Hydrolysis of salts (See the book for more details)

More examples of acidic ions:

1.) Dissociation and hydrolysis of zinc sulfate: $ZnSO_{4\,(s)} = Zn^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)}$

In aqueous solution of zinc salts, an octahedral complex, $[Zn(H_2O)_6]^{2+}$ is the predominant species. Aqueous solutions of zinc salts are mildly acidic because the aqua-ion is subject to ***hydrolysis***:

$$[Zn(H_2O)_6]^{2+} \rightleftharpoons [Zn(H_2O)_5(OH)]^{+} + H^{+}$$

2.) Hydrolysis of tin(II) chloride results in the formation of an insoluble basic salt:

$$SnCl_{2\,(aq)} + H_2O \rightleftharpoons \underline{Sn(OH)Cl}_{\,(s)} + HCl_{\,(aq)}$$

Therefore, if clear solutions of tin(II) chloride are to be used, it must be dissolved in hydrochloric acid to maintain the equilibrium towards the left-hand side (using Le Chatelier's principle).

(Chatelier's principle or "The Equilibrium Law", can be used to predict the effect of a change in conditions on some chemical equilibria. It can be stated as: “When any system at equilibrium for a long period of time is subjected to change in concentration, temperature, volume, or pressure, then the system readjusts itself to partly counteract the effect of the applied change and a new equilibrium is established.”)

Addition of hydrochloric acid enhances the formation of chlorocomplexes:

$$\underline{Sn(OH)Cl}_{\,(s)} + HCl_{\,(aq)} \rightleftharpoons [SnCl_4]^{2-} + H_2O$$

3.) Hydrolysis of bismuth chloride and bismuth nitrate:

Bismuth(III) chloride is hydrolysed readily to bismuth oxychloride:

$$Bi^{3+}_{(aq)} + Cl^{-}_{(aq)} + H_2O \rightleftharpoons \underline{BiOCl}_{\,(s)} + 2\ H^{+}_{(aq)}$$

Bismuth(III) nitrate is readily hydrolysed to form a range of oxynitrates:

$$Bi^{3+}_{(aq)} + NO_3^{-}{}_{(aq)} + 2\ H_2O \rightleftharpoons \underline{Bi(OH)_2NO_3}_{\,(s)} + 2\ H^{+}_{(aq)}$$

$$\underline{Bi(OH)_2NO_3}_{\,(s)} \rightleftharpoons \underline{BiO(NO_3)}_{\,(s)} + H_2O$$

Addition of acid enhances the dissolution through acid-base reaction:

$$\underline{BiO(NO_3)}_{\,(s)} + 2\ H^{+} \rightleftharpoons Bi^{3+} + NO_3^{-} + H_2O$$

4.) Hydrolysis of antimony trichloride:

$$Sb^{3+}_{(aq)} + Cl^{-}_{(aq)} + 2\ H_2O \rightleftharpoons \underline{Sb(OH)_2Cl}_{\,(s)} + 2\ H^{+}_{(aq)}$$

$$\underline{Sb(OH)_2Cl}_{\,(s)} \rightleftharpoons \underline{SbOCl}_{\,(s)} + H_2O$$

Addition of hydrochloric acid enhances the formation of chlorocomplexes:

$$\underline{Sb(OH)_2Cl}_{(s)} + 2H^+_{(aq)} + 3\ Cl^-_{(aq)} \rightleftharpoons [SbCl_4]^{2-} + 2\ H_2O$$

Exercises:

1.) Hydrolysis of carbonic acid: $H_2CO_3 + H_2O \rightleftharpoons H_3O^+ + HCO_3^-$

a. Identify which of these is the conjugate base and which is the weak acid.
b. Does the weak acid hydrolyse?

Solution:

a. The conjugate base is the HCO_3^-. The weak acid is the H_2CO_3.
b. Yes it hydrolyses.