

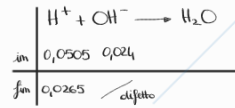
# Esercizi Mescolamenti

1) ? pH  $V_B = 25 \text{ mL NaOH } 0,120 \text{ mol/L}$   
 $V_A = 100 \text{ mL HCl } \text{pH} = 1,2$

$$C_B = \frac{0,120 \cdot 25}{125} = 0,024 \text{ M}$$

$$[H^+] = 10^{-1,2} = 0,0631 \text{ M}$$

$$C_A = \frac{0,0631 \cdot 100}{125} = 0,0505 \text{ M}$$



$$\text{pH} = -\log(0,0265) = 1,58$$

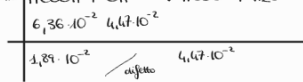
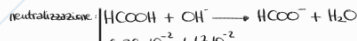
## REGOLA (FORTE - DEBILE)

- $C_{DEB} > C_{FORTE} \rightarrow$  TAMPONE CASO A
- $C_D = C_F \rightarrow$  TITOLAZIONE CASO B
- $C_D < C_F \rightarrow$  pH DELLA FORTE CASO C

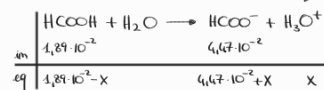
2) pH ?  $20 \text{ mL NaOH } 0,128 \text{ M}$   
 $35 \text{ mL HCOOH } 0,100 \text{ M}$   
 $K_a = 1,8 \cdot 10^{-4}$

$$C_{FA} = \frac{0,100 \cdot 35}{55} = 6,36 \cdot 10^{-2} \text{ M}$$

$$C_{FB} = \frac{0,128 \cdot 20}{55} = 4,67 \cdot 10^{-2} \text{ M}$$



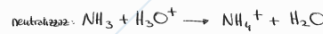
SOLUZIONE TAMPONE



$$\frac{(4,67 \cdot 10^{-2} + X) X}{1,69 \cdot 10^{-2} - X} = 1,8 \cdot 10^{-4}$$

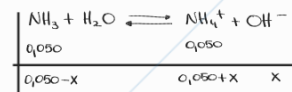
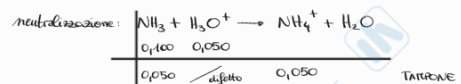
$$X = 7,6 \cdot 10^{-5} \rightarrow \text{pH} = 4,12 \text{ CASO A!}$$

3) base debole  $NH_3$   
 acido forte  $HCl$   
 $V_A = 50 \text{ mL HCl } 0,100 \text{ M}$   
 $V_B = 50 \text{ mL } NH_3 0,200 \text{ M}$   
 $K_b = 1,85 \cdot 10^{-5}$   
 ? pH



$$[H_3O^+] = \frac{0,100 \cdot 50}{100} = 0,050 \text{ M}$$

$$[NH_3] = \frac{0,200 \cdot 50}{100} = 0,100 \text{ M}$$



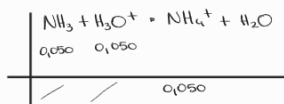
$$1,85 \cdot 10^{-5} = \frac{(0,050 + X) X}{0,050 - X}$$

$$X = 1,85 \cdot 10^{-5}$$

$$\text{pOH} = 4,73 \quad \text{pH} = 9,27 \text{ CASO A!}$$

4) ? pH  $50 \text{ mL HCl } 0,100 \text{ M}$   
 $50 \text{ mL } NH_3 0,100 \text{ M}$

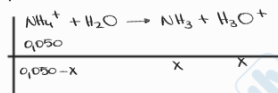
NEUTRALIZZAZIONE:



ANALOGO AL PUNTO EQUIVALENTE NELLA TITOLAZIONE

$$C_{NH_4} = \frac{0,100 \cdot 50}{100} = 0,050 = C_{NH_3}$$

equilibrio in acqua:



$$K_a = \frac{K_w}{K_b} = 5,4 \cdot 10^{-10} = \frac{X^2}{0,050 - X}$$

$$X = 5,20 \cdot 10^{-6} \quad \text{pH} = 5,28 \text{ CASO B!}$$

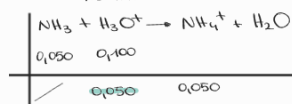
5) CASO C!

? pH  $50 \text{ mL HCl } 0,200 \text{ M}$   
 $50 \text{ mL } NH_3 0,100 \text{ M}$

$$C_{HCl} = \frac{0,200 \cdot 50}{100} = 0,100 \text{ M}$$

$$C_{NH_3} = \frac{0,100 \cdot 50}{100} = 0,050 \text{ M}$$

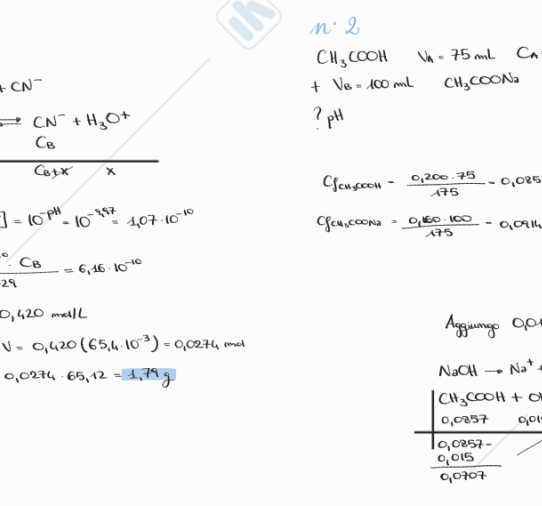
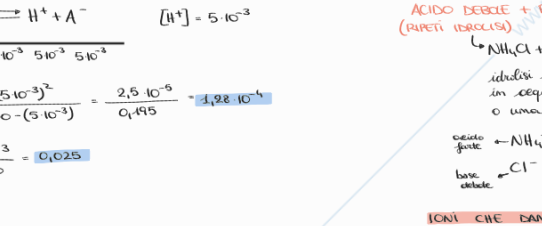
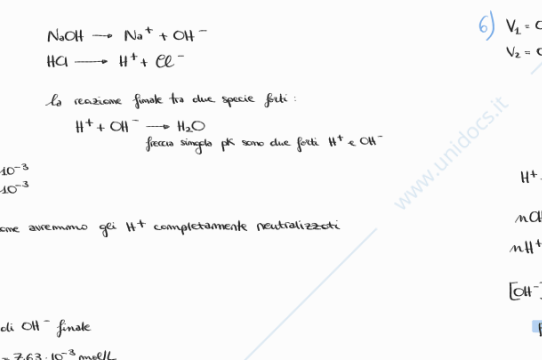
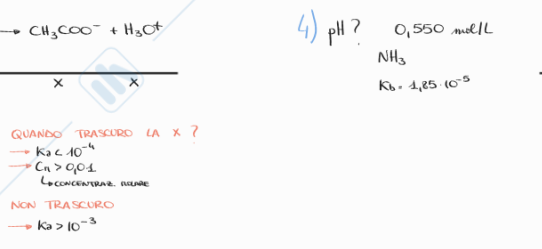
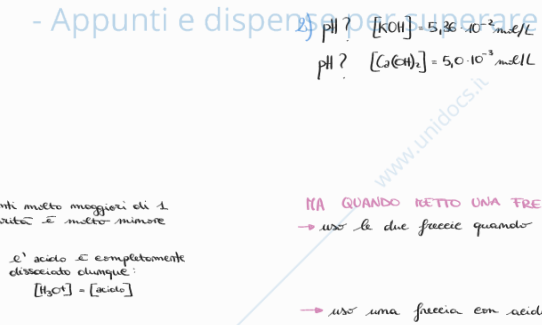
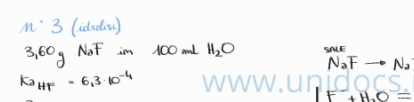
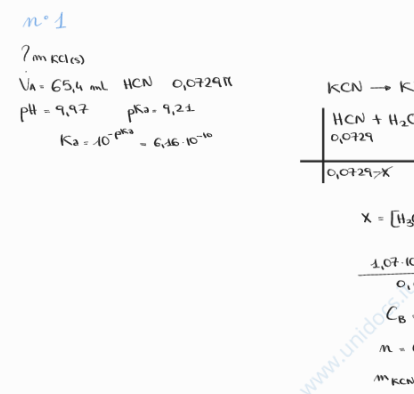
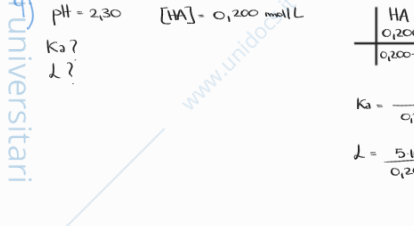
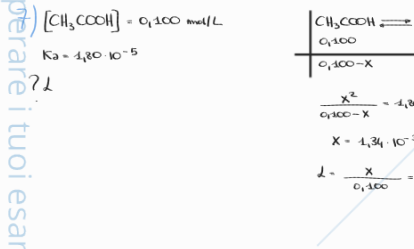
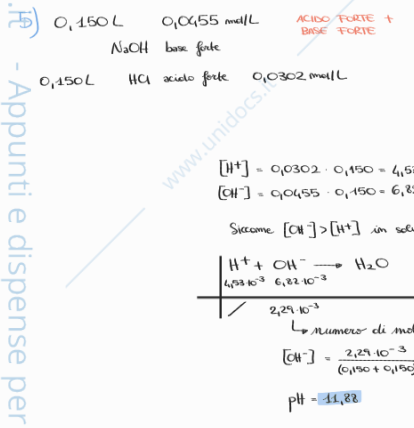
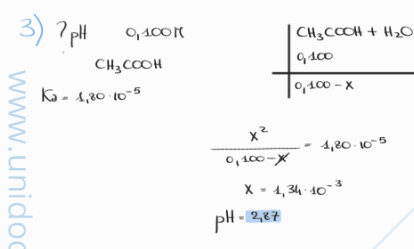
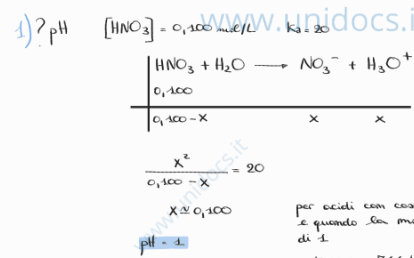
NEUTRALIZAZIONE:



← eccesso di SPECIE FORTE!

$$\text{pH} = -\log(0,050) = 1,30$$

NaOH = base forte  
 HCl = acido forte  
 $NH_3$  = base debole  
 $H_3C-COOH$  = acido debole



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$$M_{NaF} = \frac{360}{41,44} = 0,857 \text{ mol}$$

$$C_m = \frac{m}{V} = \frac{0,857}{1,00} = 0,857 \text{ N}$$

$$\frac{x^2}{0,857 - x} = \frac{K_w}{K_a} = \frac{10^{-14}}{6,3 \cdot 10^{-4}} = 1,6 \cdot 10^{-11}$$

$$x = \sqrt{0,857 \cdot (1,6 \cdot 10^{-11})} = 3,7 \cdot 10^{-6}$$

$$pOH = 5,43$$

$$pH = 14 - 5,43 = 8,57$$

## PROPRIETA' COLLEGATIVE!

1)  $P_{H_2O}^0 = 17,5 \text{ torr}$   $T = 20^\circ C$

?P  $0,55 \text{ N}$   $BaCl_2$   $\rho_{BaCl_2} = 208,25 \text{ g/mol}$   
 $d = 1,16 \text{ g/cm}^3$

Tensione vapore  
 $P = P_{solvente}^0 \cdot X_{solvente}$

Abbassamento tensione di vapore  
 $\Delta P = P^0 - P = P_{solvente}^0 \cdot X_{soluto}$

$V = 1 \text{ L}$

$$\begin{cases} 0,55 \text{ mol } BaCl_2 \\ 1160 \text{ g} = m_{H_2O} + m_{BaCl_2} \end{cases}$$

$$m_{BaCl_2} = 0,55 \cdot 208,25 = 114,5 \text{ g}$$

$$m_{H_2O} = 1160 - 114,5 = 1045,5 \text{ g}$$

$$m_{H_2O} = \frac{1045,5}{18,015} = 58 \text{ mol}$$

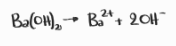
$BaCl_2$  è una specie ionica:  $Ba^{2+} + 2Cl^- \Rightarrow i = 3$

$$X_{H_2O} = \frac{58}{(58 + 0,55) \cdot 3} = 0,972$$

$$P = 17,5 \cdot 0,972 = 17,0 \text{ torr}$$

2) ?% peso  $Ba(OH)_2$

$T_{eb} = 101,05^\circ C$   $K_{eb} = 0,514 \text{ K} \cdot \text{kg/mol}$



$$\Delta T_{eb} = T_{eb} - T_{eb}^0 = K_{eb} \cdot m \cdot i$$

$$\Delta T_{eb} = 101,05 - 100 = 1,05$$

$$1,05 = 0,514 \cdot m \cdot 3$$

$$m = 0,681 \text{ mol/kg}$$

$$0,681 \text{ mol } Ba(OH)_2 \text{ in } 1000 \text{ g } H_2O$$

$$m_{Ba(OH)_2} = 0,681 \cdot 171,354 = 117 \text{ g}$$

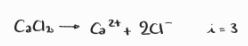
$$\% \text{ peso} = \frac{m_{soluto}}{m_{soluzione}} \cdot 100$$

$$\% \text{ peso} = \frac{117}{1000 + 117} \cdot 100 = 10,5\%$$

3)  $CaCl_2$   $1,31 \text{ mol/L} \rightarrow 1,31 \text{ mol in } 1 \text{ L}$

$d = 1,178 \text{ g/cm}^3$   $K_{cr} = 1,86^\circ C/m$

? $T_{cr}$



$$\Delta T_{cr} = K_{cr} \cdot m \cdot i$$

$$T_{cr}^0 - T_{cr} = K_{cr} \cdot m \cdot i \rightarrow -T_{cr} - 1,86 \cdot 1,27 \cdot 3 = 7,8^\circ C \Rightarrow T_{cr} = -7,8^\circ C$$

$$m_{CaCl_2} = m \cdot \rho_{sol} = 1,31 \cdot 110,98 = 145,4 \text{ g}$$

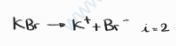
$$m_{H_2O} = 1178 - 145 = 1033 \text{ g}$$

$$m_{soluz} = d \cdot V = 1,178 \cdot 1000 = 1178 \text{ g}$$

$$C_m = \frac{1,31 \text{ mol}}{1,033 \text{ kg}} = 1,27 \text{ mol/kg}$$

4) ? $\Pi$   $T = 22^\circ C \rightarrow 301 \text{ K}$

$KBr$   $6,37\% \text{ peso}$   $d = 1,017 \text{ g/mL}$



$$\Pi = C_{eff} \cdot R \cdot T \cdot i \quad \Pi = 0,560 \cdot 0,0821 \cdot 301 \cdot 2 = 27,7 \text{ atm}$$

$$m_{soluzione} = 1017 \text{ g}$$

$$m_{soluto} = m_{soluzione} \cdot \frac{\%}{100} = 66,7 \text{ g}$$

$$n_{KBr} = \frac{66,7}{119} = 0,560 \text{ mol}$$

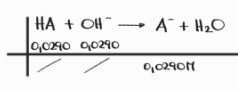
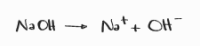
$$M = \frac{m}{V} = \frac{0,560}{1} = 0,560 \text{ N}$$

## 5) TITOLAZIONE

$21,50 \text{ mL}$   $HA$   $0,0470 \text{ N}$   
 $K_a = 5,23 \cdot 10^{-7}$   $\text{Titranti con}$

$NaOH$   $0,0759 \text{ N}$

?pH al p.e.

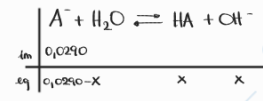


al p.e.  $n_A = n_B \rightarrow C_A V_A = C_B V_B$

$$V_B = \frac{C_A V_A}{C_B} = \frac{0,0470 \cdot 21,50}{0,0759} = 13,31 \text{ mL}$$

$$V_{tot} = 21,50 + 13,31 = 34,81 \text{ mL}$$

$$C_A - C_B = \frac{0,0470 \cdot 21,50}{34,81} = 0,290 \text{ N}$$



$$\frac{x^2}{0,0290 - x} = \frac{1 \cdot 10^{-14}}{5,23 \cdot 10^{-7}} = 1,91 \cdot 10^{-8}$$

$$x = 2,35 \cdot 10^{-5}$$

$$pOH = 4,63 \rightarrow pH = 9,37$$



