Name: Key
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Chemistry 12
Solubililty 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 4of 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 **Li^+ , Na^+ , K^+ , Rb^+ , Cs^+, and 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 $FeCO_3$ is soluble or has low solubility

1. Break the compound down into it's component ions:

$FeCO_3(s) \longrightarrow Fe^{2+}(aq) + CO_3^{2-}(aq)$

1. First locate the **anion**:

CO_3^{2-}

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

Fe^{2+}

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_2SO_4 are mixed?

1. Write out the double replacement reaction without indicating the phases:
   $CaS(aq) + Na_2SO_4 \longrightarrow CaSO_4 + Na_2S$
2. Break apart the products into component ANION and CATION
   $CaSO_4 = Ca^{2+} + SO_4^{2-}$ / $Na_2S = 2Na^+ + S^{2-}$
3. Locate the first ANION and it's corresponding CATION on the table, what is the outcome when these are paired?
   $SO_4^{2-} + Ca^{2+} \Rightarrow$ LOW SOLBILITY $\therefore$ ppt forms (s)
4. Locate the first ANION and it's corresponding CATION on the table, what is the outcome when these are paired?
   $S^{2-} + Na^+ \Rightarrow$ SOLUBLE $\therefore$ no ppt forms (aq)
5. Go back to the double replacement equation and fill in (s) beside the precipitate and (aq) beside the soluble compound.
   $CaS(aq) + Na_2SO_4(aq) \longrightarrow CaSO_4(s) + Na_2S(aq)$

NOTE: be aware that some TRANSITION METALS have MULTIPLE IONIC CHARGES ie. **Cu^+ and Cu^{2+}** these ions act differently when paired with the same ANION
Cu^+ has LOW SOLUBILITY with Cl^-, Br^- and I^- $\longrightarrow$ $CuCl(s)$, $CuBr(s)$, $CuI(s)$
Cu^{2+} is SOLUBLE with Cl^-, Br^- and I^- $\rightarrow$ $CuCl_2(aq)$, $CuBr_2(aq)$, $CuI_2(aq)$.

SOME IMPORTANT GENERALIZATIONS:

1. Compounds containing: alkali metal ions, H^+, NH_4^+ or 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 **Na^+**
you want PO_4^{3-} in solution $\therefore$ use Na_3PO_4.

b. to introduce a desired CATION into a solution use **NO_3^-**.
you want Ca^{2+} in solution $\therefore$ use $Ca(NO_3)_2$

SEATWORK/HOMEWORK: Exercises 21-24 pgs 83-84
PLO's: H1, H2, H3