

Clase 6 30 octubre 2020

Título de la nota

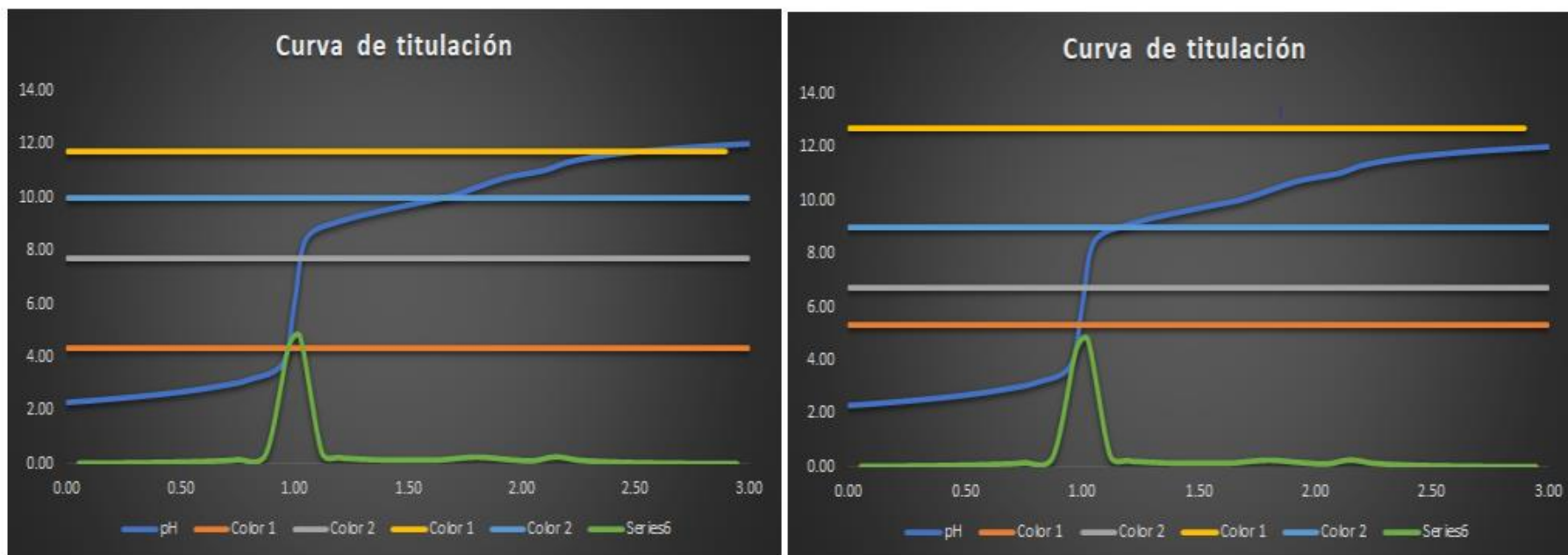
30/10/2020

Primera derivada ✓

$d\text{pH}/dV$	\bar{V}
$\frac{\text{pH}_2 - \text{pH}_1}{V_2 - V_1}$	$\frac{V_2 + V_1}{2}$
.	.
.	.

pH	(mL) V
0	0
1	5
2	12
3	15

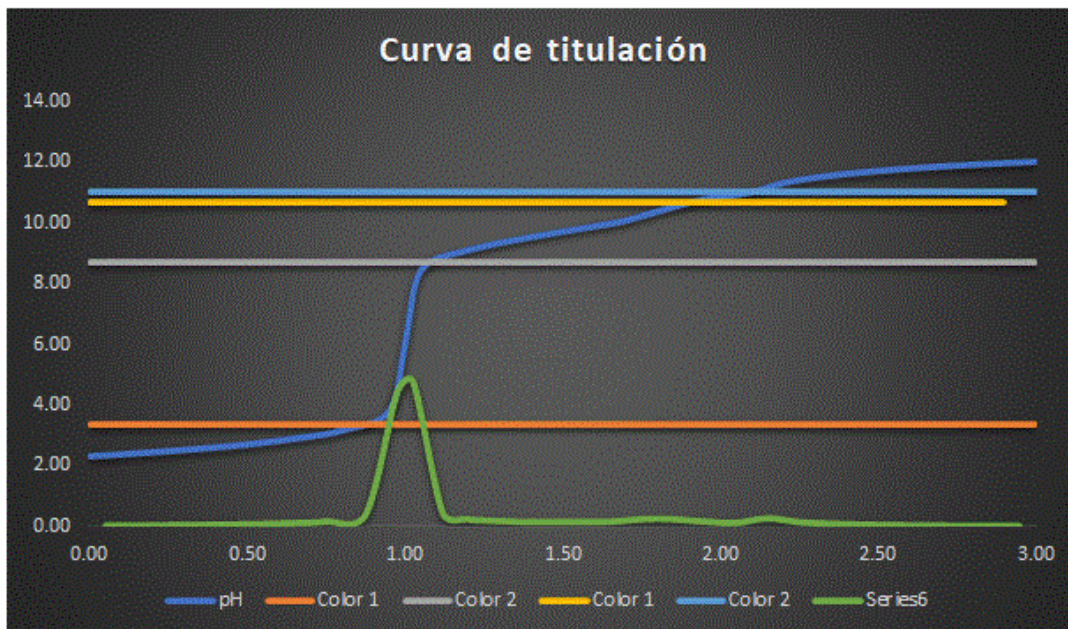
→ 0.05 mL gota



1%. error

Indicador

0.1%. error



10% error indicador

Clorhidrato de Alanina

$$pK_{a1} = 2.35 \quad 10^{-2} M$$

$$pK_{a2} = 9.7$$

$$\frac{K_{a1}}{C_0} = \frac{10^{-2.35}}{10^{-2}} = 10^{-0.35}$$

Ácido fza media

Reacción 1													
	1	H ₂ A	+	1	OH ⁻	↔	1	HA ⁻	+	1	H ₂ O	X	pH
INICIO		Co										0	2.32
AGREGADO					xCo							-	
APE 1		Co(1-x)			~0			xCo				0.5	2.71
PE 1	1	HA		1	HA ⁻	↔	1	H ₂ A	+	1	A ²⁻		
												1	6.03
Reacción 2													
	1	HA ⁻	+	1	OH ⁻	↔	1	A ²⁻	+	1	H ₂ O		
INICIO		Co										-	
AGREGADO					xCo							-	
APE 2		Co(1-x')			~0			x'Co				1.5	9.70
PE 2		εCo			εCo			Co				2	10.85
DPE 2		~0			Co(x'-1)			Co				3	12.00

$$H_2A^+ + OH^- \rightleftharpoons HA + H_2O$$

Inicio Co
 Ag xCo
 APE1 Co(1-x) ~0 xCo
 PE1 **2HA** \rightleftharpoons **H₂A⁺ + A⁻**

$$HA + OH^- \rightleftharpoons A^- + H_2O$$

Ag x'Co
 APE2 Co(1-x') x'Co
 PE2 εCo εCo Co
 DPE2 ~0 Co(x'-1) Co

$$\frac{K_{a2}}{C_0} = \frac{10^{-9.7}}{10^{-2}} = 10^{-7.7}$$

X	X'
0	0
0.5	0
1	0
1.5	0.5
2	1
2.5	1.5
3	2

X	X'	pH	comportamiento
0	0	2.32	ácido Fza media
0.5	0	2.71	amort. Fzo media
1.0	0	6.02	anfólito
1.5	0.5	9.7	amort. débil
2	1	10.85	base débil
2.5	1.5	11.7	base fte
3.0	2	12	base fte

$$\frac{K_b}{C_0} = \frac{10^{-4.3}}{10^{-2}}$$

base débil $10^{-2.3}$

$X=0$ ácido fraco media

$$[H_3O^+] = K_a \left\{ \frac{C_a - [H_3O^+] + [OH^-]}{C_b + [H_3O^+] - [OH^-]} \right\}$$

$$[H_3O^+] = K_{a1} \left\{ \frac{C_a - [H_3O^+]}{[H_3O^+]} \right\}$$

$$[H_3O^+]^2 = K_{a1} C_a - K_{a1} [H_3O^+]$$

$$[H_3O^+]^2 + K_{a1} [H_3O^+] - K_a C_a = 0$$

$$[H_3O^+]^2 + 10^{-2.35} [H_3O^+] - 10^{-2.35} \cdot 10^{-2} = 0$$

$$\begin{array}{ccc} [H_3O^+]^2 & + & 10^{-2.35} [H_3O^+] - 10^{-4.35} = 0 \\ a & & b \qquad \qquad \qquad c \end{array}$$

$x = 0.5$ Amor. fza media

$$[H_3O^+] = K_a \left\{ \frac{C_a - [H_3O^+]}{C_b + [H_3O^+]} \right\}$$

$$[H_3O^+] = K_{a1} \left\{ \frac{C_0(1-x) - [H_3O^+]}{xC_0 + [H_3O^+]} \right\}$$

$$[H_3O^+] = K_{a1} \left\{ \frac{10^{-2}(1-0.5) - [H_3O^+]}{0.5 \cdot 10^{-2} + [H_3O^+]} \right\}$$

$$[H_3O^+] = K_{a1} \left\{ \frac{5 \times 10^{-3} - [H_3O^+]}{5 \times 10^{-3} + [H_3O^+]} \right\}$$

$$[\text{H}_3\text{O}^+]^2 + 5 \times 10^{-3} [\text{H}_3\text{O}^+] = K_{a1} 5 \times 10^{-3} - K_{a1} [\text{H}_3\text{O}^+]$$

$$[\text{H}_3\text{O}^+]^2 + 5 \times 10^{-3} [\text{H}_3\text{O}^+] + K_{a1} [5 \times 10^{-3}] + K_{a1} [\text{H}_3\text{O}^+] = 0$$

$$[\text{H}_3\text{O}^+]^2 + \left\{ 5 \times 10^{-3} [\text{H}_3\text{O}^+] + K_{a1} [\text{H}_3\text{O}^+] \right\} - K_{a1} [5 \times 10^{-3}] = 0$$

$$[\text{H}_3\text{O}^+]^2 + \left\{ 5 \times 10^{-3} [\text{H}_3\text{O}^+] + 10^{-2.35} [\text{H}_3\text{O}^+] \right\} - 10^{-2.35} [5 \times 10^{-3}] = 0$$

$$[\text{H}_3\text{O}^+]^2 + 9.47 \times 10^{-3} [\text{H}_3\text{O}^+] - 2.23 \times 10^{-5} = 0$$

$$[\text{H}_3\text{O}^+] = 1.96 \times 10^{-3}$$

$$\text{pH} = -\log [\text{H}_3\text{O}^+] = 2.71$$

$X=1$ Anfólito

$$pH = \frac{(pK_{a1} + pK_{a2})}{2} = \frac{2.35 + 9.7}{2}$$
$$= 6.025$$

$X=1.5$ $X'=0.5$

$$pH = pK_{a2} + \log \frac{C_b}{C_a}$$
$$= 9.7 + \log \frac{[A^-]}{[HA]}$$
$$= 9.7 + \log \frac{[X' C_0]}{[C_0(1-X')]}$$
$$= 9.7 + \log 1$$

$$pH = 9.7$$

x	pH
0.00	2.32
0.10	2.38
0.20	2.45
0.30	2.52
0.40	2.61
0.50	2.71
0.60	2.83
0.70	2.97
0.80	3.17
0.95	3.80
1.00	6.025
1.05	8.42
1.19	9.07
1.20	9.10
1.30	9.33
1.40	9.52
1.50	9.70
1.60	9.88
1.70	10.07
1.90	10.65
2.00	10.85
2.10	11.00
2.20	11.30
2.30	11.48
2.40	11.60
2.50	11.70
2.60	11.78
2.70	11.85
2.80	11.90
2.90	11.95
3.00	12.00

pH $x=2$ $x'=1$
base débil

$$\begin{aligned}
 \checkmark \quad pH &= \frac{1}{2} pK_w + \frac{1}{2} pK_{a2} + \frac{1}{2} \log C_b \\
 &= \frac{1}{2} (14) + \frac{1}{2} (9.7) + \frac{1}{2} \log 10^{-2} \\
 &= 7 + 4.85 - 1 \\
 &= 10.85
 \end{aligned}$$

$$x = 2.5 \quad x' = 1.5$$

base. Fte.

$$pH = 14 + \log C_b$$

$$= 14 + \log C_0(x'-1)$$

$$= 14 + \log 10^{-2}(1.5-1)$$

$$= 14 + \log 10^{-2}(0.5)$$

$$= 14 + \log 5 \times 10^{-3}$$

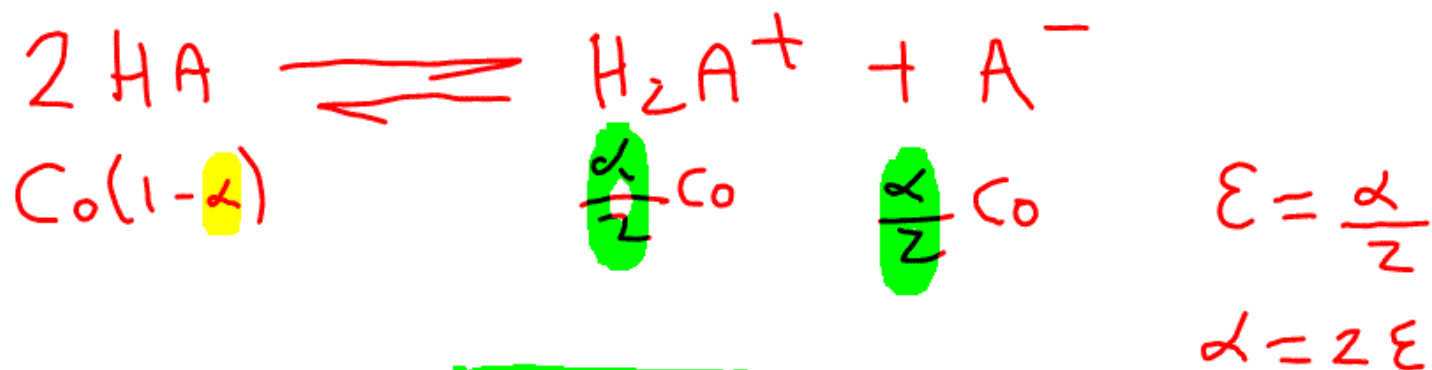
$$= 14 - 2.3 = 11.7 \quad \checkmark$$

$$x = 3 \quad x' = 2$$

$$pH = 14 + \log C_0(x'-1) = 14 + \log 10^{-2}(2-1)$$

$$= 14 - 2 = 12 \quad \checkmark$$

K_{r1}
 $p.e.1 = \text{anfólito}$



$$K_{r1} = \frac{[H_2A^+][A^-][H_3O^+]}{[HA][HA][H_3O^+]}$$

$$K_{r1} = \frac{K_{a2}}{K_{a1}} = \frac{10^{-9.7}}{10^{-2.35}} = 10^{-7.35}$$

$$K_{r1} = \frac{[H_2A^+][A^-]}{[HA]^2}$$

$$10^{-7.35} = \frac{\varepsilon C_0 \quad \varepsilon C_0}{[C_0(1-2\varepsilon)]^2} = \frac{\varepsilon^2 \cancel{C_0^2}}{\cancel{C_0^2}}$$

$$\varepsilon_1^2 = 10^{-7.35} \quad \therefore \quad \varepsilon = 10^{-7.35/2} = 10^{-3.675}$$

$$\% \alpha_1 = (1 - \varepsilon_1) = 99.97\%$$

$$K_{v2}$$


$$K_{v2} = \frac{[A^-][H_3O^+]}{[HA][OH^-][H_3O^+]}$$

$$K_{v2} = \frac{K_{a2}}{K_w} = \frac{10^{-9.7}}{10^{-14}} = 10^{4.3}$$

$$pe.2 \quad 10^{4.3} = \frac{[A^-]}{[HA][OH^-]} = \frac{C_0}{\cancel{C_0} \epsilon C_0}$$

$$\epsilon^2 = \frac{1}{K_{v2} C_0} = \frac{1}{10^{4.3} 10^{-2}}$$

$$\varepsilon_2 = \sqrt{\frac{1}{k_1 c_0}} = \sqrt{\frac{1}{10^{4.3} 10^{-2}}}$$

$$\varepsilon_2 = \sqrt{\frac{1}{10^{2.3}}} = 10^{-2.3/2} = 10^{-1.15}$$

$$1. Q_2 = (1 - \varepsilon_2) \times 100 = 93.1\%$$

1:1. APE

Amort. Fzamedia

1:1. DPE

Amort. débil

$$[H_3O^+] = K_a \left\{ \frac{C_a - [H_3O^+]}{C_b + [H_3O^+]} \right\}$$

$$[H_3O^+] = K_a \left\{ \frac{(0.01)(0.01) - [H_3O^+]}{(0.01) - [H_3O^+]} \right\}$$

$$[H_3O^+] = 10^{-2.35} \left\{ \frac{10^{-4} - [H_3O^+]}{10^{-2} + [H_3O^+]} \right\}$$

a	1
b	9.94E-03
c	-4.47E-07
x1	4.47E-05
x2	-9.64E-03
pH	4.35

$$pH = pK_a + \log \frac{C_b}{C_a}$$

$$pH = 9.7 + \log \frac{1}{100}$$

$$pH = 9.7 + \log 10^{-2}$$

$$pH = 9.7 - 2$$

$$pH = 7.7$$

Elección del indicador PE ₁	
Código	PBC
Indicador	Purpura de Bromocresol
Coloración ácida	amarillo
Coloración básica	purpura
Lim. Inferior (pH)	5.2
Lim. Superior (pH)	6.8
RECOMENDACIÓN	Utilizar

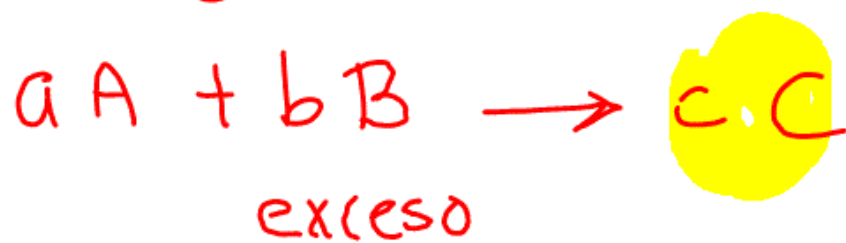
Elección del indicador PE ₁	
Código	RCF
Indicador	Rojo de clorofenol
Coloración ácida	amarillo
Coloración básica	Rojo
Lim. Inferior (pH)	4.8
Lim. Superior (pH)	6.4
RECOMENDACIÓN	Utilizar

Elección del indicador PE ₁	
Código	RM
Indicador	Rojo de Metilo
Coloración ácida	Rojo
Coloración básica	amarillo
Lim. Inferior (pH)	4.8
Lim. Superior (pH)	6
RECOMENDACIÓN	No Utilizar

6.025

Mejor

Retroceso



$$b \text{ moles } A = a \text{ moles de } B$$

$$\text{moles } B = (\text{Total} - \text{exceso})$$

$$\text{moles } B = (V_B M_B - \text{exceso})$$

$$d \text{ moles } B = b' \text{ moles } D$$

$$\text{moles } D = V_D M_D$$

$$\therefore \text{moles } B = \frac{b'}{d} \text{ moles } D$$

$$\text{moles A} = \frac{a}{b} (\text{moles de B})$$

$$= \frac{a}{b} \left(V_B M_B - V_D M_D \frac{b'}{d} \right)$$

$$\frac{m_A}{M_A} = \frac{a}{b} \left(V_B M_B - V_D M_D \frac{b'}{d} \right)$$

$$m_A = \frac{a}{b} \left(V_B M_B - V_D M_D \frac{b'}{d} \right) M_A$$

$$m_A = \left(\frac{V_B N_B}{(L) \left(\frac{e q}{L} \right)} - \frac{V_D N_D}{(L) \left(\frac{e q}{L} \right)} \right) p \cdot e \cdot A = g_A$$

$$\left(\frac{e q}{L} \right) \left(\frac{g}{e q} \right)$$