Pauta Interrogación 1 2° Semestre 2020

1. 100mL HBO_2 0,05M + 200mL HF 0,2M

$$C_{HBO_2} = \frac{0,05M \cdot 100mL}{300mL} = 0,017M \quad 2,0$$

$$C_{HF} = \frac{0,2M \cdot 200mL}{300mL} = 0,13M \quad 2,0$$

$$Ka^{HBO_2} = 10^{-9,22} = 6,03 \cdot 10^{-10}$$

$$Ka^{HF} = 10^{-3,18} = 6,61 \cdot 10^{-4}$$

$HBO_2 + H_2O \rightleftharpoons BO_2^- + H_3O^+ \quad Ka^{HBO_2}$
$HF + H_2O \rightleftharpoons F^- + H_3O^+ \quad Ka^{HF}$
$H_2O + H_2O \rightleftharpoons OH^- + H_3O^+ \quad Kw$

$$Ka^{HBO_2} = \frac{[BO_2^-][H_3O^+]}{[HBO_2]}$$

$$Ka^{HF} = \frac{[F^-][H_3O^+]}{[HF]}$$

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

2,0

BM: $C_{HBO_2} = [HBO_2] + [BO_2^-]$
$C_{HF} = [HF] + [F^-]$

BC: $[H_3O^+] = [BO_2^-] + [F^-] + [OH^-]$

BP: $[H_3O^+] = [BO_2^-] + [F^-] + [OH^-]$

2,0

$$\therefore [H_3O^+] = \frac{C_{HBO_2} \cdot Ka^{HBO_2}}{[H_3O^+] + Ka^{HBO_2}} + \frac{C_{HF} \cdot Ka^{HF}}{[H_3O^+] + Ka^{HF}} + \frac{Kw}{[H_3O^+]}$$

2//

Aproximaciones:

1. $[H_3O^+] \gg [OH^-]$

2. $C_{HBO_2} \cdot Ka^{HBO_2} = 0{,}017 \cdot 6{,}03 \cdot 10^{-10} = 1{,}025 \cdot 10^{-11}$
   $C_{HF} \cdot Ka^{HF} = 0{,}13 \cdot 6{,}61 \cdot 10^{-4} = 8{,}59 \cdot 10^{-5}$

   $\therefore C_{HF} \cdot Ka^{HF} \gg C_{HBO_2} \cdot Ka^{HBO_2}$

} 2,0

3. $[HF] \gg [F^-]$

$$\therefore [H_3O^+] = \sqrt{C_{HF} \cdot Ka^{HF}} = \sqrt{0{,}13 \cdot 6{,}61 \cdot 10^{-4}} = 9{,}27 \cdot 10^{-3} \text{ M}$$ 3,0

Chequeos

1. 5% $9{,}27 \cdot 10^{-3} \geq \frac{10^{-14}}{9{,}27 \cdot 10^{-3}} \rightarrow 4{,}635 \cdot 10^{-4} \geq 1{,}08 \cdot 10^{-12}$ ✓

2. $8{,}59 \cdot 10^{-5} \geq 100 \cdot 1{,}025 \cdot 10^{-11} = 8{,}59 \cdot 10^{-5} \geq 1{,}025 \cdot 10^{-9}$ ✓

3. 5% $0{,}13 \geq 9{,}27 \cdot 10^{-3} \rightarrow 6{,}5 \cdot 10^{-3} \geq 9{,}27 \cdot 10^{-3}$ No se cumple

} 2,0

$$\therefore [H_3O^+] = \frac{C_{HF} \cdot Ka^{HF}}{[H_3O^+] + Ka^{HF}}$$

$$[H_3O^+]^2 + Ka^{HF} \cdot [H_3O^+] - C_{HF} \cdot Ka^{HF} = 0$$

$$[H_3O^+]^2 + 6{,}61\cdot10^{-4}[H_3O^+] - 8{,}59\cdot10^{-5} = 0$$

$$\therefore [H_3O^+] = 8{,}94\cdot10^{-3}\ M \quad 2{,}0$$

$$pH = 2{,}05 \quad 3{,}0$$

2. X $\quad pK_b = 10{,}8 \quad \therefore K_b = 10^{-10{,}8} = 1{,}58\cdot10^{-11}$

$$C_X = \frac{0{,}1\,g}{500\,g/mol\ 0{,}1\,L} = 2\cdot10^{-3}\ M \quad 2{,}0$$

$$X + H_2O \rightleftharpoons XH^+ + OH^- \quad K_b$$
$$H_2O + H_2O \rightleftharpoons H_3O^+ + OH^- \quad K_w$$

$$K_b = \frac{[XH^+][OH^-]}{[X]} \qquad K_w = [H_3O^+][OH^-] \quad \Big\} 2{,}0$$

BM: $C_X = [X] + [XH^+]$
BC: $[OH^-] = [XH^+] + [H_3O^+]$
BP: $[OH^-] = [XH^+] + [H_3O^+]$ $\Big\} 2{,}0$

$$[OH^-] = \frac{C_X\cdot K_b}{[OH^-] + K_b} + \frac{K_w}{[OH^-]}$$

Aproximaciones

1. $[OH^-] \gg [H_3O^+]$
2. $[X] \gg [XH^+]$ $\Big\} 2{,}0$

$\therefore [OH^-] = \sqrt{Cx \cdot K_b} = \sqrt{2 \cdot 10^{-3} \cdot 1{,}58 \cdot 10^{-11}} = 1{,}78 \cdot 10^{-7}\ M$ 3.0 4

Chequeos

1. 5% $1{,}78 \cdot 10^{-7} \geq \frac{10^{-14}}{1{,}78 \cdot 10^{-7}} \rightarrow 8{,}9 \cdot 10^{-9} \geq 5{,}62 \cdot 10^{-8}$ No se cumple } 2.0

2. 5% $2 \cdot 10^{-3} \geq 1{,}78 \cdot 10^{-7} \rightarrow 10^{-4} \geq 1{,}78 \cdot 10^{-7}$ ✓

$\therefore [OH^-] = \frac{Cx \cdot K_b}{[OH^-]} + \frac{K_w}{[OH^-]}$

$[OH^-] = \sqrt{Cx \cdot K_b + K_w} = \sqrt{2 \cdot 10^{-3} \cdot 1{,}58 \cdot 10^{-11} + 10^{-14}} = 2{,}04 \cdot 10^{-7}\ M$ 2.0

$\therefore [H_3O^+] = \frac{K_w}{[OH^-]} = \frac{10^{-14}}{2{,}04 \cdot 10^{-7}} = 4{,}9 \cdot 10^{-8}\ M$ 2.0

$pH = 7{,}3$ 3.0

3. Experimento 1: 20mL Na_2CO_3 0,1M + 10mL HCl 0,2M

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mmol Na_2CO_3 = 20mL · 0,1M = 2
mmol HCl = 10mL · 0,2M = 2

$$Na_2CO_3 + HCl \rightarrow NaHCO_3 + NaCl$$
$$2 \quad 2 \quad - \quad -$$
$$- \quad - \quad 2 \quad 2$$
Anfolito Sal neutra

2,0

$NaCl \rightarrow Na^+ + Cl^-$
$NaHCO_3 \rightarrow Na^+ + HCO_3^-$
$HCO_3^- + H_2O \rightleftharpoons H_2CO_3 + OH^-$ Kb
$HCO_3^- + H_2O \rightleftharpoons CO_3^{2-} + H_3O^+$ Ka
$H_2O + H_2O \rightleftharpoons OH^- + H_3O^+$ Kw

$$Kb = \frac{[H_2CO_3][OH^-]}{[HCO_3^-]} \qquad Ka = \frac{[CO_3^{2-}][H_3O^+]}{[HCO_3^-]}$$

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

2,0

BM: $C_{NaCl} = [Cl^-]$
$C_{NaHCO_3} = C_{HCO_3}$
$[Na^+] = C_{NaCl} + C_{NaHCO_3}$
$C_{HCO_3} = [H_2CO_3] + [HCO_3^-] + [CO_3^{2-}]$

BC: $[H_3O^+] + [Na^+] = [HCO_3^-] + 2[CO_3^{2-}] + [OH^-]$

BP: $[H_3O^+] + [H_2CO_3] = [CO_3^{2-}] + [OH^-]$

2,0

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BM: $C_{NaCl} = [Cl^-]$

$C_{NaHCO_3} = C_{HCO_3}$

$[Na^+] = C_{NaCl} + C_{NaHCO_3}$

$C_{H_2CO_3} + C_{HCO_3} = [H_2CO_3] + [HCO_3^-]$

BC: $[H_3O^+] + [Na^+] = [Cl^-] + [HCO_3^-] + [OH^-]$

BP: $[H_3O^+] + [H_2CO_3] = [HCO_3^-] + [OH^-]$

} 2,0

Aproximación: $C_{H_2CO_3}$ y $C_{HCO_3} \gg [H_3O^+]$ y $[OH^-]$ 2,0

$$pH = pKa_1 + \log \frac{C_{HCO_3}}{C_{H_2CO_3}}$$

$$pH = 6,36 + \log \frac{\frac{1,2\ mmol}{V_T}}{\frac{0,8\ mmol}{V_T}} = 6,536$$ 2,0

Aproximación: $C_{HCO_3^-} \gg [H_3O^+]$ y $[OH^-]$ 2,0 6//

$$\therefore [H_3O^+] = \sqrt{Ka_1 \cdot Ka_2}$$

$$pH = \frac{pKa_1 + pKa_2}{2} = \frac{6,36 + 10,33}{2} = 8,35 \quad 2,0$$

b) 2 mmol $NaHCO_3$ + 4 mL HCl 0,2M en 30 mL

mmol HCl = 4 mL · 0,2M = 0,8

$NaHCO_3$	+ HCl	→ H_2CO_3	+ NaCl
2	0,8	–	2
1,2	–	0,8	2,8
			Sal neutra

Buffer

2,0

$NaCl \rightarrow Na^+ + Cl^-$

$NaHCO_3 \rightarrow Na^+ + HCO_3^-$

$HCO_3^- + H_2O \rightleftharpoons H_2CO_3 + OH^-$ Kb

$H_2CO_3 + H_2O \rightleftharpoons HCO_3^- + H_3O^+$ Ka

$H_2O + H_2O \rightleftharpoons OH^- + H_3O^+$ Kw

$$Kb = \frac{[H_2CO_3][OH^-]}{[HCO_3^-]} \qquad Ka = \frac{[HCO_3^-][H_3O^+]}{[H_2CO_3]}$$

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

2,0