Clase 12 19 Noviembre 2021

Título de la nota 19/11/2021

DATOS | PORTADA

Instrucción: llene los valores en las celdas de color amarillo
En las celdas de color verde aparecen los resultados

Catión	Concentración	pH=	10	Amortiguador	Concentración
Cd^{+2}	0.01			NH_3	0.01

	KML		K_c		pks		pka
Cd-AEDTA	3.1623E+16	Naranja de Xilenol	1.2589E+17	$Cd(OH)_2$	13.6	NH_3	9.25
LOG	16.50	LOG Naranja de Xilenol	17.10				
		Azul de Metiltimol	1.0000E+19				
		LOG Azul de Metiltimol	19.00				

Ligante	pk_1	pka_2	pka_3	pka_4	pka_5	pka_6
AEDTA	0.00	1.50	2.00	2.65	6.25	10.35
	β1	β2	β3	β4	β5	β6
AEDTA	2.2387E+10	3.9811E+16	1.7783E+19	1.7783E+21	5.6234E+22	5.6234E+22
LOG Cd(OH)n	4.30	7.70	10.30	12.00		
Cd-OH	1.9953E+04	5.0119E+07	1.9953E+10	1.0000E+12		
LOG $Cd(NH_3)n$	2.60	4.65	6.04	6.92	6.60	4.90
$Cd-NH_3$	3.9811E+02	4.4668E+04	1.0965E+06	8.3176E+06	3.9811E+06	7.9433E+04

Indicador	pka_1	pka_2	pka_3	pka4	pka5
Naranja de Xilenol	2.60	3.30	6.40	10.50	12.30
Azul de metiltimol	4.50	7.20	13.50	13.40	

pH de inicio de precipitación

$Cd(OH)_2 \leftrightarrow Cd^{+2} + 2OH^-$

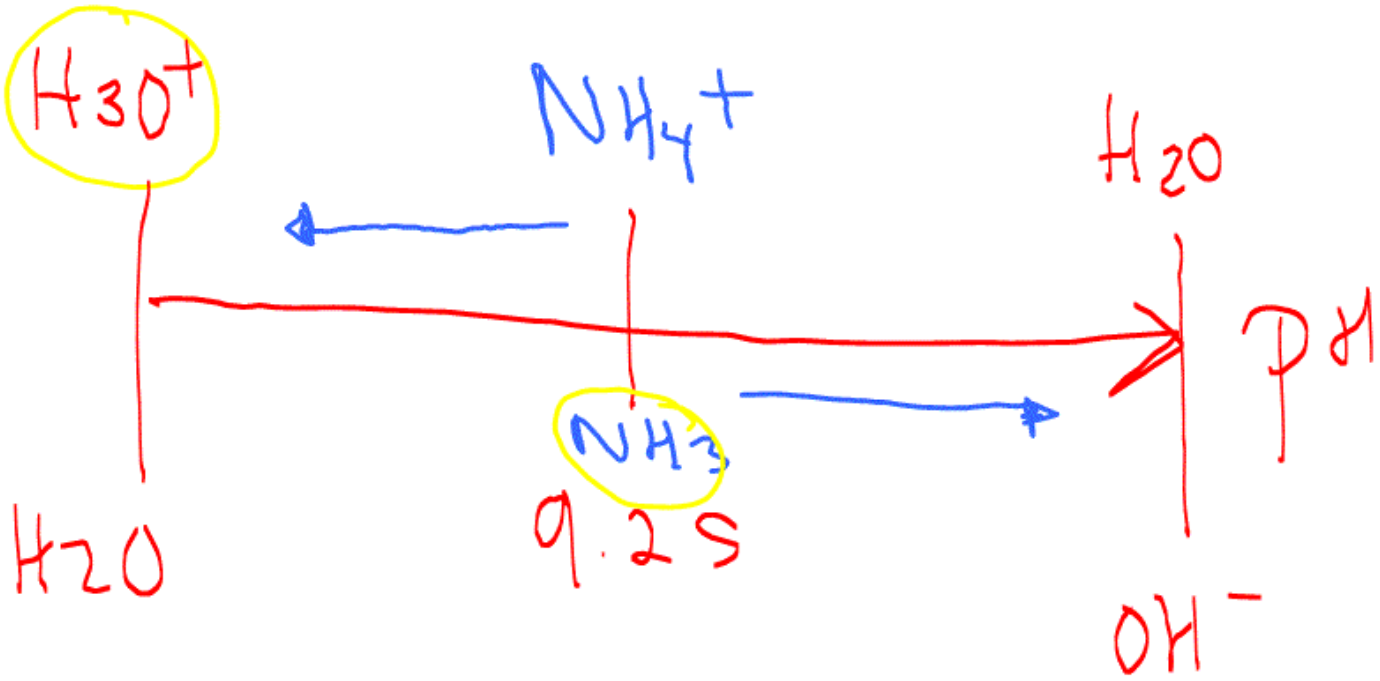
pH		8.2

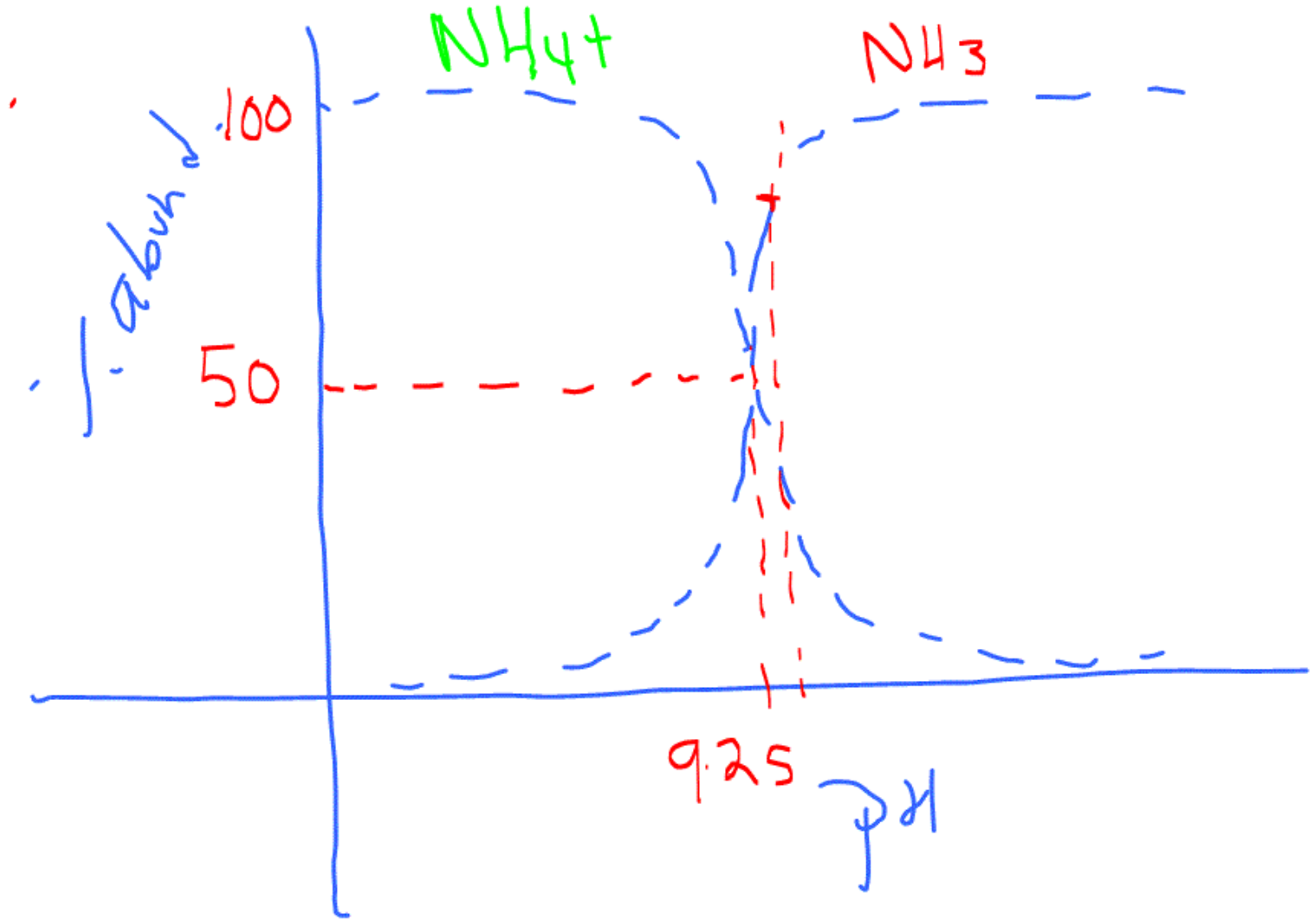
Ks=	$[Cd^{+2}]$	$[OH]^2$	=	2.51189E-14		
$[OH]^2$	=	Ks / $[Cd^{+2}]$	=	2.51189E-14 / 0.01	=	2.51189E-12

[OH]	=	1.58489E-06

$$Cd^{+2} + NH_3 \rightleftharpoons [Cd(NH_3)]^{+2} \quad \beta_1$$

$$[Cd(NH_3)]^{+2} + NH_3 \rightleftharpoons [Cd(NH_3)_2]^{+2} \quad \beta_2$$


H3O+
NH4+
H2O
H2O
NH3
9.25
OH-
pH


NH4+
NH3
100
50
Abs
9.25
pH

$$\alpha_{NH_3(H_3O^+)} = 1 + \beta_p [H_3O^+]$$

$$\alpha_{NH_3(H_3O^+)} = \frac{[NH_3']}{[NH_3]_L}$$

$$[NH_3]_L = \frac{[NH_3']}{\alpha_{NH_3(H_3O^+)}}$$

				β1	$[H_3O^+]$
$\alpha NH_3(H_3O^+)$	=	1	+	1778279410	1.00E-10
$\alpha NH_3(H_3O^+)$	=	1	+	1.78E-01	
$\alpha NH_3(H_3O^+)$	=	1.18E+00			
		LOG	=	0.071081853	

$pH = 10$

$\beta_1 = \frac{1}{K_a} = \frac{1}{10^{-9.25}}$

$\beta_1 = 10^{9.25}$

$$\alpha_{NH_3(H_3O^+)} = 1 + 10^{9.25}\left[10^{-10}\right]$$

$$= 1 + 10^{-0.75}$$

$$= 1.1778$$

$$\text{Log} = 0.07107$$

a pH = 11.25

					β1	$[H_3O^+]$
$\alpha NH_3(H_3O^+)$	=	1	+		1778279410	5.62E-12
$\alpha NH_3(H_3O^+)$	=	1	+		1.00E-02	
$\alpha NH_3(H_3O^+)$	=	1.01E+00				
		LOG	=		0.004321374	

pH de inicio de precipitación

$Cd(OH)_2$	$\leftrightarrow$	Cd^{+2}	$2OH^-$

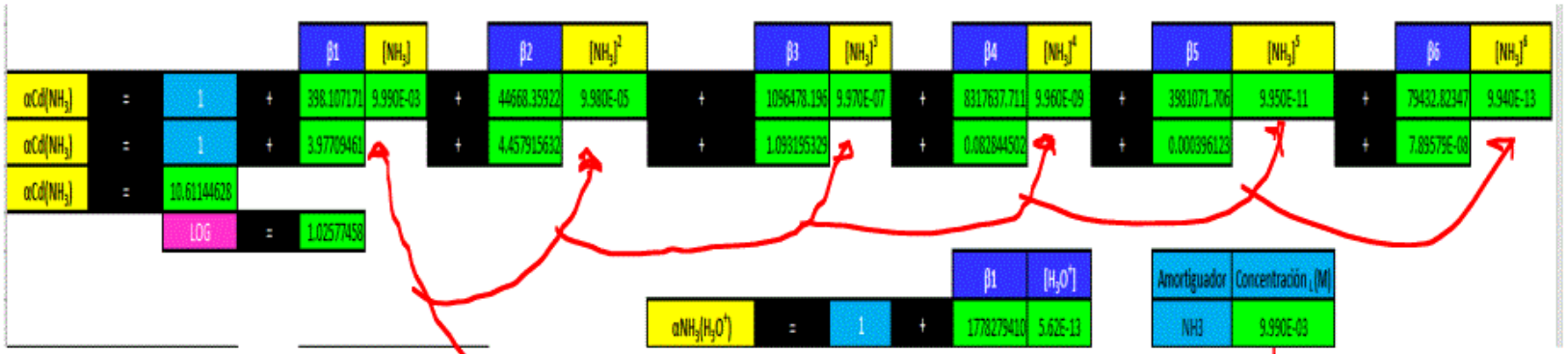
Ks=	$[Cd^{+2}]$	$[OH]^2$	=	2.51189E-14		
$[OH^-]^2$	=	Ks	=	2.51189E-14	=	2.51189E-12
		$[Cd^{+2}]$		0.01		

[OH]	=	1.58489E-06

pH	8.2

$$\alpha_{Cd(OH)} = 1 + \beta_1[OH^-] + \beta_2[OH^-]^2 + \beta_3[OH^-]^3 + \beta_4[OH^-]^4$$

$$\alpha_{Cd(NH_3)} = 1 + \beta_1[NH_3] + \beta_2[NH_3]^2 + \beta_3[NH_3]^3 + \beta_4[NH_3]^4 + \beta_5[NH_3]^5 + \beta_6[NH_3]^6$$



$pH = 12.25$

$[NH_3]_i \approx 0.01$

pH = 5

$[NH_3'] = 0.01$

$= 10^{-2}$

$\alpha_{NH_3(H_3O^+)}$

				β1	$[H_3O^+]$
$\alpha NH_3(H_3O^+)$	=	1	+	1778279410	1.00E-05
$\alpha NH_3(H_3O^+)$	=	1	+	1.78E+04	
$\alpha NH_3(H_3O^+)$	=	1.78E+04			
		LOG	=	4.250024421	

Amortiguador	Concentración $_L$ (M)
NH3	5.623E-07

$$[NH_3]_L = \frac{0.01}{1.78 \times 10^{-4}}$$

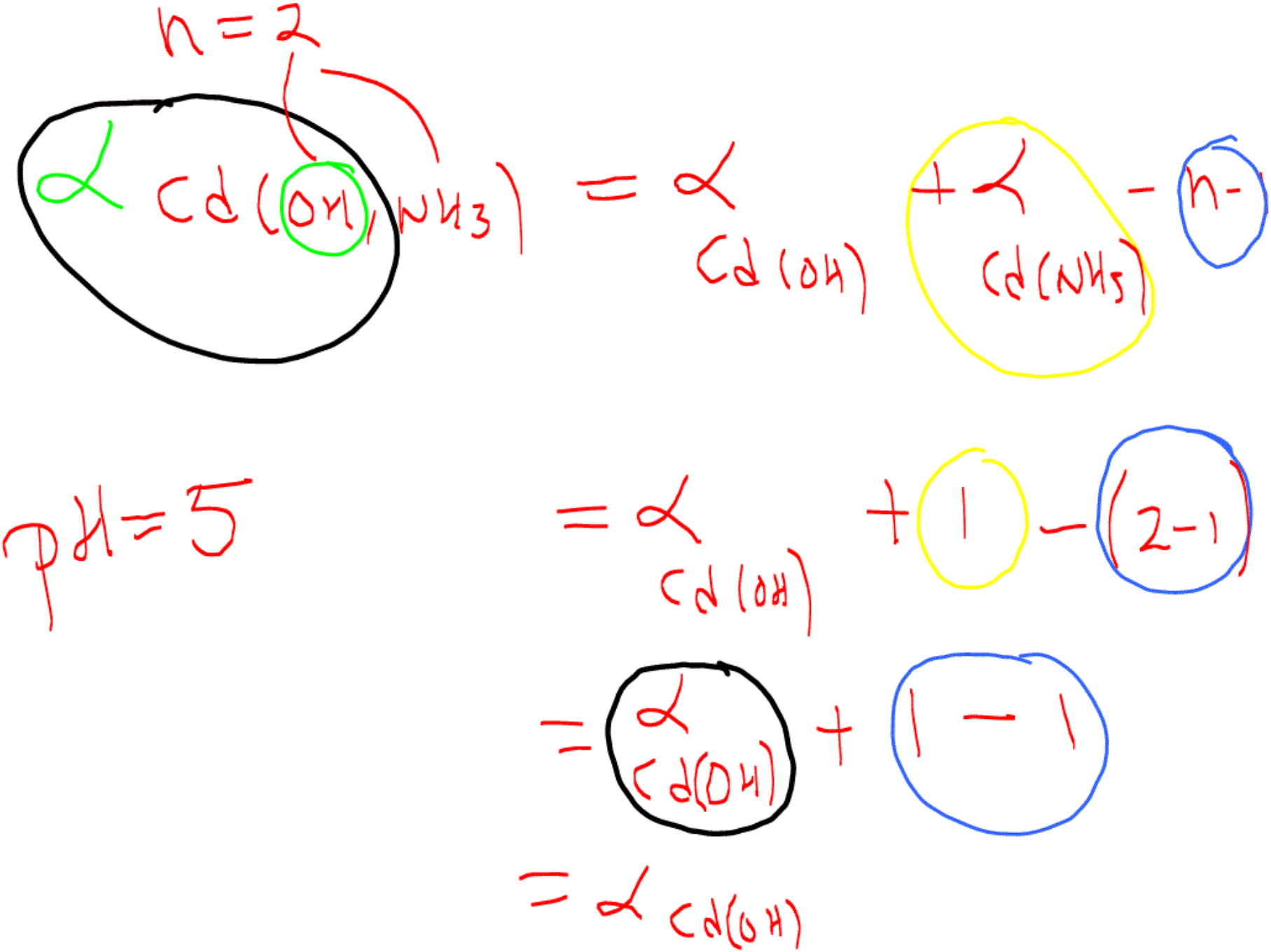
$$= 5.62 \times 10^{-7}$$

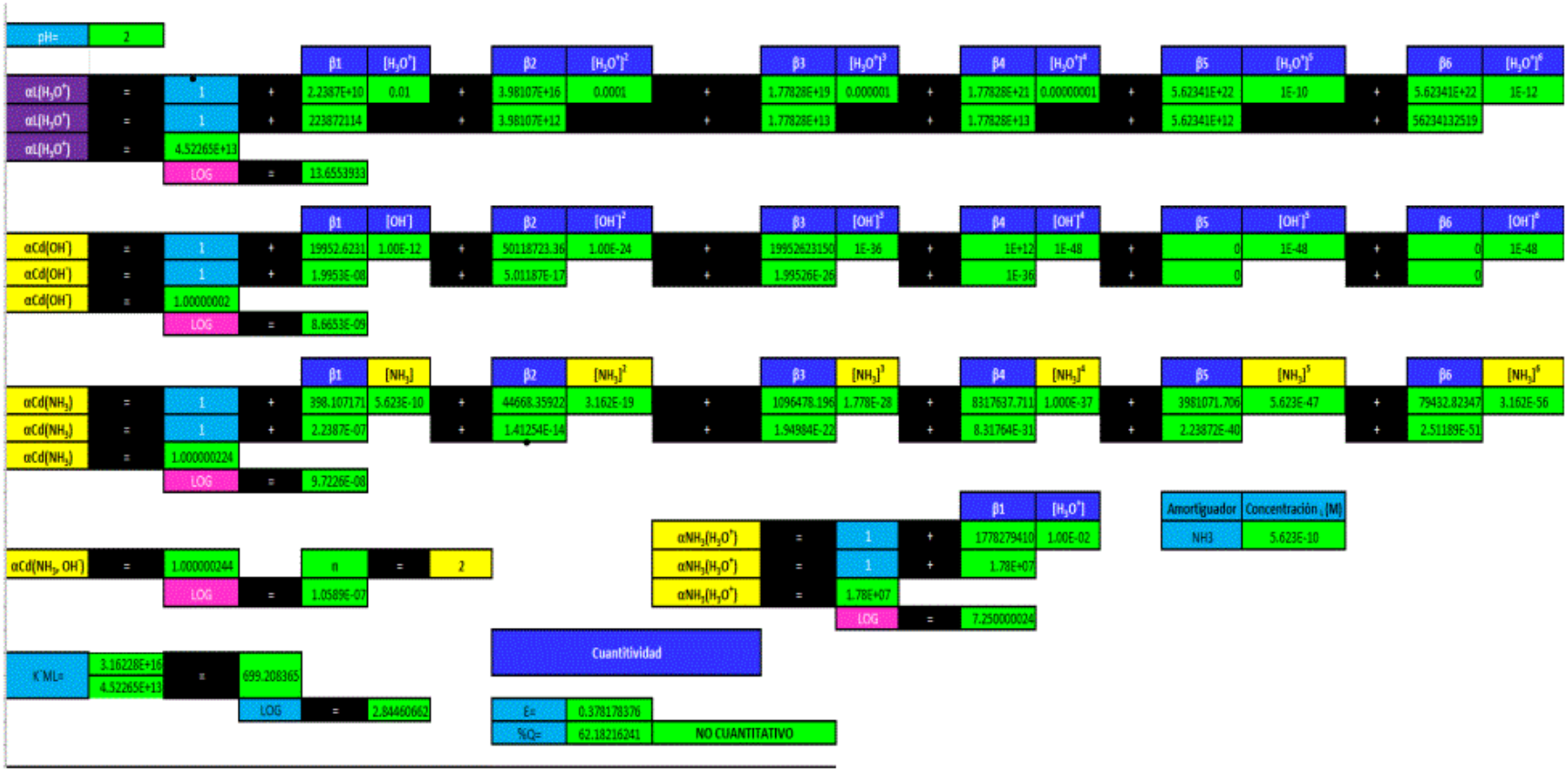
				β1	$[NH_3]$		β2	$[NH_3]^2$		β3	$[NH_3]^3$		β4	$[NH_3]^4$		β5	$[NH_3]^5$		β6	$[NH_3]^6$
$\alpha Cd(NH_3)$	=	1	+	398.107171	5.623E-07	+	44668.35922	3.162E-13	+	1096478.196	1.778E-19	+	8317637.711	9.998E-26	+	3981071.706	5.622E-32	+	79432.82347	3.161E-38
$\alpha Cd(NH_3)$	=	1	+	0.00022386		+	1.41238E-08		+	1.94652E-13		+	8.31577E-19		+	2.23809E-25		+	2.51104E-33	
$\alpha Cd(NH_3)$	=	1.000223874																		
		LOG	=	9.7216E-05																

pH = 5

$$\alpha Cd(NH_3) = 1$$

$$[Cd^{+2}]_L = \frac{[Cd^{+2}]_T}{\alpha Cd(NH_3)}$$


n = 2
α Cd(OH)2(NH3)
= α Cd(OH)
+ α Cd(NH3)
- n-
pH = 5
= α Cd(OH)
+ 1
- (2-1)
= α Cd(OH)
+ 1 - 1
= α Cd(OH)



pH=	2

				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	0.01	+	3.98107E+16	0.0001	+	1.77828E+19	0.000001	+	1.77828E+21	0.00000001	+	5.62341E+22	1E-10	+	5.62341E+22	1E-12
$\alpha L(H_3O^+)$	=	1	+	223872114		+	3.98107E+12		+	1.77828E+13		+	1.77828E+13		+	5.62341E+12		+	56234132519	
$\alpha L(H_3O^+)$	=	4.52265E+13																		
		LOG	=	13.6553933																

				β1	$[OH^-]$		β2	$[OH^-]^2$		β3	$[OH^-]^3$		β4	$[OH^-]^4$		β5	$[OH^-]^5$		β6	$[OH^-]^6$
$\alpha Cd(OH^-)$	=	1	+	19952.6231	1.00E-12	+	50118723.36	1.00E-24	+	19952623150	1E-36	+	1E+12	1E-48	+	0	1E-48	+	0	1E-48
$\alpha Cd(OH^-)$	=	1	+	1.99526E-08		+	5.01187E-17		+	1.99526E-26		+	1E-36		+	0		+	0	
$\alpha Cd(OH^-)$	=	1.00000002																		
		LOG	=	8.6653E-09																

				β1	$[NH_3]$		β2	$[NH_3]^2$		β3	$[NH_3]^3$		β4	$[NH_3]^4$		β5	$[NH_3]^5$		β6	$[NH_3]^6$
$\alpha Cd(NH_3)$	=	1	+	398.107171	5.623E-10	+	44668.35922	3.162E-19	+	1096478.196	1.778E-28	+	8317637.711	1.000E-37	+	3981071.706	5.623E-47	+	79432.82347	3.162E-56
$\alpha Cd(NH_3)$	=	1	+	2.2387E-07		+	1.41254E-14		+	1.94984E-22		+	8.31764E-31		+	2.23872E-40		+	2.51189E-51	
$\alpha Cd(NH_3)$	=	1.000000224																		
		LOG	=	9.7226E-08																

				β1	$[H_3O^+]$
$\alpha NH_3(H_3O^+)$	=	1	+	1778279410	1.00E-02
$\alpha NH_3(H_3O^+)$	=	1	+	1.78E+07	
$\alpha NH_3(H_3O^+)$	=	1.78E+07			
		LOG	=	7.250000024	

Amortiguador	Concentración $_1$ [M]
NH3	5.623E-10

$\alpha Cd(NH_3, OH^-)$	=	1.000000244		n	=	2
		LOG	=	1.0589E-07		

K´ML=	3.16228E+16 / 4.52265E+13	=	699.208365
		LOG	= 2.84460662

Cuantitividad		
E=	0.378178376	
%Q=	62.18216241	NO CUANTITATIVO

$$K_f' = \frac{K_f}{\alpha_{(d[OH,NH3])}\,\alpha_{EDTA(H3O+)}}$$

$$\frac{10^{16.5}}{(1)(10^{13.65})} = 10^{2.85}$$

$$K_F' = \frac{[cdy]}{[cd^{+2}][y']}$$

$$C_0 = 10^{-2} = \frac{\cancel{\varepsilon} C_0}{\varepsilon C_0 \; \varepsilon \cancel{C_0}} = 10^{2.85}$$

$$\frac{1}{\varepsilon^2 C_0} = 10^{2.85}$$

$$\xi = \sqrt{\frac{1}{K_F' C_0}}$$

$$\xi = \sqrt{\frac{1}{10^{2.85} \; 10^{-2}}}$$

$$\xi = \sqrt{\frac{1}{10^{0.85}}} = 10^{-0.85/2} = 10^{-0.425}$$

$$\therefore Q = (1-\varepsilon)100$$

$$= (1 - 10^{-0.425}) \times 100$$

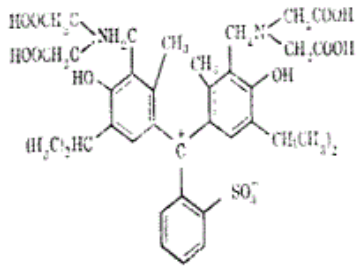
$$= 62.41\%$$

	KML		K_f		pks		pka
Cd-AEDTA	3.1623E+16	Naranja de Xilenol	1.2589E+17	$Cd(OH)_2$	13.6	NH_3	9.25
LOG	16.50	LOG Naranja de Xilenol	17.10				
		Azul de Metiltimol	1.0000E+19				
		LOG Azul de Metiltimol	19.00				

Indicador	pka_1	pka_2	pka_3	pka4	pka5
Naranja de Xilenol	2.60	3.30	6.40	10.50	12.30
Azul de metiltimol	4.50	7.20	11.50	13.40	

TABLA A.7 *(Cont.)*

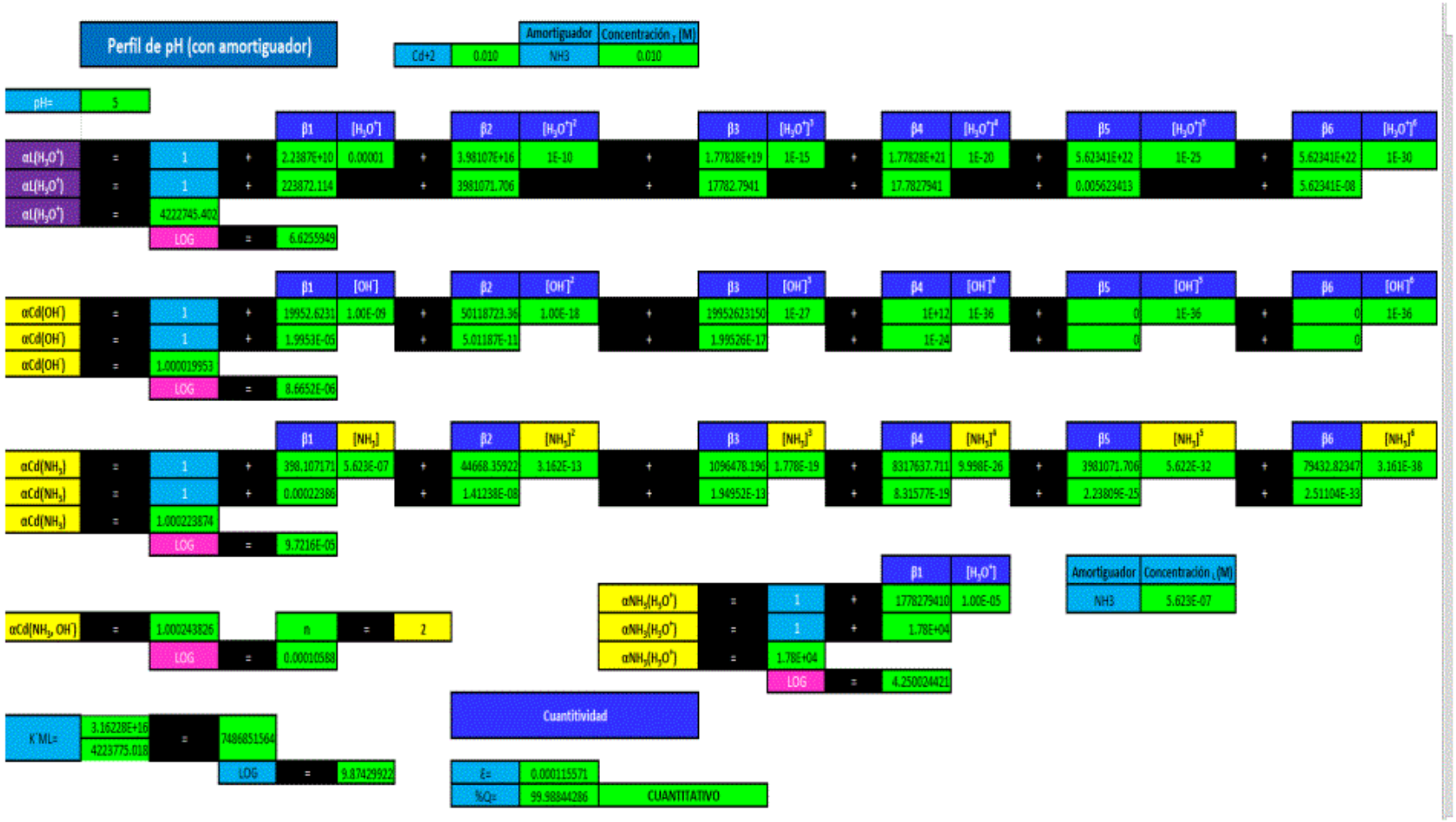
Azul de metiltimol (15)



pH_{trans}	Amarillo pálido		4,5		Amarillo		7,2
pH	4,0	4,5	5,0	5,5	6,0	6,5	7,0
			A) *Solución ácida*				
$\log \alpha_{I(H)}$	20,4	18,5	16,9	15,3	13,8	12,3	11,0
$\log \alpha_{HI(H)}$	11,3	9,9	8,8	7,6	6,7	5,7	4,9
$\log \alpha_{H_2I(H)}$	3,9	3,0	2,4	1.7	1,3	0,8	0,5
pCd_{trans} a rojo			2,5	3,3	4,1	4,9	5,6
pHg_{trans} a rojo	11,4	12,0	12,7	13,4	14,0	14,7	
pLa_{trans} a rojo			4,4	4,9	5,4		
pPb_{trans} a rojo	4,3	5,2	5,9	6,4	7,0	7,5	
pZn_{trans} a rojo			4,5	5,5	6	7	

$$\alpha_{Ind(H_3O^+)} = 1 + \beta_1 [H_3O^+] + \beta_2 [H_3O^+]^2 + \beta_3 [H_3O^+]^3 + \beta_4 [H_3O^+]^4$$

$$K'_{Cd(Ind)} = \frac{K_{F\,Cd(Ind)}}{\alpha_{Cd(OH,NH_3)} \alpha_{Ind(H_3O^+)}}$$


Perfil de pH (con amortiguador)
Cd+2 0.010
Amortiguador NH3
Concentración $_T$ (M) 0.010
pH= 5
β1 [H3O+] β2 [H3O+]2 β3 [H3O+]3 β4 [H3O+]4 β5 [H3O+]5 β6 [H3O+]6
αL(H3O+) = 1 + 2.2387E+10 0.00001 + 3.98107E+16 1E-10 + 1.77828E+19 1E-15 + 1.77828E+21 1E-20 + 5.62341E+22 1E-25 + 5.62341E+22 1E-30
αL(H3O+) = 1 + 223872.114 + 3981071.706 + 17782.7941 + 17.7827941 + 0.005623413 + 5.62341E-08
αL(H3O+) = 4222745.402
LOG = 6.6255949
β1 [OH-] β2 [OH-]2 β3 [OH-]3 β4 [OH-]4 β5 [OH-]5 β6 [OH-]6
αCd(OH-) = 1 + 19952.6231 1.00E-09 + 50118723.36 1.00E-18 + 19952623150 1E-27 + 1E+12 1E-36 + 0 1E-36 + 0 1E-36
αCd(OH-) = 1 + 1.9953E-05 + 5.01187E-11 + 1.99526E-17 + 1E-24 + 0 + 0
αCd(OH-) = 1.000019953
LOG = 8.6652E-06
β1 [NH3] β2 [NH3]2 β3 [NH3]3 β4 [NH3]4 β5 [NH3]5 β6 [NH3]6
αCd(NH3) = 1 + 398.107171 5.623E-07 + 44668.35922 3.162E-13 + 1096478.196 1.778E-19 + 8317637.711 9.998E-26 + 3981071.706 5.622E-32 + 79432.82347 3.161E-38
αCd(NH3) = 1 + 0.0002238 + 1.41238E-08 + 1.94952E-13 + 8.31577E-19 + 2.23809E-25 + 2.51104E-33
αCd(NH3) = 1.000223874
LOG = 9.7216E-05
β1 [H3O+] Amortiguador Concentración $_T$ (M)
αNH3(H3O+) = 1 + 1778279410 1.00E-05 NH3 5.623E-07
αNH3(H3O+) = 1 + 1.78E+04
αNH3(H3O+) = 1.78E+04
LOG = 4.250024421
αCd(NH3, OH-) = 1.000243826 n = 2
LOG = 0.00010588
K'ML= 3.16228E+16 / 4223775.018 = 7486851564
LOG = 9.8742992
Cuantitividad
ξ= 0.000115571
%Q= 99.98844286 CUANTITATIVO

pH = 5

amoltiguador = ?

CH_3COO^-/CH_3COOH

pKa = 4.75

3.75 - 5.75

$\alpha_{Cd(CH_3COO^-)} = ?$

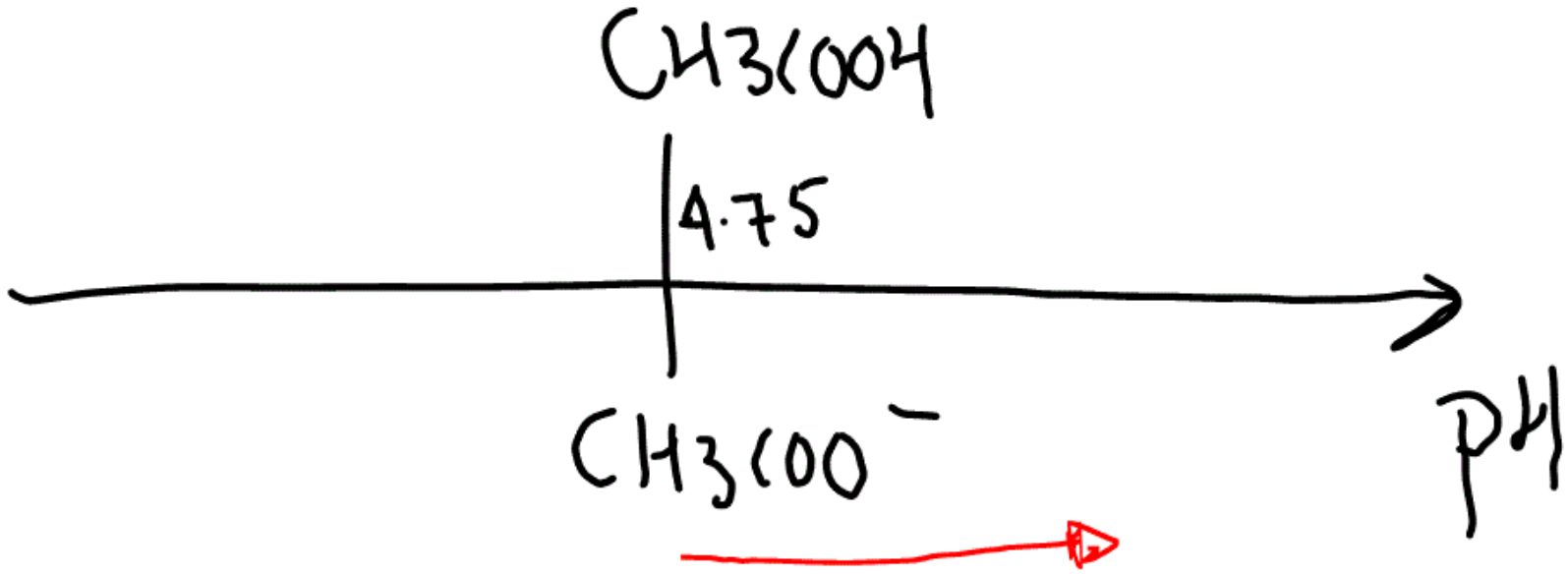


TABLA A.2e

Constantes de estabilidad de complejos metálicos con algunos iones orgánicos

Los reactivos que se recogen en esta tabla se utilizan frecuentemente como agentes tamponantes, precipitantes o enmascarantes, y, por tanto, las constantes se dan, cuando ello es posible, a fuerzas iónicas entre 0,1 y 1, que predominan en el trabajo analítico. Muchos de los valores (a menudo termodinámicos) de las referencias originales se han convertido en valores aproximados, válidos con fines prácticos. De esta forma se consigue que las diversas constantes sean más comparables entre sí, y si es suficiente una aproximación moderada, la mayoría de los valores pueden utilizarse sin aplicar correcciones de actividad.

Este tratamiento puede motivar críticas, pero es el que resulta más práctico teniendo en cuenta los objetivos que se persiguen.

Por desgracia, los valores de varias constantes de esta sección adolecen de cierta incertidumbre. Las constantes de los complejos de ácidos aminocarboxílicos se dan por separado en la tabla A.2*f*.

Acido acético	Acido salicílico
Acetilacetona	Acido tartárico
Acido cítrico	Acido sulfosalicílico
Acido oxálico	Tirón (ácido catecol-3,5-disulfónico)
Acido ftálico	2,3-dimercapto-1-propanol (BAL)

Ion metálico	*Complejo*	*Componentes*	*Fuerza iónica*	Log $K_{est.}$	*Ref. núm.*
		Acido acético $CH_3COOH=HL$			
H^+	HL	H+L	0,1	4,65	1
Ba^{2+}	BaL	Ba+L	0,2	0,4	2
Ca^{2+}	CaL	Ca+L	0,2	0,5	2
Cd^{2+}	CdL	Cd+L	1	1,0	3
	CdL_2	Cd+2L	1	1,9	
	CdL_3	Cd+3L	1	1,8	
	CdL_4	Cd+4L	1	1,3	

$$\text{acetatos} = 10^{-2}\ M$$

$$pH = pKa + \log \frac{[CH_3COO^-]}{[CH_3COOH]}$$

$$[CH_3COO^-] + [CH_3COOH] = 10^{-2}$$

$$pH = 4.75 + \log \frac{[CH_3COO^-]}{[CH_3COOH]}$$

$$pH = 4.75 + \log \frac{[CH_3COO^-]}{[CH_3COOH]}$$

$$5 = 4.75 + \log \frac{[CH_3COO^-]}{[CH_3COOH]}$$

$$0.25 = \log \frac{[CH_3COO^-]}{[CH_3COOH]}$$

$$10^{\quad} \qquad 10$$

$$10^{0.25} = \frac{[CH_3COO^-]}{[CH_3COOH]} = 1.78$$

$$= 1.78$$

$$[CH_3COO^-] = 1.78\,[CH_3COOH]$$

$$pH = 4.75$$

$$4.75 = 4.75 + \log \frac{[CH_3COO^-]}{[CH_3COOH]}$$

$$0 = \log \frac{[CH_3COO^-]}{[CH_3COOH]}$$

$$10 \qquad 10$$

$$1 = \frac{[CH_3COO^-]}{[CH_3COOH]} \qquad \frac{5 \times 10^{-3}}{5 \times 10^{-3}}$$

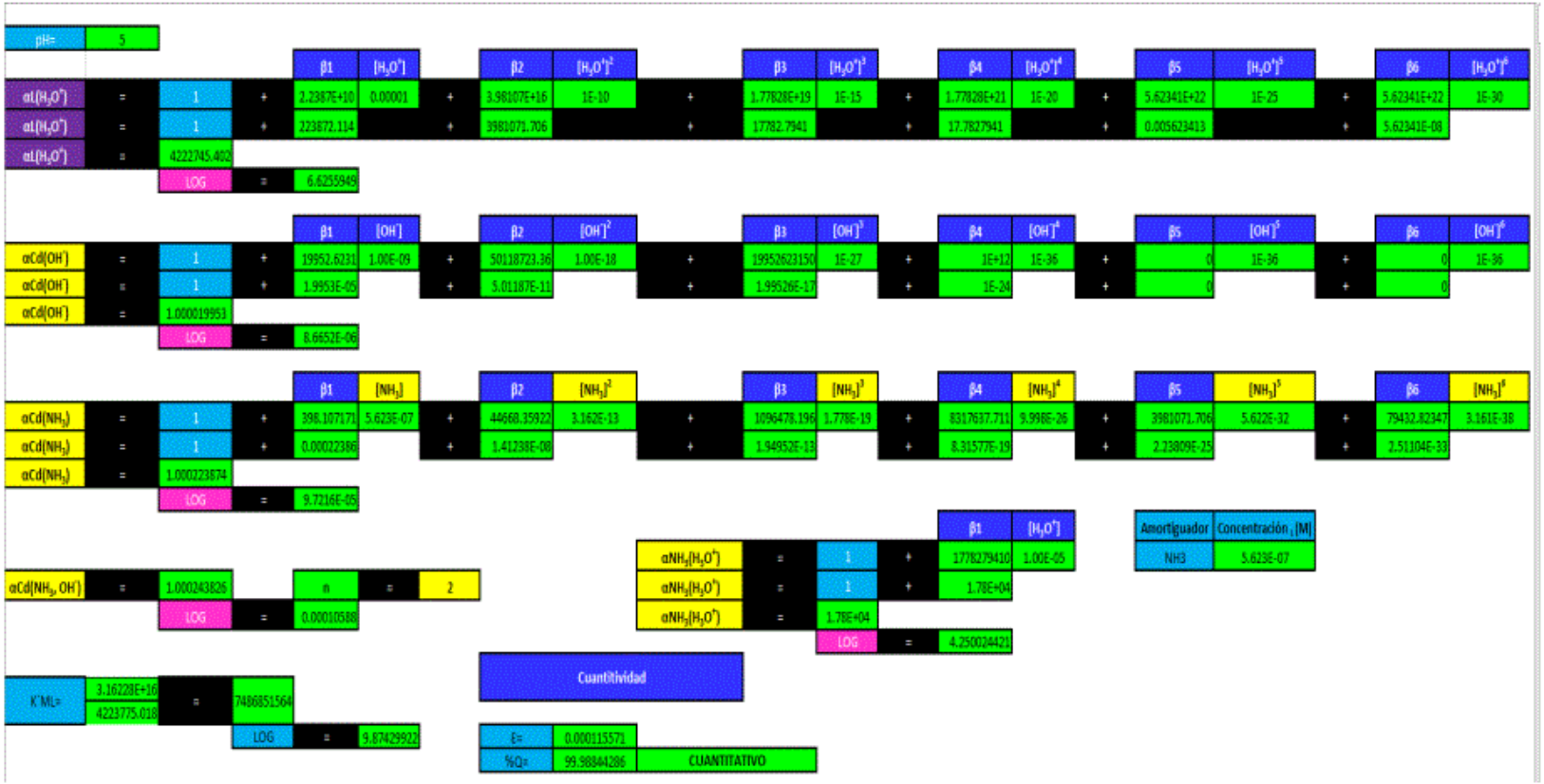
$5 \times 10^{-3} + 5 \times 10^{-3} = 0.01$

$total = 0.01$

$pH = pKa$

$$\alpha_{(H_3COO^-)(H_3O^+)} = 1 + \beta_p [H_3O^+]$$

$$= 1 + 10^{4.75} [H_3O^+]$$

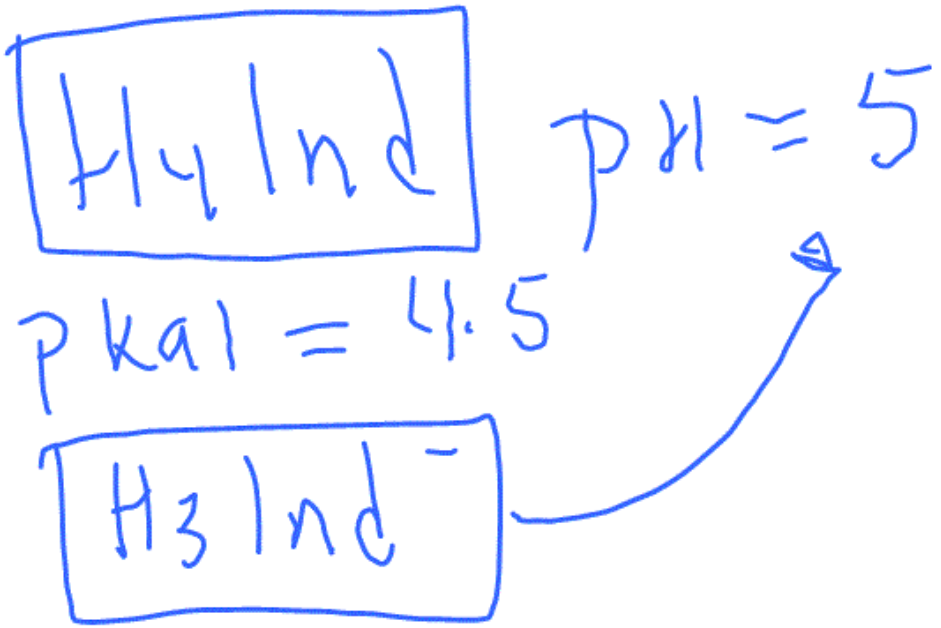

pH=
5
β1
[H3O+]
β2
[H3O+]2
β3
[H3O+]3
β4
[H3O+]4
β5
[H3O+]5
β6
[H3O+]6
αL(H3O+) = 1 + 2.2387E+10 0.00001 + 3.981071E+16 1E-10 + 1.77828E+19 1E-15 + 1.77828E+21 1E-20 + 5.62341E+22 1E-25 + 5.62341E+22 1E-30
αL(H3O+) = 1 + 223872.114 + 3981071.706 + 17782.7941 + 17.7827941 + 0.005623413 + 5.62341E-08
αL(H3O+) = 4222745.402
LOG = 6.6255949
β1
[OH-]
β2
[OH-]2
β3
[OH-]3
β4
[OH-]4
β5
[OH-]5
β6
[OH-]6
αCd(OH-) = 1 + 19952.6231 1.00E-09 + 50118723.36 1.00E-18 + 1995262315(1E-27 + 1E+12 1E-36 + 0 1E-36 + 0 1E-36
αCd(OH-) = 1 + 1.9953E-05 + 5.01187E-11 + 1.99526E-17 + 1E-24 + 0 + 0
αCd(OH-) = 1.000019953
LOG = 8.6652E-06
β1
[NH3]
β2
[NH3]2
β3
[NH3]3
β4
[NH3]4
β5
[NH3]5
β6
[NH3]6
αCd(NH3) = 1 + 398.107171 5.623E-07 + 44668.35922 3.162E-13 + 1096478.196 1.778E-19 + 8317637.711 9.998E-26 + 3981071.706 5.622E-32 + 79432.82347 3.161E-38
αCd(NH3) = 1 + 0.00022386 + 1.41238E-08 + 1.94952E-13 + 8.31577E-19 + 2.23809E-25 + 2.51104E-33
αCd(NH3) = 1.000223874
LOG = 9.7216E-05
β1
[H3O+]
αNH3(H3O+) = 1 + 17782794.10 1.00E-05
αNH3(H3O+) = 1 + 1.78E+04
αNH3(H3O+) = 1.78E+04
LOG = 4.250024421
Amortiguador
Concentración , [M]
NH3
5.623E-07
αCd(NH3, OH-) = 1.000243826 n = 2
LOG = 0.00010588
Cuantitividad
K´ML= 3.16228E+16 = 7486851564
4223775.018
LOG = 9.87429922
E= 0.000115571
%Q= 99.98844286 CUANTITATIVO

K´MInd=	100000000000000000.00 / 2.79326E+15	=	3580.04902
		LOG	= 3.553888973

LOG Azul de Metiltimol

			β_1	$[H_3O^+]$		β_2	$[H_3O^+]^2$		β_3	$[H_3O^+]^3$		β_4	$[H_3O^+]^4$
αInd(H3O+)	=	1	+ 2.51E+13	0.00001	+	7.9433E+24	1E-10	+	1.2589E+32	1E-15	+	3.9811E+36	1E-20
αInd(H3O+)	=	1	+ 2.51E+08		+	7.9433E+14		+	1.2589E+17		+	3.9811E+16	
αInd(H3O+)	=	7.9433E+14											
		LOG	= 14.9										

			Color 1		Color 2
3.553889	±	1	= 2.553889	----------	4.553889

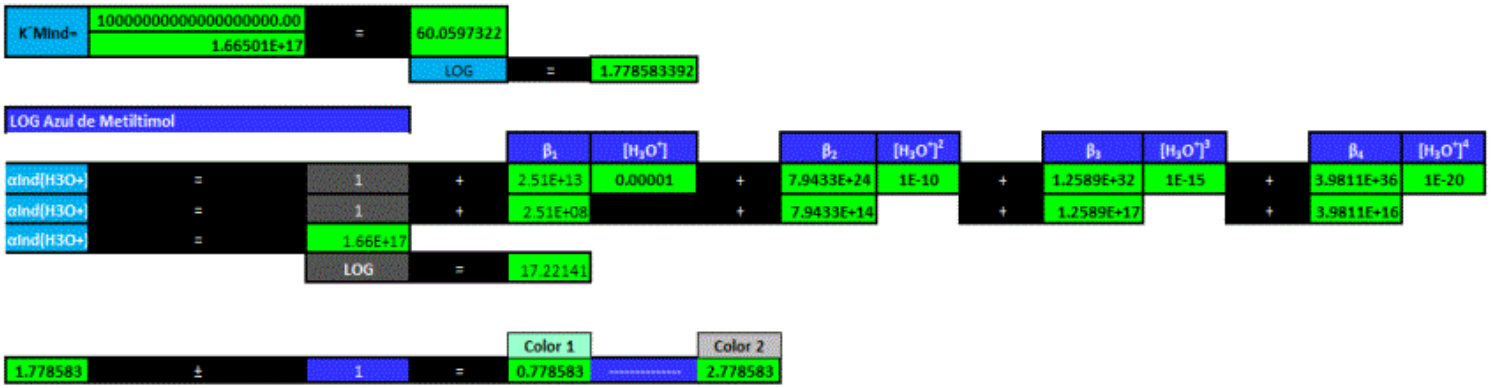


$$\alpha_{Ind(H_3O^+)} = 1 + \beta_1 [H_3O^+] + \beta_2 [H_3O^+]^2 + \beta_3 [H_3O^+]^3 + \beta_4 [H_3O^+]^4$$

$pH = 5$

$[H_3O^+] = 10^{-5}$

$$= 1 + 10^{13.4} [H_3O^+] + 10^{24.9} [H_3O^+]^2 + 10^{32.1} [H_3O^+]^3 + 10^{36.6} [H_3O^+]^4$$


K´MInd=
10000000000000000000.00
1.66501E+17
=
60.0597322
LOG
=
1.778583392
LOG Azul de Metiltimol
β1
[H3O+]
β2
[H3O+]2
β3
[H3O+]3
β4
[H3O+]4
αInd[H3O+]
=
1
+
2.51E+13
0.00001
+
7.9433E+24
1E-10
+
1.2589E+32
1E-15
+
3.9811E+36
1E-20
αInd[H3O+]
=
1
+
2.51E+08
+
7.9433E+14
+
1.2589E+17
+
3.9811E+16
αInd[H3O+]
=
1.66E+17
LOG
=
17.22141
Color 1
Color 2
1.778583
±
1
=
0.778583
2.778583

pH = 5

K´MInd=	100000000000000000000.00 / 1.37844E+14	=	72545.5558
		LOG	= 4.860610812

LOG Azul de Metiltimol

				β_1	$[H_3O^+]$		β_2	$[H_3O^+]^2$		β_3	$[H_3O^+]^3$		β_4	$[H_3O^+]^4$
αInd[H3O+]	=	1	+	2.51E+13	0.000001	+	7.9433E+24	1E-12	+	1.2589E+32	1E-18	+	3.9811E+36	1E-24
αInd[H3O+]	=	1	+	2.51E+07		+	7.9433E+12		+	1.2589E+14		+	3.9811E+12	
αInd[H3O+]	=	1.38E+14												
		LOG	=	14.1393										

				Color 1		Color 2
4.860611	±	1	=	3.860611	----------	5.860611

pH = 6

$$K'_{CdInd} = \frac{K_{CaInd}}{\alpha_{Cd(NH_3,OH)}\,\alpha_{Ind(H_3O^+)}}$$

$$= \frac{10^{19}}{10^{0}\;\;10^{14.13}} = 10^{4.87}$$

$$pM_{trans} = 4.87$$

$$3.87 - 5.87$$

K'Mind=	100000000000000000000.00	=	72545.5558
	1.37844E+14	LOG	= 4.860610812

pH = 6

LOG Azul de Metiltimol

				β_1	$[H_3O^+]$		β_2	$[H_3O^+]^2$		β_3	$[H_3O^+]^3$		β_4	$[H_3O^+]^4$
αInd[H3O+]	=	1	+	2.51E+13	0.000001	+	7.9433E+24	1E-12	+	1.2589E+32	1E-18	+	3.9811E+36	1E-24
αInd[H3O+]	=	1	+	2.51E+07		+	7.9433E+12		+	1.2589E+14		+	3.9811E+12	
αInd[H3O+]	=	1.38E+14												
		LOG	=	14.1393										

				Color 1		Color 2
4.860611	±	1	=	3.860611	----------	5.860611

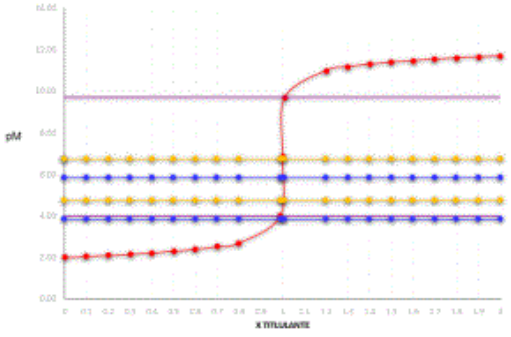
		Catión	Concentración (M)	
pH=	6	Cd+2	0.01	CUANTITATIVO

		INDICADOR	1	% ERROR
X	pCd	APE	DPE	
0	2.0011	4.000086647	9.708035	→ 6.8541
0.1	2.0468			
0.2	2.0980			
0.3	2.1560			
0.4	2.2229			
0.5	2.3021			
0.6	2.3990			
0.7	2.5299			
0.8	2.7000			
0.99	4.0011			
1	6.8541			
1.01	9.7071			
1.2	11.0081			
1.3	11.1842			
1.4	11.3091			
1.5	11.4060			
1.6	11.4852			
1.7	11.5522			
1.8	11.6102			
1.9	11.6613			
2	11.7071			

K'Mind=	1.26E+17	=	567217.2	
	2.22E+11	LOG	=	5.753749

Naranja de Xilenol

				β_1	$[H_3O^+]$
αInd[H_3O^+]	=	1	+	1.9953E+12	0.000001
αInd[H_3O^+]	=	1	+	1995262.3	
αInd[H_3O^+]	=	2.2190E+11			
		LOG	=	11.346164	



pCd

4 - 9.7

1.1. 1.1.

APE DPE

pH = 7

	Catión	Concentración [M]	
pH= 7	Cd+2	0.01	CUANTITATIVO

	INDICADOR	1	% ERROR
X	pCd	APE	DPE
0	2.0105	4.000865885	11.09796
0.1	2.0562		
0.2	2.1074		
0.3	2.1654		
0.4	2.2323		
0.5	2.3115		
0.6	2.4084		
0.7	2.5333		
0.8	2.7094		
0.99	4.0105		
1	7.5494		
1.01	11.0884		
1.2	12.3894		
1.3	12.5655		
1.4	12.6904		
1.5	12.7873		
1.6	12.8665		
1.7	12.9335		
1.8	12.9914		
1.9	13.0426		
2	13.0884		

→ 7.5494

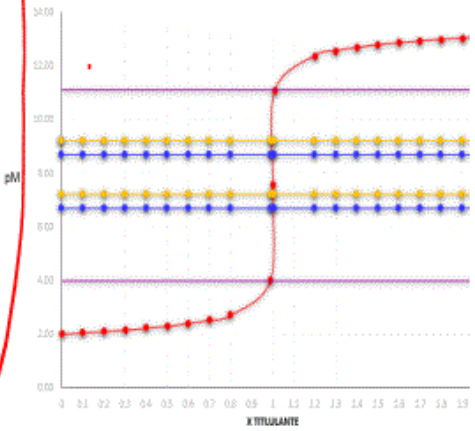
K'Mind= 1.26E+17 / 7.91E+08 = 1.59E+08

LOG = 8.201684

Naranja de Xilenol

				β_1	$[H_3O^+]$
$\alpha Ind(H_3O^+)$	=	1	+	1.9953E+12	1E-07
$\alpha Ind(H_3O^+)$	=	1	+	199526.23	
$\alpha Ind(H_3O^+)$	=	7.8968E+08			

LOG = 8.8974499



K'Mind= 100000000000000000.00 / 2.06137E+11 = 48511529.4

LOG = 7.685844967

LOG Azul de Metiltimol

				β_1	$[H_3O^+]$		β_2	$[H_3O^+]^2$		β_3	$[H_3O^+]^3$		β_4	$[H_3O^+]^4$
$\alpha Ind(H3O+)$	=	1	+	2.51E+13	0.0000001	+	7.9433E+24	1E-14	+	1.2589E+32	1E-21	+	3.9811E+36	1E-28
$\alpha Ind(H3O+)$	=	1	+	2.51E+06		+	7.9433E+10		+	1.2589E+11		+	3.9811E+08	
$\alpha Ind(H3O+)$	=	2.06E+13												

LOG = 11.31329

			Color 1	Color 2
7.685845	±	1	= 6.685845	8.685845

pCd = (6.68 - 8.68)

7.54

4 - 11

pCd