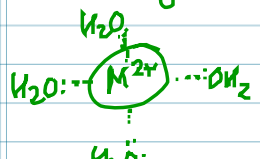
COMPLEX IONS

→ a metal ion surrounded by 1 or more molecules or ions (LIGANDS)

LIGANDS = (+) charge × 2

metal ion ⇒ Lewis acid (accepts e⁻ pair)
Ligand ⇒ Lewis Base (donates e⁻ pair)



$[M(H_2O)_4]^{2+}$

LIGANDS

NH_3 $:\ddot{Cl}:^-$ $:C\equiv N:^-$

K_f ⇒ formation constant (stability constant)

$$Co^{2+}_{(aq)} + 4Cl^-_{(aq)} \rightleftharpoons [Co(Cl)_4]^{2-}_{(aq)}$$

$$K_f = \frac{[Co(Cl)_4]^{2-}}{[Co^{2+}][Cl^-]^4}$$

the larger the K_f, the more stable the complex ion

$$MX_{(s)} \rightleftharpoons M^{2+}_{(aq)} + X^{2-}_{(aq)}$$

insoluble

add ligand → complex ion

more MX dissolves

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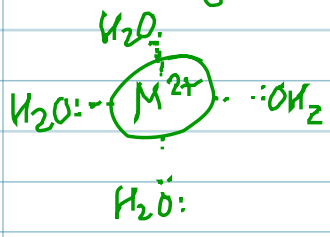

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① a) What is $[Ag^+]$ in 0.010M $AgNO_3$? 0.010M Ag^+

b) What is $[Ag^+]$ in 0.0.0M $AgNO_3$ that is also 1.0 M NH_3 (excess)? K_f $[Ag(NH_3)]^+$ 1.5×10^7

$$Ag^+ + 2NH_3 \rightleftharpoons [Ag(NH_3)_2]^+_{(aq)}$$

in 1L of this solution = 0.010 moles Ag^+

$\therefore$ 0.020 moles NH_3

$$1.5\times10^7 \; K_f = \frac{[Ag(NH_3)_2]^+}{[Ag^+][NH_3]^2} \qquad \approx 0.010 \quad 0.010$$

$$1.5\times10^7 = \frac{0.010}{[Ag^+][0.020]^2}$$

$[Ag^+] = 1.7\times10^{-6}$ M (uncomplexed)

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② a) What is the molar solubility of AgOH in H_2O?

$K_{sp} = 2.0\times10^{-8}$ $\quad AgOH \rightleftharpoons Ag^+ + OH^-$ (S, S)

$K_{sp} = s^2 \quad s = \sqrt{2.0\times10^{-8}} = 1.4\times10^{-4}$ M

b) What is the molar solubility of AgOH in 0.10M NaCN(aq)

K_f $[Ag(CN)_2]^- = 1\times10^{21}$

$AgOH \rightleftharpoons Ag^+ + OH^-$ $\quad K_{sp}$

$Ag^+ + 2CN^- \rightleftharpoons [Ag(CN)_2]^-$ $\quad K_f$

$AgOH + 2CN^- \rightleftharpoons [Ag(CN)_2]^- + OH^-$ $\quad K_{overall}$

$K_{overall} = K_{sp} \cdot K_f = (2\times10^{-8})(1\times10^{21}) = 2\times10^{13}$

$$AgOH_{(s)} + 2CN^-_{(aq)} \rightleftharpoons [Ag(CN)_2]^-_{(aq)} + OH^-_{(aq)}$$

	0,10	0	0
	− 2s	+ s	+ s
	0,1 − 2s	s	s

$$K_{overall} = \frac{s^2}{(0,1-2s)^2} = \sqrt{2 \times 10^{13}}$$

$$s = 0,05\ M$$

pure H_2O $\quad s = 1,4 \times 10^{-4}\ M$