Since the formation of these complex ions is so favorable, we often assume that these reactions go to completion, and instead look at the small amount of complex ion that DISSOCIATES!

$$AB^+ \rightleftharpoons A^+ + B$$

$$K_d = \frac{[A^+][B]}{[AB^+]} = \frac{1}{K_f}$$

Kd is called the DISSOCIATION CONSTANT, and it is equal to 1/Kf

ex: $Ag(NH_3)_2^+ \rightleftharpoons Ag^+ + 2\,NH_3$

$$K_d = \frac{[Ag^+][NH_3]^2}{[Ag(NH_3)_2^+]} = \frac{1}{1.7\times10^7} = 5.9\times10^{-8}$$

AMPHOTERIC COMPOUNDS

- All metal hydroxides react with ACIDS, but SOME metal hydroxides can react with BASES by forming a comlplex ion.

$$Al(OH)_3(s) + 3\,H_3O^+ \rightleftharpoons Al^{3+}(aq) + 3\,H_2O(l)$$

... Aluminum hydroxide is soluble in acidic solutions.

$$Al(OH)_3(s) + OH^-(aq) \rightleftharpoons Al(OH)_4^-(aq)$$

... And it is also soluble in bases due to the formation of this complex ion!

$$Al(OH)_3(s) \rightleftharpoons Al^{3+}(aq) + 3OH^-(aq)\,;\; K_{sp} = 4.6 \times 10^{-33}$$

- So aluminum hydroxide is relatively insoluble in pure water, but its solubility increases greatly if the pH goes either up or down.

COMPLEX IONS AND SOLUBILITY

- What is the effect of complex formation on solubility?

$$AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$$

$$Ag^+(aq) + 2NH_3(aq) \rightleftharpoons Ag(NH_3)_2^+$$

What will the presence of ammonia do to the solubility of silver chloride?

1. Since the formation of the silver-ammonia complex is favorable, we expect that any dissolved silver ion would react with ammonia to make the complex.
2. This will REDUCE the concentration of free silver ion.
3. The reduction of free silver ion will cause more silver chloride to dissolve (Le Chateleir's principle - the equilibrium will try to produce more free silver ion to replace what the ammonia has removed)

So, the presence of a ligand which can form a complex with an ion from a salt will greatly INCREASE the solubility of that salt!