Clase 9 20 noviembre 2020

Título de la nota 20/11/2020

AEDTA Ligante polidentado

1:1 Na^+

H_6y^{+2}

y = Ligante

Y = ligante

L = Ligante

✓

H_6L^{+2}

pKa Ligante

1 = 0

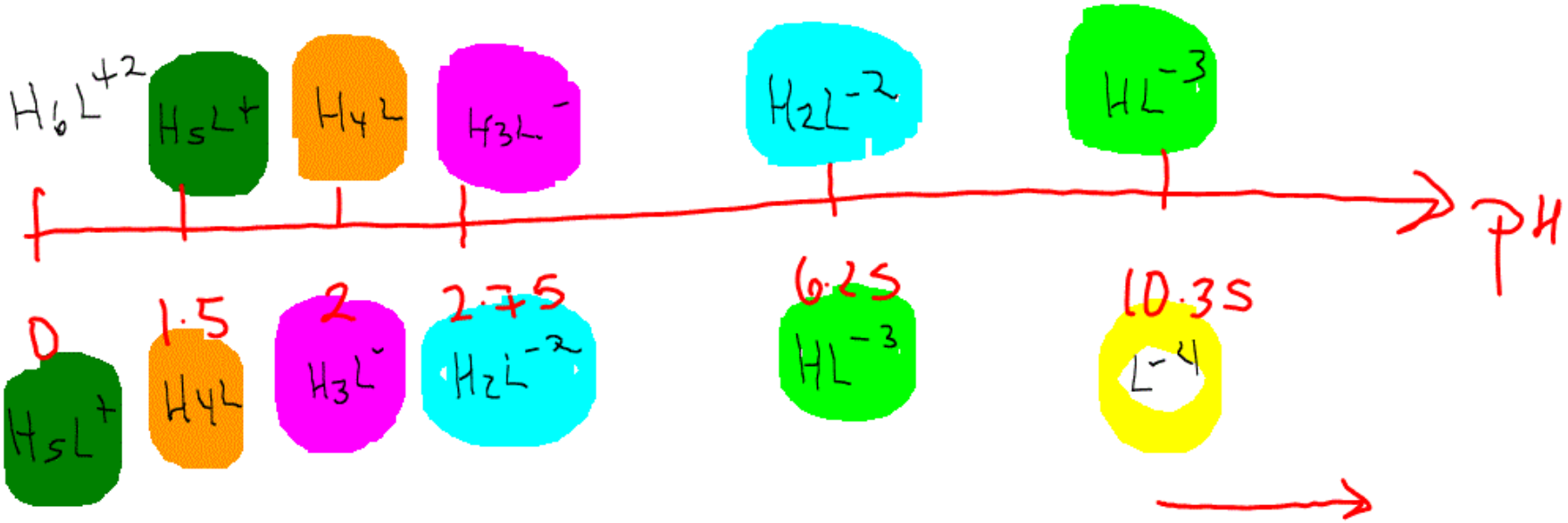
2 1.5

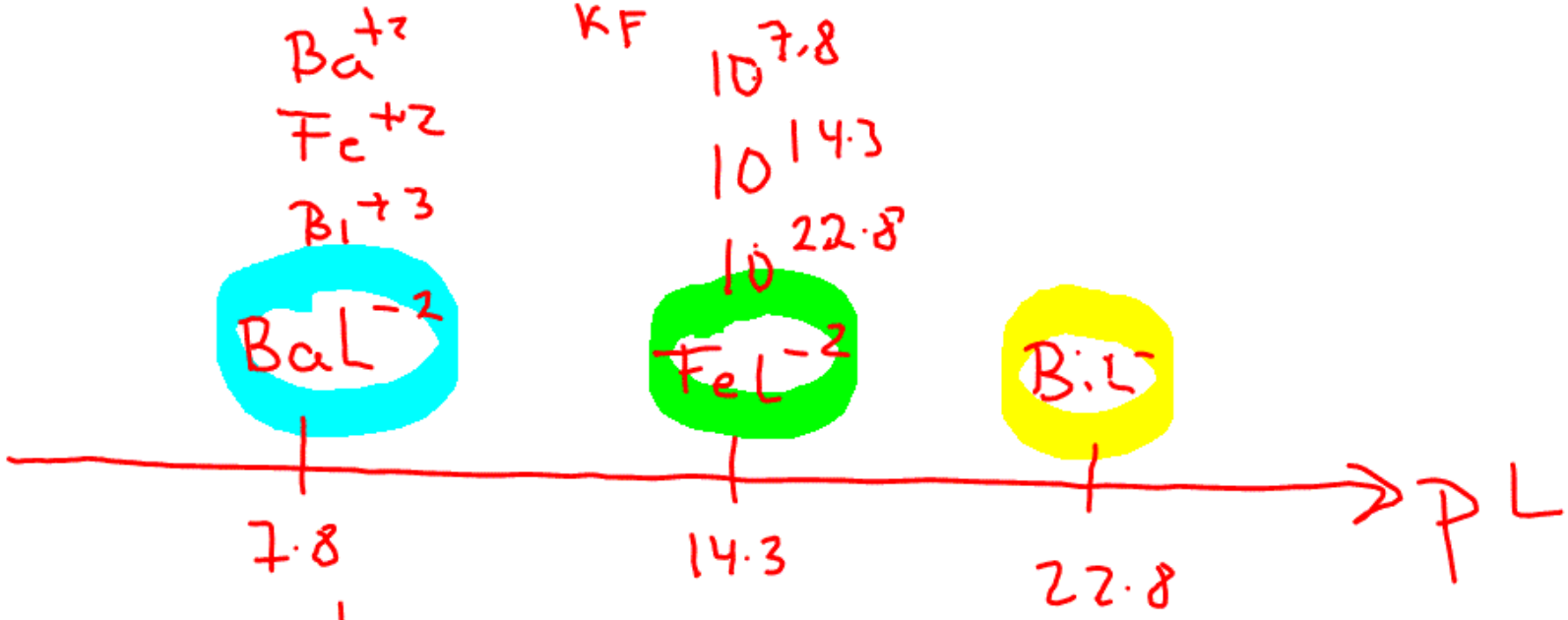
3 = 2

4 = 2.75

5 = 6.25

6 = 10.35


H_6L^{+2}
H_5L^{+}
H_4
H_3L^{-}
H_2L^{-2}
HL^{-3}
pH
0
H_5L^{+}
1.5
H_4L
2
H_3L^{-}
2.75
H_2L^{-2}
6.25
HL^{-3}
10.35
L^{-4}



$$pL = -\log a_L \qquad L = L^{-4}$$

$$Bi^{+3} + L^{-4} \underset{K_D}{\overset{K_F}{\rightleftharpoons}} BiL^{-}$$

10^{7} ≃ 10 millones

10^{14} 100,000,000,000,000,

① $Ba^{+2} + L^{-4} \rightleftharpoons BaL^{-2}$

② $BaL^{-2} + Bi^{+3} \rightleftharpoons BiL^{-} + Ba^{+2}$

$$K_{R2} = \frac{[BiL^-]\,[Ba^{+2}]\,[L^{-4}]}{[BaL^{-2}]\,[Bi^{+3}]\,[L^{-4}]}$$

$$K_{R_2} = \frac{K_{FBi}}{K_{FBa}} = \frac{10^{22.8}}{10^{7.8}} = 10^{15}$$

$$CaCO_{3(ac)} \underset{K_F}{\overset{K_S}{\rightleftharpoons}} Ca^{+} + CO_3^{-2}$$

$$CaCO_3 + 2OH^- \rightleftharpoons Ca(OH)_{2(s)}^{\circ} + CO_3^{-2}$$

$$CaCO_3 + 2H_3O^+ \rightleftharpoons Ca^{+2} + 3H_2O + CO_{2(g)}$$

$$OH^-$$

$$K_S = 5.02 \times 10^{-6} = 10^{-5.3}$$

$$Ca^{+2} + 2OH^- \rightleftharpoons Ca(OH)_2$$

$$K_F = \frac{1}{[Ca^{+2}][OH^-]^2} = \frac{1}{K_S} = \frac{1}{10^{-5.3}} = 10^{5.3}$$

$$[Ca^{+2}] \cdot [OH^-]^2 = 10^{5.3}$$

$$[Ca^{+2}] = \frac{1}{K_F [OH^-]^2}$$

$$[OH^-]^2 = \frac{1}{K_F [Ca^{+2}]}$$

$$[OH^-] = \sqrt[2]{\frac{1}{10^{5.3}\ 10^{-2}}}$$

$$[OH^-] = \sqrt{\frac{1}{10^{3.3}}}$$

$$[OH^-] = 10^{-3.3/2} = 10^{-1.65}$$

$$pH = 14 + \log [OH^-]$$

$$pH = 14 + \log 10^{-1.65}$$

$$pH = 14 - 1.65 = 12.35$$

$$Ca^{+2} = 0.1\ M$$

$$[OH^-] = \sqrt{\frac{1}{K_f [Ca^{+2}]}} = \sqrt{\frac{1}{10^{5.3}(10^{-1})}}$$

$$[OH^-] = \sqrt{\frac{1}{10^{4.3}}} = 10^{-4.3/2} = 10^{-2.15}$$

$$pH = 14 + \log [OH^-]$$

$$= 14 + \log 10^{-2.15}$$

$$= 14 - 2.15 = 11.85$$

Complejos insolubles ✓

Complejos solubles

Coeficiente de Rx de competencia.

" " " parásita.

" " " secundaria.

Coef. de Rx $\alpha_{L(H_3O^+)} = \dfrac{[L']}{[L]_L}$

$\alpha_{M^+(OH^-)} = \dfrac{[M^{+'}]}{[M^+]_L}$

$$\alpha_{L(H_3O^+)} = \frac{[L^{-4}] + [HL^{-3}] + [H_2L^{-2}] + [H_3L^{-}] + [H_4L] + [H_5L^{+}] + [H_6L^{2+}]}{[L^{-4}]}$$

$$\alpha_{L(H_3O^+)} = \frac{[L^{-4}]}{[L^{-4}]} + \frac{[HL^{-3}]}{[L^{-4}]} + \frac{[H_2L^{-2}]}{[L^{-4}]} + \frac{[H_3L^{-}]}{[L^{-4}]} + \frac{[H_4L]}{[L^{-4}]} + \frac{[H_5L^{+}]}{[L^{-4}]} + \frac{[H_6L^{2+}]}{[L^{-4}]}$$

$$\alpha_{L(H_3O^+)} = 1 + \frac{[HL^{-3}]}{[L^{-4}]} + \frac{[H_2L^{-2}]}{[L^{-4}]}$$

$$\alpha_{L(H_3O^+)} = 1 + \beta_{p1}[H_3O^+] + \beta_{p2}[H_3O^+]^2$$

$$Ka_6 = \frac{[L^{-4}][H_3O^+]}{[HL^{-3}]}$$

$$HL^{-3} + H_2O \rightleftharpoons L^{-4} + H_3O^+ = Ka_6$$

$$\frac{[HL^{-3}]}{[L^{-4}]} = \frac{[H_3O^+]}{Ka_6} \qquad \frac{1}{Ka} = \beta p$$

$$\beta p_1 = \frac{1}{Ka_6} = \frac{1}{10^{-10.35}} = 10^{10.35}$$

$$\frac{[HL^{-3}]}{[L^{-4}]} = \beta p_1 [H_3O^+]$$

$$\frac{[H_2L^{-2}]}{[L^{-4}]} =$$

$$H_2L^{-2} + H_2O \rightleftharpoons HL^{-3} + H_3O^+ = Ka_5$$

$$HL^{-3} + H_2O \rightleftharpoons L^{-4} + H_3O^+ = Ka_6$$

$$Ka_6 = \frac{[L^{-4}][H_3O^+]}{[HL^{-3}]}$$

$$\frac{[HL^{-3}]}{[L^{-4}]} = \frac{[H_3O^+]}{Ka_6}$$

$$Ka_5 = \frac{[HL^{-3}][H_3O^+]}{[H_2L^{-2}]}$$

$$[HL^{-3}] = \frac{[H_3O^+]}{Ka_5[H_2L^{-2}]}$$

$$\frac{[HL^{-3}]}{[L^{-4}]} = \frac{[H_3O^+]}{K_{a6}}$$

$$\frac{[HL^{-3}]}{[L^{-4}]} = \frac{[H_3O^+][H_3O^+]}{K_{a6}K_{a5}}$$

$$K_{a6} = \frac{[L^{-4}][H_3O^+]}{[HL^{-3}]}$$

$$[HL^{-3}] = \frac{[L^{-4}][H_3O^+]}{K_{a6}}$$

$$K_{a5} = \frac{[HL^{-3}][H_3O^+]}{[H_2L^{-2}]}$$

$$K_{a5} = \frac{[L^{-4}][H_3O^+][H_3O^+]}{K_{a6}[H_2L^{-2}]}$$

$$\frac{1}{K_{a6}K_{a5}} = \beta_{p2}$$

$$\frac{1}{10^{-10.35}\ 10^{-6.25}} = 10^{16.60} = \beta_{p2}$$

$$\frac{[H_2L^{-2}]}{[L^{-4}]} = \beta_{p2}[H_3O^+]^2$$

$$= 10^{16.6}[H_3O^+]^2$$

$$\alpha_{L(H_3O^+)} = 1 + \beta_{p1}[H_3O^+] + \beta_{p2}[H_3O^+]^2 + \beta_{p3}[H_3O^+]^3 + \beta_{p4}[H_3O^+]^4 + \beta_{p5}[H_3O^+]^5 + \beta_{p6}[H_3O^+]^6$$

$$\alpha_{L(H_3O^+)} = 1 + 10^{10.35}[H_3O^+] + 10^{16.6}[H_3O^+]^2 + 10^{19.35}[H_3O^+]^3 + 10^{21.35}[H_3O^+]^4 + 10^{22.85}[H_3O^+]^5 + 10^{22.85}[H_3O^+]^6$$

$$\beta_{p3} = \frac{1}{K_{a6} K_{a5} K_{a4}} = \frac{}{10^{10.35}\ 10^{6.25}\ 10^{2.75}} = 10^{19.35}$$

$$\beta_{p4} = \frac{1}{K_{a4} K_{a5} K_{a4} K_{a3}} = \frac{1}{10^{10.35}\ 10^{6.75}\ 10^{2.75}\ 10^{2}} = 10^{21.35}$$

$$\beta_{p5} = \frac{1}{K_{a4} K_{a5} K_{a4} K_{a3} K_{a2}} = \frac{1}{10^{10.35}\ 10^{6.75}\ 10^{2.75}\ 10^{2}\ 10^{1.5}} = 10^{2.85}$$

$$\beta_{p6} \frac{1}{K_{a6} K_{a5} K_{a4} K_{a3} K_{a2} K_{a1}} = \frac{1}{10^{10.35}\ 10^{6.75}\ 10^{2.75}\ 10^{2}\ 10^{1.5}\ 10^{0}} = 10^{22.85}$$

$$pH = 5$$

$$\alpha_L(H_3O^+) = 1 + 10^{10.35}[10^{-5}] + 10^{16.6}[10^{-5}]^2 + 10^{19.35}[10^{-5}]^3$$

$$+ 10^{21.35}[10^{-5}]^4 + 10^{22.85}[10^{-5}]^5 + 10^{22.85}[10^{-5}]^6$$

$$= 4.23 \times 10^6$$

$$= 10^{6.62}$$

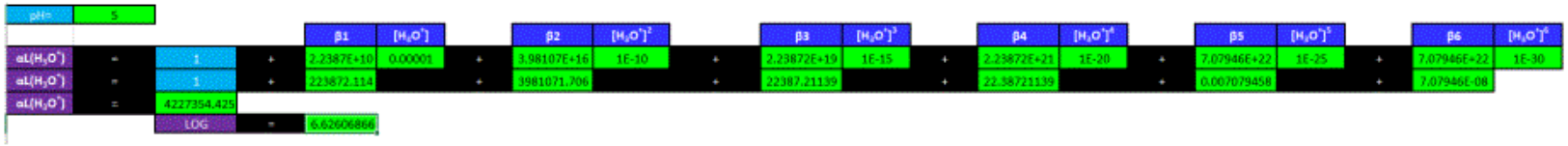
$$pH = 12$$

$$\alpha_L(H_3O^+) = 1 + 10^{10.35}[10^{-12}] + 10^{16.6}[10^{-12}]^2 + 10^{19.35}[10^{-12}]^3$$

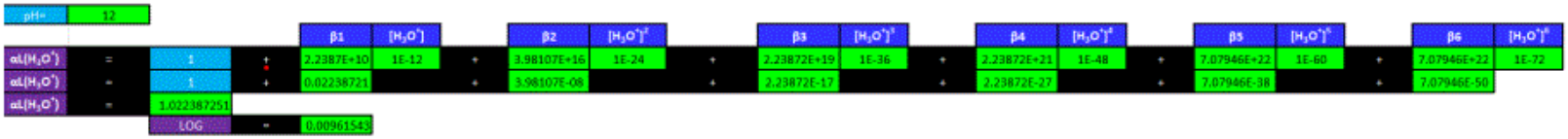
$$+ 10^{21.35}[10^{-12}]^4 + 10^{22.85}[10^{-12}]^5 + 10^{22.85}[10^{-12}]^6$$

$$= 1.0022 \simeq 1$$

$$= 10^{0.0096}$$



pH=	5																						
				β1	$[H_3O^+]$		β2	$[H_3O^+]^2$		β3	$[H_3O^+]^3$		β4	$[H_3O^+]^4$		β5	$[H_3O^+]^5$		β6	$[H_3O^+]^6$
$\alpha L(H_3O^+)$	=	1	+	2.2387E+10	0.00001	+	3.98107E+16	1E-10	+	2.23872E+19	1E-15	+	2.23872E+21	1E-20	+	7.07946E+22	1E-25	+	7.07946E+22	1E-30
$\alpha L(H_3O^+)$	=	1	+	223872.114		+	3981071.706		+	22387.21139		+	22.38721139		+	0.007079458		+	7.07946E-08	
$\alpha L(H_3O^+)$	=	4227354.425																		
		LOG	=	6.62606866																



pH=	12																						
				β1	$[H_3O^+]$		β2	$[H_3O^+]^2$		β3	$[H_3O^+]^3$		β4	$[H_3O^+]^4$		β5	$[H_3O^+]^5$		β6	$[H_3O^+]^6$
$\alpha L(H_3O^+)$	=	1	+	2.2387E+10	1E-12	+	3.98107E+16	1E-24	+	2.23872E+19	1E-36	+	2.23872E+21	1E-48	+	7.07946E+22	1E-60	+	7.07946E+22	1E-72
$\alpha L(H_3O^+)$	=	1	+	0.0223872		+	3.98107E-08		+	2.23872E-17		+	2.23872E-27		+	7.07946E-38		+	7.07946E-50	
$\alpha L(H_3O^+)$	=	1.022387251																		
		LOG	=	0.00961543																

$$\alpha_{Ca(OH)} = \frac{[Ca^{+2}]}{[Ca^{+2}_L]}$$

$$= 1 + \beta_{(OH)}\,[OH^-] = 1 + 10^{1.3}\,[OH^-]$$

$$Ca^{+2} + OH^- \rightleftharpoons [Ca(OH)^+] =$$

$pH = 12$

$$\alpha_{Ca(OH)} = 1 + \beta_{i(OH)}[OH^-]$$

$$= 1 + 10^{1.3}[10^{-2}]$$

$$= 1 + 10^{1.3}10^{-2}$$

$$= 1 + 10^{-0.7}$$

$$= 1.19$$

$$= 10^{0.07}$$

$$Ca^{+2} + L^{-4} \rightleftharpoons CaL^{-2}$$

$$K_F = \frac{[CaL^{-2}]}{[Ca^{+2}_L][L^{-4}_L]}$$

$$K_F' = \frac{[CaL^{-2}]}{[Ca^{+2\prime}][L^{-4\prime}]}$$

$$\alpha_{Ca(OH)} = \frac{[Ca^{+2\prime}]}{[Ca^{+2}_L]} \qquad \alpha_{L(H_3O^+)} = \frac{[L^{-4\prime}]}{[L^{-4}_L]}$$

$$K_F' = \frac{[CaL^{-2}]}{\alpha_{Ca(OH)}\,[Ca^{+2}]\,\alpha_{L(H_3O^+)}\,[L^{-4}]}$$

$$K_F' = \frac{K_F}{\alpha_{Ca(OH)}\,\alpha_{L(H_3O^+)}}$$

$$K_{FCaL} = 10^{10.7} \qquad a\ pH = 12$$

$$K_F' = \frac{10^{10.7}}{10^{0.07}\,10^{0.0096}} \cong 10^{10.7}$$

$$VF' = \frac{10^{10.7}}{10^{0.07}\ 10^{0.0096}} = 10^{10.7 - 0.07 - 0.0096}$$

$$= 10^{10.62}$$