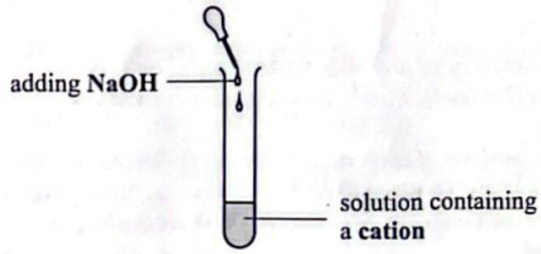
Testing of cations with NaOH solution

- The observations when the reagent NaOH is added:

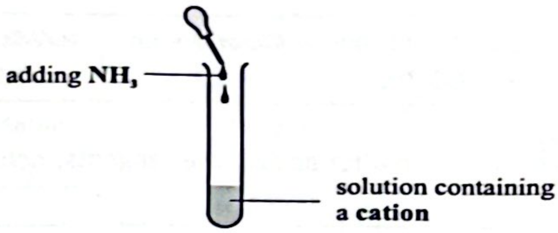


Amp

Ion	A few drops of NaOH	In excess of NaOH
Ca^{2+}	**White** precipitate of $Ca(OH)_2$ formed *Ionic equation* $Ca^{2+}(aq) + 2OH^-(aq) \rightarrow Ca(OH)_2(s)$	White precipitate **remained**
Zn^{2+}	**White** precipitate of $Zn(OH)_2$ formed *Ionic equation* $Zn^{2+}(aq) + 2OH^-(aq) \rightarrow Zn(OH)_2(s)$	White precipitate **dissolved**
Al^{3+}	**White** precipitate of $Al(OH)_3$ formed *Ionic equation* $Al^{3+}(aq) + 3OH^-(aq) \rightarrow Al(OH)_3(s)$	White precipitate **dissolved**
Fe^{2+}	**Green** precipitate of $Fe(OH)_2$ formed *Ionic equation* $Fe^{2+}(aq) + 2OH^-(aq) \rightarrow Fe(OH)_2(s)$	Green precipitate **remained**
Fe^{3+}	**Reddish brown** precipitate of $Fe(OH)_3$ formed *Ionic equation* $Fe^{3+}(aq) + 3OH^-(aq) \rightarrow Fe(OH)_3(s)$	Reddish brown precipitate **remained**
Cu^{2+}	**Blue** precipitate of $Cu(OH)_2$ formed *Ionic equation* $Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$	Blue precipitate **remained**
NH_4^+	No precipitate formed Ammonia gas (NH_3) released when heated	—

Testing of cations with aqueous NH_3

- The observations when the reagent NH_3 is added:



Ion	A few drops of NH_3	In excess of NH_3
Ca^{2+}	**No precipitation**	—
Zn^{2+}	**White** precipitate of $Zn(OH)_2$ formed *Ionic equation* $Zn^{2+}(aq) + 2OH^-(aq) \rightarrow Zn(OH)_2(s)$	White precipitate **dissolved**
Al^{3+}	**White** precipitate of $Al(OH)_3$ formed *Ionic equation* $Al^{3+}(aq) + 3OH^-(aq) \rightarrow Al(OH)_3(s)$	White precipitate **remained**
Fe^{2+}	**Green** precipitate of $Fe(OH)_2$ formed *Ionic equation* $Fe^{2+}(aq) + 2OH^-(aq) \rightarrow Fe(OH)_2(s)$	Green precipitate **remained**
Fe^{3+}	**Reddish brown** precipitate of $Fe(OH)_3$ formed *Ionic equation* $Fe^{3+}(aq) + 3OH^-(aq) \rightarrow Fe(OH)_3(s)$	Reddish brown precipitate **remained**
Cu^{2+}	**Blue** precipitate of $Cu(OH)_2$ formed *Ionic equation* $Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$	Blue precipitate **dissolved** to give **dark blue solution**

Tests for anions

- The anions to be identified in this syllabus:

Nitrate ion NO_3^-	Carbonate ion CO_3^{2-}	Chloride ion Cl^-	Iodide ion I^-	Sulfate ion SO_4^{2-}

- To confirm the identity of an anion after adding the reagents, note the following observations:

Anions	Observation
NO_3^-, CO_3^{2-}	Test for gas released
Cl^-, I^-, SO_4^{2-}	Observe the colour of precipitation

Observations for identifying negative ions

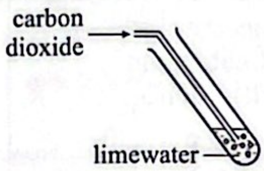
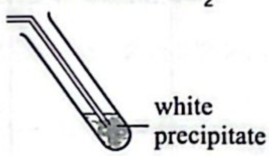
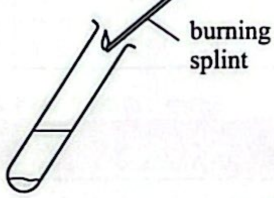
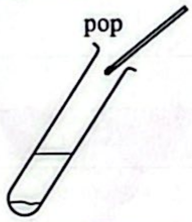
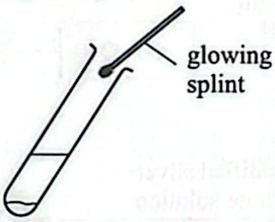
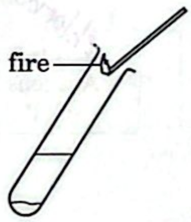
Ion	Reagent used	Observation
NO_3^-	• Add aqueous **NaOH** followed by **aluminium** powder/foil. • Warm carefully. Use damp red litmus paper to test for gas released.	• **Effervescence** is observed due to the release of NH_3 gas. • **Damp red litmus paper turns blue.** (NH_3 is a weak alkali).
CO_3^{2-}	Add **any acid**. Use limewater to test for gas released.	• **Effervescence** is observed due to the release of CO_2 gas. • **White precipitate is formed in limewater** when CO_2 produced is bubbled into it.
Cl^-	Add dilute nitric acid followed by aqueous **silver** nitrate solution.	**White** precipitate of AgCl is formed. *Ionic equation* $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$
I^-		**Yellow** precipitate of AgI is formed. *Ionic equation* $Ag^+(aq) + I^-(aq) \rightarrow AgI(s)$
SO_4^{2-}	Add dilute nitric acid followed by aqueous **barium** nitrate solution.	**White** precipitate of $BaSO_4$ is formed. *Ionic equation* $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$

Tests for gases

- The gases to be identified in this syllabus:

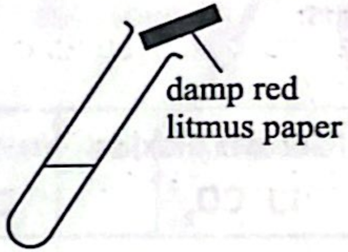
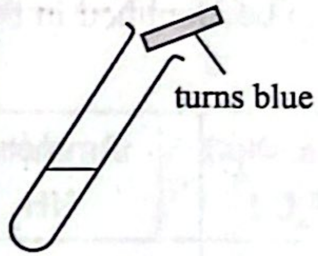
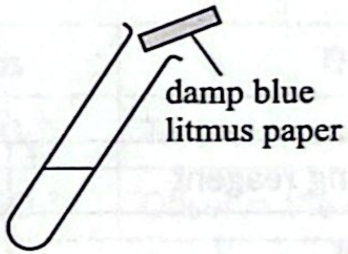
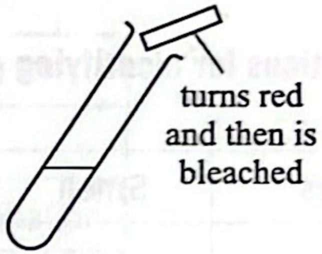
Ammonia NH_3	Carbon dioxide CO_2	Chlorine Cl_2
Hydrogen H_2	Oxygen O_2	Sulfur dioxide SO_2

Observations for identifying gases

Gas	Smell	Testing reagent	Observation
CO_2		Use limewater. 	**White precipitate** is formed and **dissolves in excess** CO_2. 
H_2	Odourless gases	Use a burning (or lighted) splint. 	The lighted splint **extinguishes** with a '**pop**' sound. 
O_2		Use a glowing splint. 	The glowing splint **relights / rekindled.** 

> **i** *Limewater, $Ca(OH)_2$, reacts with CO_2 to form white precipitate of calcium carbonate, $CaCO_3$.*
>
> *$Ca(OH)_2 + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$*
>
> *In excess CO_2, $CaCO_3$ redissolves to form soluble calcium bicarbonate*
>
> *$CaCO_3(s) + CO_2(g) + H_2O(l) \rightarrow Ca(HCO_3)_2(aq)$*

Unit 7

<table>
<tr><td>NH_3</td><td rowspan="3">Pungent gases</td><td>Use damp red litmus paper.

</td><td>Red litmus paper turns blue.

</td></tr>
<tr><td>Cl_2</td><td>Use damp blue litmus paper.

</td><td>Blue litmus paper turns red first before it is bleached.

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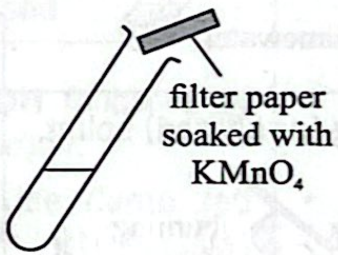
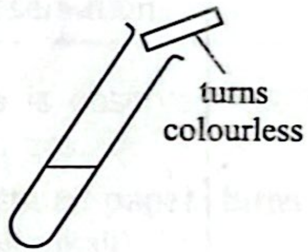
<tr><td>SO_2</td><td>Use a filter paper soaked with acidified potassium manganate(VII), $KMnO_4$.

</td><td>$KMnO_4$ changes from purple to colourless.

</td></tr>
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