Clase 10 27 Noviembre 2020

Título de la nota 27/11/2020

$$\alpha_L = \alpha_{L(M_1)} + \alpha_{L(M_2)} \cdots \alpha_{L(M_n)} \cdots$$

$$\alpha_L = \sum_{i=1}^{n} \alpha_{L(M_i)} - (n-1)$$

$$\alpha_{M(OH)} + \alpha_{M(L_1)} + \alpha_{M(L_2)}$$

$$pH = pK_{NH_4^+/NH_3} = 10$$

$$Cd^{+2} + NH_3 \rightleftharpoons [Cd(NH_3)_4]^{+2}$$

$$Cd^{+2} + y^{-4} \rightleftharpoons [Cd\,y]^{-2}$$

$$\alpha_{Cd(OH,NH_3)} = \alpha_{Cd(OH)} + \alpha_{Cd(NH_3)} - (n-1)$$

$n = 2$

Ca^{+2} 10^{-2} M pH=12

AEDTA 10^{-2} M

0.05 M ✓

0.01 M

$K_F = 10^{10.7}$

CaY

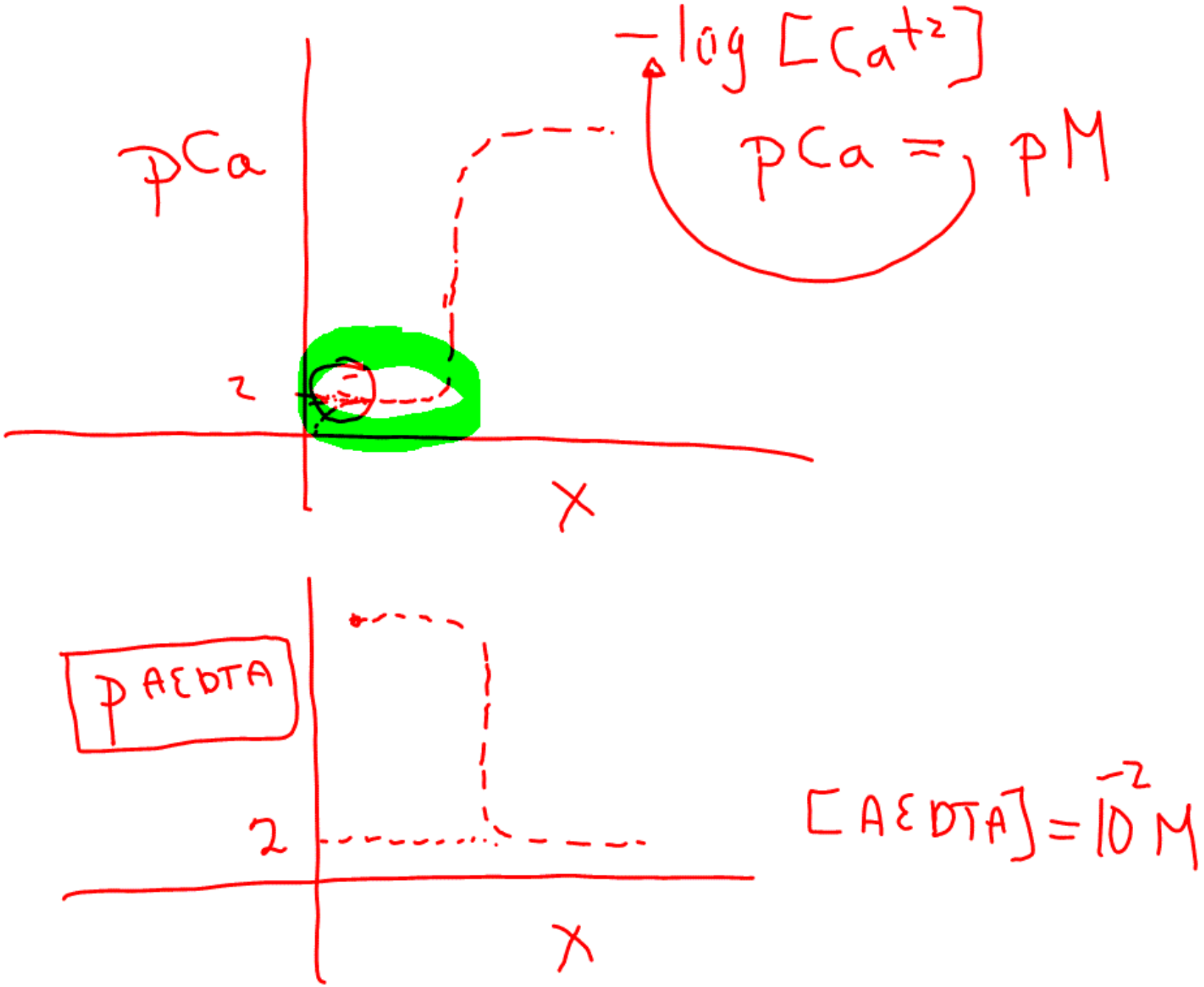
$$K_F' = \frac{K_F}{\alpha_{Ca(OH)}\,\alpha_{Y(H_3O^+)}}$$

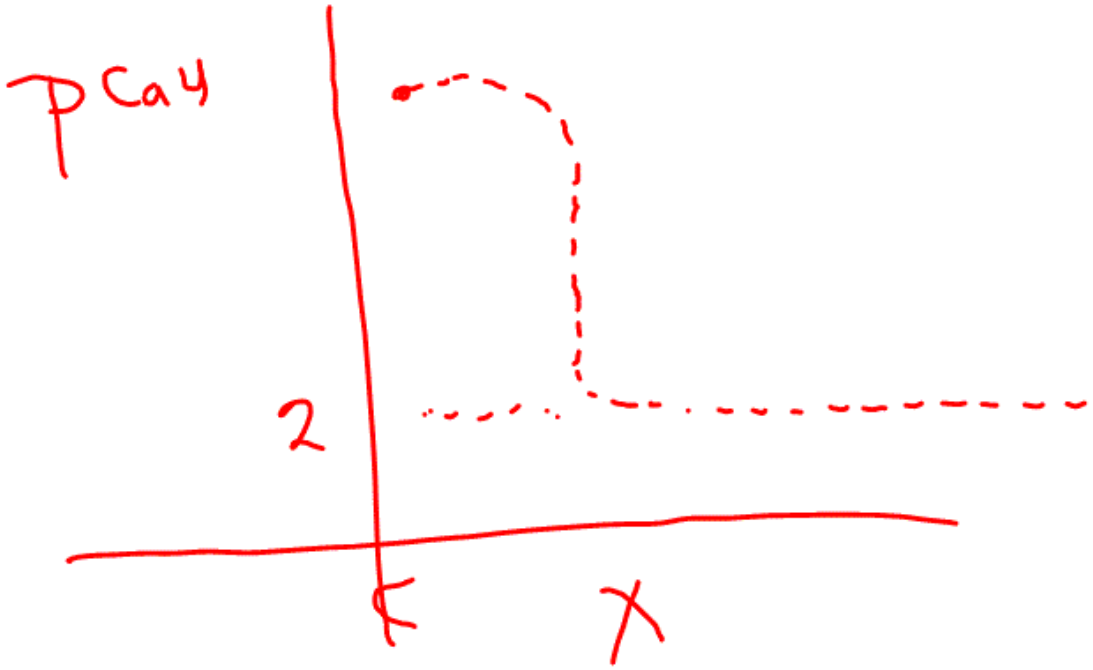
pH=12

$$\alpha_{Ca(OH)} = 10^{0.079}$$

$$\alpha_{y(H_3O^+)} = 10^{0.009}$$

$$K_F' = \frac{10^{10.7}}{10^{0.079}\ 10^{0.009}} = 10^{10.6113}$$


$-\log [Ca^{+2}]$
pCa = pM
pCa
2
X
pAEDTA
2
X
$[AEDTA] = 10^{-2} M$


P Ca 4
2
E
X

$$Ca^{+2} + y^{-4} \rightleftharpoons [Cay]^{-2}$$

Inicio	C_0		
Ag		xC_0	
APE	$C_0(1-x)$	~ 0	xC_0
PE	εC_0	εC_0	C_0
DPE	~ 0	$C_0(x-1)$	C_0

✓ 1:1

$$X = 0$$

$$pCa$$

$$\alpha_{Ca(OH)} = \frac{[Ca']}{[Ca_L]}$$

$$pM_{Libre}$$

$L = Libre$

$$[Ca_L] = \frac{[Ca']}{\alpha_{Ca(OH)}}$$

$$[M_L] = \frac{[M']}{\alpha_{M(OH)}}$$

$$\left[[M_L] = \frac{[M']}{\alpha_{M(OH)}}\right] - \log$$

$$pM = -\log[M_{..}] + \log\alpha_{M(OH)}$$

$$pCa = -\log[Ca^{+2}] + \log\alpha_{Ca(OH)}$$

$$pM = -\log C_o + \log \alpha_{M(OH)}$$

$$pCa = -\log [Ca^{+2}] + \log \alpha_{Ca(OH)}$$

$$= -\log 10^{-2} + 0.079 = 2.079$$

$$X = 0.5$$

$$pM = -\log C_o(1-x) + \log \alpha_{M(OH)}$$

$$pCa = -\log 10^{-2}(1-0.5) + \log \alpha_{Ca(OH)}$$

$$= -\log 10^{-2}(0.5) + \log 10^{0.079}$$

$$= -\log 5 \times 10^{-3} + 0.079$$

$$pCa = 2.3 + 0.079 = 2.379$$

$$x = 1$$

$$[M'] = [y^{-4'}]$$

$$K_f' = \frac{[My]}{[M'][y^{-4'}]} = \frac{[My]}{[M']^2}$$

$$K_f' = \frac{[My]}{[M']^2} = \frac{C_0}{[M']^2}$$

$$[M']^2 = \frac{C_0}{K_f'} \quad \therefore [M'] = \sqrt{\frac{C_0}{K_f'}}$$

$$\alpha_{M(OH)} = \frac{[M']}{[M_L]} \quad \therefore [M_L] = \frac{[M']}{\alpha_{M(OH)}}$$

$$\left[[M_L] = \frac{\sqrt{\frac{C_0}{K_f'}}}{\alpha_{M(OH)}} \right] - \log$$

$$\left[[M_2] = \frac{\sqrt{\frac{C_0}{K_F'}}}{\alpha_{M(OH)}} \right] - \log$$

$$pM = \frac{1}{2}\log K_F' - \frac{1}{2}\log C_0 + \log \alpha_{M(OH)}$$

$$pCa = \frac{1}{2}\log 10^{10.6113} - \frac{1}{2}\log 10^{-2} + \log 10^{0.079}$$

$$= \frac{1}{2}(10.6113) + 1 + 0.079$$

$$= 5.3065 + 1 + 0.079$$

$$= 6.3846$$

$$X = 1.5$$

$$K_F' = \frac{[MY]}{[M'][Y^{-4'}]} = \frac{C_0}{[M'] C_0 (X-1)}$$

$$K_F' = \frac{1}{[M'](X-1)}$$

$$[M'] = \frac{1}{K_F'(X-1)}$$

$$[M_L] = \frac{[M']}{\alpha_{M(OH)}}$$

$$-\log\left[[M_L] \frac{[M']}{\alpha_{M(OH)}} = \frac{1}{K_F'(X-1)\alpha_{M(OH)}}\right]$$

$$pM = \log K_F' + \log(X-1) + \log \alpha_{M(OH)}$$

$$pCa = \log 10^{10.6113} + \log(1.5-1) + \log 10^{0.079}$$

$$= 10.6113 + \log 0.5 + 0.079$$

$$= 10.6113 - 0.3 + 0.079$$

$$= 10.3892$$

p. e.

$$K_F' = \frac{[MY]}{[M'][Y^{-4'}]}$$

$$K_F' = \frac{[CaY^{-2}]}{[Ca^{+2'}][Y^{-4'}]} = 10^{10.6113}$$

$$K_F' = \frac{C_0}{\varepsilon C_0 \varepsilon C_0} = 10^{10.6113}$$

$$\varepsilon = \sqrt{\frac{1}{K_F' C_0}} = \sqrt{\frac{1}{10^{10.6113}\, 10^{-2}}}$$

$$\varepsilon = \sqrt{\frac{1}{10^{8.6113}}} = 10^{-8.6113/2}$$

$$\varepsilon = 10^{-4.305}$$

$$\%Q = (1-\varepsilon)100 = 99.994\%$$

$$K_F' C_0 > 10^5 \qquad 10^{8.6113} > 10^5$$

$$10^{10.6113} \; 10^{-2} > 10^5$$

$$X = 2$$

$$pCa = \log K_F' + \log(x-1) + \log 2_{Ca(OH)}$$

$$= \log 10^{0.6113} + \log(2-1) + \log 10^{0.079}$$

$$= 10.6113 + 0.079 = 10.6903$$

1.1. APE

$$[Ca^{+2}] = 10^{-2}\ 10^{-2} = 10^{-4}$$

Solo $\alpha = 1$ $Ca(OH)_2$

$$\alpha_{Ca(OH)_2} = \frac{[Ca^{+2}]}{[Ca^{+2}_t]} \quad \therefore [Ca_t] = \frac{[Ca^{+2}]}{\alpha_{Ca(OH)_2}}$$

$$\left[[Ca_t] = \frac{10^{-4}}{10^{0.079}} = 10^{-4.079}\right] - \log$$

$$pCa = -\log 10^{-4.079} = 4.079$$

1.1. DPE

$$[CaY^{-2}] = 10^{-2} = 0.01$$

$$[Y^{-4'}] = (10^{-2})(10^{-2}) = 10^{-4}$$

$$K_F' = \frac{[CaY^{-2}]}{[Ca^{+2'}][Y^{-4'}]} = 10^{10.6113}$$

$$K_F' = \frac{10^{-2}}{[Ca^{+2'}]\,10^{-4-2}} = 10^{10.6113}$$

$$[Ca^{+2'}] = \frac{1}{10^{10.6113}\,10^{-2}} = 10^{-8.6113}$$

$$[Ca_2] = \frac{[Ca^{+2}]}{2}$$

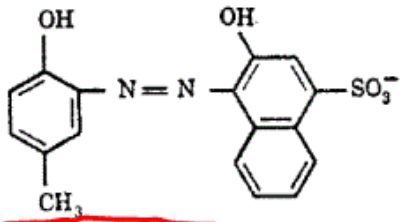
$$-\log[= \frac{10^{-8.6113}}{10^{0.079}} = 10^{-8.6903}]$$

$$pCa = 8.6903$$

$$6.3846 = \frac{8.6903 + 4.079}{2} = p.e$$

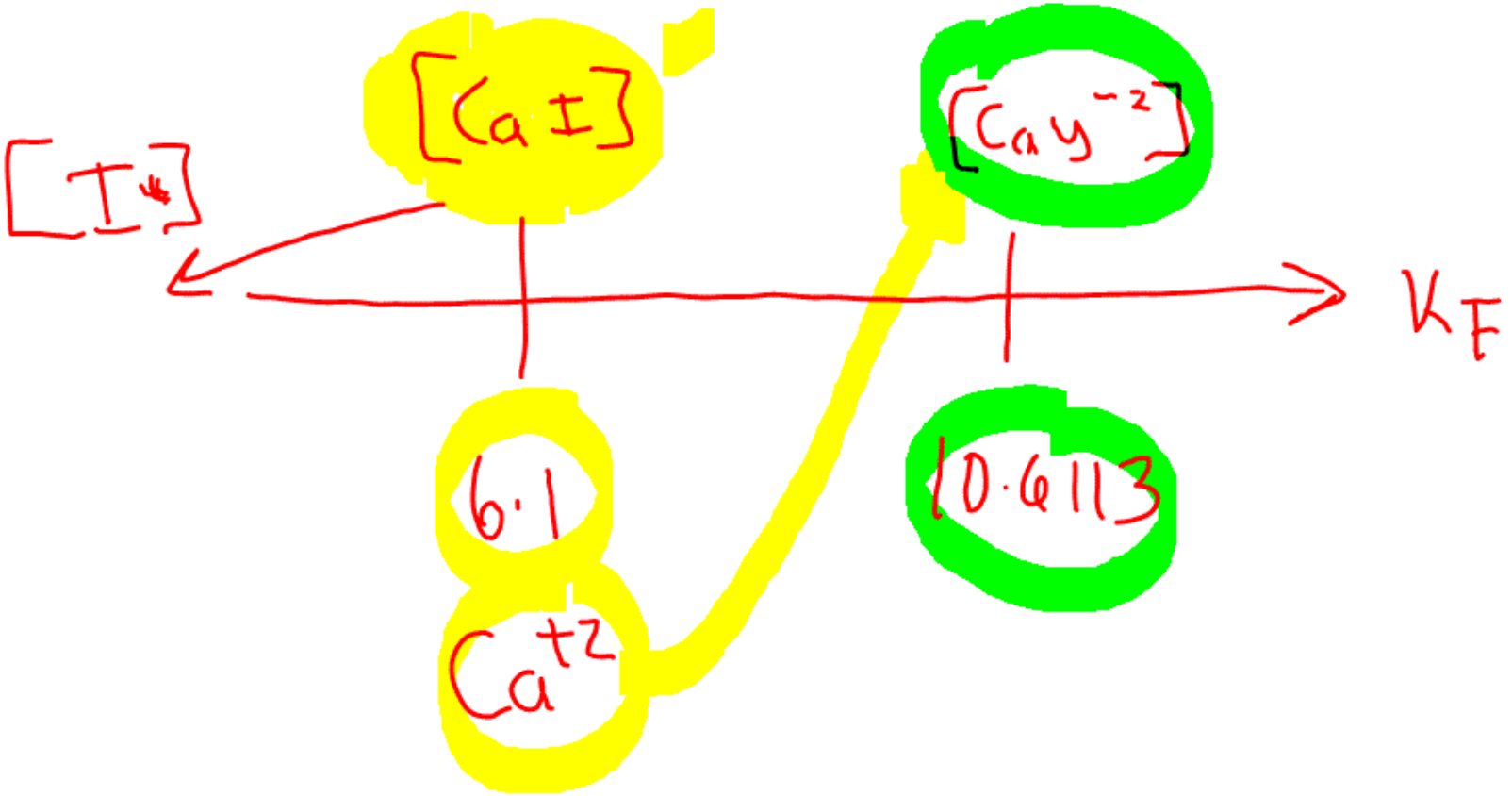
TABLA A.7 *(Cont.)*

Calmagita



pH_{trans}		Rojo	8,1	Azul		12,4	Naranja
*p*H	7,0	8,0	9,0	10,0	11,0	12,0	13,0
$\log \alpha_{I(H)}$	6,5	4,7	3,4	2,4	1,4	0,5	0,1
pCa_{trans} a rojo		1,4	2,7	3,7	4,7	5,6	6,0
pMg_{trans} a rojo	1,6	3,4	4,7	5,7	6,7	7,7	8,0

Constantes logaritmicas: K^{H}_{HI} 12,4; $K^{H}_{H_2I}$ 8,1. K_{CaI} 6,1. K_{MgI} 8,1 (4).


[Ca I]
[Ca y⁻²]
[I⁻]
K_F
6.1
10.6113
Ca⁺²

$$pM_{titración} = K_F'_{MI} \pm 1$$

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

pH=12

$$\alpha_{Ca(OH)} = 10^{0.079}$$

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

$$pKa_1 = 8.1 \qquad pKa_2 = 12.4$$

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

$$pKa_1 = 8.1 \qquad pKa_2 = 12.4$$

$$\alpha_{I(H_3O^+)} = 1 + 10^{12.4}[H_3O^+] + 10^{20.5}[H_3O^+]^2$$

$$= 1 + 10^{12.4}[10^{-12}] + 10^{20.5}[10^{-12}]^2$$

$$= 1 + 10^{0.4} + 10^{-3.5}$$

$$= 3.5122 = 10^{0.5455}$$

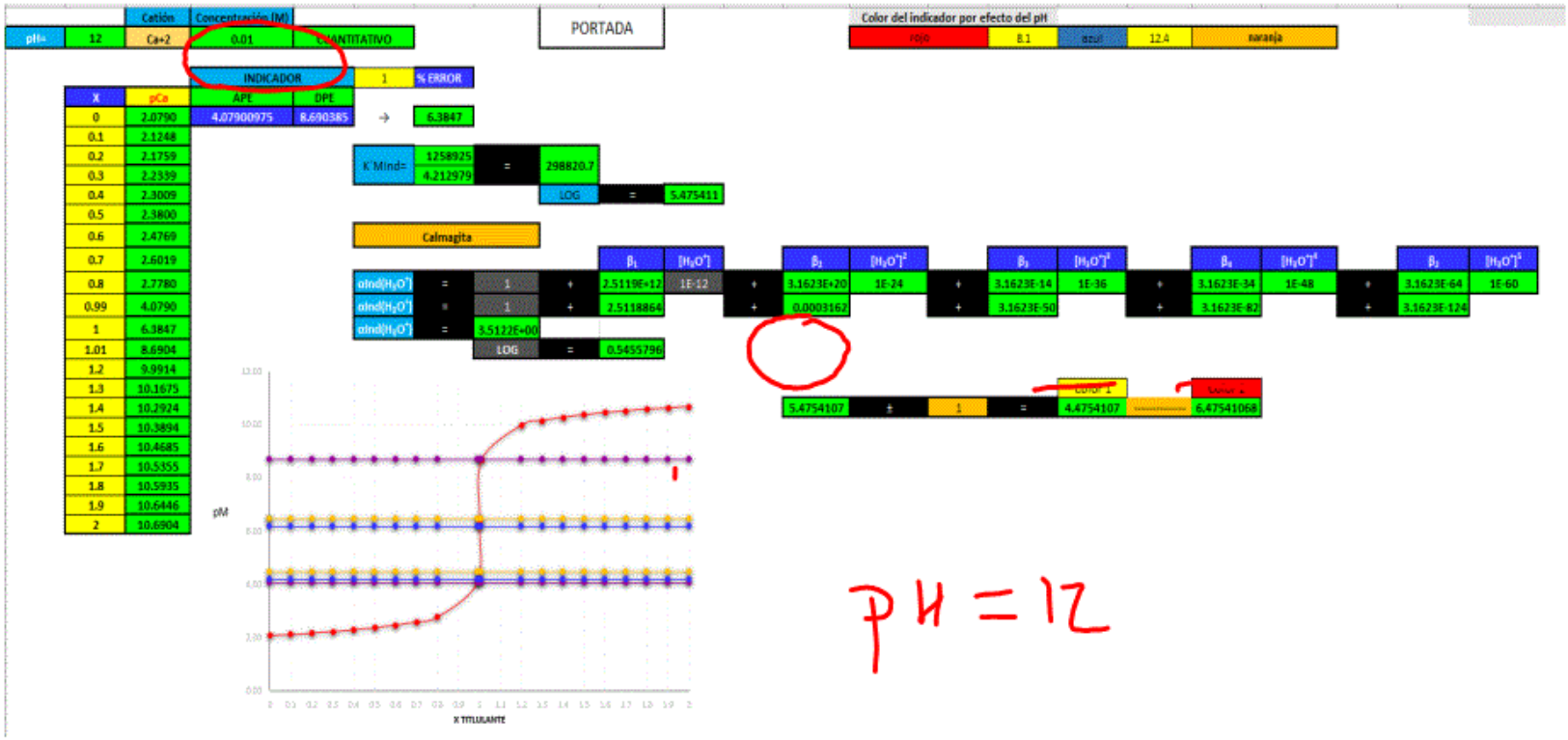
$$K_F' = \frac{K_F}{\alpha_{Ca(OH)}\,\alpha_{I(H_3O^+)}}$$

$$= \frac{10^{6.1}}{10^{0.079}\;10^{0.5455}}$$

$$= \frac{10^{6.1}}{10^{0.6745}} = 10^{5.4755}$$

$$pM_{Ions} = 5.4755 \pm 1$$

$$pCa_{Ions} = (4.4755 - 6.4755)$$


PORTADA
Color del indicador por efecto del pH
pH= 12
Catión Ca+2
Concentración (M) 0.01
CUANTITATIVO
INDICADOR
1
% ERROR
X pCa APE DPE
6.3847
K´Mind= 1258925 = 298820.7
4.212979
LOG = 5.475411
Calmagita
5.4754107 ± 1 = 4.4754107 6.4754106
pM
X TITULANTE
pH = 12

pH=	10	Catión	Concentración (M)	
		Ca+2	0.01	CUANTITATIVO

PORTADA

Color del indicador por efecto del pH

rojo	8.1	azul	12.4	naranja

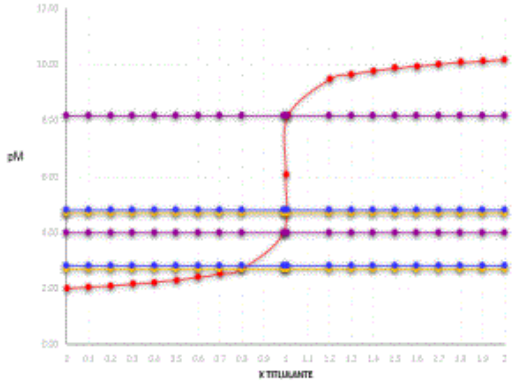
		INDICADOR	1	% ERROR
X	pCa	APE	DPE	
0	2.0009	4.000865668	8.189573	→ 6.0952
0.1	2.0466			
0.2	2.0978			
0.3	2.1558			
0.4	2.2227			
0.5	2.3019			
0.6	2.3988			
0.7	2.5237			
0.8	2.6998			
0.99	4.0009			
1	6.0952			
1.01	8.1896			
1.2	9.4906			
1.3	9.6667			
1.4	9.7916			
1.5	9.8885			
1.6	9.9677			
1.7	10.0347			
1.8	10.0927			
1.9	10.1438			
2	10.1896			

K'Mind=	1258925	=	4920.36
	255.8604	LOG	= 3.691997

Calmagita

				β_1	$[H_3O^+]$		β_2	$[H_3O^+]^2$		β_3	$[H_3O^+]^3$		β_4	$[H_3O^+]^4$		β_5	$[H_3O^+]^5$
$\alpha ind[H_3O^+]$	=	1	+	2.5119E+12	1E-10	+	3.1623E+20	1E-20	+	3.1623E-14	1E-30	+	3.1623E-34	1E-40	+	3.1623E-64	1E-50
$\alpha ind[H_3O^+]$	=	1	+	251.18864		+	3.1622777		+	3.1623E-44		+	3.1623E-74		+	3.1623E-114	
$\alpha ind[H_3O^+]$	=	2.5535E+02															
		LOG	=	2.4071374													

				Color 1		Color 2
3.6919969	±	1	=	2.6919969	----------	4.6919969



pH = 10

pH=	8	Catión	Concentración (M)	
		Ca+2	0.01	CUANTITATIVO

PORTADA

	INDICADOR		1	% ERROR
X	pCa	APE	DPE	
0	2.0000	4.000008665	6.340443	→ 5.1702
0.1	2.0458			
0.2	2.0969			
0.3	2.1549			
0.4	2.2219			
0.5	2.3010			
0.6	2.3979			
0.7	2.5229			
0.8	2.6990			
0.99	4.0000			
1	5.1702			
1.01	6.3404			
1.2	7.6415			
1.3	7.8176			
1.4	7.9425			
1.5	8.0394			
1.6	8.1186			
1.7	8.1855			
1.8	8.2435			
1.9	8.2947			
2	8.3404			

Color del indicador por efecto del pH

rojo	8.1	azul	12.4	naranja

mal indicador

K'Mind= 1258925 / 56743.77 = 22.18614

LOG = 1.346082

Calmagita

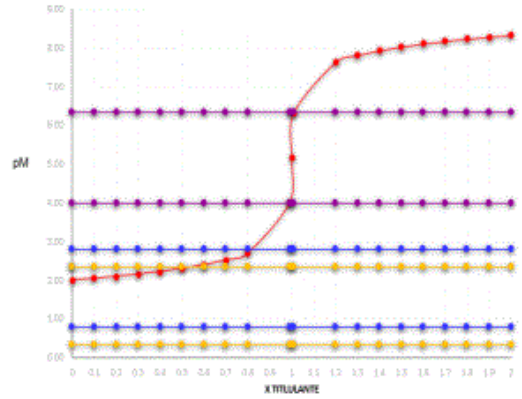
			β_1	$[H_3O^+]$		β_2	$[H_3O^+]^2$		β_3	$[H_3O^+]^3$		β_4	$[H_3O^+]^4$		β_5	$[H_3O^+]^5$
$\alpha Ind(H_3O^+)$	=	1	+	2.5119E+12	1E-08	+	3.1623E+20	1E-16	+	3.1623E-14	1E-24	+	3.1623E-34	1E-32	+	3.1623E-64	1E-40
$\alpha Ind(H_3O^+)$	=	1	+	25118.864		+	31622.777		+	3.1623E-38		+	3.1623E-66		+	3.1623E-104	
$\alpha Ind(H_3O^+)$	=	5.6743E+04															

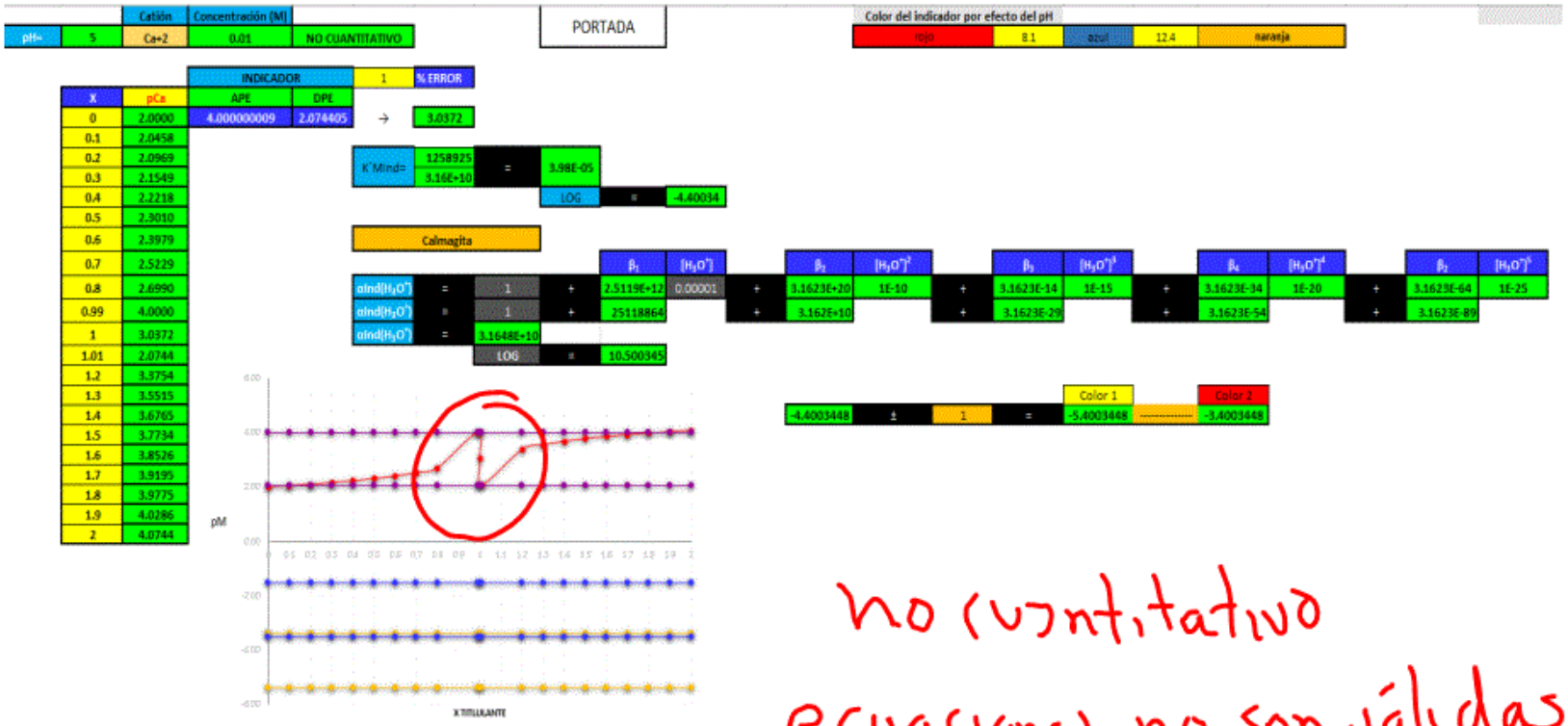
LOG = 4.7539095

				Color 1		Color 2
1.3460818	±	1	=	0.3460818	.....	2.34608179

mal indicador

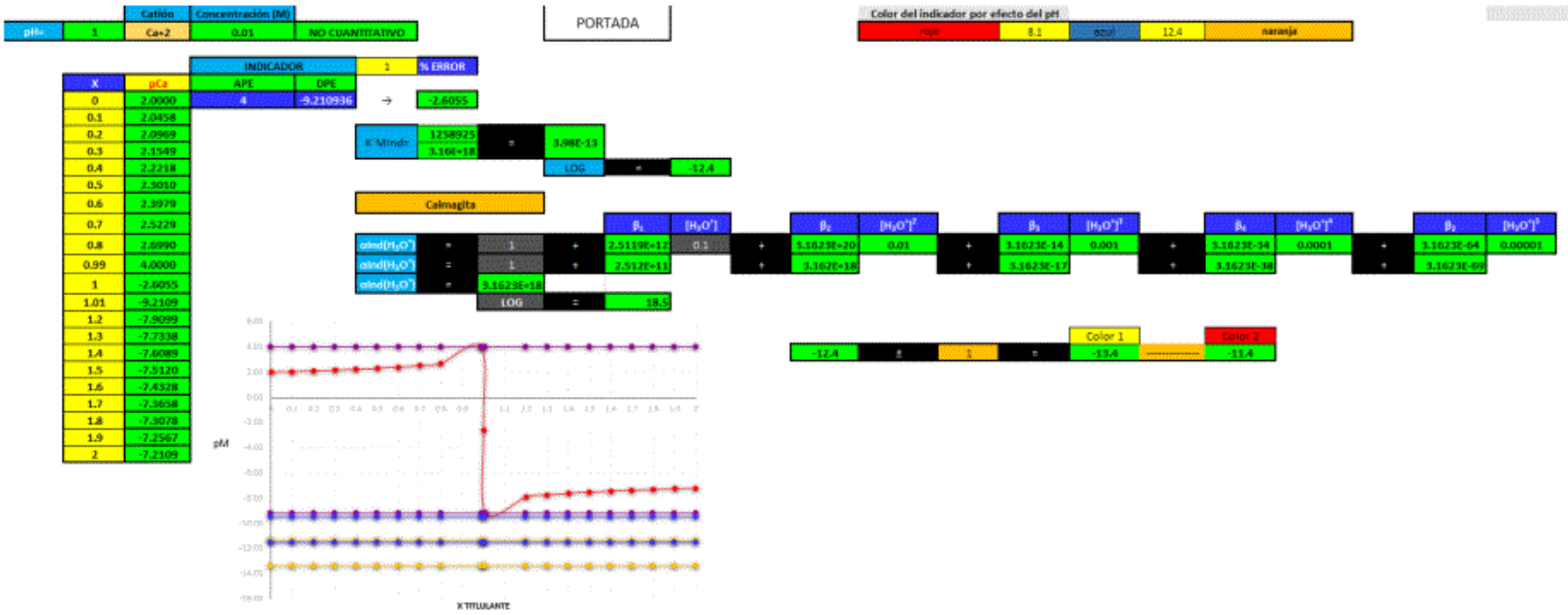
pH=8

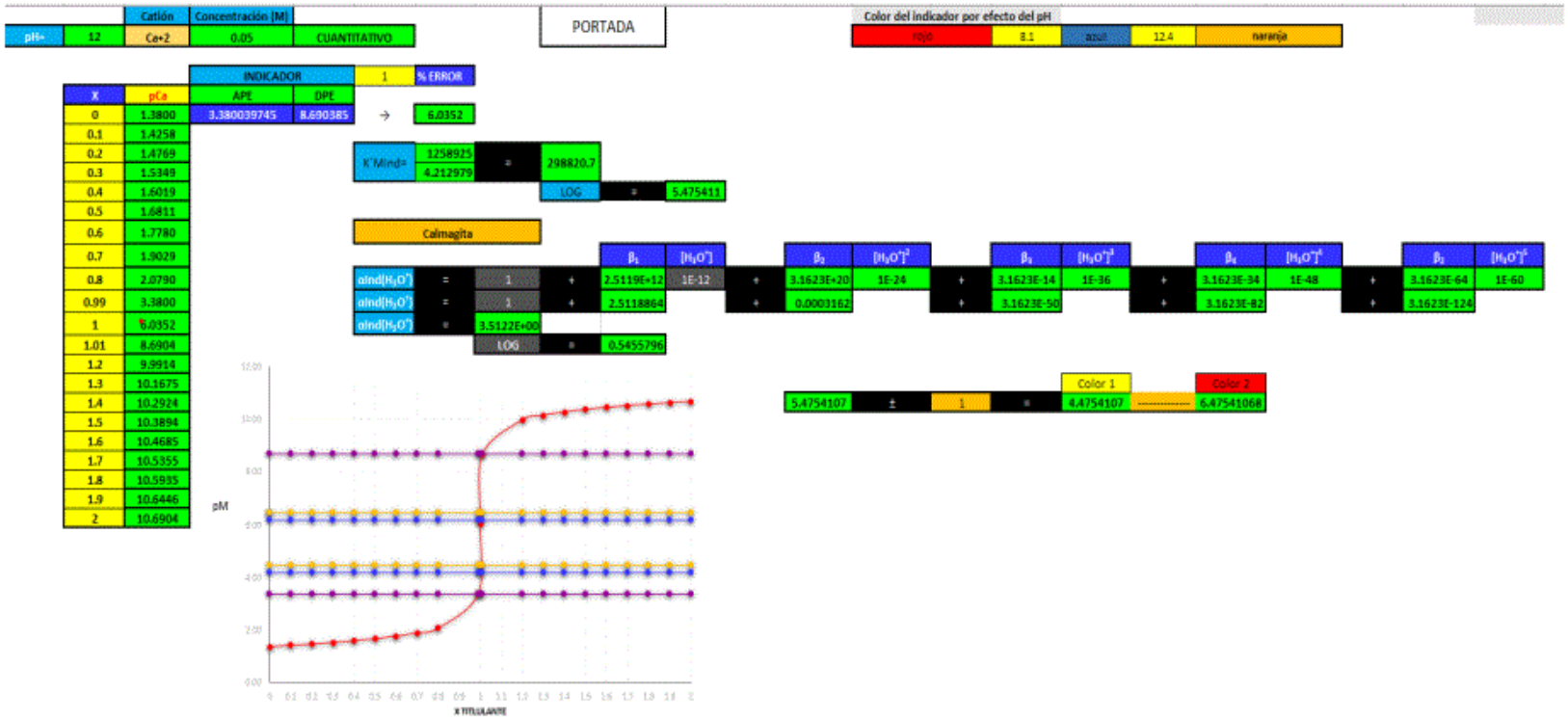




no cuantitativo

ecuaciones no son válidas


PORTADA
Color del indicador por efecto del pH
rojo
8.1
azul
12.4
naranja
Catión
Concentración (M)
pH=
1
Ca+2
0.01
NO CUANTITATIVO
INDICADOR
1
% ERROR
APE
DPE
4
-9.210936
-2.6055
X
pCa
0
2.0000
0.1
2.0458
0.2
2.0969
0.3
2.1549
0.4
2.2218
0.5
2.3010
0.6
2.3979
0.7
2.5229
0.8
2.6990
0.99
4.0000
1
-2.6055
1.01
-9.2109
1.2
-7.9099
1.3
-7.7338
1.4
-7.6089
1.5
-7.5120
1.6
-7.4328
1.7
-7.3658
1.8
-7.3078
1.9
-7.2567
2
-7.2109
K´Mindr
1258925
3.16E+18
3.98E-13
LOG
-12.4
Calmagita
Color 1
Color 2
-12.4
-13.4
-11.4
pM
X TITULANTE


Catión
Concentración [M]
pH=
12
Ca+2
0.05
CUANTITATIVO
PORTADA
Color del indicador por efecto del pH
rojo
8.1
azul
12.4
naranja
INDICADOR
1
% ERROR
X
pCa
APE
DPE
0
1.3800
3.380039745
8.690385
6.0352
0.1
1.4258
0.2
1.4769
0.3
1.5349
0.4
1.6019
0.5
1.6811
0.6
1.7780
0.7
1.9029
0.8
2.0790
0.99
3.3800
1
6.0352
1.01
8.6904
1.2
9.9914
1.3
10.1675
1.4
10.2924
1.5
10.3894
1.6
10.4685
1.7
10.5355
1.8
10.5935
1.9
10.6446
2
10.6904
K'Mind=
1258925
4.212979
298820.7
LOG
5.475411
Calmagita
β1
[H3O+]
β2
[H3O+]2
β3
[H3O+]3
β4
[H3O+]4
β5
[H3O+]5
αInd(H3O+)
1
2.5119E+12
1E-12
3.1623E+20
1E-24
3.1623E-14
1E-36
3.1623E-34
1E-48
3.1623E-64
1E-60
2.5118864
0.0003162
3.1623E-50
3.1623E-82
3.1623E-124
3.5122E+00
0.5455796
Color 1
Color 2
5.4754107
1
4.4754107
6.47541068
pM
X TITULANTE