Clase 4 24 Septiembre 2021

Título de la nota 24/09/2021

Diagrama Distribucion

$$HA + H_2O \rightleftharpoons H_3O^+ + A^-$$

$$K_a = \frac{[H_3O^+][A^-]}{[HA]}$$

$$\% A^- = \frac{[A^-]}{[A^-] + [HA]} \times 100$$

$$[HA] = \frac{[H_3O^+][A^-]}{K_a}$$

$$\frac{1}{K_a} = \beta_p$$

$$\therefore A^- = \frac{[A^-]}{[A^-] + [A^-][H_3O^+]\beta_p} \times 100$$

$$\therefore A^- = \frac{[A^-]}{[A^-]\{1 + \beta_p[H_3O^+]\}} \times 100$$

$$\% A^- = \frac{1}{1 + \beta p [H_3O^+]}$$

$$\% HA = \frac{[HA]}{[HA] + [A^-]} \times 100$$

$$\% HA = \frac{[HA]}{[HA] + [A^-]} \cdot \frac{[A^-]}{[A^-]}$$

$$\% HA = \% A^- \frac{[HA]}{[A^-]}$$

$$\% HA = \% A^- \beta p [H_3O^+]$$

$$Ka = \frac{[H_3O^+][A^-]}{[HA]}$$

$$\frac{[HA]}{[A^-]} = \frac{[H_3O^+]}{Ka}$$

$pKa = 4$

pH	% A^-	% HA
1	1	99
3	9	91
4	50	50
5	91	9
6	99	1

$$\%A^- = \frac{1}{1+\beta p[H_3O^+]} \times 100$$

$$\frac{1}{Ka} = \beta p = \frac{1}{Ka} = \frac{1}{10^{-4}} = 10^4$$

$$pH = 4 = [H_3O^+] = 10^{-4}$$

$$\%A^- = \frac{1}{1+10^4 10^{-4}} \times 100$$

$$\%\,A^- = \frac{1}{1+10^0} \times 100$$

$$\%\,A^- = \frac{1}{1+1} \times 100$$

$$= \frac{1}{2} \times 100$$

$$\%\,A^- = 50\%$$

$$\%HA = \%A^- \; \beta p\,[H_3O^+]$$

$$50\% \cdot 10^{4}\,[10^{-4}]$$

$$= 50\% \cdot 10^{0}$$

$$= 50\%$$

$$pH = 5$$

$$\therefore A^- = \frac{1}{1 + 10^{4}\,10^{-5}} \times 100$$

$$= \frac{1}{1 + 10^{-1}} \times 100$$

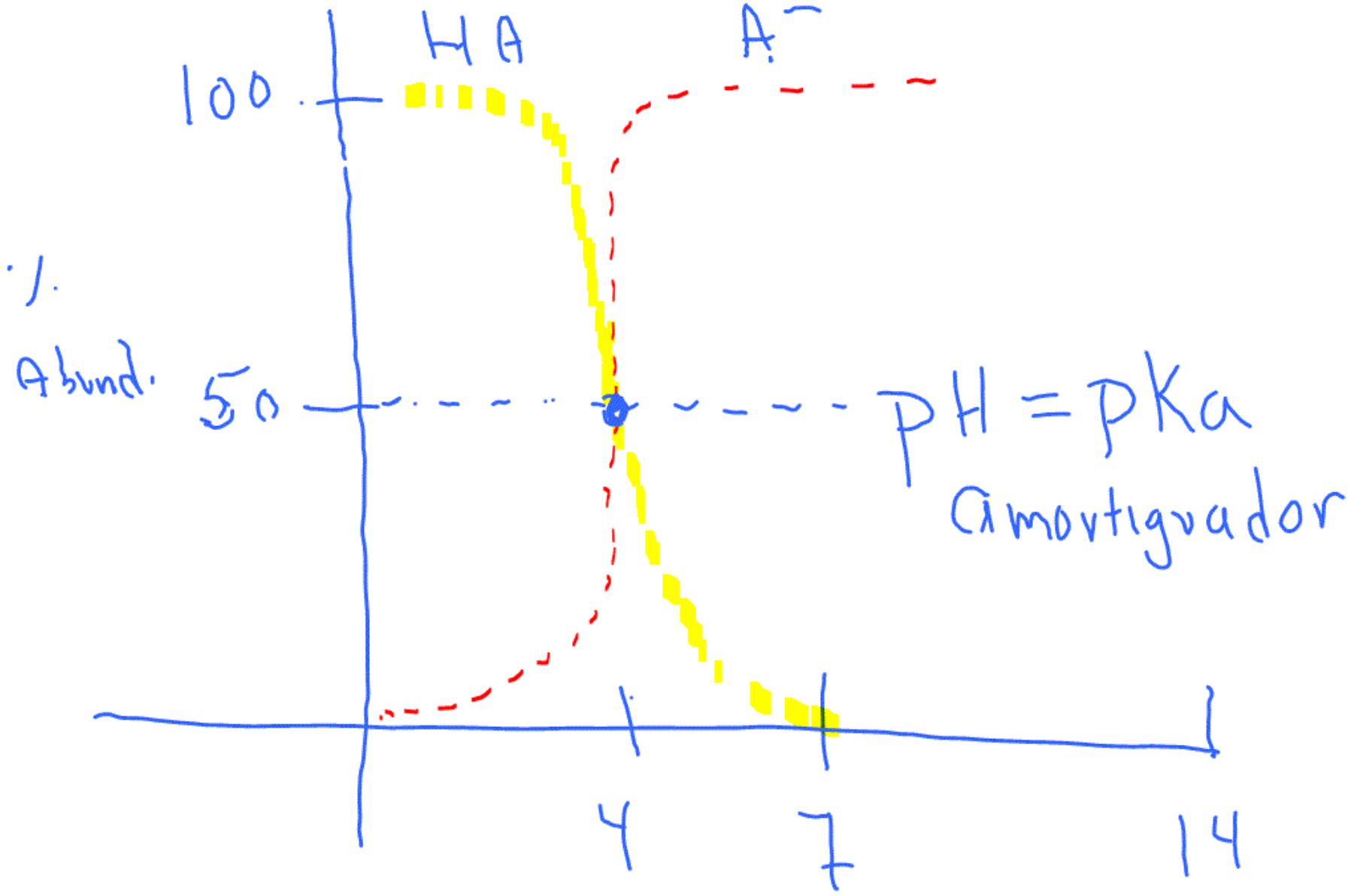
$$= \frac{1}{1.1} \times 100 \equiv 91\%$$

$$PH = 6$$

$$\%\, A^- = \frac{1}{1 + 10^4\, 10^{-6}} \times 100$$

$$= \frac{1}{1 + 10^{-2}} \times 100$$

$$\%\, A = \frac{1}{1.01} \times 100 = 99\%$$


HA
A⁻
100
%
Abund.
50
pH = pKa
Amortiguador
4
7
14

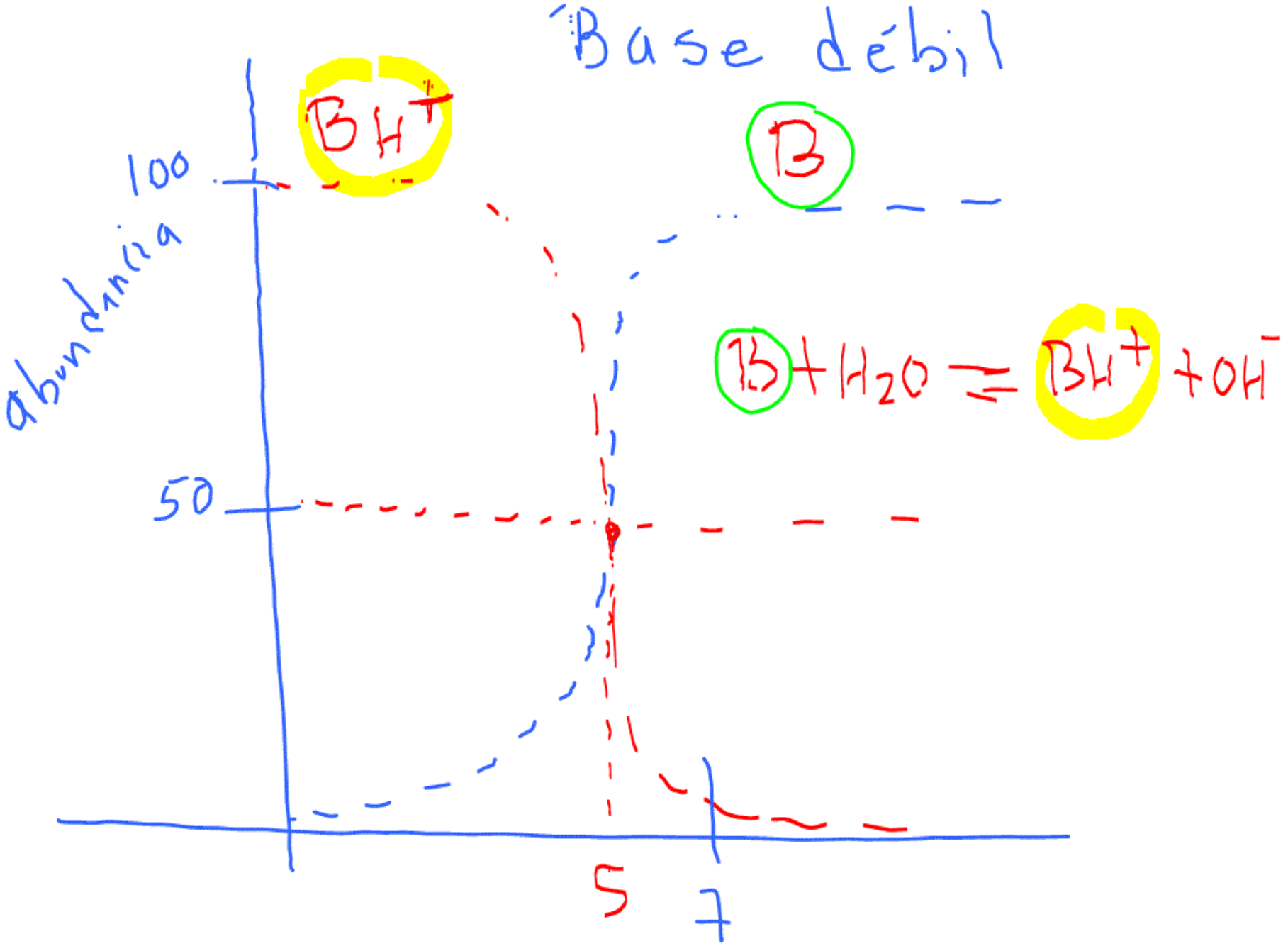
Amortiguador débil

$$pH = pK_a + \log \frac{CB}{CA}$$

$$= 4 + \log \frac{50\%}{50\%}$$

$$= 4 + \log 1$$

$$= 4 + 0 = 4$$


Base débil
BH+
B
100
abundancia
50
B + H2O ⇌ BH+ + OH-
5
7

$$pKa + pKb = pKw$$

$$5 + pKb = 14$$

$$pKb = 14 - 5$$

$$pKb = 9$$

Amortiguador

$$HA + H_2O \rightleftharpoons H_3O^+ + A^-$$

$$NaA^- + H_2O \rightleftharpoons HA + Na^+ + OH^-$$

$$[HA] + [A^-] = Ca + Cb$$

$$[Na^+] + [H_3O^+] = [A^-] + [OH^-]$$

$$Cb + [H_3O^+] = [A^-] + [OH^-]$$

$$C_b = [OH^-] + [A^-] - [H_3O^+]$$

$$[A^-] \cong C_b + [H_3O^+] - [OH^-]$$

$$K_a = \frac{[H_3O^+][A^-]}{[HA]}$$

$$[H_3O^+] = K_a \frac{[HA]}{[A^-]}$$

$$[HA] + [A^-] = C_a + C_b$$

$$[HA] = C_a + C_b - [A^-]$$

$$[HA] = C_a + C_b - \{C_b + [H_3O^+] - [OH^-]\}$$

$$[HA] = C_a - [H_3O^+] + [OH^-]$$

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

Acido Fte

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

$$\left\{ [H_3O^+] = Ca \right\} - \log$$

$$pH = -\log Ca$$

Acido débil

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

$$[H_3O^+] = \frac{K_a\, Ca}{[H_3O^+]}$$

$$\left\{ [H_3O^+]^2 = K_a Ca \right\} - \log$$

$$2pH = pKa - \log Ca$$

$$pH = \frac{1}{2} pKa - \frac{1}{2} \log Ca$$

→ pH ácido débil

Ácido Fza media

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

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

$$[H_3O^+]^2 + K_a [H_3O^+] - K_a C_a = 0$$

A B C

ecuación cuadrática

Obtenen $[H_3O^+]$ raiz positiva

$pH = -\log [H_3O^+]$

pH amortiguador débil

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

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

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

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

H de un

amortiguador débil

Henderson-Hasselbach

Base débil

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

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

$$[OH^-] = \frac{K_w}{[H_3O^+]}$$

$$[H_3O^+] = \frac{Ka\ Kw}{Cb\ [H_3O^+]}$$

$$\left\{[H_3O^+]^2 = \frac{Ka\ Kw}{Cb}\right\} -\log$$

$$2pH = pKa + pKw + \log Cb$$

$$pH = \frac{1}{2}pkw + \frac{1}{2}pKa + \frac{1}{2}\log Cb$$

$$pH = \frac{1}{2}(14) + \frac{1}{2}pKa + \frac{1}{2}\log Cb$$

$$pH = 7 + \frac{1}{2} pKa + \frac{1}{2} \log Cb$$

pH base débil

pH base Fza media

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

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

$$\frac{K_w}{[OH^-]} = \frac{K_a [OH^-]}{C_b - [OH^-]}$$

$$Ka[OH^-]^2 \simeq Kw\{Cb - [OH^-]\}$$

$$[OH^-]^2 = \frac{Kw}{Ka}\{Cb - [OH^-]\}$$

$$[OH^-]^2 = Kb\{Cb - [OH^-]\}$$

$$[OH^-]^2 + Kb[OH^-] - KbCb = 0$$

A B C

$[OH]$ raiz positiva

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

$$\{[OH^-][H_3O^+] = Kw\} - \log$$

$$pOH + pH = pKw$$

$$pH = pKw - pOH$$

$$pH = 14 - pOH$$

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

pH base Fte

$$pH = 14 + \log Cb$$

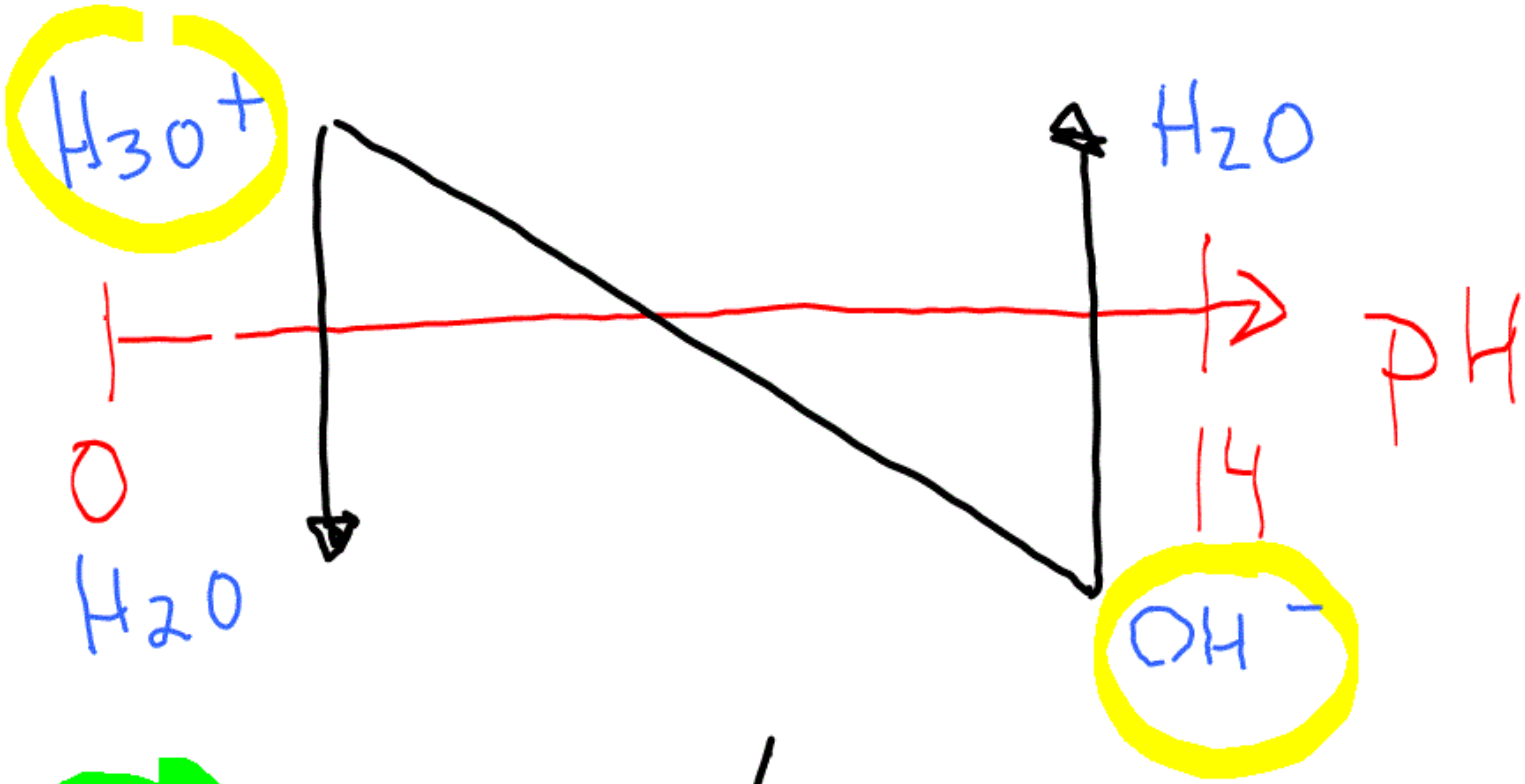
Curva Titulación

Acido Fte - Base Fte

$$aA + bB \rightarrow \text{productos}$$

$$H_3O^+ + OH^- \rightarrow H_2O$$

	H_3O^+	OH^-
Inicio	C_0	
Ag		$x\,C_0$
APE	$C_0(1-x)$	~ 0
PE	εC_0	εC_0
DPE	~ 0	$C_0(x-1)$



$$K_v = \frac{[H_2O]}{[H_3O^+][OH^-]} = \frac{1}{K_w}$$

$$= \frac{1}{10^{-14}} = 10^{14}$$

10^{-2} M H_3O^+ 10^{-2} M OH^-

$K_v = 10^{14}$

p.e.

$$K_v = \frac{1}{[H_3O^+][OH^-]}$$

$$K_v = \frac{1}{\varepsilon_0 \varepsilon_{c_0}} = 10^{14}$$

$$\xi^2 = \frac{1}{C_0^2 \, kv}$$

$$\xi^2 = \frac{1}{(10^{-2})^2 \, kv}$$

$$\xi^2 = \frac{1}{10^{-4} \, 10^{14}}$$

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

$$\varepsilon = 10^{-10/2}$$

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

$$\varepsilon = \left(10^{-10}\right)^{1/2}$$

$$\varepsilon = 10^{-5}$$

$$\%C\ o'\ \%Q = (1-\varepsilon)100$$

$$\%C = (1 - 10^{-5}) \times 100$$

$$= 99.999\ \%$$

	X	pH
inicio	0	ácido Fte
APE	0.5	ácido Fte
PE	1	neutralización
DPE	1.5	base Fte
	2	base Fte

$X = 0$

$pH = -\log C_a$

$= -\log 10^{-2}$

$= 2$

$X = 0.5$

$pH = -\log C_a(1-x)$

$= -\log 10^{-2}(1-0.5)$

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

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

$$= -\log 10^{-2}(5 \times 10^{-1})$$

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

$$= 3 - 0.7 = 2.3$$

$x = 1$ p.e.

$$[OH^-] = [H_3O^+]$$

$$[OH^-][H_3O^+] = K_w$$

$$[H_3O^+]^2 = K_w$$

$$\{[H_3O^+] = \sqrt{K_w}\} - \log$$

$$pH = -\log 10^{-14/2}$$

$$pH = 7$$

$$x = 1.5$$

$$pH = 14 + \log C_b$$

$$= 14 + \log C_b(x-1)$$

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

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

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

$$= 14 + \log 10^{-2}\left(5 \times 10^{-1}\right)$$

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

$$= 14 - \left[3 - 0.7\right]$$

$$= 14 - 2.3 = 11.7$$

$$x = 2$$

$$pH = 14 + \log c.b$$

$$= 14 + \log Cb(x-1)$$

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

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

$$= 14 - 2 = 12$$

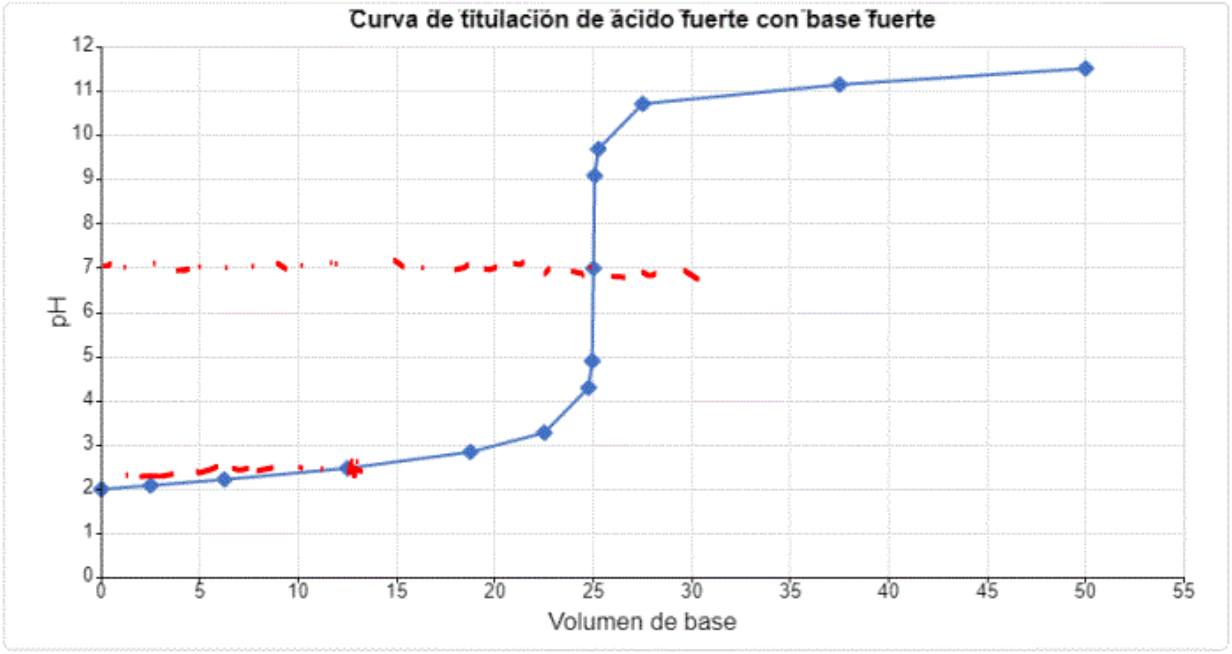
x	p_{i+1}
0	2
0.5	2.3
1	7
1.5	11.7
2	12

Reiniciar Imprimir

Instrucciones: llenar las celdas de color verde, puede cambiar el valor de Kw por otro disolvente anfiprótico o por cambio de temperatura

FES ZARAGOZA

	Ácido		Base		
concentración (M)	mL de ácido	mmol de ácido	concentración (M)	Kw	Punto de equivalencia (mL)
0.01	25	0.25	0.01	1E-14	25



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25 mL 0.01 M

$X = 0.5$

37.5 mL 25 mL + 12.5 mL

$$\left(\frac{0.01\ mol}{L}\right)\left(\frac{25\ mL}{37.5\ mL}\right)$$

$$= 0.0067$$

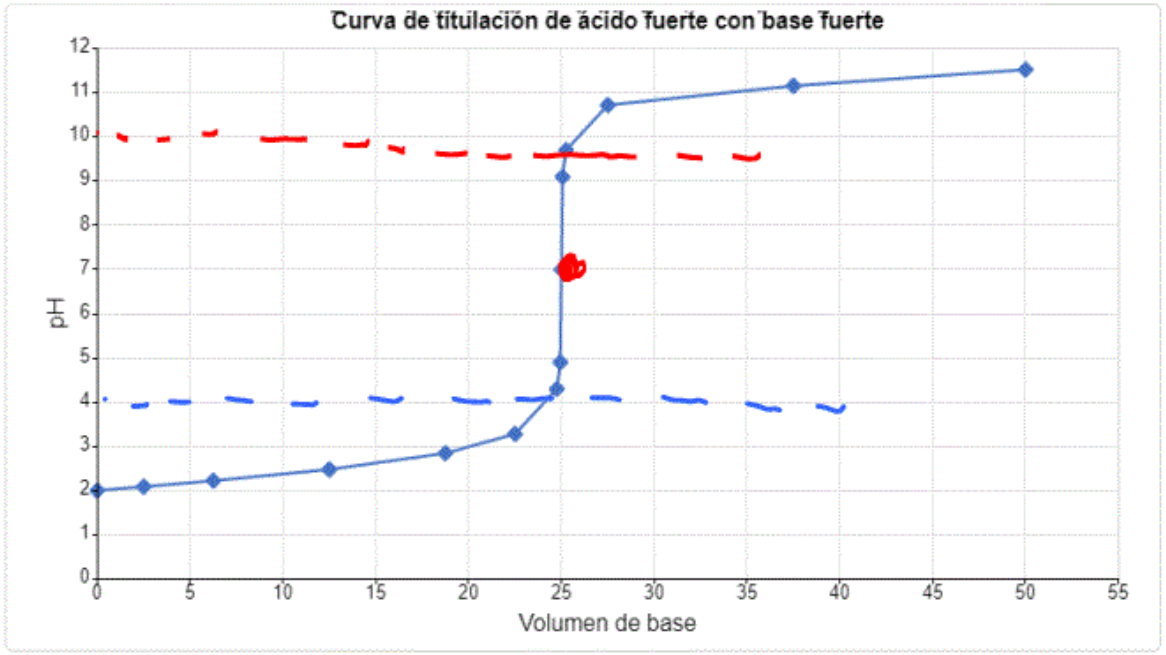
$$pH = -\log 0.0067 = 2.1$$

Reiniciar Imprimir

Instrucciones: llenar las celdas de color verde, puede cambiar el valor de Kw por otro disolvente anfiprótico o por cambio de temperatura

	Ácido		Base		
concentración (M)	mL de ácido	mmol de ácido	concentración (M)	Kw	Punto de equivalencia (mL)
0.01	25	0.25	0.01	1E-14	25

FES ZARAGOZA



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Incoloro vosa

Fenolftaleína 8 - 9.6

1.1. APE

$i = 10^{-2}$

$\frac{i}{100} \times 100$

APE ácido Fte

$pH = -\log Ca\ 10^{-2}$

$= -\log 10^{-2}\ 10^{-2} = -\log 10^{-4}$

$= 4$

1.1. DPE

base fte

$$pH = 14 + \log C_b$$

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

$$= 14 + \log 10^{-4}$$

$$= 14 - 4 = 10$$

pH APE = 4

pH DPE = 10

$$pH\ pE = \frac{4+10}{2}$$

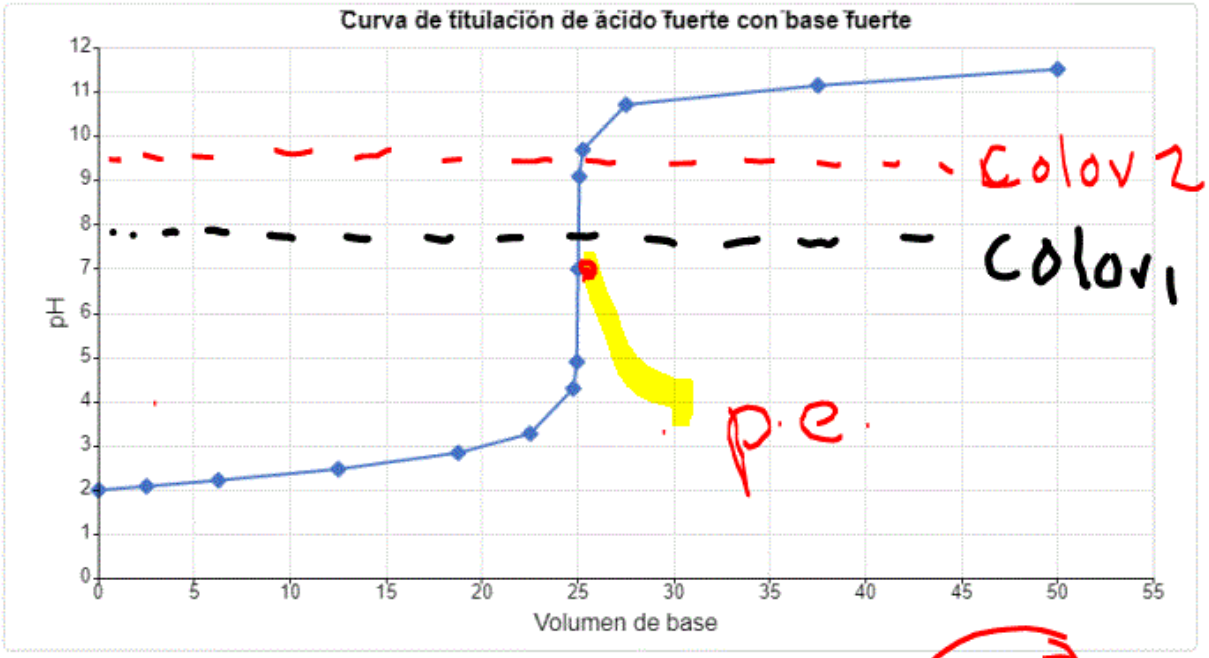
$$= \frac{14}{2} = 7$$

Reiniciar Imprimir

Instrucciones: llenar las celdas de color verde, puede cambiar el valor de Kw por otro disolvente anfiprótico o por cambio de temperatura

FES ZARAGOZA

Ácido			Base		
concentración (M)	mL de ácido	mmol de ácido	concentración (M)	Kw	Punto de equivalencia (mL)
0.01	25	0.25	0.01	1E-14	25



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10^{-3}

Teórico 4 - 10

Fenolf inc 8 - 9.6 Vosa

Teorico 5 - 9