$$M_1 V_1 = M_F V_F$$

$$[M_F]_A = \frac{0.2M \cdot 1.0L}{2.0L}$$

$$= 0.10M$$

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 _1.0L_

→ **"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 __anion_____(negative ions) are in the first column
2. the __cation_____ (positive ions) are in the second column
NOTE: recall that the ALKALI IONS include **Li^+ , Na^+ , K^+ , Rb^+ , Cs^+, and Fr^+**
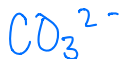3. the solubility of the possible compound is in the third column

Soluble = aqueous   low solubility = solid

Example 1. Determine whether or not $FeCO_3$ is soluble or has low solubility
1. Break the compound down into it's component ions:

$$FeCO_3 \longrightarrow Fe^{2+} + CO_3^{2-}$$

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:

low solubility $FeCO_3$ (s)

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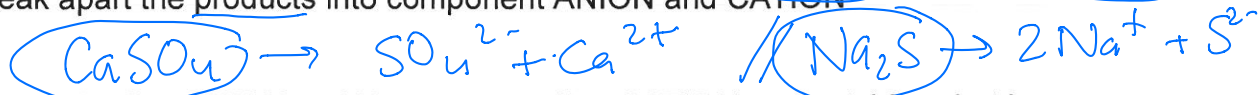   The term **SOLUBLE** means that **NO PRECIPITATE** will form.

0.20M

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:

$$CaS_{(aq)} + Na_2SO_4_{(aq)} \longrightarrow CaSO_4(?) + Na_2S(?)$$

2. Break apart the products into component ANION and CATION

$$CaSO_4 \longrightarrow SO_4^{2-} + Ca^{2+} \qquad Na_2S \longrightarrow 2Na^+ + S^{2-}$$

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

$$SO_4^{2-} \ldots Ca^{2+} \longrightarrow \text{low solubility} \quad CaSO_4 (s)$$

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

$$S^{2-} \ldots Na^+ \text{ (alkali ion)} \longrightarrow \text{soluble} \quad Na_2S_{(aq)}$$
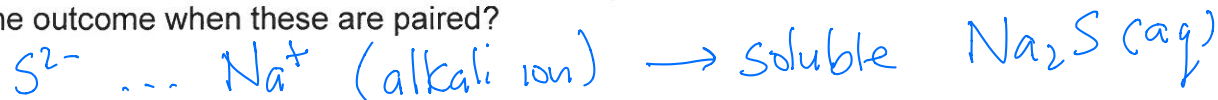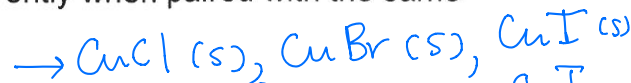
5. Go back to the double replacement equation and fill in (s) beside the precipitate and (aq) beside the soluble compound.

$$CaS_{(aq)} + Na_2SO_4_{(aq)} \longrightarrow CaSO_4_{(s)} + Na_2S_{(aq)}$$
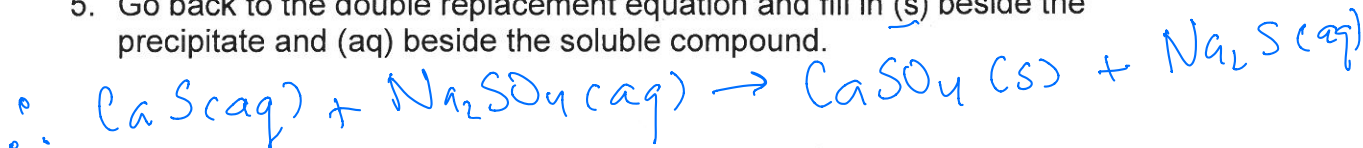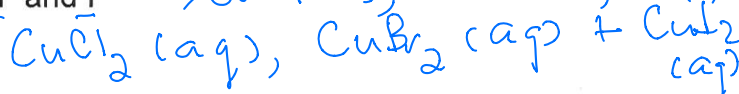
NOTE: be aware that some TRANSITION METALS have MULTIPLE IONIC CHARGES ie. Cu^+ and Cu^{2+} these ions act differently when paired with the same ANION

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^- $\quad CuCl_2_{(aq)}, CuBr_2_{(aq)} + CuI_2_{(aq)}$

SOME IMPORTANT GENERALIZATIONS:

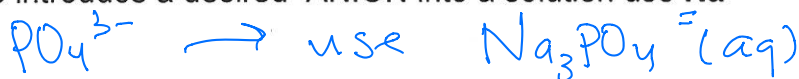1. Compounds containing: alkali ions ; NO_3^-
Are soluble in WATER!!!

2. It is therefore difficult to PRECIPITATE the alkali 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^+

$$PO_4^{3-} \longrightarrow \text{use} \quad Na_3PO_4_{(aq)}$$

b. to introduce a desired CATION into a solution use NO_3^-.

$$Ca^{2+} \longrightarrow Ca(NO_3)_2_{(aq)}$$

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

NaCl → Na+ + Cl⁻   *AB → A+ + B⁻*   (handwritten)

SOLUBILITY OF COMMON COMPOUNDS IN WATER

The term soluble here means > 0.1 mol/L at 25°C.

Negative Ions (Anions)	Positive Ions (Cations)	Solubility of Compounds
All	Alkali ions: Li^+, Na^+, K^+, Rb^+, Cs^+, Fr^+	Soluble
All	Hydrogen ion: H^+	Soluble
All	Ammonium ion: NH_4^+	Soluble
Nitrate, NO_3^-	All	Soluble
Chloride, Cl^- or Bromide, Br^- or Iodide, I^-	All others	Soluble
	Ag^+, Pb^{2+}, Cu^+	Low Solubility
Sulphate, SO_4^{2-}	All others	Soluble
	Ag^+, Ca^{2+}, Sr^{2+}, Ba^{2+}, Pb^{2+}	Low Solubility
Sulphide, S^{2-}	Alkali ions, H^+, NH_4^+, Be^{2+}, Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}	Soluble
	All others	Low Solubility
Hydroxide, OH^-	Alkali ions, H^+, NH_4^+, Sr^{2+} ?	Soluble
	All others	Low Solubility
Phosphate, PO_4^{3-} or Carbonate, CO_3^{2-} or Sulphite, SO_3^{2-}	Alkali ions, H^+, NH_4^+	Soluble
	All others	Low Solubility

(handwritten annotations) Soluble → will dissolve (aq)
Low Solubility ← not dissolve (s)
Fe^{2+}