START HERE
Add 2 drops NaOH to the sample

→ No precipitate: **Na^+**

→ Green precipitate: **Fe^{2+}**

→ Orange precipitate → New sample. Add 2 drops KSCN solution → Dark red solution: **Fe^{3+}**

→ Blue Precipitate → New sample.
- Add 2 drops NH_3
- Then add excess NH_3 solution

→
- Blue precipitate
- Blue precipitate dissolves in excess to give a deep blue solution: **Cu^{2+}**

→ Brown Precipitate → New sample.
- Add 2 drops NH_3
- Then add excess NH_3 solution

→
- Brown precipitate
- Brown precipitate dissolves in excess to give a colourless solution: **Ag^+**

→ White Precipitate

↓

Add excess NaOH solution → Precipitate remains → New sample. Add 2 drops dilute H_2SO_4

↓ ↙ ↘

Precipitate dissolves

Colourless solution: **Mg^{2+}**	White precipitate: **Ba^{2+}**

↓

New sample.
- Add 2 drops NH_3 solution
- Then add excess NH_3 solution

→
- White precipitate
- White precipitate dissolves in excess: **Zn^{2+}**

↓

- White precipitate
- White precipitate remains in excess

→ New sample. Add 2 drops dilute H_2SO_4

↗ White precipitate: **Pb^{2+}**

↘ Colourless solution **Al^{3+}**

To identify cations

Ag^+, Al^{3+}, Ba^{2+}, Cu^{2+}, Fe^{2+}, Fe^{3+}, Mg^{2+}, Pb^{2+}, Na^+, Zn^{2+}

Solution ___ (cation)

Test	Observations	Names of precipitates that form	Equations for formation of precipitates and complex ions
Add 2 drops NaOH	White precipitate	Lead hydroxide	$Pb^{2+}(aq) + 2OH^-(aq) \rightarrow Pb(OH)_2(s)$
Add excess NaOH	White precipitate dissolves	----------	$Pb^{2+}(aq) + 4OH^-(aq) \rightarrow [Pb(OH)_4]^{2-}(aq)$
New Sample Add 2 drops NH_3	White precipitate	Lead hydroxide	$Pb^{2+}(aq) + 2OH^-(aq) \rightarrow Pb(OH)_2(s)$
Add excess NH_3	White precipitate remains	----------	----------
New Sample Add dilute H_2SO_4	White precipitate forms	Lead sulfate	$Pb^{2+}(aq) + SO_4^{2-}(aq) \rightarrow PbSO_4(s)$

Justification for the elimination of other choices:

Only five ions give white precipitates with NaOH: Mg^{2+}, Ba^{2+}, Zn^{2+}, Al^{3+} and Pb^{2+}.

All others give coloured precipitates or no precipitate (Na^+) so it's not these.

Only Zn^{2+}, Al^{3+} and Pb^{2+} form a white precipitate AND a precipitate that dissolves to give a colourless complex ion with excess NaOH.

Since a white precipitate forms with NH_3 and remains in excess NH_3 then the ion is not Zn^{2+}. This leaves either Al^{3+} or Pb^{2+}.

Since a white precipitate forms with H_2SO_4 then it is not Al^{3+}/ it must be Pb^{2+}.

Ion is Pb^{2+} For use in 2018-2019