Chemistry Revision (IX)

Ch.3- ATOMS AND MOLECULES

1.Calculate the molar mass of : sugar[$C_{12}H_{22}O_{11}$], glucose[$C_6H_{12}O_6$], H_2SO_4, N_2gas, Al_2O_3

2. Write the chemical formulae of: copper nitrate, ammonium carbonate, aluminium phosphate, sodium nitrate, calcium oxide, sodium nitride, potassium chloride.

3. Calculate the number of moles in: a) 12g of oxygen gas. b) 22 g of CO_2

c) 3.011x 10 number of carbon atoms.

4. Calculate the number of particles in : a) 8g of oxygen molecules, b) 2moles of hydrogen gas.

5. (a) Name the chemical compounds represented by the following formulae:

$Al_2(SO_4)_3$ $CaCO_3$, $NaHCO_3$, CaS, $(NH_4)_2CO_3$

(b) Write the symbol of the following ions: phosphate, carbonate, nitride,silver,calcium,ammonium

6. State the laws of chemical combination.

7. Define: one mole, one atomic mass unit, valency, cation, anion, polyatomic ion, Avogadro constant.

8. Magnesium and Sulphur combine in the ratio of 3:4 by mass to form magnesium sulphide. What mass of magnesium would be required to react completely with 9 g of magnesium.

9. A 0.24 g sample of compound of oxygen and boron was found by analysis to contain 0.096 g of boron and 0.144 g of oxygen. Calculate the percentage composition of the compound by weight.

10. How many atoms are present in $CaCO_3$, SO^{2-}, AlCl, $KMnO_4$, NH_4HCO_3, PO^{3-}

Chapter-3 (Atoms and Molecules)

1) Molar / Molecular mass of $C_{12}H_{22}O_{11}$ (Sugar)
(C = 6, H = 1, O = 16)

Atomic Masses
C = 12
H = 1
O = 16

$= 12 \times 12 + 1 \times 22 + 16 \times 11$
$= 144 + 22 + 176$
$= 342$ g

Glucose $[C_6H_{12}O_6]$ molar mass

$= 12 \times 6 + 1 \times 12 + 16 \times 6$
$= 72 + 12 + 96$
$= 180$ g

Atomic masses
H = 1
S = 32
O = 16

Molar mass of $H_2SO_4 = 1 \times 2 + 32 \times 1 + 16 \times 4$
$= 2 + 32 + 64$
$= 98$ g

Atomic mass
N = 14

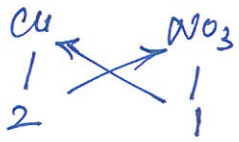
Molar (Molecular) Mass of $N_2 = 14 \times 2$
$= 28$ g

Al = 27
O = 16

Molar mass of $Al_2O_3 = 27 \times 2 + 16 \times 3$
$= 54 + 48$
$= 102$ g

(2) Chemical formula:

(i) Copper Nitrate : $Cu(NO_3)_2$
(Copper has valency 2
NO_3 (Nitrate) has valency 1)



(ii) Ammonium Carbonate : $(NH_4)_2CO_3$ NH_4^+ $(CO_3)^{2-}$

(iii) Aluminium phosphate : $AlPO_4$ Al^{3+} $(PO_4)^{3-}$

(iv) Sodium Nitrate : $NaNO_3$ Na^+ NO_3^-

(v) Calcium Oxide : CaO Ca^{2+} O^{2-}

(vi) Sodium Nitride : Na_3N Na^+ N^{3-}

(vii) Pottasium Chloride : KCl K^+ Cl^-

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(3) (a) Atomic mass of oxygen = 16 g

Now, 16 g of oxygen = 1 mole

1 g of oxygen = $\frac{1}{16}$ mole

12 g of oxygen = $\frac{12}{16}$ moles

= 0.75 mole

(b) Molar (Molecular) Mass of CO_2 = $12 \times 1 + 16 \times 2$

= 12 + 32

= 44 g

44 g of CO_2 = 1 mole of CO_2

∴ 22 g of CO_2 = $\frac{22}{44}$ mole of CO_2

= 0.5 mole of CO_2

(c) Atomic mass of Carbon = 6 g.

6.022×10^{23} atom of Carbon = 1 mole

3.011×10 atom of C = $\frac{3.011 \times 10}{6.022 \times 10^{23}}$ mole

$= \frac{1}{2} \times 10^{-22}$ mole

$= 0.5 \times 10^{-22}$ mole

$= 5 \times 10^{-23}$ mole.

(4) (a) Atomic mass of oxygen = 16 g.

Molecular mass of oxygen molecule (O_2) = 16 × 2
= 32 g

32 g of O_2 molecule = 6.022×10^{23} particle.

∴ 8 g of O_2 molecule = $\frac{6.022 \times 10^{23}}{32} \times 8$ particle.

= $\frac{6.022 \times 10^{23}}{4}$ particle.

= 1.5055×10^{23} particle of O_2.

(b) Atomic mass of hydrogen (H) = 1 g

1 mole of H_2 gas = 6.022×10^{23} particle.

2 mole of H_2 gas = $2 \times 6.022 \times 10^{23}$ particle.
= 12.044×10^{23} particle.

(5) (a) $Al_2(SO_4)_3$ - Aluminium Sulphate

$CaCO_3$ - Calcium Carbonate

$NaHCO_3$ - Sodium bi carbonate

CaS - Calcium Sulphide

$(NH_4)_2CO_3$ - Ammonium Carbonate.

(b) Phosphate - $(PO_4)^{3-}$ Carbonate ion - CO_3^{2-}

Nitride ion - N^{3-} Silver - Ag^+ Calcium - Ca^{2+}

Ammonium - NH_4^+

(6) Laws of chemical combination :

This law states that matter can neither be created nor destroyed. In other words, the total mass, that is, the sum of mass of reacting mixture and product formed remain constant.

$$A + B \longrightarrow C + D$$

Mass of reactant A & B = Mass of product C & D.

Example. $2H_2 + O_2 \longrightarrow 2H_2O$

(Reactants) (Products)

Mass of reactants $= 2 \times 2 \times 1 + 2 \times 16$

$= 4 + 32$

$= 36\ g$

Mass of product $= 2(2 \times 1 + 16)$

$= 2 \times 18$

$= 36\ g$

$\therefore$ Mass of reactants = Mass of products

(7) (i) One mole : A mole corresponds to the mass of a substance that contains 6.023×10^{23} particles of the substance.

1 mole of C-12 = 12 gram of C-12 = 6.023×10^{23} atoms (particles)

Its symbol is mol.

The mole is the SI unit for the ..... amount of a substance.

(ii) One atomic mass unit :

An atomic mass unit (amu) is defined as $\frac{1}{12}$th the mass of an atom of carbon-12.

$$1 \text{ amu} = 1.67377 \times 10^{-24} \text{ gram (g)}$$

The mass of an atom in AMU is roughly equal to the sum of the number of protons and neutrons in the nucleus.

(iii) Valency :

The valency of an element is the number of electrons an atom of the element uses to combine with atoms of the other elements. It is the combining power of an atom of the element.

Example H → 1, Mg → 2, Al → 3, C → 4
N → 3, O → 2, Cl → 1, Ne → 0

(iv) Cation and Anion

What is ion : An ion is a charged atom or molecule.

An atom can acquire a positive or negative charge.

A positively charged ion is called 'cation'.

A negatively charged ion is called an 'anion'.

Examples : cation — Na^+, K^+, Mg^{2+} etc.

Anion — Br^-, F^-, O^{2-} etc.

Monoatomic ion : Ion containing only one atom
Na^+, K^+, Br^- etc.

Polyatomic ions : Ions containing more than one atoms
CO_3^{2-}, NO_3^-, HCO_3^- etc.

(v) Avogadro Constant :

The Avogadro number denoted by N or No is the number of constituent particles that are contained in one mole.

$$1 \text{ mole} = 6.02214 \times 10^{23}$$

(8) $Mg + S \longrightarrow MgS$

Atomic mass of Mg = 24 g
Atomic mass of S = 32 g

According to the law of chemical combination,

$Mg + S \longrightarrow MgS$
24 g 32 g $\longrightarrow$ 56 g

3 g Mg + 4 g of S $\longrightarrow$ 7 g of MgS
(3 : 4 $\longrightarrow$ 7)

3×3 : 4×3 $\longrightarrow$ 7×3
9 g of Mg + 12 g of S $\longrightarrow$ 21 g of MgS

We need 12 g of Sulphur to react with 9 g of Magnesium to give 21 g of Magnesium Sulphide.

(9) Mass of compound = 0.24 g
Mass of boron = 0.096 g
Mass of oxygen = 0.144 g

$$\% \text{ of Boron} = \frac{\text{Mass of boron}}{\text{Mass of compound}} \times 100 = \frac{0.096}{0.24} \times 100$$

$$= 40\%$$

$$\% \text{ of oxygen} = \frac{\text{Mass of oxygen}}{\text{Mass of compound}} \times 100 = \frac{0.144}{0.24} \times 100$$

$$= 60\%$$

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