Acid Equilibria

Phosphate ion is a reasonably strong base. It hydrolyzes in water to form a basic solution.

\[
\text{PO}_4^{3-}(aq) + H_2O(l) \rightleftharpoons HPO_4^{2-}(aq) + OH^-(aq)
\]

with \(K_b = 1.0 \times 10^{-2}\)

\[
\text{HPO}_4^{2-}(aq) + H_2O(l) \rightleftharpoons H_2PO_4^-(aq) + OH^-(aq)
\]

with \(K_b = 1.6 \times 10^{-7}\)

\[
\text{H}_2\text{PO}_4^-(aq) + H_2O(l) \rightleftharpoons \text{H}_3\text{PO}_4(aq) + OH^-(aq)
\]

with \(K_b = 1.3 \times 10^{-12}\)

Solubility

Phosphates of the alkali metals are soluble. Most other phosphates, such as \(\text{FePO}_4\), \(\text{CrPO}_4\), \(\text{BiPO}_4\), \(\text{Ca}_3(\text{PO}_4)_2\), and \(\text{Ag}_3\text{PO}_4\) are only sparingly soluble. Phosphate ion also forms a bright yellow precipitate with ammonium molybdate:

\[
\text{PO}_4^{3-} + 3\text{NH}_4^+ + 12\text{MoO}_4^{2-} + 24\text{H}^+ \rightarrow (\text{NH}_4)_3\text{PO}_4 \cdot 12\text{MoO}_3 + 12\text{H}_2\text{O}
\]

Oxidation-Reduction

Phosphate is a very weak oxidizing agent. Since the phosphorus is in its highest oxidation state in phosphate ion, this ion cannot act as a reducing agent.