



## How to Use the Solubility Table

The solubility table on pages 61–62 in the Chemistry 0861 Lab Manual can be used to predict whether or not a given ionic compound is soluble.

### GENERAL PROCEDURE

[1] **Identify the anion** (the negative ion) **in your compound**.

[2] **Find the row of the table that mentions the anion in the first column**.

[3] **Identify the cation** (the positive ion) **in your compound**.

[4] **Check the bottom of the table to see whether the cation is listed in a group**.

The Group I ions and the Group II ions aren't in the table by name, so you might have to look for them by group.

[5] **Look for the cation in the second column in the row you found in step [2]**.

There are two sections for most of the rows in this column. In these rows, the upper section lists some cations, and the lower section says "All others". On the nitrate/chlorate row, it just says "All", so all cations belong in that section.

[6] **Decide which section your cation is in**. If it's not in the section with the list, then your cation is in the section labelled "All others".

[7] **Look in the third column to the right of the section you found in step 6**. It will either say "Soluble" or "Low solubility".

[8] **Decide whether your compound produces a precipitate**. If it says "Soluble", then the compound dissolves in cold water, and there is *no* precipitate. If it says "Low solubility", that means only a very small amount of the compound will dissolve in cold water, and the rest will precipitate out of the solution.

*Example 1:* Determine the solubility of: a)  $\text{AgCH}_3\text{COO}$  b)  $\text{Ca}(\text{CH}_3\text{COO})_2$

*Solution:* In both cases, the anion is acetate ( $\text{CH}_3\text{CO}_2^-$ ), which is found in the third row of the table:

Acetate, $\text{C}_2\text{H}_3\text{O}_2^-$	$\text{Ag}^+$ , $\text{Al}^{3+}$	Low solubility
	All others	Soluble

a) The cation is  $\text{Ag}^+$ , silver. This is not in the list of groups at the bottom, so we're just looking for the silver ion, which we find in the top section of the row for acetate. It's labelled "Low solubility", which means silver acetate will form a precipitate in solution.

b) The cation is  $\text{Ca}^{2+}$ , calcium ion. We look at the bottom of the table and we see that it's in the list of Group II ions, so we look for "Group II ions" or "calcium" in the acetate row. Since neither is listed, the calcium ion belongs in "All others". In the third column, we see "Soluble" in this section, so calcium acetate does not form a precipitate.



**Example 2:** Determine the solubility of: a)  $\text{Li}_2\text{S}$  b)  $\text{CuS}$

**Solution:** In both cases, the anion is sulfide ( $\text{S}^{2-}$ ), which is found in the sixth row of the table:

Sulfide, $\text{S}^{2-}$	Group I & II ions, $\text{H}^+$ , $\text{NH}_4^+$	Soluble
	All others	Low solubility

a) The cation is  $\text{Li}^+$ , lithium. The bottom of the table tells us lithium is a Group I ion, so we should look for “Group I” or “lithium” in the sulfide row. We see Group I in the top section of the row, it’s labelled “Soluble” in the third column, which means lithium sulfide will not form a precipitate in solution.

b) The cation is  $\text{Cu}^{2+}$ , copper (II). This is not in the list of groups at the bottom, so we’re just looking for the copper (II) ion. We look in the sulfide row, but “ $\text{Cu}^{2+}$ ” isn’t there, so this ion belongs in “All others”. In the third column, we see “Low solubility” in this section, so copper (II) sulfide does form a precipitate.

### EXERCISES

A. Do the following compounds form a precipitate in solution in cold water? Answer “yes” or “no”.

- |                               |                                  |
|-------------------------------|----------------------------------|
| 1) $\text{MgSO}_4$            | 7) $\text{NaCl}$                 |
| 2) $\text{PbF}_2$             | 8) $\text{Na}_2\text{SO}_4$      |
| 3) $\text{CaCO}_3$            | 9) $\text{FeS}$                  |
| 4) $\text{Fe}(\text{NO}_3)_3$ | 10) $\text{KOH}$                 |
| 5) $\text{K}_2\text{CO}_3$    | 11) $\text{Ca}_3(\text{PO}_4)_2$ |
| 6) $\text{PbSO}_4$            | 12) $\text{Mg}(\text{NO}_3)_2$   |

B. Which five ions or sets of ions are always soluble, no matter what other ion is in the compound?

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### SOLUTIONS

A. (1) no (2) yes (3) yes (4) no (5) no (6) yes (7) no (8) no (9) yes (10) no (11) yes (12) no

B. nitrate ( $\text{NO}_3^-$ ), chlorate ( $\text{ClO}_3^-$ ), hydrogen ( $\text{H}^+$ ), ammonium ( $\text{NH}_4^+$ ), and the Group I ions ( $\text{Li}^+$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Rb}^+$ ,  $\text{Cs}^+$ ,  $\text{Fr}^+$ )

