

Language of chemistry

Element, atom, molecule, compound,
Valency, Radical, symbol, formula,

Element

- An element is the pure substance which can neither be decomposed into, nor be built from simpler substance by ordinary physical or chemical method. There are 118 number of element known till now. Out of them 92 are naturally occurring and rest of them are synthesized.

Atom

- An atom is the smallest particle of element which can take part in chemical reaction. Which can neither be created nor destroyed by any chemical or physical process.
- Atoms of most elements are not able to exist independently . Atoms form molecule and ions. These molecule or ions aggregate in large number to form the matter(substance) that we can see, feel or touch.

Symbol

- Symbol may be defined as the abbreviated form for the lengthy name of an element. symbol has qualitative and quantitative significance.
- For eg: symbol 'Al' tells us
- Qualitatively(identity):Element 'Aluminium'
- Quantitatively (numeric):one atom of Aluminium, atomic mass of Aluminium is 27 amu , one mole of Aluminium is 27 gram which consist of Avogadro's no.(6.023×10^{23}) of atoms.

Compound

- A compound is the substance containing two or more than two elements combining together in a fixed proportion by weight and which can be decomposed in to its constituents by suitable chemical method. Further the properties of compound are completely different from those of its constituent element.
- For eg: in H_2O , H:O is 1:8 by weight.
- In CO_2 , C:O is $12:32=3:8$ by weight.

Molecule

- A molecule is the smallest particle of substance that has the chemical properties of that element or compound(substance).
- The no. of atoms present on molecule is called '**atomicity**'.
- Monoatomic : He, Ne, Ar, Zn,Mg,Cu,Ag
- Diatomic :H₂,O₂,N₂,Cl₂,Br₂
- Triatomic :O₃
- Tetratomic :P₄

Radical

- Radical is charged chemical species containing atom or group of atoms and behave as a single unit in a chemical transformation with its own valency similar to that of element.
- Radical does not exist freely like atom because the valencies of atoms of radical are not satisfied. They exist in chemical compound by combining with other atoms or radicals.
- The combining capacity of element or radical is called valency.

Classification of radicals

- **Simple and compound radical**(basis of no. of atoms)

Simple radical consists of only one atom whereas compound radical consists of two or more than two atoms.eg simple(H^+ , Cl^- , Na^+ , K^+) compound(OH^- , CO_3^{2-} , SO_4^{2-} , MnO_4^- , $\text{Fe}(\text{CN})_6^{4-}$)

- **Cation and anion** (on the basis of charge)

Negatively charged ions which move towards anode are called 'Anions' where as positively charged ions which move towards cathod are called 'Cations'

For eg; Na^+ , K^+ H^+ (cations) OH^- , CO_3^{2-} , SO_4^{2-} (anions)

- **Acid radical and basic radical** (on the basis of origin)

Negatively charged ion except OH^- that comes from acid during neutralization reaction is called 'acid radical'. for eg; Cl^- , NO_3^- , CO_3^{2-} , SO_4^{2-} , $\text{Fe}(\text{CN})_6^{3-}$.

Positively charged ion except H^+ that comes from base during neutralization reaction is called 'basic radical'. for eg; Ca^{++} , Al^{+++} Na^+ , K^+ .

Molecular formula

- The symbolic representation of a molecule of a substance which indicates the actual no of atoms of each kinds present in one molecule of that substance is called molecular formula.
- Like symbol of element molecular formula of substance has also **qualitative** and **quantitative** significance.
- The molecular weight of a substance is the sum of atomic weight of all the atoms present in the molecule.

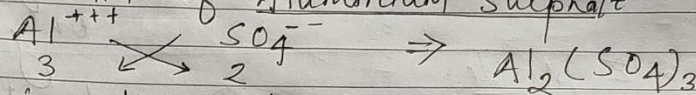
For eg : molecular weight of H_2O is $2 \times 1 + 16 = 18$ amu.

Mol.wt. of glucose($\text{C}_6\text{H}_{12}\text{O}_6$)= $6 \times 12 + 12 \times 1 + 16 \times 6 = 180$ amu.

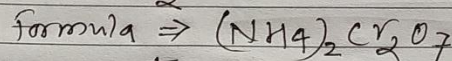
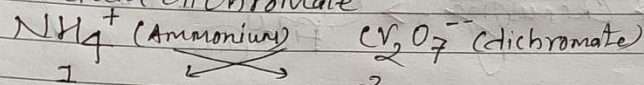
- What is the significance of formula H_2O .

Way to write correct formula

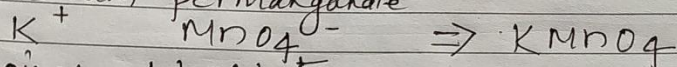
* Write Formula of Aluminium sulphate



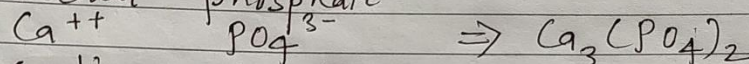
* Ammonium dichromate



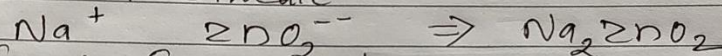
* Potassium permanganate



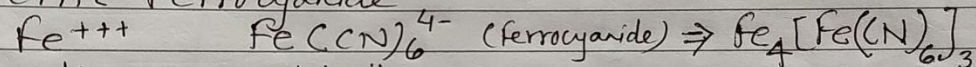
* Calcium phosphate



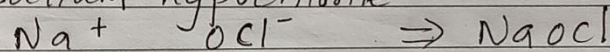
* Sodium zincate



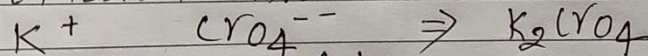
* Ferric ferrocyanide



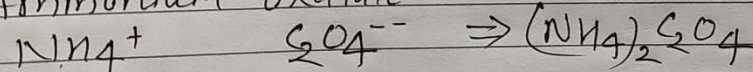
* Sodium hypochlorite



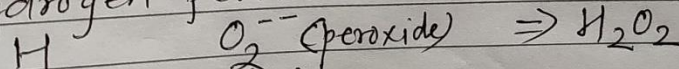
* potassium chromate



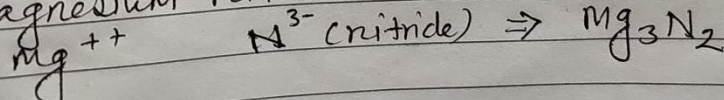
* Ammonium oxalate



* Hydrogen peroxide



* magnesium nitride



List of acid radicals

Monovalent		Bivalent (Divalent)		Trivalent	
Fluoride	F^-	Oxide	O^{2-}	Borate	BO_3^{3-}
Chloride	Cl^-	Sulphide	S^{2-}	Ferricyanide	$Fe[CN]_6^{3-}$
Bromide	Br^-	Carbonate	CO_3^{2-}	Nitride	N^{3-}
Iodide	I^-	Chromate	CrO_4^{2-}	Phosphide	P^{3-}
Hydride	H^-	Dichromate	$Cr_2O_7^{2-}$	Phosphite	PO_3^{3-}
Iodate	IO_3^-	Sulphite	SO_3^{2-}	Phosphate	PO_4^{3-}
Chlorate	ClO_3^-	Sulphate	SO_4^{2-}	Arsenate	AsO_4^{3-}
Bromate	BrO_3^-	Thiosulphate	$S_2O_3^{2-}$	Arsenite	AsO_3^{3-}
Nitrate	NO_3^-	Manganate	MnO_4^{2-}	Aluminate	AlO_3^{3-}
Meta-Aluminate	AlO_2^-	Silicate	SiO_3^{2-}	Tetravalent	
Permanganate	MnO_4^-	Stannate	SnO_3^{2-}		
Cyanide	CN^-	Zincate	ZnO_2^{2-}	Carbide	C^{4-}
Acetate	CH_3COO^-	Peroxide	O_2^{2-}	Ferrocyanide	$Fe[CN]_6^{4-}$
Bicarbonate	HCO_3^-	Biphosphite	HPO_3^{2-}		
Bisulphite	HSO_3^-				
Bisulphate	HSO_4^-				
Hypochlorite	ClO^-				

List of basic radicals

Valencies of some electro-positive radicals are tabulated below:

Monovalent	
Hydrogen	H^+
Sodium	Na^+
Potassium	K^+
Silver	Ag^+
Ammonium	NH_4^+
Cuprous	Cu^+
Mercurous	Hg^+

Tetravalent	
Stannic	Sn^{4+}
Plumbic	Pb^{4+}
Platinum (ic)	Pt^{4+}

Bivalent (Divalent)	
Barium	Ba^{2+}
Cadmium	Cd^{2+}
Cobalt	Co^{2+}
Cupric	Cu^{2+}
Plumbous	Pb^{2+}
Stannous	Sn^{2+}
Zinc	Zn^{2+}
Magnesium	Mg^{2+}
Manganous	Mn^{2+}
Strontium	Sr^{2+}
Ferrous	Fe^{2+}
Mercuric	Hg^{2+}

Trivalent	
Aluminium	Al^{3+}
Auric	Au^{3+}
Chromium(III)	Cr^{3+}
Ferric	Fe^{3+}
Antimony (ous)	Sb^{3+}
Manganic	Mn^{3+}
Bismuth	Bi^{3+}

Pentavalent	
Arsenic	As^{5+}
Antimony (ic)	Sb^{5+}

Hexavalent	
Chromium (VI)	Cr^{6+}

Common name and chemical formula

Formula of Some Common Compounds with Commercial Names

Compounds	Formula	Compounds	Formula
Bleaching powder	CaOCl_2	Soda ash	Na_2CO_3
Sal ammoniac	NH_4Cl	Baking soda	NaHCO_3
Quick lime	CaO	Limestone or marble	CaCO_3
Slaked lime	Ca(OH)_2	Sulphurated hydrogen	H_2S
Hypo	$\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$	Oil of Vitriol	H_2SO_4
Laughing gas	N_2O	Aqua fortis	HNO_3
Silica(sand)	SiO_2	Potash alum (Alum)	$\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$
Caustic soda	NaOH	Marsh gas	CH_4
Caustic potash	KOH	Carbide	CaC_2
Washing soda	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$	Horn silver	AgCl

List of elements

A	B	C
Element	Atomic number	Atomic mass
Hydrogen	1	1
Helium	2	4
Lithium	3	6.94
Beryllium	4	9.01
Boron	5	10.81
Carbon	6	12.01
Nitrogen	7	14.01
Oxygen	8	15.99
Fluorine	9	19
Neon	10	20.18
Sodium	11	22.99
Magnesium	12	25.31
Aluminium	13	26.98
Silicon	14	28.09
Phosphorus	15	30.97
Sulphur	16	32.07
Chlorine	17	35.45
Argon	18	39.95
Potassium	19	39.1
Calcium	20	40.08
Scandium	21	44.96
Titanium	22	47.87
Vanadium	23	50.94
Chromium	24	52
Manganese	25	54.94
Iron	26	55.85
Cobalt	27	58.93
Nickel	28	58.69
Copper	29	63.55
Zinc	30	65.41

Mixture

- Mixture can be defined as the combination of two or more than two chemical substance which simply lie together but do not react chemically. A mixture can be separated into its constituents generally by simple physical method.
- There are two types of mixture i.e. **homogeneous** and **heterogeneous** mixture.
- A mixture is said to be homogeneous if its composition is uniform throughout. The component of mixture are not visible with naked eye and consist of only one phase. For eg ,air, alloys ,salt sugar solution.
- A mixture is said to be heterogeneous if its composition is not uniform throughout. The component of mixture are visible with naked eye and consist of two or more distinct phase. for eg ,mixture of sand and sugar, oil and water etc.

Change in matter

Physical change	Chemical change
It is temporary change and process can be easily reversed.	It is permanent change and process can not be easily reversed.
No new compound is formed only the physical state and colour may be changed.	New compound is formed with entirely different properties.
Eg :melting of ice, dissolution of sugar in water, cooling of water into ice.	Eg :rusting of iron, burning of coal, heating of sugar into black mass.