CHEMICAL KINETICS

by SuCh

1 RATE OF REACTION AND RATE LAW

1.1 For a reaction: $A(g) + 2B(g) \rightarrow 3C(g)$| ROR or $r \equiv -\frac{d[A]}{dt} = -\frac{1}{2}\frac{d[B]}{dt} = \frac{1}{3}\frac{d[C]}{dt}$

For any ideal gas i, $[i] = \frac{n_i}{V} = \frac{P_i}{RT}$

1.2 For a reaction: $aA(g) + bB(g) \rightarrow cC(g)$| $\boldsymbol{r = k[A]^x[B]^y}$ | Order of rxn, $n = x + y$

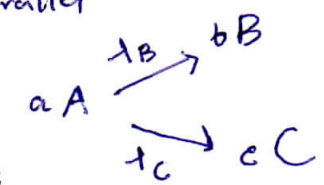
where a, b, c= Stoichiometric Coeff.; x, y= Partial Order, Order of rxn wrt A or B

k= Rate Constant/ velocity constant / Specific Rate of Reaction. *Unit* $\gg$ $[\boldsymbol{mol^{1-n} \cdot L^{n-1} \cdot s^{-1}}]$

For elementary rxn ONLY → $r = K[A]^a[B]^b$

1.3 Molecularity: M = n & **M = {1,2,3}** | not defined for complex rxn | only elementary | ie n = 1 or 2 or 3 | if n = 0, fracn, >3 | Must be complex rxn.

Parallel



$\lambda_{eff} = \lambda_B + \lambda_C = \frac{1}{t}\ln\frac{[A]_0}{[A]_t}$

$\lambda_B\% = \frac{\lambda_B}{\lambda_B + \lambda_C} \times 100$

$\frac{[B]_t}{[C]_t} = \frac{b\lambda_B}{c\lambda_C}$

2 ZERO ORDER

2.1 $-\frac{dx}{dt} = k$

2.2 For a reaction $A \rightarrow B$, $[A]_t = a - x = a - kt$ | k is rate constant

2.3 Rate of rxn is independent of conc. of reactants.

2.4 Half Life: $\tau = t_{1/2} = \frac{a}{2k}$ and Completion Time: $t_c = 2t_{1/2}$

3 1st ORDER

3.1 $-\frac{dx}{dt} = k(a - x)$ r v/s At linear

3.2 Rate Constant: $k = \frac{1}{t}\ln\left(\frac{a}{a-x}\right) = \frac{1}{t}\ln\frac{[A]_0}{[A]_t} = \frac{1}{t}\ln\left(\frac{1}{1-\alpha}\right)$ |$k = \frac{1}{t}\ln\left(\frac{p_0}{p_0 - y}\right)$; $p_T = p_0 + y$ & $p_\infty = 2p_0$

3.3 $a - x = a \cdot e^{-kt}$ | Infinite time reqd. for completion of rxn.

3.4 Degree of Dissociation $\alpha = \frac{x}{a} = 1 - e^{-kt}$

3.5 Half-Life: $t_{1/2} = \frac{\ln 2}{k}$ | $t_{\frac{3}{4}} = 2t_{\frac{1}{2}}$; $t_{\frac{7}{8}} = 3t_{\frac{1}{2}}$ | After n half-lives, $x = \frac{a}{2^n}$

3.6 Decomposition of H_2O_2: $k = \frac{1}{t}\ln\frac{V_0}{V_t}$ ($\frac{Initial\ req\ Vol\ t=0}{Vol\ req\ after\ t=t}$); t=∞ → after very long time

3.7 In terms of Vol of O_2 evolved: $k = \frac{1}{t}\ln\left(\frac{V_\infty}{V_\infty - V_t}\right)$

3.8 Hydrolysis of Ethyl of Acetate: $k = \frac{1}{t}\ln\left(\frac{V_\infty - V_0}{V_\infty - V_t}\right)$ | $V \rightarrow$ *Vol of NaOH used in titration.*

3.9 Inversion of Cane Sugar: $S \rightarrow G + F \equiv k = \frac{1}{t}\ln\left(\frac{r_\infty - r_0}{r_\infty - r_t}\right)$ | $r \rightarrow$ *Angle of rotation*

3.10 Film thickness: $k = \frac{1}{t}\ln\left(\frac{\tau_{max}}{\tau_{max} - \tau}\right)$

photochemical rxn rate, $r = K \cdot I_{abs.} \cdot C$ (Intensity of hν, conc.)

$-\frac{dA}{dt} = K[A]^n$

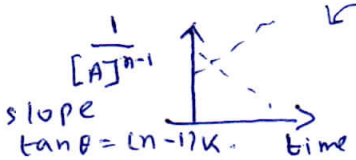
nth ORDER

$*k = \frac{1}{t(n-1)}\left[\frac{1}{(a-x)^{n-1}} - \frac{1}{a^{n-1}}\right]$

$*t_{1/2} \propto a^{1-n}$

$y = (n-1)Kx + \frac{1}{A_0^{(n-1)}}$

4 2nd ORDER



4.1 $-\frac{dx}{dt} = k(a - x)^2$

4.2 $\frac{1}{a-x} = kt + \frac{1}{a}$| For diff conc: $kt = \frac{1}{a-b}\ln\left[\frac{a-x}{b-x} \cdot \frac{b}{a}\right]$|Half Life $t_{1/2} = \frac{1}{ak}$

* A $\xrightarrow{\lambda_1}$ B $\xrightarrow{\lambda_2}$ C

[B] is max^m, at

$t_{max} = \frac{1}{\lambda_2 - \lambda_1}\ln\left(\frac{\lambda_2}{\lambda_1}\right)$

5 Arrhenius Equation

A = Arrhenius / Frequency Factor.

5.1 Rate constant $k = A.e^{-\left(\frac{E_a}{RT}\right)}$ $\left|\ln\frac{k_2}{k_1} = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)\right|$ *Generally* $E_a \approx 80\ \frac{kJ}{mol}$ |

5.2 Temp Coeff. $\mu = \frac{k_{T+10}}{k_T} \approx 2$ *generally*

ROA $\frac{d[B]}{dt} = \lambda_1[A]_t - \lambda_2[B]_t$

For REVERSIBLE reaction: $k_f + k_b = \frac{1}{t}\ln\left(\frac{x_e}{x_e - x}\right)$ ✓

*NOTE: ~ Revise the graphs, Parallel-Series parts and Energy diagrams from note copy

LIQUID-SOLUTIONS

NOTE

1) Pext = 1 bar ≡ [illegible], T < 100°C
standard b.pt.

2) Pext = 1 atm ≡ [illegible], T = 100°C
Normal b.pt.

1 atm = 10^5 Pa (SI)

1) Clausius - Clapeyron Eqn —

$$\ln \frac{P_2}{P_1} = \frac{\Delta H_{vap}}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

P_2, P_1 → V.P at T_2 & T_1 K

2) Ideal Liquid solution (Binary)

1) $\Delta H_{mix} = 0 = \Delta V_{mix}$; $\Delta S_{mix} > 0 > (\Delta G_{mix})_{T,P}$

completely (nearly) ideal —

(a) Benzene + Toluene. (b) n-hexane + n-heptane (c) Ph-Cl + Ph-Br
(d) Et-Cl + Et Br.

3) Raoult's Law —

$P_{soln} = P^\circ_A X_A + P^\circ_B X_B$ | where mole frac^n in liq → $X_A + X_B = 1$

Composition in Vapour Phase (i.e. volatile solute)

$Y_A = \frac{P^\circ_A X_A}{P_{soln}}$, $Y_B = \frac{P^\circ_B X_B}{P_{soln}}$. | $Y_A + Y_B = 1$

Again,

$P_{soln} = (P^\circ_A - P^\circ_B) X_A + P^\circ_B$ | $\Rightarrow \frac{1}{P_{soln}} = \frac{Y_A}{P^\circ_A} + \frac{Y_B}{P^\circ_B}$

$P_{soln} = P^\circ_{solvent} \times X_{solvent}$ (Non-volatile solute)

Azeotrope — Constant Boiling mixture
X = Y.
Cannot be separated by distillation

4) Non-Ideal Liquid solutions

(+) Deviation → (IMAF ↓)

a) Alcohol + H_2O (b) Acetone + Ethanol (c)  + C_2H_5OH
Form Minimum boiling Azeotrope. (+ HNO_3 + H_2O)

(−) Deviation → (IMAF ↑)

(a) Electrolyte + H_2O, (b) Acetone + Chloroform ($HC-Cl_3$) (c) Phenol and Aniline.
Form Maximum boiling Azeotrope (or H_2O + nitrobenzene)

5) Mixture of 2 immiscible liquids.

$P_{system} = P^\circ_A + P^\circ_B$; in vapour phase → $\frac{n_A}{n_B} = \frac{P^\circ_A}{P^\circ_B}$

6) Colligative Properties.

1) Relative lowering in V.P — $RL = \left(\frac{P^\circ - P_s}{P^\circ_s}\right) = i X_{solute} \simeq \frac{n_{solute} \times i}{n_{solvent}}$
(↑ P_{soln} ↓, as lowering ↑) (dilute)

Ostwald-Walker Method — $RL = \frac{P^\circ - P}{P}$ {(Mass ↓) in pure Solvent Vessel}

2) Elevation in boiling point —
$T_b = T^\circ_b + \Delta T_b$; ↑ T_b ↑ $\Delta T_b = K_b m i$ (m: molality)
Total (Mass) ↓

$K_b = \frac{R(T^\circ_b)^2 \cdot Mw}{L_{vap}}$ $K_f = \frac{R(T^\circ_f)^2 \cdot Mw}{L_{fus}}$

3) Depression in Freezing pt. — $\Delta T_f = K_f \cdot m i$
$T_f = T^\circ_f - \Delta T_f$; ↑ T_f ↓

4) Osmotic Pressure. $\pi = iCRT = \rho g h$

7) Van't Hoff Factor
Disso: → $i = 1 + (n-1)\alpha$ (> 1)
Asso: → $i = 1 + \left(\frac{1}{n} - 1\right)\alpha$ (< 1)

Carboxylic Acids form dimer, dissolved in Benzene. Take $i = n$
if α not given,

8) HENRY'S LAW: — (Low T; High P)
or $m_{gas} \propto P_{gas}$ $P_{gas} = K_H \cdot \frac{n_{gas}}{n_{gas} + n_{liq}}$
(x in liquid)

Hypotonic
Hypertonic

ALKANES (C_nH_{2n+2})

I) Methods of PREPARATION :—

(A) Reduction

(i) Catalytic Hydrogenation (Sabatier Senderens)

$R-X + H_2 \xrightarrow[Ni]{T=300^\circ C} R-H + HX$

Ease : $1^\circ > 2^\circ > 3^\circ$

Raney-Ni → at Room Temp.
Pd – C
Pt or W/Ir

Eg- 

(ii) Dissolving Metal

$R-X \xrightarrow{warm} R-H + HX$

Zn-HCl, -NaOH, -EtOH, CH_3COOH; } gives 2[H]
Na + Hg + C_2H_5OH ; Fe + dil. HCl } $1^\circ > 2^\circ > 3^\circ$

(iii) Nagai Method *

$R-X + 2[H] \xrightarrow[HI]{Red\ P} R-H + HX$

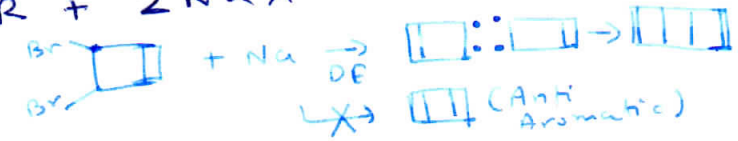
Converts all → Alkane.

(iv) Wurtz Method

$R-X + R-X + 2Na \xrightarrow[Dry\ Ether]{} R-R + 2NaX$

- Symmetrical coupling
- Even No. Carbon

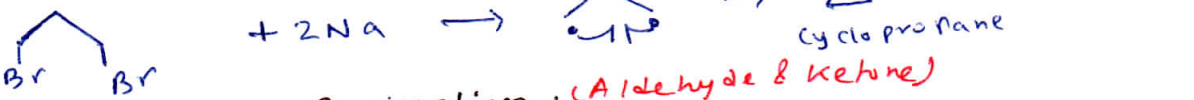
(Remove – X and put a Radical•)



(v) Frankland Reaction.

$R-X + Zn + X-R \xrightarrow{D.E} R-R + ZnX_2$

Freund Reaction



(vi) Clemmensen's Reduction. (Aldehyde & Ketone)

$>C=O \xrightarrow[2HCl]{Zn-Hg} 2[H] \rightarrow >CH_2$

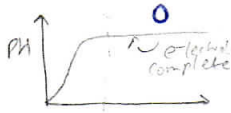
(B) Other Methods —

(vii) Kolbe's Electrolysis.

- Even No. carbon
- Na or K salt of carboxylic Acid.

$R-\underset{\underset{O}{\|}}{C}-O^-Na^+ \xrightarrow{\text{Electrolysis}} R-R + Na_2CO_3 + H_2O + H_2\uparrow$

Anode — Cathode



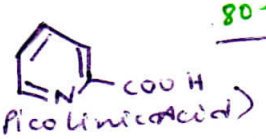
Eg:- 

Decarboxylation.

(viii) Soda-lime Process (removes CO_2 from all places)

$R-\underset{\underset{O}{\|}}{C}-O^-Na^+ + NaOH \xrightarrow{CaO} R-H + Na_2CO_3$

(ix) Pyrolisis



$\xrightarrow[\Delta]{80-220^\circ C}$  $+ CO_2$

- Other —
- Malonic Acid
- 2-Furoic Acid
- β-Keto Acid

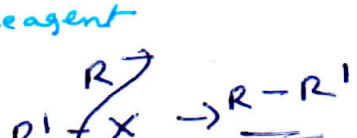
} Heat দিলেই CO_2 বেরিয়ে যাবে।

X) Corey-House - Synthesis

Gilmann's Reagent

$R-X \xrightarrow[D.E]{2Li} R-Li + LiX \xrightarrow{Cu-X} R_2CuLi$

Eg- 



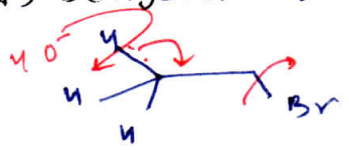
ALKENES C_nH_{2n}

Enantiotropic

I) Methods of PREPARATIONS:

(A) From Alkyl Halide

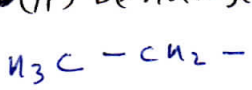
(i) Dehydrohalogenation — order R-F < R-Cl < R-Br < R-I



$\xrightarrow{EtOH \cdot KOH}$ $CH_2=CH_2 + KBr + H_2O$

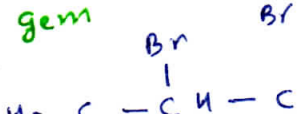
other RO^- in ROH / DBN

(ii) Dehalogenation



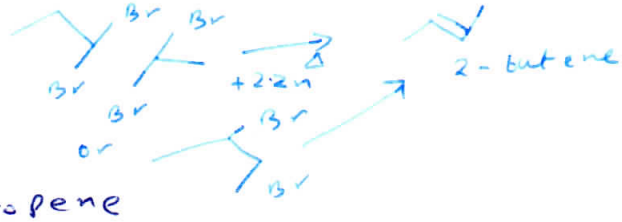
gem

$\xrightarrow[\text{or NaI in Acetone}]{Zn\ dust,\ \Delta\ 220°-310°C}$ $CH_3-CH=CH_2 + ZnBr_2$ + IBr + NaBr



vic

Eg



2-butene

(B) From Alcohols

(i) Dehydration

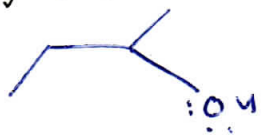


$\xrightarrow{\Delta}$ $H-HSO_4$, $H-H_2PO_4$ } conc. → propene

Eg:-



(ii) Vapour Phase



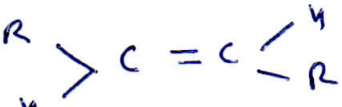
$\xrightarrow[P_2O_5]{Al_2O_3\ (Alumina)}$ $\xrightarrow[WO_3]{ThO_2\ (Thoria)}$ $+H_2$

Saytzeff product MAJOR

or

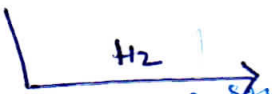
Hoffmann product MAJOR

(C) Reduction of Alkynes

(iii) $R-C\equiv C-R \xrightarrow[\text{in liq } NH_3]{Li,\ Na}$ 

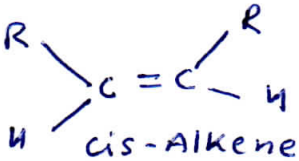
trans-Alkene

(iv)



$\xrightarrow[Pd/C]{H_2}$ Lindlar's catalyst / P-2 catalyst

or $\xrightarrow{Ni-B}$



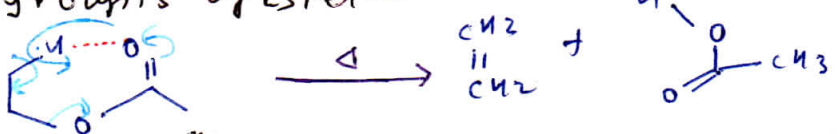
cis-Alkene 98%

(v) Hydroboration:

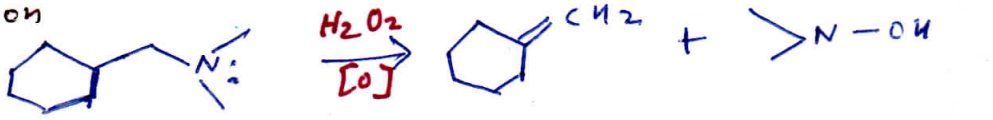
$\xrightarrow{B_2H_6}$ $(-CH=CH-)_3B \xrightarrow{H^+} -CH=CH-$

(D) Other Methods

(vi) Pyrolysis of Ester



(vii) Cope Elimination



ALKYNE(≡)

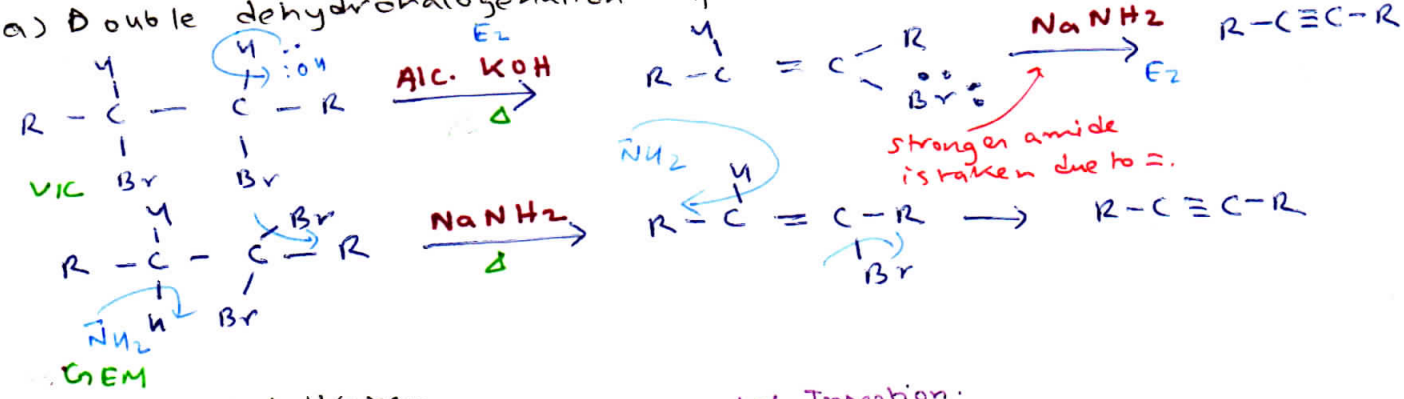
Leaving Group → strong $NO_2 < CN < F < Cl < Br < I$ ← Poor

$+I \rightarrow CH_2 > -NH > O^- > COO^- > 3^\circ > 2^\circ > 1^\circ > D > H$

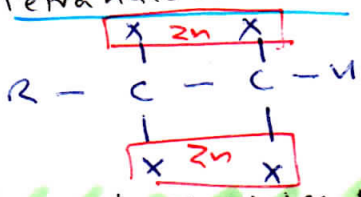
II) Methods of PREPARATION :—

1) From Halides

a) Double dehydrohalogenation of Gem & Vic dihalides.



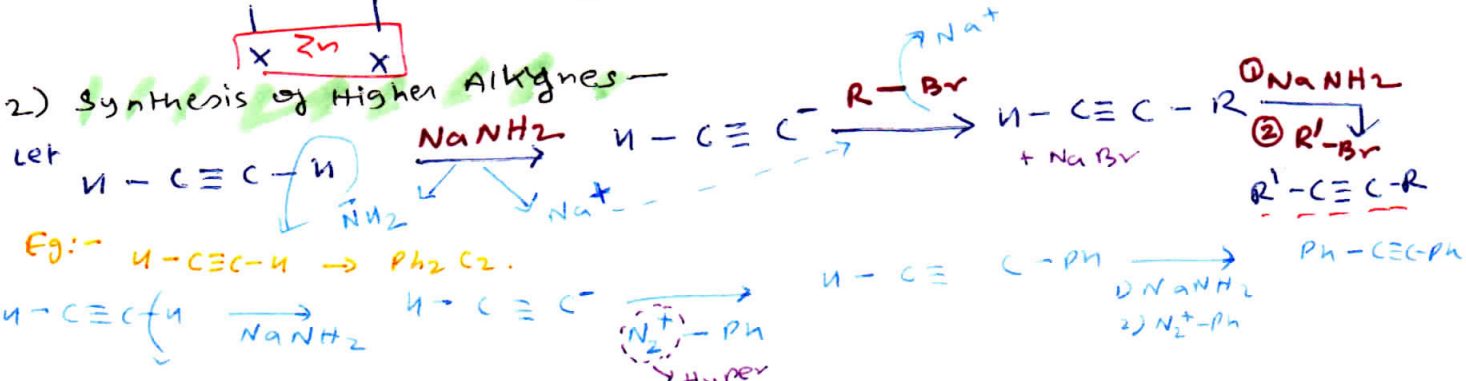
b) Tetrahaloalkanes.



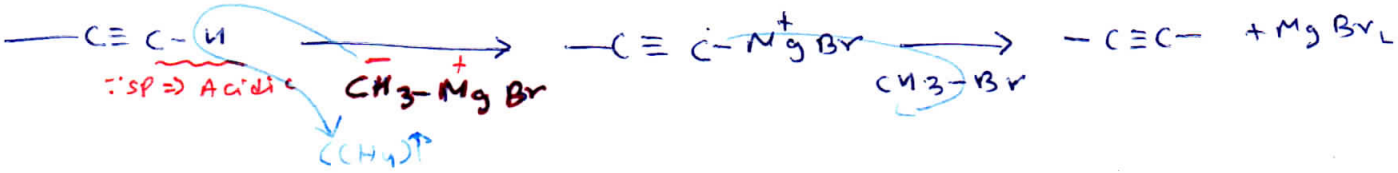
Metal Insertion.

$R-C\equiv C-H + 2ZnX_2$

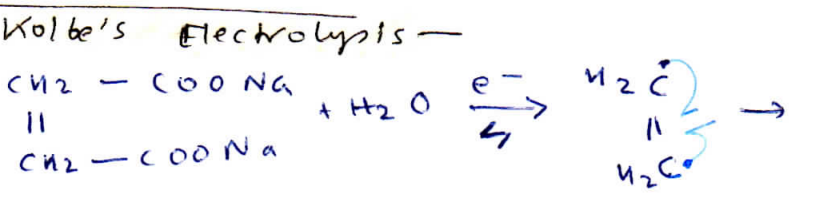
2) Synthesis of Higher Alkynes —



3) From Grignard Reagent :—



4) Kolbe's Electrolysis —



(5) From Carbides —



6) From Rxn of Chloroform & Silver.



Ammoniacal $AgNO_3$ or $[Ag(NH_3)_2]OH$ (Tollen's Reagent)

$H-C\equiv C-H$

Distinguish b/w Alkene & Alkyne.

$Ag^+ C^- \equiv C^- Ag^+ \downarrow$ White ppt.

Disilver Acetylide.

$CuCl_2 + NH_4OH$

$Cu^+ C^- \equiv C^- Cu \downarrow$ Red ppt.

Dicopper Acetylide.

HALO - ALKANES - ARENES.

①

Reactivity	1°	2°	3°
–Cl	1	3.8x	5x
–Br	1	81x	1600x

I) Methods of Preparation:—

1) Direct halogenation of Alkenes

a) $R-H + F_2 \xrightarrow{h\nu} C + HF$ (very explosive)

$\xrightarrow[(dark)]{Ni-} R-F + HF$ (Agressive)

Replaces all hydrogen

b) $R-H + Cl_2 \xrightarrow{h\nu} R-Cl + HCl$ → 3° Best

c) $R-H + Br_2 \xrightarrow{h\nu} R-Br + HBr$ (controlled, selective)

d) $R-H + I_2 \rightleftharpoons R-I + HI$ (Endo, Rev)

$R-H + I_2 \xrightarrow[HgO]{} R-I + \boxed{2HI + HgO} \longrightarrow HgI_2 + H_2O$

also HNO_3, HIO_3

$+ CrO_3 + H^+$
↓
H_2CrO_4 oxidises.
converts
1°ol → aldehyde
2°ol → C=O Ketone.

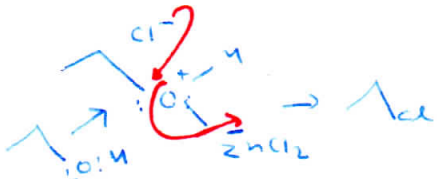
Alternate for –Cl —

$\text{C}_6\text{H}_5\text{-H} + SO_2Cl_2 \xrightarrow[\text{or } R-O-O-R]{h\nu} \text{C}_6\text{H}_5\text{-Cl} + SO_2 + HCl$

(or SC_2Br_2)

2) Groove's Method

$R-OH + \boxed{HCl + ZnCl_2 \text{ Anhyd}} \longrightarrow R-Cl + H_2O$ Lucas Reagent.



3) With PCl_5

$R-OH + PCl_5 \longrightarrow R-Cl + POCl_3 + HCl.$



4) with PX_3.

$3R-OH + PX_3 \longrightarrow 3R-X + H_3PO_3.$

Reactn $HI > HBr > HCl$

5) Darzen's Procedure—

$R-OH + SOCl_2 \xrightarrow[\text{DBN or DBU or Quinoclinidine}]{\text{Pyridine}} R-Cl + SO_2\uparrow + HCl\uparrow$

thionyl chloride

6) with NaBr.

$R-OH + NaBr \xrightarrow[H_2SO_4]{} R-Br + H_2O$

7) Hunsdiecker's Reaction— (only Alkyl Bromides) 1° > 2° > 3°

$R-COO^-Ag^+ + Br_2 \xrightarrow[CCl_4]{CH_2Cl_2 \text{ or}} R-Br + AgBr + CO_2\uparrow$

(l)

* Birnbaum-Simonini: $2\,R-COOAg + I_2 \xrightarrow{CCl_4} R-\overset{O}{\overset{\|}{C}}-OR + CO_2\uparrow + 2AgI$ (2 : 1)

gives Ester

8) Finkelstein Rxn —

$R-Cl\ (R-Br) + NaI \xrightarrow[\text{or DMSO/DMF}]{\text{Acetone}} R-I + NaCl\ (+NaBr)$

or KI

→ PP-in Acetone

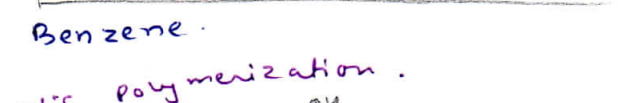
9) Swartz Rxn — $R-Br + AgF \longrightarrow R-F + AgBr$

(Controlled)

AROMATIC

I) Methods of PREPARATIONS.

NOTE

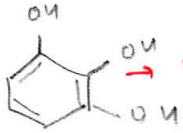


1) From Acetylene —

$HC \equiv CH$ —(Cu tube, 600°C)→ Benzene.

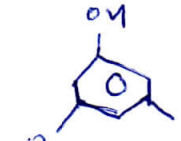
or Red HOT Fe tube, 1773K - 2273K

cyclic polymerization.



→ Pyrogallol

2) From Alcohol —

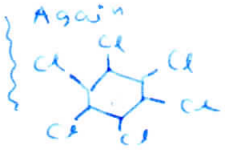


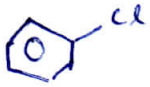
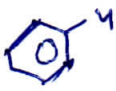
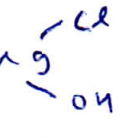
Phloroglucinol —(Zn/Δ, 200-300°C)→  + 3 ZnO

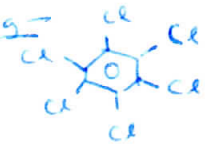
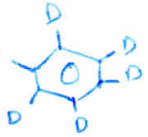
Raney Nickel ↓ Ni-Al alloy in NaOH

3) From Halobenzene.

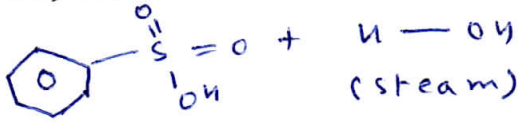
(a)  —(Raney-Nickel)→  + HCl

Again  —(Raney-Ni, 25°C)→  + 6 HCl

(b)  —(Mg powder, (Ether) Δ)→  —(H_2O)→  + 

Eg →  —(① Mg / DEA ② D-O-D (excess))→  Hexadeutro Benzene.

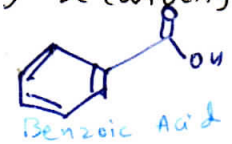
4) Desulphonation.



Benzenesulphonic Acid —(423-973K, (H-Cl), High press)→  + H_2SO_4

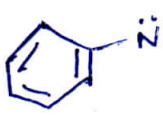
rate ∝ stability of carbocation

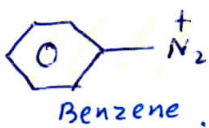
5) Decarboxylation



Benzoic Acid —($NaOH$, CaO, Δ)→  + Na_2CO_3 + H_2O

6) From Aniline —



+ HNO_2 (Nitrous Acid) —(0-5°C, under ice)→ 

Benzene Diazonium chloride —(H_2O, or Δ; $Sn + NaOH$, [H])→  + $N_2\uparrow$

$NaNO_2 + H-Cl \xrightarrow[\text{cold } 0\text{-}5^\circ C]{} NaCl + HNO_2$ (or $Sn-Cl_2$)

7) Aromatization —



n-Hexane —(Cr_2O_3 / V_2O_5 / Mo_2O_3, 773K, 10-30 atm)→  + $4H_2\uparrow$

Benzene

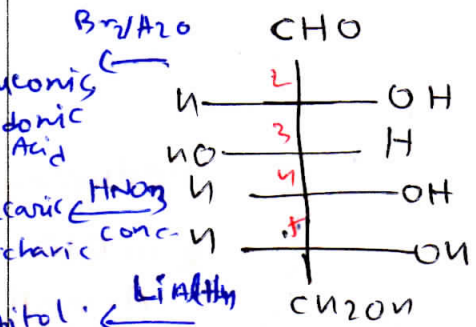
Eg:-  n-Octane →  stable product (Less dipole)

BIOMOLECULES-STRUCTURE PRACTICE SuCh

T = 5 min

Rhamnose → $C_6H_{12}O_5$

D-(+) Glucose



Br/H2O → Gluconic Aldonic Acid

Glucaric / Saccharic ← HNO3 conc.

Sorbitol ← LiAlH4

Aldohexose

Glucopyranose

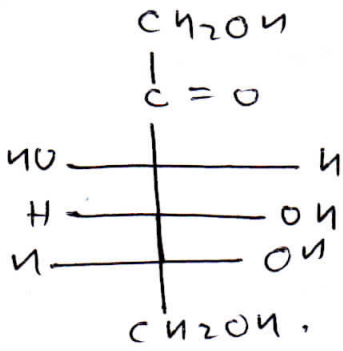
Basic medium ↓ exist as

Cy ✓

FV

ML

D-(-) Fructose

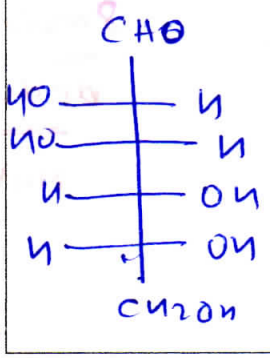


← found in fruits, honey, ketohexose

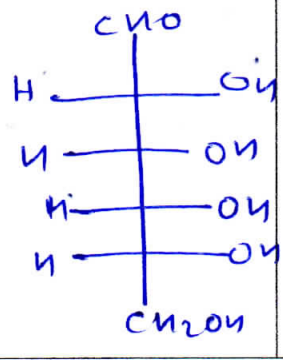
Fructofuranose

Epimers: MACI

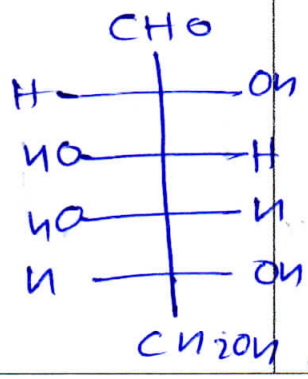
C2, D-Mannose



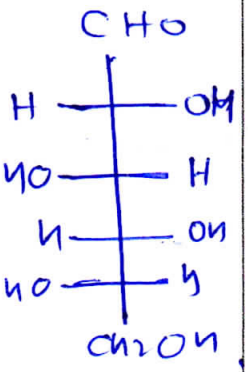
C3, D-Allose



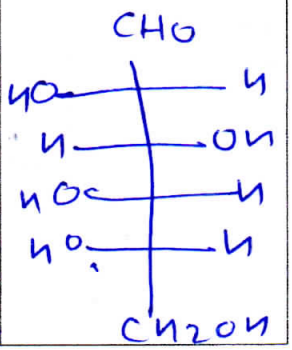
C4 D Galactose



C5 - L Idose



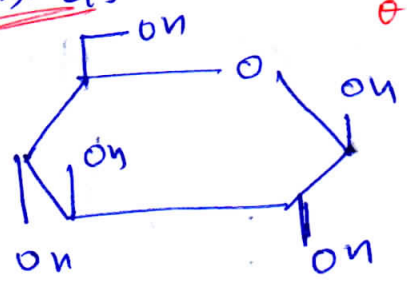
All int. L(-) Gluc



Cyclic Structures:

Anomers

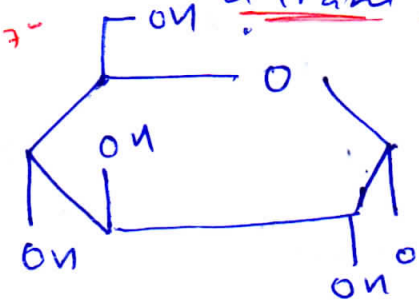
β-cis



θ = 19°

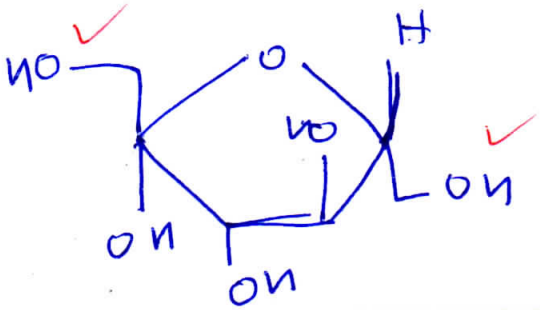
θeq = 52,7°

α trans

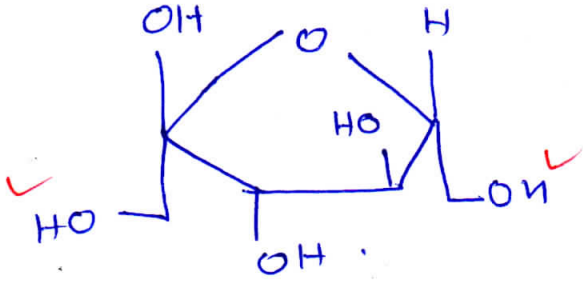


θ = 111°

Fructose β trans



α cis. (Stable, H bonds)



Inulin $(C_6H_{10}O_5)_n$ $\xrightarrow{H^+}$ $C_6H_{12}O_6$ fructose

Notes:~

Glucose

→ T, F, B → +ve

→ 2,4 DNP, Schiff Test → −ve

← 5 OH, Acetylation

(conc. Glucose Soln) | 303K. cryst. → α

371K cryst. (saturated, hot) → β

All aldoses are reducing sugars

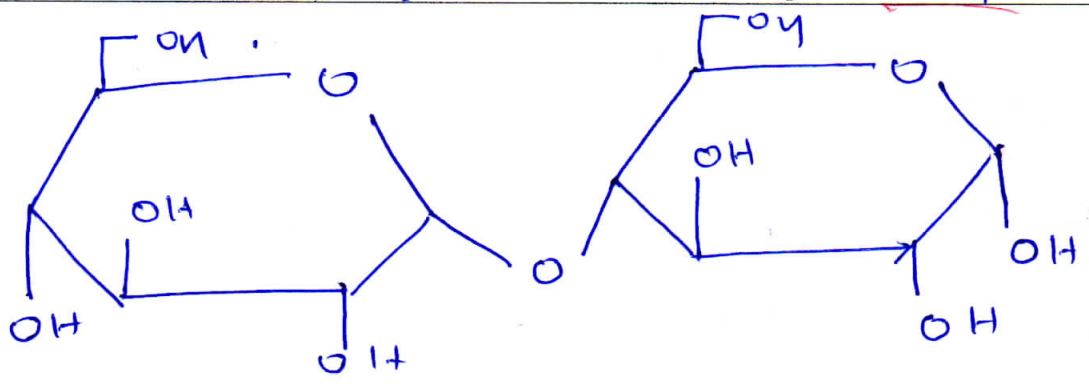
- show mutarotation
- silver mirror

BIOMOLECULES-STRUCTURE PRACTICE_____ SuCh

DI-SACCHARIDES

(α+α) D-Glucose.

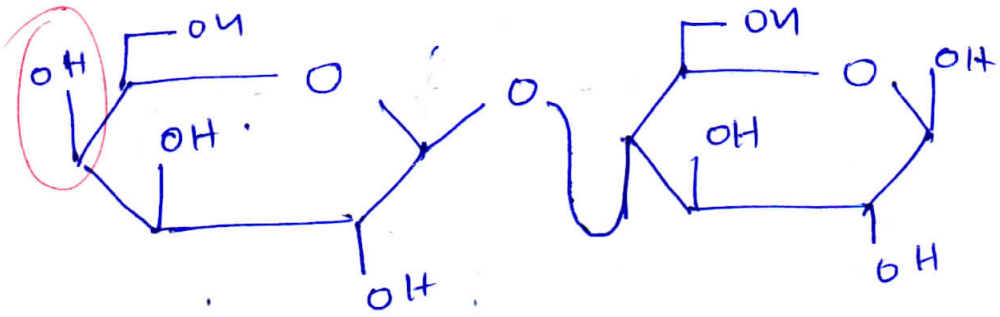
A) Maltose, Grapesugar — Linkage= C1C4 – α, Glycosidic Linkage



Reducing
8 moles
Acylation
Muta

B) Lactose, β-D galactose + β-D Glucose — Linkage= C1C4, β Linkage

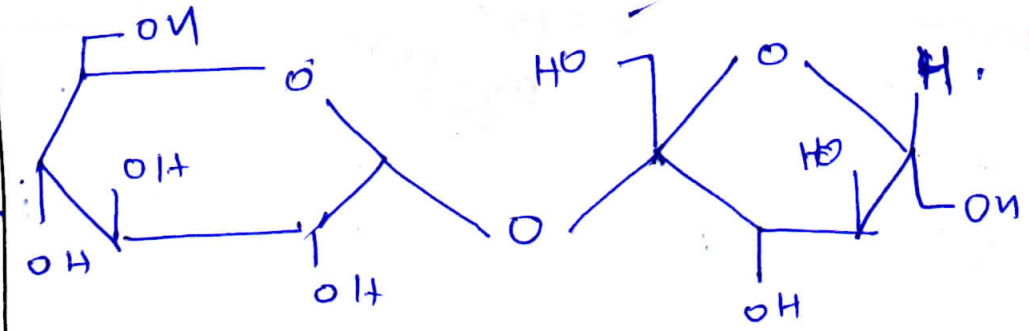
Milk Sugar



8 moles
Reducing
Muta

C) Sucrose, α-D Gluco + β-D Fructo — Linkage= C1 – C2, α Linkage

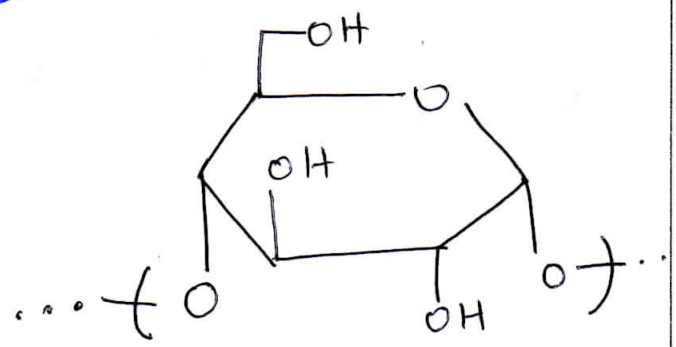
- Invert sugar
- Cane sugar
- Nomuta
- Dextro [α] = 66°
- $C_{12}H_{22}O_{11}$



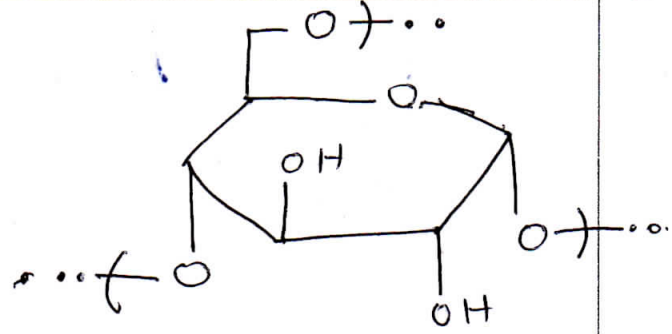
NON REDUCING SUGAR, T, F, B + X
NO

#Starch — Made of α, α D-Glucose. → insoluble in H_2O. Branched.

1) Amylose — Linkage= C1C4 — Linear



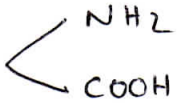
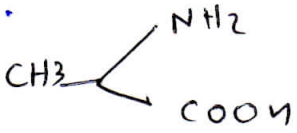
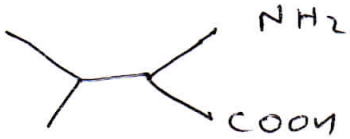
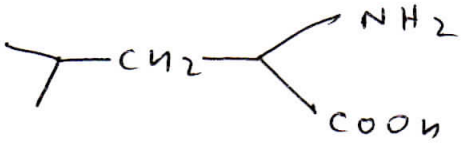
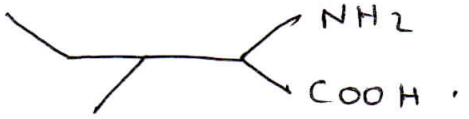
2) Amylopectin — Linkage= C1C4, C1 – C6

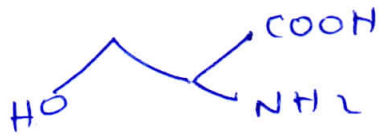
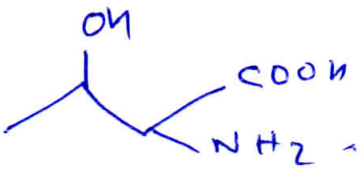
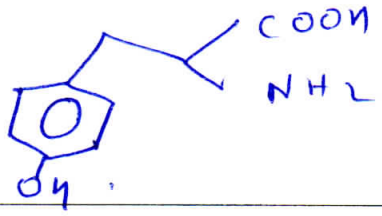
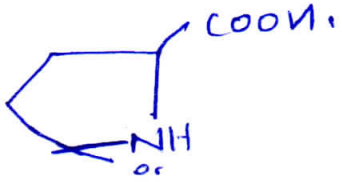
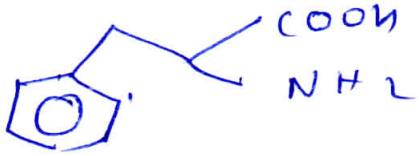
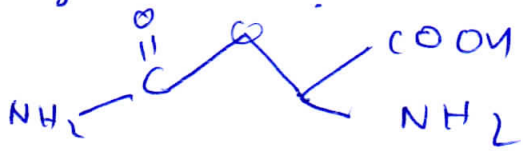
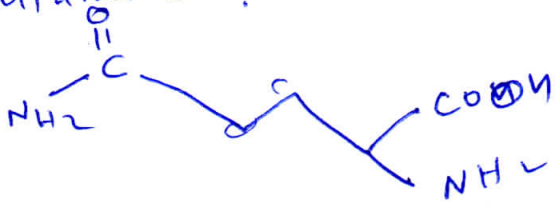


Cellulose — β- D(+) → Polysacc., Non reducing.
Glycogen — α- D(+) Glucose, Amino

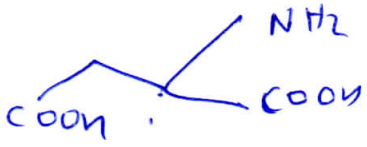
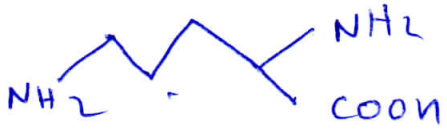
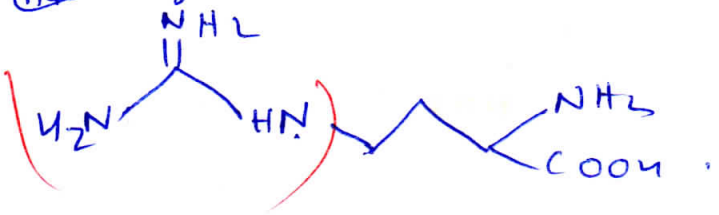
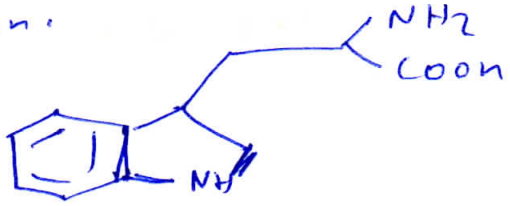
BIOMOLECULES-STRUCTURE PRACTICE SuCh

PROTEINS → colourless crystalline at Room Temp.
20 Amino Acids

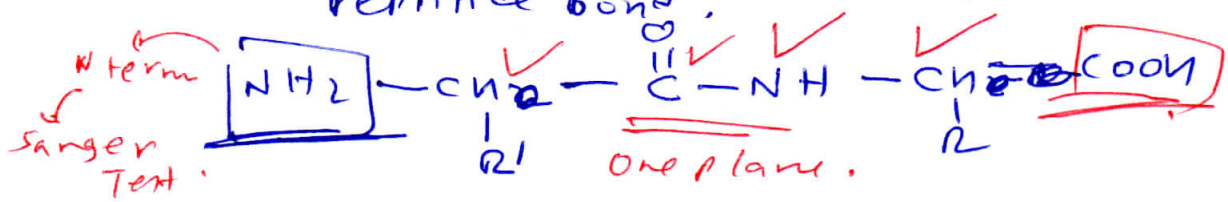
Sl No.	Name/Structure	Speciality
1. Gly	Glycine. 	Optically inactive.
2. ~~Leu~~ Ala	~~Leucine~~ Alanine. 	↓ Homologous
3. Val	Valine. 	
4. Leu	Leucine. 	
5. Ile	Isoleucine. 	
6. Met	methionine. 	↓ sulphur.
7.	Cysteine. 	

8. Ser	Serine 	– Alcohol
9. Thr	Threonine 	cont.
10 Tyr	Tyrosine 	Phenol. +ve fects
11. Pro	Proline 	2° Amino Acid ↓ Produce kink.
12 Phe	Phenyl Alanine 	Benzene ✓
13. Asn	Asparagine 	Amide
14. Gln	Glutamine 	

BIOMOLECULES-STRUCTURE PRACTICE_____ SuCh

Acidic 15. Asp	Aspartic Acid 	Acids.
Glu 16.	Glutamin Acid 	
Basic 17. Lys.	Lysine 	
18 Arg	~~His~~ Arginine 	Basic. Guanidine
B. His	Histidine 	
20.	Tryptophan. 	

Peptide bond.



BIOMOLECULES-STRUCTURE PRACTICE_____ SuCh

1) Acidic Aspartic Acid, Glutamic Acid.
2) Basic Arginine, Lysine, Histidine (✓)
3) Neutral Rest

Essential:

PVT TIM HALL

P- Phenyl Alanine
V - Valine
T - Threonine.
T - Tryptophan.

I - Isoleucine
M - Methionine
H - Histidine.
A - Arginine

L - Leucine
L - Lysine.

DNA , RNA

A = T
G ≡ C

A = U
G ≡ C .

Bases

Adenine $-NH_2$ } Purine (1', 3', 5') 2 ring on

Guanine $>C=O$ $+NH_2$

Thymine, Uracil, Cytosine → Pyrimidine. (1', 3', 5', 2') on.

All → 1 Ring.

Thymine: $1\times CH_3$, $2\times C=O$

Uracil: $2\times C=O$

Cytosine: $1\times CH_3$, $1\times C=O$.

Base + Sugar @ 1', 3' → Nucleoside + Phosphoric Acid @ 5'

Joined by Phosphodiester linkages. Total Nucleotide.

DNA —Replication→ DNA

DNA —transcription→ RNA —Translation→ Protein.

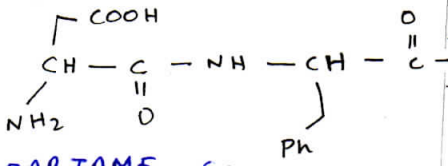
Fibrous Protein – Keratin (Hair), Myosin (Muscle).

Globular Protein – Albumin, Insulin } water soluble.

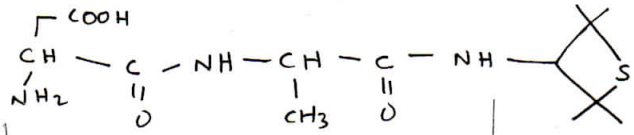
#CIEL

10/04/2022

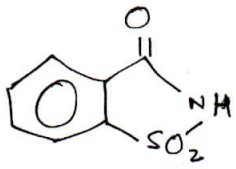
1) Sweetners



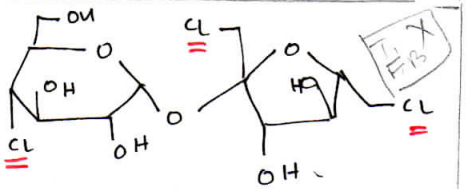
ASPARTAME - (Asp + Phe)



ALITAME - (Asp + Ala +)



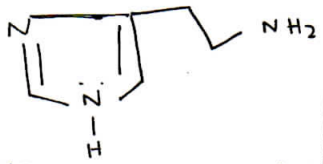
SACCHARIN



SUCRALOSE (from sucrose (α-DG + β-DF))

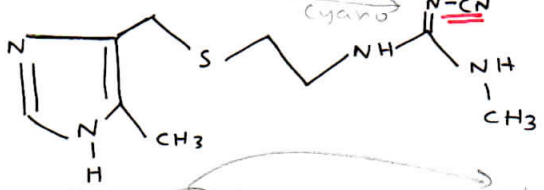
2) Antacids

Histamine stimulates pepsin + HCL

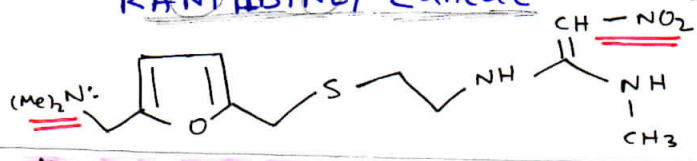


(Potent Vasodilator)

CIMETIDINE (Tegamet)

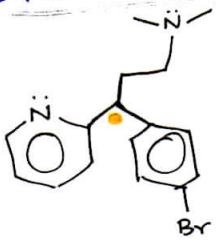


RANITIDINE / Zantac

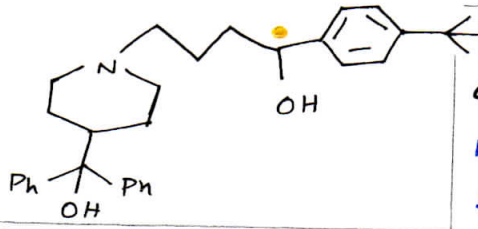


3) Anti-Histamine (cold, Allergy)

BRO-MPHENIRAMINE (Dimetapp) Dimetane



TERFENADINE (seldane)



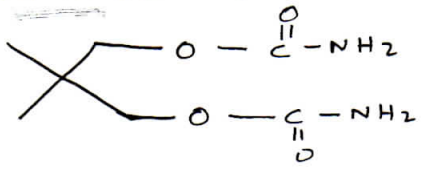
4) NEURO-ACTIV-DRUGS

a) Tranquilizers - Stress, mental, anxiety

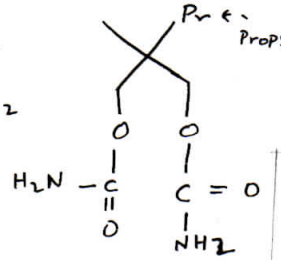
Noradrenaline - Neurotransmitter → Mood changes → Depression.

∴ Antidepressants like ↓

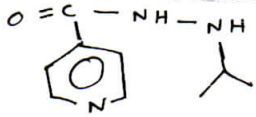
EQUANIL → hypertension



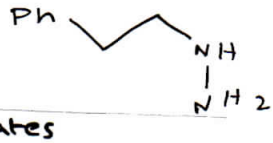
MEPROBAMATE



IPRONIAZID

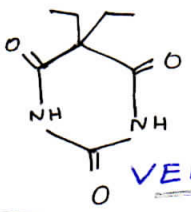


PHENELZINE / NARDIL



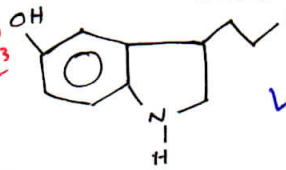
CHLORDIAZEPOXIDE also

* Hypnotic / Barbibutarates



VERONAL

SEROTONIN

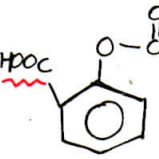


also VALIUM (3-rings)

b) Analgesic → Painkillers.

* Non-Narcotic

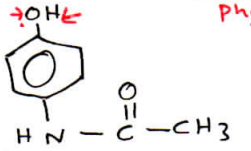
(• Antipyretic • Anti Arthritis • Anti-Heart Attack)



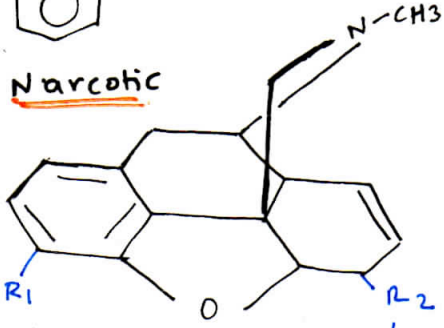
ASPIRIN

methyl-salycylic Acid

PARACETAMOL (phenol)



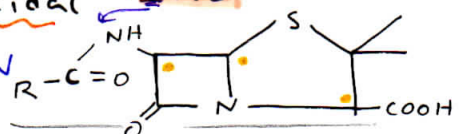
* Narcotic



5) Anti Biotics

(a) Bactericidal → PAO

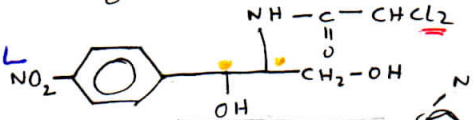
PENICILLIN (3 C.C)



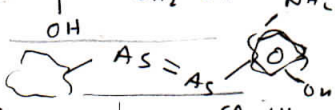
(b) Bacteriostatic → ETC

CHLORAMPHENICOL

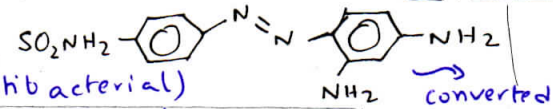
typhoid, dysentry, meningitis, pneumonia.



SALVARSAN / ARSPHENAMINE → Syphilis.



PROTOSIL



1st (Antibacterial)

converted

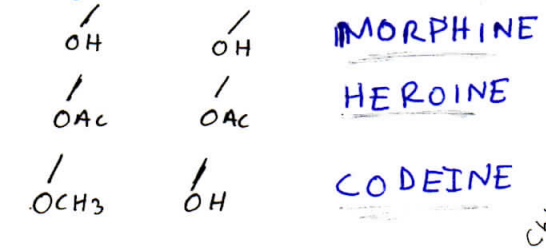
SULPHANILAMIDE

POPPY.

MORPHINE

HEROINE

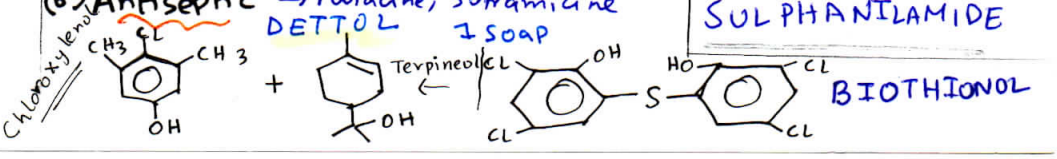
CODEINE



(6) Antiseptic → Furacine, Soframicine

DETTOL

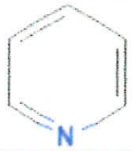
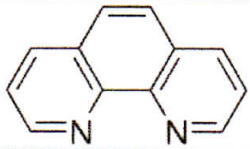
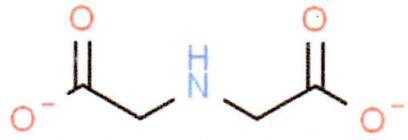
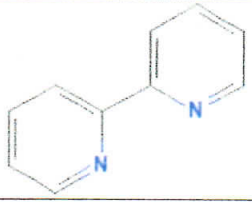
I SOAP



BIOTHIONOL

Coordination Compounds LIGANDS

Sumata Chattopadhyay

Denticity	Symbol	Name	Structure
1(Mono)	-	X^-, OH^-, NO_2^-, SCN^-, H_2O, CO, NO, CO_3^{2-}, py(pyridine)	
2(Bi/Di)	ophen	Ortho-phenanthrolene	
3(Tri)	$imda^{2-}$	iminodiacetato	
2	dipy	dipyridyl	

Note, (NH–C(=O)–CH3) (O–C(=O)–CH3) show +M

MKA
Nu: attack where more, d H/

Cis Anti Threo ≠0
Trans Anti Erythro ≠0
(Fischer)

More stable carbocation:
Cis B Syn Erythro ≠0
Trans E Syn Threo ≠0
1° > 2° > 3° > CH3+
(MKA)
Anti

Allene
a–c=c=c–b
O. Active

* An alkyne is an isomer with Alkadiene, as DOU = 2 (both).
DBE = 1 + Σni(Vi − 2)/2
DBE → 1 DBE = 1 → 1 Ring = 2

Bredt's Rule → cannot be Bridge-head sp2 X

E–Z
Nucleophilicity → more → unstable
W.A → unstable
E → Energy ↑
Eg CH3O− ↑ Most Nucl

R–S
Name Enantiom.
Start
Right (R)
Left (S)
2S,3R

CCl_3
↓
meta directing

Deactivating
X / N=O / S=O / –CH=CH–CHO
rate = −I (slow) – CH=CH–COOH
Direc = +M (o,p)

SN1
T.S = 1 + intermed

39 Wurtz (1,2) X

Blood red complex
$Fe^{+3} + 3KSCN \rightarrow Fe(SCN)_3 + 3K^+$
or
$[Fe(H_2O)_5(SCN)]^{2+}$

Metal ion	reagents used
Co^{+2}	α-nitroso β-naphthol
Al^{3+}	8-hydroxy quinoline
Fe^{3+}	$(H_2O)_2$ ophen
Ni^{2+}	DMG
Cu^{2+}	Benzoin oxime

METALLURGY - 1

Nitrate → water soluble, No ~~ore~~ Mineral.

Ore — Mineral

All +3 oxides Eg: Al_2O_3.
↙
oxide + hydroxide ore

$CuFeS_2 = Cu_2S + FeS + FeS_2$

ref S_2^{2-}

A) OXIDE ORES

1) ZnO = Zincite
2) $ZnSiO_3$ = Willemite
4) $ZnSiO_3, ZnO \cdot H_2O$ = Electric Calamine
5) $Fe_3O_4 = FeO \cdot Fe_2O_3$ = Magnetite
6) Fe_2O_3 = Haematite
7) $Fe_2O_3 \cdot 3H_2O$ = Limonite
8) $FeO \cdot TiO_2$ = Ilmenite
9) $FeCr_2O_4$ = Chromite
10) Al_2O_3 = corundum
11) $Al_2O_3 \cdot H_2O$ = Diaspore
12) $Al_2O_3, 2H_2O$ = Bauxite (Both oxide & Hydroxide ore)
13) $Al_2O_3 \cdot 3H_2O$ = Gibbesite
14) SnO_2 = Tinstone/Cassiterite
15) TiO_2 = Rutile
16) MnO_2 = Pyrolusite
17) $CaWO_4$ = Sheelite
18) $(Fe,Mn)WO_4$ = Wolframite
19) $Ca_2B_6O_{11} \cdot 5H_2O$ = Colemanite (Ferro)
20) $Na_2B_4O_7 \cdot 10H_2O$ = Borax/Tincal
21) Cu_2O = Cuprite/Ruby copper
22) U_3O_8 = Pitch Blende.

B) CARBONATE ORES

1) Green $Cu(OH)_2 \cdot CuCO_3$ = Malachite
2) Blue $Cu(OH)_2 \cdot 2CuCO_3$ = Azurite
3) $CaCO_3$ = Limestone
4) $MgCO_3$ = Magnesite
5) $CaCO_3 \cdot MgCO_3 = CaMg(CO_3)_2$ = Dolomite
6) $FeCO_3$ = Siderite
7) $ZnCO_3$ = Calamine
8) $PbCO_3$ = Cerussite.

$Fe^{3+}[Fe^{2+}(CN)_6]^{1-}$
Prussian Blue

C) SULPHIDE ORES

1) PbS - Galena
2) Cu_2S - Chalcocite
3) FeS_2 - Fool's Gold or Iron Pyrite
4) $CuFeS_2$ - Chalcopyrite
5) Ag_2S - Argentite, Peacock ore, Silver Glance
6) HgS - Cinnabar
7) ZnS - Zinc Blende, sphalerite.

D) SULPHATE ORES

1) $CaSO_4 \cdot 2H_2O$ = Gypsum
2) $K_2SO_4 \cdot MgSO_4 \cdot MgCl_2 \cdot 6H_2O$ = Kainite
3) $PbO \cdot PbSO_4$ = Lankerite
4) $Na_2SO_4 \cdot 10H_2O$ = Glauber's salt
5) $MgSO_4 \cdot 7H_2O$ - Epsom salt.
6) $MgSO_4 \cdot H_2O$ - Kieserite
7) $PbSO_4$ - Anglesite
8) $BaSO_4$ - Baryte.

E) HALIDE ORE

1) Na_3AlF_6 = Cryolite
2) CaF_2 = Fluorspar
3) $NaCl$ = Rock Salt
4) KCl = Sylvite/silvine
5) $KCl + NaCl$ = Sylvinite
6) $AgCl$ = Horn silver
7) $KCl \cdot MgCl_2 \cdot 6H_2O$ = Carnallite
8) $Cu_2Cl(OH)_3$ = Atacamite.

F) NITRATE ORES

1) KNO_3 - Indian salt Peter
2) $NaNO_3$ - Chile salt Peter

$Fe^{2+}[Fe^{3+}(CN)_6]^{3-}$
Turnbull's Blue

* MISCELLANEOUS NAMES (NOTORE!!)

1) $Ca(NO_3)_2$ - Norwegian salt peter
2) Lapis-Lazuli - Alumino silicate.
3) $KAlSi_3O_8$ Microline
4) Beryl - Alumino silicate with Be^{2+}, Cr^{2+}
5) SiO_2 - Silica.
6) (Fe+Mn+C) Alloy - spiegeleisen
7) [illegible]
8) $Cu_2S + Fe_2S + SO_2$
98% 2%
- Copper Matte.
$Cu_2S + Cu_2O \rightarrow 6Cu + SO_2\uparrow$
- Blister copper.
9) SnO_2 60-70%. Black Tin
10) Impure ZnS, Spelter zinc
11) Thomas slag - $Ca_3(PO_4)_2$
12) Iron slag $FeSiO_3$
13) Calcium slag $CaSiO_3$
14) Apatite Family.
[illegible]
$X = F, Cl, OH$.
$3Ca_3(PO_4)_2 \cdot CaX_2$

PULVERISATION →
Crushing & Grinding

1) CONCENTRATION / DRESSING / BENEFECATION (– Gangue)

A) PHYSICAL PROCESS

(i) Gravity separation / Levigation / Hydraulic washing.

Used – Fe_2O_3, SnO_2, $FeCr_2O_4$

Principle – Ore Heavy, diff in density

"WILFREY TABLE"

(ii) Magnetic separation

Principle – When ore is M, impurity NM vice versa (wolframite)

Impurity M – (Fe, Mn) WO_4, NM – SiO_2

Ore NM – SnO_2 M – Fe_2O_3, $FeCr_2O_4$, MnO_2,

(iii) Froth Floatation.

Used – Sulphide Ore (HgS, PbS,) Ag_2S)

Principle – Adsorbtion, like dissolve like, Differential Wet Ability.

Xanthate – collector (high PP → Non Polar)

Pine oil – Frother, Collector

Cresol, Aniline – Froth stabilizer, S.Tension ↓

NaCN – Depressant (for PbS)

$CuSO_4$ – Activator (for ZnS).

B) CHEMICAL PROCESS (LEACHING)

(i) Bayer's Process.

• Red Bauxite (Fe_2O_3 imp),

Al_2O_3 (+ Fe_2O_3) $\xrightarrow[\Delta]{NaOH}$ $NaAlO_2$ (aq) + $Fe_2O_3\downarrow$

Fe_2O_3 – for solubility

$NaAlO_2$ (aq) $\xrightarrow[\text{seeding, low T}]{CO_2}$ $Al(OH)_3\downarrow$ $\xrightarrow{\Delta}$ Al_2O_3 (impure)

(ii) Cyanide / Mc Arthur Forrest Process.

M = Ag, Au (Ag_2S)

NaCN + O_2 = Leaching / complexing Agent

Zn Powder – Anti " / Reducing Agent.

Ag_2S + NaCN $\xrightarrow{O_2}$ $Na^+[Ag(CN)_2]^-$ + SO_4^{2-}, S↓

$Ag\downarrow$ + $Na_2[Zn(CN)_4]^{2-}$ $\xleftarrow{Zn}$

O_2 used due to low K_{sp} of Ag_2S.

#

1) S-Block + Al – Electrolytic Reduction

2) Ag, Au, Pt + Low grade Cu – Reduction in water

3) Rest – Pyrometallurgy.

(Mn, Zn ... Fe, Cu, Hg)

NOTE $Ag_2S \xrightarrow[O_2]{\Delta} Ag_2O$ unstable NOT ROASTED.

2) OXIDATION OF ORE (Heating done below m.p)

Reverbatory Furnace → Roasting

Rotatory Kiln → Calcination.

Roasting

- Excess of air
- Sulphide ore
- Exothermic
- SO_2, As_2O_3, Sb_2O_3
- Oxidation
- Sintering – Batter of powdered ore after roasting.
- Refractory – Heat Absorb (SiO_2, MgO, CaO)
- Smelting – Slag formation, Carbon reduction

Calcination.

- Absence of air
- Carbonates, Hydroxides, oxysalt.
- Endothermic
- H_2O, CO_2, (S, As, Sb).
- Decomposition

Partial Roasting

(a) selective Oxd.

$CuFeS_2$ + Lim O_2 $\xrightarrow{\Delta}$ Cu_2S + FeS + FeS_2

(b) Self Reduction.

PbS + PbO → Pb + $SO_2\uparrow$

Cu_2S + CuO → Cu + $SO_2\uparrow$

Slag

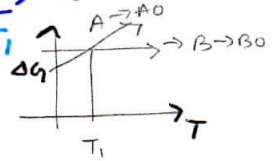
- immisible, lendenser
- lower mp. • thermally stable.

(Imp) + Flux → ~~Gangue~~ Slag

Read Reduction of Iron, Metallurgy from NOTES, Also MS.

* ELLINGHAM DIAGRAM

$A + BO \underset{>T_1}{\overset{<T_1}{\rightleftharpoons}} B + AO$



$\Delta G = (-T)\Delta S + \Delta H$

যত নিচে, তত ভালো 'O' Affinity বেশি। তাহলে নিচের টা উপরের টা কে Redn করতে পারবে।

(i) Electrolytic Reduction

O_2 → Anode → CO/CO_2 (coke, CO')

• 6 Na, K, S-Block ..

* Hall – Heroult's Process (Al)

Na_3AlF_6 (85%) Al_2O_3 (10%) CaF_2 (5%)

- Conductivity ↑
- Working Temp ↓
- Solvent

Now we Li_2CO_3

- Working Temp ↓
- High LE (req) • High Ea (for C)

(ii) Carbon – Reduction.

Fe, Zn, Sn ← Anthracite coal ($CO + N_2 + O_2$)

(iii) Self Redn.

Cu ← Bessemerization

← Partial Roasting / Hg

Pb ← Self Reduction.

(iv) Alumino Thermite (Goldschmidt).

Mn, Cr | MnO_2 (3:1) $\xrightarrow{\Delta}$ Mn_3O_4 + Al → Al_2O_3 + Mn(l)

ignite – KO_2/BaO_2, Mg ribbon

3) REDUCTION OF ORE

(v) By Hydrogen – Mo, W

(vi) Thermal Decomposition.

$H_2O \rightleftharpoons H_2 + O_2$

METALLURGY - ②

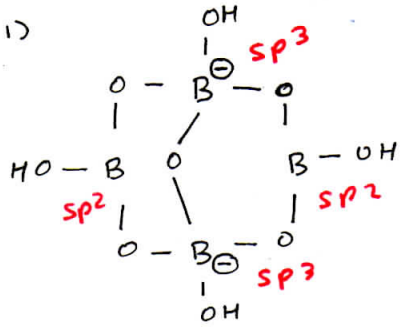
30/12/2021

4) REFINING OF ORES

PROCESS	METALS	CONCEPT
i) Electrorefining	→ Molten state: S-Block + Al → Aq. Medium (Rest except Fe, Zn, Au, Ag ✗ Hg, Al)	For Zn → Cathode = Al For Pb → Electrolyte = $PbSiF_6$ + H_2SiF_6 + Gelatin Anode – Impure Metal Thick Anode Mud – Ag, Au, Gangue, etc. Electrolyte – Metal salt + (H_2SO_4) it's Acid Cathode Pure strip. Zn^{2+}, Fe^{2+} oxidise
ii) Distillation	Zn, Cd, Hg (∵ d-d metal bonding ✗ Weak Attr, $d^{10}s^2$)	BP of pure metal < BP of impurity. Metal → gaseous form↑.
iii) Liquation / Sweating impure metal heated on sloped surface.	Sn, Pb, Bi Heavy p-Block Metal M–M bonding weak.	MP of pure metal < Impurity.
iv) Zone-Refining Use – Ring heater. obtain ultra-pure metal • semiconductors.	Si, B, Ga, Ge, As, In.	• Impurities more soluble in molten state wrt solid state • Fractional Crystallization.
v) Vapour-phase refining. (volatile thermally unstable intermediate).	$Ni_{(impure)} + CO \xrightarrow{40-50^\circ C} Ni(CO)_4\uparrow$ $Ni(CO)_{4(g)} \xrightarrow{200-220^\circ C} Ni_{(s)} + CO_{(g)}\uparrow$	• Impure Metal + Reagent $\xrightarrow{T_1}$ (M+R)↑ (no volatile thermally unstable) (M+R) $\xrightarrow{T_2 > T_1}$ M + R↑.
(a) Mond's Procem → Ni	$M + I_2 \xrightarrow{400K} MI_x + imp$ $MI_x \xrightarrow[\text{tungsten}]{1400K} M_{pure} + I_2$	
(b) Van-Arkel Procem → Ti, Zr, Hf, B x=4 x=3		
vi) Cupellation. in cupel.	(Ag >>> Pb) $Ag + Pb \xrightarrow[O_2]{\Delta} Ag + PbO\uparrow$	• Oxidative Refining • Impurity has more Affinity for oxygen.
vii) Parke's Procem. Desilverisation of Argentiferous Lead →	(Pb >>> Ag) $(Pb-Ag)_{(l)} + Zn_{(l)} \downarrow$ $(Zn-Ag)_{(s)} + Pb_{(l)}\downarrow$ $\xrightarrow{dist.} Ag + ZnO\uparrow$	• Almost same size (Zn-Ag, Ag-Pb) form alloy • Distribution Law, Partition Coeff.
viii) Pattison's Procem.	(Pb >>> Ag)	• Fractional crystallisation
ix) Amalgamation.	Ag, Au. (in stream of Hg).	• Difference in density.
x) Polling Use of fresh green Bamboo बाँस	Blister Copper (Cu) Sn, Pb	• where ore has its own oxide impurity $MO_x + CO + C_xH_y \rightarrow Metal + CO_2$. • use of volatile Reducing Agent

Metal	Main Ore	Concentration	Reduction	Refining
Au	Alluvium, Anode Mud	MacArthur Cyanide Procen ($NaCN + O_2$, Zn)	—	1) Amalgamation 2) Electrorefining [$AuCl_3$, $HAuCl_4$]
Ag	Argentite, Ag_2S	〃	—	1) Cupellation 2) Amalgamation 3) Electrorefining [$AgNO_3$, HNO_3]
Hg	Cinnabar, HgS	Froth Floatation procen	(1) Partial Roast → Self Reduch (2) Complet 〃 → Thermal Decomp.	Distillation
Cu	Chalcopyrite, $CuFeS_2$	〃	(1) Partial Roast → $Cu_2S + FeO + SO_2 + FeS$ (Matte) (2) Bessemerization → Cu (B.C.) $+ SO_2$ + slag. ($FeO \xrightarrow{SiO_2} FeSiO_3$)	1) Polling 2) Electro. [$CuSO_4 + H_2SO_4$]
Pb	Galena, PbS	FFP (NaCN depremant) ($-ZnS$)	Partial Roast → Self reduch.	1) Parke's Procen 2) Pattison's Procen 3) Polling 4) Liquation 5) Electroref. [$PbSiF_6 + H_2SiF_6$ + Gelatin)
Sn	Tinstone, SnO_2	Magnetic Sep. ($-FeWO_4$, $MnWO_4$ Wolframite)	(1) Low T, Roast, $\rightarrow H_2O$ (2) Black tin → Anthracite coal Reduc	1) Polling 2) Liquation 3) Electroref. [$SnSO_4 + H_2SO_4$]
Zn	Sphalerite, ZnS	FFP (CuSO4 Activator)	(1) Roasting (2) C-Red. @ (Vertical Retort) (3) Rapid Cool → spelter zinc	1) Distillation 2) Electroref. [Al cathode]
Al	Bauxite, $Al_2O_3 \cdot 2H_2O$	1) Hall's Procen → RED (Fe_2O_3) use Na_2CO_3 (fuse) 2) Serpeck's 〃 → WHITE (SiO_2) use $C + N_2$ @1800°C ⇒ 1100°C 3) Bayer's Procen → RED use NaOH	Hall-Heroults-Procen ($CaF_2 + Na_3AlF_6 + Al_2O_3$) 85%	1) HOOPE'S PROCESS (use Al + Cu + Si, Anode ↓ $Na_3AlF_6 + BaF_2$ cathode ↑)
Fe	Haematite Fe_2O_3	Magnetic seperation.	(1) Roasting (2) Calcination → Fe_2O_3 (Fe_2O_3 (Blast Furnace) ($CO \rightarrow Fe_3O_4 \rightleftharpoons FeO \xrightarrow{CO} Fe$) (sponge Iron))	[Fe] → Pig Iron (4% C) → Cast Iron (2–3% C); Steel; Wrought Iron (pure)
		+ STEEL 1) ANNEALING → SOFT STEEL 2) TEMPERING → MILD STEEL 3) QUENCHING → HARD, Brittle Steel	PIG IRON —SCRAP IRON, $C + O_2$→ CAST IRON (CUPOLA FURNACE); PIG IRON —LD Process, OA + flux→ STEEL	PIG —PUDDLING PROCESS→ WROUGHT (Mn ↓ scavenger + Fe_2O_3 (OA flux) → $MnSiO_3$ (slag); $P_4O_{10} \xrightarrow{Fe_2O_3} Fe_3(PO_4)_2$)
Na	Rock Salt, NaCl	DOWNS PROCESS; Eutectic Mixture ($CaCl_2 + NaCl$), MOLTEN ELECTROLYSIS		
K	KCl	$KCl + Na \xrightarrow[\Delta]{885°C} K(g)\uparrow + NaCl$		
Ti	–	KROLL'S PROCESS: $TiCl_4 + Na/Mg \xrightarrow{\Delta} Ti + NaCl + MgCl_2$		
Mg	Dolomite $MgCO_3 \cdot CaCO_3$ seawater. Carnallite: $KCl \cdot MgCl_2 \cdot 6H_2O$	(1) DOW'S SEAWATER PROCESS (seawater) $\xrightarrow{Ca(OH)_2} Mg(OH)_2\downarrow \xrightarrow{HCl} MgCl_2$ (aq) $\xrightarrow{\text{cryst}} MgCl_2 \cdot 6H_2O \xrightarrow{\text{dry HCl}} MgCl_2(s) + H_2O$ ↳ $Mg + Cl_2\uparrow$ (2) PIDGEON PROCESS $CaCO_3 \cdot MgCO_3 \xrightarrow{\Delta} CaO \cdot MgO \xrightarrow{Si\text{-}Fe} Mg + [SiO_2 + CaO \rightarrow CaSiO_3]$ (3) $MgCl_2 + Na \xrightarrow[\text{coal gas}]{} Mg + NaCl$.		

Sushmita Chattopadhyay
31/12/2021

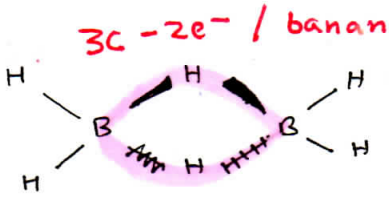
1) 

Borax,

$\rightarrow Na_2[B_4O_5(OH)_4]\cdot 5H_2O$

$\rightarrow Na_2B_4O_7\cdot 10H_2O$

- 2 tetrahedral
- 2 Trisonal unit.

2) 

3C - 2e⁻ / banana

Diborane, B_2H_6

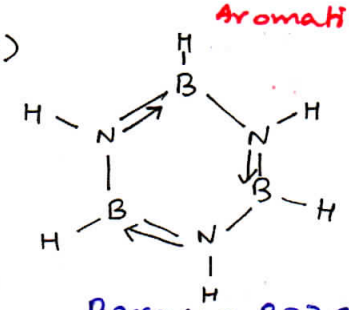
- small ligand → unsym L
- Bis P(Me)$_3$ → sym L

$\xrightarrow{1:2\,NH_3,\ T=200^\circ C}$ $2B_3N_3H_6$.

↓ low T, +NH$_3$

↓ T > 200°C, excess NH$_3$

$[BH_2(NH_3)_2][BH_4]$ $(BN)_x$

3) 

Aromatic

Borazine, Bozole.

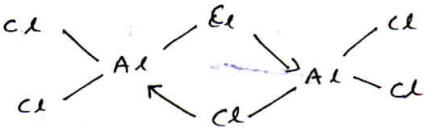
$B_3N_3H_6$,

- Inorganic Benzene

4) C_{60} (sp^2, Aromatic)

Buckminster Fullerene

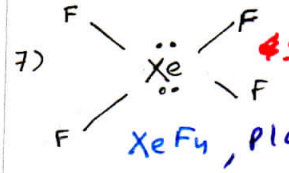
- 20 Hexagons, 12 Pentagons.

5) 

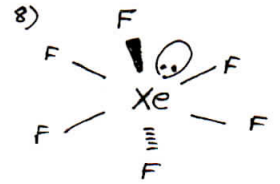
Al_2Cl_6 (g)

6) 

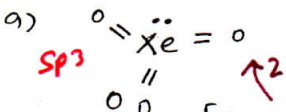
XeF_2

7) 

XeF_4, planar.

8) 

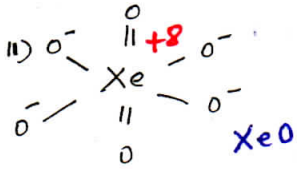
XeF_6

9) 

XeO_3

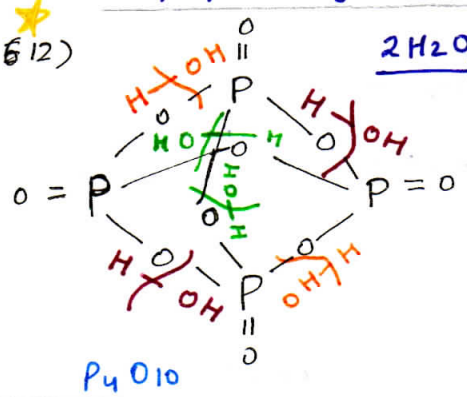
10) 

$XeOF_4$

11) 

XeO_6^{4-} perxenate.

$XeO_3 \xrightarrow{\text{alkali}} Xe + O_2$

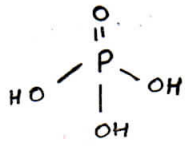
12) 

P_4O_{10}

$\xrightarrow{2H_2O}$ $(HPO_3)_3$ meta

$\xrightarrow{2H_2O}$ $H_4P_2O_7$ pyro

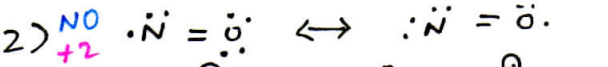
$\xrightarrow{2H_2O}$ H_3PO_4 Ortho

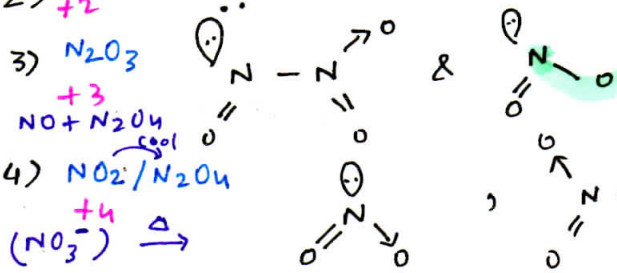


1) N_2O, +1 

Nitrous

Nitric

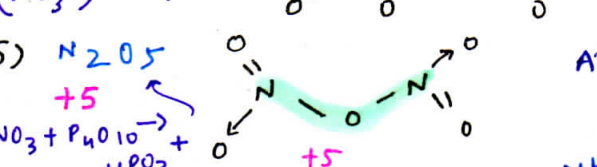
2) NO, +2 

3) N_2O_3, +3, $NO + NO_2$ 

Anhydr. of HNO_2

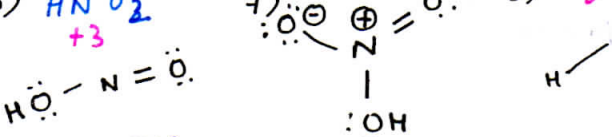
4) NO_2/N_2O_4, +4, (NO_3^-)

Mixed Anhy.

5) N_2O_5, +5 

$HNO_3 + P_4O_{10} \rightarrow HPO_3 +$

Anhydr. of HNO_3

6) HNO_2, +3 

Nitrous

7) HNO_3

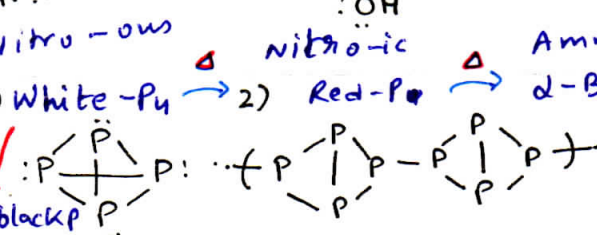
Nitric

8) NH_3, −3

Ammonia.

9) N_2

1) White-P$_4$ $\xrightarrow{\Delta}$ 2) Red-P $\xrightarrow{\Delta}$ α-Black P



β-black P

3) P_4O_6

P_4O_7 P_4O_8

4) $H_4P_2O_5$, +3

pyrophosphorous

5) $H_4P_2O_7$, +5

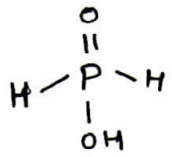
pyrophosphoric

7) $H_5P_3O_{10}$

8) $H_4P_2O_6$, +4

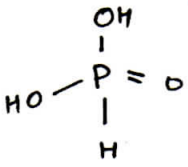
Hypophosphoric.

9) H_3PO_2 (+1)



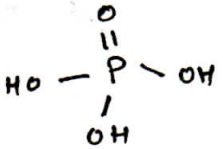
Phosphinic / hypophosphorous

10) H_3PO_3 (+3)



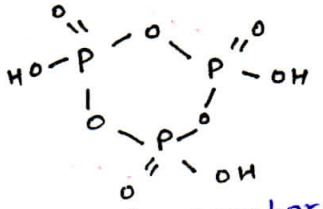
Phosphonic / (Ortho) Phosphorous

11) H_3PO_4 (+5)



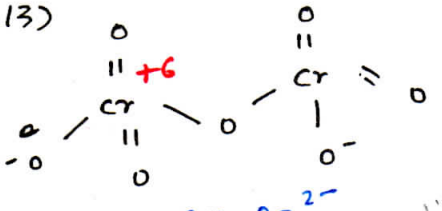
Orthophosphoric

12) $(HPO_3)_n$



Meta phosphoric.

13) $Cr_2O_7^{2-}$ (+6)



- Orange, Dia

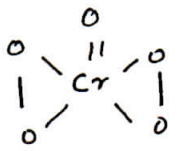
OH^- / H_2O ⇌ H^+ (dil. H_2SO_4)

CrO_4^{2-} (+6)

- Yellow, Dia

★ $K_2Cr_2O_7 (s) \xrightarrow{\Delta} K_2CrO_4 + Cr_2O_3 + O_2$ (Ampho).

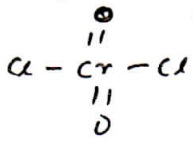
★ $K_2Cr_2O_7 / H^+$ (aq) $+ H_2O_2 \rightarrow CrO_5$



Butterfly Blue on stand

$Cr_2O_3 + O_2 \uparrow$ (green)

★ $K_2Cr_2O_7 + H_2SO_4$ conc. $+ KCl \rightarrow$

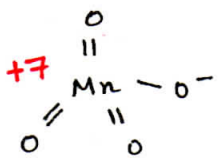


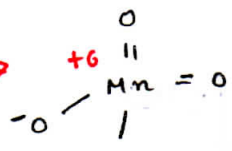
CrO_2Cl_2

Chromyl chloride.

Red-orange vapour.

14) MnO_4^- (+7) $\xrightarrow{\Delta}$ MnO_4^{2-} (+6)





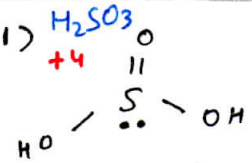
- Dia
- Purple/Black → solid
- Violet/Pink → aq.

- Para.
- Green.

★ $KMnO_4$ (H^+ → Mn^{2+}; H_2O → MnO_2; OH^- → K_2MnO_4).

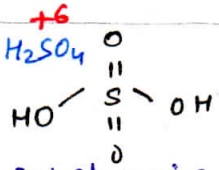
★ $KMnO_4 \xrightarrow{h\nu} K_2MnO_4 + MnO_2 + O_2$ (Ampho).

1) H_2SO_3 (+4)



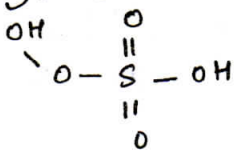
Sulphurous

2) H_2SO_4 (+6)



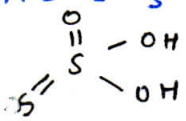
Sulphuric

3) H_2SO_5



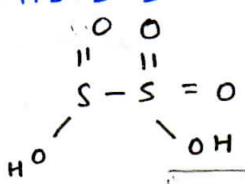
Peroxomonosulphuric / Caro's Acid.

4) $H_2S_2O_3$



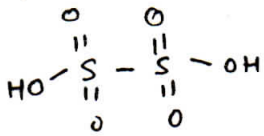
Thiosulphuric.

5) $H_2S_2O_5$



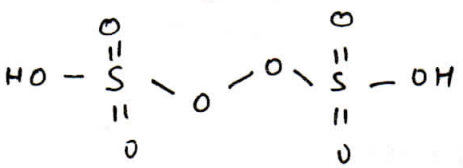
Pyrosulphuric / Oleum.

6) $H_2S_2O_6$



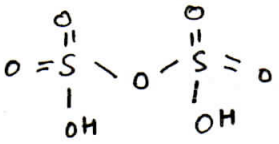
Dithionic

7) $H_2S_2O_8$

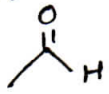


Peroxodisulphuric, Marshall's Acid.

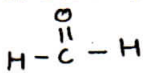
8) $H_2S_2O_7$



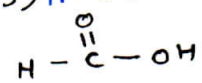
1) CH_3-CHO Acetaldehyde.



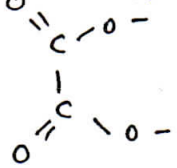
2) $HCHO$ Formaldehyde.



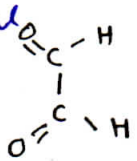
3) $H-COOH$ Formic Acid.



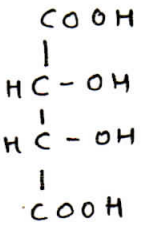
4) $HOOC-COOH$ Oxalic Acid.



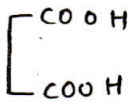
5) $OHC-CHO$ Glyoxal



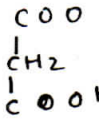
6) $C_4H_6O_6$, Tartaric Acid



7) Succinic Acid.

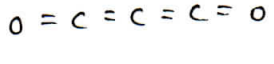


8) Malonic Acid.



$+ P_4O_{10} \rightarrow C_3O_2$

Carbon suboxide



ELECTRONIC CONF OF D, F Blocks

by SuCh

A) 3D [Ar] ...

Sakti VKramanm Feko ni Cuzn

21	Sc	4s2 3d1
22	Ti	4s2 3d2
23	V	4s2 3d3
24	Cr*	4s1 3d5
25	Mn	4s2 3d5
26	Fe	4s2 3d6
27	Co	4s2 3d7
28	Ni	4s2 3d8
29	Cu*	4s1 3d10
30	Zn	4s2 3d10

B)4D [Kr] ...

Ye Zara Nabi Mowth Tc, Rukhwate Rha mai Padega, Agey Caddu

+18

39	Y	5s2 4d1
40	Zr	5s2 4d2
41	Nb*	5s1 4d4
42	Mo*	5s1 4d5
43	Tc	5s2 4d5
44	Ru	5s1 4d7
45	Rh*	5s1 4d8
46	Pd*	5s0 4d10
47	Ag*	5s1 4d10
48	Cd	5s2 4d10

C)5D [Xe] ...

La HafTa Warna Re Us (Os) Iron (rod se) Pitega Aur Hgne jaega.

Lundon H(f)ong Kong T(a)okyo Washington Re Osama Idhar nahin, Pata nahin Aur kahan H(g)ai

+15

57	La	4f0 5d1 6s2
72	Hf	4f14 5d2 6s2
73	Ta	4f14 5d3 6s2
74	W	4f14 5d4 6s2
75	Re	4f14 5d5 6s2
76	Os	4f14 5d6 6s2
77	Ir	4f14 5d7 6s2
78	Pt*	4f14 5d9 6s1
79	Au*	4f14 5d10 6s1
80	Hg	4f14 5d10 6s2

90	Th*	5f0 6d2 7s2
91	Pa*	5f2 6d1 7s2
92	U*	5f3 6d1 7s2
93	Np*	5f4 6d1 7s2
94	Pu	5f6 7s2
95	Am	5f7 7s2
96	Cm*	5f7 6d1 7s2
97	Bk	5f9 7s2
98	Cf	5f10 7s2
99	Es	5f11 7s2
100	Fm	5f12 7s2
101	Md	5f13 7s2
102	No	5f14 7s2
103	Lr*	5f14 7s2 7p1

D) Lanthanoids 4F [Xe] ...

1)..John Cena Parson New Delhi main Prime minister Se Mila| Europe Germany Turbey Denmark Holland| Engineer Tum Yebhi Ludo

Zr ≈ Hf

2)..Celina aur Priety Ne dande se Pammy aur Simmy ko mara

Europe G(d)aya to TB(b) aur Di(y)arrohoea Ho Er Tum Yablu.

+3 → stable
+4 → Oxidising
+2 → Reducing

La^{+3}, Ce^{+4}
Lu^{+3}, Yb^{+2}
colorless.

58	Ce*	4f1 5d1 6s2
59	Pr	4f3 6s2
60	Nd	4f4 6s2
61	Pm	4f5 6s2
62	Sm	4f6 6s2
63	Eu	4f7 6s2
64	Gd*	4f7 5d1 6s2
65	Tb	4f9 6s2
66	Dy	4f10 6s2
67	Ho	4f11 6s2
68	Er	4f12 6s2
69	Tm	4f13 6s2
70	Yb	4f14 6s2
71	Lu*	4f14 5d1 6s2

E) Actinoids 5F [Rn] ...

Thode Papa Uranus, Neptune, Pluto jake, Aam CM ko Bkenge Cafi Esa...Final Mood No Larai.

EXCEPTIONS OF EC:

Aica Tha wo Pagal Uhi Nhi-pita Camina Laura

89	Ac	5f0 6d1 7s2

IMPORTANT PROCESSES in IOC

by SuCh

Sl.No.	Name	Compound / Element	Catalysts	Working
1	Moisson's Process	F_2	$KF_{(s)}$	$HF_{(l)} + KF_{(s)} \rightarrow K^+HF_2^-$ A: $2F^- \rightarrow F_2\uparrow$ C: $2H^+ \rightarrow H_2\uparrow$
2	Deacon's Process	Cl_2	$CuCl_2$	$2HCl + \frac{1}{2}O_2 \xrightarrow{CuCl_2} H_2O + Cl_2\uparrow$
3	Contact Process	H_2SO_4	V_2O_5 ($Fe(OH)_3$ to remove imp.)	Sulphide Ore $\xrightarrow{roast} SO_2$ $SO_2 + O_2 \xrightarrow{V_2O_5} SO_3$ $2SO_3 + H_2O \rightleftharpoons H_2S_2O_7$ oleum $H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$
4	Haber's Process	NH_3	Fe, Fe oxide Promoter – MO, K_2O, $+ Al_2O_3$	$N_2 + 3H_2 \rightleftharpoons 2NH_3$ 20 MPa
5	Down's Process	Na	use – $CaCl_2$, NaCl.	40% NaCl + 60% $CaCl_2$ $\xrightarrow{fuse}$ 1080K. Eutectic Mixture. Electrolysis C: $Na^+ + e^- \rightarrow Na$ A: $2Cl^- \rightarrow Cl_2\uparrow$
6	Dows Seawater Process	Mg	use – seawater, electrolysis	(seawater) $+ Ca(OH)_2 \rightarrow$ $\downarrow MgCl_2 \xleftarrow{HCl} Mg(OH)_2$ Cryst. (aq) $MgCl_2.6H_2O \xrightarrow[HCl]{dry} MgCl_2(s)$ $\xrightarrow{electrolysis} Mg + Cl_2$
7	Birkeland-Eyde Process	HNO_3	lightning	$N_2 + O_2 \xrightarrow{2000K} NO$ $NO + O_2 \rightarrow NO_2$ $2NO_2 + H_2O \rightarrow 2HNO_3 + NO$
8	Ostwald Process	HNO_3	Rh, Pt 700°C	$NH_3 + O_2 \xrightarrow[\Delta]{Rh,Pt} NO$ $NO + O_2 \rightarrow NO_2$ $NO_2 + H_2O \rightarrow HNO_3 + HNO_2$ $HNO_2 \xrightarrow{\Delta} NO + HNO_3$
9	Solvay Process	Na_2CO_3	use – NaCl, NH_3, CO_2	$NH_3 + CO_2 + H_2O \rightarrow NH_4(HCO_3)$ paste $NH_4(HCO_3) + NaCl \rightarrow NH_4Cl + NaHCO_3\downarrow$ $2NaHCO_3 \xrightarrow[270°C]{\Delta} Na_2CO_3 + H_2O$
10	Bosch Process	H_2	Ni and Fe_2O_3, Cr_2O_3	$C_{coke} + H_2O_{(g)} \xrightarrow[1270K]{Ni} CO + H_2\uparrow + H_2O$ water/syngas $KOH/NaAsO_2$ Fe_2O_3/Cr_2O_3 $\downarrow CO_2 + 2H_2\uparrow$ High P, T H_2 pure.

IMPORTANT PROCESSES in IOC

by SuCh

11	Kroll Process	Ti	use Na/Mg	$TiCl_4 \rightleftharpoons + Na/Mg \xrightarrow{\Delta}$ $Ti^{\circ} + NaCl + MgCl_2$
12	Hall-Heroult's Process	Al	cryolite (85%) $+ Al_2O_3$ (20%) $+$ 5% CaF_2. now Li_2CO_3.	A: $F^- \rightarrow F_2$. $F_2 + O^{-2} \rightarrow O_2 + F^-$. $O_2 \xrightarrow[\text{Anode}]{C} CO/CO_2$ $Al^{+3} \rightarrow Al(l)$
13	Hoope's Process	Al	-	Anode - Al + Cu + Si. Cathode - $Na_3AlF_6 + BaF_2$.
14	Goldschmidt (Alumino-Thermite) Process	Mn, Cr.	Mg + BaO_2 + KCl ignition + Al. ($+Fe_2O_3$)	$Cr_2O_3 + Al \xrightarrow{\Delta} Al_2O_3 + Cr$ & $MnO_2 \rightarrow Mn_3O_4 \xrightarrow{Al} Al_2O_3 + Mn$ (Al : Fe_2O_3 1:3 by mass)
15	Mc-Arthur Forrest Process	M = Ag, Au	use, NaCN, Zn, O_2 bubble	$MS_x + NaCN \xrightarrow[O_2]{} [M(CN)_2]^- + S\downarrow$ Native ore. $M\downarrow + [Zn(CN)_4]^{2-} \leftarrow Zn$.
16	Halls' Process	Red Bauxite	use Na_2CO_3 fused	$Al_2O_3 + Na_2CO_3 \rightarrow CO_2\uparrow + NaAlO_2$ ($+Fe_2O_3$) $NaAlO_2 \xrightarrow{H_2O} Fe_2O_3\downarrow$ (aq) $\xrightarrow{CO_2}$ $Al(OH)_3 \xrightarrow{\Delta} Al_2O_3$.
17	Serpeck's Process	White Bauxite	$C + N_2$.	$Al_2O_3 + SiO_2 + C + N_2 \xrightarrow{1800^{\circ}C} CO\uparrow + Si\uparrow + AlN$ $Al_2O_3 \xleftarrow{\Delta}$ $AlN \xrightarrow{H_2O} Al(OH)_3 + NH_3$
18	Bayer's Process	Red Bauxite	NaOH, CO_2	Al_2O_3 ($+Fe_2O_3$) $\xrightarrow[\Delta]{NaOH} NaAlO_2 + Fe_2O_3\downarrow$ $\xrightarrow[\text{seeding}]{CO_2} Al(OH)_3$ $Al_2O_3 + H_2O \xleftarrow{\Delta} + Na_2CO_3$
19	Pidgeon Process	Mg	use Dolomite	$MgCO_3 \cdot CaCO_3 \xrightarrow{\Delta} MgO \cdot CaO$ Mg $\leftarrow$ Si-Fe $+ [CaSiO_3$
20	Puddling Process	Fe	Mn $\leftarrow$ scavenger Fe_3O_4, Fe_2O_3 (Al flux)	PIG iron $\xrightarrow{Fe_2O_3 + Mn + Fe_3O_4}$ WROUGHT IRON. $\rightarrow$ Fe Pur.
21	Parke's Process	~~Ag~~ ~~Pb~~. Pb.	Zn(l)	Pb-Ag(l) $\rightarrow$ $\xrightarrow{Zn(l)}$ Pb + Zn-Ag
22	Pattison's Process		-	Heating of Pb-As ore: As(l) & PbO$\uparrow$.
23	Mond's Process	Ni	CO (g)	$Ni + CO \xrightarrow[40-70^{\circ}C]{} Ni(CO)_4\uparrow$ $Ni(CO)_4 \xrightarrow[200-220^{\circ}C]{} Ni(s) + CO\uparrow$
24	Van-Arkel Process	Ti, Zr, Hf, B	I_2	$M + I_2 \xrightarrow{400K} MI_n$. $MI_n \xrightarrow[\text{Wire}]{1400K} M_{pure} + I_2\uparrow$.