

Short Notes: Form 5 Chemistry

Rate of Reaction

Calculation

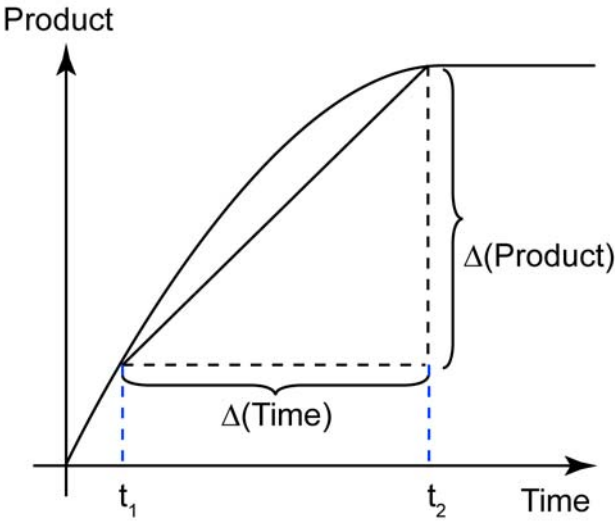
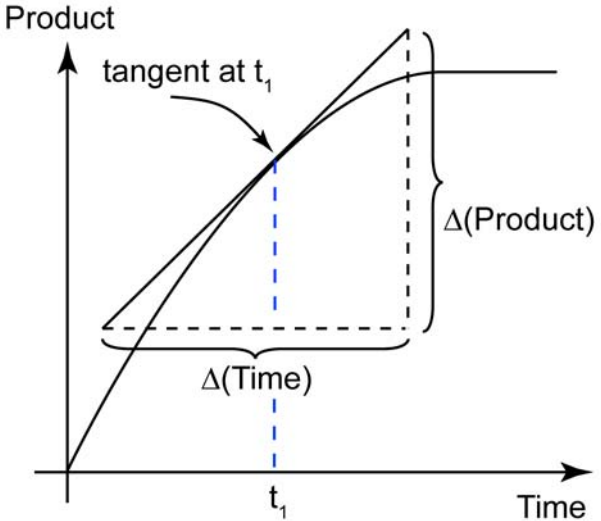
Rate of Reaction (Average Rate)

$$\text{Rates of reaction} = \frac{\text{Quantity change of reactants/products}}{\text{Total time for the reaction}}$$

If the quantity change is immeasurable

$$\text{Rates of reaction} = \frac{1}{\text{Total time for the reaction}}$$

Find the Rate From a Graph

Average Rate	Rates At an Instant
<p>The rate of reaction is equal to the slope of the graph of quantity against time.</p> $\text{Rate of Reaction} = \frac{\Delta(\text{Product})}{\Delta(\text{Time})}$ 	<p>The rate of reaction at an instant, t, is equal to the slope of tangent at that instant.</p> $\text{Rate of Reaction} = \frac{\Delta(\text{Product})}{\Delta(\text{Time})}$ 

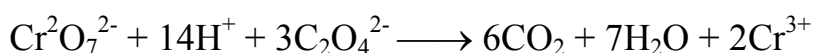
Chemical Reaction**Precipitation of Sulphur**

**Notes:**

1. Yellow precipitate (sulphur) is formed.
2. The reaction is slow.

$\text{Na}_2\text{S}_2\text{O}_3$: Sodium thiosulphate

Potassium Dichromate (VI) with Ethanedioic Acid

**Notes:**

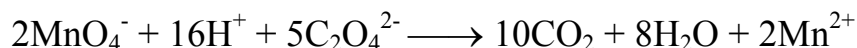
1. In the reaction, the orange colour of the solution turns into green.

$\text{Cr}^2\text{O}_7^{2-}$: dichromate(VI) ion (Orange)

$\text{C}_2\text{O}_4^{2-}$: ethanedioate ion (Colourless)

Cr^{3+} : Chromium(III) ion (green)

Potassium Manganate(VII) with Ethanedioic Acid

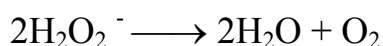
**Notes:**

1. Mn^{2+} is colourless
2. In the reaction, the purple colour of the solution turns into colourless.

MnO_4^- : Manganate(VII) ion (Purple)

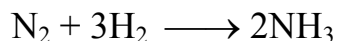
Mn^{2+} : Manganese(II) ion colourless

Decomposition of Hydrogen Peroxide



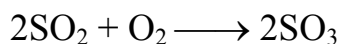
Catalyst: manganese(IV) oxide(MnO_2), Iron(III) oxide (Fe_2O_3), silver (Ag)

Haber Process (Manufacture Ammonia)



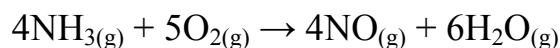
(More detail in Form 4 Chapter 9)

Contact Process(Manufacture Sulphuric Acid)

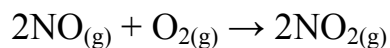
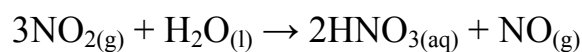


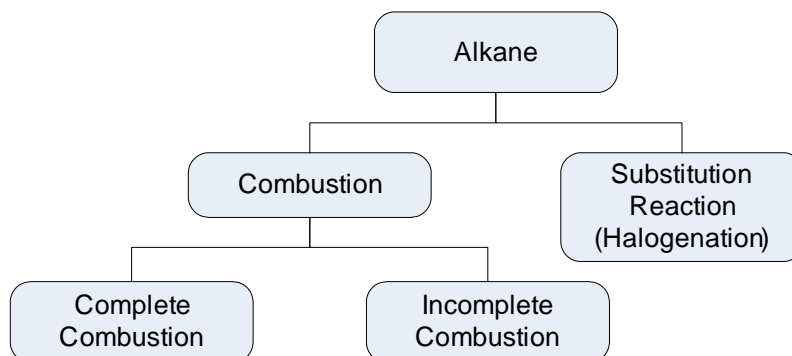
(More detail in Form 4 Chapter 9)

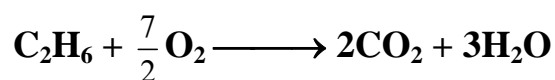
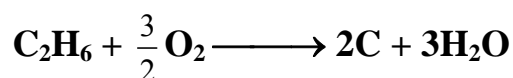
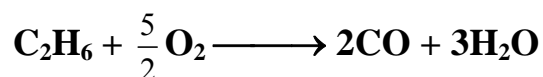
Ostwald Process (Manufacture Nitric Acid)

Stage 1**Notes:**

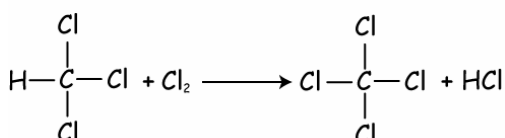
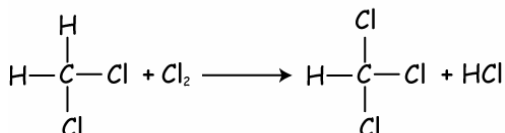
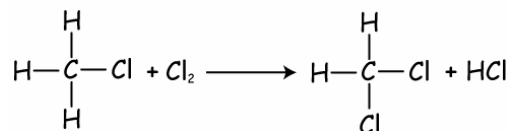
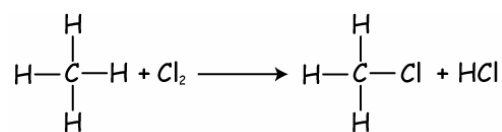
1. Temperature = 900oC
2. Pressure = 4-10 atm
3. Catalyse = Platinum (Pt)

Stage 2**Dissolve in water****Carbon Compound****Alkane**

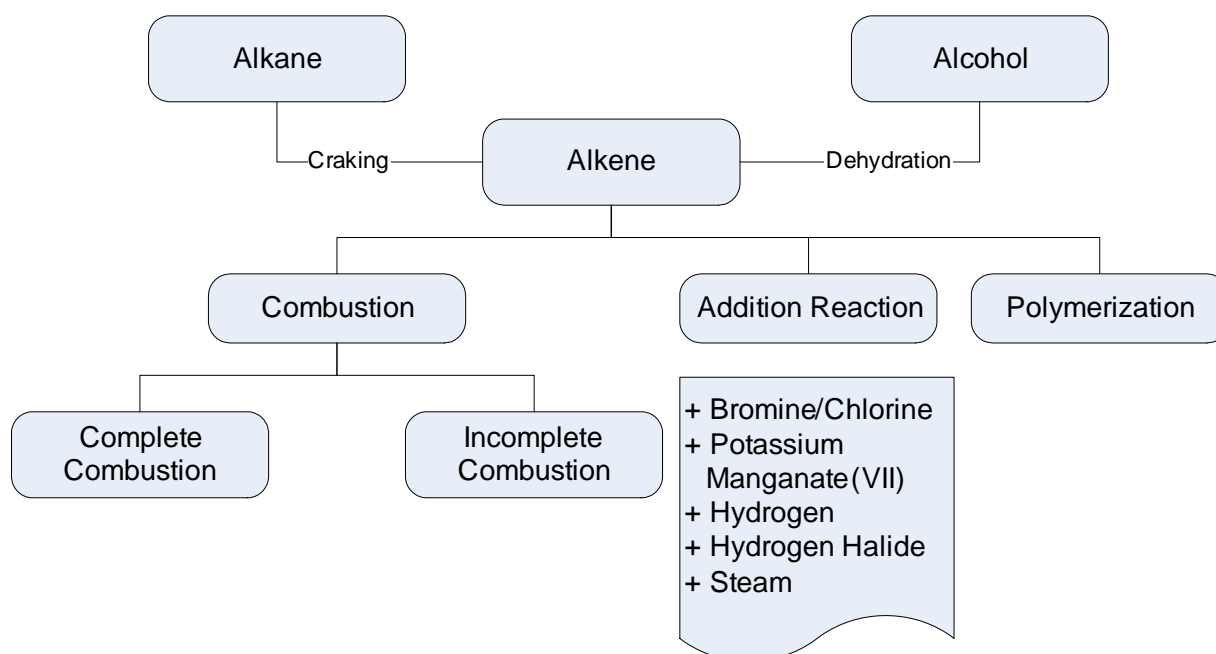
**Combustion**

Complete combustion**Incomplete combustion**

Substitution Reaction

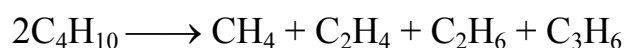


Alkene

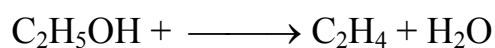


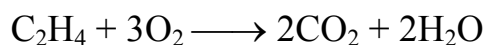
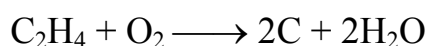
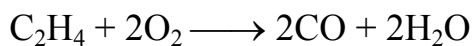
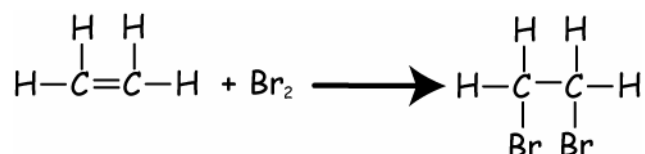
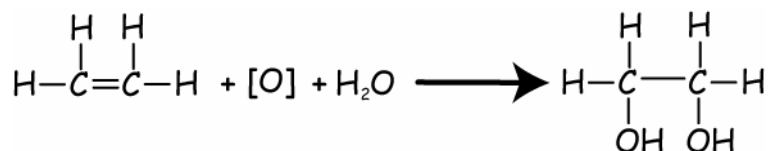
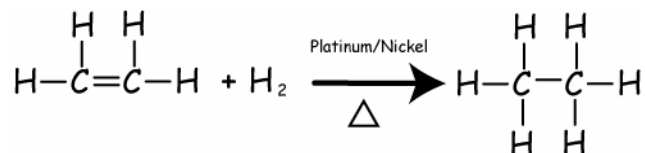
Preparation of Alkene

Cracking of Alkane

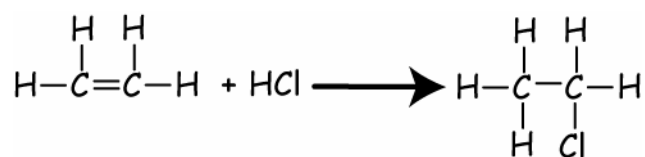
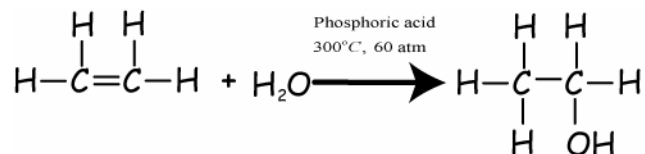


Dehydration of Alcohol

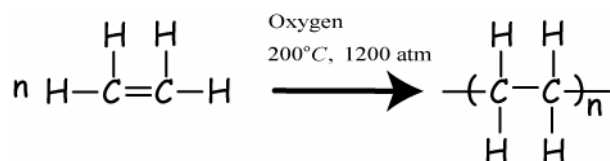


Combustion:**Complete combustion:****Incomplete combustion****Addition Reaction:****+ Bromine:****+ Potassium Manganate(VII):****+ Hydrogen:**

(Catalyst: platinum/nickel)

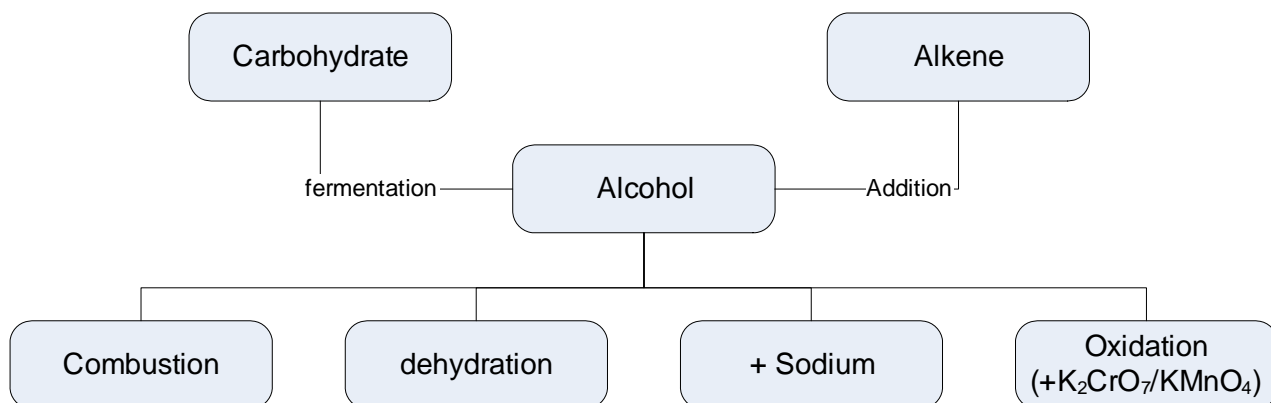
+ Hydrogen Halide:**+ Steam (H₂O):**

(Catalyst: phosphoric acid; Temperature: 300°C; Pressure: 60atm)

Polymerization

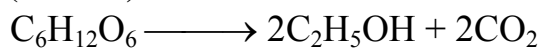
(Catalyst: oxygen; Temperature: 200°C; Pressure: 1200atm)

Alcohol

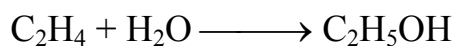


Preparation of alcohol

Fermentation of Carbohydrate (Glucose)

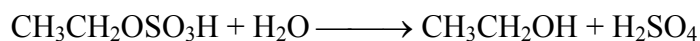
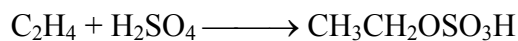


Addition of Alkene

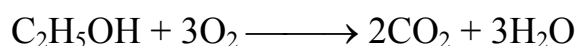


[Catalyst: Phosphoric acid; Temperature: 300°C; Pressure: 60atm]

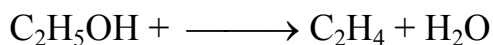
or



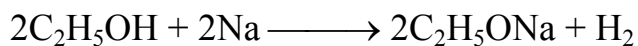
Combustion of Alcohol



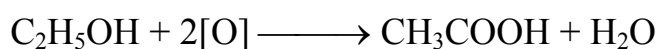
Dehydration of Alcohol

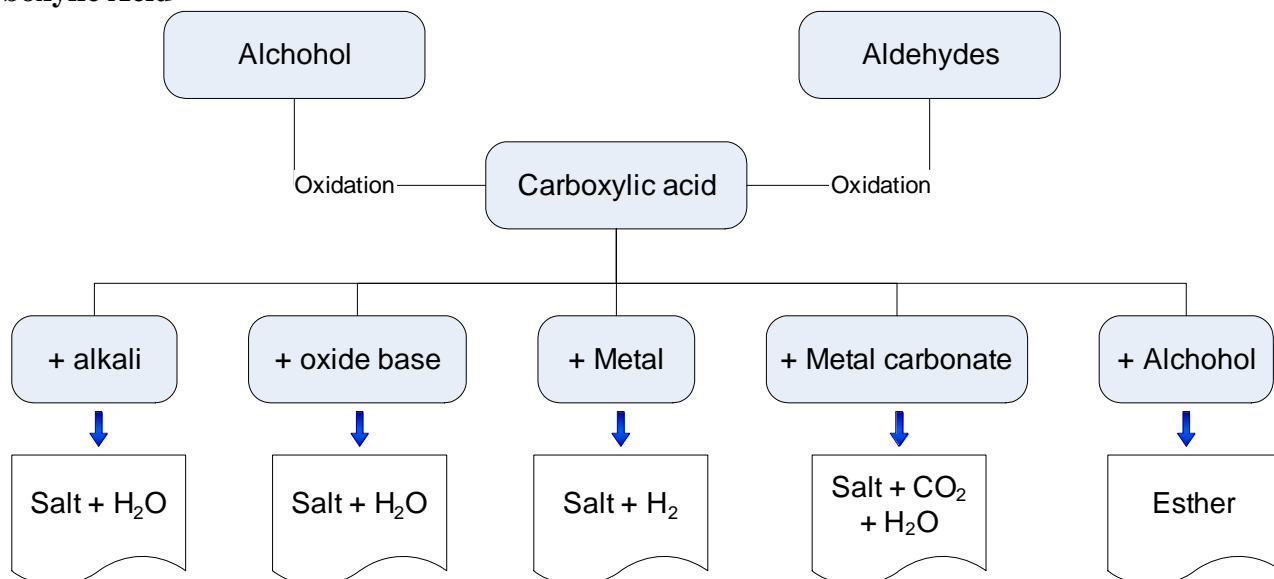
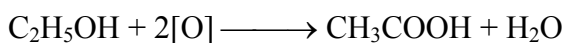
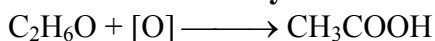
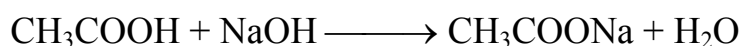
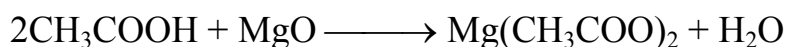
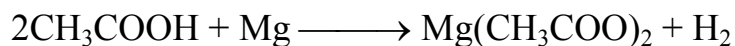
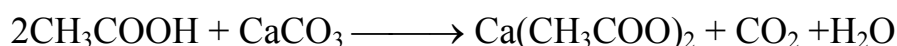
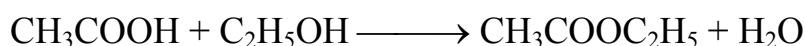


Alcohol + Sodium

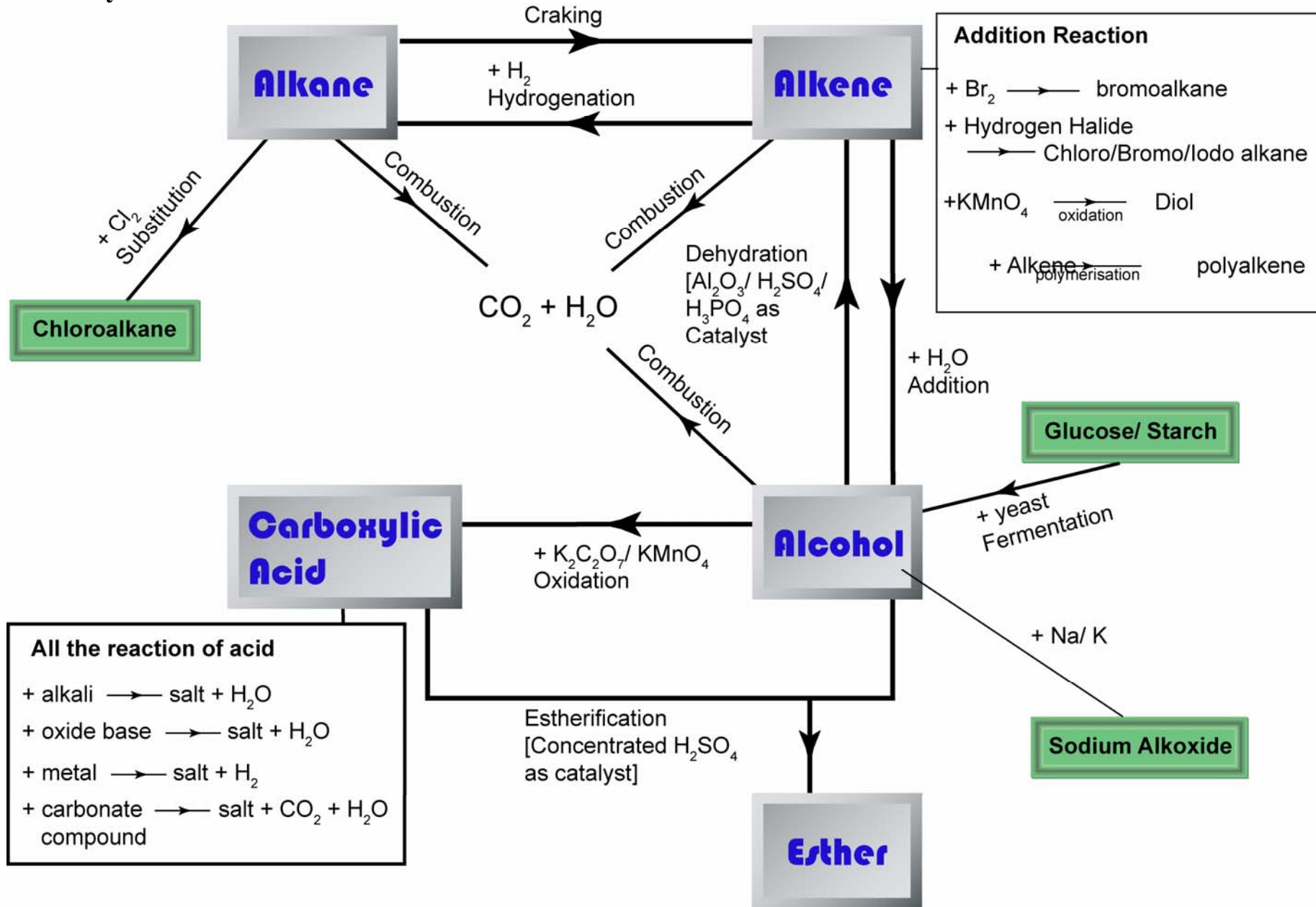


Oxidation of Alcohol



Carboxylic Acid**Preparation of Carboxylic acid****Oxidation of Alcohol****Oxidation of Aldehyde****Reaction****Carboxylic Acid + Alkali****Carboxylic Acid + Metal Oxide****Carboxylic Acid + Metal****Carboxylic Acid + Metal Carbonate****Carboxylic Acid + Alcohol**

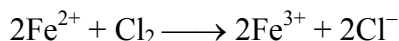
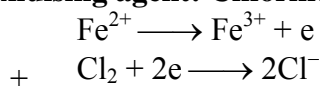
Summary of The Reaction



Oxidation and Reduction

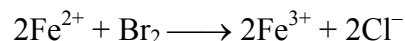
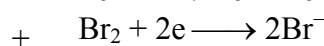
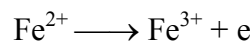
Iron(II) to Iron(III)

Oxidising agent: Chlorine or Bromine



Observation:

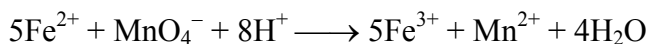
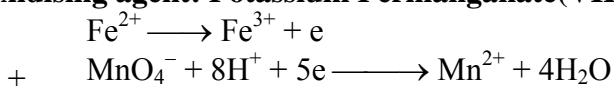
1. The green colour of Fe^{2+} solution turns brown



Observation:

1. The green colour of Fe^{2+} solution turn brown
2. The brown colour of bromine water turns into colourless.

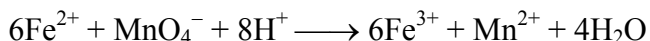
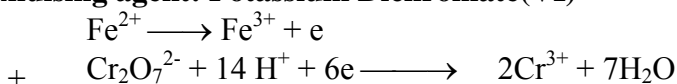
Oxidising agent: Potassium Permanganate(VII)



Observation:

1. The green colour of solution Fe^{2+} turns brown
2. The purple colour of the MnO_4^- solution turns into colourless

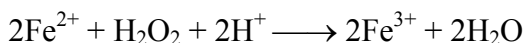
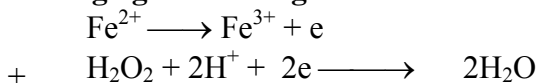
Oxidising agent: Potassium Dichromate(VI)



Observation:

1. The green colour of solution Fe^{2+} turns brown.
2. The orange colour of the $\text{Cr}_2\text{O}_7^{2-}$ solution turns green.

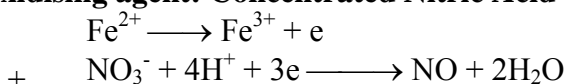
Oxidising agent: Hydrogen Peroxide



Observation:

1. The green colour of solution Fe^{2+} turns brown

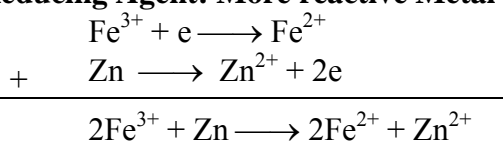
Oxidising agent: Concentrated Nitric Acid



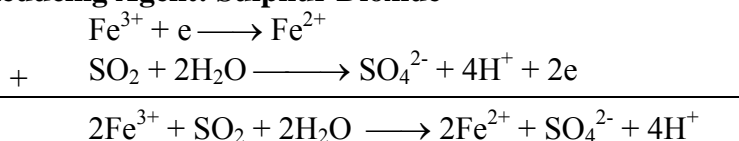
Observation:

1. The green colour of solution Fe^{2+} turns brown

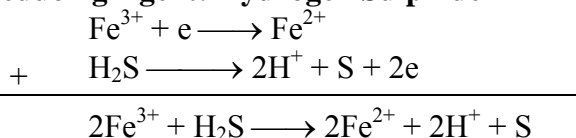
Iron(III) to Iron(II)

Reducing Agent: More reactive Metal**Observation:**

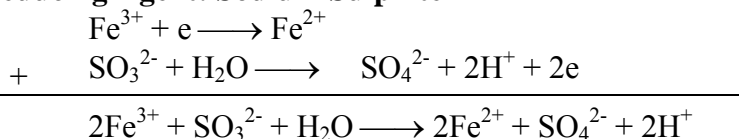
1. The brown colour of the iron(III) solution turn green.
2. Zinc powder dissolve in the solution.

Reducing Agent: Sulphur Dioxide**Observation:**

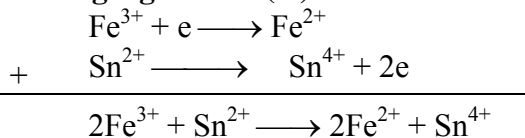
1. The brown colour of the iron(III) solution turn green.

Reducing Agent: Hydrogen Sulphide**Observation:**

1. The brown colour of the iron(III) solution turn green.
2. Yellow precipitate forms in the solution.

Reducing Agent: Sodium Sulphite**Observation:**

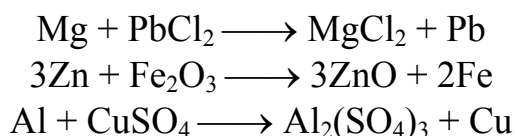
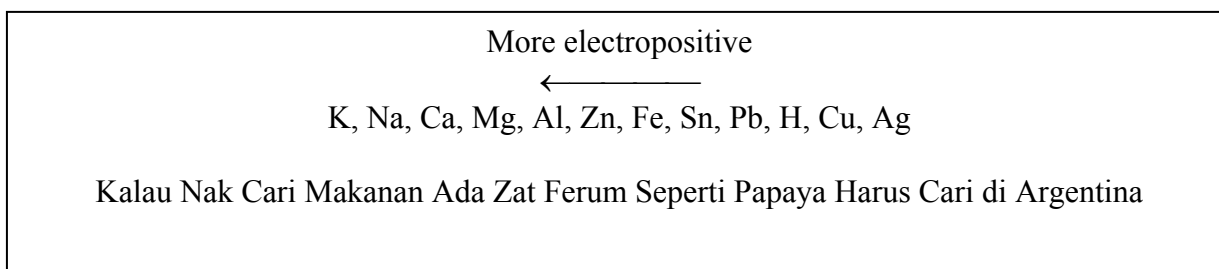
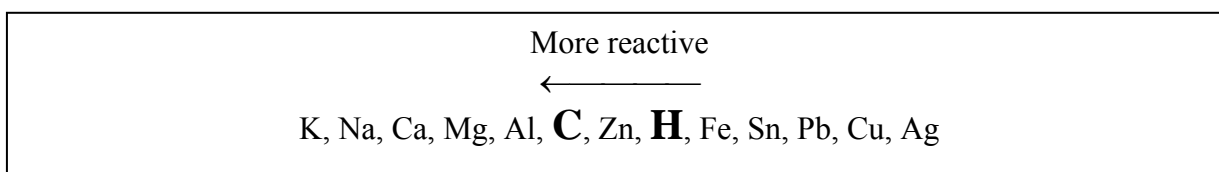
1. The brown colour of the iron(III) solution turn green.

Reducing Agent: Tin(II) Chloride**Observation:**

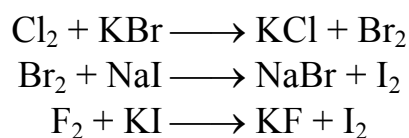
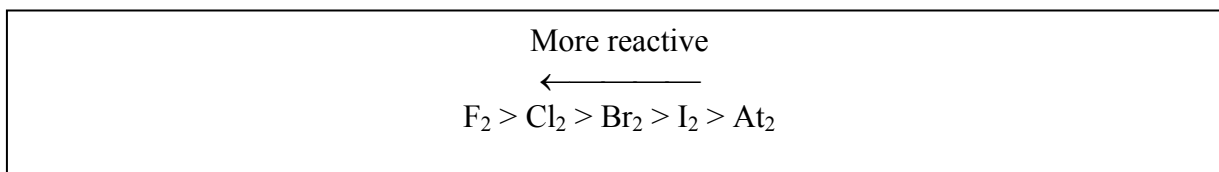
1. The brown colour of the iron(III) solution turn green.

Displacement of Metal

[A more reactive metal can displace a less reactive ion of metal from its compound.]

Example:**Electrochemical Series****Reactivity Series****Displacement of Halogen**

[A more reactive halogen can displace a less reactive halide from its compound.]

Example:**Reactivity of Halogen****Colour of Halogen and Halide**

Halogen	Colour in water	Colour in CCl_4
Chlorine (Cl_2)	Pale Yellow	Pale Yellow
Bromine (Br_2)	Brown/Orange/ Yellow	Brown/Orange/ Yellow
Iodine (I_2)	Brown/Orange/ Yellow	Purple

Halogen	Colour in water	Colour in CCl_4
Chloride (Cl^-)	Colourless	Colourless
Bromide (Br^-)	Colourless	Colourless
Iodide (I^-)	Colourless	Colourless

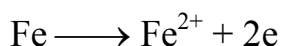
The Oxidising Agent and Reducing Agent

Oxidising Agent (Reduction)	Reducing Agent (Oxidation)
Halogen $\text{Cl}_2 + 2\text{e} \longrightarrow 2\text{Cl}^-$ $\text{Br}_2 + 2\text{e} \longrightarrow 2\text{Br}^-$ $\text{I}_2 + 2\text{e} \longrightarrow 2\text{I}^-$	Metal $\text{Mg} \longrightarrow \text{Mg}^{2+} + 2\text{e}$ $\text{Zn} \longrightarrow \text{Zn}^{2+} + 2\text{e}$ $\text{Al} \longrightarrow \text{Al}^{3+} + 2\text{e}$
Metal Ion $\text{Mg}^{2+} + 2\text{e} \longrightarrow \text{Mg}$ $\text{Pb}^{2+} + 2\text{e} \longrightarrow \text{Pb}$ $\text{Sn}^{2+} + 2\text{e} \longrightarrow \text{Sn}$	Halide Ion $2\text{Cl}^- \longrightarrow \text{Cl}_2 + 2\text{e}$ $2\text{Br}^- \longrightarrow \text{Br}_2 + 2\text{e}$ $2\text{I}^- \longrightarrow \text{I}_2 + 2\text{e}$
Fe³⁺ $\text{Fe}^{3+} + \text{e} \longrightarrow \text{Fe}^{2+}$	Fe²⁺ $\text{Fe}^{2+} \longrightarrow \text{Fe}^{3+} + \text{e}$
Potassium Manganate(VII) $\text{MnO}_4^- + 8\text{H}^+ + 5\text{e} \longrightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$	Sulphur Dioxide $\text{SO}_2 + 2\text{H}_2\text{O} \longrightarrow \text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}$
Potassium Dichromate(VI) $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6\text{e} \longrightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	Hydrogen Sulphide $\text{H}_2\text{S} \longrightarrow 2\text{H}^+ + \text{S} + 2\text{e}$
Hydrogen Peroxide $\text{H}_2\text{O}_2 + 2\text{H}^+ + 2\text{e} \longrightarrow 2\text{H}_2\text{O}$	Sodium Sulphite Aqueous $\text{SO}_3^{2-} + \text{H}_2\text{O} \longrightarrow \text{SO}_4^{2-} + 2\text{H}^+ + 2\text{e}$
Concentrated Nitric Acid $\text{NO}_3^- + 4\text{H}^+ + 3\text{e} \longrightarrow \text{NO} + 2\text{H}_2\text{O}$	Tin(II) Chloride Aqueous $\text{Sn}^{2+} \longrightarrow \text{Sn}^{4+} + 2\text{e}$

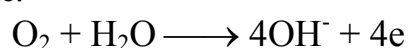
Rusting

Step 1: Formation of Ion

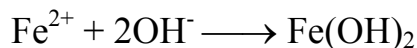
Anode:



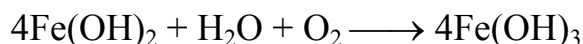
Cathode:



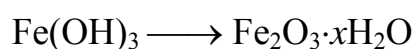
Step 2: Corrosion of Iron



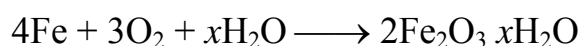
Step 3: Formation of iron(III) hydroxide



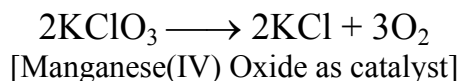
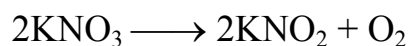
Step 4: Formation of Hydrated Iron(III) Oxide

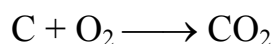
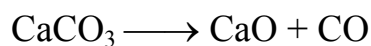


General Equation

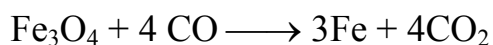
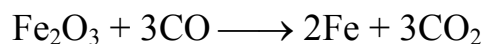


Preparation of Oxygen Gas

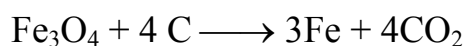
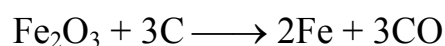
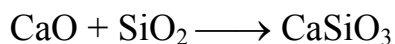
Decomposition of Potassium Manganate (VII)**Decomposition of Potassium Chlorate (V)****Decomposition of Potassium Nitrate****Extraction of Iron From Its Ore**

Production of Carbon Dioxide**Production of Carbon Monoxide****Reduction of Iron Ore to Iron**

Upper Section of the Ballast Furnace



Lower Section of the Ballast Furnace

**Removal of Impurities**

Thermochemistry

Calculation

Heat of Reaction

$$\Delta H = \frac{\text{Thermal Energy Change}}{\text{Number of Mole}}$$

Thermal Energy Change

$$Q = mc\Delta\theta$$

m = mass of solution = volume of solution
 c = specific heat capacity of solution

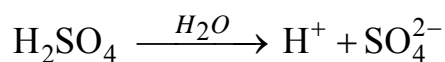
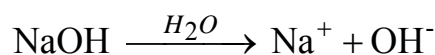
Number of Mole

For solution $n = \frac{MV}{1000}$	For gas (When volume is given) $n = \frac{\text{Volume of gas}}{\text{Molar volume of gas (22.4dm}^3 \text{ at stp / 24dm}^3 \text{ at rtp)}}$
	For solid, liquid or gas (When mass is given) $n = \frac{\text{mass}}{\text{Molar mass (RAM/RMM)}}$

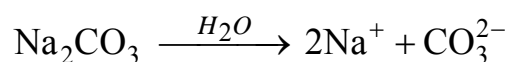
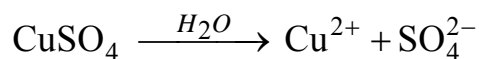
Chemical Reaction

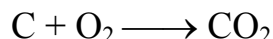
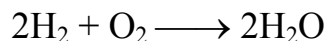
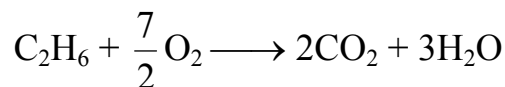
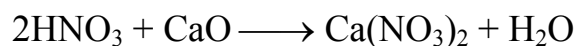
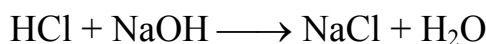
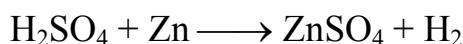
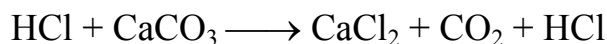
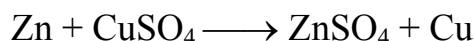
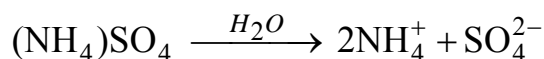
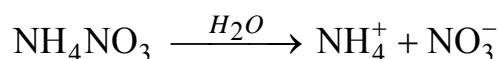
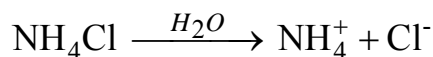
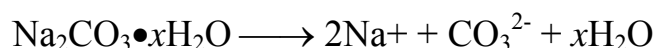
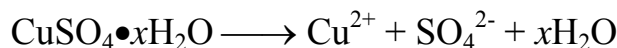
Exothermic Reaction

Dissolving Alkali or Acid



Dissolving of Anhydrous Salt



Combustion of Fuel**Example:****Combustion of Carbon****Combustion of Hydrogen****Combustion of Ethane****Reaction of Acid****Neutralisation****Acid + Reactive Metal****Acid + Carbonate Acid****Displacement Reaction****Endothermic Reaction****Dissolving of Ammonium Chloride, Ammonium Nitrate and Ammonium Sulphate****Dissolving of Hydrated Salt****Thermal Decomposition of salts**