LISTA Nº 3 PARTE A

1) TEORIA ARRHENIUS — Ácido ⇒ produz H_3O^+; base ⇒ produz OH^-

TEORIA BRÖNSTED – LOWRY — Ácido ⇒ doador H^+ (próton); base ⇒ receptor H^+ (próton)

TEORIA LEWIS

Ácido: recebe/coordena par elétrons ·· / ELETRÓFILO

Base: doa/ par elétrons ·· / NUCLEÓFILO

2) a) $HI + H_2O \rightleftharpoons H_3O^+ + I^-$

ác iodídrico — iodeto (base conjugada)

$$K_a = \frac{[H_3O^+][I^-]}{[HI]} \gg 1 \qquad pK_a = -10$$

b) $H_2PO_4^- + H_2O \rightleftharpoons HPO_4^{2-} + H_3O^+$

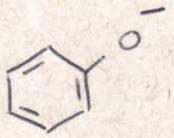
di-hidrogeno fosfato (ác) — hidrogeno fosfato (base conj.)

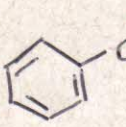
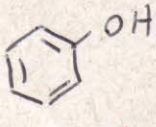
$$K_a = \frac{[H_3O^+][HPO_4^{2-}]}{[H_2PO_4^-]} \qquad pK_a = 7,2$$

2) c) $HPO_4^{2-} + H_2O \rightleftharpoons PO_4^{2-} + H_3O^+$

hidrogeno fosfato — fosfato (base conj)

$$K_a = \frac{[PO_4^{2-}][H_3O^+]}{[HPO_4^{2-}]} \qquad pK_a = 12,7$$

d) $C_6H_5O^-$  ion fenolato

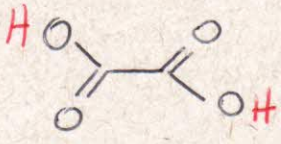
 $+ H_2O \rightleftharpoons$  $+ OH^-$

fenol

$$K_b = \frac{[\text{fenol}][OH^-]}{[\text{fenolato}]}, \qquad pK_a = 10,0$$

Assim: $pK_b = pK_w - pK_a = 14 - 10 = 4,0$

e) Ác. Oxálico (diácido)

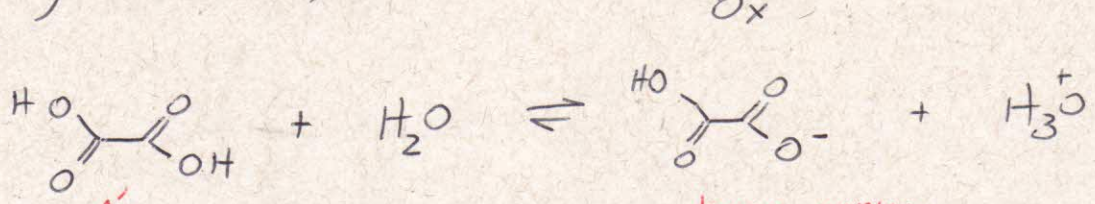


Ác. Ox

$pK_{a1} = 1,25$

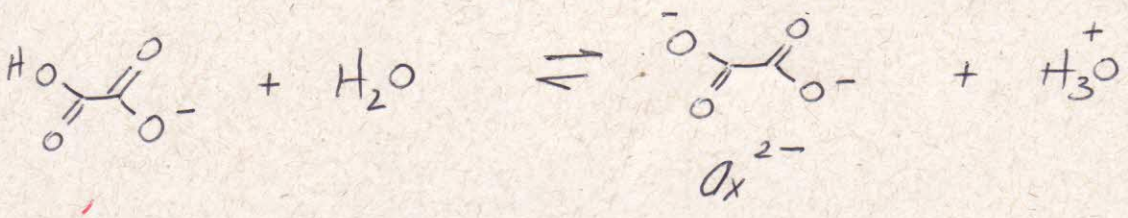
$pK_{a2} = 4,23$

2) e) CONTINUAÇÃO



Ác — base conj.

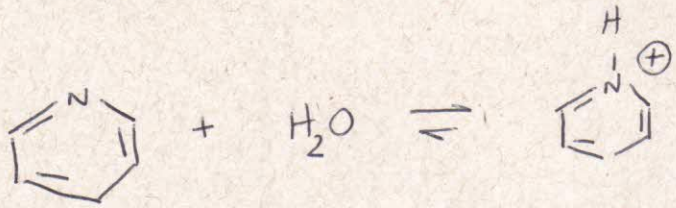
$$K_{a1} = \frac{[Ox^-][H_3O^+]}{[AcOx]} \Rightarrow pK_{a_1} = 1,25$$



Ác. — base conj

$$K_{a2} = \frac{[Ox^{2-}][H_3O]}{[Ox^-]} \Rightarrow pK_{a2} = 4,23$$

f) Piridina



base — ácido conj

pir — pir^+ (piridínio)

$$K_b = \frac{[pir^+][OH^-]}{[pir]} \quad ; \quad pK_a = 5,2$$

$$pK_b = pK_w - pK_a = 14 - 5,2 = 8,8$$

2)

g) Glicina $H_2\ddot{N} - CH_2 - COOH$

Zwitterion

$$H_3\overset{+}{N} - CH_2 - COOH \rightleftharpoons H_3\overset{+}{N} - CH_2 - COO^- \rightleftharpoons H_2N - CH_2 - COO^-$$

pK_{a_1} pK_{a_2}

2,3 9,6

(3) $K_a \cdot K_b = K_w$ então

$pK_a + pK_b = pK_w$

(4) Eq. de Henderson - Hasselbalch

$$pH = pK_a + \log \frac{[\text{base conj}]}{[\text{ácido}]}$$

(a) $\underset{\text{ácido}}{\underset{1,2\ mol/L}{H_2PO_4^-}} + H_2O \rightleftharpoons \underset{\text{base conj}}{\underset{0,6\ mol/L}{HPO_4^{2-}}} + H_3O^+ \quad pK_a = 7,2$

$$pH = 7,2 + \log\left(\frac{0,6}{1,2}\right)$$

$$pH = 7,2 + \log(1/2) = 7,2 - 0,3 = 6,9$$

(b) Ác. fórmico $H-C(=O)-OH + H_2O \rightleftharpoons \underset{\text{formiato (base conj.)}}{H-C(=O)-O^-} + H_3O^+$

$pK_a = 3,75$

$$pH = pK_a + \log \frac{[\text{Formiato}]}{[\text{ác. fórmico}]}$$

$$pH = 3,75 + \log \frac{(0,5/0,5)}{(0,25/0,5)} = 3,75 + 0,30$$

$pH = 4,05$

(4)

(c) 100 mL ácido acético + 20 mL acetato Na

1,0 mol/L 2,0 mol/L

$[\text{ác acético}] = 1,0 \text{ mol/L} \cdot \left(\frac{100}{120}\right) =$

$[\text{acetato}] = 2.0 \cdot \left(\frac{20}{120}\right) =$ } DILUIÇÃO !

$AcH + H_2O \rightleftharpoons Ac^- + H_3O^+ \qquad pK_a = 4,75$

$pH = pK_a + \log \frac{[\text{acetato}]}{[\text{Ac. Acético}]}$

$pH = 4,75 + \log \left(\frac{2. \times (2/12)}{10/12} \right)$

$pH = 4,75 + \log (4/10) = 4,75 - 0,4$

$pH = 4,35$

(d) $NH_3 + H_2O \rightleftharpoons \underbrace{NH_4^+}_{\text{ác. conj}} + OH^-$

base

$pH = pK_b + \log \frac{[\text{ac. conj}]}{[\text{base}]} \qquad pK_b = 4,75$

$pH = 4,75 + \log \frac{[NH_4^+]}{[NH_3]}$

$pH = pK_a = 4,75$

$[NH_4^+] = 0,3 \times \left(\frac{50}{200}\right)$

$[NH_3] = 0,1 \left(\frac{150}{200}\right)$

DILUIÇÃO !

$[NH_4^+]/[NH_3] \equiv 1,0$

(5) Eq. H. H.

$$pH = pK_a + \log \frac{[\text{base conj}]}{[\text{ácido}]}$$

Assim:

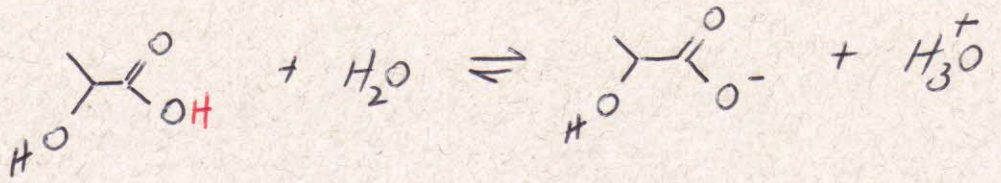
$$\log \frac{[\text{base conj}]}{[\text{ácido}]} = pH - pK_a = 0,5$$

$$\frac{[\text{base conj}]}{[\text{ácido}]} = 10^{0,5} \quad \text{ou} \quad 10^{-0,5}$$

p/ uma unidade $\frac{[\text{base conj}]}{[\text{ácido}]} = 10$

(6) para $pH = pK_a \iff [\text{base conj}] = [\text{ácido}]$

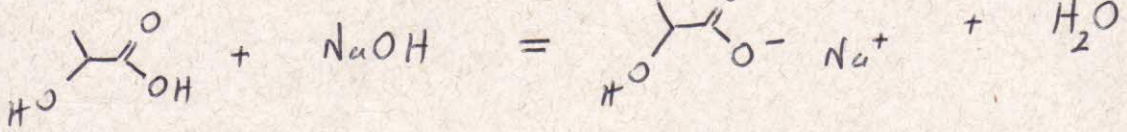
(7) Ac Láctico



ac. base conj

$pKa = 3,85$

titulação



ac. lactico Lactato de sódio

$[NaOH] = 0,05\ mol/L \qquad V_{titulado} = 20\ mL$

$n.^o\ mols\ NaOH = 0,05 \times 20 \times 10^{-3} = 10^{-3}\ mols$

$n.^o\ mol\ Ac\ Laichco = 10^{-3}\ mols \quad em \quad 50\ mL$

$[ac\ laictico]_{original} = \dfrac{10^{-3}\ mols}{5 \times 10^{-2}\ L} = 2,0 \times 10^{-2}\ mol/L$

(a) $2,0 \times 10^{-2}\ mol/L$

(b) calculo da conc de lactato de sódio $C_3H_5O_3Na$

$112\ g/mol \qquad [C_3H_5O_3Na] = \dfrac{2g/112\ g/mol}{0,1\ L} = 0,1786\ mol/L$

$pH = pKa + \log \dfrac{[lactato\ Na]}{[ac\ Laictico]} = 3,85 + \log\left(\dfrac{0,1786}{0,02}\right) = 4,8$

(8) Ác Bórico H_3BO_3

$$H_3BO_3 + H_2O \rightleftharpoons \underset{\text{BORATO}}{H_2BO_3^-} + H_3O^+ \quad pka = 9,23$$

$$pH = pka + \log \frac{[\text{BORATO}]}{[\text{Ác Bórico}]} = 8,3$$

Assim

$$\log \frac{[\text{BORATO}]}{[\text{Ác Bórico}]} = 8,30 - 9,23 = -0,93$$

ou $$\frac{[\text{BORATO}]}{[\text{Ác Bórico}]} = 10^{-0,93}$$

$$\frac{[\text{Ac Bórico}]}{[\text{BORATO}]} = 10^{0,93} = 8,5$$

(9) TEORIA LEWIS

$$Cu^{2+}_{aq} + 4\,\ddot{N}H_3 = [Cu(NH_3)_4]^{2+}$$

Ac LEWIS — BASE LEWIS — Reaçaõ de COMPLEXAÇÃO

CO_2 $\quad O=C=O + \ddot{O}H^- = HCO_3^-$

$\delta-\ \ \delta+\ \ \delta-$

A'CIDO LEWIS — BASE LEWIS — ADUTO

$BF_3 + \ddot{N}H_3 = F_3BNH_3$

AC. LEWIS — BASE LEWIS — ADUTO