulphide

a) NH_3 b) CO c) HCl

d) AlF_3 e) MgS

Ratio by mass a) 14:3 b) 12: 16 c) 1:35.5 d) 27 : 57 e) 24: 32

Simple Ratio 14: 3 3: 4 2:71 9: 19 3: 4

8. State the number of atoms present in each of the following chemical species :

a) CO_3^{2-} **b)** PO_4^{3-} **c)** P_2O_5 **d) CO**

a) CO_3^{2-} contains 4 atoms b) PO_4^{3-} contains 5 atoms

c) P_2O_5 contains 7 atoms d) CO contains 2 atoms

9. What is the fraction of the mass of water due to neutrons?

No. Of neutrons in H_2O= 8 [because hydrogen does not have neutron and oxygen has 8 neutrons]

Therefore , fraction of the mass of water due to neutrons = $\frac{8}{18} = \frac{4}{9}$

10. Does the solubility of a substance change with temperature? Explain with the help of an example.

Yes, the solubility of solid in liquid increases with increase in temperature, e.g. cold water can dissolve less amount of sugar, whereas hot water can dissolve more amount of sugar.

11. Classify each of the following on the basis of their atomicity.

a) F_2 **b)** NO_2 **c)** N_2O

d) $C_2\ H_6$ **e)** P_4 **f)** H_2O_2

g) P_4O_{10} **h)** O_3 **i) HCl**

j) CH_4 **k) He** **l) Ag**

a) Diatomic b) Triatomic c) Triatomic

d) Octa-atomic e) Tetra-atomic f) Tetra-atomic

g) Tetra deca-atomic (14) h) Triatomic i) Diatomic

j) Penta- atomic k) Monoatomic l) Monoatomic

12. You are provided with a fine white coloured powder which is either sugar or salt. How would you identify it without testing?

Heat the given substance. If it turns black on heating, then it is sugar, otherwise salt. because sugar will lose water on heating and black coloured carbon will be left back.

OR

Take ice cold water. If the given substance dissolves easily, it is salt. If it does not dissolve easily, it is sugar.

13. Calculate the number of moles of magnesium present in a magnesium ribbon weighing 12 g. Molar atomic mass of magnesium is 24 g mol^{-1}.

1 mole of Mg = 24 g

24 g of Mg = 1 mole

12g of Mg $= \frac{1}{24}$ x 12 = 0.5 mol

14. Verify by calculating that

a) 5 moles of CO_2 and 5 moles of H_2O do not have the same mass.

b) 240 g of calcium and 240 g magnesium elements have a mole ratio of 3 : 5.

a) 1 mole of CO_2 = 44g

5 moles of CO_2 = 44 x 5 = 220 g

1 mole of H_2O = 18 g

5 moles of H_2O = 18 x 5 = 90g

Clearly, both do not have the same mass.

b) 1 mole of Ca = 40g

40g of Ca = 1 mole

240 g of Ca = $\frac{1}{40}$ x 240 = 6 moles

24 g of Mg = 1 mole

240 g of Mg = $\frac{1}{24}$ x 240 = 10 moles

Molar ratio = 6: 10 i.e. 3: 5. Hence proved.

15. Find the ratio by mass of the combining elements in the following compounds:

a) $CaCO_3$ b) $MgCl_2$ c) H_2SO_4 d) C_2H_5OH e) NH_3 f) $Ca(OH)_2$

a) $CaCO_3$ b) $MgCl_2$ c) H_2SO_4 d) C_2H_5OH e) NH_3 f) $Ca(OH)_2$

Ratio by mass (a) 40 : 12 : 48 b) 24 :71 c) 2: 32 : 64 d) 24 : 6 : 16
e) 14 :3 f) 40: 32 : 2

Simple ratio 10 : 3 : 12 24 :71 1: 16 : 32 12 : 3 : 8
14 :3 20: 16 : 1

16. Calcium chloride when dissolved in water dissociates into its ions according to the following equation.

$CaCl_2$ (aq) ⟶ Ca^{2+} (aq) + $2Cl^-$ (aq)

Calculate the number of ions obtained from $CaCl_2$ when 222 g of it is dissolved in water.

$CaCl_2$ (aq) ⟶ Ca^{2+} (aq) + $2Cl^-$ (aq)

1 mole of $CaCl_2$ = 111 g

111 g of $CaCl_2$ = 1 mole

222 g of $CaCl_2$ = $\frac{1}{111}$ x 222 = 2 moles

1 mole of $CaCl_2$ gives 3 moles of ion

2 mole of $CaCl_2$ gives 6 moles of ion

= 6 x 6.022 x 10^{23} ions

= 36.132 x 10^{23} ions = 3.6132 x 10^{24} ions

17. The difference in the mass of 100 moles each of sodium atoms and sodium ions is 5.48002 g. Compute the mass of an electron.

Na $\longrightarrow$ Na^+ + e^-

1 mole 1 mole 1 mole

100 moles 100 moles 100 moles

100 moles of electrons weigh = 5.48002 g

100 x 6.022 x 10^{23} electrons weigh = 5.48002 g

1 electron weighs + $\frac{5.48002\ g}{100\ x\ 6.022\ x\ 10^{23}}$

=0.91 x $10^{-25}\ g$ = 9.1 x $10^{-29}\ g$

It is not the real mass of electron.

18. Cinnabar (HgS) is a prominent ore of mercury. How many grams of mercury are present in 225 g of pure HgS? Molar mass of Hg and S are 200.6 mol^{-1} respectively.

Molar mass of HgS = 200. 6 + 32 = 232.6 g mol^{-1}

232.6 g of HgS contains 200.6 g of pure Hg

225 g of HgS contains $\frac{200.6}{232.6}$ x 225 = 194.04 g

19. The mass of one steel screw is 4.11 g. Find the mass of one mole of these steel screws. Compare this value with the mass of the Earth (5.98 x 10^{24} kg) Which one of the two is heavier and by how many times?

Mass of 1 steel screw = 4.11 g

Mass of 6.022 x 10^{23} steel screws

= 4.11 x 6.022 x 10^{23} g = 2.475 x 10^{24} g = 2.475 x 10^{21}

Therefore, mass of one mole of screws

= 2.475 x 10^{21}

= $\frac{Mass\ of\ Earth}{Mass\ of\ 1\ mole\ screws}$ = $\frac{5.98\ X\ 10^{24}\ kg}{2.475\ x\ 10^{21}}$ = 2.4 x 10^{23}

Mass of the earth is 2400 times the mass of 1 mole of screws

20. A sample of vitamin C is known to contain 2.58 x 10^{24} oxygen atoms.. How many moles of oxygen atoms are present in the sample?

Number of moles of oxygen atoms

$$= \frac{No.of\ atoms}{Avogadro's\ Number} = \frac{2.58\ X\ 10^{24}}{6.022\ X\ 10^{23}}$$

= 4.28 moles.

21. Raunak took 1 mole of carbon atoms in a container and Krish also took 5 moles of sodium atoms in another container of the same weight.

(a) Whose container is heavier?

(b) Whose container has more number of atoms?

a) 1 mole of carbon atoms = 12g

5 moles of carbon atoms = 12 x 5 = 60g

1 mole of Na = 23 g

5 moles of Na = 23 x 5 = 115 g

Thus, Krish's container is heavier than that of Raunak.

b) Both the containers have same number of atoms as both have the same number of moles and both elements are mono atomic.

22. Fill in the missing data in the Table

Species	**H_2O**	**CO_2**	**Na atom**	**$MgCl_2$**
Property				
No. Of moles	2	-	-	0.5
No. Of particles	-	3.011 x 10^{23}	-	-
Mass	36 g	-	115 g	-

1 mole of H_2O = 1 x 2 + 16 = 18 g

2 mole of H_2O = 2 x 18 = 36 g

2 moles of H_2O contains = 2 x 6.022 x 10^{23} = 12.044 x 10^{23} molecules

1 mole of CO_2 = 12 + 2 + 16 = 44 g

0.5 mol of CO_2 = 44 x 0.5 = 22 g

1 mole of CO_2 will contains 6.022 x 10^{23} molecules

0.5 mol of CO_2 will contain 0.5 x 6.022 x 10^{23} = 3.011 x 10^{23} molecules

1 mole of Na = 23g

5 moles of Na = 23 x 5 = 115g

1 mole of Na = 6.022 x 10^{23} atoms

5 moles of Na = 5 x 6.022 x 10^{23} = 30.110 x 10^{23} atoms

1 mole of $MgCl_2$ = 24 + 2 x 35.5 = 24 + 71 =95g

0.5 mole of $MgCl_2$ = 0.5 x 95 = 47.5g

1 mole of $MgCl_2$ = 6.022 x 10^{23}

0.5 mole of $MgCl_2$ = 0.5 x 6.022 x 10^{23} = 3.011 x 10^{23} formula units.

Species	H_2O	CO_2	Na atom	$MgCl_2$
No. Of moles	2	0.5	5	0.5
No. Of Particles	12.044 x 10^{23} molecules	3.011 x 10^{23}	30.110 x 10^{23}	3.011 x 10^{23}
Mass	36g	22g	115g	47.5g

23. The visible universe is estimated to contain 10^{22} stars. How many moles of stars are present in the visible universe?

Number of moles of stars = $\frac{10^{22}}{N_A} = \frac{10^{22}}{6.022\ x\ 10^{23}}$

= 0.167 x 10^{-1} = 0.0167 mole.

24. What is the SI prefix for each of the following multiples and sub-multiples of a unit?

(a) 10^3 **(b) 10^{-1}** **(c) 10^{-2}**

(d) 10^{-6} **(e) 10^{-9}** **(f) 10^{12}**

(a) *Kilo* (b) deci (c) centi

(d) micro (e) nano (f) pico

25. Express each of the following in kilograms:

(a) 5.84 x 10^{-3}mg (b) 58.34g (c) 0.584 g (d) 5.873 x $10^{-21}g$

(a) 5.84 x 10^{-3}mg x 10^{-6} = 5.84 x 10^{-9} kg

[$\because$ 1 mg = 10^{-3} g = $10^{-6}kg$]

(b) 58.34 g x 10^{-3} kg = 5.834 x 10^{-2} kg

[$\because$ 1 g = 10^{-3} kg]

(c) 0.584 g = 0.584 x 10^{-3} kg = 5.84 x 10^{-4} kg

(d) 5.873 x 10^{-21} g x 10^{-3} = 5.873 x 10^{-24} kg

26. Compute the difference in masses of 10^3 moles each of magnesium atoms and magnesium ions.

(Mass of an electron = 9.1 x $\mathbf{10^{-31}kg}$) [HOTS]

Mg $\longrightarrow$ Mg^{2+} + $2_{\bar{e}}$

1 mole	1 mole	2 mole
1000 moles	1000 moles	2000 moles

1 electron weighs = 9.1 x $\mathbf{10^{-31}kg}$

$\because$ 2000 x 6.022 $x\mathbf{10^{23}}$ electrons weigh

= 9.1 x 10^{-31}x 2000 x 6.022 x 10^{23} kg

= 109.6004 x 10^{-5} kg = 1.096004 x 10^{-3}kg

27. Which has more number of atoms?

100 g of N_2 or 100 g of NH_3

1 mole of N_2 = 28 g

28 g of N_2 = 1 mole

100 g of N_2 = $\frac{1}{28}$ x 100 = $\frac{25}{7}$ moles

= $\frac{25}{7}$ x 6.022 x 10^{23} x 2 atoms

= $\frac{301.100}{7}$ $X10^{23}$ atoms

= 43.01 $X10^{23}$ atoms

= 4.30 $X10^{24}$ atoms

1 mole of NH_3 = 17 g

17 g of NH_3 = 1 mole

100 g NH_3 = $\frac{1}{17}$ x 100 mole

$\frac{100}{17}$ X 4 x 6.022 x 10^{23} atoms

= $\frac{24.088}{17}$ x 10^{25} atoms

1.417 x 10^{25} atoms

Therefore 100 g of NH_3 contains more number of atoms.

28. Compute the number of ions present in 5.85 g of sodium chloride.

Na ⟶ Na^+ + e^-

1 mole of Nacl = 23 + 35.5 = 58.5 g

58.5 g of Nacl = 1 mole

5.85 g of Nacl = $\frac{1}{58.5}$ x 5.85 = 0.1 mol

1 mole of Nacl of gives 2 moles of ions

0.1 mol of Nacl gives 2 x 0.1 =0.2 mol

= 0.2 x x 6.022 x 10^{23} ions = 1.2044 x 10^{23} ions

29. A gold sample contains 90% of gold and the rest copper. How many atoms of gold are present in one gram of this sample of gold?

Amount of gold in 1g of 90% pure gold

= $\frac{1\ x\ 90}{100}$ = 0.9g

1 mole of Au = 197g

1 mole of Au = 6.022 x 10^{23} atoms

0.9 g of gold contains $\frac{6.022 \text{ x } 10^{23}\ X\ 0.9}{197}$

= 2.75 X 10^{21} $atoms$

30. What are ionic and molecular compounds? Give examples

Ionic compounds are those compounds which are solid and form ions in aqueous solution, have high melting and boiling points, do not conduct electricity in solid state but conduct electricity in molten state or in aqueous solution, e.g.NaCl, KCl, MgO, Cao, etc.,

Molecular compounds may be solids, liquids or gases, do not form ions in aqueous solution, have low melting and boiling points, do not conduct electricity e.g. CH_4, CCl_4, NH_3, PH_3, etc.,

31. Compute the difference in masses of one mole each of aluminium atoms and one mole of its ions (Mass of an electron is 9.1 x $10^{-28}g$) [HOTS]
Which one is heavier?

Al $\longrightarrow$ Al^{3+} + $3e^-$

1 mole 1 mole 3 mole

Mass of 1 electron = 9.1 x 10^{-28} g

Mass of 3 x 6.022 x 10^{23}

= 9.1 x 10^{-28} x 3 x 6.022 x 10^{23}

Mass of 3 miles of electrons = 164.400 x 10^{-5} g

= 0.00164 g

Molar mass of Al^{3+} ions = 27 – 0.00164 g

= 26.9984g mol^{-1}

Difference in mass between Al and Al^{3+} = 0.00164 g

32. A silver ornament of mass 'm' gram is polished with gold equivalent to 1% of the mass of silver. Compute the ratio of the number of atoms of gold and silver in the ornament [HOTS]

Mass of gold in the ornament

= m x $\frac{1}{100}$ = $\frac{m}{100}$ = 0.01 $m\ gram$

108 g of Ag contains 6.022 x 10^{23} atoms

m gram of Ag contains $\frac{6.022 \times 10^{23}}{108}$ x m

= $\frac{m}{100}$ = 6.022 x 10^{23} atoms

197 g of Au contains 6.022 x 10^{23} atoms

$= \frac{m}{100}\ g\ of\ Au\ contains\ \frac{6.022 \times 10^{23}}{197}\ x\ \frac{m}{100}$ atoms

Ratio of number of atoms of gold and silver = Au : Ag

$= \frac{6.022 \times 10^{23}}{197}\ x\ \frac{m}{100} : \frac{6.022 \times 10^{23}\ x\ m}{108}$

= 108 : 19700 = 1 : 182.41

33. A sample of ethane (C_2H_6) gas has the same mass as 1.5 x 10^{20} molecules of methane (CH_4), How many C_2H_6 molecules does the sample of gas contain?

1 mole of CH_4 = 16g

1 mole of CH_4 contains 6.022 x 10^{23} molecues

6.022 x 10^{23} molecules of CH_4 has mass = 16g

1.5 x 10^{20} molecules of CH_4 has mass

$= \frac{16}{6.022 \times 10^{23}}$ x 1.5 x 10^{20} g

Now, 1 mole of C_2H_6 = 6.022 x 10^{23} molecules

30 g of C_2H_6 contains 6.022 x 10^{23} moles

$\therefore \frac{16\ x\ 1.5\ x\ 10^{-3}}{6.022}$ g of C_2H_6 contains

$= = \frac{6.022 \times 10^{23}}{30}\ x\ \frac{16 \times 1.5 \times 10^{-3}}{6.022}$

$= \frac{24}{30}\ x\ 10^{20} = 0.8\ x\ 10^{20}$

= 8 x 10^{19} molecules

34. Fill in the blanks"

a) In a chemical reaction, the sum of the masses of the reactants and products remains unchanged. This is called _____.

b) A group of atoms carrying a fixed charge on them is called _____.

c) The formula unit mass of $Ca_3(PO_4)_2$ is _____ [Ca=40u, P=31 u, O = 16 u]

d) Formula of sodium carbonate is _____. And that of ammonium sulphate is _____.

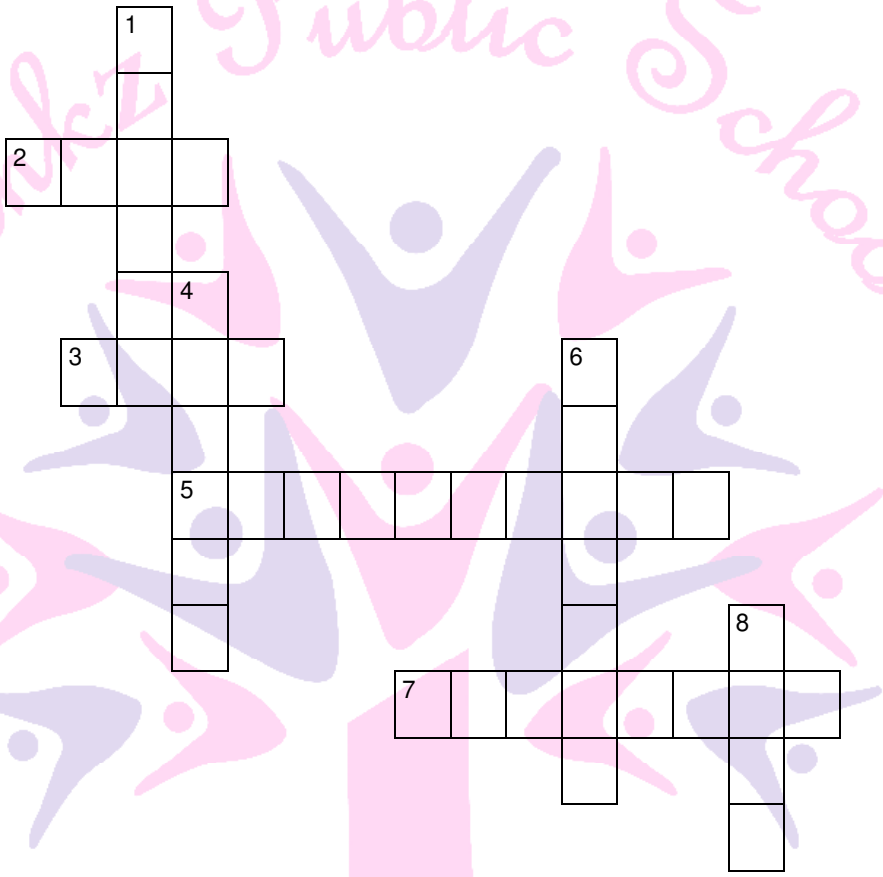
a) Law of conservation of mass

b) Polyatomic ions [radicals]

c) 40 x 3 + 2 x 31 + 8 +16 = 120 + 62 + 128 = 310 u

d) Na_2CO_3 ; $(NH_4)_2SO_4$

35. Complete the following crosswor4d puzzle by using the name of the chemical elements. Use the data given in Table.



Across

2. The element used by Rutherford during his $\propto$ – scattering experiment (4)

3. An element which forms rust on exposure to moist air (4)

5. A very reactive non-metal stored under water (10)

7. Zinc metal when treated with dilute hydrochloric acid produces a gas of this element which when tested with burning splinter produces a pop sound (8)

Down

1. A white lustrous metal used for making ornaments and which tends to get tarnished black in the presence of moisture (6)

4. Both brass and bronze are alloys of the element (6)

6. The metal which exists in the liquid state at room temperature (7)

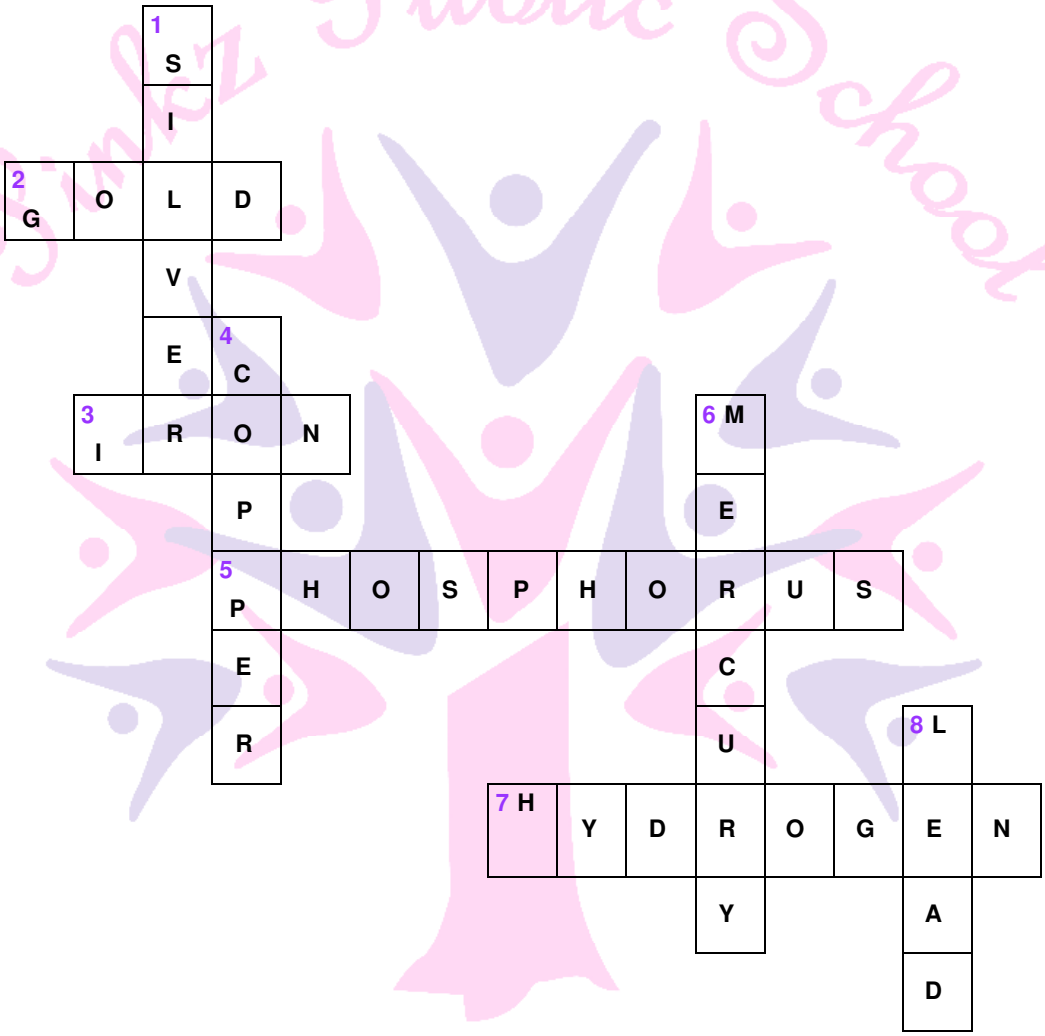
8. An element with symbol Pb (4)

Across

2. GOLD 3. IRON 5. PHOSPHORUS 7. HYDROGEN

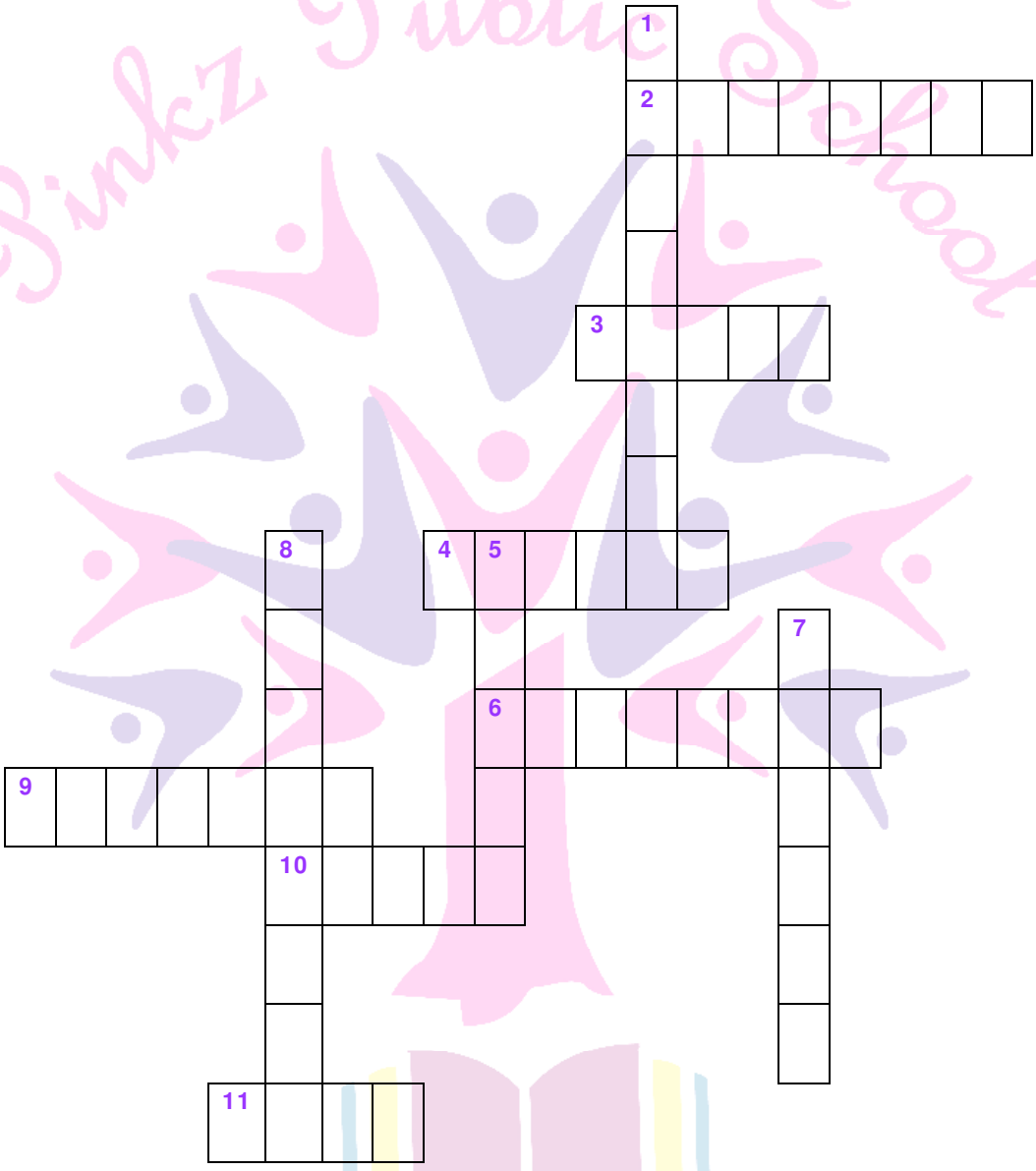
Down

1. SILVER 4. COPPER 6. MERCURY 8. LEAD



36. (a) In the given crossword puzzle, names of 11 elements are hidden, the symbols of these elements are given below. Complete the puzzle

1. C **2. H** **3. Ar** **4. O** **5. Xe** **6. N**
7. He **8. F** **9. Kr** **10. Rn** **11. Ne**



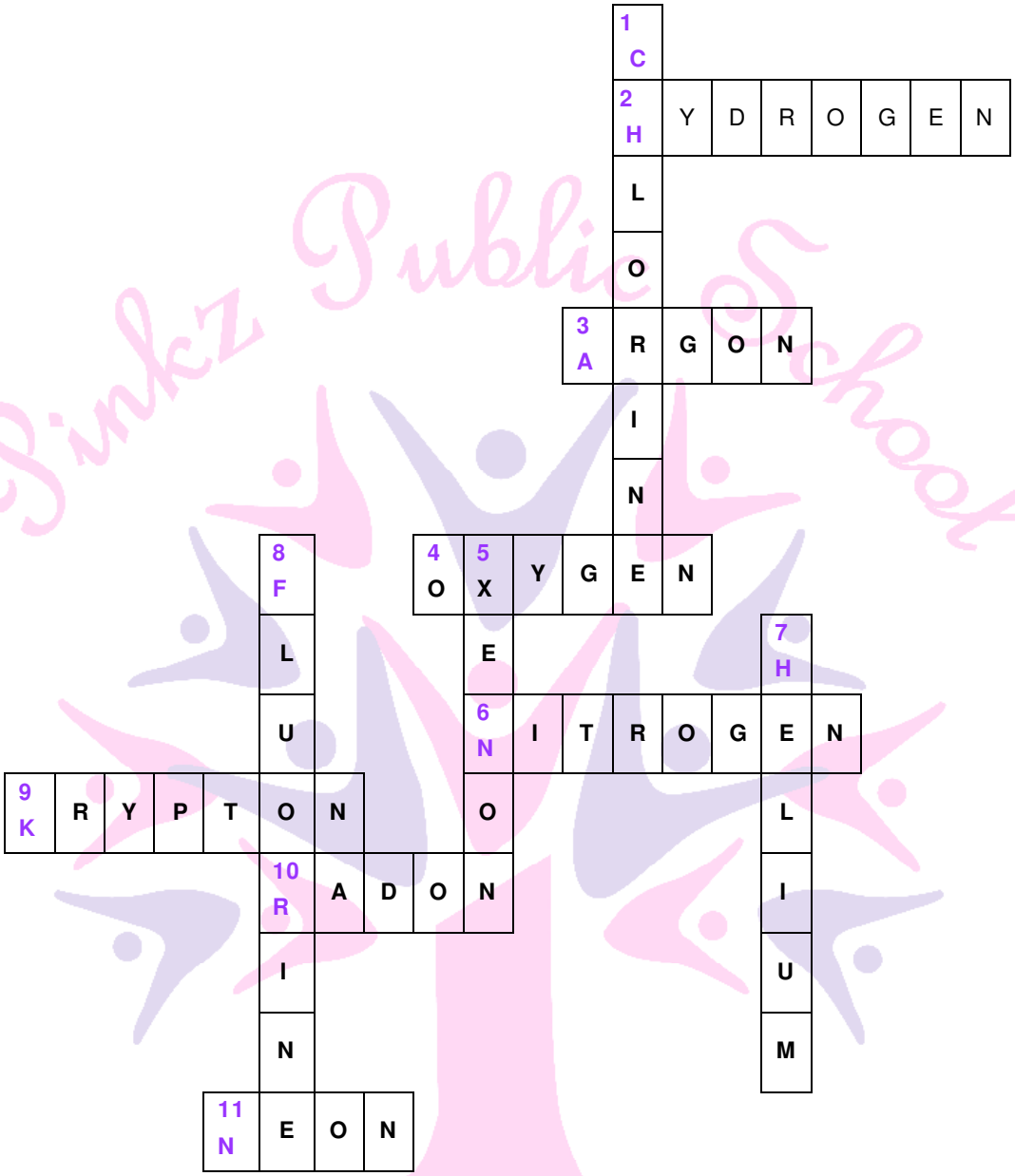
b) Identify the total number of inert gases, their names and symbols from this crossword puzzle.

1. Cl – CHLORINE 2. H – HYDROGEN 3. Ar – ARGON

4. O – OYGEN 5. Xe – XENON 6. N – NETROGEN

7. He – HELIUM 8. F – FLUORINE 9. Kr – KRYPTON

10. Rn – RADON 11. Ne - NEON



(b) Helium (He), Neon (Ne), Argon (Ar), Krypton (Kr), Xenon (Xe), and Radon (Rn) are six inert gases.

37. Write the formulae for the following and calculate the molecular mass for each one of them.

a) Caustic potash **b) baking powder**

c) Lime stone **d) Caustic soda**

e) Ethanol **f) Common salt**

a) Caustic potash is KOH, Molecular mass

$= 39 + 16 + 1 = 56$ u

b) Baking powder is $NaHCO_3$ Molecular mass

$= 23 + 1 + 12 + 48 = 84$ u

c) Lime stone is $CaCO_3$ Molecular mass

$= 40 + 12 + 48 = 100$ u

d) Caustic soda is NaOH, Molecular mass

$= 23 + 16 + 1 = 40$ u

e) Ethanol is C_2H_5OH Molecular mass

$= 24 + 5 + 16 + 1 = 46$ u

f) Common salt is NaCl, Molecular mass

$= 23 + 35.5 = 58.5$ u

38. In photosynthesis, 6 molecules of carbon dioxide combine with an equal number of water molecules through a complex series of reactions to give a molecule of glucose having a molecular formula $C_6H_{12}O_6$. How many grams of water would be required to produce 18 g of glucose? Compute the volume of water so consumed, assuming the density of water to be 1 g cm^{-3} [HOTS]

$$6CO_2 + 6H_2O \xrightarrow[Sunlight]{Chlorophyll} \underset{\text{(Glucose)}}{C_6H_{12}O_6} + 6O_2$$

Molar mass of $C_6H_{12}O_6$

$= 6 \times 12 \times 12 \times 1 + 6 \times 16$

$= 72 + 12 + 96 = 180$ g mol^{-1}

180 g of $C_6H_{12}O_6$ needs 108 g of H_2O

18 g of $C_6H_{12}O_6$ needs $\frac{108}{180} \times 18$

$= 10.8$ g of H_2O

Volume of water $= \frac{Mass\ of\ water}{Density\ of\ Water} = \frac{10.8\ g}{1\ g\ cm^{-3}}$

Volume of water $= 10.8\ cm^3$