

Chemistry 12
 Tutorial 9 - SOLUTIONS
 Separating Ions By Precipitation and Qualitative Analysis

1. A solution is known to contain either Ag^+ or Ba^{2+} ions. (One but not the other). Look on the Solubility Table in the box with "Sulphide" (S^{2-}) on the left.

Sulphide, S^{2-}	Alkali ions, H^+ , NH_4^+ , Be^{2+} , Mg^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+}	Soluble

	All others	Low Solubility

S^{2-} ions are added to this solution and a precipitate DOES NOT FORM. Which ion, (Ag^+ or Ba^{2+}) is present in the solution?

Answer: Ba^{2+} (Ag^+ is in "All others" so it would form a ppt.)

2. A solution is known to contain either Ba^{2+} or Mg^{2+} ions.

Suggest a method by which these solutions could be analyzed to find out which ion is present.

Be specific about any *compounds* that are added.

Sulphate, SO_4^{2-}	All others	Soluble

	Ag^+ , Ca^{2+} , Sr^{2+} , Ba^{2+} , Pb^{2+}	Low Solubility

Mg²⁺ is in All others

To a sample of each solution, add some $\text{Na}_2\text{SO}_{4(\text{aq})}$. The one which forms a precipitate would be the one with the Ba^{2+} .

3. A solution is known to contain **one** of these ions: Mg^{2+} , Ca^{2+} , Sr^{2+} , or Be^{2+} . Mixing samples of the solution with various reagents gives the following data:

Reagent	Na_2S	Na_2SO_4	NaOH
Result	no ppt.	ppt.	no ppt.

From these data, which one of the four ions is present?

Use your solubility table to see how these are obtained:

	Mg^{2+}	Ca^{2+}	Sr^{2+}	Be^{2+}
no ppt. with S^{2-}	✓	✓	✓	✓
ppt. with SO_4^{2-}	x	✓	✓	✓
no ppt. with OH^-	x	x	✓	x

The only one which is consistent with all the data is Sr^{2+} , so that is the answer.

Answers to SELF-TEST on Tutorial 9

- You have 3 unlabelled test tubes containing I^- , Cu^{2+} , and Ca^{2+} . What procedures could you use to test these and find out which is which?
 - To a sample of each solution, add some $\text{AgNO}_3(\text{aq})$ solution. The one with the precipitate contains the I^- .
 - To samples of the other two solutions, add some $\text{Na}_2\text{SO}_4(\text{aq})$ solution. The one with the precipitate would be the Ca^{2+} .
 - The remaining solution would contain the Cu^{2+} .
- A solution contains both SO_4^{2-} and OH^- . Outline an experimental procedure to **remove** each ion **individually** from the solution and identify the reagents (**compounds**) used in this procedure. Include **net-ionic equations** for any precipitates formed. (Re-read the example on pages 8-10!)
 - Add some 1.0 M $\text{Sr}(\text{NO}_3)_2(\text{aq})$ solution. The Sr^{2+} will precipitate the SO_4^{2-} but not the OH^- .
 NIE: $\text{Sr}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{SrSO}_4(\text{s})$
 - Filter out the $\text{SrSO}_4(\text{s})$.
 - To the filtrate, add $\text{Fe}(\text{NO}_3)_2(\text{aq})$ (or any nitrate solution except alkalis, H^+ , NH_4^+ or Sr^{2+}). This will precipitate the OH^- .
 NIE: $\text{Fe}^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq}) \rightarrow \text{Fe}(\text{OH})_2(\text{s})$
 - Filter out the $\text{Fe}(\text{OH})_2(\text{s})$.