

Name: Key  
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**Chemistry 12**  
**Solubility Lesson #3**  
**PREDICTING THE SOLUBILITY OF SALTS**

The term "**SOLUBLE**" is used to describe a substance that will DISSOLVE 100% in WATER

As nothing is truly **INSOLUBLE** we use the term "**LOW SOLUBILITY**" to describe a substance that will not DISSOLVE 100% in WATER

A substance is said to have "**LOW SOLUBILITY**" if a saturated solution of the substance is LESS than 0.1M!!!!

**NOTE:** the phrase "having a solubility less than 0.1M" is often represented in the form of

**"EQUAL VOLUMES OF 0.2 M cmpd A and 0.2 M cmpd B ARE MIXED"**  
After **DILUTION**, both cmpd A and cmpd B are present as 0.1 M solutions. IF a precipitate forms when A and B are mixed, the precipitate qualifies as having **LOW SOLUBILITY**.

Let us investigate the table

"**SOLUBILITY OF COMMON COMPOUNDS IN WATER**" found on pg 4 of the Data Booklet.

The Table is divided so that

1. the ANIONS (negative ions) are in the first column

2. the CATIONS (positive ions) are in the second column

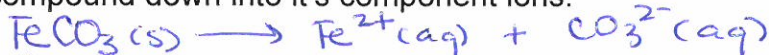
**NOTE:** recall that the **ALKALI IONS** include  $\text{Li}^+$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Rb}^+$ ,  $\text{Cs}^+$ , and  $\text{Fr}^+$

3. the solubility of the possible compound is in the third column

SOLUBLE (no ppt)      LOW SOLUBILITY (ppt forms)

**Example 1.** Determine whether or not  $\text{FeCO}_3$  is soluble or has low solubility

1. Break the compound down into its component ions:



1. First locate the **anion**:



2. Beside the anion try to locate the corresponding **cation**:



3. Identify the outcome from combining the anion and cation from the third column:

"all others" → Low solubility.

**NOTE:** the term **LOW SOLUBILITY** means that a **PRECIPITATE** will form  
The term **SOLUBLE** means that **NO PRECIPITATE** will form.

**Example 2.** Will a precipitate form when equal volumes of CaS and Na<sub>2</sub>SO<sub>4</sub> are mixed?

1. Write out the double replacement reaction without indicating the phases:



2. Break apart the products into component ANION and CATION



3. Locate the first ANION and it's corresponding CATION on the table, what is the outcome when these are paired?



4. Locate the first ANION and it's corresponding CATION on the table, what is the outcome when these are paired?



5. Go back to the double replacement equation and fill in (s) beside the precipitate and (aq) beside the soluble compound.



**NOTE:** be aware that some TRANSITION METALS have MULTIPLE IONIC CHARGES ie.  $\text{Cu}^+$  and  $\text{Cu}^{2+}$  these ions act differently when paired with the same ANION

$\text{Cu}^+$  has LOW SOLUBILITY with  $\text{Cl}^-$ ,  $\text{Br}^-$  and  $\text{I}^- \rightarrow \text{CuCl}(\text{s}), \text{CuBr}(\text{s}), \text{CuI}(\text{s})$

$\text{Cu}^{2+}$  is SOLUBLE with  $\text{Cl}^-$ ,  $\text{Br}^-$  and  $\text{I}^- \rightarrow \text{CuCl}_2(\text{aq}), \text{CuBr}_2(\text{aq}), \text{CuI}_2(\text{aq})$ .

### SOME IMPORTANT GENERALIZATIONS:

1. Compounds containing: <sup>ions</sup> alkali metals,  $\text{H}^+$ ,  $\text{NH}_4^+$  or  $\text{NO}_3^-$  Are soluble in WATER!!!

2. It is therefore difficult to PRECIPITATE the above ions From solution

3. IF you have to write the formula for a SOLUBLE COMPOUND use the \*\*\*\*\*RULE OF N\*\*\*\*\*

- a. to introduce a desired ANION into a solution use  $\text{Na}^+$

you want  $\text{PO}_4^{3-}$  in solution  $\therefore$  use  $\text{Na}_3\text{PO}_4$ .

- b. to introduce a desired CATION into a solution use  $\text{NO}_3^-$ .

you want  $\text{Ca}^{2+}$  in solution  $\therefore$  use  $\text{Ca}(\text{NO}_3)_2$

**SEATWORK/HOMEWORK:** Exercises 21-24 pgs 83-84

**PLO's:** H1, H2, H3