IMPORTANT FORMULAE AND REACTIONS:

CHEMISTRY IIYR:

C.1: SOLID STATE:

① **Braggs Equation** ***SAQ.

$n\lambda = 2d \sin\theta$.

C.2: SOLUTIONS: ***VSAQ/SAQ.

① **Molarity** $= \frac{w}{GMW} \times \frac{1000}{V \text{ (in ml)}}$.

② **Molality** $= \frac{w}{GMW} \times \frac{1000}{\text{wt of solvent in g}}$.

③ **Mole fraction**: $\frac{\text{No. of moles of component}}{\text{Total no. of moles of all components.}}$

④ **Raoults law**:

$\frac{p^0 - p_s}{p_0} = x_{\text{solute}}$ p^0 – Vapour pressure of pure solvent. p_s – Vapour pressure of Solution.

⑤ **Henrys law**.

$p = K_H \cdot x$. K_H = Henry constant. x = Mole fraction.

⑥ **Relative Lowering of Vapour Pressure RLVP**:

$RLVp = \frac{p^0 - p_s}{p^0}$.

C.3: Electrochemistry:

Molar conductivity. $\lambda_m = \frac{K \times 1000}{M}$.

K = Specific conductance.

M = Molarity.

***

Faradays First law:

$W \propto Ct$, $W = ect$.

$\therefore W = \frac{A\,Ct}{ZF}$.

t = time; Z = valency.

W = weight of substance

A = Atomic weight.

E = chemical Equivalent.

C = current in amperes.

* Faraday Second law: ** VSAQ

$m_1 : m_2 = E_1 : E_2$.

m = mass of substance

E = Equivalent weight of substance

(or) $\frac{m_1}{E_1} = \frac{m_2}{E_2}$.

(3) Nernst Equation for metal electrodes.

$E = E^\circ + \frac{2.303RT}{nF} \log C$. = $E = E^\circ + \frac{0.0591}{n} \log C$.

Nernt Equation for non-metal electrodes.

$E = E^\circ - \frac{0.0591}{n} \log C$.

(4) Gibbs Energy: **

$\Delta_r G^\circ = -nF E^\circ_{cell}$.

(5) Kohlrausch law. ** LAQ

$\lambda_0 = \lambda_0^+ + \lambda_0^-$ (ions).

λ_0^+ and λ_0^- are ionic conductance at infinity dilution.

(6) Chemical kinetics:

Order of a reaction ** LAQ.

Ex: Zero order of a reaction: Formation of HCl from H_2

$H_2 + Cl_2 \longrightarrow 2HCl$.

First order reaction: Decomposition of N_2O_5-

$N_2O_5 \longrightarrow N_2O_4 + \frac{1}{2}O_2$

* Units of rate constants: * VSAQ

Zero order - moles $lit^{-1} sec^{-1}$

first order - sec^{-1}

Second order - $mole^{-1}$ lit sec^{-1}.

** VSAQ:

Examples of second order *

(1) Decomposition of H_2O_2:

$$2H_2O_2 \xrightarrow[OH^-]{I^-} 2H_2O + O_2.$$

$$r = K[H_2O_2][I^-].$$

(2) Hydrolysis of Ester

$$CH_3COOC_2H_5 + NaOH \longrightarrow CH_3COONa + C_2H_5OH.$$

** VSAQ

Rate constant of first order $K = \frac{0.693}{t_{1/2}}$

$t_{1/2}$ (half of reaction): $t_{1/2} = \frac{0.693}{K}$

Half life of a reaction:

* VSAQ:

Gaseous first order reaction: (14).*

Hydrogenation of C_2H_4 to C_2H_6:

$$C_2H_4 + H_2 \longrightarrow C_2H_6$$

* VSAQ/LAQ:

(1) Examples of bimolecular gaseous reaction:

$$2HI \longrightarrow \underset{(g)}{H_2} + I_2(g)$$

(2) Examples of trimolecular gaseous reaction

$$O_2 + 2NO \longrightarrow 2NO_2.$$

C-4: Surface chemistry:

* Example of homogenous catalaytic reaction. * VSAQ.

(a) $CH_3COOH_{(l)} + H_2O_{(l)} \longrightarrow CH_3COOH_{(l)} + CH_3OH_{(l)}$.

(b) $2SO_{2(g)} + O_{2(g)} \xrightarrow{NO_{(g)}} 2SO_{3(g)}$

* Ex. of helerogenous catalytic reaction * VSAQ.

(a) $2SO_{2(g)} + O_{2(g)} \xrightarrow[V_2O_{5(s)}]{Pt_{(s)} \text{ (or)}} 2SO_{3(g)}$.

(b) Vegetable oil $_{(l)}$ + $H_{2(g)} \longrightarrow$ Vegetable ghee (s).

5- General Principles of Metallurgy:

Composition of alloys: * * VSAQ.

Brass - Cu-60%, Zn-40%.

Bronze - Cu-75-95% Sn-10 to 25%.

Germansilver - Cu-25-40%, Zn-25-35%, Ni-40-50%.

* VSAQ:

Gangue - FeO, Flux - SiO_2

Gangue + Flux $\longrightarrow$ slag.

$FeO + SiO_2 \longrightarrow FeSiO_3$.

* Extraction of zinc from zinc blend:

Roasting:

$2ZnS + 3O_2 \longrightarrow 2ZnO + 2SO_2$.

$ZnS + 2O_2 \longrightarrow ZnSO_4$.

$2ZnSO_4 \longrightarrow 2ZnO + 2SO_2 + O_2$.

Reduction:

$ZnO + C \longrightarrow Zn + CO$.

C-6 : p-BLOCK Elements :

** LAQ. Group-15 : ** LAQ.

(1) Ammonia preparation by Habers process :

$$N_2 + 3H_2 \xrightleftharpoons[200\ atm,\ 450^\circ C]{Fe+Mo} 2NH_3 \quad \Delta H = -92\ kJ$$

(a) Reaction with $ZnSO_4$:

(a) $ZnSO_4 + 2NH_4OH \longrightarrow Zn(OH)_2 \downarrow + (NH_4)_2SO_4$

(b) Reaction with $CuSO_4$:

$$CuSO_4 + 4NH_4OH \longrightarrow [Cu(NH_3)_4]SO_4 + 4H_2O$$

(c) Reaction with AgCl :

$$2NH_4OH + AgCl \longrightarrow [Ag(NH_3)_2]Cl + 2H_2O.$$

** LAQ :

(2) Preparation of Nitric acid : ** LAQ.

(a) $4NH_3 + 5O_2 \xrightleftharpoons[Pt+Rh\ (9:1),\ 800^\circ C - 6\text{-}7\ atm]{} 4NO + 6H_2O \quad \Delta H = -90\ kJ.$

(b) $2NO + O_2 \rightleftharpoons 2NO_2.$

(c) $4NO_2 + 2H_2O + O_2 \longrightarrow 4HNO_3 + NO.$

* Reaction with Nitric acid : with copper ** **

$$3Cu + 8HNO_3\ (dilute) \longrightarrow 3(Cu(NO_3)_2 + \underline{2NO} \uparrow + 4H_2O$$

$$Cu + 4HNO_3\ (Conc.) \longrightarrow Cu(NO_3)_2 + \underline{2NO_2} \uparrow + 2H_2O$$

* Reaction of Nitric acid with Zn. ** LAQ

$$4Zn + 10HNO_3 \longrightarrow 4Zn(NO_3)_2 + 5H_2O + \underline{N_2O}$$

$$Zn + 4HNO_3 \longrightarrow Zn(NO_3)_2 + 2H_2O + \underline{2NO_2}$$

* Reaction with S_8:

$$S_8 + 48\,HNO_3 \longrightarrow 8\,H_2SO_4 + 48\,NO_2 + 16\,H_2O$$

* Reaction with P_4:

$$P_4 + 20\,HNO_3 \longrightarrow 4\,H_3PO_4 + 20\,NO_2 + 4\,H_2O.$$

Group-16:

(1) Preparation of Sulphuric acid: ** LAQ.

(a) $S + O_2 \longrightarrow SO_2$.

$$4FeS_2 + 11\,O_2 \longrightarrow Fe_2O_3 + 8\,SO_2.$$

(b) $2\,SO_2 + O_2 \xrightarrow[\Delta]{V_2O_5} 2\,SO_3$.

(c) $SO_3 + H_2SO_4 \longrightarrow H_2S_2O_7$.

$$H_2S_2O_7 + H_2O \longrightarrow H_2SO_4.$$

** LAQ

Preparation of Ozone and Reactions: ** LAQ/SAQ.

(a) $3\,O_2 \rightleftharpoons 2\,O_3$ $\quad \Delta H = +284.5\ KJ$.

Silent electric discharge → Ozone.

(b) Reaction with PbS:

$$PbS + 4\,O_3 \longrightarrow PbSO_4 + 4\,O_2 \uparrow.$$

(c) Reaction with KI:

$$KI + H_2O + O_3 \longrightarrow 2\,KOH + I_2 + O_2 \uparrow.$$

(d) Reaction with Hg:

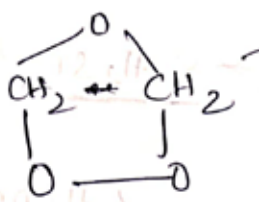
$$2\,Hg + O_3 \longrightarrow Hg_2O + O_2 \uparrow.$$

(e) Reaction with Ag:

$$2\,Ag + O_3 \longrightarrow Ag_2O + O_2.$$

(f) Reaction with C_2H_4:

(e) Reaction with C_2H_4:

$CH_2 = CH_2 + O_3 \longrightarrow$  $\xrightarrow{H_2O} 2CH_2O + H_2O_2$.

Formaldehyde.

** VSAQ: Group-17

Reactions of F_2 & Cl_2 with water: ** VSAQ.

$2F_2 + 2H_2O \longrightarrow 4HF + O_2$.

$3F_2 + 3H_2O \longrightarrow 6HF + O_3$.

Chlorine:

$Cl_2 + H_2O \longrightarrow 2HCl + (O)$.

$Cl_2 + H_2O \longrightarrow HCl + HOCl$.

** VSAQ:

Reactions of Cl_2 with NaOH:

(a) $Cl_2 + NaOH \longrightarrow NaCl + \underline{NaOCl} + H_2O$.

(Cold. dil. NaOH) ↓ sodium hypochlorite

(b) $3Cl_2 + 6\,NaOH \longrightarrow NaCl + \underline{NaClO_3} + H_2O$

(hot. conc). ↓ sodium chlorate.

*** VSAQ:

Reaction of Cl_2 with dry slaked lime:

$Ca(OH)_2 + Cl_2 \longrightarrow CaOCl_2 + H_2O$

Bleaching powder.

*** Preparation of chlorine by Deacons process: * VSAQ/LAQ

$4HCl + O_2 \xrightarrow{CuCl_2} 2Cl_2 + 2H_2O$.

* Laboratory method:

$4HCl + MnO_2 \longrightarrow MnCl_2 + 2H_2O + Cl_2\uparrow$.

Reactions of Cl2 with Fe (Iron):

(a) $2Fe + 3Cl_2 \longrightarrow 2FeCl_3$.

(b) with NaOH.

$6NaOH + Cl_2 \longrightarrow 5NaCl + NaClO_3 + 3H_2O$.

(c) acidified $FeSO_4$:

$2FeSO_4 + Cl_2 + H_2SO_4 \longrightarrow Fe_2(SO_4)_3 + 2HCl$.

(d) with Iodine:

$I_2 + 6H_2O + 5Cl_2 \longrightarrow 2HIO_3 + 10HCl$.

(e) with H_2S:

$H_2S + Cl_2 \longrightarrow 2HCl + S$.

(f) with $Na_2S_2O_3$:

$Na_2S_2O_3 + Cl_2 + H_2O \longrightarrow Na_2SO_4 + S + 2HCl$.

Group-18 Elements: SAQ.

XeF_2 preparation:

$Xe + F_2 \xrightarrow[1\ bar]{673\ K} XeF_2$

(b) XeF_4:

$Xe + 2F_2 \xrightarrow[7\ bar]{873\ K} XeF_4$

(c) XeF_6:

$Xe + 3F_2 \xrightarrow[60-70\ bar]{600\ K} XeF_6$

Reactions with water:

(a) $2XeF_2 + 2H_2O \longrightarrow 4HF + 2Xe + O_2$

(b) $XeF_4 + 6H_2O \longrightarrow 2Xe + XeO_3 + 12HF$

(c) $XeF_6 + 3H_2O \longrightarrow XeO_3 + 6HF$

(a) XeO_3: Preparation.

$XeF_6 + 3H_2O \longrightarrow XeO_3 + 6HF$

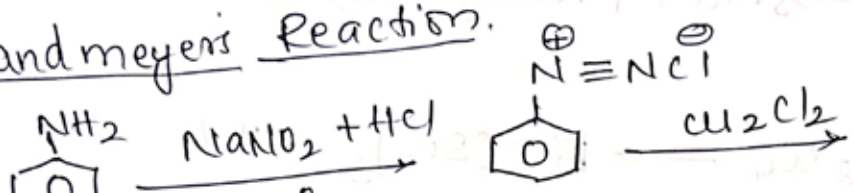
(b) $XeOF_4$:

$XeF_6 + H_2O \longrightarrow XeOF_4 + 2HF$

CH: 11, 12, 13 Organic chemistry Name reactions:
** LAQ ***
(Any 4 Reactions - LAQ)

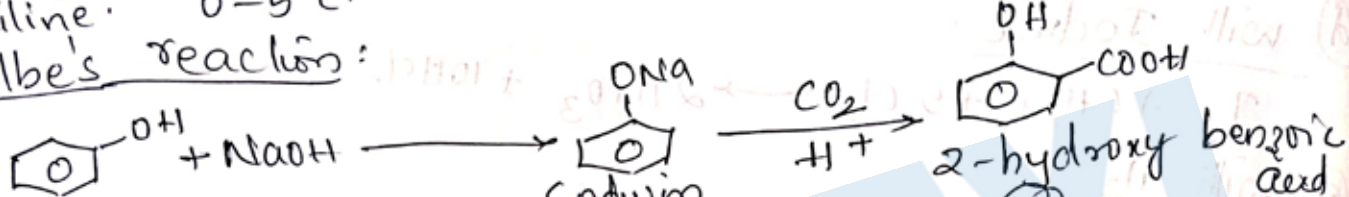
(a) Wurtz Reaction (Wurtz-Fittig Reaction):

(b) Sandmeyer's Reaction:



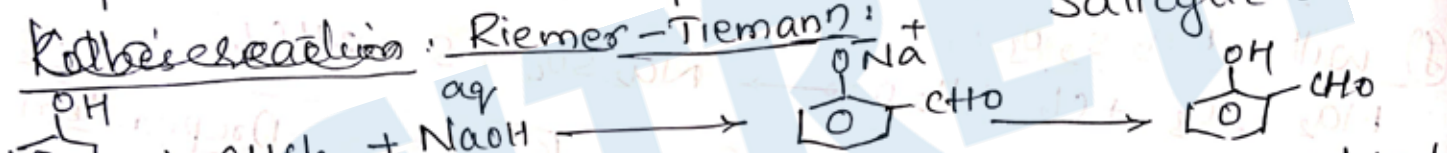
aniline.

** @Kolbe's reaction:



Phenol — Sodium phenoxide — 2-hydroxy benzoic acid (or) Salicylic acid.

*** (d) Kolbe's reaction: Riemer-Tiemann:



*** Phenol — Salicylaldehyde

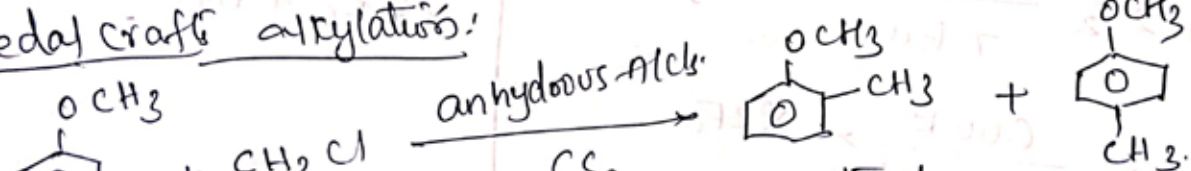
(e) Williamson's ether synthesis.

$R-X - R^1-ONa \longrightarrow R-O-R^1 + NaX.$

$C_2H_5ONa + I-C_2H_5 \longrightarrow C_2H_5-O-C_2H_5 + NaCl.$

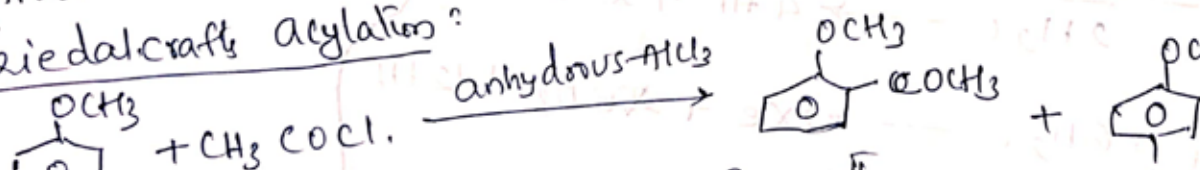
Diethyl ether.

(f) Friedal Crafts alkylation:



Anisole — Chloromethane — 2-methyl anisole — 4-methyl anisole.

(g) Friedal crafts acylation:



Anisole — (Acetyl chloride) — 2-methoxy acetophenone — 4-methoxy acetophenone

(b) Esterification:

$R-COOH + HO-R \xrightleftharpoons{conc.\ H_2SO_4} R-\overset{O}{\overset{\|}{C}}-O-R + H_2O$.

Acid alcohol Ester.

$CH_3-COOH + HO-CH_3 \rightleftharpoons CH_3-\overset{O}{\overset{\|}{C}}-O-CH_3 + H_2O$.

Acetic acid Methanol Ester.

i. Decarboxylation:

$CH_3COONa + NaOH \xrightarrow[heat]{CaO} CH_4 + Na_2CO_3$

Methane

$-CO_2$.

j. Aldol Condensation:

$2\,CH_3CHO \xrightarrow{NaOH} CH_3-\underset{OH}{\underset{|}{CH}}-CH_2-CHO$

Acetaldehyde 3-hydroxybutanal

(k) Cross Aldol condensation:

$CH_3CHO + CH_3CH_2CHO \xrightarrow[\Delta]{NaOH} CH_3-CH=CH-CHO + CH_3-CH_2-\underset{CH_3}{\underset{|}{C}}=CH-CHO$.

(l) Cannizaro Reaction:

$2\,CH_2O \xrightarrow{conc.\ NaOH} CH_3OH + HCOONa$.

Formaldehyde Methanol Sodiummethanoate.

(m) Carbylamine Test:

$CH_3NH_2 + CH_3CCl_3 + 3KOH \longrightarrow CH_3NC + 3KCl + 3H_2O$

(n) HVZ Reaction:

$CH_3COOH + Cl_2 \xrightarrow{Red\ phosphorous} CH_2Cl-COOH \xrightarrow{Cl_2} CHCl_2COOH \xrightarrow{Cl_2} CCl_3COOH$

(Hell-Volhard-Zelinsky Reaction).

Trichloroacetic acid.