

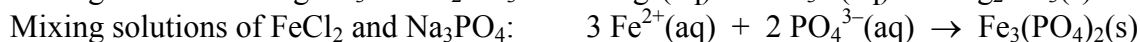
PROPERTIES AND REACTIVITY OF INORGANIC COMPOUNDS FOR CHEM 101A

1) Solubility rules and precipitation reactions

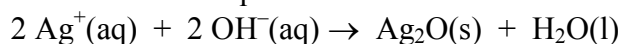
All compounds that contain the cations Na^+ , K^+ or NH_4^+ , or the anions NO_3^- or $\text{C}_2\text{H}_3\text{O}_2^-$ are soluble in water. It is best to memorize these. Beyond this, solubilities are normally classified using the anion in the compound. Here are the rules that you will need to know in Chem 101A:

Anion	Cations that produce soluble compounds	Cations that produce insoluble compounds
NO_3^- , $\text{C}_2\text{H}_3\text{O}_2^-$	All	None
Cl^- , Br^- , I^-	Most	Ag^+ Pb^{2+} Hg_2^{2+}
SO_4^{2-}	Most	Ag^+ Pb^{2+} Hg_2^{2+} Ca^{2+} Sr^{2+} Ba^{2+} (the heavier IIA elements)
OH^-	Na^+ K^+ (NH_4^+ reacts with OH^- : see below) Ba^{2+}	All others (see note below on Ag^+)
CO_3^{2-} , PO_4^{3-}	Na^+ K^+ NH_4^+	All others
S^{2-}	Na^+ K^+ NH_4^+ Mg^{2+} Ca^{2+} Sr^{2+} Ba^{2+} (group IIA)	All others (the reactions of sulfide with 3+ ions are not simple precipitations: you do not need to know these)

An insoluble salt will be produced whenever its constituent ions are mixed. Here are two examples:



The reaction of Ag^+ with OH^- produces Ag_2O (and water), not AgOH . This is a “quirk” of the chemistry of silver ions. The net ionic equation for this reaction is:

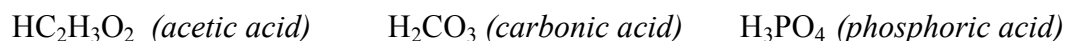


2) Acid-base reactivity

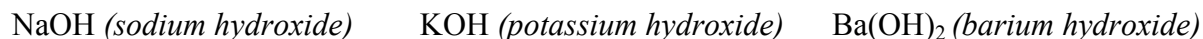
Any compound that contains hydrogen and can lose it (in the form of H^+) is an **acid**. The following acids are strong (100% ionized in aqueous solution):



You may assume that any other acid you encounter is weak. Here are three common weak acids whose formulas you should know:



Any ionic compound that contains OH^- ion is a **base**. Most of these are insoluble in water. The following strong bases are soluble in water and 100% ionized:

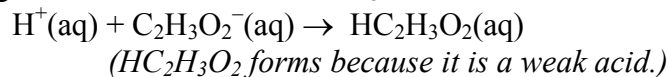


3) Note on weak electrolytes

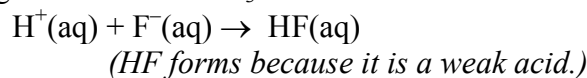
All weak acids are weak electrolytes (by definition). There are a few other weak electrolytes, but you do not need to learn them.

Weak electrolytes will be formed whenever their constituent ions are mixed. Here are two examples:

Mixing solutions of HCl and $\text{KC}_2\text{H}_3\text{O}_2$:

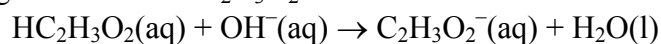


Mixing solutions of HNO_3 and NaF:



If a weak electrolyte is a reactant, it must be written as a molecule, not as ions. Here is an example of an acid-base reaction that involves a weak acid (acetic acid):

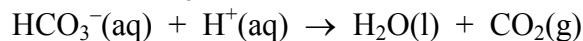
Mixing solutions of $\text{HC}_2\text{H}_3\text{O}_2$ and KOH:



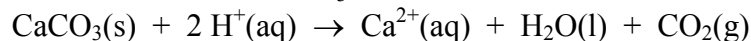
4) Special reactions of carbonate and bicarbonate ions

Carbonate ion and bicarbonate ion react with H^+ to form H_2CO_3 (carbonic acid). However, carbonic acid can only exist at very low concentrations. Under normal circumstances, carbonic acid decomposes into CO_2 and H_2O . Therefore, carbon dioxide and water are the normal products whenever carbonate or bicarbonate react with acids. Here are some examples:

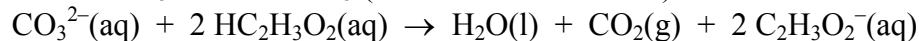
Mixing solutions of NaHCO_3 and HCl:



Adding a solution of HCl to solid CaCO_3 :



Mixing solutions of $\text{HC}_2\text{H}_3\text{O}_2$ and K_2CO_3 (with the acid in excess):



You can see an example of this kind of reaction for yourself by mixing baking soda (NaHCO_3) and vinegar (a solution of acetic acid) in your kitchen. The mixture will bubble vigorously as gaseous carbon dioxide forms.