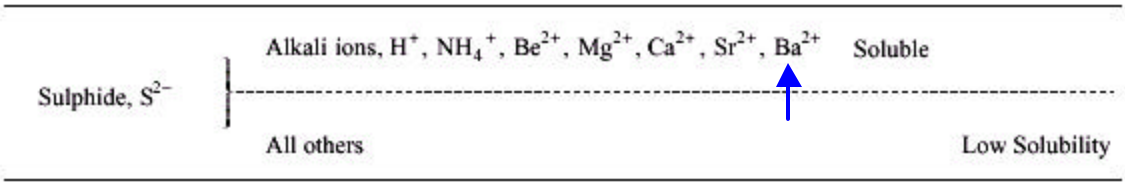
Chemistry 12
Tutorial 9 - SOLUTIONS
Separating Ions By Precipitation and Qualitative Analysis

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.

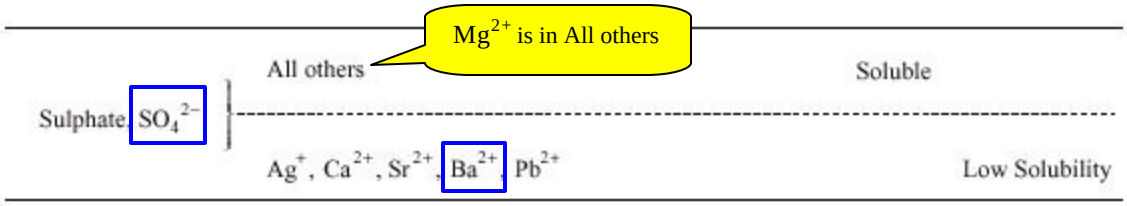


S^{2-} ions are added to this solution and a precipitate DOES NOT FORM. Which ion, (Ag^+ or Ba^{2+}) is present in the solution?

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.



To a sample of each solution, add some $Na_2SO_{4(aq)}$ .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

1. 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?

1. To a sample of each solution, add some $AgNO_{3\,(aq)}$ solution. The one with the precipitate contains the I^-.

2. To samples of the other two solutions, add some $Na_2SO_{4\,(aq)}$ solution. The one with the precipitate would be the Ca^{2+}.

3. The remaining solution would contain the Cu^{2+}.

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!)

1. Add some 1.0 M $Sr(NO_3)_{2\,(aq)}$ solution. The Sr^{2+} will precipitate the SO_4^{2-} but not the OH^-.

NIE: $Sr^{2+}_{(aq)} + SO_4^{2-}_{(aq)} \rightarrow SrSO_{4\,(s)}$

2. Filter out the $SrSO_{4(s)}$.

3. To the filtrate, add $Fe(NO_3)_{2\,(aq)}$ (or any nitrate solution except alkalis, H^+, NH_4^+ or Sr^{2+}). This will precipitate the OH^-.

NIE: $Fe^{2+}_{(aq)} + 2OH^-_{(aq)} \rightarrow Fe(OH)_{2\,(s)}$

4. Filter out the $Fe(OH)_{2(s)}$