Q.1 What is chemistry?

Ans. Chemistry is the branch of science that deals with the properties, composition, and structure of elements and compounds.

Q Who is the father of the chemistry?

Ans. Antoine Lavoisier (एंटोनी लावोइसियर)

More about Chemistry

1. Arbic → al-kimiya (अल्कीमिया) → 8th century
2. Latin → al-chemiya (अल्केमिया) → 12th century
3. Old english → alchemie (अल्केमी) → 14th century
4. Middle english → chemetre (केमी) → 15th century
5. Modern english → chemistry → 16th century

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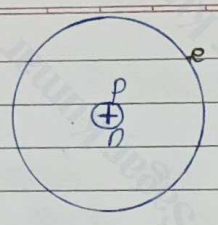
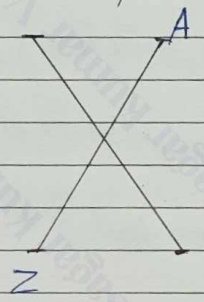


S.No	Atom	Charge	Charge	Mass no.
1.	electron	-ve	-1.6×10^{-19} C	9.1×10^{-31} kg
2.	Proton	+ve	1.6×10^{-19} C	1.67×10^{-27} kg
3.	Neutron	No.	0	1.67×10^{-27} kg

Atom Representation

* 

* X = atom
* Z = atomic Number
* A atomic mass number

Number of electron = number of proton = number of Neutron

* $\boxed{e = p = n}$

* $A = n + p$

Examples

1. $^{23}_{11}Na$ (proton) (electron)

Find = n = ?, e = ?, p = ?, A = ?, Z = ?

Sol. n = 12, e = 11, p = 11, A = 23, Z = 11

$\Rightarrow A = n + p$
$\therefore n = A - p$
$\Rightarrow 23 - 11 = 12$, $n = 12$

2. $^{26}_{13}Al$ / $^{40}_{20}Al$

Find = n = ?, e = ?, p = ?, A = ?, Z = ?

Sol. n = 13
e = 13
p = 13 (e = p)
A = ~~13~~ 26
Z = 13

$\Rightarrow A = n + p$
$\therefore n = A - p$
$\Rightarrow n = 26 - 13 = 13$

n = 13, p = 13

$\Rightarrow A = n + p$
$= 13 + 13$
$= 26$

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3. H^{1} (pro, electron) / H^{1}

Find = A = ? , Z = ? , e = ? , P = ? , n = ?

Sol. - A = 1 , Z = 1 , e = 1 , P = 1 (e = P)
n = 0

⇒ A = n + P
⇒ n = A − P
∴ n = 1 − 1 = 0

4. $^{40}_{20}Ca$

Find A = ? , Z = ? , e = ? , P = ? , n = ?

Sol. A = 40 , Z = 20 , e = 20 , P = 20 (e = P)
n = 20

A = n + P
⇒ n = A − P
∴ n = 40 − 20 = 20

5. $_{8}O^{16}$

Find A = ? , Z = ? , e = ? , P = ? , n = ?

Sol. - A = 16 , Z = 8 , e = 8 , P = 8 (e = P) , n =

A = n + P
⇒ n = A − P
∴ n = 16 − 8 = 8

Q. Electron की खोज किसने और कब किया ?

Ans. जे० जे० थॉमसन (J.J Thomson) 1897

Q. Proton की खोज किसने और कब किया?

Ans. गोल्डस्टीन / रदरफोर्ड (Goldstein / Rutherford) 1920

Q. Neutron की खोज किसने और कब किया?

Ans. जेम्स चैडविक (Jems Chadwick) 1932

Trick → ई ट पर/पग नाच

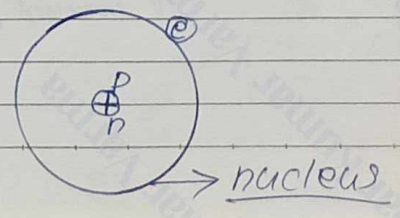
ई - electron , ट - थॉमसन , प - Proton , र = रदरफोर्ड
/ ग - गोल्डस्टीन , न - Neutron , च = चैडविक

Q. What is Atomic Number ?

Ans. The number of proton in a nucleus is called atomic number.

* Nucleus में जितना प्रोटॉन रहता है, उसे atomic number कहते हैं।

Symbol = Z =



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Q. What is ~~Atom~~ Mass Number ?

Ans. The mass number is defined as the total number of proton and neutrons in an atom is called mass number.

* प्रोटोन का कुल संख्या और न्यूट्रॉन का कुल संख्या को जोड़ने पर जो प्राप्त होता है उसे ~~Atom~~ Mass number कहते हैं।

समस्थानिक –

समभारिक –

Isotopes :- Atoms of the same element which have the same atomic number but different mass numbers.

Ex: (i) $^{1}_{1}H$ (H) — Hydrogen (Protium) — (one proton)

$^{2}_{1}H$ (D) Deuterium (one proton, one neutron)

$^{3}_{1}H$ (T) Tritium (one proton, two neutron)

2. Chlorine – $^{35}_{17}Cl$ (17 proton, 18 neutron)

$^{37}_{17}Cl$ (17 proton, 20 neutron)

Periodic Table

S. No.	Elements	Symbol	Atomic No.	Mass no.
1.	Hydrogen	H	1	1
2.	Helium	He	2	4
3.	Lithium	Li	3	7
4.	Berylium	Be	4	9
5.	Boron	B	5	11
6.	Carbon	C	6	12
7.	Nitrogen	N	7	14
8.	Oxygen	O	8	16
9.	Flourine	F	9	19
10.	Neon	Ne	10	20
11.	Sodium	Na	11	23
12.	Magnesium	Mg	12	24
13.	Aluminium	Al	13	27
14.	Silicon	Si	14	28
15.	Phosphorous	P	15	31
16.	Sulphur	S	16	32
17.	Chlorine	Cl	17	35 (35.5)
18.	Argon	Ar	18	40
19.	Potassium	K	19	39
20.	Calcium	Ca	20	40
21.	Scandium	Sc	21	45 (44.96
22.	Titanium	Ti	22	48 (47.88)
23.	Vanadium	V	23	51 (50.94)
24.	Chromium	Cr	24	52
25.	Manganese	Mn	25	55 (54.94)
26.	Iron	Fe	26	56 (55.85)
27.	Cobalt	Co	27	59 (58.93)
28.	Nickel	Ni	28	59 (58.69)
29.	Copper	Cu	29	63.55
30.	Zinc	Zn	30	65.39

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Isobars :- Atoms of different elements having the same mass number but different atomic numbers are called isobars.

Ex:- $^{40}_{18}Ar$ $^{40}_{19}K$ $^{40}_{20}Ca$

18 protons	19 protons	20 protons
22 neutrons	21 neutrons	20 neutron
(A-Z)		

Isotones :- Atoms having same number of neutrons but different mass number ar called Isotones.

Ex:- 1. $^{14}_{6}C$ $^{15}_{7}N$ $^{16}_{8}O$, 2. $^{30}_{14}Si$ $^{31}_{15}P$ $^{32}_{16}S$

Quantum Number

1. Principle quantum number (n) :- It identifies shell, determines sizes and energy of orbitals.

n = 1	K-shell	- 2 electron
n = 2	L-shell	- 8 electron
n = 3	M-shell	- 18 electron
n = 4	N-shell	- 32 electron

2. Azimuthal quantum no. (n) :- It identifies sub-shell, determines the shape of orbitals.

No. of orbital in sub-shell = $2l+1$

Subshell	s	p	d	f	g
value of l	0	1	2	3	4
No. of orbital	1	3	5	7	9

Energy order of the sub-shell

$s < p < d < f$

3. Magnetic quantum no. (m) :- It gives information about the spatial orientation of the orbital with respect to standard, set of co-ordinate axis.

Azimuthal quantum Number (l)	Magnetic quantum Number (m)
$l = 0$ (s-sub shell)	$m = 0$
$l = 1$ (p-sub shell)	$m = -1, 0, +1$
$l = 2$ (d-sub shell)	$m = -2, -1, 0, +1, +2$
$l = 3$ (f-sub shell)	$m = -3, -2, -1, 0, +1, +2, +3$

4. Spin quantum Numbers (s) :- It refers to the orientation of the spin of the electron.

$+1/2$, $-1/2$

↑↓	↑	↓
$+1/2$ $-1/2$	$m_s = +1/2$	$m_s = -1/2$
	Anti-clockwise	clockwise

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Aufbau Principle

Subshell - s → 2
p → 6
d → 10
f → 14

Shell
K → 2
L → 8
M → 18
N → 32

1s
2s 2p
3s 3p 3d
4s 4p 4d 4f
5s 5p 5d 5f
6s 6p 6d 6f
7s 7p 7d 7f

1s → 2s →
2p 3s → 3p 4s →
3d 4p → 5s 4d → 5p 6s →
4f 5d 6p → 7s 5f → 6d 7p 8s →

ex:- $_{13}Al \rightarrow 2, 8, 3 \Rightarrow \underbrace{1s^2}_{2}, \underbrace{2s^2\ 2p^6}_{8}\ \underbrace{3s^2\ 3p^1}_{3}$

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Ions from configurations

1. $_1H \rightarrow 1 \rightarrow 1s^1$

2. $_2He \rightarrow 2 \rightarrow 1s^2$

3. $_3Li - 3 \rightarrow 1s^2\ 2s^1$

$_4Be - 2, 2 \rightarrow 1s^2\ 2s^2$

$_5B - 2, 3 \rightarrow 1s^2\ 2s^2\ 2p^1$

$_6C - 2, 4 \rightarrow 1s^2\ 2s^2\ 2p^2$

$_7N - 2, 5 \rightarrow 1s^2\ 2s^2\ 2p^3$

$_8O - 2, 6 \rightarrow 1s^2\ 2s^2\ 2p^4$

$_9F - 2, 7 \rightarrow 1s^2\ 2s^2\ 2p^5$

$_{10}Ne - 2, 8 \rightarrow 1s^2\ 2s^2\ 2p^6$

$_{11}Na - 2, 8, 1 \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^1$

$_{12}Mg - 2, 8, 2 \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2$

$_{13}Al - 2, 8, 3 \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$

$_{14}Si - 2, 8, 4 \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$

$_{15}P - 2, 8, 5 \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$

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$_{16}S$ – 2,8,6 → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$

$_{17}Cl$ – 2,8,7 → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

$_{18}Ar$ – 2,8,8 → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

$_{19}K$ – 2,8,8,1 → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$

$_{20}Ca$ – 2,8,8,2 → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$

$_{21}Sc$ – 2,8,9,2 → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^1$

$_{22}Ti$ – 2,8,10,2 → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^2$

$_{23}V$ – 2,8,11,2 → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^3$

* $_{24}Cr$ – 2,8,12,2 → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^5$

$_{25}Mn$ – 2,8,13,2 → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^5$

$_{26}Fe$ – 2,8,14,2 → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ \cancel{3d^6}\ 4s^2\ 3d^6$

$_{27}Co$ – 2,8,15,2 → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^7$

$_{28}Ni$ – 2,8,16,2 → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^8$

* $_{29}Cu$ – 2,8,17,2 → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^{10}$

$_{30}Zn$ – 2,8,18,2 → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}$

Subshell electronic configuration

1. $_1H$ → $1s^1$
2. $_2He$ – $1s^2$
3. $_3Li$ → $1s^2\ 2s^1$ ⇒ $[He]\ 2s^1$
4. $_4Be$ → $1s^2\ 2s^2$ ⇒ $[He]\ 2s^2$
5. $_5B$ → $1s^2\ 2s^2\ 2p^1$ ⇒ $[He]\ 2s^2\ 2p^1$
6. $_6C$ – $1s^2\ 2s^2\ 2p^2$ → $[He]\ 2s^2\ 2p^2$
7. $_7N$ – $1s^2\ 2s^2\ 2p^3$ → $[He]\ 2s^2\ 2p^3$
8. $_8O$ – $1s^2\ 2s^2\ 2p^4$ → $[He]\ 2s^2\ 2p^4$
9. $_9F$ → $1s^2\ 2s^2\ 2p^5$ → $[He]\ 2s^2\ 2p^5$
10. $_{10}Ne$ – $1s^2\ 2s^2\ 2p^6$ → $[He]\ 2s^2\ 2p^6$
11. $_{11}Na$ – $1s^2\ 2s^2\ 2p^6\ 3s^1$ → $[Ne]\ 3s^1$
12. $_{12}Mg$ – $1s^2\ 2s^2\ 2p^6\ 3s^2$ → $[Ne]\ 3s^2$
13. $_{13}Al$ – $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$ → $[Ne]\ 3s^2\ 3p^1$
14. $_{14}Si$ – $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$ → $[Ne]\ 3s^2\ 3p^2$
15. $_{15}P$ – $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$ → $[Ne]\ 3s^2\ 3p^3$

16. $_{16}S - 1s^2 2s^2 2p^6 3s^2 3p^4 \rightarrow [Ne]\, 3s^2 3p^4$

17. $_{17}Cl - 1s^2 2s^2 2p^6 3s^2 3p^5 \rightarrow [Ne]\, 3s^2 3p^5$

18. $_{18}Ar - 1s^2 2s^2 2p^6 3s^2 3p^6 \rightarrow [Ne]\, 3s^2 3p^6$

19. $_{19}K - 1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 \rightarrow [Ar]\, 4s^1$

20. $_{20}Ca - 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 \rightarrow [Ar]\, 4s^2$

21. $_{21}Sc - 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^1 \rightarrow [Ar]\, 4s^2 3d^1$

22. $_{22}Ti - 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^2 \rightarrow [Ar]\, 4s^2 3d^2$

23. $_{23}V - 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^3 \rightarrow [Ar]\, 4s^2 3d^3$

* 24. $_{24}Cr - 1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^5 \rightarrow [Ar]\, 4s^1 3d^5$

25. $_{25}Mn - 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^5 \rightarrow [Ar]\, 4s^2 3d^5$

26. $_{26}Fe - 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6 \rightarrow [Ar]\, 4s^2 3d^6$

27. $_{27}Co - 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^7 \rightarrow [Ar]\, 4s^2 3d^7$

28. $_{28}Ni - 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^8 \rightarrow [Ar]\, 4s^2 3d^8$

* 29. $_{29}Cu - 1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10} \rightarrow [Ar]\, 4s^1 3d^{10}$

30. $_{30}Zn - 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} \rightarrow [Ar]\, 4s^2 3d^{10}$

In Ions of configuration

1. $_1H \rightarrow 1s^1$
   $H^+ \rightarrow 1s^0$

2. $_2He \rightarrow 1s^2$

3. $_3Li \rightarrow 1s^2 2s^1$
   $Li^+ \rightarrow 1s^2 2s^0$

4. $Be \rightarrow 1s^2 2s^2$
   $Be^+ \rightarrow 1s^2 2s^1$
   $Be^{2+} \rightarrow 1s^2 2s^0$

5. $B \rightarrow 1s^2 2s^2 2p^1$
   $B^+ \rightarrow 1s^2 2s^2 2p^0$

6. $C \rightarrow 1s^2 2s^2 2p^2$
   $C^+ \rightarrow 1s^2 2s^2 2p^1$
   $C^{2+} \rightarrow 1s^2 2s^2 2p^0$
   $C^{3+} \rightarrow 1s^2 2s^1 2p^0$
   $C^{4+} \rightarrow 1s^2 2s^0 2p^0$

   $C^- \rightarrow 1s^2 2s^2 2p^3$
   $C^{2-} \rightarrow 1s^2 2s^2 2p^4$
   $C^{3-} \rightarrow 1s^2 2s^2 2p^5$
   $C^{4-} \rightarrow 1s^2 2s^2 2p^6$

7. $_7N \rightarrow 1s^2 2s^2 2p^3$
   $_8N^- \rightarrow 1s^2 2s^2 2p^2$
   $_9N^{2-} \rightarrow 1s^2 2s^2 2p^1$
   $_{10}N^{3-} \rightarrow 1s^2 2s^2 2p^0$

8) $_8O \rightarrow 1s^2 2s^2 2p^4$
   $_9O^- \rightarrow 1s^2 2s^2 2p^5$
   $_{10}O^{2-} \rightarrow 1s^2 2s^2 2p^6$

9) $_9F \rightarrow 1s^2 2s^2 2p^5$
   $_{10}F^- \rightarrow 1s^2 2s^2 2p^6$

10). $_{10}Ne \rightarrow 1s^2 2s^2 2p^6$

11). $_{11}Na \rightarrow 1s^2 2s^2 2p^6 3s^1$

    $_{10}Na^+ \rightarrow 1s^2 2s^2 2p^6 3s^0$

12). $_{12}Mg \rightarrow 1s^2 2s^2 2p^6 3s^2$
    $_{11}Mg^+ \rightarrow 1s^2 2s^2 2p^6 3s^1$
    $_{10}Mg^{2+} \rightarrow 1s^2 2s^2 2p^6 3s^0$

13). $_{13}Al \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^1$
    $_{12}Al^+ \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^0$
    $_{11}Al^{2+} \rightarrow 1s^2 2s^2 2p^6 3s^1 3p^0$
    $_{10}Al^{3+} \rightarrow 1s^2 2s^2 2p^6 3s^0 3p^0$

14). $_{14}Si \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^2$
    $_{13}Si^+ \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^1$
    $_{12}Si^{2+} \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^0$
    $_{11}Si^{3+} \rightarrow 1s^2 2s^2 2p^6 3s^1 3p^0$

    $_{10}Si^{4+} \rightarrow 1s^2 2s^2 2p^6 3s^0 3p^0$

15. $_{15}P \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$
$_{16}P^- \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$
$_{17}P^{2-} \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$
$_{18}P^{3-} \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

17. $_{17}Cl \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$
$_{18}Cl^- \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

18. $_{18}Ar \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

19. $_{19}K \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$
$_{18}K^+ \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^0$

20. $_{20}Ca \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$
$_{19}Ca^+ \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$
$_{18}Ca^{2+} \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^0$

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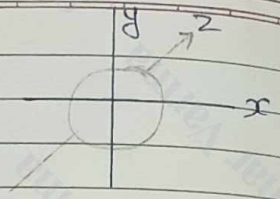
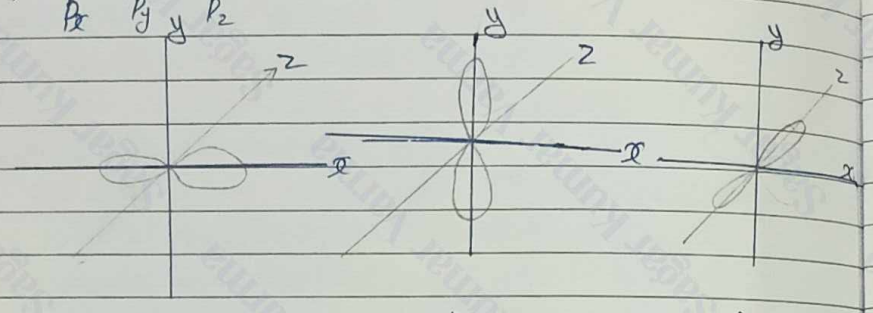
Shape of orbital/subshell/shell

s → [ ] → spherical



P → [ ][ ][ ] → Dumbell

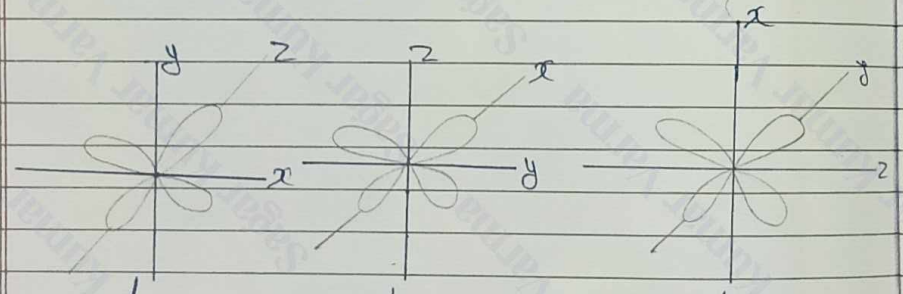
P_x P_y P_z



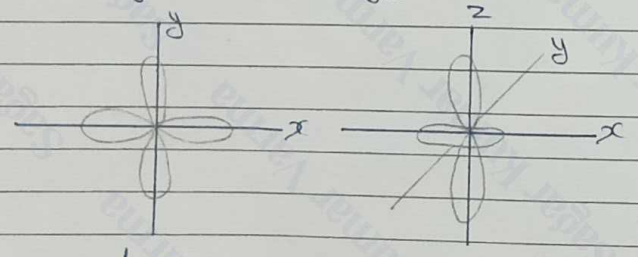
P_x P_y P_z

d → [ ][ ][ ][ ][ ] → Double dumbell

d_{xy} d_{yz} d_{zx} $d_{x^2-y^2}$ d_{z^2}



d_{xy} d_{yz} d_{zx}



$d_{x^2-y^2}$ d_{z^2}

f = Complecated.

Different between orbit and orbitals

orbit	orbital
(i) The orbits are represented by the letters K, L, M, N	(i) orbitals are represented by the letters S, P, d, f
(ii) The maximum number of electrons in an orbit is given by $2n^2$ rule.	(ii) orbitals can contain maximum of two electrons probability.
(iii) The number of orbits from the nucleous are $n = 1, 2, 3, 4$, etc.	(iii) The number of orbitals relative to energy levels are $n^2 = 1, 4, 9, 16$ etc.
(iv) orbit is a fixed circular described by a moving electron around the nucleus	(iv) orbital is a 3d region around the nucleous in which the posibility of finding the electron is maximum (90-95%).
(v) orbits are circular path or elliptical in shape.	(v) orbitals have different geomatical shape. i.e – spherical shape. dumbell etc.

Aufbau principle

German word → Building (construction)

⇒ Aufbau principle state that the electrons always enters the various orbital in the order of increasing energy.

or

In the ground state of an atom the electrons occupied two occupied available orbitals in the increasing order of energies the orbital of lower energy being field first this is called Aufbau principle or building up.

1s
2s 2p
3s 3p 3d
4s 4p 4d 4f
5s 5p 5d 5f
6s 6p 6d 6f

1s
2s 2p
3s 3p 3d
4s 4p 4d 4f
5s 5p 5d 5f
6s 6p 6d 6f

1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s < 4d < 5p < 6s < 4f < 5d < 6p
(Low) (High)

Hund's Rule

Assign

⇒ Hund's rule state that when several orbitals of the same type/energy are available the electron's first fill all the orbitals with parallel spin before pairing in any one orbital.

* # # # *

$_1H \rightarrow 1s^1$ [1] 1s

$_2He \rightarrow 1s^2$ [↑↓] 1s

$_3Li \rightarrow 1s^2\ 2s^1$ [↑↓] 1s [1] 2s

$_4Be \rightarrow 1s^2\ 2s^2$ [↑↓] 1s [↑↓] 2s

$_5B \rightarrow 1s^2\ 2s^2\ 2p^1$ [↑↓] 1s [↑↓] 2s [1] [ ] [ ] 2p

$_{6}C \rightarrow 1s^2\,2s^2\,2p^2$ [↑↓] [↑↓] [↑][↑][ ]
1s 2s 2p

$_{7}N \rightarrow 1s^2\,2s^2\,2p^3$ [↑↓] [↑↓] [↑][↑][↑]
1s 2s 2p

$_{8}O \rightarrow 1s^2\,2s^2\,2p^4$ [↑↓] [↑↓] [↑↓][↑][↑]
1s 2s 2p

$_{9}F \rightarrow 1s^2\,2s^2\,2p^5$ [↑↓] [↑↓] [↑↓][↑↓][↑]
1s 2s 2p

$_{10}Ne \rightarrow 1s^2\,2s^2\,2p^6$ [↑↓] [↑↓] [↑↓][↑↓][↑↓]
1s 2s 2p

$_{11}Na \rightarrow 1s^2\,2s^2\,2p^6\,3s^1$ [↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑]
1s 2s 2p 3s

$_{12}Mg \rightarrow 1s^2\,2s^2\,2p^6\,3s^2$ [↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑↓]
1s 2s 2p 3s

$_{13}Al \rightarrow 1s^2\,2s^2\,2p^6\,3s^2\,3p^1$ [↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑↓] [↑][ ][ ]
1s 2s 2p 3s 3p

$_{14}Si \rightarrow 1s^2\,2s^2\,2p^6\,3s^2\,3p^2$ [↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑↓] [↑][↑][ ]
1s 2s 2p 3s 3p

$_{15}P \rightarrow 1s^2\,2s^2\,2p^6\,3s^2\,3p^3$ [↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑↓] [↑][↑][↑]
1s 2s 2p 3s 3p

$_{16}S \rightarrow 1s^2\,2s^2\,2p^6\,3s^2\,3p^4$ [↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑↓] [↑↓][↑][↑]
1s 2s 2p 3s 3p

$_{17}Cl \rightarrow 1s^2\,2s^2\,2p^6\,3s^2\,3p^5$ [↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑↓] [↑↓][↑↓][↑]
1s 2s 2p 3s 3p

$_{18}Ar \rightarrow 1s^2\,2s^2\,2p^6\,3s^2\,3p^6$ [↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑↓] [↑↓][↑↓][↑↓]
1s 2s 2p 3s 3p

$_{19}K \rightarrow 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^1$ [↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑]
1s 2s 2p 3s 3p 4s

$_{20}Ca \rightarrow 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2$ [↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑↓]
1s 2s 2p 3s 3p 4s

$_{21}Sc \rightarrow 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^1$
[↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑↓] [↑][ ][ ][ ][ ]
1s 2s 2p 3s 3p 4s 3d

$_{22}Ti \rightarrow 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^2$

[↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑↓] [↑][↑][ ][ ][ ]
1s 2s 2p 3s 3p 4s 3d

23. $_{23}V \rightarrow 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^3$

[↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑↓] [↑][↑][↑][ ][ ]
1s 2s 2p 3s 3p 4s 3d

24. $_{24}Cr \rightarrow 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^1\,3d^5$

[↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑↓] [↑↓][↑↓][↑↓] [↑] [↑][↑][↑][↑][↑]
1s 2s 2p 3s 3p 4s 3d

$_{25}Mn \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^5$

1s	2s	2p	3s	3p	4s	3d
↑↓	↑↓	↑↓ ↑↓ ↑↓	↑↓	↑↓ ↑↓ ↑↓	↑↓	↑ ↑ ↑ ↑ ↑

$_{26}Fe \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$

1s	2s	2p	3s	3p	4s	3d
↑↓	↑↓	↑↓ ↑↓ ↑↓	↑↓	↑↓ ↑↓ ↑↓	↑↓	↑↓ ↑ ↑ ↑ ↑

$_{27}Co \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^7$

1s	2s	2p	3s	3p	4s	3d
↑↓	↑↓	↑↓ ↑↓ ↑↓	↑↓	↑↓ ↑↓ ↑↓	↑↓	↑↓ ↑↓ ↑ ↑ ↑

$_{28}Ni \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^8$

1s	2s	2p	3s	3p	4s	3d
↑↓	↑↓	↑↓ ↑↓ ↑↓	↑↓	↑↓ ↑↓ ↑↓	↑↓	↑↓ ↑↓ ↑↓ ↑ ↑

* $_{29}Cu \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$

1s	2s	2p	3s	3p	4s	3d
↑↓	↑↓	↑↓ ↑↓ ↑↓	↑↓	↑↓ ↑↓ ↑↓	↑	↑↓ ↑↓ ↑↓ ↑↓ ↑↓

$_{30}Zn \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10}$

1s	2s	2p	3s	3p	4s	3d
↑↓	↑↓	↑↓ ↑↓ ↑↓	↑↓	↑↓ ↑↓ ↑↓	↑↓	↑↓ ↑↓ ↑↓ ↑↓ ↑↓

Valency

* Types of valency :-

⇒ There are three types of valency

(i) Electro valency / Electrovalent bond / Ionic - bond

(ii) Co-Valency / Covalent bond / Non-Ionic bond

(iii) Co-ordinate bond

* (i) Electro valency :-

The number of electrons that an atom of an element gains or loses to complete its last orbit is called electro valency.

or

A bond is form between the two disimilar atoms or ions due to electrostatic forces of attraction this is calles electrovalent / Ionic bond. (electrovalent linkage)

* Types of electrovalency :-

(i) Positive (+ve) electrovalency
(ii) Negative (-ve) electrovalency

(i) Possitive electrovalency:-

⇒ The valency obtained by the loss of valency electrons from the atom of metalic element so as to complete its last cell is known as positive (+ve) electrovalency.

ex:- (i) $Na \rightarrow Na^{+} + 1e^{-}$
(2,8,1)

- - - → loss element
gain element → - - -

(ii) $Mg \rightarrow Mg^{2+} + 2e^{-}$
(2,8,2)

(iv) $K \rightarrow K^{+} + 1e^{-}$
(2,8,8,1)

(iii) $Al \rightarrow Al^{3+} + 3e^{-}$
(2,8,3)

(ii) Negative electro valency:-

⇒ The valency obtained by the gain of valency electrons from the atom of non-metallic elements so as to complete its last cell is known negative electrovalency.

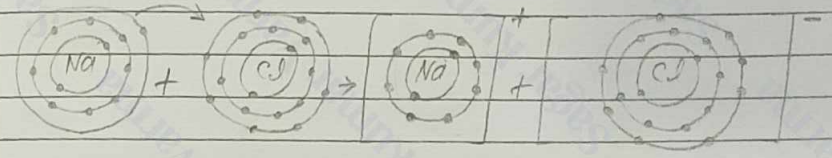
ex:- (i) $Cl + 1e^{-} \rightarrow Cl^{-}$
(2,8,7)

(ii) $O + 2e^{-} \rightarrow O^{2-}$
(2,6)

(iii) $N + 3e^{-} \rightarrow N^{3-}$
(2,5)

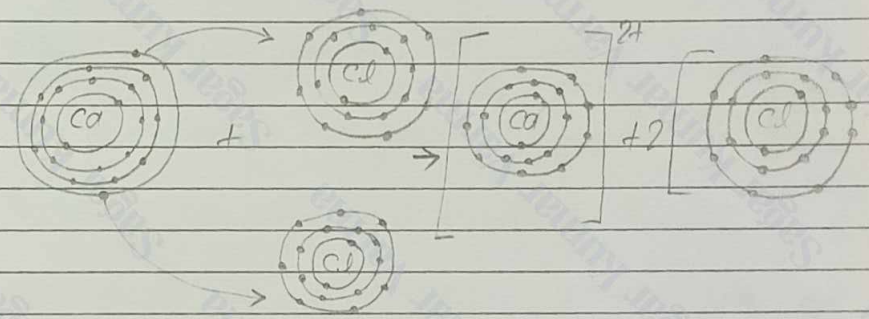
Formation of electrovalent / Ionic compounds.

a. NaCl, $_{11}Na$ = 2,8,1 $_{17}Cl$ → 2,8,7



$Na^{\cdot} + Cl\ddot{:} \rightarrow [Na]^{+} + [Cl]^{-} \rightarrow NaCl$

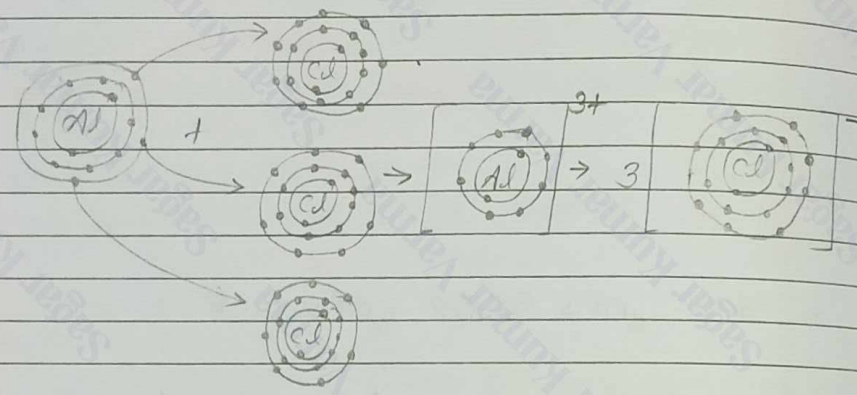
b. $CaCl_2$, $_{20}Ca$ → 2,8,8,2 $_{17}Cl$ → 2,8,7

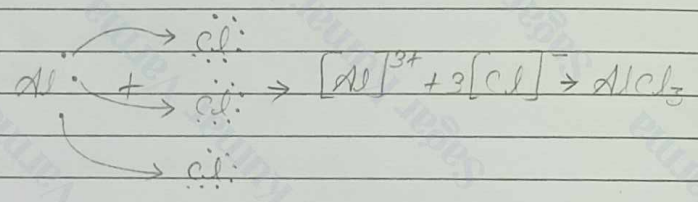


$Ca + \ddot{Cl}: + \ddot{Cl}: \rightarrow [Ca]^{2+} + 2[Cl]^{-} \rightarrow CaCl_2$

(c) $AlCl_3$

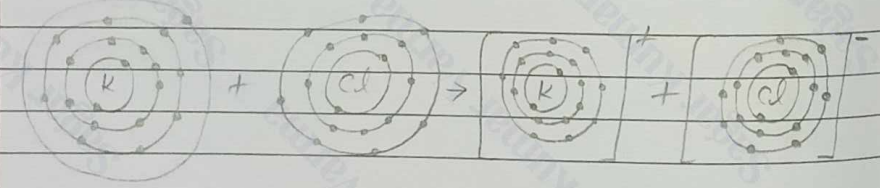
$_{13}Al \rightarrow 2,8,3$
$_{17}Cl \rightarrow 2,8,7$

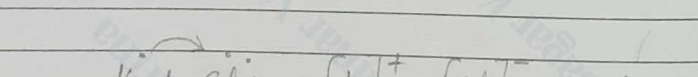




d. KCl

$_{19}K \rightarrow 2,8,8,1$
$_{17}Cl \rightarrow 2,8,7$





Properties of electrovalent / Ionic compound

(i) Ionic compounds or electrovalent compounds are soluble in non-polar solvent like benzen, carbon disulphide, etc

(ii) Ionic compound are inished in the fused as well as in solution state hence they conduct a electricity.

(iii) Ionic compound have high melting and boiling point.

(iv) They are not volatile in nature

(v) They are mostly inorganic compound (अकार्बनिक यौगिक)

Co-valency / Covalent bond / Non-Ionic Bond.

⇒ The valency obtained by the mutual sharing of electrons between the similar or dissimilar atoms so as to complete there last orbits is called co-valency or covalent bond.

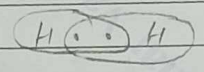
- The compound formed by sharing of electrons between the atoms are called covalent compounds.
- covalent bond, no. electrical charges are developed as there is no loss an gain of electrons.

Sharing of electrons occurs in the following ways:-

- When a covalent compound is form by mutual sharing of "one pair" of electrons between the two atoms it is called [Single covalent bond]

Examples:- H_2

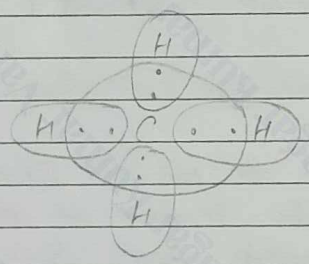
$H_1 \rightarrow 1$, $H_1 \rightarrow H_1$

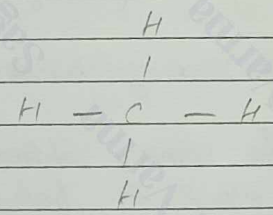


, H – H

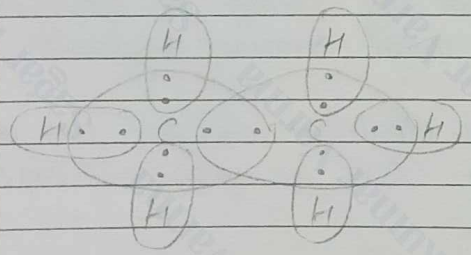
(i) Alkane (C_nH_{2n+2})

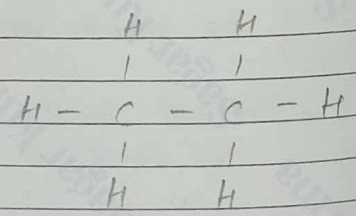
(i) CH_4 (Methane)



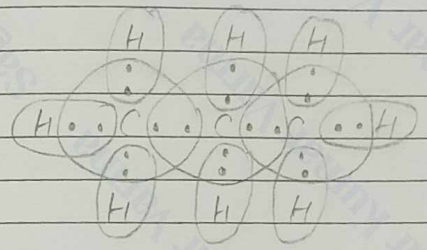


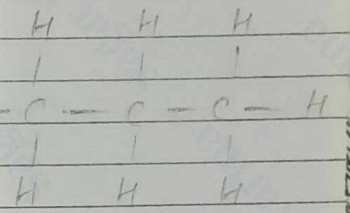
(ii) C_2H_6 (Ethane)



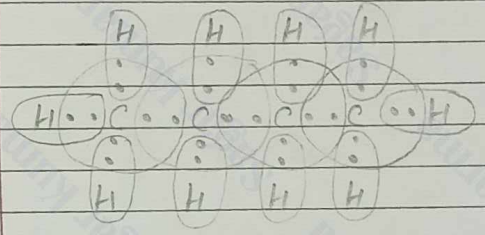


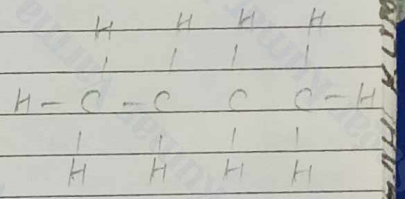
(iii) C_3H_8 (Propane)



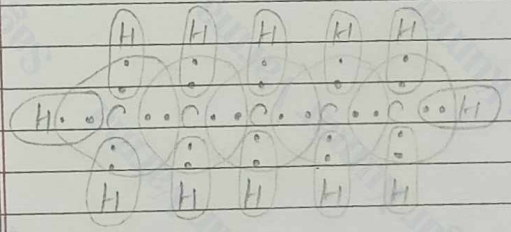


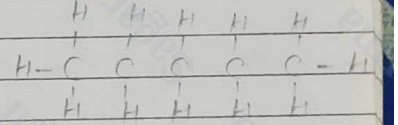
(iv) C_4H_{10} (Butane)



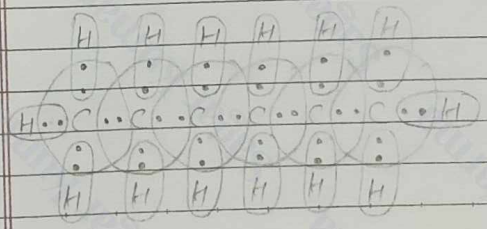


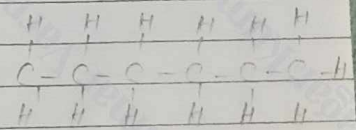
(v) C_5H_{12} (Pentane)



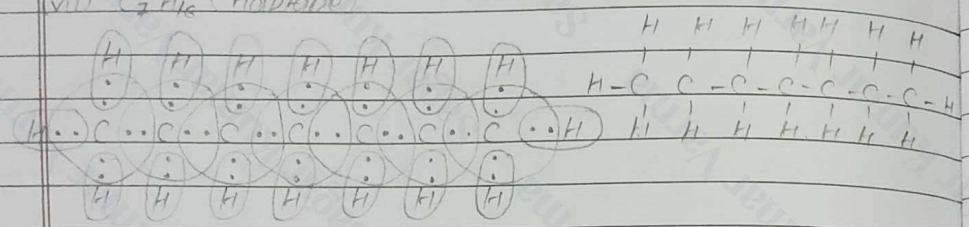


(vi) C_6H_{14} (Hexane)

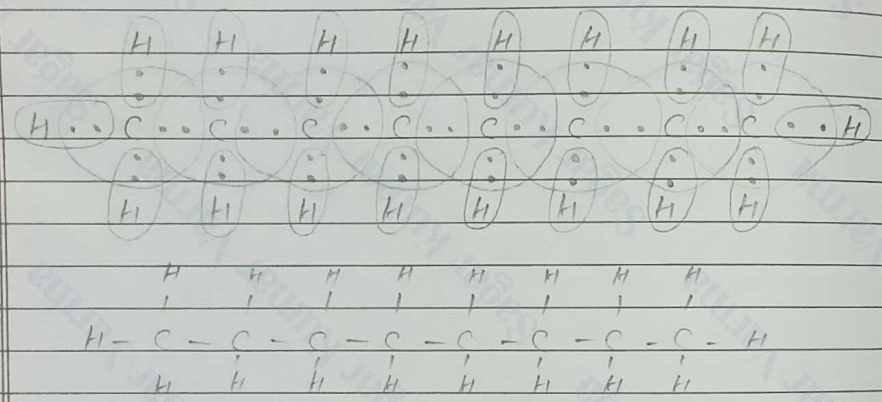




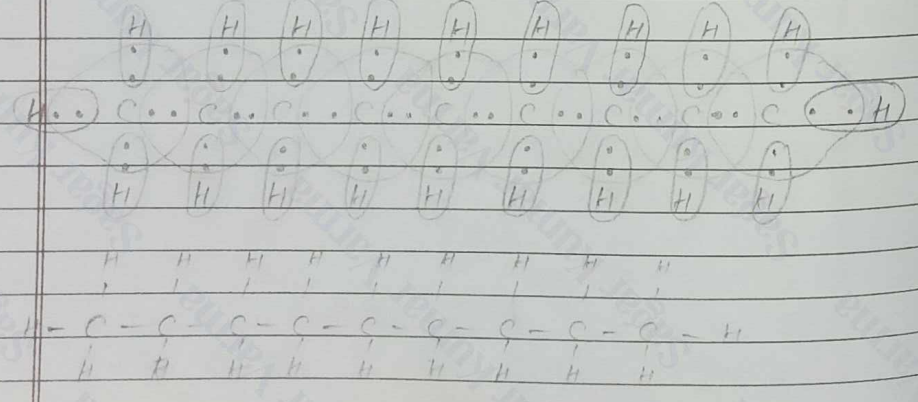
(vii) C_7H_{16} (Heptane)



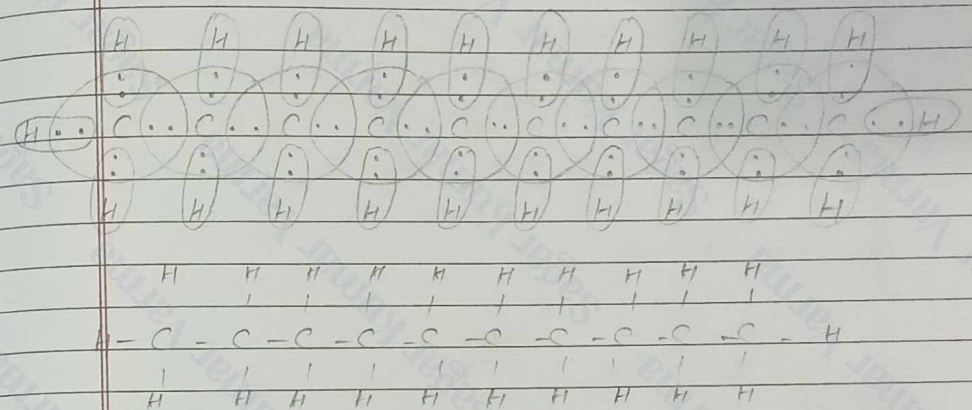
(viii) C_8H_{18} (Octane)



(ix) C_9H_{20} (Nonane)

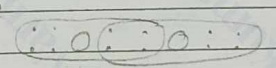


(x) $C_{10}H_{22}$ (Decane)



- When a covalent compound is form by mutual sharing of "two pair" of electrons between the two atoms it is called double covalent bond (=).

Example:- O_2

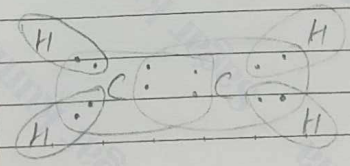


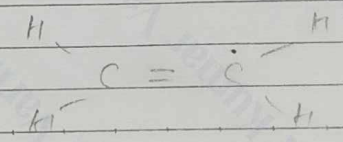
O = O

1. Alkene (C_2H_{2n})

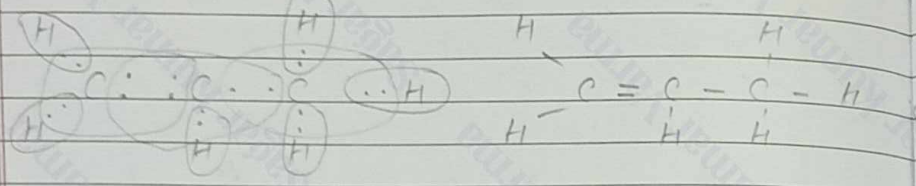
(i) Methene

(ii) C_2H_4 (Ethene)

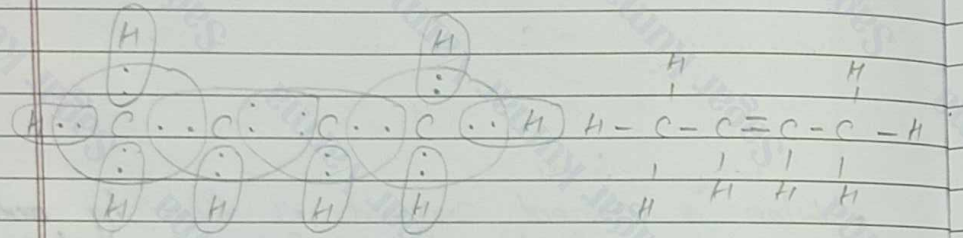




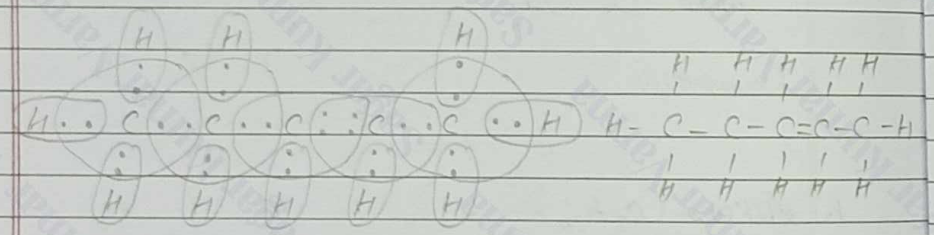
(iii) C_3H_6 (Propene)



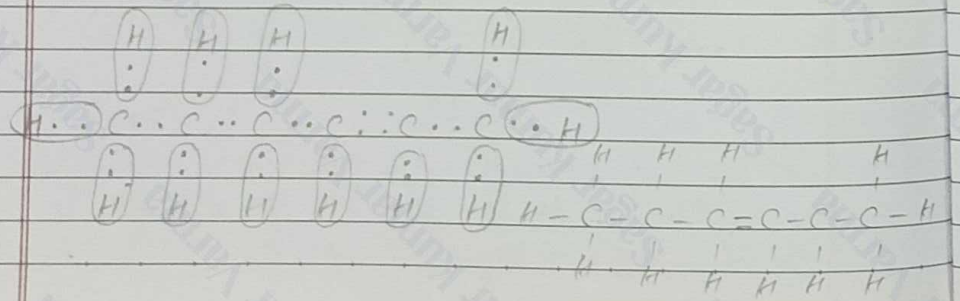
(iv) C_4H_8 (Butene)



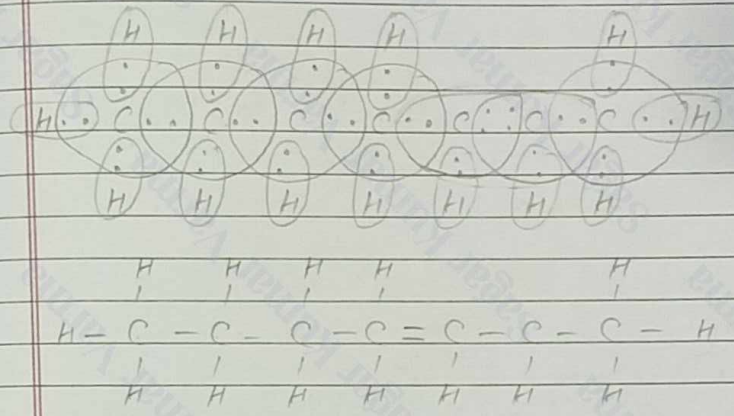
(v) C_5H_{10} (Pentene)



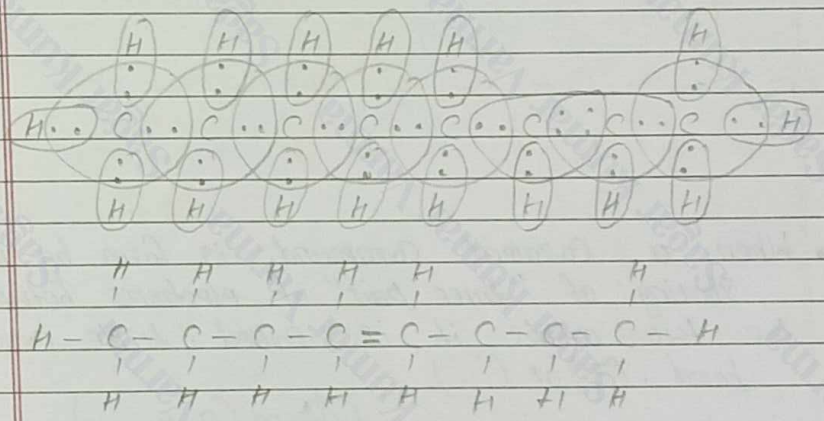
(vi) C_6H_{12} (Hexene)



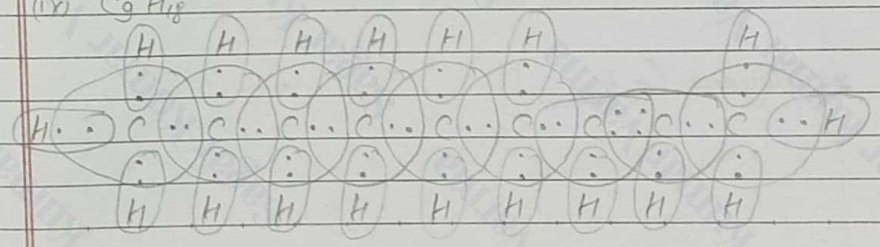
(vii) C_7H_{14}

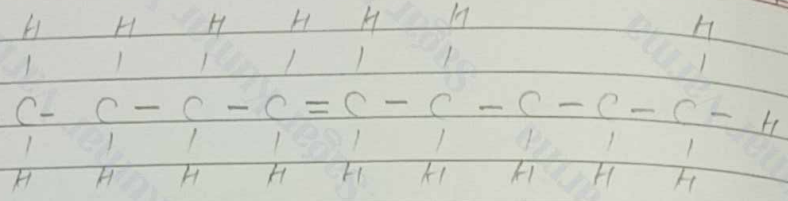


(viii) C_8H_{16} (octene)

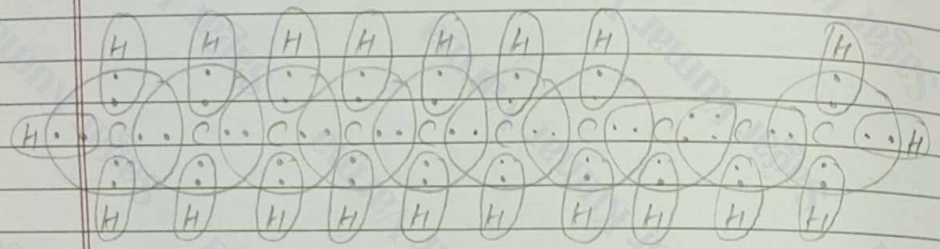


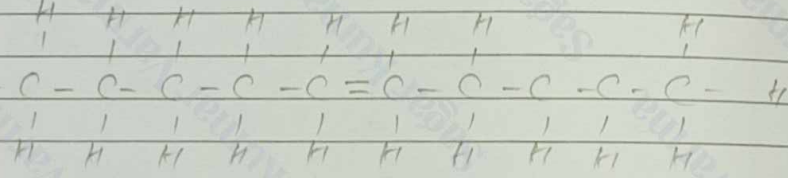
(ix) C_9H_{18}





(x) $C_{10}H_{20}$ (Decene)

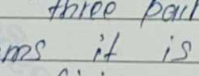




- When a covalent compound is form by mutual sharing of "three pair" of electron's between the two atoms it is called triple covalent bond. (≡) or (:::)

Alkyne (C_nH_{2n-2})

Examples:- N_2

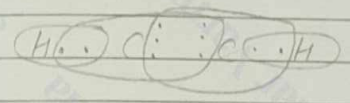


$N \equiv N$

* Alkyene (C_nH_{2n-2})

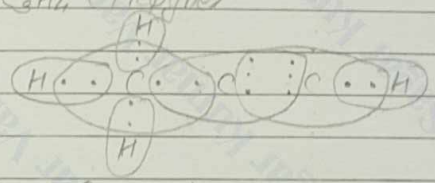
(i) Methyne

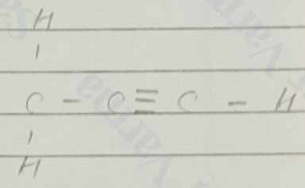
(ii) C_2H_2 (Ethyne)



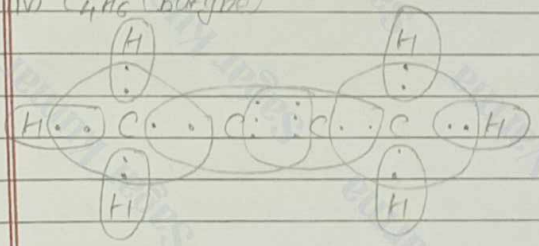
$N - C \equiv C - N$

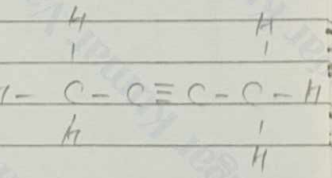
(iii) C_3H_4 (Propyne)



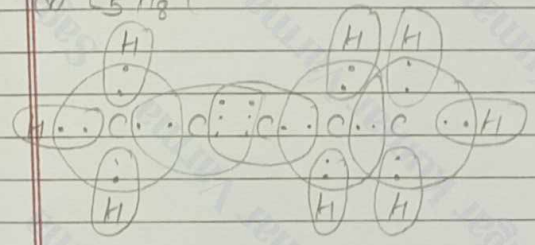


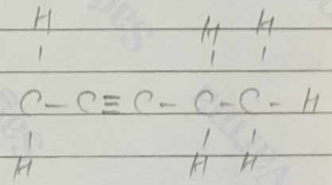
(iv) C_4H_6 (butyne)



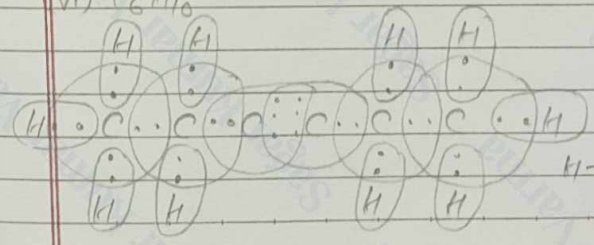


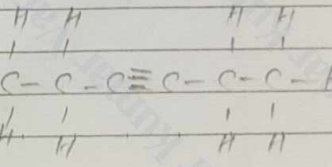
(v) C_5H_8 (



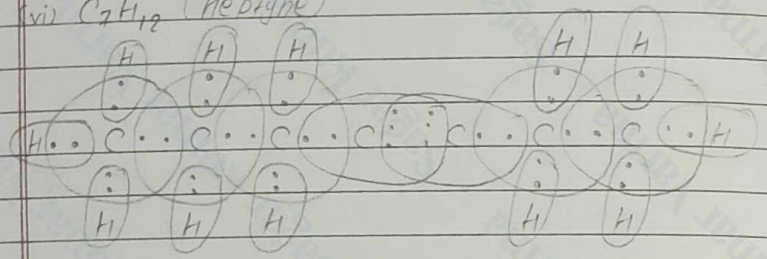


(vi) C_6H_{10}

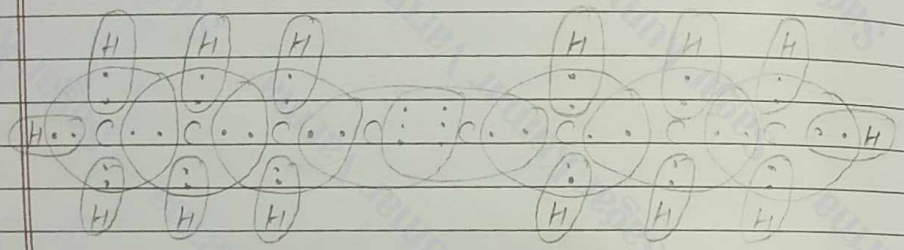


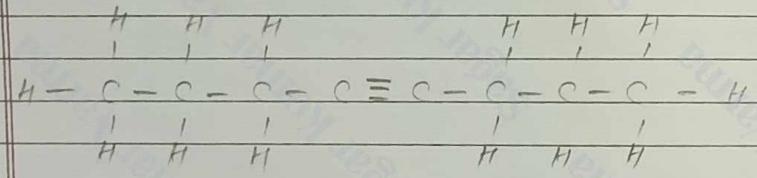


(vi) C_7H_{12} (Heptyne)

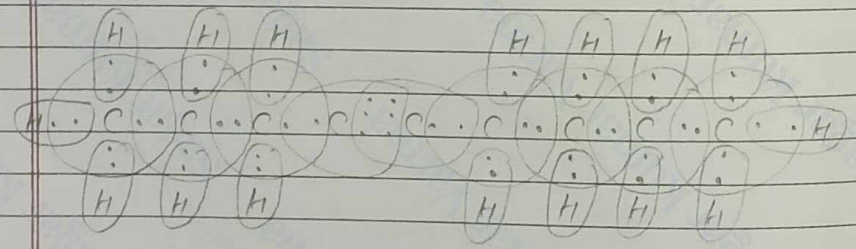


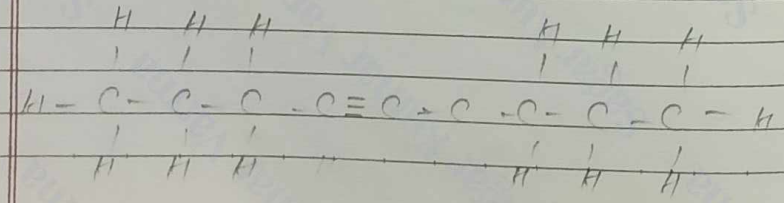
(vii) C_8H_{14} (Octyne)



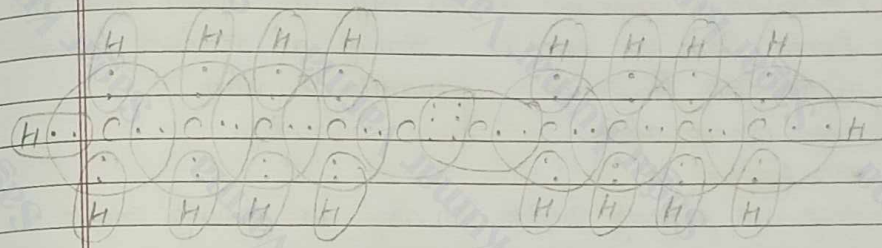


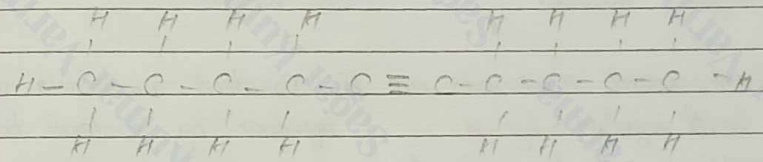
(viii) C_9H_{16}





(ix) $C_{10}H_{18}$





Properties of covalent compound

* Covalent compounds are generally insoluble in polar solvent but readily soluble in non-polar solvent.
  Ex:- Banzene (C_6H_6), Aldehyde, etc.

* Covalent compounds do not ionized when deserved in solution state (water). Thus they are non-polar in nature. Hence they do not conduct electricity.

* Covalent compound are generally volatile in nature.

* Covalent compounds have low melting and boiling point.

* They are generally organic compounds.

Q. Distinction between Electrovalent & Co-valent compound.

Ans:

Electrovalent compound	covalent compound.
(i) Electrovalent compounds are formed from the transfer of electrons from one atom to the others. ex:- NaCl	(i) They are formed from the sharing of electrons between constituent atom. ex:- CCl_4, H_2O
(ii) They are generally soluble in water and insoluble in organic solvent.	(ii) They are generally soluble in organic solvent and insoluble in water.
(iii) Electrovalent compounds are held together by a network of ionic bond.	(iii) Covalent compounds are held together by covalent bonds.
(iv) Electrovalent compounds have definite shape.	(iv) Covalent compound has no shape.

Environmental Effects

* Pollution:-

Pollution may be define as the present of undesirable substances / unwanted substance / foreign matters in the environment thereby adversely altering the the natures quality of the environment and causing damage to human / plant / Animals life.

or

A pollution may be define as ~~the~~ an present of unwanted undesirable ~~substances~~ foreign matters added to the environment.

* Causes of pollution:-

(i) The uncontroled growth in number i.e (thatis) tremendous increase in population all over the world.

(ii) The rapid industrilazation.

(iii) The rapid valcanice erruptions

(iv) The rapid deforestation, excessive use of insecticides, pesticides and other chemical.

(v) Radioactivity, strong winds, forest fire

(vi) Minerals Sand and dust.

* Types of pollution:-

1. Air pollution:-

(i) Most common from of pollution.
(ii) Urbanization and air pollution goes hand in hand.
(iii) Primary reasons are - cooking, transportation and other industrial activities.
(iv) Sulphur dioxide (SO_2) is the most common gas that makes the air toxic.
(v) It is produced by burning fossil fules (coal and oil) & the smelting of minerals ores (aluminum, copper, zinc, lead and iron).

(vi) other greenhouse gasses such as- Water vapour (H_2O), Carbon dioxide (CO_2). Methane (CH_4), Nitrous oxide (N_2O), Ozone (O). Chlorofluorocarbons (CFCs) causes global warming.

(vii) It also causes acid rain.

2. Water pollution:-

(i) Most common way of water pollution occurs due to dumping of industrial effluents.

(ii) Massive use of Insecticides and pesticides also pollutes the water system.

(iii) Oil spills in the ocean from large tankers is another reason.
(iv) Domestic usage of water for washing clothes, utensils creative waste water.

(v) Large scale release of pollutants blocks sunlight from penetrating into deep water.

(vi) It reduces oxygen for the marine life and creates bacteria, viruses and harmful microorganisms that causes diseases like cholera and diarrhoea.

3. Soil pollution:-

(i) It is also called as land pollution.
(ii) Use of insecticides and pesticides are the common from of land pollution.
(iii) other forms of land pollution occur due to
(a). dumping of industrial waste
(b). mining
(c). deforestation.
(iv) Industrial wastes can be categorised into three types:-
(a). Chemical wastes - ~~can be~~ it includes harmful and dangerous chemical produced by factories, Govt. agencies ensure onsite segregation of chemical waste before disposing.
(b). Solid waste - It includes a variety of different materials, including paper, cardboard, plastics, ~~packaging~~ packaging materials, wood, and scrap metal. These materials can be recycled for reducing overall cost.

(c). Toxic and Hazardous waste - It includes dangerous byproducts materials generated by factories, farms, construction sites, laboratories, garages, hospitals, and certain production and manufacturing plants.

(v) Mining activities - It causes erosion, formation of sinkholes, loss of biodiversity, relocation of the tribal people, contamination of soil, depletion of groundwater and surface water.

(vi) Deforestation - It means cutting of trees and clearing the forest area. When there are no trees, the soil becomes loose. I mean it is the tree that holds soil together. Excessive rainfall can Trigger landslides and mudslides which then leads to massive soil erosion.

4. Noise pollution:-

(i) Unwanted or excessive sound that affects human and environmental health.

(ii) According to the WHO, sound levels < 70 dB are suitable for living organisms.

(iii) Anything more than that will lead to psychological problems like stress, permanent hearing impairment & hypertension.

(iv) Noise pollution comes from-

(a). Industrail noises - factories, construction sites.
(b). Non-industrial noises - Transportation, rain traffic, aircraft landing/taking off, residential cooling and heating system, household equipments, concert, function, festivals etc....

5. Radioactive pollution :-

(i) It is the most dangerous pollution because of its permanent effects.

(ii) It occurs due to emission of proton (alpha-particles), electrons (beta-particles) and gamma rays (short wave electromagnetic waves) when they disintegrate from atomatic nuclei of some elements.

(iii) Radiation is of two types -

(a). Ionization radiation - it has enough energy to remove or break lightly bound electrons from the orbit of an atom, causing the atom to become charged or ionized.
Examples - radioactive particles, medical x-rays, metal wielding. It can cause mutation, cancer or tumor.

(b). Non-ionization radiation - these are electromagnetic radiation that does not carry enough energy to break the atoms and molecules.
Examples - radio waves, microwaves, or any extremely low frequency wave. It cannot penetrate in deep tissue but can damage upper skin layer and eyes.

6. Thermal / heat pollution :-

(i) It is caused by power plants and industrial manufactures.

(ii) These industries use water as coolant.

(iii) Water is taken from river, pond >>> water is cooled or heated for machines to work better >>> afterwards water is ejected back to river or pond.

(iv) Increasing or decreasing the temp of water changes its oxygen level.

(v) Change in oxygen level of water can be disastrous for the local marine ecosystem and the nearby communities.

7. E-waste :-

(i) It is also known as electronic waste.

(ii) When electronic products are of no use, many electronic devices become trash.

(iii) All these electronic equipment contains hazardous substances such as - mercury, lead, cadmium and beryllium.

(iv) All these chemicals are polluting drinking water and harming ecosystems around the world.

Hydrogen Bond

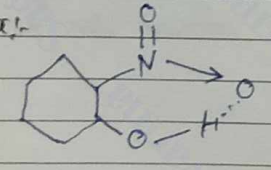
* The attractive force which binds hydrogen atom of one molecule with electronegative atom (F, O, N) of another molecule is known as hydrogen bond or hydrogen bonding. Hydrogen bond increases the B.P, M.P and solubility of one substance in another.
Ex - H_2O, NH_3, HF

Types of Hydrogen bond

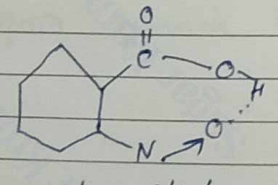
i) Intermolecular hydrogen bond.
ii) Intramolecular hydrogen bond.

i) Intermolecular hydrogen bond :- Intermol. hydr. bond is formed between two different molecules of the same or different substances.
~~ex:- (i) Hydrogen bond is formed between two different molecules of the same or different substances.~~
ex:- (i) Hydrogen bond between the molecules of hydrogen fluoride.
(ii) Hydrogen bond in alcohol or water molecule.

ii) Intramolecular Hydrogen bonding - Intram. hydr. bond is formed between the hydrogen atom and the highly electronegative atom (F, O or N) present in the same molecule.
ex:-



ortho Nitrophenol



ortho nitrobenzoic Acid.

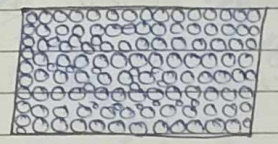
Metallic Bond

The simultaneous force of attraction between the mobile electrons and the positive kernels which binds the metal atom together is known as metallic bond. ~~bond~~

It is a weak bond because mobile electron are simultaneosly attracted by a large number of kernes. This bond is non-directional

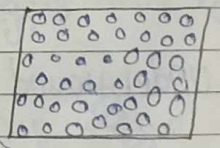
Molecular Arrangement of solid liquid and Gases.

Solid
- Solids are very hard and rigid.
- Solids have a definite shape and definite volume

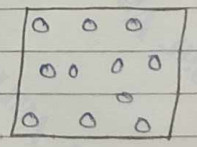


Liquid
- Liquids have a definite volume but not a definite shape.
- The molecules in liquids can move from one place to another and this property of liquid is called fluidity.

Gas
- Gases neither have definite shape, or definite volume.



- Due to the ~~large~~ large space between the molecule, the molecules are free to move.



Water on Earth

* 97% = Salt Water, oceans, Seas, Some Lakes, and Ground Water.
* 2.4% = Glaciers and Ice caps
* 0.5% = Fresh Water that is unavailable, to far underground or polluted
* 0.03% = Water to drink

Q What is Water Pollution?

→ Water pollution can be defined as the alteration in the physical, chemical or Biological characteristics of of water so that it either becomes health hazard or unfit for use.

→ Water pollution is the contamination of water bodies, usually as a result of human activities. Water bodies include for example lakes, rivers, oceans and groundwater.

Types of Water Pollution

1. **Surface Water Pollution:** Water over the surface of earth gets polluted.

2. **Underground Water Pollution:** Water below the earths surface gets polluted.

Sources of Pollution

1. Point source water pollution:- Refers to contaminants that enter a waterway from a single, identifiable source, such as a pipe or ditch. **Examples** of sources in this category include discharges from a sewage treatment plant, a factory, or a city storm drain.

2. Nonpoint source Pollution:- Refers to diffuse contamination that does not originate from a single discrete source. **Example:** is the leaching out of nitrogen compounds from fertilized agricultural lands. Nutrient runoff in storm water from "sheet flow" over an agricultural field or a forest, pet wastes are also cited as examples of non-point source pollution.

Broad Classification

1. Domestic Effluents
2. Industrial Effluents
3. Surface Runoff
4. Waste Heat

1. Domestic Effluents:-
In this case waste waters are discharged in a common public sewerage.
* Human and Animal excreta
* Organic matter in the form of food residue
* Detergents
* Large no. of bacteria like faecal coliforms, salmonella etc.

Most laundry detergent contains Phosphates. Beautiful Dal lake has been polluted due to the dumping of raw sewage and domestic effluents from houseboats and nearby localities.

Biological oxygen demand (BOD) :- Amount of dissolved oxygen needed by bacteria in decomposing the organic wastes present in water.

2. Industrial Effluents :-
- Industries usually discharge waste water into ponds, lakes and rivers.
- Industrial waste water contains heavy metals like :-

  Mercury, Lead, Arsenic, Copper and cadmium

- Inorganic pollutants such as acids, alkalies and bleaching liquids
- organic pollutants such as Proteins, cellulose fibres, putrescible organic matter.

3. Surface Run off :-
The surface runoff from fields of inorganic fertilizers, pesticides, insecticides, manures bring heavy loads of pollutants into natural water bodies. This can occur when the soil is saturated to full capacity, and rain arrives more quickly than soil can absorb it.

4. Thermal Water Pollution :-
It is the rise of temperature of water.
Thermal power plants, refineries etc. discharge hot water into nearby lakes, rivers, sea, etc.

Effects of Water Pollution

Effects on Aquatic Ecosystem :-

- Polluted water reduces dissolved oxygen content and thereby eliminates the sensitive organisms like planktons, molluscs, and fish
- Pesticides directly eliminate sensitive aquatic organisms
- Algal blooms.

Effects of Thermal Pollution

- Deoxygenation of water bodies.
- Trouts eggs fail to hatch and some fishes fail to spawn.
- Radioactive pollution.

Effects on Human Beings

(1) Disease causing microorganisms like viruses, bacteria, parasitic protozoa are known as pathogens and these pathogens are spreading disease directly among humans. It is a source of water borne diseases like diarrhoea, jaundice, cholera, typhoid, amoebiasis etc.

2. Water contaminated with cadmium causes itai itai disease (a painful disease of bones and joints) and cancer of lungs and liver.

3. Drinking of Arsenic polluted water causes black foot disease. It also causes diarrhoea, peripheral neuritis, hyperkeratosis and also lung and skin cancer.

Control Measures of Water pollution

- Hot waters should be cooled before release from the power plants.
- Cleaning in tanks, streams, and rivers, which supply drinking water should be prohibited.
- Organic Farming and Efficient use of animal residues as fertilizers.
- Use nitrogen fixing plants to supplement the use of fertilisers.
- Planting trees would reduce pollution by sediments and will also prevent soil erosion.
- For the control of industrial wastes and toxic compounds should be purified before draining into the rivers, lakes and seas.
- Waste waters should be properly treated by the primary and secondary treatments.

Chemical Oxygen Demand (COD)

⇒ The chemical oxygen demand (COD) test is commonly used to indirectly measure the amount of organic and inorganic compounds in water.

* It is expressed in milligrams per liter or in parts per million (PPm), which indicates the mass of oxygen consumed per liter of solution.

* "It is a measure of oxidisable impurities present in the sewage."

⇒ Any organic material such as hydrocarbon when trought in contact with oxygen, is oxidised to get CO_2 and H_2O. Because of the presence of carbaceous material, the end product is certainly CO_2.

⇒ If this organic material contains hydrogen, Nitrogen, sulphur etc. in addition to carbon then the chemical oxidation leads to formation of CO_2, H_2O, NO_2, SO_2 etc.

⇒ In environmental chemistry, the chemical oxygen demand (COD) is an indicative measure of the amount of oxygen that can be consumed by reactions in a measured solution.

⇒ Chemical oxygen demand (COD) is a measure of the capacity of water to consume oxygen during the decomposition of organic matter and the oxidation of inorganic chemicals such as Amonania and nitric.

BOD (Bio-Chemical oxygen Demand)

→ BOD of a sewage is defined as "the amount of free oxygen required in water for bacteria which consume organic matter. (the bio-chemical oxidation of the organic matter) under aerobic conditions at 20°C and for a period of 5 days".

⇒ The unit of BOD is mg/l or PPm. At 20°C, a BOD has an average sewage of 30 mg/Litre.

* BOD can be used as a guage of the effectiveness of waste water treatment plants.

* A commonly recognized method for the measurement of BOD.

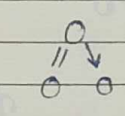
Ozone Depletion

* Ozone layer is present in Stratosphere zone of atmosphere.

⇒ Ozone layer protects us from harmful u.v radiations.

⇒ This ozone creats a barrier that protects humans sun's damaging ultraviolet radiation.

⇒ Symbol of ozone is O_3



Ozone depletion → Hole in ozone
→ Reduction in the thickness of ozone layer.

1st of all ozone hole was discovered in Antarctica in 1985 and in Arctic region in 1990.

* Ozone depletion by chlorofluoro carbon (CFC)

⇒ CFCs enters the atmosphere because of their exercise use in solvents, aeros of sprays, propellants, refrigerants, AC etc.

$$CF_2Cl_2 \xrightarrow{\text{ultraviolet rays}} CF_2Cl + Cl \text{ (free radical)}$$

⇒ Chlorofluoro carbons are decomposed by ultra-violet rays to highly reactive chlorine.

⇒ This free radical (Cl) reacts with ozone and chlorine monoxide is formed.

$$Cl + O_3 \longrightarrow ClO + O_2$$

(chlorine oxide MnO)

⇒ This causes depletion of ozone.

* Chlorine monoxide (ClO) further reacts with atomic oxygen to produce more free radicals of Chlorine.

$$CF_2Cl_2 \xrightarrow{U.V.ray} CF_2Cl + Cl$$

$$Cl + O_3 \longrightarrow ClO + O_2$$

$$Cl + O \longrightarrow Cl + O_2$$

⇒ This process is a continuous process, giving rise to large scale ozone depletion.

Causes of depletion of ozone

⇒ The ozone layer is depleting due to the production of chloro fluoro carbon by man because this compound can not be degraded. When it reaches the stratosphere attacks the ozone layer and reduces it.

⇒ Due to excessive amount of Nitrogen oxide in the atmosphere ozone layer has been affected badly.

⇒ The gases released in the environment due to nuclear explosion have also badly affected the ozone layer.

⇒ **Volcanoes eruption** → Chlorine gas produced distroying atoms of ozone gas.

⇒ **Radioactive radition** → from the nuclear centres have also badly affected the ozone layer.

Effects

1. Effects on Human Health

(a) Increase in UV-B rays → Increase the risk of cancer.

(b). Increase in UV-B rays → Plays a major role in the development of malignant melanoma, Sunburns, eye cataracts, Blindness, etc.

2. Effects on Animals

Direct UV-radiation exposure causes skin and eye cancer in animals.

3. Effects on plants:

⇒ UV-B rays in harmful to plants and crops. It may result in plant growth, smaller leaf size, blooming and photosynthesis in plants

⇒ I lower the agricultural quality.

⇒ UV-B radiation causes various indirect changes including plant shape, timing of development phases.

Acid Rain

2) HNO_3 and H_2SO_4 combine with HCl form HCl emission to gereseate acidic precipitation which is widely known as acid rain.

The NO_x and SO_x entesing the atmosphere are converted into HNO_3 and H_2SO_4 respectively.

$$NO + O_3 \longrightarrow NO_2 + O_2$$
$$NO_2 + O_3 \longrightarrow NO_3 + O_2$$
$$NO_2 + NO_3 \longrightarrow N_2O_5$$
$$N_2O_5 + H_2O \longrightarrow 2 \cdot HNO_3$$

$$SO_2 + \frac{1}{2}O_2 + H_2O \xrightarrow[\text{Soot particle}]{(HC,\ HOx)} H_2SO_4$$

Acid rain causes extensive damage to buildings and sculptural materials of marble, limestone, slate, mortar etc.

Green House effect

The green house effect is the process by which radiation from a plant's atmosphere warms the ~~planet's~~ planet's surface to a temperature above what it would be without its atmosphere. Among the constituents of the atmosphere, only carbon dioxide and water vapour strongly absorb infrared radiation (14000 – 25000 nm) and effectively block a large fraction of the earth's emitted radiation. The radiation thus absorbed by CO_2 and H_2O vapour is partially reemitted to earth's surface. The net result is that the earth's surface gets heated up by a phenomenon called the green house effect. Relative contribution of green house gases to rise temperature:

$CO_2 \rightarrow 50\%$, $CH_4 \rightarrow 19\%$, $CFC \rightarrow 17\%$, $O_3 \rightarrow 8\%$, etc.

CO_2 is not only culpit contributing greenhouse effect 360 million hectares of rice field and 1.2 billion cattle emit CH_4.

Smog Formation

Smog is a mixture of smoke and fog. The name smog is derived from combination of smoke and fog.

Smog are of two types namely.

1. Classical smog:- It is commonly known as smog and is produced from gases like SO_2 and NO present in air.

$$SO_2 + \frac{1}{2}O_2 \longrightarrow SO_3$$

$$SO_3 + H_2O \longrightarrow H_2SO_4$$

2. Photo Chemical smog:- It is an oxidising smog having a high concentration of oxidants. Photochemical smog is characterised by brown, hazy fumes which irritates the eyes and lungs and also leads to cracking of rubber and extensive damage of plant life.

Environmental Effects Pollution

* **Pollution:-**
The contamination of any part of the environment is called pollution.

* **Pollutants:**
The substances which cause pollution are called pollutants.
When the concentration of a substance already present in nature or of a new substance increases to undesirable proportions causing danger to human being other animals or vegetation and other materials, the substance is treated as a pollutant.

The common pollutants are:-

(i) gases like carbon monoxide, sulphur dioxide oxides of nitrogen etc.
(ii) Compounds of metals like lead, mercury, zinc, etc.
(iii) Pollen grains, dust
(iv) Pesticides and detergents
(v) sewage.
(vi) Radioactive substance

Normally highly toxic substances are considered as pollutants.

Types of Environmental Pollution:

The environmental pollution may be of the following types:
1). Air pollution
2). Water pollution
3). Soil or land Pollution

1. **Air Pollution:** Air pollution occurs when the concentration of a normal component of the air or new chemical substance added to undesirable proportions causing harms to humans, other animals, vegetation and materials.

* **Air Pollutants:-** The chemical substance causing pollution is called air pollutant.

There are two types of air pollutants:-

1. Primary air Pollutants:- A primary air pollutant is a harmful chemical substance that directly enters the air as a result of natural events or human activities.

Ex:- Carbon oxide (Co and Co_2), Nitrogen oxides (No) Sulphur oxides (SO_2), suspended particulate matter.

2. Secondary air pollutants:- A secondary air pollutant is a harmful chemical that form in the air due to a chemical reaction between two or more air components or a primary pollutant and one or more air components.

Primary pollutant secondary pollutants.

eg.: (i) $SO_2 + O_2 \longrightarrow 2SO_4$

(ii) $SO_3 + H_2O \longrightarrow H_2SO_4$

secondary pollutants

SO_3, H_2SO_4, NO_2, N_2O, HNO_3, O_3 etc.

Causes of Air Pollution:-

1. Burning of Fossil Fuel:- The combustion of fossil fuels emits a large amount amount of sulphur dioxide and carbon monoxide, which results in air pollution.
2. Automobiles- The gases emitted from vehicles such as car, bike, bus etc are the major source of greenhouse gases, which pollute the environment.
3. Agricultural Activities- The insecticides, pesticides, and fertilisers emit harmful chemicals in the atmosphere and contaminate it.
4. Factories and Industries- Factories and Industries releases carbon monoxide, organic compound hydrocarbons and chemicals and degrades air quality.
5. Mining Activities- The dust and chemicals released during the process of mining pollute the air.
6. Domestic Source:- The household cleaning products and paints contain toxic chemicals that are released in the air.

Effect of Air Pollution

1. Diseases- Air pollution has resulted in several respiratory disorders and heart diseases among humans. Many people die every year due to direct or indirect effect of air pollution.
2. Global Warming- Due to the emission of greenhouse gases, there is an imbalance in the gaseous composition of the air. This leads to the increase in ~~in~~ the temperature of the erth. This increase in earth's temperature is know as global warming.
3. Acid Rain- The water droplets combines with the harmful gases such as nitrogen oxides and sulphur oxides in the air becomes acidic and fall as acid rain which damages human, animal and plant life.
4. Ozone Layer Depletion:- The release of chlorofluorocarbon and hydrochlorofluoro carbons in the atmosphere is the major cause of ozone layer depletion. Depletion of ozone layers leads to skin diseases and eye problems.
5. Effect on Animals- In the air pollution the pollutants suspend in the water bodies and effect aquatic life. Pollution also compels the animals to leave their habitat and shift to a new place.

Measures for controlling air pollution:

1. The use of clean energy resources such as solar, wind and geothermal energies reduces air pollution at a larger level.

2. Use of energy-efficient devices such as LED which results energy conservation, also control pollution to a greater level as a large number of fossil fuels are burnt to generate electricity.

3. By minimising and reducing the use of fire and fire products.

4. Air pollution can be controlled by growing vegetation.

5. The use of filters should be used in the air exhaust of factories and industries reduce air pollution.

~~6. The use of filters should be used in the air ex~~

6. Avoid use of products with chemicals such as paints, perfumes;

Air Pollution due to deforestation:-

Due to industrialization and construction project a large section of forests gets cleared every year. Deforestation has put the entire ecosystem at risk.

As we know, trees play a vital role in the generation of oxygen in the environment by absorbing carbon dioxide (CO_2).

Deforestation also increases the risk of forest fire. Wild fire spreads faster and burns better, releasing more toxic pollutants into the air.

Clearcut areas of forest reduces humidity levels and lead to unstable ecosystem.

We can controll this by controlling the deforestation and planting more and more trees.

Ozone Layers Depletion

ozone layer depletion refers to the thinning of the ozone layer in Earth's stratosphere, primarily caused by human-made chemicals. The ozone layer, located about 10 to 50 kilometers above Earth's surface, plays a crucial role in absorbing the sun's harmful ultraviolet (UV) radiation, protecting life on Earth.

Causes of ozone layer depletion:

1. The use of solvent, spray aerosol, refrigerators, air conditioness etc. which releases chlorofluoro carbons or CFCs are the main cause of ozone layers depletion.

2. ~~Ung~~ unregulated rocket launches.

3. The volcanic eruption are also responsible for the depletion of ozone layers.

Effect of ozone layer Depletion-

1. Effect on human health- This causes serious health issues among humans, such as skin diseases, cancer, sunburn, quick ageing and weak immune system.

2. Effect on animals- Direct exposure to ultra violet radiation leads to skin and eye cancer in animals.

3. Effect on environment- strong ultraviolet ray may leads to minimal growth, flowering and photosynthesis in plants.

4. Effect on Marine life- Planktons are greatly affected by the exposure to harmful ultraviolet ray.

Controling measures of ozone layer depletion.

1. Avoid or Reduce the use of ozone depleting substances such as refrigerator and air conditioners etc.

2. Minimise the use of vehicles as vehicles emit a large amount of greenhouse gases that leads to global warming as well as ozone layers.

3. Use of Eco-friendly cleaning products.

4. Use of Nitrous oxide should be prohibited.

Greenhouse Effect

"Greenhouse effect is the process by which radiations from the sun are absorved by the greenhouse gases and not reflected back into space. This insulates the surface of the earth and prevent it from freezing."

Example of greenhouse gases are CO_2, water vapour, Nitrous oxide (N_2O) and ozone (O_3) etc.

Causes of Greenhouse effect-

1. Burning of fossil fuel led to an increase in the ~~he~~ release of greenhouse gases in the atmosphere.
2. Due to deforestation there is a considerable increase in the greenhouse gases which increases the earth's temperature.
3. Industrial waste and landfills releases greenhouse ~~effect in the~~ gases such as carbon dioxide and methane.

Effect of Greenhouse effect-

The main effects of an increased greenhouse gases are:-

(i) Global warming
(ii) Depletion of ozone layer.
(iii) Acidification of water bodies.
(iv) Smog and Air pollution.

Electrochemistry

The branch of chemistry which deals with conversion of electrical energy into chemical energy and vice-versa is known as electrochemistry.

Arrhenius Theory of Ionization

Arrhenius in 1887, put forwarded a theory about the electrolytes, to explain a number of phenomena related to electrolytes, to explain a number of phenomena related to electrolytes such as conductance electrolysis, anomalous behaviour of electrolytes towards colligative properties (i.e. higher values of osmotic pressure, elevation in boiling point, depression in freezing point and lowering of vapour pressure than expected). This theory is known as Arrhenius theory of electrolytic dissociation or Ionization.

The main points of this theory are as follow:

1. An electrolyte when dissolved in water splits or dissociates into positively and negatively charged particles called ions.
   This process is called ionization or electrolytic dissociation.

$$NaCl \longrightarrow Na^+ + Cl^-$$

$$MgCl_2 \longrightarrow Mg^{2+} + 2Cl^-$$

2. The total charge carried by the positive ions is equal to that carried by the negative ions so that the solution as a whole is electrically neutral.

3. On electrolysis, the positive ion migrate towards cat and hence are called cations while the negative ion migrate towards the anode and are therefore called anions.

4. The ions formed constantly reunite to form the undissociated molecules till ultimately there is an equilibrium between the ions and the undissociated molecules.

$$NaCl \rightleftharpoons Na^+ + Cl^-$$

5. The degree of dissociation increases with dilution and becomes maximum at the infinite dilution.

6. The properties of an electrolyte are the properties of its ions.

Degree of Ionization – The fraction of the total number of molecules of the electrolyte that dissociates into ions is called the degree of ionization. It is usually denoted by x.

* Degree of Ionization (x) = $\frac{\text{No. of molecule dissociates}}{\text{Total no. of molecules taken.}}$

Factors Affecting Degree of Ionization:

The degree of ionization or dissociation of an electrolyte in the solution depends upon the following factors:

1. Nature of the Solute:-

In aqueous solution, some electrolytes like acids, alkalies and most of the salts are almost completely ionized. They are called strong electrolytes.

On the other hand, some electrolytes like organic acids and bases and some inorganic acids and bases ionizes only to a small extent. These are called weak electrolytes.

2. Nature of the Solvent – The ionizing power of the solvent depends upon its dielectric constant. The greater the value of the dielectric constant greater will be ionizing power of solvent and greater will be the degree of ionization.

3. Dilution: The degree of ionization increases with an increase in dilution. At infinite dilution even the weak electrolytes are almost completely ionised.

4. Temperature – The degree of ionization increases with the increase in temperature.

Important terms involved in Electrolysis

1. Conductors – Those substances which allow electricity to pass through them are know as conductors.

2. Insulators – Those substance which ~~donot~~ do not electricity to pass through them are known as insulators.

3. Electrolytic conductors / Electrolytes – Electrolytes are the substances which undergo decomposition when current is passed through them.

Ex:- Solution of acid, salt, bases in water.
In this case, the flow of electricity is due to the movement of ions.

Electrolytes
- Strong Electrolytes
- Weak Electrolytes

1. Strong Electrolytes :- The electrolytes which completely dissociates into ions when dissolved into solvent.

Ex:- $NaOH$, HNO_3, H_2SO_4, HCl.

2. Weak Electrolytes – The electrolytes which is partially dissociates into ions when dissolved in water.

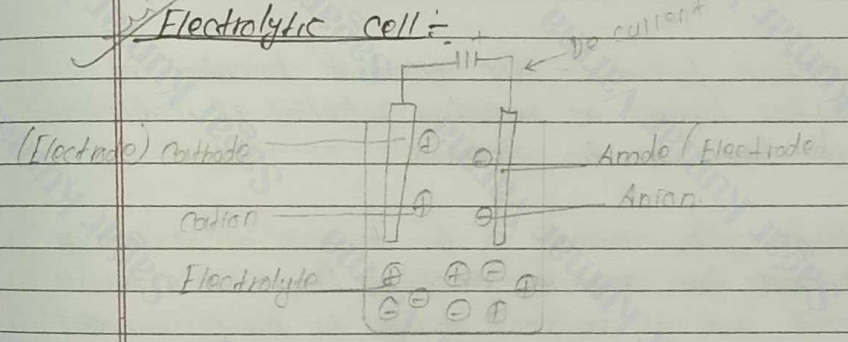
Ex:- CH_3COOH, NH_4OH, $CuCl_2$ etc.

* Non-Electrolyte – A non-electrolyte is a material that does not conduct electricity in its aqueous solution. When compounds are dissolved in water, non-electro- do not create ions.

Ex – Sugar, Urea, glucose etc.

* Electrolysis :- Electrolysis is defined as a process of decomposing ionic compounds into their elements by passing a direct electric current through the compound in a fluid form. The cation are reduced at cathode and anions are ionized at anode.

Electrolytic cell :-



Electrolytic cell

Electrolytic cell is a device that utilizes electric energy to decompose some chemical compound by a process known as Electrolysis. The electrolytic cell.

* Electrode - Electrodes can be defined as conductors that are used to make electrical contact with a non-metallic part of ~~of~~ the circuit.

* Electrode Potential - The tendency of ~~and~~ electrode to lose or gain electrons when it is in contact with its own ions in the solution is called its electrode potential.

* Oxidation Potential - ~~The tendency of an electrode to lose or~~ The electrode potential is further termed as reduction potential if reduction take place at the electrode.

* Reduction Potential - The electrode potential is further termed as reduction potential if reduction take place at the electrode

* Cathode - The cathode is the positive or oxidizing electrode that acquires electrons from the external circuit and is reduced during the electrochemical reaction.

* Anode - The Anode is the negative or reducing electrode that releases electrons to the external circuit and oxidizes during the electrochemical reaction.

Applications of Electrolysis

* Electroplating - "The process of producing metallic coating of more resistant metals (like silver, gold, nickel, chromimum etc.) on the base metal with the help of electric current is called electroplating."

The aim of electroplating are:-

- To prevent the base metal from corrosion.
- To make it more attractive in appearance.

* Electro-refining - This is the process of refining. The metal i.e, removing impurity from metal by the use of electrolysis method.
The metal like copper, silver, gold, aluminium, tin etc are refined by electrolysis.

* Electro-Typing - This is a process by which a process of electro-plating reproduces wood cuts etc. in copper. A mould is first made of the type in wax in this process, then coated with back lead to give it a metalic surface and then subjected to the electro-deposition process.

* Electro-metallurgy - It is the process of obtaining metal from its ~~ore~~ by electrolysis. The metal like Sodium, potassium, calcium, magnesium etc. are prepared by the electrolysis of fused sodium hydroxide.

Difference between Electrochemical cell and Electrolytic cell.

~~Differenc~~

Electrochemical cell	Electrolytic cell.
1. It is a device to convert chemical energy into electrical energy.	1. It is a device to convert electrical energy into chemical energy.
2. It is based upon redox reaction which is spontaneous	2. The redox reaction is non-spontaneous and takes place only when electrical energy is supplied.
3. The two electrodes may be set up in solutions of the same or different electrolytes.	3. The two electrodes are set up in the same electrolytic solution.
4. To set up this cell, a salt bridge or a porous pot is used	4. No salt bridge is used in this case.
5. Two electrodes are usually set up in two separate beakes.	5. Both the electrode are suspended in the solution or molter electrolyte in the same beakes.

Faraday's law of Electrolysis

* Michael Faraday was the first scientist who described the quantitative aspects of electrolysis.

* First law :- The amount of chemical reaction which occurs at any electrode during electrolysis by a current is proportional to the quantity of electricity passed through the electrolytes.

$$W \propto I \times t = I \times t \times z = Q \times z \quad \left[z = \frac{E}{F} \right]$$

- I = current in ampere
- t = time in second.
- Q = quantity of charge
- z = is a constant known as electrochemical equivalent.

* Second Law :- The amount of different substances liberated by the same quantity of electricity passing through the electrolytic solution are proportional to their chemical equivalent weights.

$$\frac{\text{Mass of A}}{\text{Mass of B}} = \frac{\text{Equivalent weights of A}}{\text{Equivalent weights of B}}$$

* Faraday :- The quantity of electricity is called Faraday. It is represented by the symbol F.

$$\boxed{1\,F = 96500 \text{ coloumbs mol}^{-1}}$$

Battery

* Battery is defined as an electrochemical cell connected in series, that can be used as a source of direct electric current at a constant voltage.

Types of cell

There are two types of cell or battery:-

1. Primary cell:- In primary ~~cell~~ batteries, the reaction occurs only once and after use over a period of time battery becomes dead and cannot be reused again.
   Ex:- Dry cell, used for radio, torch, calculator etc.

   The primary cells have limited energy producing capacity.
2. Secondary cell:- A secondary cell after use can be recharged by passing current through it in the opposite direction so, that it can be used again.
   The secondary cells are capable of producing large amount of energy.

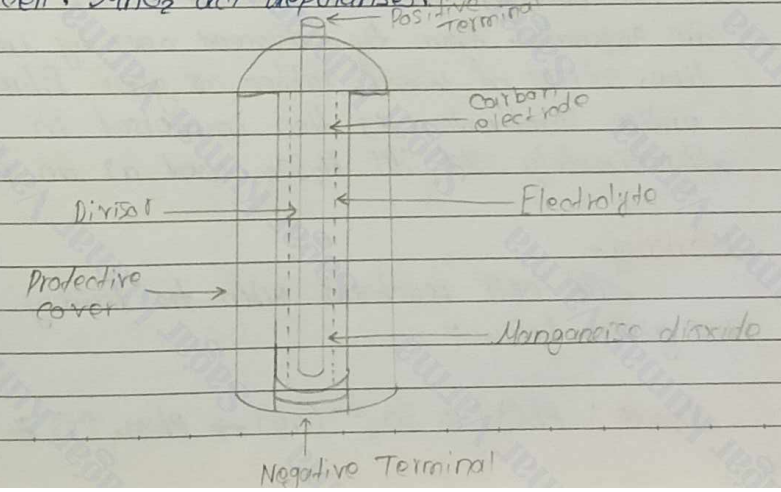
Example of secondary cells are lead-acid storage cell, Nickel-cadmium (Ni-cd) cell, silver-cadmium (Ag-cd) cell etc.

Dry cell

Dry cell is a type of primary cell.

* Construction of dry cell- The dry cell consist of following components:-

1. Outer metal covering- The metal covering is made up of zinc metal and is whitish in appearance. It act as a negative terminal of the cell.
2. Electrolyte- Inside the zinc metal, there is the electrolyte filled between two layers. Electrolyte is a wet pulp of zinc chloride ($ZnCl_2$) and Ammonium chloride (NH_4Cl). It is the charge carrier of electricity as it contains negatively charged and positively charged ions.
3. Metal Rod- There is a graphite rod at the centre of the cell. It is surrounded by paste of Magnesium dioxide (MnO_2). It act as the positive terminal of the cell. MnO_2 act depolarises.



Working :-
Chemical reactions takes place between. The electrolyte, zinc container and graphite rod. Because of this, electric charge is produced on the two terminals of the cell and electric current flow in the circuit.

Lead - Acid storage Battery

Lead Acid storage battery produces direct current (DC) electricity that flows in only one direction. When the battery is discharging, it changes chemical energy into electrical energy, thereby releasing stored energy. During charging (current flowing into the battery from the charging system), electrical energy is converted into chemical energy.

Construction :- In lead storage cell one of its electrode is made of lead. The other electrode is made of lead ~~The~~ dioxide (PbO_2). A number of lead plate are connected in parallel. The lead plates fit in between the lead dioxide plates. Various plates are separated from the adjacent ones by insulators like strips of wood, rubber or glass fibre. The entire combination is then immersed in approximately 38% dil H_2SO_4 used as an electrolyte.

Working -
The cell reactions when the battery is in use are given below:

Anode :- $Pb(s) + SO_4^{2-}(aq) \rightarrow PbSO_4(s) + 2e^-$

Cathode :- $PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \rightarrow PbSO_4(s) + 2H_2O(l)$

ie, overall cell reaction consisting of cathode and anode reactions is:-

$Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \rightarrow 2PbSO_4(s) + 2H_2O(l)$

On charging the battery the reaction is reversed and $PbSO_4(s)$ on anode and cathode is converted into Pb and PbO_2, respectively.

Plastics

* Plastics :- "Plastics are the organic materials of high molecular weight, which can be moulded into any desired form, when subjected to heat and pressure in the ~~pressure~~ presence of catalyst."

* Resins :- Resins are the basic binding materials, which form a major part of the plastics, and which actually has under gone polymerization and condensation reactions, during their preparation.

Formation of Plastic

In the formation of plastics, the polymerisation of monomers take place by two methods:

(i). Addition Polymerisation.
(ii). Condensation Polymerisation

(i) Addition Polymerisation – It is the process in which the monomers undergo repeated addition, resulting in the formation of long chain polymer without the elimination of simple molecules like H_2O, HCl, NH_3 etc.

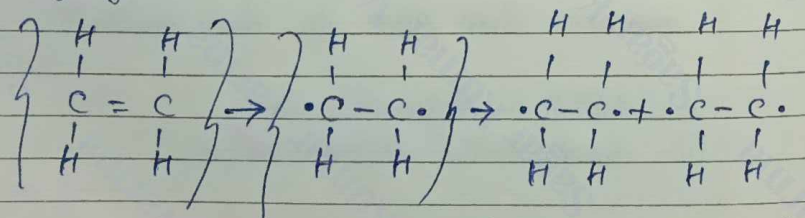
$$n\,CH_2=CH_2 \xrightarrow[(CH_3CH_2)_3Al + TiCl_4]{330-350K,\ 1\,atm} \left(CH_2-CH_2\right)_n$$

Ethylene — polyethylene.

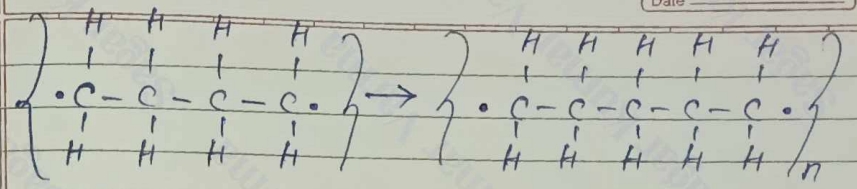
Catalyst used in this reaction is triethylaluminium and tetrachloride.

Formation of polythylene by addition polymerization.

Monomers taking part in polymerization should contain at least one double bond. In addition polymerization, one of the two bonds between the two carbon atoms of ethylene molecule ($CH_2=CH_2$) is opened up and form an unstable molecule of ethylene ($-CH_2-CH_2-$). Due to opening of the bond, two valence electrons of C-atom are made free valencies. The compound formed by joining two ethylene molecules, in its turn join with one more molecule of ethylene and the process is continued, until it form a large molecule of polyethylene.



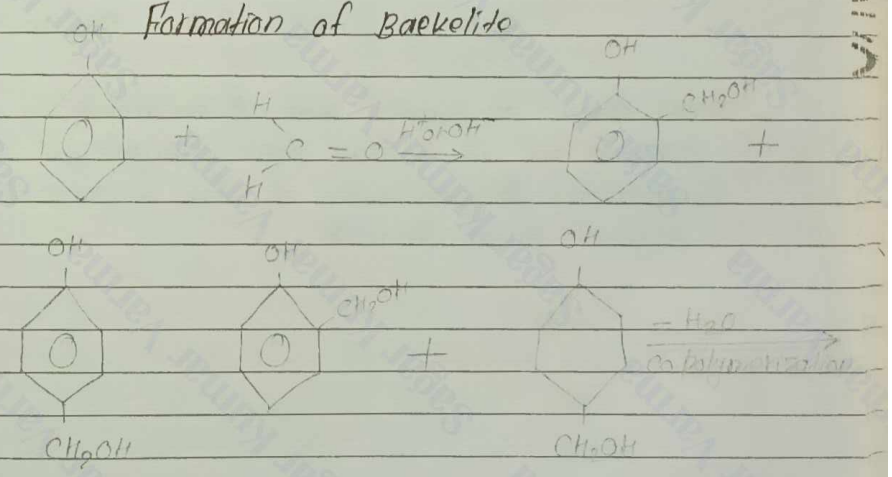
ethylene monomer — unstable molecule of ethylene. — Monomer unstable — Monomer

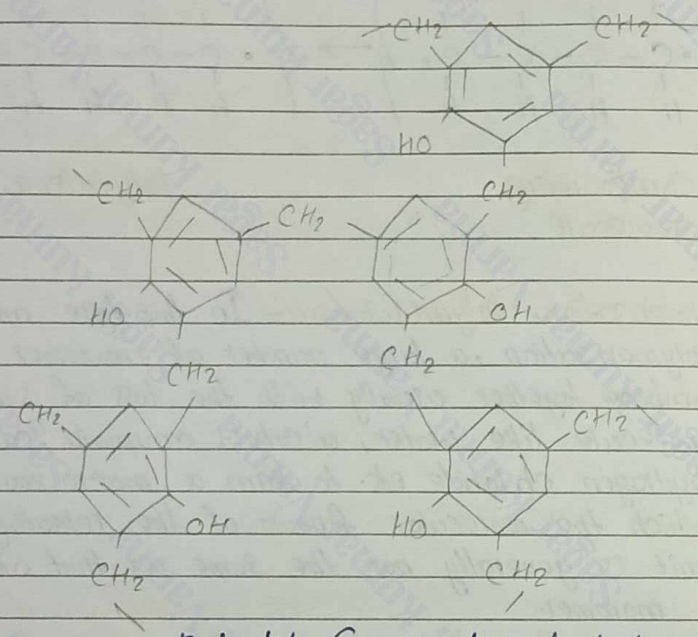


Compounding molecule — polythlene

(ii) Condensation Polymerisation :- In this type of polymerization, a large number of monomer molecules combine together usually with the loss of simple molecule like water, alcohol, ammonia, carbon dioxide, hydrogen chloride etc. to form a macro molecule in which the molecular formula of the repeating structural unit is generally not the same as that of the monomer.

Formation of Baekelite





Bakelite (cross-linked polymer)

When phenol is treated with formaldehyde in the presence of an acid or basic catalyst, it undergoes condensation polymerization to form a cross-linked polymer called bakelite.

~~Com~~

Compounding of plastics-

(i) Fillers- Fillers are added to give the final plastic better hardness, tensile strength, opacity, finish and workability. Fillers may be either of organic or inorganic origin.

Ex:- Quartz, mica are added to provide extra hardness to the plastics.

(ii) Plasticizers- Plasticizers are the materials that are added to resins to increase the plasticity and flexibility of thermosetting plastics. It decreases the tensile strength and chemical resistance.

Ex:- Camphor, non-drying vegetable oil, Triphenyl phosphate, etc.

(iii) Accelerators:- Accelerators are used only in case of thermosetting plastics. It accelerates the polymerization of fusible plastic into cross-linked infusible form during moulding operations.

Ex:- H_2O_2, metallic oxide such as ZnO, metal like, Ag, Cu and Pb etc.

(iv) Pigment- Pigments are the colouring material added to plastic to impart the desired colours to the plastic articles.

e.g.:- organic dyestuff and opaque inorganic pigments.

Difference between Thermoplastics & Thermosetting plastics.

Thermo plastics	Thermosetting plastics
(i) They are formed by addition polymerisation.	(i). They are formed by condensation polymerisation.
(ii) They consist of polymers of smaller molecular weight.	(ii). They consist of polymers of higher molecular weight.
(iii) They are softened on heating and hence can be reshaped and rewed.	(iii) They do not soften on heating, hence cannot be reshaped and rewed.
(iv) Their intermolecular bonds are weakes.	(iv) They are joined by strong covalent bonds.
(v) They are soluble in ~~sut~~ suitable organic solvent as their bond ar weakes.	(v) They are insoluble in organic solvent as their bonds are stronges.
(vi) Ex:- polythylene, PVC, polystyrene etc.	(vi). Ex:- Bakelite, polyesters, Silicon plastics etc.

Properties of Plastics

1. They are light in weight and their specific gravity varies from 1 to 2.4.
2. They possess low thermal and electrical conductivities.
3. They are highly resistance to corrosion and chemicals.
4. They are ready moulded, drilled, machined.
5. Their shades or colours do not fade easily.
6. They have good tensile strength.
7. They have low melting points but high refractive index.

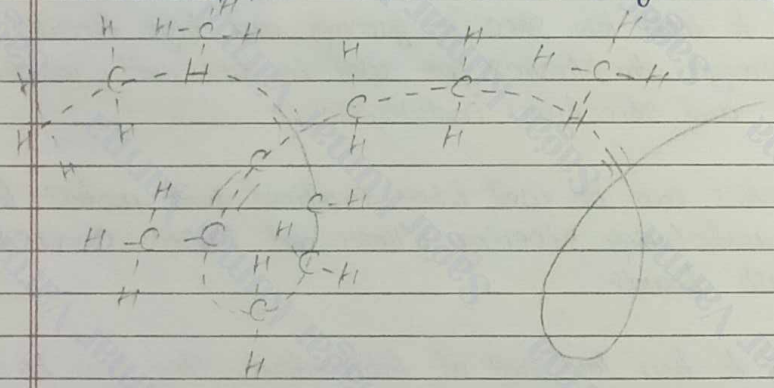
Applications of Plastics.

1. Due to their low specific gravity and high tensile strength, the plastics are used in aircraft, motors car and structural industries.
2. Plastics can be used when combined with metals for manufacturing steering wheels and Plastic covered dash boards.
3. Due to their low cost of fabrication, They can be easily and cheaply moulded with accurate dimension.
4. Being a bad conductor of heat, plastics are used for making handles of hot objects like electric iron, pressure cooker etc.
5. Due to their low electrical conductivity, plastics are used as solid electrical insulator or wire insulator.

Rubber (elastomers)

Rubber :- Rubber is a natural elastomeric polymer in which the polymer chains are held together by weak van der Waals force. The weak forces help the polymer in regaining its shape once the deforming force is removed.

⇒ Rubber or elastomers are high polymers which sustain or can undergo very large reversible elongations at relatively low stresses. Thus, a rubber-band can be stretched 5 to 10 times its original length and as soon as the stretching force is released, it returns to its original length.



Poly-Isoprene

Types of Rubber

1. Natural Rubber :- "Natural rubber is a high molecular weight linear hydrocarbon polymer which exhibits elasticity and other rubber like properties."

Natural rubber in manufactured from rubber latex, which is a colloidal dispersion of rubber in water. Natural rubber is a polymer of Isoprene (2-methyl-1,3-butadiene) with a chemical formula (C_5H_8) is joined together forming long polymer chain of cis-1,4-polyisoprene which is also known as natural rubber. India, Including the countries like, Thailand, Indonesia, and Malaysia are on of the top natural rubber producing countries in the world.

$$\left[CH_2-\overset{CH_3}{\overset{|}{C}}=CH-CH_2 \right] \xrightarrow{\text{polymerisation}} \left[CH_2-\overset{CH_3}{\overset{|}{C}}=CH-CH_2 \right]_n$$

Isoprene → Polyisoprene (rubber)

DRAWBACKS of Natural Rubber

⇒ Pure rubber is weless as pure gold. There are number of drawbacks of raw rubber :-

(a) During summer, the raw rubber becomes soft and sticky, while in cold weather it becomes hard and brittle.

(b) It has a large water absorbing capacity.

(c) It has low tensile strength (200 kg/cm²).

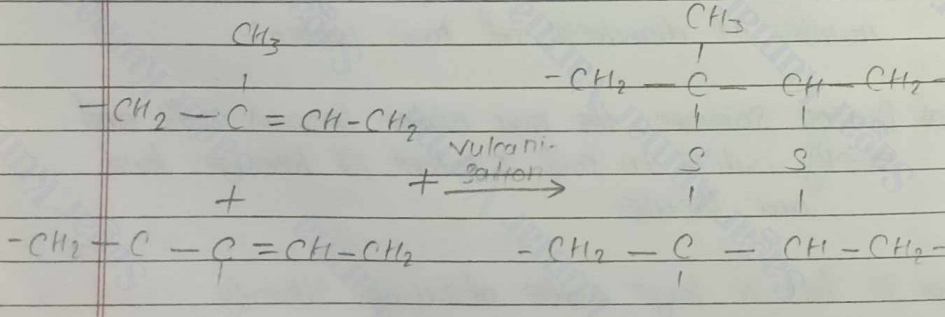
(d) on stretching, it undergoes permanent deformation.

(e). It is too weak to be used in heavy duty operation.

(f) It is affected by solvents like gasoline, benzene, carbon tetrachloride (CCl_4) vegetable oils etc.

Vulcanisation of Rubber.

⇒ The mechanical properties like tensile strength, elasticity and abrasion resistance of natural rubber can be improved by vulcanisation. Vulcanisation consists of heating the natural rubber with 3-5% of sulphur at about 373 K to 415 K. This results in the formation of sulphur act as a crosslinking agent. When a stretching force is applied on the vulcanised rubber, the polymer straightens out but does not slip past one another because of the polysulphide bridges. When the applied force is removed, the rubber regains its original shape.



Note:- In the manufacture of tyres, 5% sulphur is used as a cross-linking agent.

Synthetic Rubber:- Synthetic rubbers are artificial rubber produced chemically mainly form petroleum by products and natural gas.
ex:- Neoprene, Buna-N, Buna-S etc.

⇒ Synthetic rubber is any vulcanisable artificially prepared to 300% or more of its original length, but returns rapidly to its approximate original shape and dimension when to stretching force is released.

Distinction between Natural and Synthetic rubber.

	Natural Rubber	Synthetic Rubber
i.	It is an polymer of Isoprene (C_5H_8)$_n$ molecule	(i) It is a rubber-like product obtained by some chemical reaction.
(ii)	It is an elastic material obtained from a milky emulsion (latex) of rubber tree	(ii) It is a polymere of substances having unsaturated nature.
(iii)	Its tack property is high.	(iii) Its tack property is low.
(iv)	It is ~~non~~ soluble in organic solvents.	(iv) It is highly resistant to oxidation. It is insoluble in organic ~~oxidation~~ solvents ~~It is highly resistant to~~
(v)	It is non-resistant to oxidation.	
(vi)	It becomes soft and sticky by application of heat	(vi) It does not becomes soft and sticky by application of heat.

Jno

Properties of Rubber

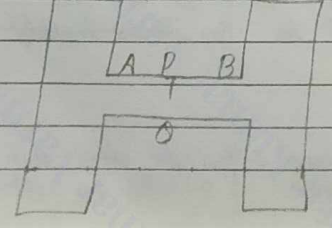
(a) Elasticity:- Elasticity is the property by virtue of which a material undergoes deformation under stress and regains its original shape on removal of the stress.

Elasticity is thus opposite of plasticity and is measured by measuring plasticity. If elasticity is high it requires excessive power and time for processing.

(b) Tack:- Tack is the special characteristic of rubber by virtue of which two or more surfaces can stick or adhere to each other. Synthetic rubbers generally lack this property.

(c) Abrasion Resistance:- Abrasion is a process of wearing of surface by friction. "The property of resisting wearing away of a surface by friction is known as abrasion resistance."

d) Stress-Strain properties:- A dumb-bell shaped piece of synthetic rubber is cut with a die. On narrow portion, make two marks one inch apart as shown in fig:- It is then placed in the machine and stretched until it breaks. The load at which it breaks is its "tensile strength." This property is used when rubber is used for v-belts and conveyor belts.



Dumb-bell shaped piece of synthetic rubber.

(e) Hardness:- Hardness is the ability of the rubber to withstand wear and abrasion and resist the penetration

(f) Rebound:- It is the measure of resilience that is ability to absorb energy and return without permanent deformation of a synthetic rubber. This property is utilized in mountings and shocked absorbers.

Applications of Rubber.

(a) Sealing fluids:- Rubber's flexibility and resilience make it ideal for creating airtight and watertight seals, such as in o-rings, gaskets, and seals for pipes and valves.

(b) Conducting fluids:- Rubber is used to create flexible and durable hoses and pipes for transporting fluids like water, oil and gas as seen in garden hoses and fuel lines.

(c) Storing Energy:- Rubber's elastic properties allow it to store and release energy, as seen in bungee cords, springs, and shock absorbers.

(d) Transmitting Energy:- Rubber is used in drive belts and other mechanical components to transmit rotational or linear motion efficiently.

Thermal Insulating Materials

⇒ "The materials which are used to prevent the flow of heat are know as thermal Insulators."

* ⇒ The use of thermal insulators is very important in various industrial and engineering operations where the flow of heat is to be prevented.

E.g:- In cold storage refrigerators, boilers, ovens, steam carrying pipes, brine pipe line etc. all need thermal insulators.

⇒ The good thermal insulators have extremely low thermal conductivity the most commonly used thermal insulators are glass wool, thermocole, ~~ab~~ asbestos and cork.

* Characteristics of Good Insulating Materials

⇒ It should be cheap.
⇒ It should be chemically inert to water, surrounding atmosphere and high temperature.
⇒ It should be physically and mechanically stable at the working temperatures.
⇒ It should withstand the effects of shock and vibrations
⇒ It's density should be low.
⇒ It should be fire proof.

* Glass Wool:- Glass wool is a fibrous wool like material which is made up of intermingled fine filaments of glass, like ordinar wool.

* Preparation:- Glass filaments are obtained by forcing molten mass of alkali-free glass through sieve holes having the average diameter of 0.0005 cm continuosly. The filaments of glass so obtained are thrown over a rapidly revolving drum to get the material in wool-like form.

Properties:-

* Its density is low.
* Its thermal conductivity is low
* It is fire-proof and non-combustible.
* Its electrical conductivity ~~is~~ is also low.
* Its tensile strength is about ~~eight~~ three more than steel.
* It average diameter of fibre is 0.0005 cm.
* It is resistant to chemicals and does not ~~ab~~ absorb moisture.

Uses / Application:-

* It is used for sound and electrical insulation.
* It is also used in air-filters as dust filtering material.
* It is used in the manufacturing of fibre glass by reinforcing it with plastic resins.

* It is widely used as a thermal insulating material in domestic and industrial appliances such as motors, ovens, refrigerators, walls and roofs of houses, because it is soft heat. proof

* Being resistant to chemicals, glass wool is used as a filtering material for corrosive liquids like acids and acidic solutions in industry.

Thermocole

Q Physical Properties of Metals?

→ (i) Luster- Metals have a shiny appearance.
(ii) Malleability:- Can be hammered or rolled in thin sheet
(iii) Conductivity:- Good conductors of heat and electricity
(iv) High Density:- Generally heavy.
(v) Hardness:- Most metals are hard, through some (e.g. sodium, potassium) are soft and can be cut with a knife.

Q Chemical properties of Metals?

(i) Reaction with ~~water~~ oxygen:- Metals react with oxygen to form metal oxides.

(ii) Reaction with water:- Some metal react with water to form metal hydroxides and hydrogen gas.

(iii) Reaction with Acids:- Most metal react with acids to produce salt and hydrogen gas.

Alloys

When two or more metals are mixed in their molten state, they solidify without separation. On solidification they form a homogenous substance called alloy.

Alloy is a homogenous mixture of two or more elements one of which must be a metal.

Example: (i) Bronze is an alloy of copper and tin.

(i) Cu = 75% (ii) Sn (Tin) = upto 12%.
Other elements such as magonese, aluminium, zinc, nickel.

(ii) Steel: Steel is an alloy of iron and carbon for stainless steel.

Fe - (iron) - approximatily 85-88%.
Chromium (Cr) - at least 10.5%.
Carbon (C) - less than 1.2%.

Name of the same commercial alloy.
i) Steel
ii) Nichrome (Ni + Cr)
iii) Bronze (Cu + Sn)
iv) Brass (Cu + Zn)
v) Duralumin (Al + Cu + Mg + Mn)

Properties of alloy:

1) An alloy is a substance that has metallic properties and is composed of two or more element, out of which at least one is the metal.

It also conduct heat and electricity. Alloys are less brittle, corrosion-resistant, harder or even have a more describe luster and colour.

Amalgam:
An amalgam is an alloy of mercury with another metal.

Ex:- (i) Zinc amalgam:
It is a binary (liquid-solid) solution of mercury and zinc.

(ii) Potassium:
KHg (gold coloured compound)
KHg_2 (Silver coloured compound).

(iii) Sodium amalgam
(iv) Aluminium amalgam
(v) Tin amalgam

Purpose of making alloy

Following are the main purpose of alloying:

i) To improve the hardness of metal-
An alloy is harder than its components. The hardness of a metal can be enhanced by alloying it with another metal or non-metal.

ii) Lower the melting point:
The melting point lowers when pure metals are alloyed with other metals or non-metals. This makes the metal easily fusable.
Ex:- Solder alloy

iii) To increase the tensile strength:
Alloy formation increases the tensile strength of the parent metal.
- Addition of 1% carbon increases the tensile strength of pure iron by ten times.

iv) To reduce malleability and ductility:-
Alloying metal with suitable metal reduces the malleability and ductile, hence make the product tough.

Alloy

Preparation of alloy:

An alloy can be prepared by any of the following methods :-

i) Fusion Method
ii) Electro-deposition Method
iii) Compression Method
iv) Reduction Method

1. Fusion Method:

In this method, the Component having higher melting point is melted first and than the other Component with a lower melting point is added to the melt in the requried quantity. Both the metal components are mixed well and allowed to melt further.

In the manufacture of brass, an alloy of copper and zinc, the Copper (melting point is 1089) is first melted and than the requried quantity of zinc is add it. The molten mass is stirred and allowed to cool. To avoid oxidation of copper and zinc, The surface of molten mass is allowed to cool slowly to get brass.

2) Electro-deposition:

The method involves simultaneous deposition of different component metals from the electrolytic solution containing their salts solution mixture by passing direct electricity.

Brass, alloy of copper and zinc can be obtained by this method. Electrolysis process is involved in this method.

3. Compression Method:

In the compression method making alloy, Two or more metal powders are mixed intimately and the intimate mixture is compressed under high pressure in a mould. The moluded article is then heated to the temperature just below the melting point of an alloy. Due to this, The tiny particles of metals are firmly welded to one another.

4. Reduction Method:

Metals may exist in the form of compounds. Reduction is a chemical process which a compound of one component can be seprated from, another

Component, to get pure metal.

Ferrous Alloy:
Ferrous alloy contain iron as one of their main components.
Ex:- Steel, Alnico

NON-Ferrous Alloy:
NON-Ferrous alloy do not contain iron as one of their main components.
Ex: Bronze, Duralumin etc.

Properties:

- Melting point of non-ferrous alloy are lower than those of ferrous alloy.
- It is very much corrosion resistant.
- It can be easily cleaned and has attractive apperance.
- It has low magnetic pereability.
- It has tensile strength and 5500 kg/cm².

Composition and Properties and alloy applications of alloy:

1. Alnico:
Aluminium (Al) = 20%, Ni = 20%, Co = 10%, Steel = 50%

Property:

- It can be magnetised to produced strong magnetic field.
- It has high resistance to demagnetization.
- It can lift 4450 times of its own weight.

Application:
- ~~Due~~ Alnico are widly used in industrial and consumer applications where strong permanent magnet are needed.
Ex: Loudspeaker, electric motor, microphones etc.

2. Duralumin:
It is an aluminium alloy.
Al = 95%, Cu = 4%, Mn = 0.5% and Mg = 0.5%

Properties:
- It is light tough, highly ductile good conductor of heat and electricity.

- It is a strong as mild steel, through its density is one-thired that of steel.
- It process high machinability.

Application:

- Due to its good strength and low density, it find extensive use in aircrafts industry.
- It is also used in making autoparts and locomotive parts.
- It is used for making surgical instruments, cables, fluorescent tube caps etc.

WOOD Metal:

Composition:
Bi = 50%, Pb = 25%, Sn = 12.5% and Cd = 12.5%

Properties:
- Its melting point is low (70°C)
- It is an easily fusible alloy.

Application:
- It is used for making safety plugs for cooker, milk pot etc.
- It is used for making fire drams and automatic sprinkless.

Monel Metal:
It is a copper-nickel alloy.

Composition:
Cu = 30%, Ni = 67%, Fe + Mn = 3%.

Properties:
- It has good mechnical property even at high temperature.
- It has low magnatic permeability.
- It is very much resistant to chemical and sea water corrosion.

Application:
- It is used in tubline blades and automobile parts.
- In part of machine used for processing food & dyes.
- It is used in kitchen sinks, counter tops, hot-water boilers valves and resistance wire etc.

Gun Metal:

It is an alloy copper.
It is one of the form of bronze.

Composition:
Cu = 85%, Zn = 4%, Sn = 8%, Pb = 3%

Properties:
- It is hard, tough, strong to resist the force of explosion.
- It is resistant to corrosion by water and atmosphere.

Application:
- It is used for making parts of high pressure steam, plants, water fittings, marinelike pumps.
- It is used for making gun-barrels and foundry works.
- It is also used in hydraulic fittings and heavy load bearings.

Bibbit Metal:

It is a tin, antimony, copper alloy.

Composition:
Sn = 50-90%, Sb = 7-10%, Cu = 2-6%, Pb = 5-30%.

Properties:
- It is a silvery-white metal.
- It does not tarnish easily and also can be polished easily.
- It has low cofficient of friction.

Application:
- It making engine bearings since it distributes the load uniformly.
- As a common bearing metal in cast iron box.

Dutch Metal:

It is an alloy of copper
Dutch metal is one of the form of brass.

Composition:
Cu = 80%, Zn = 20%

Properties:
- It is golden in colour.
- It is very malleable and ductile.

Thermocole:

Thermocole is a formed plastic obtained by fo blowing air through molten polystrene or polyurethanes.

It is a spongy porous foam like in structure. Due to large number of air cells it possosses an outstanding insulating property.

Properties:

- Its Density is low.
- It is quite strong, though extermely light.
- Its electrical and thermal conductivity is low.
- It is chemically inert and resistsageing.
- It can be used upto 55°C.

Metals

Introduction: Metals are natural compounds of earth's crust in which they are generally found in the form of metal ores, assiciated both with each other and with many other elements. They are also naturally present in the rocks washed by surface water and ground-water and in atmospheric dust.

Define: Metals are subtances that form naturally below the surface of the Earth. Most metals and lustrous or shiny. Metals are Inorganic, which means they are made of subtances that were never alive.

Properties of Metal:

The important mechanical properties of the metals is given below:

(a) **Hardness:** Hardness is the ability of the metal to resist wear or abrasion and resist penetration.

Example: Tungsten (W) metal is found to be the hardest and potassium (K) is found to be the soft test among the metals.

(b) Toughness: The property of a metal to resist repeted shocks or nibrations without breaking is called as toughness. It is highly property of any metal. Ex:- Au, Ag are tough metals.

(c) Ductility: It is the property of the metal by which it can be stretched in length without breaking. Metals like gold, Silver, platinum having this property can be easily drawn into wires.

(d) Malleability: It is the property by virtue of which a metal can be hammered into shapes. Without cracking or rolled into thin sheets without tearing or breaking.

EX:- Au, Ag, Pt, Al, Cu etc.

Occurrence of Metal

Metal occur in nature.

(a) Native State Or Free state:

The inactive metal like silver gold: Platinum etc. are found in the free state eg; in the elementary form in Nature. Such metals are placed at the bottom of the activity series.

(b) Combined State: A Naturally occuring substance present in earth's crust which contains metal in the native or in combined state is known as mineral.

- Most of the metal occur in nature in the form of their compounds due to the action of moisture, air, carbon dioxide and the non-metal present in the earth crust.

"A mineral from which the metal can be extracted economically is known as an ore.

(c) Gangue: Ores obtained from earth's crust are always assiciated with impurities like sand, clay, rocks etc. and these unwanted impurities associted with the ores are known as 'Gangue' or 'matrix'.

Oxides:-

Types of ore:-	Ore	Composition	Metal present
1) Oxides	Hamematile	Fe_2O_3	Fe
	Bauxite	$Al_2O_3 \cdot 2H_2O$	Al
	Cuprite	Cu_2O	Cu
	Zincite	ZnO	Zn
	Tinstone	SnO_2	Sn
ii) Sulphides	Copper pyrite	$CuFeS_2$	Cu
	Copper glance	Cu_2S	Cu
	Zinc Blender	ZnS	Zn
	Cinnabar	HgS	Hg
	Galena	PbS	Pb
3) Carbonates	Limestone	$CaCO_3$	Ca
	Magnesite	$MgCO_3$	Mg
	Dolamite	$CaCO_3 \cdot MgCO_3$	Mg
	Calamine	$ZnCO_3$	Zn
	Malachite	$CuCO_3 \cdot Cu(OH)_2$	Cu
4) Sulphates	Epsum salt	$MgSO_4 \cdot 7H_2O$	Mg
	Gypsum salt	$CaSO_4 \cdot 2H_2O$	Ca
	Barytes	$BaSO_4$	Ba
	Anglesite	$PbSO_4$	Pb

Physical Properties and Application of Metals

Iron (Fe): Pure iron is soft and has silvery white grayish colour.

Properties:

* It melting point 1530°C.
* It boiling point 2450°C
* It malleable and ductile.
* It specific gravity is 7.86.
* Its thermal conductivity is high.

Application:

* It is used for making chains, nails hooks, pipes etc.
* In making heavy machinery agricultural implements.
* In building of ships and bridgs.

Copper (Cu) :

Properties :

* It is reddish brown in Colour.
* M.P → 1089°C , B.P → 2350°C
* It is a very good Conductor of heat and electricity.
* It is tough and resistant to corrosion.

Application :

* Pure Cu is used in making electrical lories and cables.
* In heating utensils pans.
* In making coins or naments.
* In electroplating and electrotyping.
* In making alloys such as brass, bronze monel metal, gun metal, bell metal etc.

Aluminium (Al) :

Properties :

* It is a high blush lohite metal and reflects light.
* Specific gravity 2.7, M.P → 658°C, B.P → 1800°C.
* It is tough ductile.
* It can be easily cast and welded.

Application :

* It is used in making household utensils frames etc.
* In making surgical instruments.
* Since aluminium is a very poor conductor of electricity. It is used in making electric wire and cables.
* As foil in wrapping cigarettes and confectionary.

Chromium (Cr):

Properties:

- It is a silvery white metal having specific gravity 7.14.
- It is hard and brittle metal.
- M.P → 1900°C, B.P → 2480°C
- In can take high polish and resists atmospheric corrosion.

Applications:

- It is used in Chrome plating
- In making alloy steels such as stainless steel, tungsten steel etc.
- In domestic utensils and surgical instruments.
- As alloy michrome is used in resistance coils.

Tin (Sn):

Properties:

- Specific gravity = 7.3
- MP 232°C, B.P = 2276°C
- Malleable and Ductile
- It is softer than zinc but harder than lead (Pb).

Application:

- In tinning household utensils.
- It is also used in the manufacture of alloys tice solder babbit metal gun metal, bronze, type metal, rose metal etc.
- For making collapsible tubes for tooth pastes ointments etc.

Cobalt (Co):

Properties:

- Silvery white metal.
- MP = 1478°C, B.P = 3000°C
- Sg = 8.7
- Hard and feebly magnetic nature.

Application:

- In cancer treatment.
- It alloy 'alnico' in making small powerful permanent magnents for magneto. loud speakers.
- It salt is used in colouring glass and pottery etc.

Tungsten (W):

Properties:

- Silver white metal.
- S.g = 19.3
- MP = 3370°C, BP = 5700°C
- It is hard, brittle and crystallic in the powdered form.

Application:

- It is used in anticathodes in X-ray tubes.
- In surgical instruments, spark coils.
- It is mainly preparing filaments of electric bulbs.

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