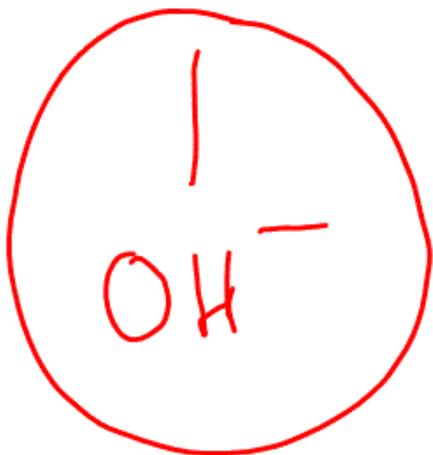
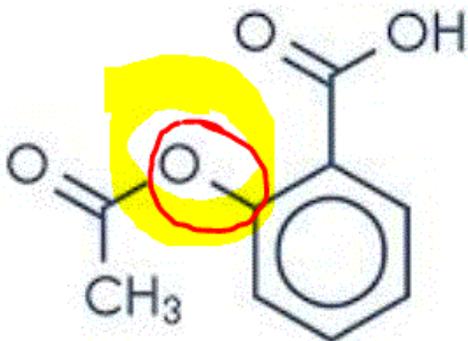


Clase 7 6 Noviembre 2020

Título de la nota

06/11/2020



proFarmaCO

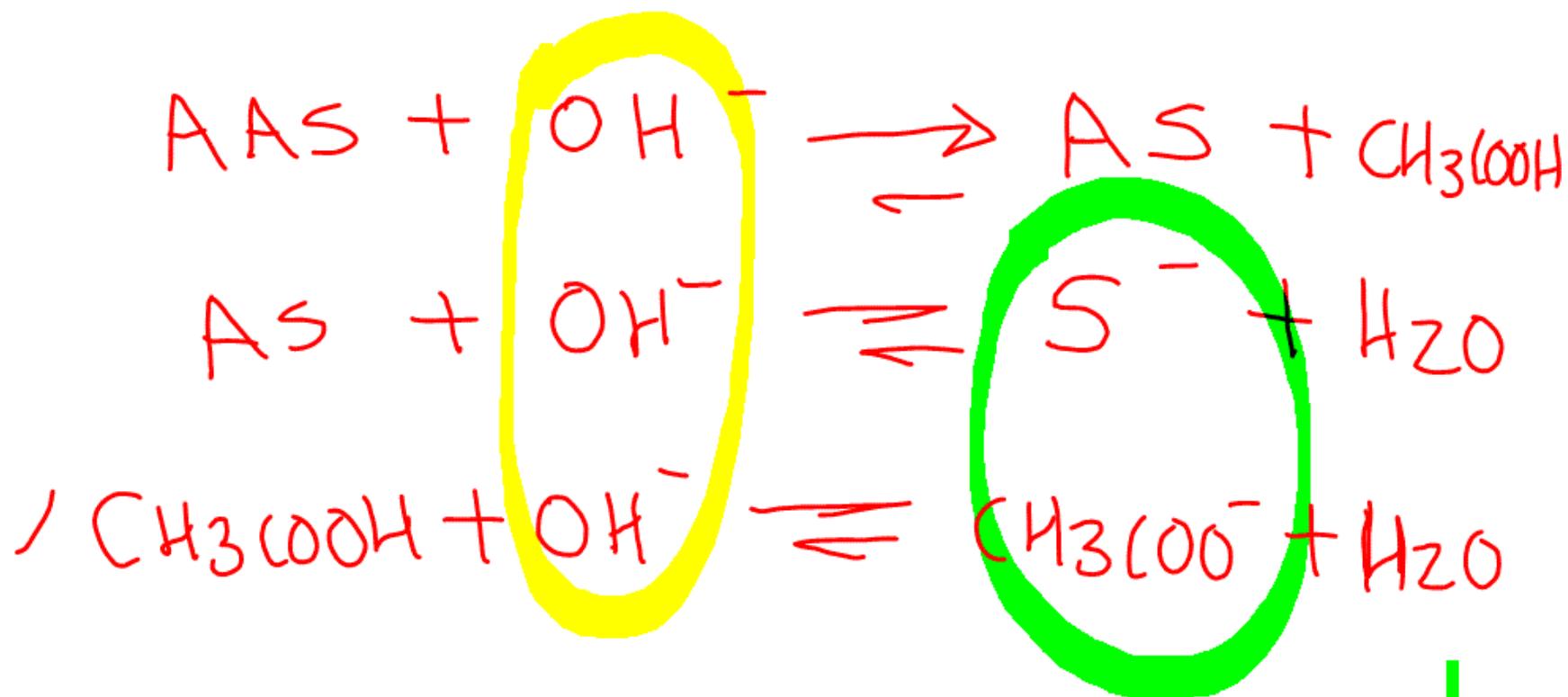
AS pKa = 3.2
 A Benzoico pKa = 4.2

CH₃COOH ácido acético

1.5 g AAS $M = \frac{180.16 \text{ g}}{\text{mol}}$

$$\frac{1.5 \text{ g}}{180.16 \text{ g/mol}} = \frac{8.32 \times 10^{-3} \text{ mol}}{50 \text{ mL NaOH}}$$

$$\text{NaOH} = 0.5 \text{ N} \approx 0.5 \text{ M}$$



$$(8.32 \times 10^{-3} \text{ mol}) \cdot 3 = \boxed{2.5 \times 10^{-2} \text{ mol. OH}^-}$$

$$\left(\begin{array}{c} 0.05 \text{ L} \\ \text{(L)} \end{array} \right) \left(\begin{array}{c} 0.5 \text{ M} \\ \text{(} \frac{\text{mol}}{\text{L}} \text{)} \end{array} \right) = \boxed{2.5 \times 10^{-2} \text{ mol}}$$

AS $\text{pK}_a = 3.2$ ✓

$\text{CH}_3(\text{COOH}) \text{ pK}_a = 4.75$



$$\text{pH} = \text{pK}_a_{\text{AS}} + \log \frac{\text{CB}}{\text{CA}}$$

Find

$$= 3.2 + \log \frac{100}{1}$$

$$= 3.2 + \log 10^2$$

$$= 3.2 + 2 = 5.2$$

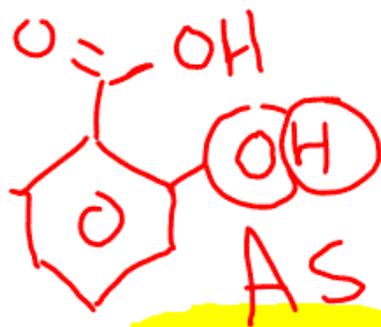
Incoloro ✓

Fenolftaleína ✓

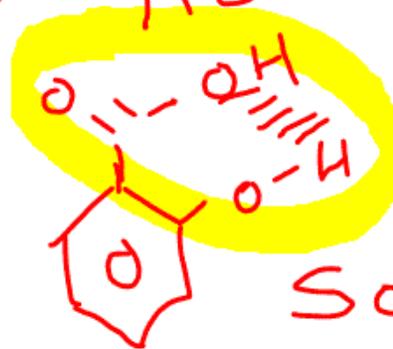
5-6

$$\text{AAS p.e.} = \frac{180.16 \text{ g}}{2 \text{ eq}}$$

$$= 90.08 \text{ g/eq}$$



pKas { 3.2 monoácido
12.9 X



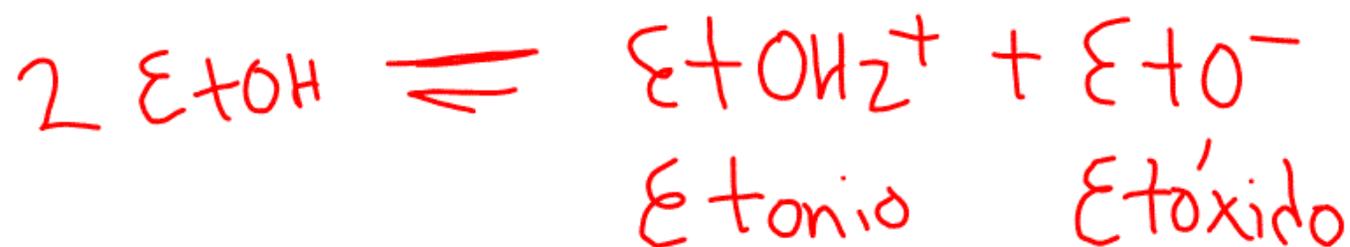
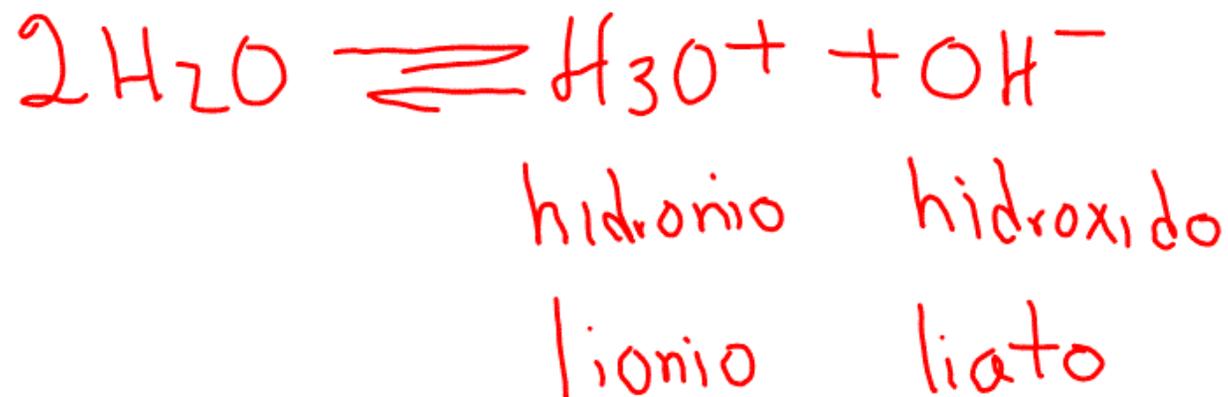
Solubilidad disminuye.

AS

Titulación disolventes orgánicos (medio no acuoso)

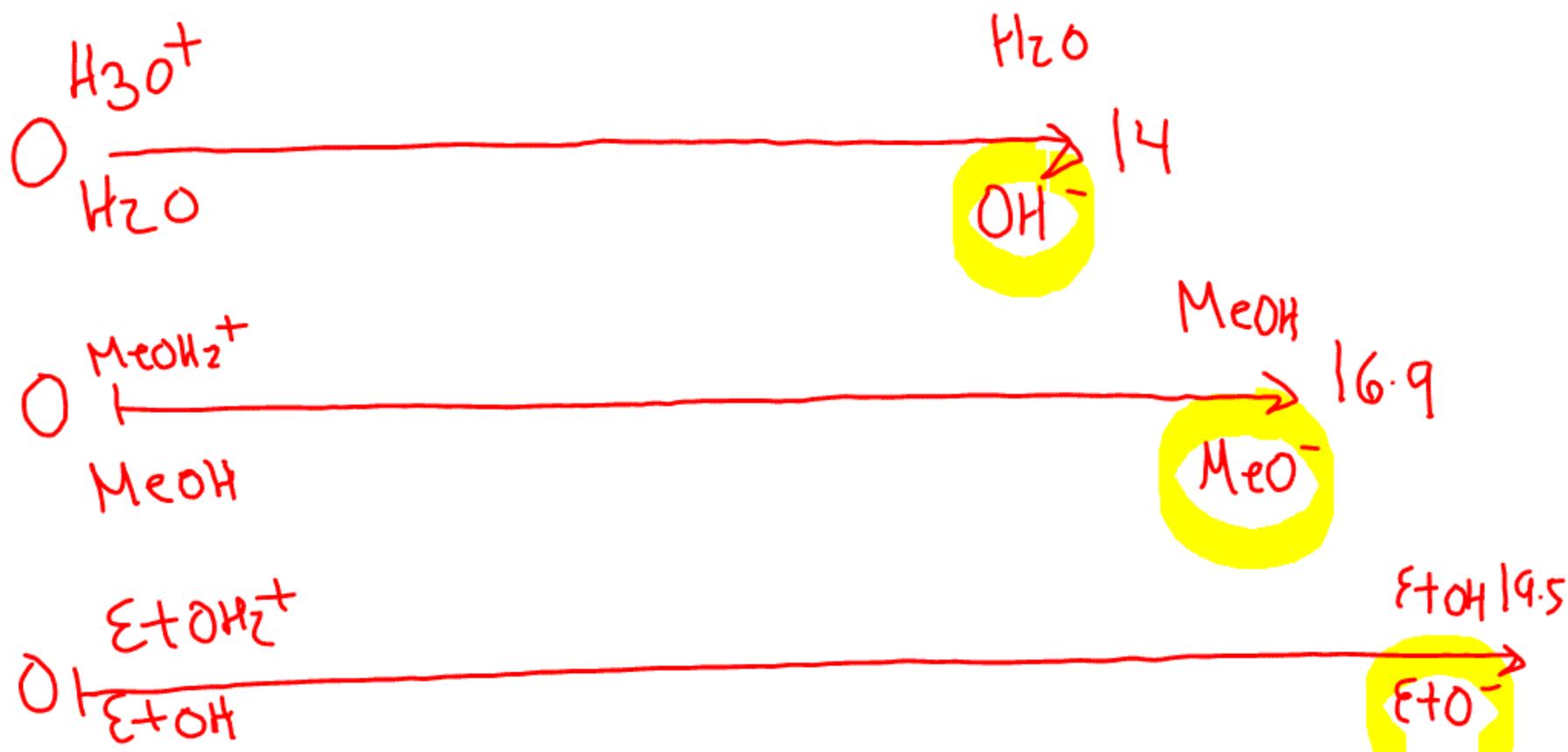
Propiedades { p.e. alta alcoholes
Disolventes { MeOH, EtOH, PrOH, iPrOH
BuOH

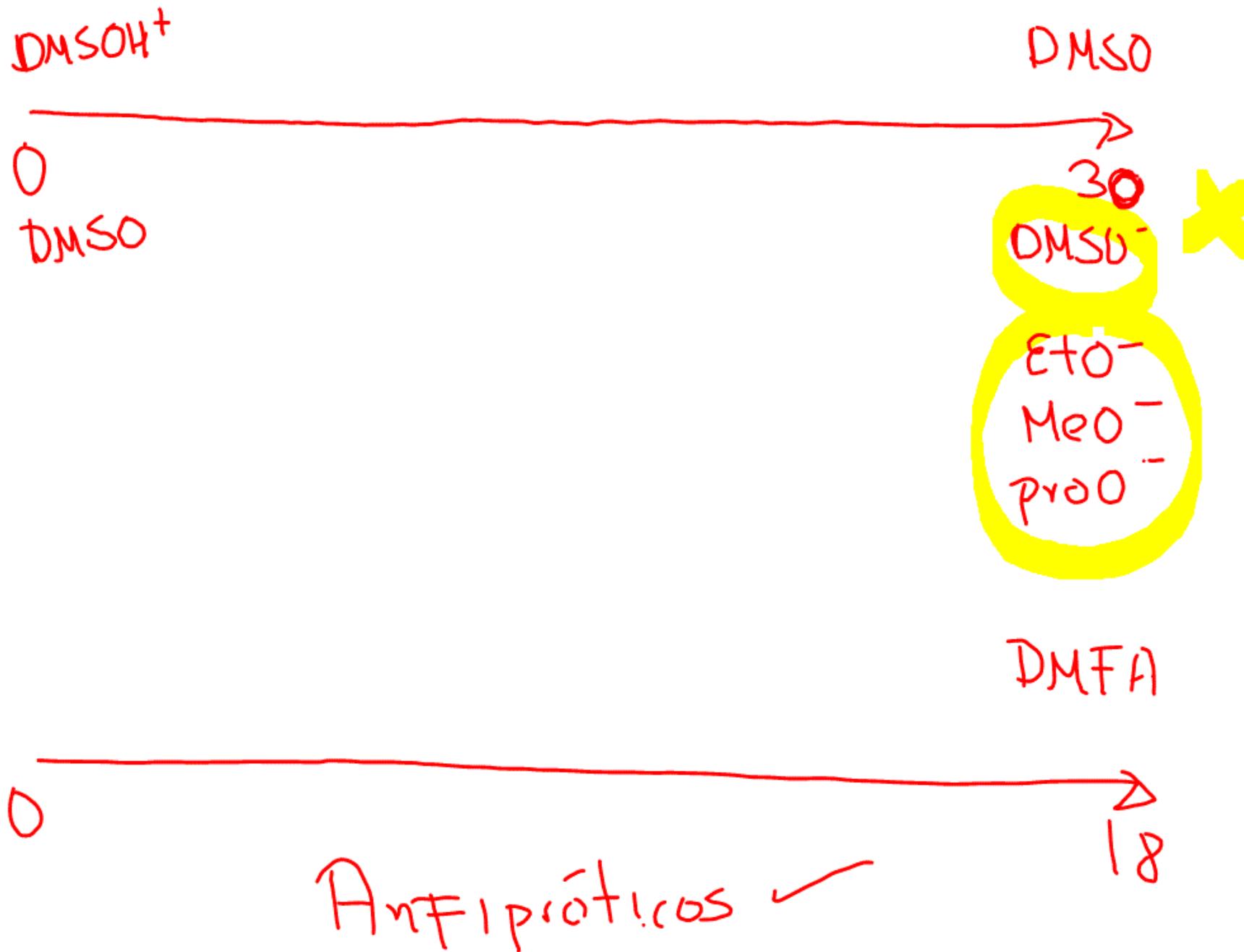
alcoholes
disolventes { polaridad, autoprotolisis



$$pH = -\log a_{H_3O^+}$$

$$pH_2S = -\log a_{L\text{ ionio}}$$







Propiedad disolventes { constante dielectrica (ϵ)

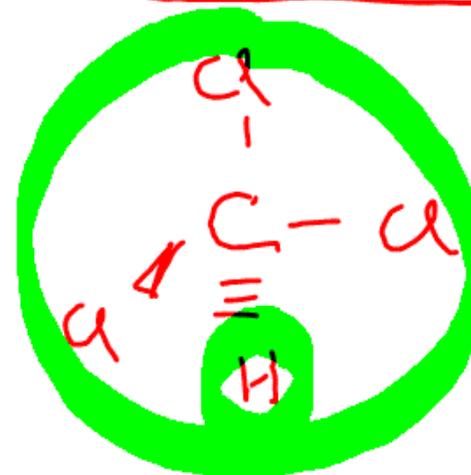
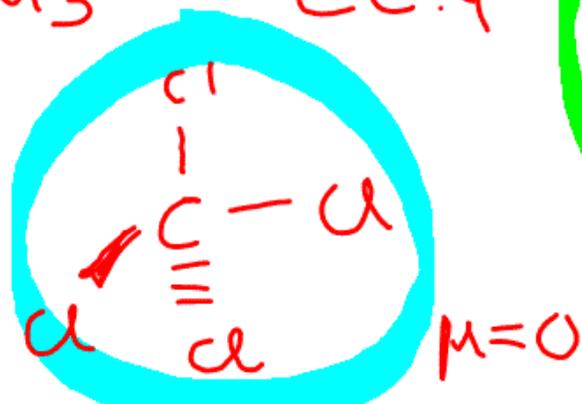
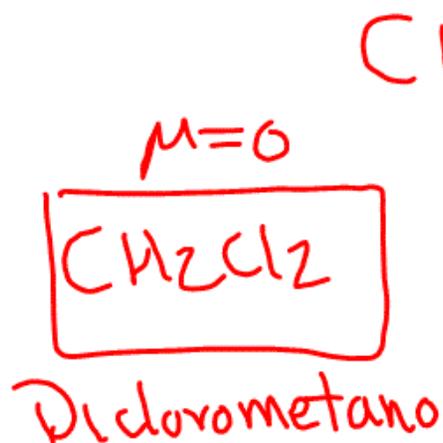
alcoholes

Agua

NH₃ AcN $\epsilon > 20$

{ $\epsilon < 20$
AcoH,

no polares poco

dioxano, CCl₄, CHCl₃

$$pK_{a_{HS}} = pK_{a_{H_2O}} + \Delta pK_a$$

Disolvente	pK	HA	BH+	B	A-	
Metanol	16.9	4.8	1.1	1.8	-2	
Etanol	19.5	5.7	1.1	4.4	-0.2	
DMFA	18	6.9	-0.7	4.7	-2.9	
DMSO	30	6	5.6	10.3	10	
AN	26	15	7.4	4.6	-3	
Agua	14	0	0	0	0	

As agua $pK_a = 3.2$ agua no es muy soluble

$$pK_{a_{MeOH}} = pK_{a_{H_2O}} + \Delta pK_a$$

$$= 3.2 + 4.8 = 8.0$$

$$pK_{a_{EtOH}} = pK_{a_{H_2O}} + \Delta pK_a$$

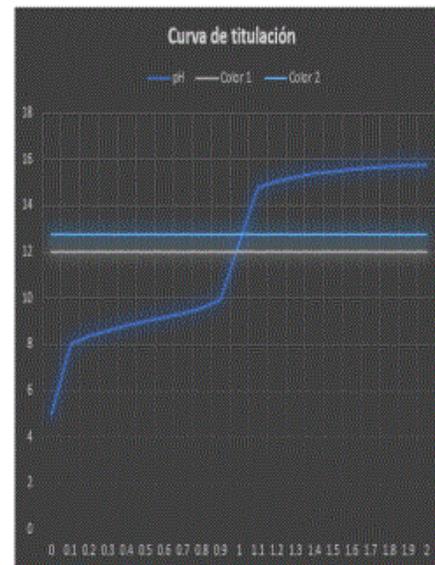
$$= 3.2 + 5.7 = 8.9$$

Disolvente	Metanol
Sustancia	Ác Benzoico
Co	0.077
pKa	8.987086643
ka	1.03018E-09
pK disolvente	16.9
kw	1.25893E-17
Fuerza	1.3379E-08
error de indicador	0.1
[] con error	0.000077
pH Indicador APE	11.98708664
pH indicador DPE	12.78649073

Ácido Debil

Cuantitatividad	
Req.	81830151.77
c	3.06753E-05
P%	99.99693247
Cuantitativo	

Fracción	pH	Color 1	Color 2
0	5.05029796	11.9870866	12.7864907
0.1	8.03284413	11.9870866	12.7864907
0.2	8.38502665	11.9870866	12.7864907
0.3	8.61910986	11.9870866	12.7864907
0.4	8.81099538	11.9870866	12.7864907
0.5	8.98708664	11.9870866	12.7864907
0.6	9.1631779	11.9870866	12.7864907
0.7	9.3506343	11.9870866	12.7864907
0.8	9.58914663	11.9870866	12.7864907
0.9	9.94132915	11.9870866	12.7864907
1	12.3867887	11.9870866	12.7864907
1.1	14.7864907	11.9870866	12.7864907
1.2	15.0875207	11.9870866	12.7864907
1.3	15.263612	11.9870866	12.7864907
1.4	15.3885507	11.9870866	12.7864907
1.5	15.4854607	11.9870866	12.7864907
1.6	15.564642	11.9870866	12.7864907
1.7	15.6315888	11.9870866	12.7864907
1.8	15.6895807	11.9870866	12.7864907
1.9	15.7407332	11.9870866	12.7864907
2	15.7864907	11.9870866	12.7864907



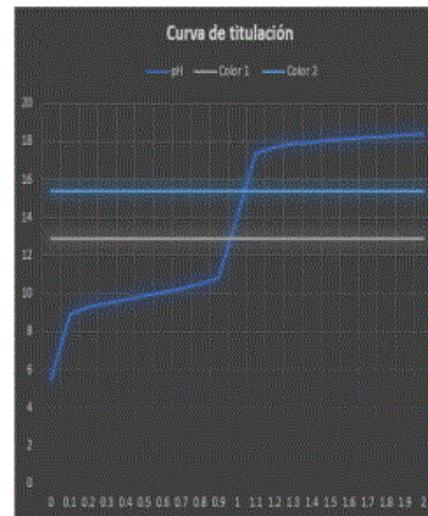
Disolvente	Etanol
Sustancia	Ác Benzóico
Co	0.077
pKa	9.887086643
ka	1.29692E-10
pk disolvente	18.5
kw	3.30216E-30
Fuerza	1.68431E-08
error de indicador	0.1
] con error	0.000077
pH indicador APE	12.88708664
pH indicador DPE	15.38649073

Acido Debil

Cuantitatividad	
Req.	4101222739
e	4.313E-06
P%	99.9995667

Cuantitativo

Fracción	pH	Color 1	Color 2
0	5.50029796	12.8870866	15.3864907
0.1	8.93284413	12.8870866	15.3864907
0.2	9.28502665	12.8870866	15.3864907
0.3	9.51910986	12.8870866	15.3864907
0.4	9.71099538	12.8870866	15.3864907
0.5	9.88708664	12.8870866	15.3864907
0.6	10.0631779	12.8870866	15.3864907
0.7	10.2550634	12.8870866	15.3864907
0.8	10.4891466	12.8870866	15.3864907
0.9	10.8413292	12.8870866	15.3864907
1	14.1367887	12.8870866	15.3864907
1.1	17.3864907	12.8870866	15.3864907
1.2	17.6875207	12.8870866	15.3864907
1.3	17.863612	12.8870866	15.3864907
1.4	17.9885507	12.8870866	15.3864907
1.5	18.0854607	12.8870866	15.3864907
1.6	18.164642	12.8870866	15.3864907
1.7	18.2315888	12.8870866	15.3864907
1.8	18.2895807	12.8870866	15.3864907
1.9	18.3407332	12.8870866	15.3864907
2	18.3864907	12.8870866	15.3864907

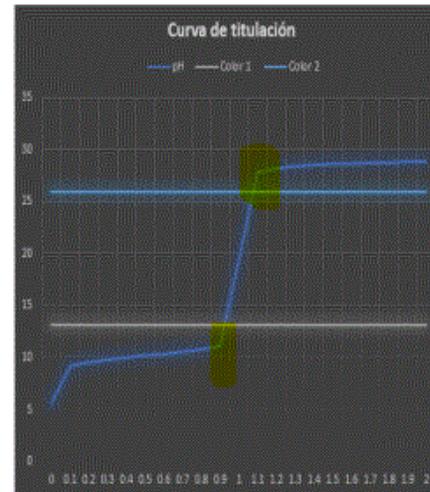


Disolvente	DMSO
Sustancia	Ác Benzoico
Co	0.077
pKa	10.18708664
ka	6.5E-11
pk disolvente	30
kw	1E-30
Fuerza	8.44156E-10
error de indicador	0.1
[] con error	0.000077
pH indicador APE	13.18708664
pH indicador DPE	25.88649073

Ácido Debil

Cuantitatividad	
Keq.	6.5E+19
ε	3.44182E-11
P%	100
Cuantitativo	

Fracción	pH	Color 1	Color 2
0	5.65029796	13.1870866	25.8864907
0.1	9.23284413	13.1870866	25.8864907
0.2	9.58502665	13.1870866	25.8864907
0.3	9.81910986	13.1870866	25.8864907
0.4	10.0109954	13.1870866	25.8864907
0.5	10.1870866	13.1870866	25.8864907
0.6	10.3631779	13.1870866	25.8864907
0.7	10.5550634	13.1870866	25.8864907
0.8	10.7891466	13.1870866	25.8864907
0.9	11.1413292	13.1870866	25.8864907
1	19.5367887	13.1870866	25.8864907
1.1	27.8864907	13.1870866	25.8864907
1.2	28.1875207	13.1870866	25.8864907
1.3	28.363612	13.1870866	25.8864907
1.4	28.4885507	13.1870866	25.8864907
1.5	28.5854607	13.1870866	25.8864907
1.6	28.664642	13.1870866	25.8864907
1.7	28.7315888	13.1870866	25.8864907
1.8	28.7895807	13.1870866	25.8864907
1.9	28.8407332	13.1870866	25.8864907
2	28.8864907	13.1870866	25.8864907



AS agua, MeOH, EtOH

pKa	3.2	8	8.9
-----	-----	---	-----



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



Inicio	C_0		
Ag		χC_0	
APE	$C_0(1-\chi)$	~ 0	χC_0
PE	ϵC_0	ϵC_0	C_0
DPE	~ 0	$C_0(\chi-1)$	C_0



Inicio	C_0		
Ag		χC_0	
APE	$C_0(1-\chi)$	~ 0	χC_0
PE	ϵC_0	ϵC_0	C_0
DPE	~ 0	$C_0(\chi-1)$	C_0

Comportamiento

Agua

$$\frac{K_a}{C_0}$$

$$\frac{10^{-3.2}}{10^{-2}}$$

$$10^{-1.2}$$

Fzamedia

MeOH

$$\frac{K_a}{C_0}$$

$$\frac{10^{-8}}{10^{-2}}$$

$$10^{-6}$$

débil

EtoH

$$\frac{K_a}{C_0}$$

$$\frac{10^{-8.9}}{10^{-2}}$$

$$10^{-6.9}$$

débil

$$k_r = \frac{[S^-]}{[A.S][OH^-]}$$

$$= \frac{k_{aH_2O}}{k_w}$$

$$= \frac{10^{-3.2}}{10^{-14}}$$

$$= 10^{10.8}$$

$$\frac{[S^-]}{[A.S][MeO^-]}$$

$$\frac{k_{aMeOH}}{k_{HS}}$$

$$\frac{10^{-8}}{10^{-16.9}}$$

$$10^{8.9}$$

$$\frac{[S^-]}{[A.S][EtO^-]}$$

$$\frac{k_{aEtOH}}{k_{HS}}$$

$$\frac{10^{-8.9}}{10^{-19}}$$

$$10^{10.1}$$

$$k_r = \frac{C_0}{\epsilon C_0 \epsilon C_0}$$

$C_0 = 10^{-2}$ Agua

Медь EтOH

$$10^{10.8} = \frac{1}{\epsilon^2 C_0}$$

$$\epsilon = \sqrt{\frac{1}{k \cdot C_0}}$$

$$\epsilon = \sqrt{\frac{1}{10^{10.8} \cdot 10^{-2}}}$$

$$\epsilon = \sqrt{\frac{1}{10^{8.8}}}$$

$$\epsilon = 10^{-8.8/2}$$

$$\epsilon = 10^{-4.4}$$

$$\epsilon = \sqrt{\frac{1}{10^{8.9} \cdot 10^{-2}}}$$

$$\epsilon = \sqrt{\frac{1}{10^{6.9}}}$$

$$\epsilon = 10^{-6.9/2}$$

$$\epsilon = 10^{-3.45}$$

$$\epsilon = \sqrt{\frac{1}{10^{10.1} \cdot 10^{-2}}}$$

$$\epsilon = \sqrt{\frac{1}{10^{8.1}}}$$

$$\epsilon = 10^{-8.1/2}$$

$$\epsilon = 10^{-4.05}$$

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

$$= 99.996\%$$

$$99.96\%$$

$$99.992\%$$

Comportamiento	X	pH _{2S} Agua	pH _{2S} MeOH	pH _{2S} EtOH	Comportamiento
Ac. Fz media	0	2.64	5	5.45	ácido débil
Am. Fz a media	0.5	2.75	8	8.9	Am débil
base débil	1	7.6	11.45	12.95	base débil
Base Fte	1.5	11.7	14.6	16.7	Base fte
	2.0	12	14.9	17	Base fte

5	APE 2	Co(1-x')	%	x'Co	1.5	13.74		
6	PE 2	Co	Co	Co	2	12.87		
7	DPE 2	Co	Co(x'-1)	Co	3	12.00		

	Acido	Selecione			
9	Co	0.01	Cantidadidad 1	Kr ₁	1.70E-11
10	ka 1	1.07E-03		ε ₁	4.1242E-06
11	pka 1	2.97		%Q ₁	99.9995876
12	ka 2	1.82E-14			
13	pka 2	13.74			
14	pkw	14			
15	Fuerza	1.07E-01	Acido Fza. Media		
16	% error del indicador	1			
17	[] con error	0.0001	Cantidadidad 2	Kr ₂	1.82E+00
18	pH Indicador APE ₁	4.97		ε ₂	7.41248317
19	pH Indicador DPE ₁	11.74		%Q ₂	-641.249337
20	pH Indicador APE ₂	15.74			
21	pH Indicador DPE ₂	10.00			

Lista de indicadores		Código
Violeta de metilo	.....	VM
Rojo de cresol ácido	.....	RCA
Azul de timol ácido	.....	ATA
Púrpura de cresol	.....	PCA
Enteozina disódica	.....	ED
Anaranjado de metilo	.....	AM
Rojo Congo	.....	RCN
Anaranjado de etilo	.....	AE
Verde de bromocresol	.....	VB
Rojo de metilo	.....	RM
Rojo de clorofenol	.....	RCF
Púrpura de bromocresol	.....	PBC
p-Nitrofenol	.....	PN
Tornasol	.....	TOR
Azul de bromotimol	.....	ABT
Rojo de fenol	.....	RF
Rojo Neutro	.....	RN
Rojo de cresol	.....	RCB
o-Naftoleína	.....	AN

Curva de titulación

Legend: pH (blue line), Color 1 (orange), Color 2 (grey), Color 3 (yellow), Color 4 (light blue), Series5 (green).

Elección del indicador PE ₁		Elección del indicador PE ₂	
Código	Indicador	Código	Indicador
ATB	Azul de timol	FNT	Fenolftaleína
	Coloración ácida amarillo		Coloración ácida incolore
	Coloración básica azul		Coloración básica rojo
	Lim. Inferior (pH) 8		Lim. Inferior (pH) 8
	Lim. Superior (pH) 9.6		Lim. Superior (pH) 9.6
	RECOMENDACIÓN Utilizar		RECOMENDACIÓN No Utilizar

		PE ₂	
x	pH	Color 1	Color 2
0.00	2.56	4.97	11.74
0.10	2.65		
0.20	2.75		
0.30	2.86		
0.40	2.98		
0.50	3.11		
0.60	3.25		
0.70	3.42		
0.80	3.64		
0.82	3.69		
1.00	8.355		
1.17	13.05		
1.19	13.11		
1.20	13.14		
1.30	13.37		
1.40	13.56		
1.50	13.74		
1.60	13.92		
1.70	14.11		
1.90	14.69		
2.00	12.87		
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		

$X=0$ Acido Fza media

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

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

$$[H_3O^+]^2 + 10^{-3.2} [H_3O^+] - 10^{-3.2} 10^{-2} = 0$$

$$[H_3O^+]^2 + 10^{-3.2} [H_3O^+] - 10^{-5.2} = 0$$

$$[H_3O^+] = 2.21 \times 10^{-3}$$

$$pH = -\log [H_3O^+] = 2.65$$

$$x = 0.5$$

Amort. Fza media

$$[H_3O^+]^2 = K_a \frac{C_a - [H_3O^+]}{C_B}$$

$$[H_3O^+]^2 = 10^{-3.2} \frac{[C_0(1-x) - [H_3O^+]]}{x C_0}$$

$$[H_3O^+]^2 = 10^{-3.2} \frac{10^{-2}(1-0.5) - [H_3O^+]}{0.5 \cdot 10^{-2}}$$

$$[H_3O^+]^2 = 10^{-3.2} \left\{ \frac{5 \times 10^{-3} - [H_3O^+]}{5 \times 10^{-3}} \right\}$$

$$[\text{H}_3\text{O}^+]^2 + 5 \times 10^{-3} [\text{H}_3\text{O}^+] = (10^{-3.2}) (5 \times 10^{-3}) - 10^{-5.2} [\text{H}_3\text{O}^+]$$

$$[\text{H}_3\text{O}^+]^2 + 5 \times 10^{-3} [\text{H}_3\text{O}^+] + 10^{-3.2} [\text{H}_3\text{O}^+] - (10^{-3.2}) (5 \times 10^{-3}) = 0$$

$$[\text{H}_3\text{O}^+]^2 + 10^{-2.3} [\text{H}_3\text{O}^+] + 10^{-3.2} [\text{H}_3\text{O}^+] - 10^{-3.2} 10^{-2.3} = 0$$

$$[\text{H}_3\text{O}^+]^2 + 10^{-5.5} [\text{H}_3\text{O}^+] - 10^{-5.5} = 0$$

$$[\text{H}_3\text{O}^+] = 1.77 \times 10^{-3}$$

$$\text{pH} = -\log [\text{H}_3\text{O}^+] = 2.75$$

$x = 1$ base débi

$$\begin{aligned} \text{pH} &= \frac{1}{2} \text{p}K_w + \frac{1}{2} \text{p}K_a + \frac{1}{2} \log C_B \\ &= \frac{1}{2} (14) + \frac{1}{2} (3.2) + \frac{1}{2} \log 10^{-2} \\ &= 7 + 1.6 - 1 = 7.6 \end{aligned}$$

$x = 1.5$ base Fte

$$\begin{aligned} \text{pH} &= 14 + \log C_B \\ &= 14 + \log (C_0(x-1)) \\ &= 14 + \log 10^{-2}(1.5-1) \\ &= 14 + \log 5 \times 10^{-3} \\ &= 14 - 2.3 = 11.7 \end{aligned}$$

$x = 2$

$$\begin{aligned} \text{pH} &= 14 + \log (C_0(x-1)) \\ &= 14 + \log 10^{-2}(2-1) \\ &= 14 - 2 = 12 \end{aligned}$$

$X=0$ MeOH, EtOH
débil

$$pH_2S = \frac{pK_{a \text{ MeOH}}}{2} - \frac{1}{2} \log C_a$$

$$= \frac{8.0}{2} - \frac{1}{2} \log 10^{-2}$$

$$= 4.0 + 1 = 5.$$

$$pH_2S = \frac{1}{2} pK_{a \text{ EtOH}} - \frac{1}{2} \log C_A$$

$$= \frac{8.9}{2} - \frac{1}{2} \log 10^{-2}$$

$$= 4.45 + 1 = 5.45$$

$x = 0.5$ Amort. débi!

$$pH_2S = pK_{a1} + \log \frac{C_B}{C_A}$$

$$= 8 + \log \frac{x C_0}{C_0(1-x)}$$

$$= 8 + \log \frac{0.5 C_0}{C_0(1-0.5)}$$

$$= 8 + \log 1 = 8$$

$$pH_2S = pK_{a2} + \log \frac{C_B}{C_A}$$

$$= 8.9 + \log \frac{0.5 C_0}{C_0(1-0.5)} = 8.9$$

Base débil

$X=1$ MeOH

$$\begin{aligned}
 \text{pH}_{25} &= \frac{1}{2} \text{p}K_{\text{HS}} + \frac{1}{2} \text{p}K_{\text{a MeOH}} + \frac{1}{2} \log C_B \\
 &= \frac{16.9}{2} + \frac{1}{2} (8) + \frac{1}{2} \log 10^{-2} \\
 &= 8.45 + 4 - 1 = 11.45
 \end{aligned}$$

EtOH

$$\begin{aligned}
 \text{pH}_{25} &= \frac{1}{2} \text{p}K_{\text{HS}} + \frac{1}{2} \text{p}K_{\text{a EtOH}} + \frac{1}{2} \log C_B \\
 &= \frac{1}{2} (19) + \frac{1}{2} (8.9) + \frac{1}{2} \log 10^{-2} \\
 &= 9.5 + 4.45 - 1 = 12.95
 \end{aligned}$$

1.1. APE

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

$$C_A = 1$$

$$C_B = 100$$

$$pH = 5.2$$

$$p.e. \text{ agua} = 7.6$$

$$7.6 = \frac{x + 10}{2}$$

1.1. DPE

Base Fte

$$pH = 14 + \log C_B$$

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

$$= 14 - 4 = 10$$

10

$$x = 1.5 \text{ MeOH}$$

$$\begin{aligned} \text{pH}_2\text{S} &= \text{pK}_{\text{H}_2\text{S}} + \log \text{CB} \\ &= 16.9 + \log (0(x-1)) \\ &= 16.9 + \log 10^{-2}(1.5-1) \\ &= 16.9 + \log 5 \times 10^{-3} \\ &= 16.9 - 2.3 = 14.6 \end{aligned}$$

$$x = 2$$

$$\begin{aligned} \text{pH}_2\text{S} &= 16.9 + \log \text{CB} \\ &= 16.9 + \log (0(x-1)) = 16.9 + \log 10^{-2}(2-1) \\ &= 14.9 \end{aligned}$$