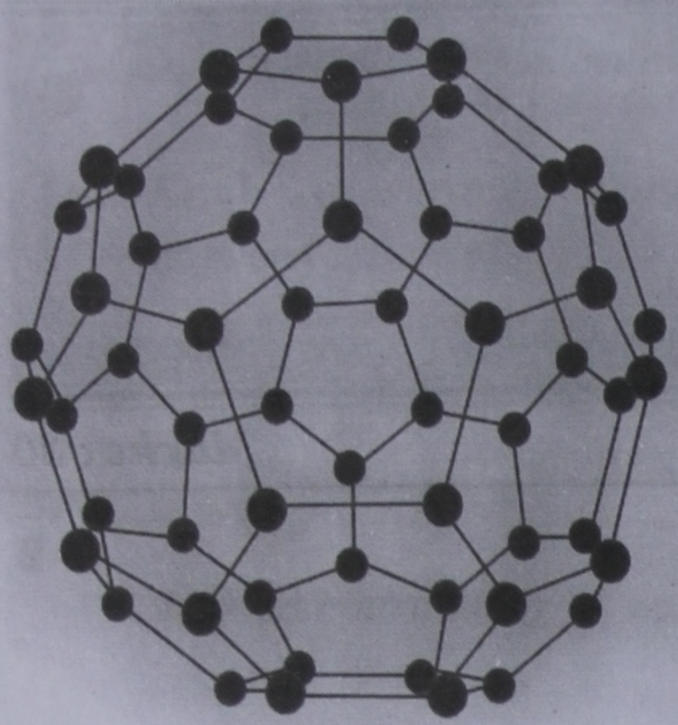


4

THE LANGUAGE OF CHEMISTRY

SCOPE OF SYLLABUS

Symbol of an element; valency; formulae of radicals and formulae of compounds. Balancing of simple chemical equations.

Symbol – definition; symbols of the elements used often.

Valency – definition; hydrogen combination and number of valence electrons of the metals and non-metals; mono, di, tri and tetravalent elements.

Radicals – definition of radicals; formula and valencies of the radicals and formula of compounds.

Chemical equation – definition and examples of chemical equations with one reactant and two or three products, two reactants and one product, two reactants and two products and two reactants and three or four products; balancing of equations. (By partial equation method and hit and trial method).

IMPORTANT POINTS TO REMEMBER

1. The **simplified**, **abbreviated** names of the **elements** are called **symbols**. The names of the elements represented are in English, Latin or Greek.
2. A **symbol** is generally **represented** by the **first alphabet** of an **atom** of the **element** in **capital letter**.
3. In case, the name of more than one element begins with the same alphabet, then the **first two alphabets** are chosen. In this case, the **first alphabet** is written in **capital** and the **second alphabet** is written in **small letter**.
4. **Symbols of some common elements are given in the following table :**

Element	*Symbol*	*Element*	*Symbol*
Hydrogen	H	Yttrium	Y
Helium	He	Zirconium	Zr
Lithium	Li	Niobium	Nb
Beryllium	Be	Molybdenum	Mo
Boron	B	Technetium	Tc
Carbon	C	Ruthenium	Ru
Nitrogen	N	Rhodium	Rh
Oxygen	O	Palladium	Pd
Fluorine	F	Silver	Ag
Neon	Ne	Cadmium	Cd
Sodium	Na	Indium	In
Magnesium	Mg	Tin	Sn

Aluminium	Al	Antimony	Sb
Silicon	Si	Tellurium	Te
Phosphorus	P	Iodine	I
Sulphur	S	Xenon	Xe
Chlorine	Cl	Caesium	Cs
Argon	Ar	Barium	Ba
Potassium	K	Lanthanum	La
Calcium	Ca	Hafnium	Hf
Scandium	Sc	Tantalum	Ta
Titanium	Ti	Tungsten	W
Vanadium	V	Rhenium	Re
Chromium	Cr	Osmium	Os
Manganese	Mn	Iridium	Ir
Iron	Fe	Platinum	Pt
Cobalt	Co	Gold	Au
Nickel	Ni	Mercury	Hg
Copper	Cu	Thallium	Tl
Zinc	Zn	Lead	Pb
Gallium	Ga	Bismuth	Bi
Germanium	Ge	Polonium	Po
Arsenic	As	Astatine	At
Selenium	Se	Radon	Rn
Bromine	Br	Francium	Fr
Krypton	Kr	Radium	Ra
Rubidium	Rb	Actinium	Ac
Strontium	Sr		

5. **Qualitatively** symbol **represents** a **specific element** and **one atom** of an **element**.
   For example, O represents one element of oxygen
   O represents one atom of oxygen.
6. **Radicals** are the **group** of **atoms** of **different elements** which behave as a **single unit**, having their **own combining capacity** and **existing independently**.
7. **Positive radicals** are called **basic radicals** or **cations**.
8. **Negative radicals** are called **acidic radicals** or **anions**.
9. **Valency** is the **combining capacity** of an **element**.
10. **Valency** represents the **number of hydrogen atoms** which combine **directly** or **indirectly** with **one atom of an element**.
11. **Valency** is equal to the **number of electrons lost**, **gained** or **shared** by **an element** during **chemical bond formation**.
12. The **valency** of **hydrogen** and **metals** is **positive** whereas **non-metals** have **negative valency**.
13. Certain elements exhibit **more** than **one valency** by **losing electrons** present in the **penultimate shell**, such **valency** is called as **variable valency**.
14. If the **element** has **two different positive valencies**, then suffix-'**ic**' is attached at the end of the name of the metal for the **higher valency** and suffix-'**ous**' is attached at the end of the name of the metal for the **lower valency**.
    For example, **Lead** (**Plumbum**) exhibits **two valencies + 2** and **+ 4**. The **lower valency** of **lead** (Pb^{2+}) is named as **plumbous**. The **higher valency** of **lead** (Pb^{4+}) is named as **plumbic**.

Element	*Symbol*	
	Lower Valency	*Higher Valency*
Lead	+2, Plumbous (Pb^{2+})	+4, Plumbic (Pb^{4+})
Iron	+2, Ferrous (Fe^{2+})	+3, Ferric (Fe^{3+})
Mercury	+1, Mercurous (Hg^{+} or Hg_2^{2+})	+2, Mercuric (Hg^{2+})
Tin	+2, Stannous (Sn^{2+})	+4, Stannic (Sn^{4+})

POSITIVE RADICALS

Monovalent (*unipositive*)		*Divalent* (*dipositive*)	
Potassium	K^+	Calcium	Ca^{2+}
Sodium	Na^+	Magnesium	Mg^{2+}
Cuprous	Cu^+	Barium	Ba^{2+}
Mercurous	Hg^+	Ferrous	Fe^{2+}
Hydrogen	H^+	Cupric	Cu^{2+}
Silver	Ag^+	Plumbous	Pb^{2+}
Ammonium	NH_4^+	Manganese	Mn^{2+}
		Zinc	Zn^{2+}
		Nickel	Ni^{2+}
		Stannous	Sn^{2+}
		Mercuric	Hg^{2+}
Trivalent (*tripositive*)		*Tetravalent* (*tetrapositive*)	
Ferric	Fe^{3+}	Stannic	Sn^{4+}
Aluminium	Al^{3+}	Plumbic	Pb^{4+}
Chromium	Cr^{3+}	Platinum	Pt^{4+}
Antimony	Sb^{3+}		

NEGATIVE RADICALS

Monovalent (*uninegative*)		*Divalent* (*dinegative*)	
Fluoride	F^-	Sulphate	SO_4^{2-}
Chloride	Cl^-	Sulphite	SO_3^{2-}
Bromide	Br^-	Sulphide	S^{2-}
Iodide	I^-	Carbonate	CO_3^{2-}
Hydride	H^-	Oxide	O^{2-}
Hydroxide	OH^-	Peroxide	O_2^{2-}
Bicarbonate	HCO_3^-	Thiosulphate	$S_2O_3^{2-}$
Bisulphate	HSO_4^-	Zincate	ZnO_2^{2-}
Bisulphite	HSO_3^-	Stannate	SnO_3^{2-}
Bisulphide	HS^-	Plumbate	PbO_2^{2-}
Hypochlorite	ClO^-	Manganate	MnO_4^{2-}
Chlorate	ClO_3^-	Chromate	CrO_4^{2-}
Perchlorate	ClO_4^-	Dichromate	$Cr_2O_7^{2-}$
Nitrate	NO_3^-	Oxalate	$C_2O_4^{2-}$

Nitrite	NO_2^-	Silicate	SiO_3^{2-}
Permanganate	MnO_4^-	Acetylide	C_2^{2-}
Acetate	CH_3COO^-		
Cyanide	CN^-		
Aluminate	AlO_2^-		

Trivalent (Trinegative)		*Tetravalent (Tetranegative)*	
Nitride	N^{3-}	Methanide	C^{4-}
Phosphate	PO_4^{3-}	Ferrocyanide	$[Fe(CN)_6]^{4-}$
Phosphite	PO_3^{3-}		
Phosphide	P^{3-}		
Ferricyanide	$[Fe(CN)_6]^{3-}$		

15. A **chemical compound** is always **electrically neutral**.
16. The **positive** and the **negative valencies** of the **radicals** present in the **compound add to zero**.
17. The **method** of **writing the formula** is called **CRISS-CROSS METHOD**.
The following steps are involved in writing the formula of the compound.

Step I

The symbols of positive radicals with their valency is written on the left hand side and the symbol of negative radicals with their valency is written on the right hand side.

Step II

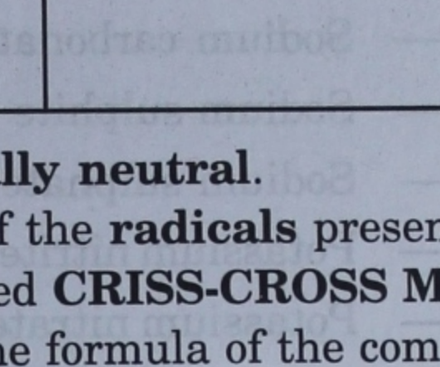
Divide the valency number by the highest common factor if any. Now interchange the valencies, ignoring the ($^+$) and ($^-$) signs. Bring the valencies in the subscript.

Step III

Shift the valency number to the lower right of the atom or the radical. If radical receives number more than one, then enclose it in simple brackets. Single atoms are not enclosed in brackets.

For example :

Manganese dioxide

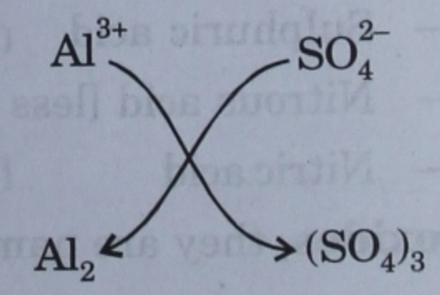


Taking highest common factor $Mn_{2/2}$ $O_{4/2}$

Mn O_2

$= MnO_2$

Aluminium sulphate



$= Al_2(SO_4)_3$

18. **For naming the chemical compound from the formula the following rules are followed.**
(*i*) If a compound is **binary** (**containing two elements only**) such that one atom is **metal** and other is **non-metal**, the **metal** is named **first** and **non-metal** is named **at the end** with suffix **'ide'**.
For example : Na_2O — Sodium oxide
AlN — Aluminium nitride

(*ii*) The compounds containing **two non-metals** are named by using **prefix mono**, **di**, **tri**, etc.

For example :

CO — Carbon monoxide
NO_2 — Nitrogen dioxide
CO_2 — Carbon dioxide
SO_3 — Sulphur trioxide
PCl_5 — Phosphorus pentachloride
PCl_3 — Phosphorus trichloride

(*iii*) For **tertiary compounds**, *i.e.*, compounds having **three elements**, out of which, **one** is **oxygen** are named by suffix - ***ate***, if there is only one such compound. If there are **two compounds**, the **one** with **less number** of **oxygen** is termed with suffix - ***ite*** and the **one** with **more number** of **oxygen** is named with suffix - ***ate***.

For example : Na_2CO_3 — Sodium carbonate
Na_2SO_3 — Sodium sulphite
Na_2SO_4 — Sodium sulphate
KNO_2 — Potassium nitrite
KNO_3 — Potassium nitrate.

(*iv*) If in a given compound **number** of **oxygen** is **less** than **oxygen** present in a **compound ending** with - ***ite***, then it is named with the prefix ***hypo*** and if it is more than **oxygen** present in a **compound ending** with - ***ate***, then it is named with the prefix ***per***.

For example : $NaClO$ — Sodium hypochlorite.

It contains less oxygen than $NaClO_2$ (Sodium chlorite)

$NaClO_4$ — Sodium perchlorate.

It contains more oxygen than $NaClO_3$ (Sodium chlorate)

19. The **acids** containing **two elements**, in which **one atom** is **essentially hydrogen** which combines with one **non-metal** are named by adding prefix ***hydro*** and suffix - ***ic*** to the name of **second element (non-metal).**

For example : HCl — Hydrochloric acid
HBr — Hydrobromic acid
HF — Hydrofluoric acid
HI — Hydroiodic acid

20. If the **acids** containing **radicals** and **polyatomic groups** then names are given on the basis of **second group**, but the prefix ***hydro*** is **not used**.

For example : H_2SO_3 — Sulphurous acid [less number of oxygen atoms]
H_2SO_4 — Sulphuric acid
HNO_2 — Nitrous acid [less number of oxygen atoms]
HNO_3 — Nitric acid

21. **Bases** are the **metallic hydroxides**, they are named as **hydroxides** after the **name** of the **metal** or **radical.**

For example : NH_4OH — Ammonium hydroxide
$NaOH$ — Sodium hydroxide
KOH — Potassium hydroxide

22. An **equation** is a **statement** that describes a **chemical change** in terms of **symbols** and **formulae**.

23. In a chemical reaction **reactants** change into **products**.

24. The **substances** written on the **left hand side** of the **arrow** are called **reactants** (the **substances** that **take part** in a **chemical reaction**).

25. The **substances** written on the **right hand side** of the **arrow** are called **products** (the **substances** which are **formed** as a result of **chemical reaction**).

26. A **chemical equation** may **involve**

(*i*) One reactant and two or three products

(*ii*) Two reactants and one product

(*iii*) Two reactants and two products

(*iv*) Two reactants and three or four products.

27. One reactant and two or three products :

The following examples can be put under the given category of equations. These equations basically involve **thermal decomposition reaction.**

(*a*) $2Zn(NO_3)_2 \xrightarrow{\Delta} 2ZnO + 4NO_2 + O_2$

(*b*) $MgCO_3 \xrightarrow{\Delta} MgO + CO_2$

(*c*) $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

(*d*) $2Ag_2CO_3 \xrightarrow{\Delta} 4Ag + 2CO_2 + O_2$

(*e*) $2Pb_3O_4 \xrightarrow{\Delta} 6PbO + O_2$

(*f*) $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + 4H_2O + Cr_2O_3$

28. Two reactants and one product :

The following examples can be put under the given category of equations. These equations basically involve **synthesis** and **direct combination reaction.**

(*a*) $C + O_2 \longrightarrow CO_2$

(*b*) $N_2 + O_2 \longrightarrow 2NO$

(*c*) $NH_3 + HCl \longrightarrow NH_4Cl$

(*d*) $2NO + O_2 \longrightarrow 2NO_2$

(*e*) $N_2 + 3H_2 \longrightarrow 2NH_3$

(*f*) $S + O_2 \longrightarrow SO_2$

29. Two reactants and two products :

The following examples can be put under the given category of equations. These examples basically involve the **double decomposition reaction** (**neutralization** and **precipitation** reactions) and **simple displacement reaction**.

(*a*) $KOH + HCl \longrightarrow KCl + H_2O$

(*b*) $2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$

(*c*) $BaCl_2 + Na_2SO_4 \longrightarrow BaSO_4 + 2NaCl$

(*d*) $FeCl_3 + 3NaOH \longrightarrow Fe(OH)_3 + 3NaCl$

(*e*) $AgNO_3 + HCl \longrightarrow AgCl + HNO_3$

(*f*) $CuSO_4 + Fe \longrightarrow FeSO_4 + Cu$

30. Two reactants and three or four products :

The following examples can be included in the given category of equations.

(*a*) $CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$

(*b*) $K_2Cr_2O_7 + 14HCl \longrightarrow 2KCl + 2CrCl_3 + 7H_2O + 3Cl_2$

(*c*) $PbO_2 + 4HCl \longrightarrow PbCl_2 + Cl_2 + 2H_2O$

(*d*) $Na_2SO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + SO_2$

(*e*) $Mg + 2H_2SO_4 \longrightarrow MgSO_4 + 2H_2O + SO_2$

(*f*) $Pb_3O_4 + 8HCl \longrightarrow 3PbCl_2 + Cl_2 + 4H_2O$

31. The **number** of **atoms** of **each element** on the **left hand side** (**reactants**) of an **equation** are always **equal** to the **number** of **atoms** of **each element** on the **right hand side (products)**. Such type of an equation is called a **balanced equation**.

32. In order to **balance** the **chemical equation**, it is **essential** to **know** the **reactants** taking part in the chemical reaction and the **products** formed as a result of reaction. It becomes more convenient if the equation is written in the form of **language** or as **equations**.

33. A chemical equation is **balanced** by **hit** and **trial method**. Chemical equations are balanced by **assigning suitable coefficients** to the **molecules**, wherever necessary. This method will be clear from the following examples.

Example 1 : $KOH + HCl \longrightarrow KCl + H_2O$

Element	*Number of atoms on*	
	Reactant side (LHS)	*Product side* (RHS)
H	2	2
K	1	1
Cl	1	1
O	1	1

Thus, this equation is a balanced equation.

Example 2 : $Mg(OH)_2 + HCl \longrightarrow MgCl_2 + H_2O$

Step-1 :

Element	*Number of atoms on*	
	Reactant side (LHS)	*Product side* (RHS)
Mg	1	1
H	3	2
Cl	1	2
O	2	1

Step-2 : To balance Cl, put the coefficient 2 before HCl on reactant side (LHS).

$$Mg(OH)_2 + 2HCl \longrightarrow MgCl_2 + H_2O$$

Step-3 : To balance O, put the coefficient 2 before H_2O on product side (RHS).

$$Mg(OH)_2 + 2HCl \longrightarrow MgCl_2 + 2H_2O$$

Step-4 : Check the number of atoms of hydrogen, it gets automatically balanced.
Thus, the above equation gets balanced.

34. Although **hit** and **trial method** is very useful in balancing of the equation, yet this method is very time consuming. However, the balancing can be done more easily by **partial equation method**.

35. **Examples** for the balancing of equation by **partial equation method**.

(*i*) Oxidation of carbon to carbon dioxide by concentrated sulphuric acid.

(*a*) Firstly sulphuric acid decomposes to give water, sulphur dioxide and nascent oxygen.

$$H_2SO_4 \longrightarrow H_2O + SO_2 + [O] \qquad ...(i)$$

(*b*) Carbon gets oxidized to carbon dioxide by nascent oxygen.

$$C + 2[O] \longrightarrow CO_2 \qquad ...(ii)$$

To balance [O] multiply equation (*i*) by 2 and then, add both the equations.

$$2H_2SO_4 \longrightarrow 2H_2O + 2SO_2 + 2[O]$$
$$C + 2[O] \longrightarrow CO_2$$
$$\overline{C + 2H_2SO_4 \longrightarrow 2H_2O + 2SO_2 + CO_2}$$

Thus, the above equation gets balanced.

(*ii*) Oxidation of halogen acid to halogen by ozone.

(*a*) Ozone decomposes to give nascent oxygen.

$$O_3 \longrightarrow O_2 + [O] \quad ...(i)$$

(*b*) HCl (halogen acid) gets oxidized to give Cl_2 (halogen) by nascent oxygen.

$$2HCl + [O] \longrightarrow H_2O + Cl_2 \quad ...(ii)$$

On adding both the equations,

$$\begin{array}{rl} O_3 & \longrightarrow O_2 + [O] \\ 2HCl + [O] & \longrightarrow H_2O + Cl_2 \\ \hline 2HCl + O_3 & \longrightarrow O_2 + H_2O + Cl_2 \end{array}$$

Thus, the above equation gets balanced.

36. The balanced chemical equation conveys the following information :

(*i*) It tells about the reactants taking part in the chemical reaction.

(*ii*) It tells about the products formed in the chemical reaction.

(*iii*) It tells the number of atoms of each element participating in the reaction.

(*iv*) It tells the number of molecules of different substances taking part in the chemical reaction.

(*v*) It tells about the volumes of gaseous reactants and products

$$\underset{\text{1 volume}}{N_2} + \underset{\text{3 volumes}}{3H_2} \longrightarrow \underset{\text{2 volumes}}{2NH_3}$$

3 volumes of hydrogen

1 volume of nitrogen

2 volumes of ammonia

(*vi*) It tells about the masses of reactants and products involved during the reaction.

$$\underset{\text{24 g}}{Mg} + \underset{\text{98 g}}{H_2SO_4} \longrightarrow \underset{\text{120 g}}{MgSO_4} + \underset{\text{2 g}}{H_2}$$

24 g of Mg reacts with 98 g of H_2SO_4 to form 120 g of $MgSO_4$ and 2g of H_2.

37. A balanced chemical equation **does not tell** whether the reaction is **fast** or **slow**, *i.e.*, it **does not** tell about the **rate of the reaction**.

38. A balanced equation **does not** give any idea about the **conditions**, *i.e.*, **pressure**, **temperature** and **concentration**.

39. A balanced equation **does not** tell about the **physical states** of the **reactants** and **does not** even tell that whether **the reaction gets completed or not**.

IMPORTANT QUESTIONS

Q1. State the valency and formulae of the following radicals or ions.

(*i*) Ammonium
(*ii*) Cupric
(*iii*) Ferric
(*iv*) Plumbous
(*v*) Nitrate
(*vi*) Nitrite
(*vii*) Sulphate
(*viii*) Sulphite
(*ix*) Bicarbonate
(*x*) Thiosulphate
(*xi*) Silicate
(*xii*) Stannate
(*xiii*) Oxalate
(*xiv*) Bisulphide
(*xv*) Peroxide
(*xvi*) Dichromate
(*xvii*) Permanganate
(*xviii*) Zincate
(*xix*) Phosphide
(*xx*) Iodide.

Ans.

	Valency	*Formula*
(*i*) Ammonium	+ 1	NH_4^+
(*ii*) Cupric	+ 2	Cu^{2+}
(*iii*) Ferric	+ 3	Fe^{3+}
(*iv*) Plumbous	+ 2	Pb^{2+}
(*v*) Nitrate	– 1	NO_3^-
(*vi*) Nitrite	– 1	NO_2^-
(*vii*) Sulphate	– 2	SO_4^{2-}
(*viii*) Sulphite	– 2	SO_3^{2-}
(*ix*) Bicarbonate	– 1	HCO_3^-
(*x*) Thiosulphate	– 2	$S_2O_3^{2-}$
(*xi*) Silicate	– 2	SiO_3^{2-}
(*xii*) Stannate	– 2	SnO_3^{2-}
(*xiii*) Oxalate	– 2	$C_2O_4^{2-}$
(*xiv*) Bisulphide	– 1	HS^-
(*xv*) Peroxide	– 2	O_2^{2-}
(*xvi*) Dichromate	– 2	$Cr_2O_7^{2-}$
(*xvii*) Permanganate	– 1	MnO_4^-
(*xviii*) Zincate	– 2	ZnO_2^{2-}
(*xix*) Phosphide	– 3	P^{3-}
(*xx*) Iodide	– 1	I^-

Q2. Write the formulae of the following salts.

(*i*) Sodium chloride
(*ii*) Sodium sulphate
(*iii*) Potassium nitrate
(*iv*) Potassium nitrite
(*v*) Cupric sulphate
(*vi*) Mercury (II) nitrate/mercuric nitrate
(*vii*) Sodium chlorate
(*viii*) Calcium silicate
(*ix*) Ammonium phosphate
(*x*) Zinc nitrate
(*xi*) Calcium oxalate
(*xii*) Sodium acetate
(*xiii*) Hydrogen peroxide
(*xiv*) Cupric hydroxide
(*xv*) Iron (III) sulphate
(*xvi*) Ammonium acetate
(*xvii*) Lead chromate
(*xviii*) Calcium carbide
(*xix*) Aluminium carbide
(*xx*) Sodium bicarbonate.

Ans. (*i*) $Na^+ + Cl^- \rightarrow Na_1Cl_1$ = $NaCl$

(*ii*) $Na^+ + SO_4^{2-} \rightarrow Na_2(SO_4)_1$ = Na_2SO_4

(*iii*) $K^+ + NO_3^- \rightarrow K_1(NO_3)_1$ = KNO_3

(*iv*) $K^+ + NO_2^- \rightarrow K_1(NO_2)_1$ = KNO_2

(*v*) $Cu^{2+} + SO_4^{2-} \rightarrow Cu_1(SO_4)_1$ = $CuSO_4$

(*vi*) $Hg^{2+} + NO_3^- \rightarrow Hg_1(NO_3)_2$ = $Hg(NO_3)_2$

(*vii*) $Na^+ + ClO_3^- \rightarrow Na_1(ClO_3)_1$ = $NaClO_3$

(*viii*) $Ca^{2+} + SiO_3^{2-} \rightarrow Ca_1(SiO_3)_1$ = $CaSiO_3$

(*ix*) $NH_4^+ + PO_4^{3-} \rightarrow (NH_4)_3(PO_4)_1$ = $(NH_4)_3PO_4$

(*x*) $Zn^{2+} + NO_3^- \rightarrow Zn_1(NO_3)_2$ = $Zn(NO_3)_2$

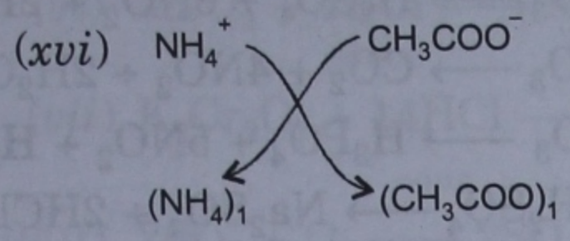
(*xi*) $Ca^{2+} + C_2O_4^{2-} \rightarrow Ca_2(C_2O_4)_2$ = CaC_2O_4

(*xii*) $Na^+ + CH_3COO^- \rightarrow Na(CH_3COO)$ = CH_3COONa

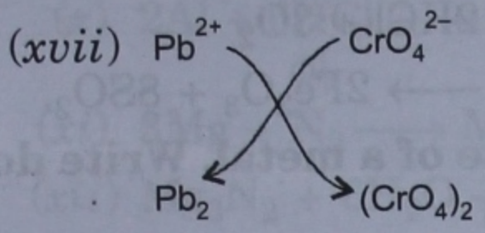
(*xiii*) $H^+ + O_2^{2-} \rightarrow H_2(O_2)_1$ = H_2O_2

(*xiv*) $Cu^{2+} + OH^- \rightarrow Cu_1(OH)_2$ = $Cu(OH)_2$

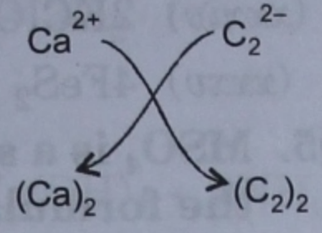
(*xv*) $Fe^{3+} + SO_4^{2-} \rightarrow Fe_2(SO_4)_3$ = $Fe_2(SO_4)_3$

(*xvi*) 

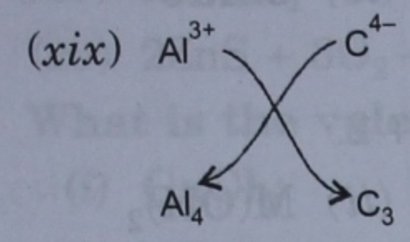
$= CH_3COONH_4$

(*xvii*) 

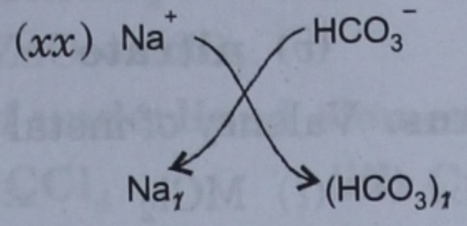
$= PbCrO_4$

(*xviii*) 

$= CaC_2$

(*xix*) 

$= Al_4C_3$

(*xx*) 

$= NaHCO_3$

Q3. Give the names of the following compounds.

(*i*) NH_4Cl (*ii*) Na_2O_2

(*iii*) $Zn(OH)_2$ (*iv*) $KHCO_3$

(*v*) $K_4[Fe(CN)_6]$ (*vi*) $NaClO$

(*vii*) $CaSO_4$ (*viii*) $Na[Ag(CN)_2]$

(*ix*) $AgNO_3$ (*x*) HNO_2.

Ans. (*i*) Ammonium chloride

(*ii*) Sodium peroxide

(*iii*) Zinc hydroxide

(*iv*) Potassium bicarbonate

(*v*) Potassium ferrocyanide

(*vi*) Sodium hypochlorite

(*vii*) Calcium sulphate

(*viii*) Sodium argentocyanide

(*ix*) Silver nitrate

(*x*) Nitrous acid.

Q4. Balance the following chemical equations.

(*i*) $N_2 + O_2 \longrightarrow NO$

(*ii*) $NO + O_2 \longrightarrow NO_2$

(*iii*) $NO_2 + H_2O + O_2 \longrightarrow HNO_3$

(*iv*) $Pb(NO_3)_2 \xrightarrow{\Delta} PbO + NO_2 + O_2$

(*v*) $AgNO_3 \xrightarrow{\Delta} Ag + NO_2 + O_2$

(*vi*) $Ag_2CO_3 \xrightarrow{\Delta} Ag + CO_2 + O_2$

(*vii*) $C_{22}H_{46} + Cl_2 \longrightarrow C + HCl$

(*viii*) $CuSO_4 + NaOH \longrightarrow Na_2SO_4 + Cu(OH)_2$

(*ix*) $NaNO_3 \xrightarrow{\Delta} NaNO_2 + O_2$

(*x*) $KNO_3 \xrightarrow{\Delta} KNO_2 + O_2$

(*xi*) $NH_3 + Cl_2 \longrightarrow NCl_3 + HCl$

(*xii*) $NH_3 + Cl_2 \longrightarrow NH_4Cl + N_2$

(*xiii*) $PbO + HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O$

(*xiv*) $NaOH + Cl_2 \longrightarrow NaCl + NaClO + H_2O$

(*xv*) $NaOH + Cl_2 \longrightarrow NaCl + NaClO_3 + H_2O$

(*xvi*) $CH_4 + O_2 \longrightarrow CO_2 + H_2O$

(*xvii*) $C_2H_6 + O_2 \longrightarrow CO_2 + H_2O$

(*xviii*) $C_2H_4 + O_2 \longrightarrow CO_2 + H_2O$

(*xix*) $C_2H_2 + O_2 \longrightarrow CO_2 + H_2O$

(*xx*) $Na + H_2O \longrightarrow NaOH + H_2$

(*xxi*) $Pb_3O_4 \xrightarrow{\Delta} PbO + O_2$

(*xxii*) $PbO_2 \xrightarrow{\Delta} PbO + O_2$

(*xxiii*) $Mg + HNO_3 \longrightarrow Mg(NO_3)_2 + H_2$

(*xxiv*) $NH_3 + CuO \longrightarrow N_2 + H_2O + Cu$

(*xxv*) $NH_3 + O_2 \longrightarrow N_2 + H_2O$

(*xxvi*) $H_2S + Cl_2 \longrightarrow HCl + S$

(*xxvii*) $H_2S + SO_2 \longrightarrow H_2O + S$

(*xxviii*) $H_2S + H_2SO_4 \longrightarrow H_2O + SO_2 + S$

(*xxix*) $S + HNO_3 \longrightarrow H_2SO_4 + NO_2 + H_2O$

(*xxx*) $C + HNO_3 \longrightarrow CO_2 + NO_2 + H_2O$

(*xxxi*) $P + HNO_3 \longrightarrow H_3PO_4 + NO_2 + H_2O$

(*xxxii*) $NaCl + H_2SO_4 \longrightarrow Na_2SO_4 + HCl$

(*xxxiii*) $Cu + H_2SO_4 \longrightarrow CuSO_4 + H_2O + SO_2$

(*xxxiv*) $KClO_3 \longrightarrow KCl + O_2$

(*xxxv*) $FeS_2 + O_2 \longrightarrow Fe_2O_3 + SO_2$.

Ans. (*i*) $N_2 + O_2 \longrightarrow 2NO$

(*ii*) $2NO + O_2 \longrightarrow 2NO_2$

(*iii*) $4NO_2 + 2H_2O + O_2 \longrightarrow 4HNO_3$

(*iv*) $2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_2 + O_2$

(*v*) $2AgNO_3 \xrightarrow{\Delta} 2Ag + 2NO_2 + O_2$

(*vi*) $2Ag_2CO_3 \xrightarrow{\Delta} 4Ag + 2CO_2 + O_2$

(*vii*) $C_{22}H_{46} + 23Cl_2 \longrightarrow 22C + 46HCl$

(*viii*) $CuSO_4 + 2NaOH \longrightarrow Na_2SO_4 + Cu(OH)_2$

(*ix*) $2NaNO_3 \xrightarrow{\Delta} 2NaNO_2 + O_2$

(*x*) $2KNO_3 \xrightarrow{\Delta} 2KNO_2 + O_2$

(*xi*) $NH_3 + 3Cl_2 \longrightarrow NCl_3 + 3HCl$

(*xii*) $8NH_3 + 3Cl_2 \longrightarrow 6NH_4Cl + N_2$

(*xiii*) $PbO + 2HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O$

(*xiv*) $2NaOH + Cl_2 \longrightarrow NaCl + NaClO + H_2O$

(*xv*) $6NaOH + 3Cl_2 \longrightarrow 5NaCl + NaClO_3 + 3H_2O$

(*xvi*) $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

(*xvii*) $2C_2H_6 + 7O_2 \longrightarrow 4CO_2 + 6H_2O$

(*xviii*) $C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O$

(*xix*) $2C_2H_2 + 5O_2 \longrightarrow 4CO_2 + 2H_2O$

(*xx*) $2Na + 2H_2O \longrightarrow 2NaOH + H_2$

(*xxi*) $2Pb_3O_4 \xrightarrow{\Delta} 6PbO + O_2$

(*xxii*) $2PbO_2 \xrightarrow{\Delta} 2PbO + O_2$

(*xxiii*) $Mg + 2HNO_3 \longrightarrow Mg(NO_3)_2 + H_2$

(*xxiv*) $2NH_3 + 3CuO \longrightarrow N_2 + 3H_2O + 3Cu$

(*xxv*) $4NH_3 + 3O_2 \longrightarrow 2N_2 + 6H_2O$

(*xxvi*) $H_2S + Cl_2 \longrightarrow 2HCl + S$

(*xxvii*) $2H_2S + SO_2 \longrightarrow 2H_2O + 3S$

(*xxviii*) $H_2S + H_2SO_4 \longrightarrow 2H_2O + SO_2 + S$

(*xxix*) $S + 6HNO_3 \longrightarrow H_2SO_4 + 6NO_2 + 2H_2O$

(*xxx*) $C + 4HNO_3 \longrightarrow CO_2 + 4NO_2 + 2H_2O$

(*xxxi*) $P + 5HNO_3 \longrightarrow H_3PO_4 + 5NO_2 + H_2O$

(*xxxii*) $2NaCl + H_2SO_4 \longrightarrow Na_2SO_4 + 2HCl$

(*xxxiii*) $Cu + 2H_2SO_4 \longrightarrow CuSO_4 + 2H_2O + SO_2$

(*xxxiv*) $2KClO_3 \xrightarrow{\Delta} 2KCl + 3O_2$

(*xxxv*) $4FeS_2 + 11O_2 \longrightarrow 2Fe_2O_3 + 8SO_2$.

Q5. MSO_4 is a sulphate of a metal. Write down the formula of its

(*i*) chloride **(*ii*) hydroxide**

(*iii*) carbonate **(*iv*) oxide**

(*v*) nitrate

Ans. Valency of metal 'M' is + 2.

(*i*) MCl_2 (*ii*) $M(OH)_2$

(*iii*) MCO_3 (*iv*) MO

(*v*) $M(NO_3)_2$

Q6. Write the formulae and balance the following chemical equations.

(*i*) Zinc + dilute Sulphuric acid ⟶ Zinc sulphate + Hydrogen

(*ii*) Copper + conc. Nitric acid ⟶ Copper nitrate + Nitrogen dioxide + Water

(*iii*) Copper + dil. Nitric acid ⟶ Copper nitrate + Nitric oxide + Water

(*iv*) Ammonium chloride + Calcium hydroxide ⟶ Calcium chloride + Water + Ammonia

(*v*) Ammonia + Oxygen ⟶ Nitric oxide + Water

(*vi*) Manganese (IV) oxide + conc. Hydrochloric acid ⟶ Manganese (II) chloride + Water + Chlorine

(*vii*) Potassium dichromate + conc. Hydrochloric acid ⟶ Potassium chloride + Chromium chloride + Water + Chlorine

(*viii*) Sulphur dioxide + Oxygen ⟶ Sulphur trioxide

(*ix*) Zinc + Water ⟶ Zinc oxide + Hydrogen

(*x*) Aluminium + dil. Hydrochloric acid ⟶ Aluminium chloride + Hydrogen

(*xi*) Magnesium + Nitrogen ⟶ Magnesium nitride

(*xii*) Magnesium nitride + Water ⟶ Magnesium hydroxide + Ammonia

(*xiii*) Copper hydroxide $\xrightarrow{\Delta}$ Copper oxide + Water

(*xiv*) Potassium chlorate $\xrightarrow{\Delta}$ Potassium chloride + Oxygen

(*xv*) Zinc sulphide + Oxygen ⟶ Zinc oxide + Sulphur dioxide

Ans. (*i*) $Zn + \underset{\text{dil.}}{H_2SO_4} \longrightarrow ZnSO_4 + H_2$

(*ii*) $Cu + \underset{\text{conc.}}{4HNO_3} \longrightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

(*iii*) $3Cu + \underset{\text{dil.}}{8HNO_3} \longrightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

(*iv*) $2NH_4Cl + Ca(OH)_2 \longrightarrow CaCl_2 + 2H_2O + 2NH_3$

(*v*) $4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$

(*vi*) $MnO_2 + 4HCl \xrightarrow{\text{conc.}} MnCl_2 + 2H_2O + Cl_2$

(*vii*) $K_2Cr_2O_7 + 14HCl \xrightarrow{\text{conc.}} 2KCl + 2CrCl_3 + 7H_2O + 3Cl_2$

(*viii*) $2SO_2 + O_2 \longrightarrow 2SO_3$

(*ix*) $Zn + H_2O \longrightarrow ZnO + H_2$

(*x*) $2Al + 6HCl \xrightarrow{\text{dil.}} 2AlCl_3 + 3H_2$

(*xi*) $3Mg + N_2 \longrightarrow Mg_3N_2$

(*xii*) $Mg_3N_2 + 6H_2O \longrightarrow 3Mg(OH)_2 + 2NH_3$

(*xiii*) $Cu(OH)_2 \xrightarrow{\Delta} CuO + H_2O$

(*xiv*) $2KClO_3 \xrightarrow{\Delta} 2KCl + 3O_2$

(*xv*) $2ZnS + 3O_2 \longrightarrow 2ZnO + 2SO_2$.

Q7. What is the valency of underlined element in the following compounds ?

(*i*) $\underline{Ca}Cl_2$ (*ii*) $\underline{C}Cl_4$ (*iii*) $\underline{Cu}SO_4$ (*iv*) $\underline{Mg}_3N_2$ (*v*) $\underline{Mn}O_2$

Ans. (*i*) + 2 (*ii*) + 4 (*iii*) + 2 (*iv*) + 2 (*v*) + 4

Q8. Identify the cationic (Basic radical) and anionic (Acidic radical) parts in the following compounds and then write their chemical formulae.

(*i*) Nickel sulphate
(*ii*) Sodium silicate
(*iii*) Ferrous sulphate
(*iv*) Calcium fluoride
(*v*) Sodium nitrite.

Ans.

Basic radical	Acidic radical	Chemical formula
(*i*) Ni^{2+}	SO_4^{2-}	$NiSO_4$
(*ii*) Na^+	SiO_3^{2-}	Na_2SiO_3
(*iii*) Fe^{2+}	SO_4^{2-}	$FeSO_4$
(*iv*) Ca^{2+}	F^-	CaF_2
(*v*) Na^+	NO_2^-	$NaNO_2$

Q9. Give the names of the following compounds.

(*i*) HClO (*ii*) $HClO_2$ (*iii*) $HClO_3$ (*iv*) $HClO_4$

Ans. (*i*) Hypochlorous acid

(*ii*) Chlorous acid

(*iii*) Chloric acid

(*iv*) Perchloric acid.

LET'S RECALL

Fill Your Answer in the Space Given for Each Question.

Q1. Match the following :

A.	**Column I (Element)**	**Column II (Symbol)**
	(*i*) Fluorine	(*a*) Sc
	(*ii*) Sodium	(*b*) C
	(*iii*) Carbon	(*c*) Xe
	(*iv*) Sulphur	(*d*) Hg
	(*v*) Xenon	(*e*) Cu
	(*vi*) Lead	(*f*) F
	(*vii*) Mercury	(*g*) Ti
	(*viii*) Copper	(*h*) Pb
	(*ix*) Titanium	(*i*) S
	(*x*) Scandium	(*j*) Na

Ans. (*i*) ☐ (*ii*) ☐ (*iii*) ☐ (*iv*) ☐ (*v*) ☐

(*vi*) ☐ (*vii*) ☐ (*viii*) ☐ (*ix*) ☐ (*x*) ☐

B.	**Column I (Name of the compound)**	**Column II (Formula)**
	(*i*) Sodium hypochlorite	(*a*) Na_2SO_4
	(*ii*) Sodium zincate	(*b*) Na_2CO_3
	(*iii*) Sodium bicarbonate	(*c*) $NaClO_3$
	(*iv*) Sodium silicate	(*d*) $NaNO_2$
	(*v*) Sodium bisulphate	(*e*) Na_2SiO_3
	(*vi*) Sodium nitrite	(*f*) Na_2ZnO_2
	(*vii*) Sodium nitrate	(*g*) NaClO
	(*viii*) Sodium sulphate	(*h*) $NaHCO_3$
	(*ix*) Sodium chlorate	(*i*) $NaHSO_4$
	(*x*) Sodium carbonate	(*j*) $NaNO_3$

Ans. (*i*) ☐ (*ii*) ☐ (*iii*) ☐ (*iv*) ☐ (*v*) ☐

(*vi*) ☐ (*vii*) ☐ (*viii*) ☐ (*ix*) ☐ (*x*) ☐

Q2. Fill in the blanks.

(*i*) Positive radicals are called _____ radicals.

(*ii*) Negative radicals are called _____ radicals.

(*iii*) Chloride, Bromide and Iodide are _____ radicals.

(*iv*) Sulphuric acid contains _____ atoms of oxygen and sulphurous acid contains _____ atoms of oxygen.

(*v*) _____ radical is a basic radical although it is not a metal.

Q3. State whether the following statements are True or False.

(*i*) Oxide ion is dinegative. ☐

(*ii*) A molecule of a metal is diatomic. ☐

(*iii*) A chemical equation predicts whether the reaction is fast or slow. ☐

(*iv*) $N_2 + 3H_2 \longrightarrow 2NH_3$ is a balanced equation. ☐

(*v*) Formulae are made by criss cross-method. ☐

Q4. Each question has four options, out of which only one option is correct. Dark the bubble for correct answer.

(*i*) The formula of ferric sulphate is

(*a*) $Fe_3(SO_4)_3$ (*b*) $Fe_3(SO_4)_2$ (*c*) $Fe_2(SO_4)_3$ (*d*) Fe_3SO_4

Ans. (*a*) (*b*) (*c*) (*d*)

(*ii*) The symbol for nitrate ion is

(*a*) NO_3^- (*b*) NO_2^- (*c*) N^{3-} (*d*) NO_2^{2-}

Ans. (*a*) (*b*) (*c*) (*d*)

(*iii*) The formula for magnesium nitride is

(*a*) MgN (*b*) Mg_2N_3 (*c*) Mg_3N_4 (*d*) Mg_3N_2

Ans. (*a*) (*b*) (*c*) (*d*)

(*iv*) The valency of iron in FeO is

(*a*) +1 (*b*) +2 (*c*) +3 (*d*) +2 and +3

Ans. (*a*) (*b*) (*c*) (*d*)

(*v*) The formulae of two chlorides of phosphorus are

(*a*) PCl_2 and PCl_3 (*b*) PCl_3 and PCl_4 (*c*) PCl_3 and PCl_5 (*d*) PCl and PCl_2

Ans. (*a*) (*b*) (*c*) (*d*)

Answers

1. A. (*i*) *f*	(*ii*) *j*	(*iii*) *b*	(*iv*) *i*	(*v*) *c*	(*vi*) *h*
(*vii*) *d*	(*viii*) *e*	(*ix*) *g*	(*x*) *a*		
B. (*i*) *g*	(*ii*) *f*	(*iii*) *h*	(*iv*) *e*	(*v*) *i*	(*vi*) *d*
(*vii*) *j*	(*viii*) *a*	(*ix*) *c*	(*x*) *b*		
2. (*i*) basic	(*ii*) acid	(*iii*) acid	(*iv*) four, three	(*v*) ammonium	
3. (*i*) True	(*ii*) False	(*iii*) False	(*iv*) True	(*v*) True	
4. (*i*) *c*	(*ii*) *a*	(*iii*) *d*	(*iv*) *b*	(*v*) *c*	

SELF EVALUATION TEST

Time : *30 minutes* ***Marks :*** *30*

Q1. Give the chemical name of the following compounds. **2**

(*a*) NaClO (*b*) $NaClO_3$ (*c*) $NaClO_2$ (*d*) $NaClO_4$

Q2. Give the formula for **3**

(*i*) potassium ferrocyanide

(*ii*) potassium ferricyanide

(*iii*) potassium sulphocyanide

Q3. Give the valency and the formula of the following radicals. **5**

(*i*) Chlorate (*ii*) Oxalate

(*iii*) Stannate (*iv*) Zincate

(*v*) Cupric (*vi*) Silicate

(*vii*) Phosphate (*viii*) Nitride

(*ix*) Phosphide (*x*) Acetylide

Q4. Copy and balance the following equations. **10**

(*i*) $K_2Cr_2O_7 + HCl \longrightarrow KCl + CrCl_3 + H_2O + Cl_2$

(*ii*) $(NH_4)_2Cr_2O_7 \longrightarrow N_2 + H_2O + Cr_2O_3$

(*iii*) $Mg(NO_3)_2 \longrightarrow MgO + NO_2 + O_2$

(*iv*) $Hg(NO_3)_2 \longrightarrow Hg + NO_2 + O_2$

(*v*) $Na_2S_2O_3 + HCl \longrightarrow NaCl + H_2O + SO_2 + S$

(*vi*) $CaOCl_2 + NH_3 \longrightarrow CaCl_2 + H_2O + N_2$

(*vii*) $Al + Fe_2O_3 \longrightarrow Fe + Al_2O_3$

(*viii*) $NH_3 + O_2 \longrightarrow NO + H_2O$

(*ix*) $Zn + HNO_3 \longrightarrow Zn(NO_3)_2 + H_2O + NO$

(*x*) $Mg + HNO_3 \longrightarrow Mg(NO_3)_2 + H_2O + NO_2$

Q5. The valency of metal 'M' is +3. Give the formula of its **10**

(*i*) chloride (*ii*) hydroxide

(*iii*) sulphide (*iv*) nitrate

(*v*) sulphate (*vi*) phosphate

(*vii*) nitride (*viii*) carbonate

(*ix*) methanide (*x*) phosphide

(***Note :*** Do not identify the element)