Structure of Atom and Chemical Bonding

Atom

An atom is the smallest particle of an element that can take part in a chemical reaction. The size of an atom is indicated by its radius which is called "atomic radius" (radius of an atom). Atomic radius is measured in "nanometers "(nm).
1 meter = 10_9 nanometres or 1nm = 10^{-9} m.
hydrogen atom is the smallest atom of all having an atomic radius 0.337nm.
maharishi Kanad told that if we keep dividing matter on and on, we will get the smallest particle called as parmanu (which was later termed as atom by John Dalton).

Symbol

"A symbol is a brief representation of the name of the element".
Berzelius, a Swedish chemist, was the first to introduce the system of using letters as symbols for the elements.
(a) Symbols may be derived from the first letter of the English name of the element.
e.g. Hydrogen (H), Oxygen (O), Nitrogen (N) etc.
(b) Symbols may be derived from the first letter and another significant letter of the name of element.
e.g. Aluminium (Al), Bromine (Br), Calcium (Ca) etc.
(c) Symbols may be derived from their Latin names of the elements.
e.g. Copper (Cuprum-Cu), Iron (Ferrum-Fee), Silver (Argentum-Ag), Sodium (Natrium-Na), Pottasium (Kalium-K), Gold (Aurum-Au) etc.

Dalton's Atomic Theory

(i) Matter consists of small indivisible particles called atoms
(ii) All atoms of an element are identical.
(iii) The atoms of an element are different from the atoms of any other element.
(iv) A compound is formed by combination of atoms of two or more elements in simple ratio. e.g. Ratio between H and O in water is 2:1 by volume.
(v)Atoms take part in chemical reactions.
(vi) Atoms can neither be created nor be destroyed.

Merits

(i) Dalton's theory explains the law of conservation of mass and law of constant proportion.
(ii) Atoms of elements take part in chemical reaction this is true till today.

Demerits

(i) The atom is no longer supposed to be indivisible.
(ii) He could not explain that why do atoms of same element combined with each other.
(iii) Atoms of the same element may not necessarily be identical in all aspects. e.g. isotopes.
(iv) Atoms of different elements may not necessarily be different in all aspects. e.g., isobars.

Laws of Chemical Combination

There are two important laws of chemical combination.
(a) Law of Conservation of Mass or Matter:
Give by Lavosisier in 1774. According to the law of conservation of mass, matter can neither be created nor be destroyed in a chemical reaction.
The law of conservation of mass means that in a chemical reaction, the total mass of products in equal to the total mass of the reactants. There is no change in mass during a chemical reaction e.g.

$$\underset{(100g)}{CaCO_3} + Heat \longrightarrow \underset{56g}{CaO} + \underset{44g}{CO_2}$$

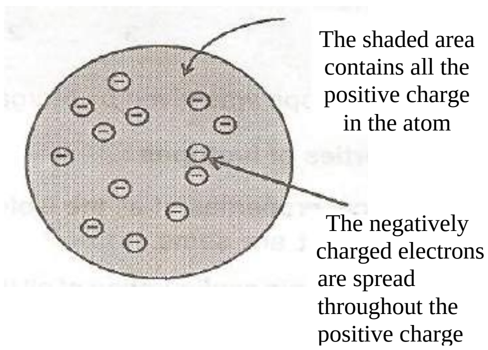
56g + 44g=100g

(b) Law of Constant Proportions/Law of Definite Proportions:
Given by Prouts, in 1799. According to the law of constant proportions a chemical compound always consists of the same elements combined together in the same proportion by mass. e.g.
Water is a compound of hydrogen and oxygen. 9 parts by weight of water is always found to contain 1 part by weight of hydrogen and 8 parts by weight of oxygen.
The converse of Law of definite proportions that when same elements combine in the same proportion, the same compound will be formed, is not always true.

Atomic Models

(a) Thomson's Model of an Atom: Plum Pudding Model:
J.J. Thomson proposed this model of the atom in the year 1903 (then only electors and protons were known to be present in the atom).
(i) An atom consists of a sphere (or ball) of positive charge in which negatively charged electrons are embedded like plum in pudding.

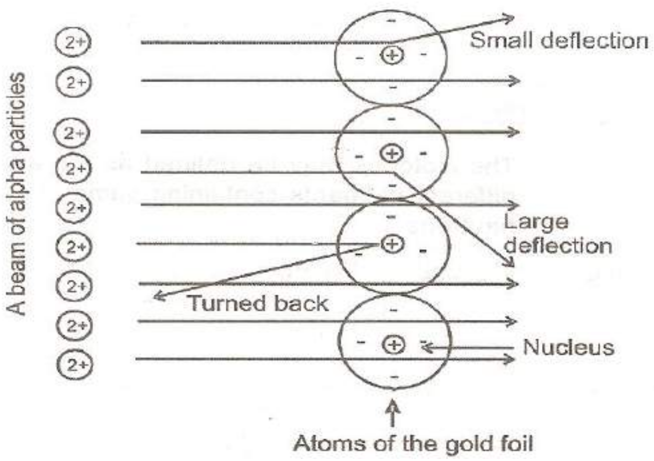
(ii) The positive and negative charges in an atom are equal in magnitude, due to which an atom is electrically neutral.



(b) Rutherford's Nuclear Model of an Atom:

(i) Rutherford's alpha – particle scattering experiment (1911):

Rutherford chose an extremely thin gold foil and bombarded it with alpha particles, the alpha particles are emitted by radioactive substances. Each alpha particle has a charge of two protons and their mass is 4 atomic mass units.



(ii) Observations and conclusions:

(A) Most of the particles passed through the gold foil along a straight line path hence, there must be large empty space within the atom.

(B) Some particles were deflected through small angles and large angles, therefore, there must be something massive and positively charged present in the atom.

(C) A very small fraction of the particles returned on their path or bounced back, therefore, the whole positive charge in the atom is concentrated in a very small space.

(iii) Rutherford's nuclear model of an atom:

(A) Most of the space in an atom is empty.

(B) An atom consist of a positively charged, dense and very small nucleus containing all the protons.

(C) Almost the entire mass of an atom is concentrated inside the nucleus.

(D) The nucleus is surrounded by negatively charged electrons. The electrons are revolving around the nucleus in circular paths at very high speed.

(E) An atom is electrically neutral. This is because the number of protons and electrons in an atom is equal.

(C) Bohr's Atomic Model (1913):

(i) The nucleus is situated at the centre of the atom.

(ii) Electrons revolve around the nucleus in certain definite circular paths, called orbits or shells.

(iii) In each orbit, electrons possess a certain definite amount of energy. This energy is different for different orbits, but it is fixed for any one orbit, hence, these orbits are also known as energy levels.

(iv) The energy levels are designated as K,L,M,N,O, …………, with K being the nearest to the nucleus.

(v) As long as an electron moves in a particular energy level, its energy remains constant.

Modern atomic theory

(a) Structure of an atom:

An atom consists of two parts-

(i) Nucleus: Nucleus is situated in the centre of an atom.

All the protons & neutrons are situated in the nucleus. The overall charge of nucleus is positive due to the presence of positively charged protons. The protons & neutrons are collectively called nucleons. The radius of the nucleus of an atom is of the order of 10_{13} cm and its density is of the order of 10_{15} g/cm_3.

(ii) Extra nuclear region: In extra nuclear part electrons are present which revolve around the nucleus in orbits of fixed energies.

The maximum number of electrons that can be accommodated in a shell is given by the formula $2n^2$ (n = number of shells i.e. 1,2,3 -----)

Shell		$2n^2$	Maximum electrons
K	1	$2(1)^2$	2
L	2	$2(2)^2$	8
M	3	$2(3)^2$	18
N	4	$2(4)^2$	32

(b) Composition of an atom:

It consists of three elementary particles electrons, proton and neutron. These are known as sub-atomic particles.

Property	Electron	Proton	Neutron
1. Discovery	J.J. Thomson	E. Goldstein	James Chadwick
2. Symbol	E	P	N
3. Nature	Negatively charged	Positively charged	Neutral
4. Relative charge	-1	+1	0
5. Absolute charge	1.602×10^{-19} C	1.602×10^{-19} C	0
6. Relative mass	$\frac{1}{1837}$	1	1
7. Absolute mass	9.109×10^{-28} g	1.6725×10^{-24} g	1.6748×10^{-24} g

Atomic number (Z)

Z= no. of protons = no. of electrons (in electrically neutral atoms).

eg. $^{27}_{13}Al$

Z = 13

P = 13

E = 13

Each element has a unique atomic number

Mass number (A)

A=no. of protons + no. of neutrons (total no. of nucleons)

A = p+n

A = Z+n

e.g. $^{27}_{13}Al$

Z = 13

A = 27

P = 13

e = 13

n = A-Z

= 27-13=14

Isotopes

The atoms of the same element having some atomic number, but different mass number are called isotopes.

or

The atoms of the same element having equal number of protons but different number of neutrons.

e.g. Isotopes of Hydrogen

	Z	A	n
Protium $^{1}_{1}H$	1	1	0
Protium $^{2}_{1}H$	1	2	1
Tritium $^{3}_{1}H$	1	3	2

The terms isotope was given by Margaret Todd.

(a) Properties of Isotopes:

(i) Chemical properties of all the isotopes of the same element is same.

(ii) The electronic configuration of all the isotopes of same element is same.

(iii) The physical properties like mass, boiling point, melting point of isotopes of same element are different.

Isobars

The atoms of different element with different atomic number, but same mass number are called isobars.

e.g. $^{14}_{6}C$ *and* $^{14}_{7}N$ *are isobars*

$^{40}_{20}Ca$ *and* $^{40}_{18}Ar$ *are isobars*

Isotones

The isotones may be defined as the atoms of different element containing same number of neutrons.

e.g. $^{13}_{3}$ C and $^{14}_{7}$ N [Number of neutrons (N) = A - Z]

For $^{13}_{6}C\ N = 13 - 6 = 7$

For $^{14}_{7}N\ N = 14 - 7 = 7$

Other example $^{30}_{14}Si$, $^{31}_{15}P$ *and* $^{32}_{16}S$

Isoelectronic

Ion or atom or molecule which have the same number of electrons are called as isoelectronic species.

e. g.	Cl^-	Ar	K^+	Ca^{+2}
No. of electrons	18	18	18	18

Electronic Configuration

The arrangement of the electrons in different shells is known as the electronic configuration of the element.

If the outermost shell has its full quota of 8 electrons it is said to be an octet. If the first shell has its full quota of 2 electrons, it is said to be duplet.

(a) Bohr-Bury scheme for distribution of electrons in various shells:

Name of shells K L M N

Number of shells	1	2	3	4
Maximum Number of electrons ($2n^2$)	2	8	18	32

(b) Electronic Configuration of some Elements-

Atomic number	Symbols of the element	Name of the element	Electronic configuration
1	H	Hydrogen	1
2	He	Helium	2
3	Li	Lithium	2,1
4	Be	Beryllium	2,2
5	B	Boron	2,3
6	C	Carbon	2,4
7	N	Nitrogen	2,5
8	O	Oxygen	2,6
9	F	Fluorine	2,7
10	Ne	Neon	2,8
11	Na	Sodium	2,8,1
12	Mg	Magnesium	2,8,2
13	Al	Aluminium	2,8,3
14	Si	Silicon	2,8,4
15	P	Phosphorus	2,8,5
16	S	Sulphur	2,8,6
17	Cl	Chlorine	2,8,7
18	Ar	Argon	2,8,8
19	K	Potassium	2,8,8,1
20	Ca	Calcium	2,8,8,2

(c) Significance of Electronic Configuration:

(i) Electronic configuration of an atom helps us to understand the chemical reactivity of the element.
(ii) When the outermost shell of an atom is completely filled as per Bhor-Bury scheme then the element is unreactive.
(iii) When the outermost shell or an atom is not completely filed according to Bohr-bury rule, the element is reactive.
An atom can get the noble gas electronic configuration in three ways-
By losing one or more electrons.
By gaining one or more electrons.
By sharing one or more electrons with other atom or atoms.

Valance shell and valence electrons

The outermost shell of an atom is known as the valence shell. The electrons present in the valence shell of an atom are known as valence electrons.

The remainder of the atom i.e. the nucleus and other electrons is called the core of the atom. Electrons present in the core of an atom are known as core electrons.
e.g.
The electronic configuration of the sodium (Na) atom is:-

	K	L	M
Na (11)	2	8	1

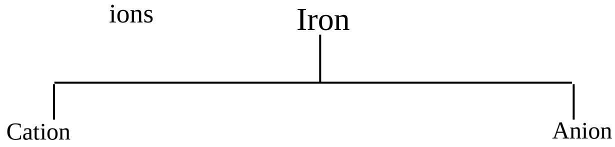
Thus, valence electrons in Na atom =1 and core electrons in Na atom = 2+8=10

(a) Valency: Valency of an element is the combining capacity of the atoms of the element with atoms of the same of different elements.
the valency of an element = number of valence electrons.
(when number of valence electrons are from 1 to 4)
the valencey of an element = 8- number of valence electrons are more than 4)

(b) Variable Valency: Certain elements (metals and non-metals) exhibit more than one valency.
(i) Among the metals iron, copper, silver etc. show variable valency. For lower valency a suffix ous and for higher valency a suffix –ic is attached at the end of the name of the metal.
e.g.
Ferrous = Fe^{+2}
Ferric = Fe^{+3}
(ii) Among the non-metals nitrogen, phosphorus, sulphur etc. show variable valency.

Ions

The charged particles formed by an atom on the gain or loss of one or more electron (s) are called ions



Cation: The loss of an electron by an atom leads to the formation of a cation.

e.g. $\underset{11e^-}{Na} - e \longrightarrow \underset{10e^-}{Na^+}$

Anion: The gain of an electron by an atom leads to formation of an anion.

e.g. $\underset{17e^-}{Cl} + e^- \longrightarrow \underset{18e^-}{Cl^-}$

Radicals

A molecule of an inorganic compound is mad up of two electrically charged species which are known as radicals. The positively charged radical is known as the basic radical while negatively charged radical is called acidic radical

(a) Type of radicals:

(i) Simple radicals: When a radical consists of only one element, it is called simple radical.

eg. Ag^+, Ba^{2+}, Cl^-, Br^-, S^{2-} etc.

(ii) Compound radicals: When a radical consists of more than one type of elements, it is called a compound radical.

eg. $NO_3{}^-$, $SO_4{}^{2-}$, $NH_4{}^+$, $BO_3{}^{3-}$, $PO_4{}^{3-}$ etc.

List of Common Electrovalent Positive Radicals

Monovalent Electropositive	Bivalent Electropositive	Trivalent Electropositive	Tetravalent Electropositive
1. Hydrogen H^+	1. Magnesium Mg^{2+}	1. Aluminum Al^{3+}	1. Stannic [Tin (IV)] Sn^{4+}
2. Ammonium $NH_4{}^+$	2. Calcium Ca^{2+}	2. Ferric [Iron (III) Fe^{3+}	2. Plumbic [Lead (IV)] Pb^{4+}
3. Sodium Na^+	3. Zinc Zn^{2+}	3. Chromium Cr^{3+}	
4. Potassium K^+	4. Plumbous [Lead (II)] Pb^{2+}		
5. Cuprous [(Copper (I)] Cu^+	5. Cupric [(Cupper (II)] Cu^{2+}		
6. Argentous [(Silver (I)] Ag^+	6. Argentic [Silver (II)] Ag^{2+}		
7. Mercurous [(Mercury (I)] Hg^+	7. Stannous [Tin (II)] Sn^{2+}		
	8. Ferrous [Iron (II)] Fe^{2+}		
	9. Mercuric [Mercury (II)] Hg^{2+}		
	10. Barium Ba^{2+}		

List of Common Electrovalent Negative Radicals

Monovalent Electropositive	Bivalent Electropositive	Trivalent Electropositive	Tetravalent Electropositive
1. Fluoride F^+	1. Sulphate $SO_4{}^{2-}$	1. Nitride N^{3-}	1. Carbide C^{4-}
2. Chloride Cl^-	2. Sulphite $SO_3{}^{2-}$	2. Phosphide P^{3-}	
3. Bromide Br^-	3. Sulphide S^{2-}	3. Phosphite $PO_3{}^{3-}$	
4. Iodide I^-	4. Thisoulphate $S_2O_3{}^{2-}$	4. Phosphate $PO_4{}^{3-}$	
5. Hydride H^-	5. Zincate $ZnO_2{}^{2-}$		
6. Hydroxide OH^-	6. Oxide O^{2-}		
7. Nitrite $NO_2{}^-$	7. Peroxide $O_2{}^{2-}$		
8. Nitrate $NO_3{}^-$	8. Dichromate $Cr_2O_7{}^{2-}$		
9. Bicarbonate or Hydrogen carbonate $HCO_3{}^-$	9. Carbonate $CO_3{}^{2-}$		
10. Bisulphite or Hydrogen carbonate $HSO_3{}^-$	10. Silicate $SiO_3{}^{2-}$		
11. Bisulphide or Hydrogen sulphite HS^-			
12. Bisulphide or Hydrogen sulphate $HSO_4{}^-$			
13. Acetate CH_3COO^-			

Chemical formula

Molecule of an element or a compound may be represented by symbols of the elements present in one molecule of the compound. It is known as a chemical formula.

eg. HCl is the formula of hydrogen chloride and NaCl is that of sodium chloride.

(a) Significance of a Chemical Formula:

(i) Names of the elements present in the compound.
(ii) Number of atoms of each element.
(iii) Molecular weight of the compound.
(iv) The relative proportion of weights of the elements.

(b) Writing a Chemical Formula:

Step-1 Write the symbol of the positive ion or the radical to the left and that of the negative ion or radical to the right.

Step-2 Put the valence number of each radical or the ion on its top right. Divide the valence number by the highest common factor, if any, to get a simple ratio. Now ignore the (+) and (-) signs. Interchange the valence numbers or radicals or ions.

Step-3 Shift the valence numbers to the lower right side of the radical or ion. If the compound radical receives number more than 1, enclose it within brackets. Do not enclose simple radicals within brackets.

Names of compounds	Symbols with valence numbers (I and II stops)	Shifting valence numbers (III step)	Formula
Calcium chloride	Ca^{+2} Cl^{-3}		$CaCl_2$
Magnesium sulphate	Mg^{+2} SO_4^{-2} or Mg^{+1} SO_4^{-} 4		$MgSO_4$
Aluminium sulphate	Ar^{+3} SO_4^{+2}		$Al_2(SO_4)_3$
Ammonium phosphate	NH_4^{-1} PO_4^{+3}		$(NH_4)_3PO_4$
Potassium dichvomate	$K^{+1}Cr_2O_2^{+2}$		$K_2Cr_2O_2$

(c) Formula of some useful compounds:

S. No.	Compounds	Common Names	Chemical Names
1	CaO	Lime	Calcium oxide
2	$NaHCO_3$	Braking soda	Sodium hydrogen carbonate
3	Na_2CO_3. $10H_2O$	Washing soda	Sodium carbonate decahydrate
4	$CaCO_3$	Limestone	Calcium carbonate
5	$Ca(OH)_2$	Slaked lime	Calcium hydroxide
6	$CuSO_4.5H_2O$	Blue vitriol	Copper sulphate pentahydrate
7	NaCl	Common salt	Sodium chloride
8	Na_2CO_3	Soda ash	Sodium carbonate
9	NaOh	Caustic soda	Sodium hydroxide
10	KOH	Caustic potash	Potassium hydroxide
11	$CaOCl_2$	Bleaching powder	Calcium oxychloride
12	$CaSO_4.1/2H_2O$	Plaster of parts	Calcium sulphae hemihydrate
13	$CaSO_4.2H_2O$	Gypsum	Calcium sulphate dehydrate
14	$FeSO_4.7H_2O$	Green vitriol	Ferrous sulphate heptahydrate
15	H_2SO_4	Oil of vitriol	Sulphuric acid

Octet Rule

Octet rule was given by G.N. Lewis and W. Kossel in 1916.

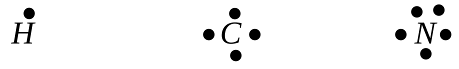
According to octet rule "an atom whose outermost shell contains 8 electrons (octet) is stable".

Elements	Symbol	Atomic number	Electronic configuration	No. of valence electrons
Neon	Ne	10	2,8	8
Argon	Ar	18	2,8,8	8
Krypton	Kr	36	2,8,18,8	8

Electron dot representation (Lewis symbols)

(i) Give by G.N. Lewis:

(ii) To draw the Lewis symbol for an element, we write its chemical symbol surrounded by a number of dots or crosses, which represents the valence electros of the atom.



etc.

(Z=1) (Z=6) (2, 4) (Z=7) (2, 5)

Chemical bonding

A force of attraction developed between the atoms which holds them together is called a chemical bond.

in a chlorine molecule (Cl_2) two chlorine atoms are held together by a chemical bond.

A chemical bond is accompanied by release of energy, thus the resulting molecule has less energy and is more stable.

(a) Reason for the Formation of a Chemical Bond:

The atoms combine gases do not usually form bonds with other elements, because they are stable. So atoms of elements, because they are stable. So atoms of elements combine with one another to achieve the inert gas configuration and become stable.

Ionic bond

(a) Formation of an Ionic Bond:

this bond is formed the atoms of electropositive and electronegative elements. Electropositive elements lose electrons in chemical reaction and electronegative elements gain electrons in chemical reaction. Electrostatic force of attraction acts between the positively and negatively charged ions due to which both ions are bonded with each other. As a result, a chemical bond is formed between the ions, which is known as ionic or electrovalent compound.

Number of electrons donated or accepted by any element is called electrovalency.

In ionic compound every cation is surrounded by fixed number of anion and every anion is surrounded by fixed number of action and they are bonded in a fixed geometry in a three dimensional structure.

e.g. Sodium chloride

sodium atom (electropositive element) by losing an electron from its outermost orbit, gets converted into a cation and attains noble gas like stable configuration.

$$\underset{(2,8,1)}{Na} + IE \rightarrow \underset{(2,8)}{Na^+} + e^-$$

Energy required for this process is called "ionization energy"

$$\underset{(2,8,7)}{Cl + e^-} \rightarrow \underset{(2,8,8)}{Cl^-} + EA$$

In this process energy is released which is known as "electron affinity."

$$Na^+ + Cl- \rightarrow Na^+Cl^- \ or \ NaCl$$

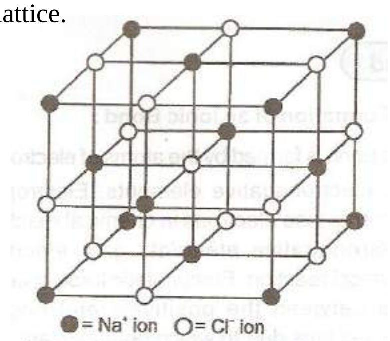
Here electrovalency of sodium and chlorine atom is one.
For the formation of ionic bond, it is necessary that the ionisation energy or electropositive element should be less and electron affinity of electronegative element should be high.

(b) Properties of Ionic Compounds:

(i) Ionic Compounds consist of ions:
For example, sodium chloride consists of Na^+ and Cl^- ions.

(ii) Physical nature: Ionic compounds are solid and relatively hard due to strong electrostatic force of attraction between the ions of ionic compound

(iii) Crystal structure:
ionic compounds do not exit as simple single molecules as Na^+Cl^-. This is due to the fact that the forces of attraction are not restricted to single unit but due to uniform electric field around an ion, each ion is attracted to a large number of other ions. As a result, there is a regular arrangement of these ions in three dimensions such a regular arrangement is called crystal lattice.

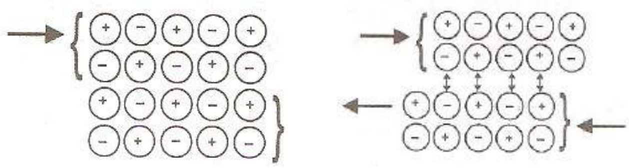


Lattice structure of Sodium chloride

(iv) Melting point and boiling point: Strong electrostatic force of attraction is present between ions of opposite charges. So their melting points and boiling points are high.

(v) Solubility: Ionic compounds are generally soluble in polar solvents like water and insoluble in non-polar solvents like carbon tetrachloride, etc.

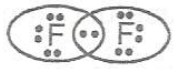
(vi) Brittle nature: Ionic compounds on applying external force or pressure are broken into small pieces, such substances are known as brittle and this property is known as brittleness. When external force is applied on the ionic compound, layers of ions slide over one anther and particles of the same charge come near to each other as a result due to the strong repulsion force, crystals of compounds are broken.



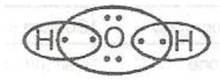
(vii) Electrical conductivity: Ionic are non conductor of electricity in solid state, while in fused state or in solution they conduct electricity due to the presence of free ions.

Covalent bond

(a) Formation of Covalent Bond:
When two atoms of electronegative elements approach each other then they share electrons. Bonds formed in this manner are called covalent bonds and compounds are termed as covalent compound.
Number of electrons taking part in the process of sharing is called covalency of that element.
e.g.



F – F or F_2 molecule



H – O – or H_2O molecule

the electrons that participate in bond formation are called bond pairs of electrons while those which do not take part in bond formation are called lone pairs of electrons.

(b) Properties of covalent compounds:

(i) Covalent compounds consist of molecules:
For example – hydrogen, oxygen, nitrogen etc. consist of H_2, O_2 and N_2 molecules respectively.

(ii) Physical state: Weak vander Wall's forces are present between the molecules of covalent compounds. So, covalent compounds are in gaseous or liquid state at normal temperature and pressure.
e.g. Hydrogen, chlorine, methane, oxygen, nitrogen are gases while carbon tetrachloride, ethyl alcohol, ether, bromine etc. are liquids. Glucose, sugar, urea, iodine etc. are some solid covalent compounds.

(iii) Crystal structure: Covalent compounds are both crystalline (like borax, sugar) and non crystalline (like glass, urea).

(iv) Melting point and boiling point: Due to the presence of weak vander Waal's force, their melting and boiling points are less.

(v) Electrical conductivity: Covalent compounds are bad conductor of electricity due to the absence of free electrons of free ions.

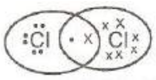
(vi) Solubility: They are soluble in non-polar solvents like benzene, carbon tetrachloride etc.

(a) Types of Covalent Bonds:

(i) Depending upon the number of electrons shared between the two bonded atoms, covalent bonds are of following tow types:

(A) Single covalent bond: Formed by sharing of one pair of electors between two atoms.

e.g.



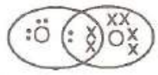
Cl – Cl or Cl_2 molecule

Other examples: H-H, F-F, F,H-Cl etc.

(B) Multiple covalent bond: It is of following two types:

Double covalent bond: Formed by sharing of 2 pairs of electrons between the atoms. It is represented by two line (=) between the atoms.

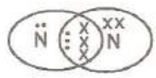
e.g.



O = O or O_2 molecule

Other examples: CO_2, C_2H_4 etc.

Triple covalent bond: Formed by sharing of 3 pairs of electrons and is represented by three line (=) between the bonded atoms.



N ≡ N or N_2 molecule

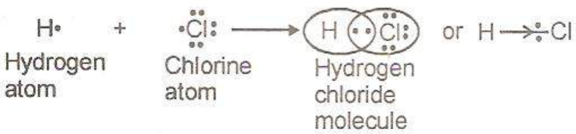
Other examples: C_2H_2 etc.

(ii) Depending on whether the two bonded atoms differ in their electronegativities or not i.e. on bond polarity covalent bonds are of two types:

(A) Polar covalent bond:

A Polar covalent bond is formed when two atoms having different electronegativities combine or in other words a polar covalent bond is formed between different types of atoms.

e.g. HCl molecule



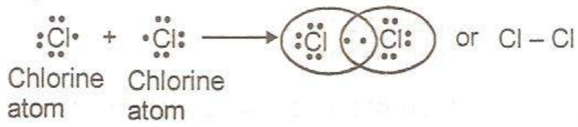
Since the electrons are attracted more towards the Cl atom it acquires a slight negative charge (δ^-) while H acquires a slight positive charge (δ^+) as electrons move away from it. This can be represented as –

$$\overset{\delta^+}{H} \text{———} \overset{\delta^-}{Cl}$$

Other examples: HF, H_2O, NH_3 etc.

(B) Non-polar covalent bond: A non-polar covalent bond is formed when two atoms having equal electro negativities combine or when same type of atoms combine.

e.g. Chlorine molecule.



Other examples: Fluorine molecule (F_2), hydrogen molecule (H_2), oxygen molecule (O_2) etc.

Polar compounds dissolve in polar solvents like water and non polar compounds dissolve in non-polar solvents like benzene, carbon tetrachloride etc.

Difference between Ionic and covalent compounds.

S. No.	Ionic compounds	Covalent compounds
1	These are usually crystalline solids.	These are usually liquids or gases. Only some of them are solids.
2	Ionic compounds have high melting & boiling points i.e., they are non-volatile.	Convalent compounds have usually low melting & boiling points i.e., they are volatile.
3	Ionic compounds conduct electricity when dissolved in water or melted i.e., they are electrolytes.	Convalent compounds do not conduct electricity i.e., they are non-electrolytes.
5	Ionic compounds are usually soluble in water	Most of the convalent compounds are usually insoluble in water. (except some like glucose, sugar, urea etc.)

EXERCISE

1. The valency of an element 'X' is 3 and that or 'Y' is 2. The combination XY would be-
(A) Aluminium sulphate (B) Aluminium nitrate
(C) Aluminium phosphate (D) Aluminium oxide

2. Study the given figure.

The nucleus consists of –
(A) protons (B)neutrons
(C) electrons (D)nucleons

3. Which of the following statements is incorrect?
(A) The charges on an electron and a proton are equal and opposite.
(B) Neutrons have not get charge.
(C) Electrons and protons have the same mass
(D) The mass of proton and a neutron and nearly the same.

4. The ratio of the volume of an atom and the volume of a nucleus is-
(A) 10^{10} (B) $1O^{12}$
(C) 10^{15} (D) 10^{20}

5. The species having more electrons that neutrons is -
(A) F (B) Na^{+}
(C) $O2^{-}$ (D) Mg^{2+}

6. Mass number of an element is 2Z+6, where Z is the number of electrons. Number of neutrons will be-
(A) 2Z+6 (B) Z+6
(C) Z+8 (D) Z+2

7. The introduction of a neutron into the nuclear composition of an atom would lead to change in-
(A) the number of electrons.
(B) the chemical natural of atom
(C) its atomic number
(D) its atomic weight

8. Which of the following is iso-electronic with neon?
(A) O^{2-} (B) S^{2-}
(C) Mg (D) Na

9. The electronic energy levels in Bohr's atomic model are called-
(A) ground states (B) orbitals
(C) orbits (D) Rydberg levels

10. Which of the following electronic transitions in a hydrogen atom will require the largest amount of energy?
(A) From n=1 to n=2
(B) From n=2 to n=3
(C) From n= to n=1

11. When an electron jumps from L level to M level, there occurs-
(A) emission of energy
(B) absorption of energy
(C) emission of γ-radiation
(D) emission of X-rays

12. ……….. tavourable conditions for electrovalency are-
(A) low charge on ions, large cation and small anion.
(B) high charge on ions, small cation and large anion
(C) high charge on ions, large cation and small anion
(D) low charge on ions, small cation and large anion

13. A bond with maximum covalent character between non-metallic elements is found-
(A) between atoms of same size
(B) between chemically similar atoms
(C) between identical atoms
(D) between atoms of widely differing electronegativities

14. When sodium chloride is dissolved in water, the sodium ion gets-
(A) oxidised (B) reduced
(C) hydrolysed (C) hydrated

15. Which one of the following bonds will be the most polar?

(A) N-Cl (B) O-F

(C) C-F (D) N-N

16. Rutherford α-particle scattering experiment eventually led to the conclusion that-

(A) mass and energy are related

(B) electrons occupy space around the nucleus

(C) neutrons are buried deep in the nucleus

(D) the point of impact with matter can be precisely determined

17. The electronegativity of O,F,N, Cl and H are 3.5, 4.0, 3.2 and 2.1 respectively. The strongest bond will be -

(A) F-O (B) O-Cl

(C) N-H (D) O-H

Instructions:

The questions from 18 to 20 consist of an Assertion (a) and Reason (r). Use the following key to choose the correct answer-

(A) If both (a) and (r) are correct and(r) is the correct explanation of (a).

(B) If both (a) and (r) are correct ant (r) is not the correct explanation of (a).

(C) If (a) is correct but (r) in incorrect

(D) If (a) is incorrect but (r) in correct

18. (a) In Rutherford gold foil experiment, very few α-particles are deflected back.

(r) Nucleus present inside the atom is heavy.

19. (a) Ionic compounds tend to be non-volatile.

(r) Inter molecular forces in these compounds are weak.

20. (a) The atoms in a covalent molecule are said to share electrons, yet some are polar.

(r) In polar covalent molecules, the shard electrons spend more time on the average near one of the atoms.

21. Two atoms A and B are represented by their mass number and atomic number as-

(NTSE State-II/2007)

$\underset{9}{19}A \ and \ \underset{9}{21}B$

Read the following statements:

(A) A and B belong to the same element

(B) A and B have the same number of protons

(C) A and B are isotopes

(D) A and B are isobars

(E) A and B have the same number of neutrons

Which one of the following group of statements in correct?

(A) c,e,d (B) a,b,d

(C) b,c,a (D) e,ab

22. Mass number of oxygen is -

(A) 8 (B) 16

(C) 20 (D) 32

ANSWER – KEY

STRUCTURE OF ATOM AND CHEMICAL BONODINH

Q.	1	2	3	4	5	6	7	8	9	10
A.	D	D	C	C	C	B	D	A	C	A
Q.	11	12	13	14	15	16	17	18	19	20
A.	B	C	C	D	C	B	D	B	C	A
Q.	21	22								
A.	C	B								