

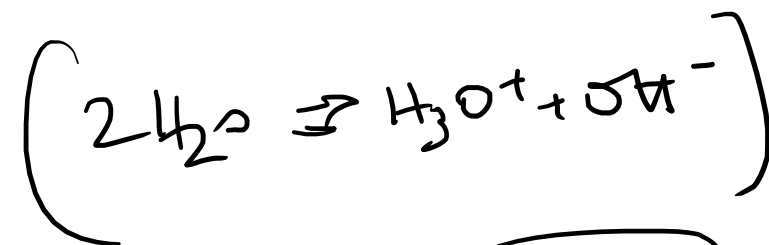
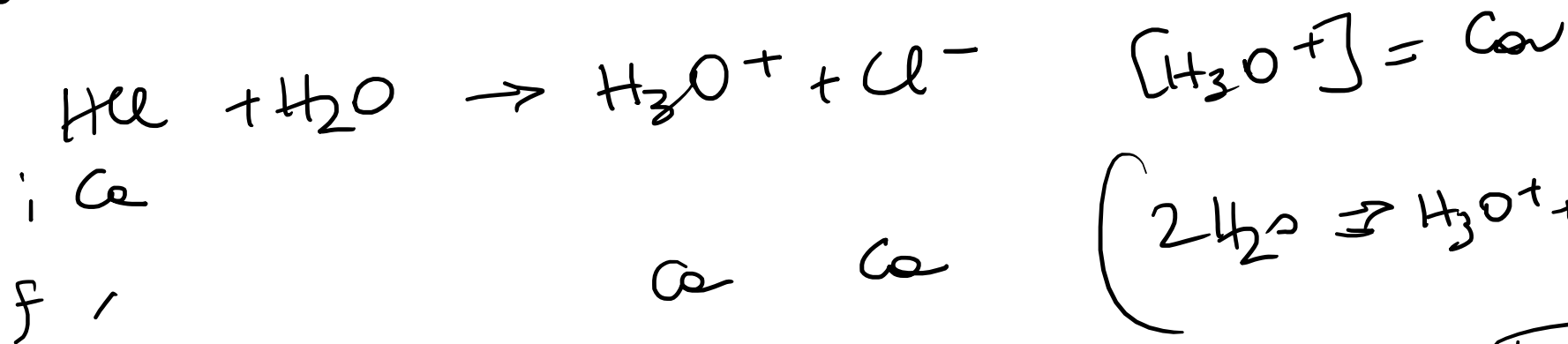
Lezione 16: equilibri acido base ed esercizi

Ex 1

32.8 mL HCl 37% m/m $d = 1.190 \text{ g/mL} \rightarrow 1 \text{ L H}_2\text{O}$ pH = ?

$$32.8 \text{ mL} \cdot 1.190 \text{ g/mL} = 39.0 \text{ g sol. HCl 37\%}$$

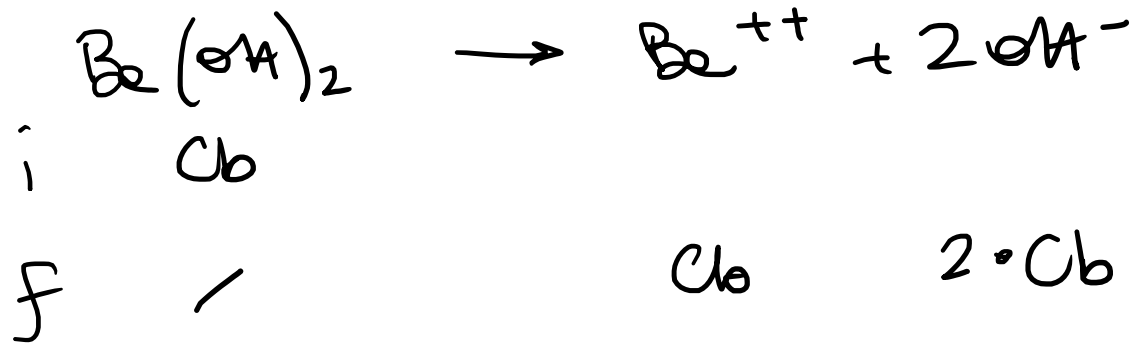
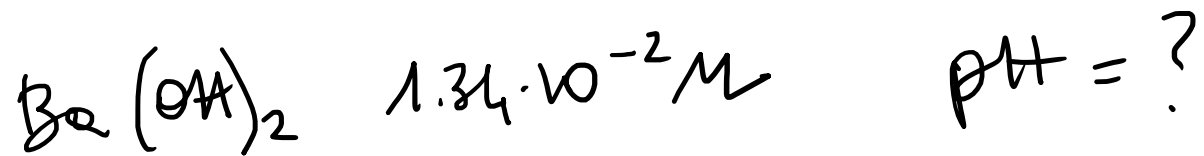
$$39.0 \text{ g} \cdot 0.37 = 14.4 \text{ g HCl pure}$$



$$C_e = \frac{14.4 \text{ g} / 36.5 \text{ g/mol}}{1 \text{ L}} = 0.396 \text{ M} = [\text{H}_3\text{O}^+] \quad \boxed{\text{pH} = -\log(0.396) = 0.402}$$

①

Ex 2



$$[\text{OH}^-] = 2 \cdot \text{Cb} = 2 \cdot 1.34 \cdot 10^{-2} \frac{\text{mol}}{\text{L}} = 2.68 \cdot 10^{-2} \text{ M}$$

~~pOH = 1.57~~

$\text{pH} = 14 - 1.87 = 12.43$

②

EX3

$V_{mL} = ?$

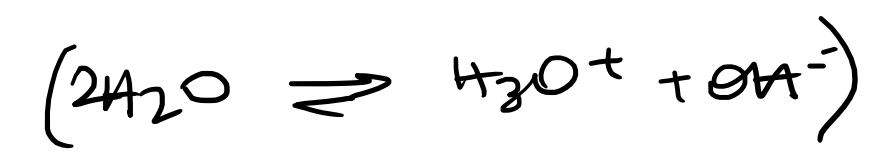
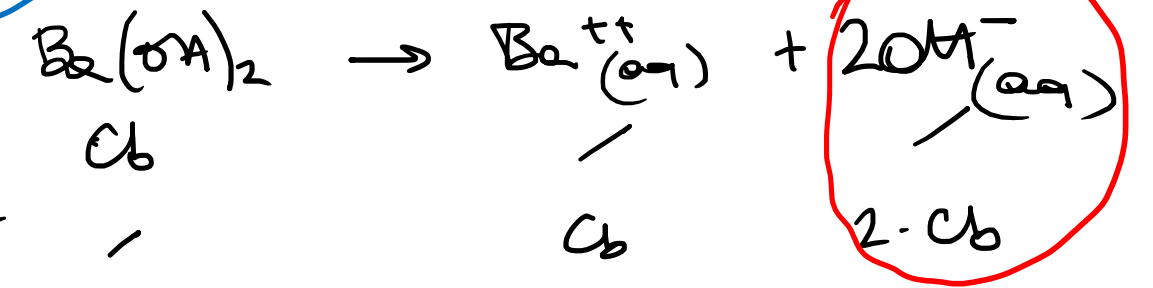
$Ba(OH)_2$

$4.52 \cdot 10^{-3} M C_{bi}$

$100 mL$
 V_f

$pH = 10.25$ } C_{bf}

i
 C_b
 f



$$[H_3O^+] = 10^{-10.25} = 5.62 \cdot 10^{-11} M \Rightarrow [OH^-]_f = \frac{10^{-14}}{5.62 \cdot 10^{-11}} = 1.78 \cdot 10^{-4} M$$

$$[OH^-] = 1.78 \cdot 10^{-4} M = 2 \cdot C_{bf} \Rightarrow C_{bf} = 8.9 \cdot 10^{-5} M$$

$$C_{bi} V_i = C_{bf} \cdot V_f \Rightarrow 4.52 \cdot 10^{-3} M \cdot V_i = 8.9 \cdot 10^{-5} \cdot 0.100 L$$

$$V_i = 1.97 \cdot 10^{-3} L \Rightarrow 1.97 mL$$

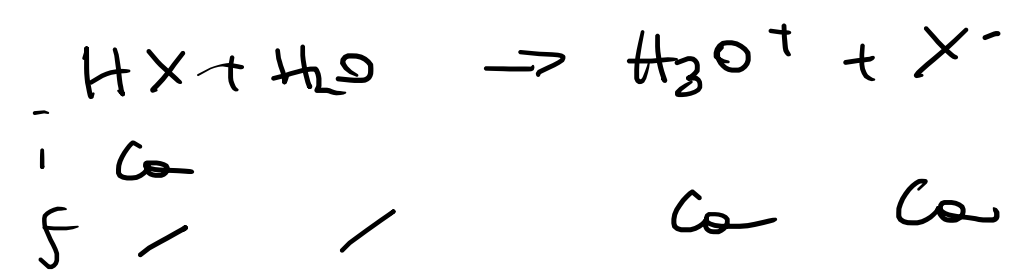
(2)

ex 4

$pH_f = ?$



i) 1L HX $pK_a = 4$ + ii) 1L HX $pK_a = 3.2$



$$[\text{H}_3\text{O}^+]_f = [\text{H}_3\text{O}^+]_i + [\text{H}_3\text{O}^+]_{ii} \left(+ [\text{H}_3\text{O}^+]_{KW} \right)$$

i) $[\text{H}_3\text{O}^+] = 10^{-4} \text{ M}$

ii) $[\text{H}_3\text{O}^+] = 10^{-3.2} = 6.3 \cdot 10^{-4} \text{ M}$

$$[\text{H}_3\text{O}^+]_f = \frac{10^{-4} \text{ mol} + 6.3 \cdot 10^{-4} \text{ mol}}{2 \text{ L}} = 3.65 \cdot 10^{-4} \text{ M}$$

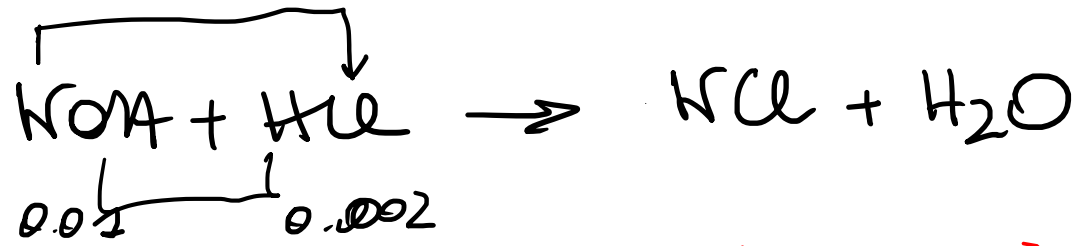
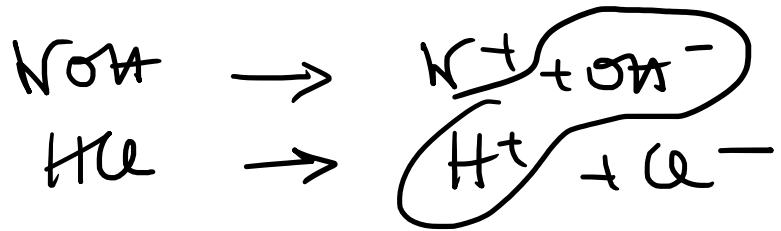
$\Rightarrow \boxed{pH = 3.44}$

(4)

EX5

pH = ?

500 mL KOA 0.02 M
20 mL HCl 0.1 M



i	0.01	0.002		
f	0.01 - 0.002	/	0.002	0.002

mol KOA = 0.500 L \cdot 0.02 $\frac{\text{mol}}{\text{L}}$ = 0.01 mol

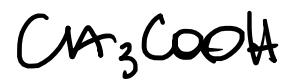
mol HCl = 0.020 L \cdot 0.1 $\frac{\text{mol}}{\text{L}}$ = 0.002 mol

$[\text{OA}^-] = 0.01 - 0.002 = \frac{0.008 \text{ mol}}{0.520 \text{ L}} = 0.01538 \text{ M} \Rightarrow$

pOHA = 1.81
pH = 12.19

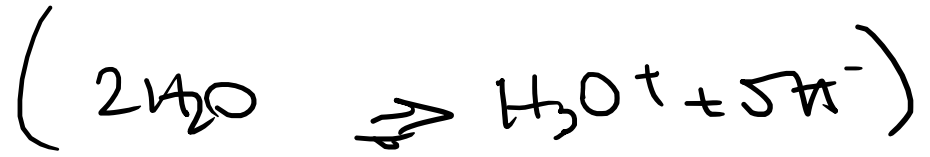
(5)

Ex 6



ΔM

$K_a = 1.8 \cdot 10^{-5}$



pH = ?

\rightleftharpoons
 C_a



$C_a \gg K_a$
(3 ordres)

i C_a

e $C_a - x$

\times

\times

$$K_a = \frac{[\text{CH}_3\text{COO}^-][\text{H}_3\text{O}^+]}{[\text{CH}_3\text{COOH}]} = \frac{x^2}{C_a - x} = \frac{x^2}{1} = \frac{[\text{H}_3\text{O}^+]^2}{C_a}$$

~~$C_a - x$~~

raisonnable

$\Rightarrow [\text{H}_3\text{O}^+] = \sqrt{K_a \cdot C_a} = \sqrt{1\text{M} \cdot 1.8 \cdot 10^{-5}} = 4.24 \cdot 10^{-3}\text{M}$

$\text{pH} = 2.37$

⑥

Ex 7



i Ca

e $\text{Ca} - x$

x x

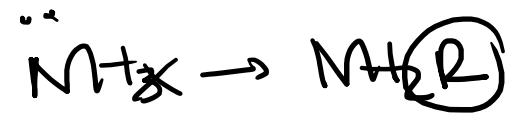
$$K_a = \frac{x^2}{\text{Ca} - x} = \frac{x^2}{10^{-3} - x} = 1.8 \cdot 10^{-5} \rightarrow \text{Non } \bar{e} \text{ Approximable}$$

$$x = 1.254 \cdot 10^{-4} \text{ M} = [\text{H}_3\text{O}^+] \Rightarrow$$

$$\boxed{\text{pH} = 3.90}$$

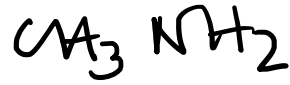
⑦

Ex 8



pH = ?

1M



$$K_b = 3.7 \cdot 10^{-4}$$



i C_b

e C_b - x

x

x

C_b >> K_b

$$K_b = \frac{[\text{CH}_3\text{NH}_3^+][\text{OH}^-]}{[\text{CH}_3\text{NH}_2]} = \frac{x^2}{C_b - x} = \frac{[\text{OH}^-]^2}{C_b - [\text{OH}^-]} = \frac{[\text{OH}^-]^2}{C_b} = K_b$$

$$\rightarrow [\text{OH}^-] = \sqrt{K_b \cdot C_b} = \sqrt{1\text{M} \cdot 3.7 \cdot 10^{-4}} = 1.92 \cdot 10^{-2}\text{M}$$

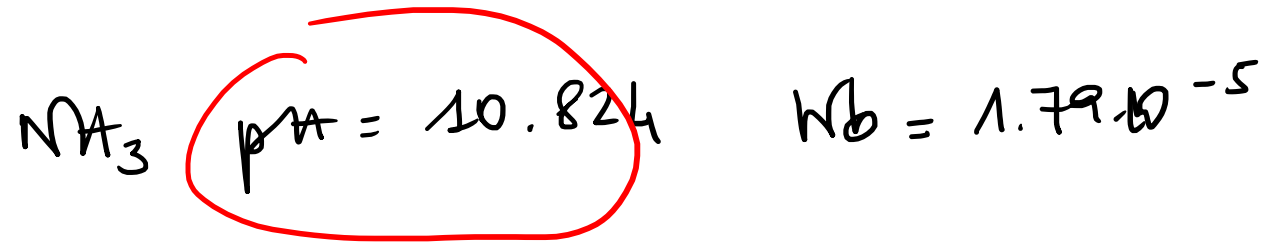
pOH = 1.72

$$\text{pH} = 14 - 1.72 = 12.28$$

@

Ex 9

$C_b = ?$



i	C_b			
e	$C_b - x$	x	x	

$x = [\text{OH}^-] = \frac{10^{-14}}{10^{-10.824}} = 6.67 \cdot 10^{-4} \text{ M}$

$K_b = \frac{x^2}{C_b - x} = 1.79 \cdot 10^{-5} \Rightarrow \frac{(6.67 \cdot 10^{-4})^2}{C_b - 6.67 \cdot 10^{-4}} = 1.79 \cdot 10^{-5}$

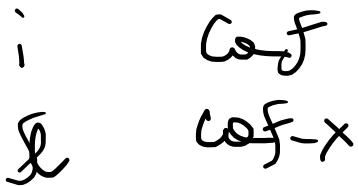
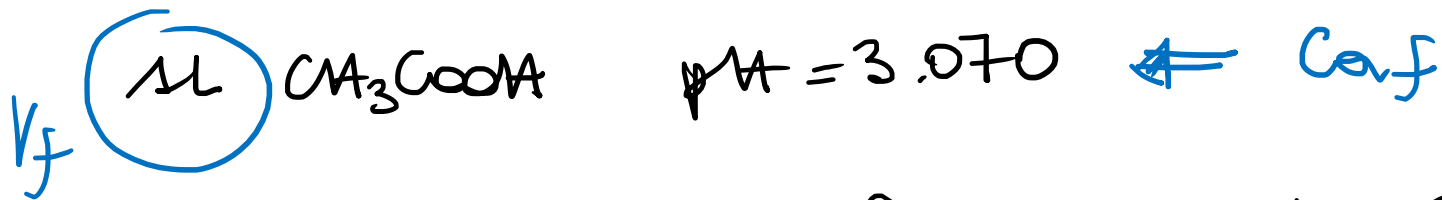
$C_b = 2.55 \cdot 10^{-2} \text{ M}$

Ex 10

$V_{i, \text{mL}} = ?$



$C_{a_i} V_i = C_{a_f} V_f$



$[\text{H}_3\text{O}^+]_f = 10^{-3.070} = 8.51 \cdot 10^{-4} \text{ M} = x$

$K_a = 1.76 \cdot 10^{-5} = \frac{(8.51 \cdot 10^{-4})^2}{C_{a_f} - 8.51 \cdot 10^{-4}} = \frac{x^2}{C_{a_f} - x}$

$\Rightarrow C_{a_f} = 4.2 \cdot 10^{-2} \text{ M}$

$$C_i V_i = C_f \cdot V_f$$

$$8M \cdot V_i = 4.2 \cdot 10^{-2} M \cdot 1L$$

$$V_i = 5.25 \cdot 10^{-3} L \Rightarrow$$

5.25 mL CH_3COOH
8M

(11)

EXM
0.544 M

C_{aj}

HA $pK_A = 2.85$

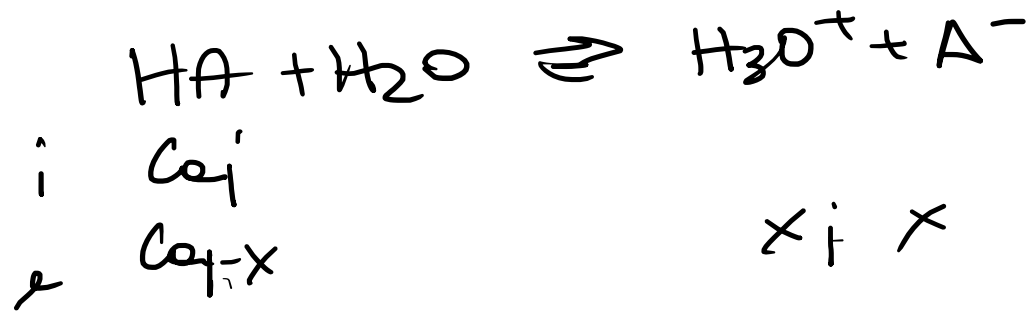
C_{aj}

$V_{H_2O} = ?$

+ 75 mL V_i

$\Rightarrow pK_A = 3.00$

$K_a HA = ?$



$$[H_3O^+]_i = x = 10^{-2.85} = 1.4 \cdot 10^{-3} M$$

$$K_a = \frac{x^2}{C_{aj} - x} = \frac{(1.4 \cdot 10^{-3} M)^2}{0.544 - 1.4 \cdot 10^{-3}} = 3.6 \cdot 10^{-6}$$

(12)



i C_{af}

e $C_{\text{af}} - x$

x x

$$K_a = 3.6 \cdot 10^{-6}$$

$$x = [\text{H}_3\text{O}^+]_{\text{f}} = 10^{-3} \text{ M}$$

$$K_a = 3.6 \cdot 10^{-6} = \frac{x^2}{C_{\text{af}} - x} = \frac{(10^{-3})^2}{C_{\text{af}} - 10^{-3}} \Rightarrow C_{\text{af}} = 2.8 \cdot 10^{-1} \text{ M}$$

$$C_{\text{a}} \cdot V_{\text{i}} = C_{\text{af}} \cdot V_{\text{f}} =$$

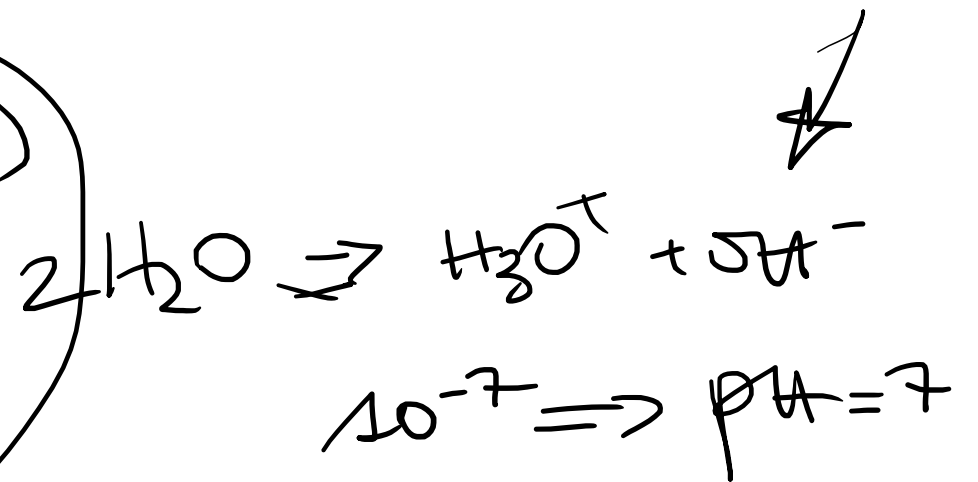
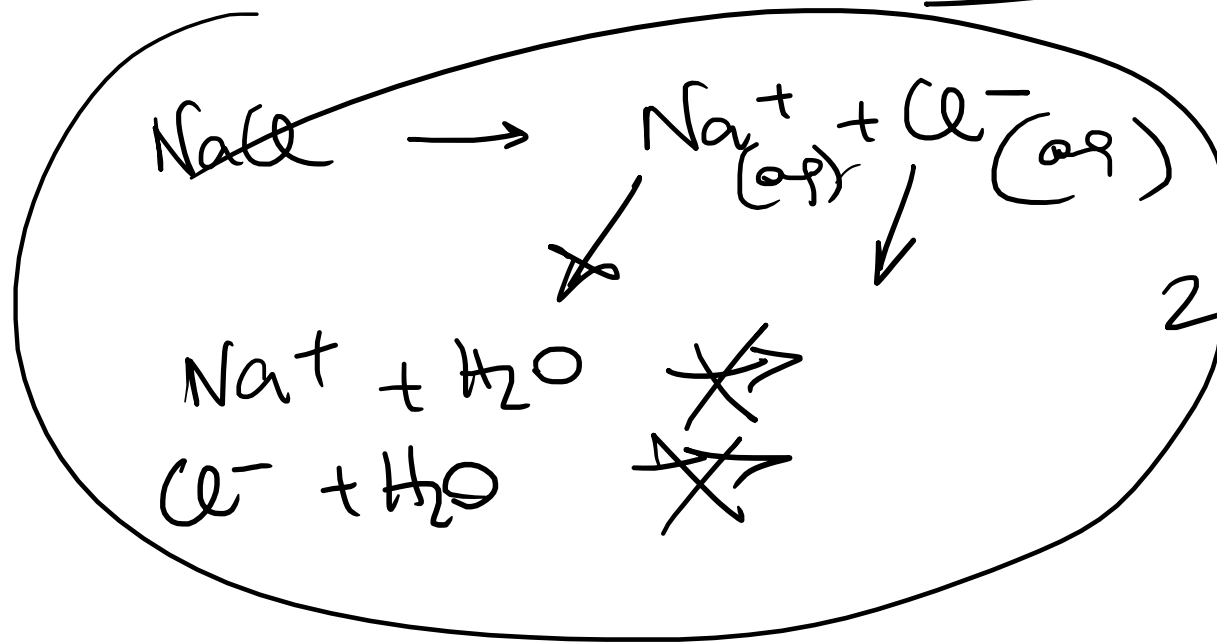
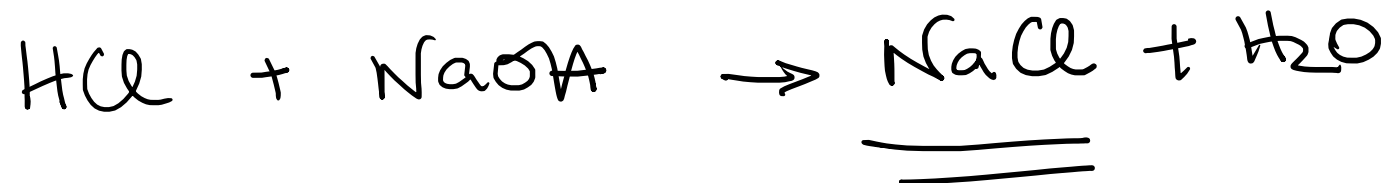
$$0.544 \text{ M} \cdot 0.075 \text{ L} = 2.8 \cdot 10^{-1} \text{ M} \cdot V_{\text{f}}$$

$$V_{\text{f}} = 0.146 \text{ L}$$

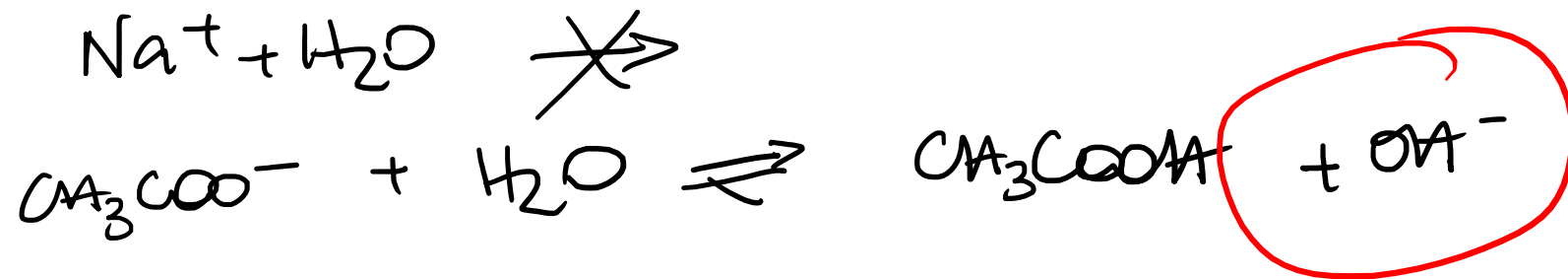
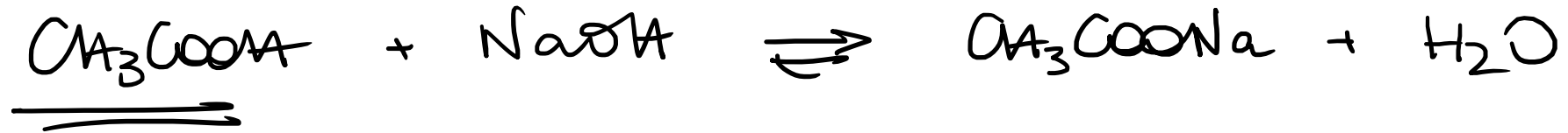
$$V_{\text{H}_2\text{O}} = 0.146 \text{ L} - 0.075 \text{ L} = 0.071 \text{ L}$$

12

Acidi forti + basi forti \rightarrow SALE NEUTRO

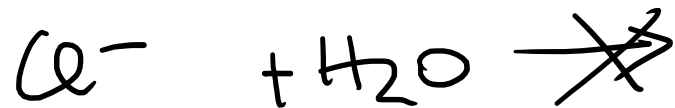
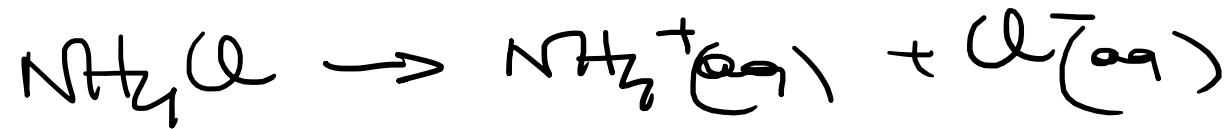
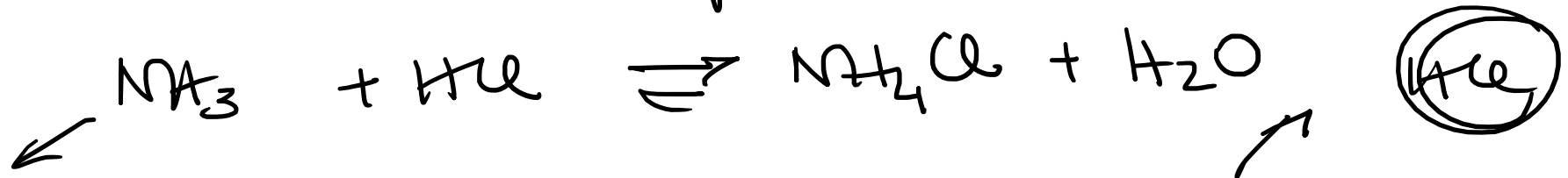


Acido débil + base fuerte \rightarrow SALE BASICO



base debòle + acido forte \rightarrow SALE ACIDO

$$K_b = 18 \cdot 10^{-5}$$



base debòle + acido debòle \Rightarrow $\text{CH}_3\text{COONH}_4$
Na Kb