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Equations

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for

ICSE

Class 10

Chemistry

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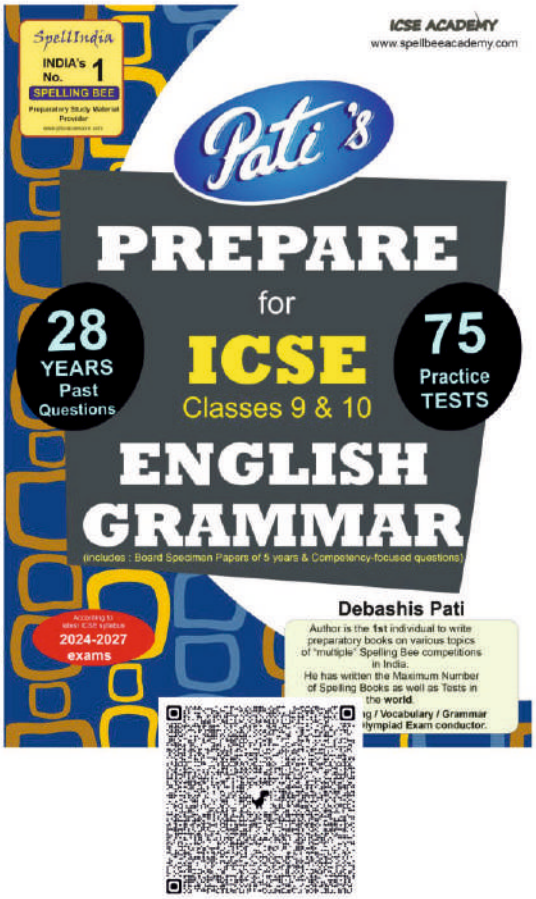

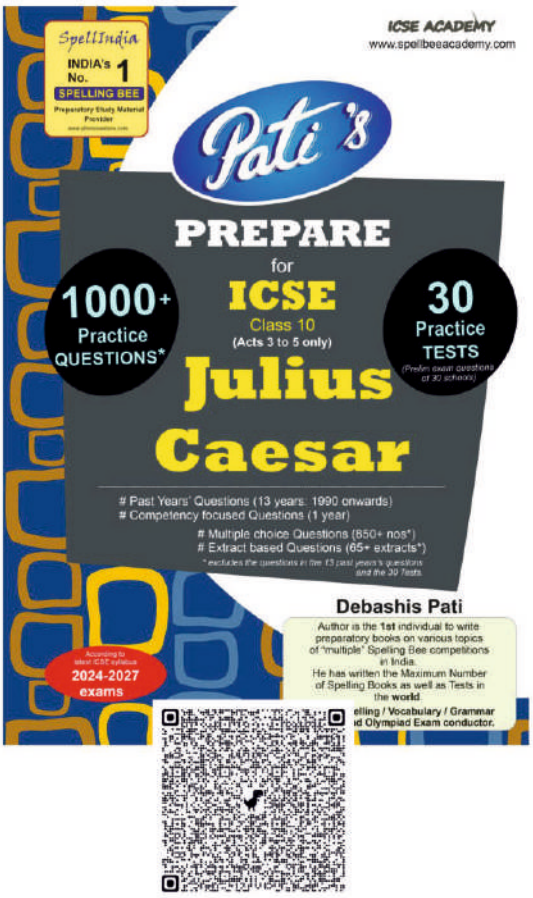

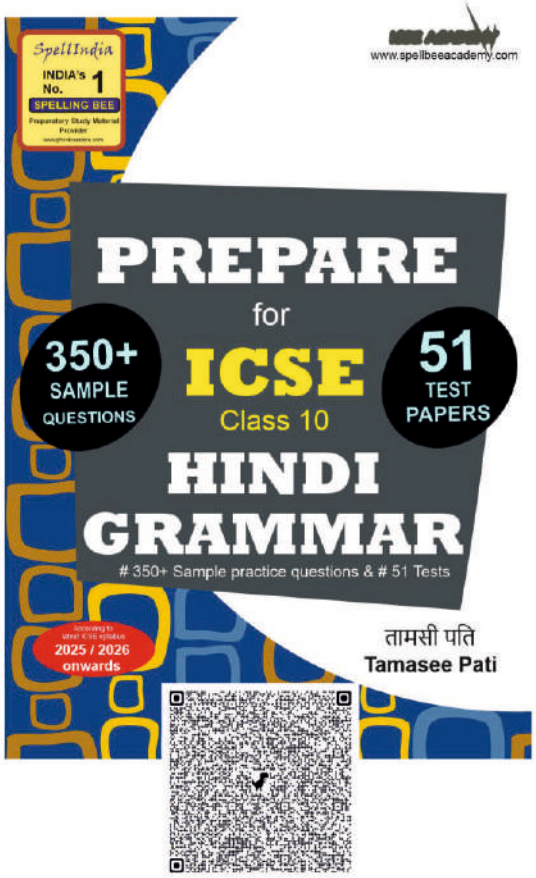

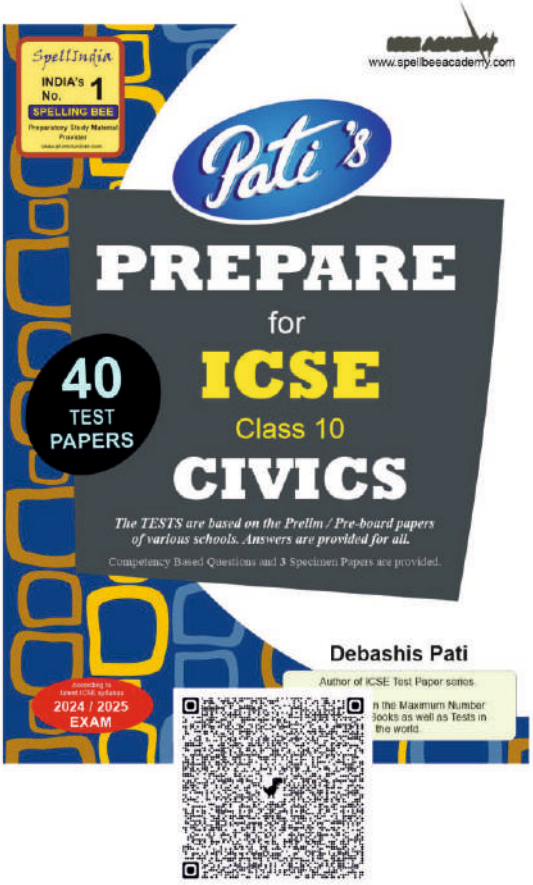

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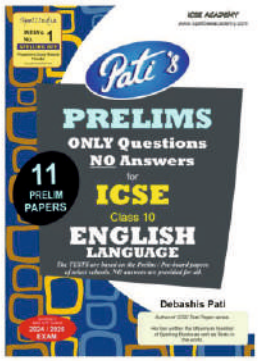

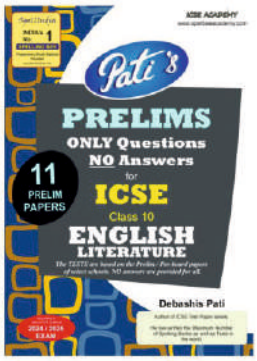

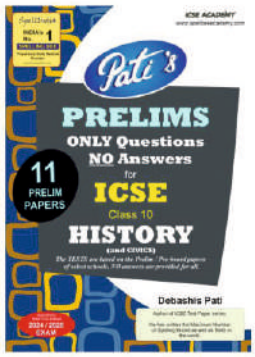

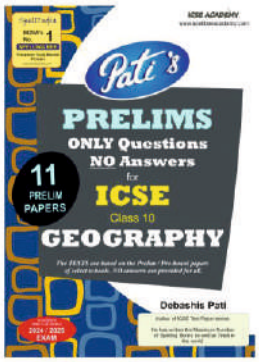

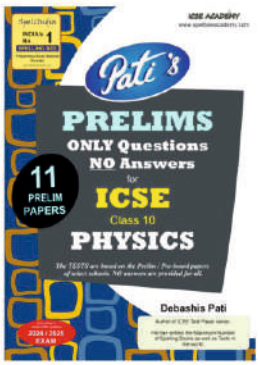

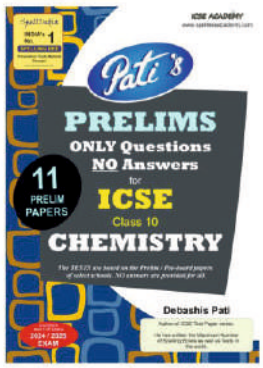

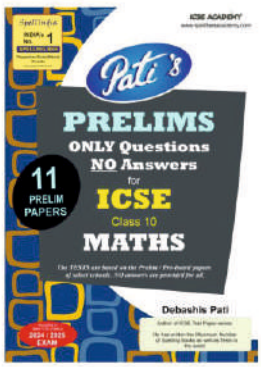

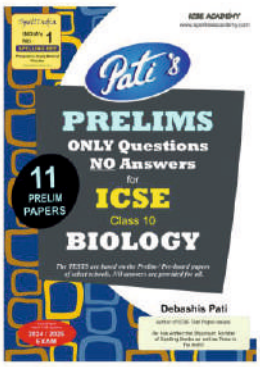

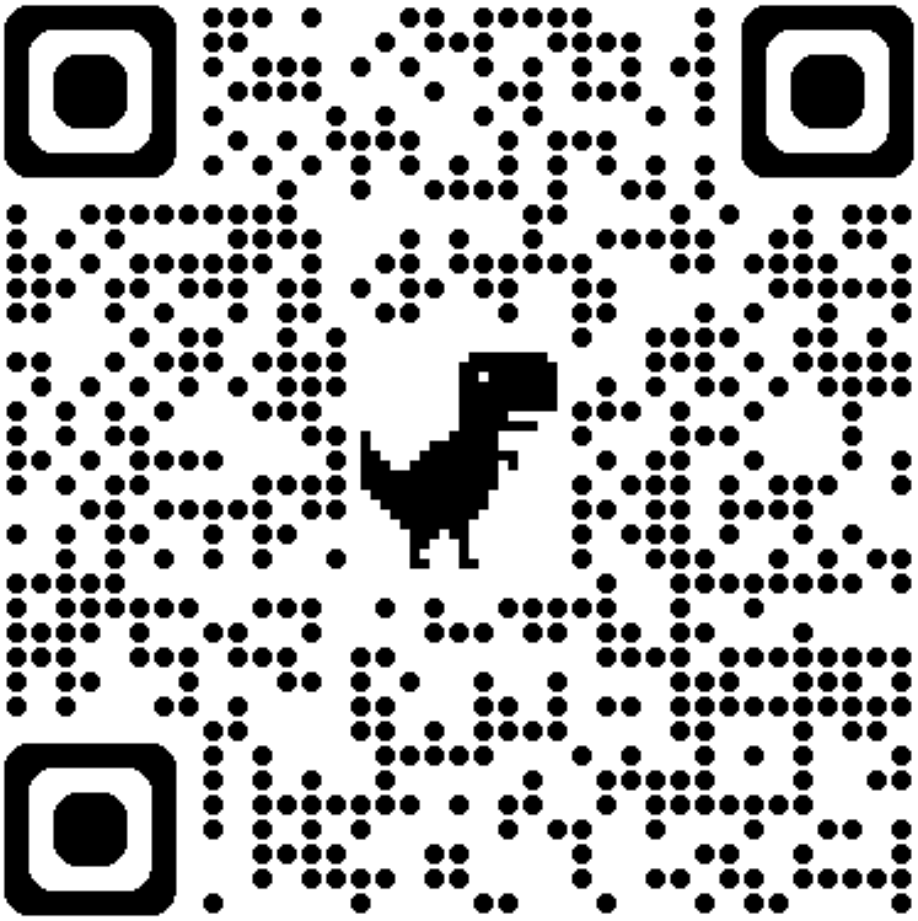

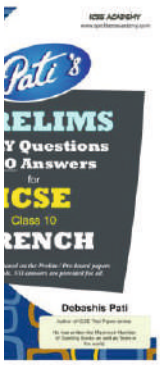

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Chemistry Equations

Ammonia

1) Laboratory preparation of NH_3 :-

$$2NH_4Cl + Ca(OH)_2 \xrightarrow{\Delta} CaCl_2 + 2H_2O + 2NH_3$$

2) $NH_4Cl + NaOH \xrightarrow{\Delta} NaCl + H_2O + NH_3$

3) $3Mg + N_2 \longrightarrow Mg_3N_2$

$Mg_3N_2 + 6H_2O$ (warm) $\longrightarrow 3Mg(OH)_2 + 2NH_3$

$3Ca + N_2 \longrightarrow Ca_3N_2$

$Ca_3N_2 + 6H_2O$ (warm) $\longrightarrow 3Ca(OH)_2 + 2NH_3$

$2Al + N_2 \longrightarrow 2AlN$

$AlN + 3H_2O$(warm) $\longrightarrow Al(OH)_3 + NH_3$

4) Industrial process of NH_3 : Haber's process

$$N_2 + 3H_2 \underset{200-900\ atm}{\overset{Fe,Mo}{\rightleftharpoons}_{450°-500°}} 2NH_3 + \Delta$$

5) $NH_3 + HCl \longrightarrow NH_4Cl$
dil

6) $NH_3 + HNO_3 \longrightarrow NH_4NO_3$
dil

7) $2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2SO$
dil

8) Ammonia is a strong reducing agent

a) $3CuO + 2NH_3 \longrightarrow 3\ Cu + 3H_2O + N_2$
Black — Reddish brown

b) $3PbO + 2NH_3 \longrightarrow 3\ Pb + 3H_2O + N_2$
buff yellow (Amphoteric) — Grey

c) $8\ NH_3 + 3\ Cl_2 \longrightarrow 6NH_4Cl + N_2$
excess

d) $NH_3 + 3\ Cl_2 \longrightarrow NCl_3 + 3HCl$
Excess — Nitrogen trichloride (yellow explosive liquid)

Ammonia

9) Oxidation (Burning of Ammonia)

$4NH_3 + 3O_2 \longrightarrow 2N_2 + 6H_2O$

Ammonia burn in excess of oxygen with a greenish yellow flame

10) Catalytic oxidation of NH_3 :

$$4\ NH_3 + 5O_2 \xrightarrow[700°C - 800°C]{pt} 4NO + 6H_2O + \Delta$$

11) Ammonium Hydroxide reacts with different metallic salts to give precipitate of respective metal hydroxides.

a. $FeSO_4 + 2NH_4OH \longrightarrow Fe(OH)_2 + (NH_4)_2SO_4$ — Dirty green precipitate

b. $FeCl_3 + 3NH_4OH \longrightarrow Fe(OH)_3 + 3NH_4Cl$ — Reddish brown precipitate

c. $Pb(NO_3)_2 + 2NH_4OH \longrightarrow Pb(OH)_2 + 2NH_4NO_3$ — Chalky white precipitate

d. $CuSO_4 + 2NH_4OH \longrightarrow Cu(OH)_2 + (NH_4)_2SO_4$ — Pale blue precipitate

e. $ZnSO_4 + 2NH_4OH \longrightarrow Zn(OH)_2 + (NH_4)_2SO_4$ — Gelatinous white precipitate

Sulphuric Acid

1) Industrial process : contact process ?

a) $S + O_2 \longrightarrow SO_2$

b) $2SO_2 + O_2 \underset{1-2\ atm}{\overset{V_2O_5}{\underset{450°-500°}{\rightleftharpoons}}} 2SO_3 + \Delta$

c) $SO_3 + H_2SO_4 \longrightarrow \underset{\text{Oleum}}{H_2S_2O_7}$

$H_2S_2O_7 + H_2O \longrightarrow 2H_2SO_4$

2) $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

$Mg + H_2SO_4 \longrightarrow MgSO_4 + H_2$

$Fe + \underset{\text{dil}}{H_2SO_4} \longrightarrow FeSO_4 + H_2$

3) $Na_2CO_3 + \underset{\text{dil}}{H_2SO_4} \longrightarrow Na_2SO_4 + H_2O + CO_2$

4) $2KHCO_3 + \underset{\text{dil}}{H_2SO_4} \longrightarrow K_2SO_4 + 2H_2O + 2CO_2$

5) $Na_2SO_3 + \underset{\text{dil}}{H_2SO_4} \longrightarrow Na_2SO_4 + H_2O + SO_2$

6) $Na_2S + \underset{\text{dil}}{H_2SO_4} \longrightarrow Na_2SO_4 + H_2S$

7) $ZnS + \underset{\text{dil}}{H_2SO_4} \longrightarrow ZnSO_4 + H_2S$

8) $\underset{\text{Black}}{CuS} + \underset{\text{dil}}{H_2SO_4} \longrightarrow \underset{\text{Blue}}{CuSO_4} + H_2S$

9) $FeS + \underset{\text{dil}}{H_2SO_4} \longrightarrow FeSO_4 + H_2S$

10) $Pb(NO_3)_2 + \underset{\text{dil}}{H_2SO_4} \longrightarrow \underset{\text{White ppt.}}{PbSO_4} + 2HNO_3$

Sulphuric Acid

11) $BaCl_2 + \underset{\text{dil}}{H_2SO_4} \longrightarrow \underset{\substack{\text{White ppt.}\\ \text{insoluble in dil HCl/HNO}_3}}{BaSO_4} + 2HCl$

12) Conc. H_2SO_4 is a non-volatile acid

Preparation of HCl : -

$$NaCl + \underset{\text{conc.}}{H_2SO_4} \xrightarrow{< 200^\circ c} NaHSO_4 + HCl$$

Preparation of HNO_3 : -

$$KNO_3 + \underset{\text{conc.}}{H_2SO_4} \xrightarrow{< 200^\circ c} KHSO_4 + HNO_3$$

13) Conc. H_2SO_4 is an oxiding agent

$$C + \underset{\text{conc.}}{2H_2SO_4} \longrightarrow CO_2 + 2H_2O + 2SO_2$$

$$S + \underset{\text{conc.}}{2H_2SO_4} \longrightarrow 2H_2O + 3SO_2$$

$$Cu + \underset{\text{conc.}}{2H_2SO_4} \longrightarrow CuSO_4 + 2H_2O + 2SO_2$$

14) Conc. H_2SO_4 is a dehydrating agent

$$C_{12}H_{22}O_{11} \xrightarrow{conc.\ H_2SO_4} \underset{\substack{\text{Black spongy}\\ \text{charred mass}}}{12C} + 11H_2O$$

$$\underset{\substack{\text{Blue vitriol}\\ \text{(Blue crystalline salt)}}}{CuSO_4.5H_2O} \xrightarrow{conc.\ H_2SO_4} \underset{\text{White anhydrous powder}}{CuSO_4} + 5H_2O$$

15) Ethanol to ethene

$$C_2H_5OH \xrightarrow[170^oC]{conc.\ H_2SO_4} C_2H_4 + H_2O$$

Nitric Acid

1) Laboratory preparation of HNO_3 : -

$$KNO_3 + \underset{\text{conc.}}{H_2SO_4} \xrightarrow{< 200^\circ c} KHSO_4 + HNO_3$$

2) Decomposition of HNO_3 : -

$$4HNO_3 \xrightarrow{\Delta} 2H_2O + 4NO_2 + O_2$$

3) Industrial process of HNO_3 : Ostwald's process

$$4\ NH_3 + 5O_2 \xrightarrow[700℃ - 800℃]{pt} 4NO + 6H_2O + \Delta$$

4) $C + \underset{\text{conc.}}{4HNO_3} \longrightarrow CO_2 + 2H_2O + 4NO_2$

5) $S + \underset{\text{conc.}}{6HNO_3} \longrightarrow H_2SO_4 + 2H_2O + 6NO_2$

6) $Cu + \underset{\text{conc.}}{4HNO_3} \longrightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$

Observation for reaction 4. 5. And 6:

A reddish brown acidic gas is evolved which turns moist KI paper brown.

7) $3\ Cu + \underset{\text{dil}}{8HNO_3} \longrightarrow 3\ Cu(NO_3)_2 + 4H_2O + 2NO$

8) $Fe(OH)_3 + \underset{\text{dil}}{3HNO_3} \longrightarrow Fe(NO_3)_3 + 3H_2O$

9) $\underset{\text{Light green}}{CuCO_3} + 2HNO_3 \longrightarrow \underset{\text{Blue}}{Cu(NO_3)_2} + H_2O + CO_2$

Nitric Acid

10) Action of heat on nitrates :

a) $2KNO_3 \xrightarrow{\Delta} 2KNO_2 + O_2$

b) $2Cu(NO_3)_2 \xrightarrow{\Delta} 2\,CuO + 4NO_2 + O_2$

Blue → Black

$2Zn(NO_3)_2 \xrightarrow{\Delta} 2\,ZnO + 4NO_2 + O_2$

yellow when hot, white when cold

$2Pb(NO_3)_2 \xrightarrow{\Delta} 2\,PbO + 4NO_2 + O_2$

c) $NH_4NO_3 \xrightarrow{\Delta} N_2O + 2H_2O$

Hydrochloric Acid

1) Laboratory preparation of HCl gas

$$NaCl + \underset{\text{conc.}}{H_2SO_4} \xrightarrow{< 200^\circ c} NaHSO_4 + HCl\ (g)$$

2) $2NaCl + \underset{\text{conc.}}{H_2SO_4} \xrightarrow{> 200^\circ c} Na_2SO_4 + 2HCl\ (g)$

3) $CaO + \underset{\text{dil}}{2HCl} \longrightarrow CaCl_2 + H_2O$

4) Active Metal + Acid $\longrightarrow$ Salt + H_2

$Zn + \underset{\text{dil}}{2HCl} \longrightarrow ZnCl_2 + H_2$

$Mg + \underset{\text{dil}}{2HCl} \longrightarrow MgCl_2 + H_2$

$Fe + \underset{\text{dil}}{2HCl} \longrightarrow FeCl_2 + H_2$

Observation : A colourless, odourless, neutral gas is evolved which burns with a pale blue flame and pop sound.

5) Metallic carbonate/ bicarbonate + Acid $\longrightarrow$ Salt + H_2O + CO_2

$Na_2CO_3 + \underset{\text{dil}}{2HCl} \longrightarrow 2NaCl + H_2O + CO_2$

$NaHCO_3 + \underset{\text{dil}}{HCl} \longrightarrow NaCl + H_2O + CO_2$

$Ca(HCO_3)_2 + \underset{\text{dil}}{2HCl} \longrightarrow CaCl_2 + 2H_2O + 2CO_2$

Observation : A colourless, odourless, acidic gas is evolved which turns lime water milky but has no effect on acidified KMO_4 solution and acidified $k_2Cr_2O_7$ solution.

Hydrochloric Acid

6) Metallic sulphite/bisulphite + Acid ⟶ Salt + H_2O + SO_2

$Na_2SO_3 + 2HCl \xrightarrow{dil} 2NaCl + H_2O + SO_2$

$MgSO_3 + 2HCl \longrightarrow MgCl_2 + H_2O + SO_2$

Observation : A colourless, suffocating odour acidic gas is evolved which turn lime water milky & turns acidified KMO_4 solution pink to clear colourless & acidified $K_2Cr_2O_7$ solution orange to clear green.

7) Metallic sulphide + Acid ⟶ Salt + H_2S

$Na_2S + 2HCl \xrightarrow{dil} 2NaCl + H_2S$

$FeS + 2HCl \xrightarrow{dil} FeCl_2 + H_2S$

$CuS + 2HCl \longrightarrow CuCl_2 + H_2S$

Black dil Blue

Observation: A colourless, rotten egg smelling acidic gas is evolved which turns moist lead acetate paper silvery black.

8) $Pb(NO_3)_2 + 2HCl \xrightarrow{dil} PbCl_2 + 2HNO_3$ (white ppt.)

$PbCl_2$ is a white ppt. soluble in hot water.

9) $AgNO_3 + HCl \xrightarrow{dil} AgCl + HNO_3$ (white ppt.)

AgCl is a white ppt soluble in excess of NH_4OH solution (NH_3 solution)

10) $CuO + 2HCl \longrightarrow CuCl_2 + H_2O$

Black dil Blue

11) Oxidising agents oxidized conc. HCl to greenish yellow Cl_2 gas.

$MnO_2 + 4HCl\ (conc) \xrightarrow{\Delta} MnCl_2 + 2H_2O + Cl_2$

12) Aqua regia is a mixture of 1 part of conc. HNO_3 + 3 parts of concentrate HCl (Oxidising agent)

Electrolysis

1. Electrolysis of Molten Lead Bromide

Dissociation Reaction

$PbBr_2 \rightleftharpoons Pb^{2+} + 2Br^-$

At cathode

$Pb^{2+} + 2e^- \longrightarrow Pb$

observation – silvery grey metal deposit

At Anode

$Br^- - e^- \longrightarrow Br$

$Br + Br \longrightarrow Br_2$

observation – reddish brown fumes

2. Electrolysis of Acidified Water

Dissociation Reactions

$H_2SO_4 \rightleftharpoons 2H^+ + SO_4^{2-}$

$H_2O \rightleftharpoons H^+ + OH^-$

At cathode

$H^+ + e^- \longrightarrow H \quad X\ 4$

$2H + 2H \longrightarrow 2H_2$

Observation – a neutral gas evolved which burns with pale blue flame and pop sound

At Anode

$OH^- - e^- \longrightarrow OH \quad X\ 4$

$4OH \longrightarrow 2H_2O + O_2$

Observation – neutral gas evolved which rekindle the glowing splinter

3. Electrolysis of Aq. Copper sulphate using inert electrode

Dissociation Reactions

$CuSO_4 \rightleftharpoons Cu^{2+} + SO_4^{2-}$

$H_2O \rightleftharpoons H^+ + OH^-$

At cathode

$Cu^{2+} + 2e^- \longrightarrow Cu$

Observation – Size of Cathode Increases

At Anode

$OH^- - e^- \longrightarrow OH \quad X\ 4$

$4OH \longrightarrow 2H_2O + O_2$

Observation – neutral gas evolved which rekindle the glowing splinter

Electrolysis

4. Electrolysis of Aq. Copper sulphate using Active (Copper) electrode

Dissociation Reactions

$CuSO_4 \rightleftharpoons Cu^{2+} + SO_4^{2-}$

$H_2O \rightleftharpoons H^+ + OH^-$

At cathode

$Cu^{2+} + 2e^- \longrightarrow Cu$

Observation – Size of Cathode Increases

At Anode

$Cu - 2e^- \longrightarrow Cu^{2+}$

Observation – Size of anode diminishes

5. Electroplating with Nickel

Dissociation Reactions of Aq. Nickel Sulphate

$NiSO_4 \rightleftharpoons Cu^{2+} + SO_4^{2-}$

$H_2O \rightleftharpoons H^+ + OH^-$

At cathode

$Ni^{2+} + 2e^- \longrightarrow Ni$

Observation – Size of Cathode Increases

At Anode

$Ni - 2e^- \longrightarrow Ni^{2+}$

Observation – Size of anode diminishes

6. Electroplating with Silver

Dissociation Reactions of Aq. Solution of Sodium Silver Cyanide

$Na[Ag(CN)_2] \rightleftharpoons Na^+ + Ag^+ + 2CN^-$

$H_2O \rightleftharpoons H^+ + OH^-$

At cathode

$Ag^+ + e^- \longrightarrow Ag$

Observation – Size of Cathode Increases

At Anode

$Ag - e^- \longrightarrow Ag^+$

Observation – Size of anode diminishes

Electrolysis

7. Electrorefining of Impure Copper

Dissociation Reactions

$CuSO_4 \rightleftharpoons Cu^{2+} + SO_4^{2-}$

$H_2O \rightleftharpoons H^+ + OH^-$

At cathode

$Cu^{2+} + 2e^- \longrightarrow Cu$

Observation – Size of Cathode Increases

At Anode

$Cu - 2e^- \longrightarrow Cu^{2+}$

Observation – Size of anode diminishes

Metallurgy

1) Bayer's Process

$$\underset{\text{Impure bauxite}}{Al_2O_3.2H_2O} + \underset{\text{conc.}}{2NaOH} \xrightarrow{150 \text{ to } 200^\circ C} \underset{\text{Sodium Aluminate (Salt)}}{2NaAlO_2} + 3H_2O$$

$$\underset{\text{Sodium Aluminate}}{NaAlO_2} + 2H_2O \xrightarrow{50 \text{ to } 60^\circ C} NaOH + \underset{\text{Aluminum Hydroxide}}{Al(OH)_3} \downarrow$$

$$2Al(OH)_3 \xrightarrow{1100^\circ C} \underset{\text{Pure Alumina}}{Al_2O_3} + 3H_2O$$

Electrolytic reactions

$$Al_2O_3 \rightleftharpoons 2Al^{3+} + 3O^{2-}$$

At Cathode – $2Al^{3+} + 6e^- \longrightarrow 2Al$

At Anode - $3O^{2-} - 6e^- \longrightarrow 3[O]$

$3[O] + 3[O] \longrightarrow 3O_2$

Product formed

At Cathode – Pure Aluminum metal

At Anode - Oxygen gas [CO & CO_2]

Organic Chemistry

A. Laboratory Preparation of Methane & Ethane

1. Sodium acetate + Soda lime (NaOH + CaO)

$$\underset{\text{Sodium ethanoate}}{CH_3COONa} + NaOH \xrightarrow[\Delta]{CaO} Na_2CO_3 + \underset{\text{Methane}}{CH_4}$$

2. Sodium propionate + Soda lime (NaOH + CaO)

$$\underset{\text{Sodium propanoate}}{C_2H_5COONa} + NaOH \xrightarrow[\Delta]{CaO} Na_2CO_3 + \underset{\text{Ethane}}{C_2H_6}$$

B. From Alkyl Halides

$$\underset{\text{Methyl Iodide}}{CH_3I} + \underset{\text{Nascent Hydrogen}}{2[H]} \xrightarrow{Zn\ /\ Cu\ Couple\ in\ Alcohol} \underset{\text{Methane}}{CH_4} + \underset{\text{Hydrogen Iodide}}{HCl}$$

$$\underset{\text{Ethyl Chloride}}{C_2H_5Cl} + \underset{\text{Nascent Hydrogen}}{2[H]} \xrightarrow{Zn\ /\ Cu\ Couple\ in\ Alcohol} \underset{\text{Ethane}}{C_2H_6} + \underset{\text{Hydrogen Chloride}}{HCl}$$

Substitution Reactions (By only saturated Hydrocarbons) of Methane and Ethane

$$CH_4 + Cl_2 \xrightarrow{Diffused\ Sunlight} CH_3Cl + HCl$$

$$CH_3Cl + Cl_2 \xrightarrow{Diffused\ Sunlight} CH_2Cl_2 + HCl$$

$$CH_2Cl_2 + Cl_2 \xrightarrow{Diffused\ Sunlight} CHCl_3 + HCl \quad \text{(formation of chloroform)}$$

$$CHCl_3 + Cl_2 \xrightarrow{Diffused\ Sunlight} CCl_4 + HCl \quad \text{(formation of Carbon tetra chloride)}$$

$$CH_4 + 4Cl_2 \xrightarrow{Diffused\ Sunlight} CCl_4 + 4HCl$$

$$C_2H_6 + Cl_2 \xrightarrow{Diffused\ Sunlight} C_2H_5Cl + HCl$$

$$C_2H_5Cl + Cl_2 \xrightarrow{Diffused\ Sunlight} C_2H_4Cl_2 + HCl$$

$$C_2H_4Cl_2 + Cl_2 \xrightarrow{Diffused\ Sunlight} C_2H_3Cl_3 + HCl$$

$$C_2H_3Cl_3 + Cl_2 \xrightarrow{Diffused\ Sunlight} C_2H_2Cl_4 + HCl$$

$$C_2H_2Cl_4 + Cl_2 \xrightarrow{Diffused\ Sunlight} C_2HCl_5 + HCl$$

$$C_2HCl_5 + Cl_2 \xrightarrow{Diffused\ Sunlight} C_2Cl_6 + HCl$$

Organic Chemistry

Oxidation Reactions

Complete oxidation (oxygen in excess)

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$

$$2C_2H_6 + 7O_2 \longrightarrow 4CO_2 + 6H_2O$$

Lab Preparation of Ethene (ethylene)

1. Ethanol (Ethyl Alcohol) ⟶ Ethene (ethylene)

$$C_2H_5OH \xrightarrow[170^oC]{conc.\ H_2SO_4} C_2H_4 + H_2O$$

$$C_2H_5OH \xrightarrow[350^oC]{Al_2O_3} C_2H_4 + H_2O$$

2. Bromo ethane (Ethyl Bromide) ⟶ Ethene (Ethylene)

$$C_2H_5Br + KOH \xrightarrow[\text{alcoholic}]{Boil} C_2H_4 + H_2O + KBr$$

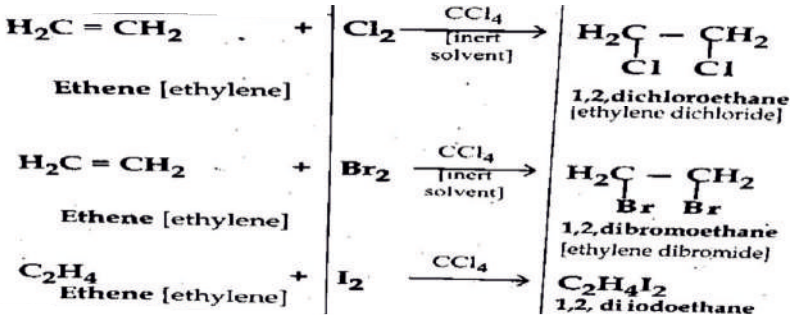
Addition Reactions By Alkenes

1. Catalytic Hydrogenation

Ethene ⟶ Ethane

$$H_2C = CH_2 + H_2 \xrightarrow[300^oC]{Nickel} H_3C -$$

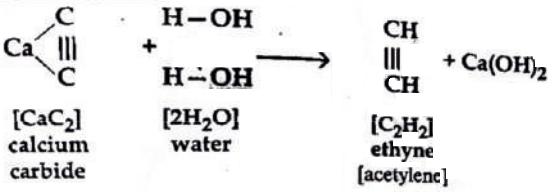
2. Halogenation



Organic Chemistry

Lab Preparation of Ethyne (ethylene)

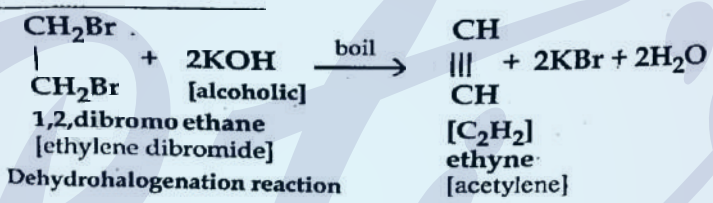
Calcium carbide



Preparation of calcium carbide

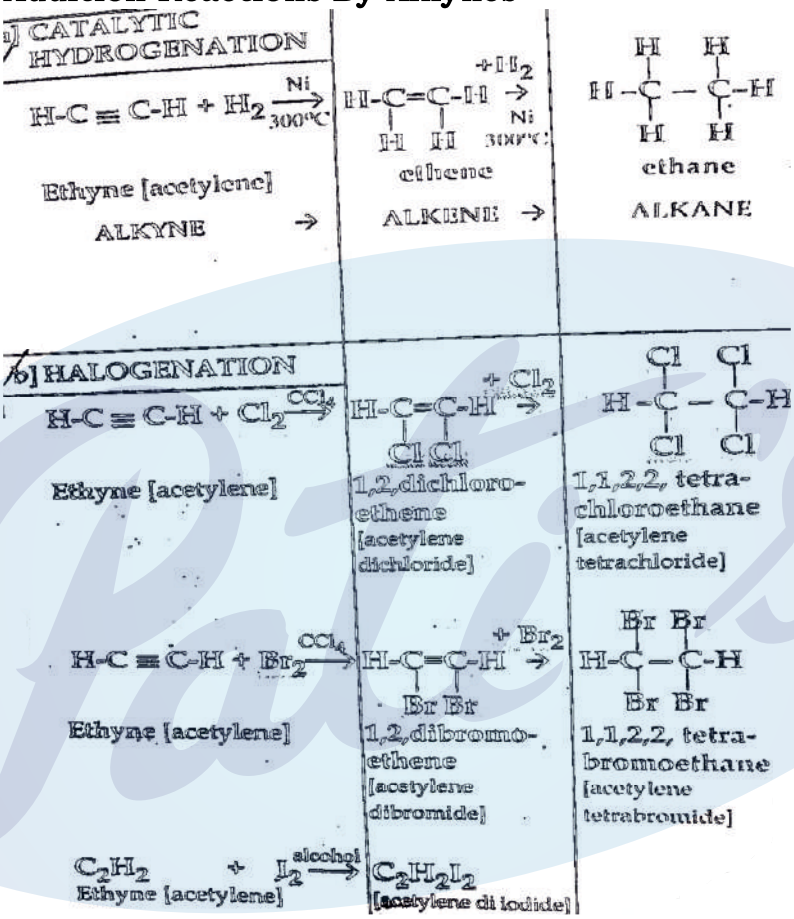
$[CaO + 3C \xrightarrow{2000^{\circ}C} CaC_2 + CO]$

1,2 dibromoethane
[ethylene dibromide]



Organic Chemistry

Addition Reactions By Alkynes



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