

Clase 2 12 Marzo 2021

Título de la nota

12/03/2021

ácido de Fza media

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

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

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

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

$$\begin{array}{ccccccc} a & & b & & c & & \\ a x^2 & + & b x & - & c & = & 0 \end{array}$$

$$X = [H_3O^+]$$

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

Amortiguador

$$pKa \pm 1$$

$$4.75 \pm 1$$



$$pKa = 4.75$$



$$pH = 5$$

$$3.75 - 5.75$$

$$0.01 - 0.005 M$$

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

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

$$pH = pK_a - \log \frac{C_A}{C_B}$$

$$pH = pK_a + \log \frac{C_B}{C_A}$$

Ec. Henderson
Hasselbach

base débil

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

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

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

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

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

$$2pH = pK_a + pK_w + \log C_B$$

$$\begin{aligned}
 \text{pH} &= \frac{1}{2} \text{pK}_a + \frac{1}{2} \text{pK}_w + \frac{1}{2} \log C_B \\
 &= 7 + \frac{1}{2} \text{pK}_a + \frac{1}{2} \log C_B
 \end{aligned}$$

Base Forte

$$\left\{ \begin{aligned} [\text{H}_3\text{O}^+] &= \frac{1}{-C_B [\text{OH}^-]} \end{aligned} \right\} \quad [\text{OH}^-] = \frac{K_w}{[\text{H}_3\text{O}^+]}$$

$$\left\{ \begin{aligned} [\text{H}_3\text{O}^+] &= \frac{1}{-C_B [\text{OH}^-]} \end{aligned} \right\}$$

$$- [\text{H}_3\text{O}^+] [\text{OH}^-] = \frac{1}{C_B}$$

$$- K_w = \frac{1}{C_B} \quad ?$$

$$[\text{H}_3\text{O}^+] = \frac{K_w}{C_B}$$

$$\text{pH} = 14 + \log C_B$$

$$K_w = [\text{H}_3\text{O}^+] [\text{OH}^-]$$

$$[\text{H}_3\text{O}^+] = \frac{[\text{H}_3\text{O}^+] [\text{OH}^-]}{C_B}$$

Base Fz. media

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

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

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

$$\begin{aligned}
 [\text{H}_3\text{O}^+] &= \frac{K_a}{\frac{C_B - K_w}{[\text{H}_3\text{O}^+]} - K_w} \\
 &= \frac{K_a K_w}{C_B [\text{H}_3\text{O}^+] - K_w}
 \end{aligned}$$

$$[\text{H}_3\text{O}^+] = \frac{K_a K_w}{C_B [\text{H}_3\text{O}^+] - K_w}$$

$$[\text{H}_3\text{O}^+]^2 C_B - K_w [\text{H}_3\text{O}^+] = K_a K_w$$

$$[\text{H}_3\text{O}^+]^2 C_B - K_w [\text{H}_3\text{O}^+] - K_a K_w = 0$$

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

Ampolito

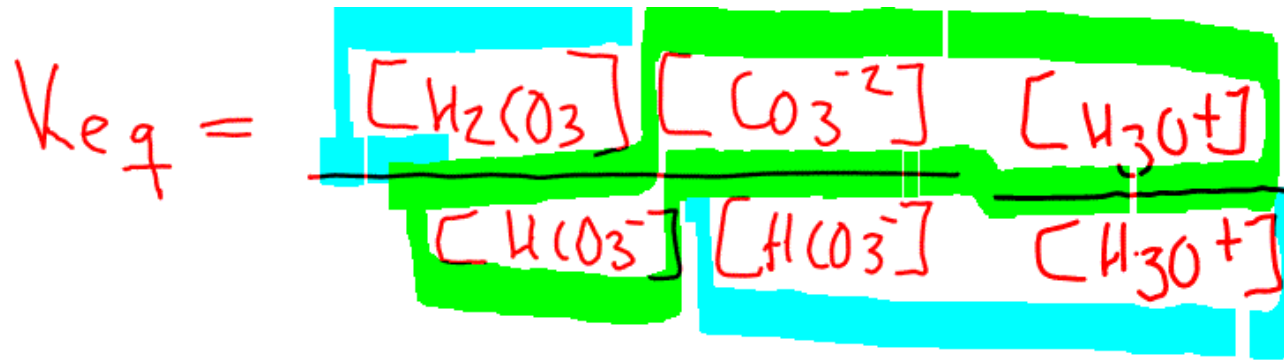
pH $\cdot HCO_3^-$?



$$pK_{a1} = 6.4$$

$$pK_{a2} = 10.8$$

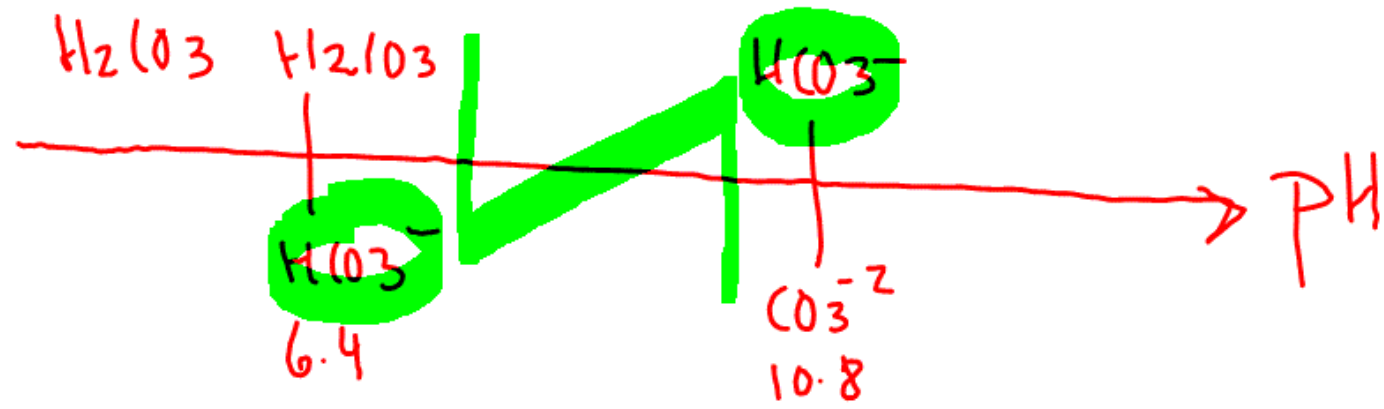
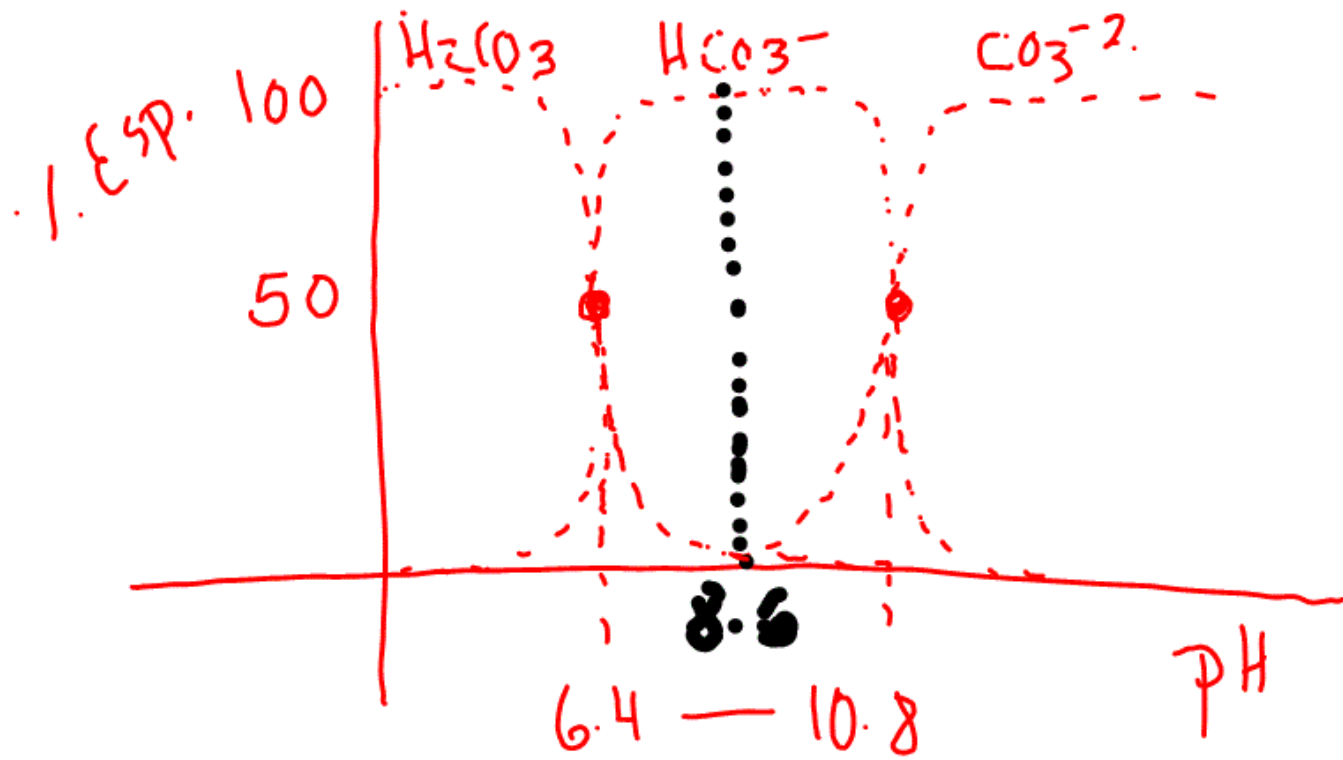
$$K_{eq} = \frac{[\text{H}_2\text{CO}_3][\text{CO}_3^{2-}]}{[\text{HCO}_3^-][\text{HCO}_3^-]}$$

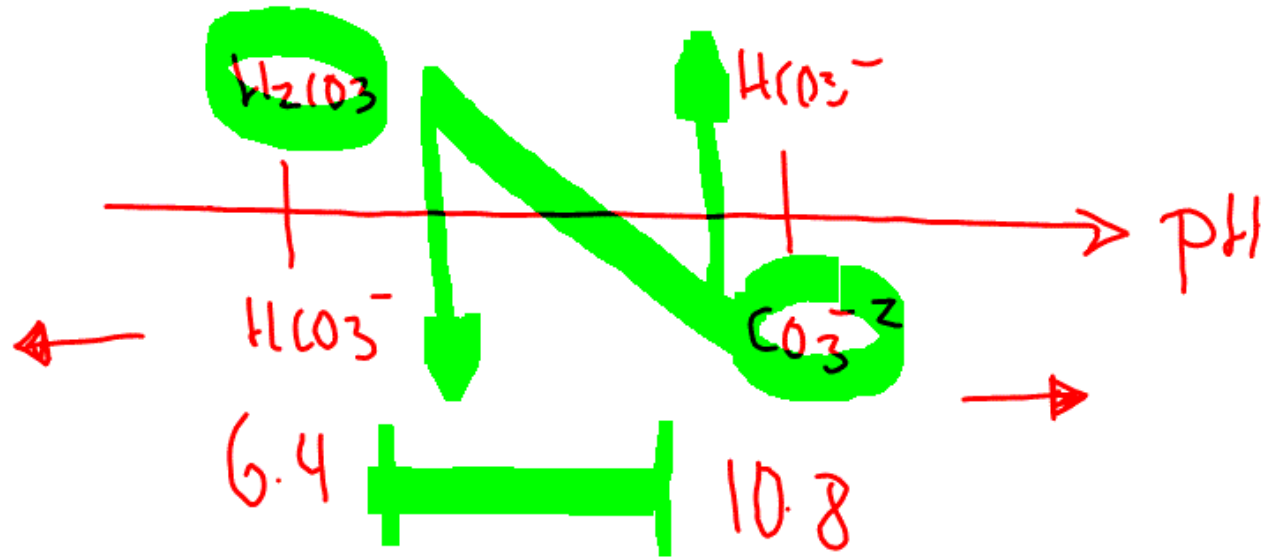


$$K_{dismut.} = \frac{K_{a2}}{K_{a1}} = \frac{10^{-10.8}}{10^{-6.4}} = 10^{-4.4}$$

$$K_{AnF} = \frac{1}{K_{dism}} = \frac{1}{10^{-4.4}} = 10^{4.4}$$

$$pH = \frac{pK_{a1} + pK_{a2}}{2} = \frac{6.4 + 10.8}{2} = 8.6$$



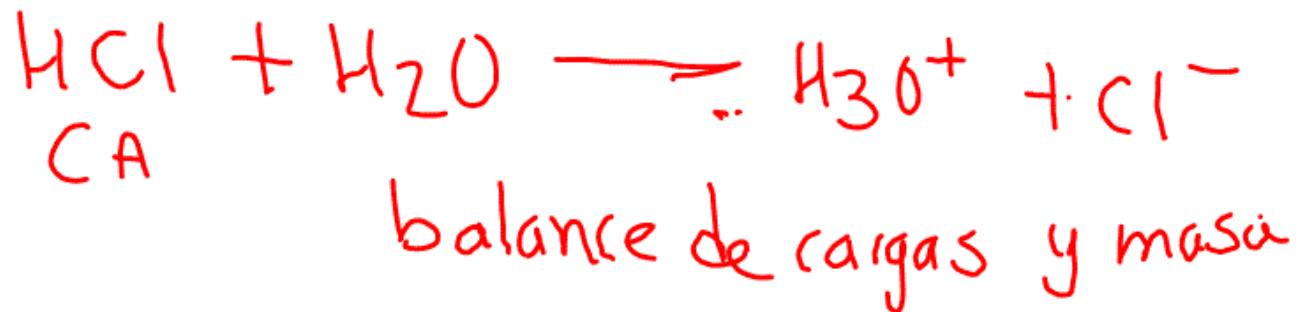


Calcular el pH del HCl $10^{-7} M$

M = masa molar

M = Molaridad

F = Formalidad = $\frac{FUF}{L \text{ Disp.}}$



$$[\text{H}_3\text{O}^+] = [\text{Cl}^-] + [\text{OH}^-]$$

$$\text{pH} = -\log(1.61 \times 10^{-7})$$
$$= 6.79$$

$$[\text{HCl}] = 10^{-8} \text{ F}$$

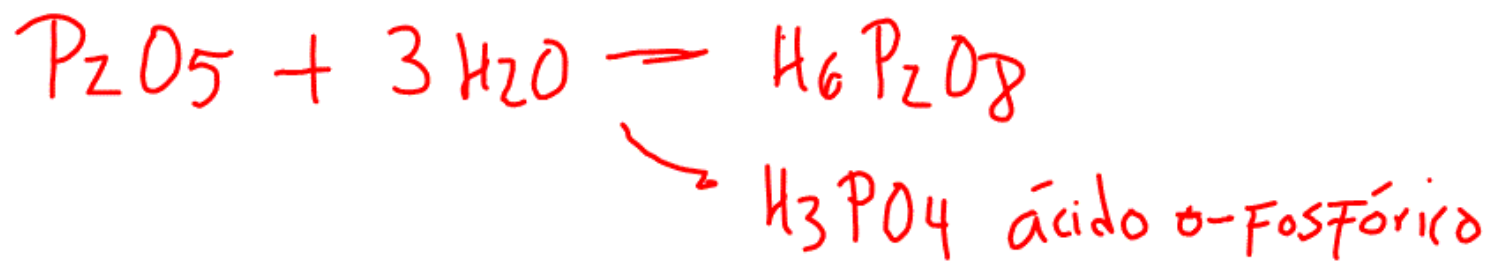
$$x = \begin{cases} 1.05 \times 10^{-7} \\ -9.51 \times 10^{-8} \end{cases}$$

$$\text{pH} = -\log 1.05 \times 10^{-7}$$
$$= 6.97$$

Unidades
de
Concentración

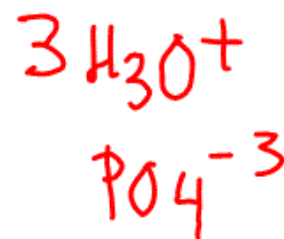
- Molaridad (M)
- molalidad (m)
- Normalidad (N)
- Formalidad (F)

Calcular cuantos mL de ácido ortofosfórico
 son necesarios medir para preparar 400 mL de
 una disolución 0.3 N $\rho = 1.23$
 pureza = 40%.



$$M_{H_3PO_4} = 98 \text{ g/mol.}$$

$$\text{peq } H_3PO_4 = \frac{M}{3}$$



$$\begin{aligned}
 mL &= \left(\frac{eq}{L} \right) \left(\frac{g}{eq} \right) (L) \left(\frac{1}{\rho \frac{g}{mL}} \right) \left(\frac{100}{\text{pureza}} \right) \\
 &= \left(\frac{0.3 eq}{L} \right) \left(\frac{98g}{3 eq} \right) (0.4 L) \left(\frac{1}{1.23g/mL} \right) \left(\frac{100}{40} \right) \\
 &= 7.96 mL
 \end{aligned}$$



Hom

UC1

UC2

UC3

UC4

UC5

Preparación de soluciones a partir de reactivos líquidos y sólidos

Instrucción: Llenar las celdas de color amarillo, los resultados aparecen en color verde.

Reactivo líquido

Disperso (2)	H ₃ PO ₄		Dispersante (1)		Agua
M ₂ (g/mol)	ρ ₂ (g/mL)	M (mol/L)	V dis (mL)	% pureza	V dis (L)
98.00	1.2000	0.23	350.00	37.00	0.3500

V ₂ (mL)	17.7680
---------------------	---------

M ₂ (g/mol)	# eq	ρ ₂ (g/mL)	N (eq/L)	V dis (mL)	% pureza	V dis (L)
98.00	3	1.2300	0.3	400.00	40.00	0.4000

V ₂ (mL)	7.9675
---------------------	--------

X	Hom	UC1	UC2	UC3	UC4	UC5
---	-----	-----	-----	-----	-----	-----

Preparación de soluciones a partir de reactivos líquidos y sólidos

Instrucción: Llenar las celdas de color amarillo, los resultados aparecen en color verde.

Reactivo líquido

Disperso (2)	H3PO4		Dispersante (1)		Agua
M_2 (g/mol)	ρ_2 (g/mL)	M (mol/L)	V dis (mL)	% pureza	V dis (L)
98.00	1.2300	0.1	400.00	40.00	0.4000

V_2 (mL)	7.9675
------------	--------

M_2 (g/mol)	# eq	ρ_2 (g/mL)	N (eq/L)	V dis (mL)	% pureza	V dis (L)
98.00	3	1.2300	0.3	400.00	40.00	0.4000

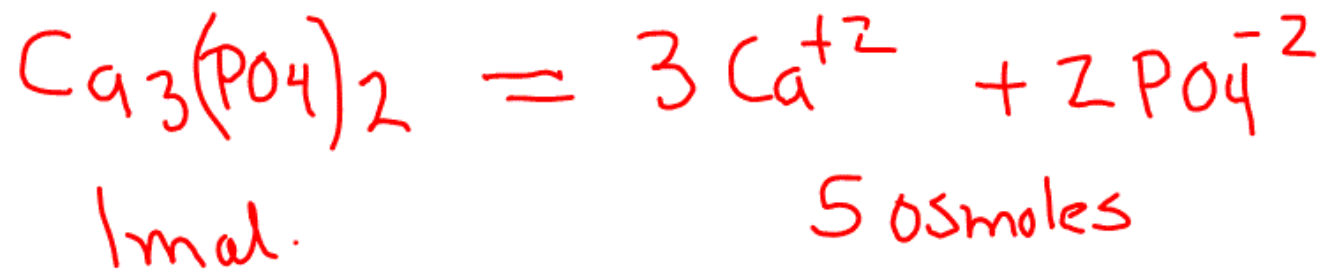
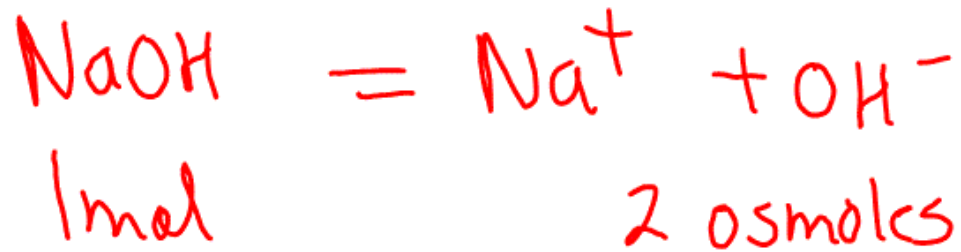
V_2 (mL)	7.9675
------------	--------

$$N = (M) \left(\frac{\text{eq}}{\text{mol}} \right) = \left(\frac{\text{mol}}{\text{L}} \right) \left(\frac{\text{eq}}{\text{mol}} \right)$$

$$N = \left(\frac{0.1 \text{ mol}}{\text{L}} \right) \left(\frac{3 \text{ eq}}{\text{mol}} \right) = \frac{0.3 \text{ eq}}{\text{L}}$$

$$M = \frac{N}{(\text{eq/mol})} = \frac{0.3 \text{ eq/L}}{3 \text{ eq/mol}} = \frac{0.1 \text{ mol}}{\text{L}}$$

Osmol { electrolitos depende del # especies
 { no electrolitos = mol



$$0.05 \text{ M} = 0.25 \text{ Osm}$$



0.1 m 3 Osmoles

0.1 m = 0.3 Osm

$$\begin{aligned} \text{m/v} &= \frac{\text{mg}}{100 \text{ mL Disp}} \times 100 \\ &= \frac{177.6 \text{ g}}{100 \text{ mL Dis}} \times 100 \\ &= 177.6 \% \end{aligned}$$

Calcular cuantos mL son necesarios para preparar

500 mL H_2SO_4 0.5 N

ρ 1.84 g/mL $M = 98$ g/mol.

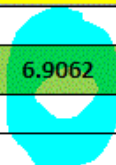
pureza 96.4%.

Preparación de soluciones a partir de reactivos líquidos y sólidos					
Instrucción: Llenar las celdas de color amarillo, los resultados aparecen en color verde.					
Reactivo líquido					
Disperso (2)	H2SO4		Dispersante (1)		Agua
M ₂ (g/mol)	ρ ₂ (g/mL)	M (mol/L)	V dis (mL)	% pureza	V dis (L)
36.50	1.1500	0.23	350.00	37.00	0.3500

V ₂ (mL)	6.9054
---------------------	--------

M ₂ (g/mol)	# eq	ρ ₂ (g/mL)	N (eq/L)	V dis (mL)	% pureza	V dis (L)
98.00	2	1.8400	0.5	500.00	96.40	0.5000

V ₂ (mL)	6.9062
---------------------	--------



M = ?

$$\rho = 1.84 \text{ g/mL}$$

pureza
96.4%

$$\frac{1840 \text{ g}}{\text{L DISP}} \left\{ \begin{array}{l} \text{H}_2\text{SO}_4 (0.964) = 1773.76 \text{ g} \\ \text{H}_2\text{O} (1 - 0.964) = 66.24 \text{ g} \end{array} \right.$$

$$n \text{ H}_2\text{SO}_4 = \frac{1773.76 \text{ g}}{98 \text{ g/mol}} = 18.0995$$

=

$$M = \frac{n \text{ H}_2\text{SO}_4}{\text{L DISP}} = 18.0995$$

X	Hom	UC1	UC2	UC3	UC4	UC5
---	-----	-----	-----	-----	-----	-----

Obtención de unidades de concentración a partir de % pureza y densidad					
Disperso (2)	H2SO4		Dispersante (1)		Agua
Instrucción: Llenar las celdas de color amarillo, los resultados aparecen en color azul.					
M_2 (g/mol)	n_2 (mol)	n_1 (mol)	x_2	x_1	M_1 (g/mol)
98.00	18.0996	3.6800	0.83103	0.16897	18.00
% pureza	V dis (mL)	V dis (L)	peq ₂ (g/eq)	m dis (g)	m_1 (g)
96.40	1000.00	1.00	49.00	1840.00	66.240
ρ dis (g/mL)	eq ₂	m_2 (g)		Osmoles ₂	# eq ₂
1.8400	36.1992	1773.76		3	2



Unidades de concentración							
Molaridad	Formalidad	Normalidad	Molalidad	%m/m	%m/v	Osmolalidad	Osmolaridad
18.0996	18.0996	36.1992	273.2426	96.4000	177.3760	819.7279	54.2988
	ppm	ppb	ppt				
	1.774e+6	1.774e+9	1.774e+12				

Dr. Juan Carlos Vázquez Lira 2021 V1

Con apoyo del programa DGAPA-UNAM-PAPIME PE-202021

18.0996 M preparación

36.1992 N preparación 500 mL 0.5 N

$$N_1 V_1 = N_2 V_2$$

$$V_1 = \frac{N_2 V_2}{N_1} = \frac{(0.5 N)(0.5 L)}{(36.1992 N)}$$

$$V_1 = 0.0069 L$$

$$V_1 = 6.9 mL$$

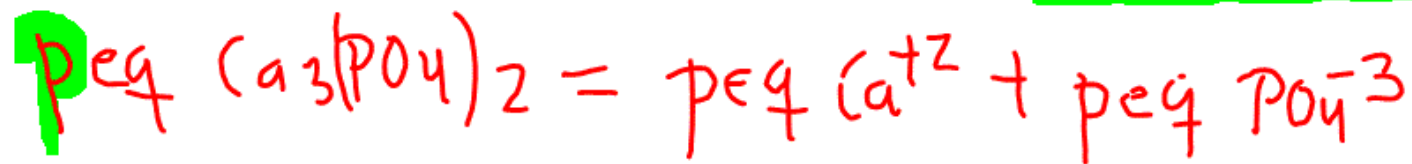
$$\text{peg } \text{Ca}_3(\text{PO}_4)_2 = \frac{310 \text{ g/mol}}{6} = 51.66 \text{ g/eq}$$

$$\text{peg } \text{Ca}^{+2} = \frac{3 \text{ p.a. Ca}^{+2}}{6} = \frac{1}{2} \text{ p.a. Ca}^{+2} = \frac{40 \text{ g/mol}}{2 \text{ eq/mol}} = 20 \text{ g/eq}$$

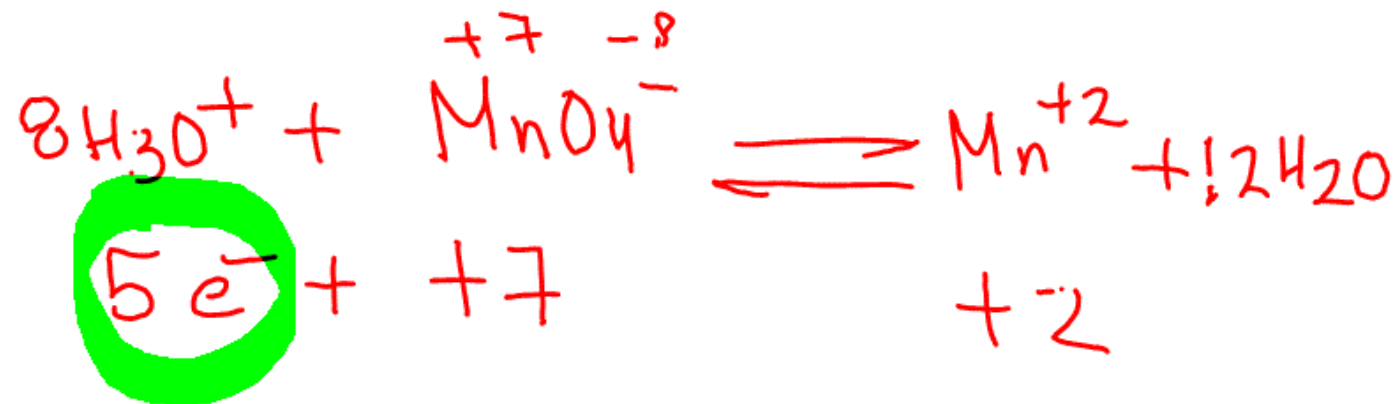
$$M \text{Ca}_3(\text{PO}_4)_2 = (95 \times 2) (40 \times 3) = 310 \text{ g/mol}$$



$$\text{peq } \text{PO}_4^{-3} = \frac{2 \text{ M } \text{PO}_4^{-3}}{6} = \frac{1 \text{ M } \text{PO}_4^{-3}}{3} = \frac{(95 \text{ g/md})}{3 \text{ eq/md}} = 31.66 \text{ g/eq}$$



$$= 51.66 \text{ g/eq} \quad \checkmark$$



$$\text{peq MnO}_4^- = \frac{\text{MnO}_4^-}{5}$$

