



Corso Luigi Einaudi, 55 - Torino

Appunti universitari

Tesi di laurea

Cartoleria e cancelleria

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Rilegature

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A P P U N T I

STUDENTE: Lo Curzio

MATERIA: Chimica Eserc.

Prof. Penazzi

Il presente lavoro nasce dall'impegno dell'autore ed è distribuito in accordo con il Centro Appunti.

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**ATTENZIONE: QUESTI APPUNTI SONO FATTI DA STUDENTIE NON SONO STATI VISIONATI DAL DOCENTE.
IL NOME DEL PROFESSORE, SERVE SOLO PER IDENTIFICARE IL CORSO.**

STECCHIOMETRIA E REAZIONI

① $n = \frac{m}{PM} = \frac{35}{207,2} = 0,17$ (Pb) $N_{\text{atomi}} = N_{\text{Av}} \cdot n =$
 $= 0,17 \cdot 6,022 \cdot 10^{23} = 1 \cdot 10^{23}$ atomi

② $n = \frac{m}{PM} \rightarrow m = n \cdot PM = 2,55 \cdot 46 = 117,3$

③ $N_{\text{atomi}} = N_{\text{Av}} \cdot n \rightarrow n = \frac{N_{\text{atomi}}}{N_{\text{Av}}} = \frac{8 \cdot 10^{20}}{6,022 \cdot 10^{23}} = 1,328 \cdot 10^{-3}$
 $m = n \cdot PM = 1,328 \cdot 10^{-3} \cdot 28 = 37,19 \cdot 10^{-3} = 0,037 \approx 0,04 \text{ g}$

④ $\text{Al}_2(\text{SO}_4)_3$ solfato di alluminio

$\% \text{ Al} = \frac{PA}{PM} \cdot 100 = \frac{27}{123,05} \cdot 100 = 22\%$
percent. in peso.

$\% \text{ S} = \frac{32}{123} \cdot 100 = 26\%$

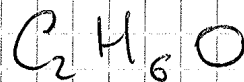
$\% \text{ O}_4 = \frac{64}{123} \cdot 100 = 52\%$

⑤ $\text{C} = 52,2\% \rightarrow 52,2 \text{ g} \quad n = \frac{52,2}{12} = 4,35 \text{ mol}$
 $\text{H} = 13\% \rightarrow 13 \text{ g} \quad n = 13 \text{ mol}$
 $\text{O} = 34,8\% \rightarrow 34,8 \text{ g} \quad n = 2,12 \text{ mol}$

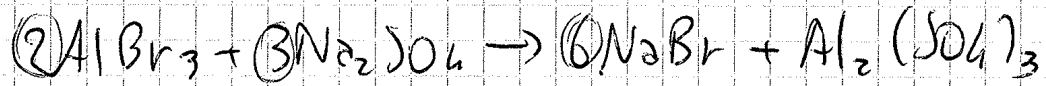
$\frac{4,35}{2,12} = 2,05 \approx 2$

$\frac{2,12}{2,12} = 1$

$\frac{13}{2,12} \approx 6,13 \approx 6$



(13)



$$M_{\text{NaBr}} = \frac{259}{203} = 1,5$$

$$6:1 = 1,5 : M_{\text{Al}_2(\text{SO}_4)_3}$$

$$M_{\text{Al}_2(\text{SO}_4)_3} = \frac{1 \cdot 1,5}{6} = 0,25$$

$$m = 0,25 (342) = 85,5$$

$$M_{\text{AlBr}_3} = 0,25 \cdot (27 + 180 + 81) = 133,5 \text{ mol}$$

$$M_{\text{Na}_2\text{SO}_4} = 0,25 (46 + 32 + 64) = 35,5 \text{ mol}$$

(11)



$$\text{PM} = 63,5 + 32 + 64 + 10 + 80 = 249,5$$

$$\% \text{Cu} = \frac{63,5}{249,5} \cdot 100 = 25,44\%$$

$$\% \text{S} = \frac{32}{249,5} \cdot 100 = 12,81\%$$

$$\% \text{O} = \frac{96}{249,5} \cdot 100 = 38,47\%$$

$$\% \text{H} = \frac{9}{249,5} \cdot 100 = 3,61\%$$

GAS

① $V = 55 \text{ ml} = 0,05 \text{ l}$
 $P_1 = 0,95 \text{ atm}$
 $P_2 = 1,48 \text{ atm}$

$P_1 V_1 = P_2 V_2$ legge di Boyle

$V_2 = \frac{P_1 V_1}{P_2} = \frac{0,95 \cdot 0,05 \text{ l}}{1,48 \text{ atm}} = 32 \cdot 10^{-3} \text{ l}$

② $V = 80 \text{ ml} = 0,08 \text{ l}$ $P = \text{cost.}$
 $t_1 = 15^\circ\text{C}$ $t_2 = 60^\circ\text{C}$

$V = V_0 (1 + \alpha \Delta T) = 0,08 \left(1 + \frac{1}{273} \cdot 45 \right) = 82,8 \cdot 10^{-3} \text{ l}$
 legge di Gay-Lussac

③ $T_1 = 10^\circ\text{C} = 283 \text{ K}$
 $P = 745 \text{ Torr} = 1 \text{ atm}$
 $V = 2,85 \text{ l}$

$T_2 = 25^\circ\text{C} = 298 \text{ K}$
 $P_2 = 1,25 \text{ atm}$
 $V = ?$

$P_1 V_1 = n R T_1$

$P_2 V_2 = n R T_2$

$n = \frac{P_1 V_1}{R T_1} = \frac{2,85}{283 \cdot 0,082} = 0,122$

$V_2 = \frac{n R T_2}{P_2}$

$= \frac{0,122 \cdot 0,082 \cdot 298}{1,25} = 2,4 \text{ l}$

④ $V = 20 \text{ l}$
 $P = 140 \text{ atm}$
 $T = 293 \text{ K}$

$m = \frac{140 \cdot 20}{293 \cdot 0,082} = 116,5 \text{ g}$

$m = n \cdot M = 116,4 \cdot 32 = 3720$

↓
 l'ossigeno è solfame
 di O_2

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$$p = 0,98 \text{ atm}$$

$$m_1 = 8 \text{ g } O_2$$

$$m_2 = 6 \text{ g } CO_2$$

~~$$P_i = \frac{P \cdot m_i}{m_1 + m_2} = 0,98$$~~

$$m_1 = \frac{8}{32} = 0,25 \quad m_2 = \frac{6}{44} = 0,13$$

$$P_1 = \frac{P \cdot m_1}{m_1 + m_2} = \frac{0,98 \cdot 0,25}{0,38} = 0,64 \text{ atm}$$

$$P_2 = \frac{P \cdot m_2}{m_1 + m_2} = \frac{0,98 \cdot 0,13}{0,38} = 0,33 \text{ atm}$$

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$$10\% O_2 = 10 \text{ g}$$

$$64\% N_2 = 64 \text{ g}$$

$$26\% CO = 26 \text{ g}$$

$$PM_{O_2} = 32 \quad m = 0,31$$

$$PM_{N_2} = 28 \quad m = 2,29$$

$$PM_{CO} = 28 \quad m = 0,93$$

$$m_{TOT} = 3,53$$

$$P_{TOT} = 1,11 \text{ atm}$$

$$X_i = \frac{m}{m_{TOT}} \left\{ \begin{array}{l} X_1 = 0,088 \\ X_2 = 0,649 \\ X_3 = 0,263 \end{array} \right.$$

$$P_1 = X_1 \cdot P_{TOT} = 1,11 \cdot 0,088 = 0,097 \text{ atm}$$

$$P_2 = // = 0,72 \text{ atm}$$

$$P_3 = // = 0,29 \text{ atm}$$

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$$d = \frac{PM \cdot P}{RT}$$

$$P = \frac{dRT}{PM} = \frac{1,86 \cdot 0,0821 \cdot 293}{35,45} =$$

$$= 1,26 \text{ atm}$$

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84,5% CO_2
15,5% H_2

$P = 1 \text{ atm}$
 $T = 275 \text{ K}$ } C.N.

$$m_1 = 84,5 \text{ g}$$

$$M_1 = \frac{84,5}{44} = 1,92$$

$$m_2 = 15,5 \text{ g}$$

$$M_2 = \frac{15,5}{2} = 7,75$$

$$X_1 = \frac{1,92}{1,92 + 7,75} = 0,2$$

$$X_2 = \frac{7,75}{1,92 + 7,75} = 0,80$$

$$\frac{84,48 + 15,5}{1,62} = 10,33$$

$$\bar{PM} = \frac{1,92 \cdot 44 + 7,75 \cdot 2}{1,92 + 7,75} = \frac{84,48 + 15,5}{10,33} = 8,17$$

$$d = \frac{10,33 \cdot 0,0821 \cdot 273}{8,17} = 2,73 \text{ g/l}$$

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$M_{\text{CO}_2} = 2,5 \text{ g}$

$V = ?$

$$P = 735 \text{ Torr} = 0,97 \text{ atm}$$

$$T = 85,2^\circ \text{C} = 358,2 \text{ K}$$

$$PV = nRT$$

$$V = \frac{nRT}{P} = \frac{\frac{m}{PM} RT}{P} = \frac{2,5 \text{ g} \cdot 0,0821 \cdot 358}{44 \cdot 0,97} = 1,78$$

(21)

$$\left\{ \begin{array}{l} d = 0,997 \text{ g/l} \\ T_1 = 135^\circ\text{C} \\ P_1 = 0,475 \text{ atm} \end{array} \right.$$

$$\left\{ \begin{array}{l} V = 7,45 \text{ l} \\ T_2 = 50,5^\circ\text{C} \\ P_2 = 1,85 \text{ atm} \end{array} \right.$$

↓

$$PV = nRT$$

$$m = \frac{PV}{RT} = \frac{1,85 \cdot 7,45}{0,0821 \cdot 323,5} = 0,52 \text{ mol}$$

$$d = \frac{P \cdot PM}{RT}$$

$$0,997 = \frac{0,475 \cdot \frac{m}{0,52}}{0,0821 \cdot 405}$$

$$\rightarrow m = \frac{0,997 \cdot 0,0821 \cdot 405 \cdot 0,52}{0,475} = 36,5 \text{ g}$$

(23)

$$V = 5,83 \text{ l}$$

$$T = 80,5^\circ\text{C}$$

$$P_{\text{TOT}} = ?$$

$$m_{N_2} = 0,40 \text{ g} \Rightarrow m = \frac{0,40 \cdot 28}{28} = 0,4 \text{ g}$$

$$m_{\text{mol CO}} = 3,01 \cdot 10^{-23} \Rightarrow m = \frac{3,01 \cdot 10^{-23} \cdot 60}{60} = 0,5 \text{ g}$$

$$m_{CO_2} = 28 \cdot 10^{-3} \text{ g}$$

$$P_{\text{TOT}} = \frac{(m_1 + m_2 + m_3) RT}{V} = \frac{4,97 \cdot 0,5168}{5,83} = 2,56 \text{ atm}$$

(19)

$$V = 10 \text{ L}$$

$$T = 305 \text{ K}$$

$$P = 657 \text{ Torr} = 0,86 \text{ atm}$$

$$H_2 = 10,2\%$$

$$O_2 = 74,9\%$$

$$N_2 = 274,9\%$$

$$X_1 = \frac{10,2}{100} = 0,1$$

$$X_2 = \frac{74,9}{100} = 0,75$$

$$X_3 = \frac{274,9}{100} = 2,75$$

~~$P_{H_2} = 0,86 \cdot 0,1 = 0,086$~~

$$P_{H_2} = 0,86 \cdot 0,1 = 0,086$$

$$P_{O_2} = 0,86 \cdot 0,75 = 0,645$$

$$P_{N_2} = 0,86 \cdot 2,75 = 2,365$$

$$P_{\text{tot}} = X_i P_{\text{tot}}$$

$$m_i = \frac{P_i m_{\text{tot}}}{P_{\text{tot}}} \quad \text{ricordare!}$$

$$m_{\text{tot}} = \frac{PV}{RT} = 0,345 \text{ mol}$$

$$m_{H_2} = \frac{0,086 \cdot 0,345}{0,864} = 0,035 \text{ mol}$$

$$m_{O_2} = \frac{0,645 \cdot 0,345}{0,864} = 0,258 \text{ mol}$$

$$m_{N_2} = \frac{2,365 \cdot 0,345}{0,864} = 0,94 \text{ mol}$$

$$m_{H_2} = 0,035 \cdot 2 = 0,07 \text{ g}$$

$$m_{O_2} = 0,258 \cdot 32 = 8,26 \text{ g}$$

$$m_{N_2} = 0,94 \cdot 28 = 26,32 \text{ g}$$

15) $\%_p \text{ CO}_2 = 84,5\% = 84,5 \text{ g}$

$\%_p \text{ H}_2 = 15,5\% = 15,5 \text{ g}$

$$d = \frac{P \cdot PM}{RT}$$

$$n_{\text{CO}_2} = \frac{84,5}{44} = 1,92 \text{ mol}$$

$$n_{\text{H}_2} = \frac{15,5}{2} = 7,75 \text{ mol}$$

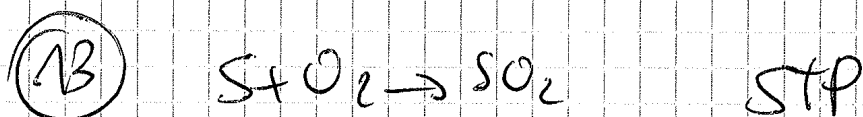
$$n_{\text{TOT}} = 7,75 + 1,92 = 9,67 \text{ mol}$$

$$X_{\text{CO}_2} = \frac{1,92}{9,67} = 0,20$$

$$X_{\text{H}_2} = \frac{7,75}{9,67} = 0,80$$

$$PM = (0,2 \cdot 44) + (0,8 \cdot 2) = 10,4 \text{ g/mol}$$

$$d = \frac{P \cdot PM}{RT} = \frac{1 \cdot 10,4}{0,0821 \cdot 273} = 0,418 \text{ g/l}$$



$m_s = 60 \text{ g}$ $n_s = 1,870 \text{ mol}$

~~$m_{\text{O}_2} = 2 \cdot 1,870 \cdot 32 = 59,84 \text{ g}$~~

$$PV_{\text{O}_2} = nRT$$

$$V_{\text{O}_2} = \frac{nRT}{P} = \frac{1,870 \cdot 0,0821 \cdot 273}{1} = 45,75 \text{ L}$$

$45,75 : 20 = x : 100$

$$V_{\text{O}_2} = \frac{45,75 \cdot 100}{20} = 228,75 \text{ L}$$

$$⑤ \quad m \text{ NaOH} = 10,15 \text{ g}$$

$$m \text{ H}_2\text{O} = 70,55 \text{ g}$$

$$\% \text{ NaOH} = \frac{10,15}{80,70} \cdot 100 = 12,57$$

$$\% \text{ H}_2\text{O} = \frac{70,55}{80,70} \cdot 100 = 87,42\%$$

$$⑥ \quad V_1 \text{ HCl} = 7,5 \text{ ml} = 0,075 \text{ l}$$

$$M_1 \text{ HCl} = 0,2 \text{ M}$$

$$V_2 \text{ HCl} = 25,8 \text{ ml} = 0,026 \text{ l}$$

$$M_2 \text{ HCl} = 0,45 \text{ M}$$

$$M_1 = \frac{m_1}{V_1} \Rightarrow m_1 = M_1 V_1 = 0,2 \cdot 0,075 \text{ l} = 0,015 \text{ mol}$$

$$M_2 = \frac{m_2}{V_2} \Rightarrow m_2 = M_2 V_2 = 0,45 \cdot 0,026 \text{ l} = 0,0117 \text{ mol}$$

$$M = \frac{0,0117 + 0,015}{0,101} = 0,264$$

\downarrow
 V_{TOT}

12. $V_{HCl} = 125 \text{ mL} = 0,125 \text{ L}$
 $M_{HCl} = 1$ $M_{Zn} = 0,17$

$$n = \frac{m}{M} = 0,125 \text{ mol}$$

$$V_2 = \frac{n}{M_2} = \frac{0,125}{0,1} = 1,25 \text{ L}$$

14. $V = 450 \text{ mL}$
 $m = 15 \text{ g}$ $PM = 180$

$$T = 298 \text{ K}$$

$$n = \frac{m}{M} = \frac{15}{180} = 0,083 \text{ mol}$$

$$\pi V = nRT$$

$$\pi = \frac{0,083 \cdot 0,0821 \cdot 298}{0,45} = 4,53 \text{ atm}$$

15. $m = 6 \text{ g}$
 $V = 500 \text{ mL} = 0,5 \text{ L}$

$$T = 291 \text{ K}$$

$$\pi = 1,1687 \text{ atm}$$

$$n = \frac{\pi V}{RT} \Rightarrow \frac{m}{PM} = \frac{\pi V}{RT} \Rightarrow$$

$$\Rightarrow PM = \frac{mRT}{\pi V} = \frac{6 \cdot 0,0821 \cdot 291}{1,1687 \cdot 0,5} = 245 \text{ g/mol}$$

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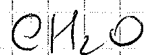
$$m_{\text{glucosio}} = 45 \text{ g}$$

$$m_{\text{H}_2\text{O}} = 500 \text{ g}$$

$$T_c = -0,93^\circ\text{C}$$

$$K_c = 1,86$$

$$PM_{\text{glucosio}} = ?$$



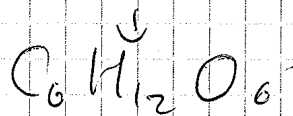
$$0,93 = 1,86 \cdot \frac{m_{\text{glucosio}}}{95}$$

$$m_{\text{glucosio}} = \frac{0,93 \cdot 95}{1,86} = 0,25$$

$$PM = \frac{m}{n} = \frac{45}{0,25} = 180$$

formula molecolare

$$PM_{\text{C}_6\text{H}_{12}\text{O}_6} = 180 \rightarrow$$



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$$T_c = -1,30^\circ\text{C}$$

$$K_c = 1,86$$

$$K_e = 0,52$$

$$T_{\text{eb}} = ?$$

$$1,30 = 1,86 \cdot m$$

$$m = \frac{1,30}{1,86} = 0,7$$

$$T_{\text{eb}} = 100 + 0,52 \cdot 0,7 = 100,36$$

(21)

$$T = 30^{\circ}\text{C}$$

$$P_1^{\circ} = 118 \text{ mm Hg}$$

$$PM = 78$$

$$P_2^{\circ} = 37 \text{ mm Hg}$$

$$PM = 92$$

$$m_1 = m_2 = 60$$

$$P_1 = P_1^{\circ} \frac{m_1}{m_1 + m_2} = 0,155 \cdot \frac{0,641}{0,641 + 0,543} = 0,0839$$

$$P_2 = P_2^{\circ} \frac{m_2}{m_1 + m_2} = 0,0486 \cdot \frac{0,543}{1,184} = 0,022$$

$$P_{\text{TOT}} = (0,0839 + 0,022) 760 = 80,74 \text{ Torr}$$

(22)

$$m_{\text{H}_2\text{O}} = 100 \text{ g}$$

$$m_X = 2 \text{ g}$$

$$V = 101 \text{ ml}$$

$$\Delta T_c = 0,620^{\circ}\text{C}$$

$$K_c = 1,86$$

$$\Delta T_c = K_c m$$

$$m = \frac{\Delta T_c}{K_c} = \frac{0,620}{1,86} = 0,333$$

$$M = \frac{0,033}{0,101} = 0,33$$

8

$$V_{H_2O} = 125,5 \quad d = 1$$

$$V_{Ca_3} = 68,2 \quad d = 2,7$$

$$d_{TOT} = 2,954 \text{ g/ml}$$

$$m_{H_2O} = 125,5 \text{ ml}$$

$$m_{Ca_3} = 33,3$$

$$m_{TOT} = 179,378$$

$$V = \frac{179,378}{2,954} = 188 \text{ ml}$$

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$$m_{HCl} = 34 \text{ g}$$

$$d_{sol} = 1,17 \text{ g/ml}$$

$$m_{H_2O} = 100 \text{ g}$$

$$m_{HCl} = \frac{34}{74} = 0,4594$$

$$m_{H_2O} = \frac{100}{18} = 5,555$$

$$\chi = \frac{0,4594}{6,0149} = 0,076$$

$$V_{soluz.} = \frac{734}{1,17} = 114,5299 \text{ ml}$$

$$M = \frac{0,4594}{0,1145299} = 4$$

$$m = \frac{0,4594}{0,1} = 4,59$$

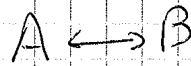
EQUILIBRI

①

$$m = 0,6 \text{ mol}$$

$$K_c = 0,8$$

$$K_c = \frac{[B]}{[A]}$$



A	B
-	0,6
x	0,6 - x

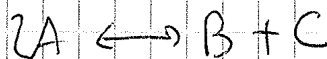
$$0,8 = \frac{0,6 - x}{x}$$

$$\rightarrow 0,8x = 0,6 - x$$

$$0,8x + x = 0,6$$

$$x = \frac{0,6}{1,8} = 0,33$$

②



$$K_c = 1 \cdot 10^{-2}$$

$$[A] = 2,8 \cdot 10^{-2} \text{ M}$$

$$[B] = 1,2 \cdot 10^{-2} \text{ M}$$

A	B	C
$2,8 \cdot 10^{-2}$	$1,2 \cdot 10^{-2}$	-
$2,8 \cdot 10^{-2} - 2x$	$1,2 \cdot 10^{-2} + x$	x

$$1 \cdot 10^{-2} = \frac{(1,2 \cdot 10^{-2} + x)(x)}{(2,8 \cdot 10^{-2} - 2x)^2}$$

$$1 \cdot 10^{-2} (7,84 \cdot 10^{-4} + 4x^2 - 11,2 \cdot 10^{-2} x) = 1,2 \cdot 10^{-2} x + x^2$$

$$7,84 \cdot 10^{-6} + 4x^2 \cdot 10^{-2} - 11,2 \cdot 10^{-4} x = 1,2 \cdot 10^{-2} x + x^2$$

$$(4 \cdot 10^{-3} - 1)x^2 - 11,2 \cdot 10^{-4} x - 1,2 \cdot 10^{-2} x + 7,84 \cdot 10^{-6} = 0$$

$$-0,96 x^2 - 13,12 \cdot 10^{-3} x + 7,84 \cdot 10^{-6} = 0$$

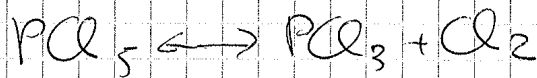
$$96 \cdot 10^{-7} x^2 + 131 \cdot 10^{-2} x - 7,84 \cdot 10^{-6} = 0$$

4

$$V = 0,5 \text{ L}$$

$$T = 540 \text{ K}$$

$$m_{\text{PCl}_5} = 8,5 \cdot 10^{-2}$$



$$P_{\text{Tot eq}} = 11,10 \text{ atm}$$

$$K_p = ?$$

$$P_i V = nRT$$

$$P_i = \frac{nRT}{V} = \frac{8,5 \cdot 10^{-2} \cdot 0,0821 \cdot 540}{0,5} = 7,53 \text{ atm}$$

	PCl_5	PCl_3	Cl_2
i	7,53	-	-
eq.	$7,53 - x$	x	x

$$P_{\text{Tot eq}} = 7,53 - x + x + x = 7,53 + x$$

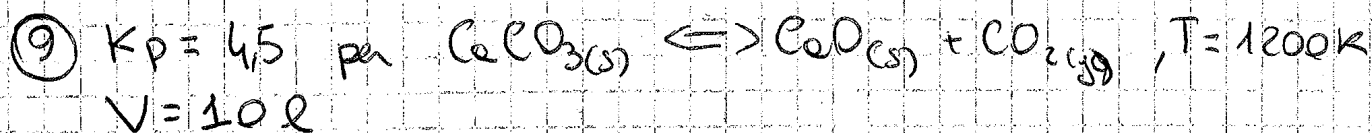
$$11,10 = 7,53 + x$$

$$x = 3,57$$

$$P_{\text{PCl}_3} = P_{\text{Cl}_2} = 3,57$$

$$P_{\text{PCl}_5} = 3,96$$

$$K_p = \frac{3,57 \cdot 3,57}{3,96} = 3,22$$



80 g di CaCO_3

$M_{\text{CaCO}_3} = \frac{80\text{g}}{100\text{g mol}^{-1}} = 0,8\text{mol}$

$P_{\text{CO}_2} = ?$

M_{CaCO_3} all'equilibrio = ?

$K_p = \frac{P_{\text{CaO}} \cdot P_{\text{CO}_2}}{P_{\text{CaCO}_3}} = P_{\text{CO}_2} = 4,5\text{atm}$

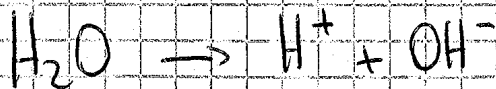
	CaCO_3	CaO	CO_2
Cond. Iniz.	0,8	-	-
Cond. Equil.	0,8 - x	x	x

$K_c = \frac{[\text{CaO}][\text{CO}_2]}{[\text{CaCO}_3]} = [\text{CO}_2] = \frac{x}{10} = 4,5$

$x = 4,5 \cdot 10 = 45\text{mol}$

$M_{\text{CaCO}_3, \text{eq}} = 80 - 45 = 35\text{mol}$

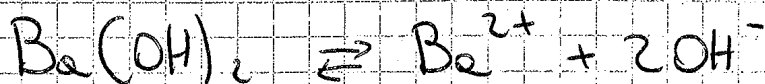
10) $[\text{OH}^-] = 2,00\text{M}$



$\text{p}(\text{OH}) = -\log(2) = -0,3$

$\text{pH} + \text{pOH} = 14 \Rightarrow \text{pH} = 14 + 0,3 = 14,3$

44) $\Gamma = 1,34 \cdot 10^{-2}$ Γ di $\text{Be}(\text{OH})_2$



$$[\text{Be}^{2+}] = 1,34 \cdot 10^{-2} \text{ mol l}^{-1} + \frac{1 \cdot 10^{-14} \text{ mol}^2 \text{ l}^{-2}}{1,34 \cdot 10^{-2} \text{ mol l}^{-1}} =$$

$$= 0,0134 \text{ M}$$

$$[2\text{OH}^-] = 2(1,34 \cdot 10^{-2} \text{ mol l}^{-1}) + \frac{1 \cdot 10^{-14} \text{ mol}^2 \text{ l}^{-2}}{1,34 \cdot 10^{-2} \text{ mol l}^{-1}} =$$

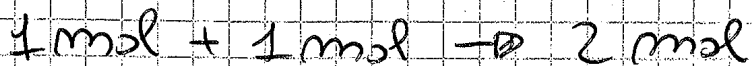
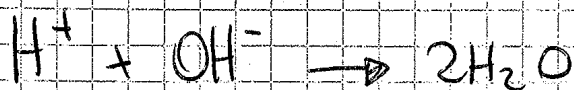
$$= 0,0268 \text{ M}$$

$$\text{pOH} = -\log(0,0268) = 1,571$$

$$\text{pH} = 14 - 1,571 = 12,429$$

45) 30 ml di NaOH 0,2 M
 20 ml di HCl 0,38 M

Quando le due soluzioni vengono mescolate avviene la reazione di neutralizzazione:



$$n_{\text{H}^+} = 0,02 \text{ l} \cdot 0,38 \text{ M} = 7,6 \cdot 10^{-3} \text{ mol}$$

$$n_{\text{OH}^-} = 0,03 \text{ l} \cdot 0,2 \text{ M} = 6 \cdot 10^{-3} \text{ mol}$$

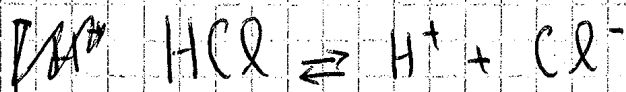
OH^- è il reagente in difetto. ~~6,6 \cdot 10^{-3} mol di~~
~~reagente~~ Nelle soluzione finale

avremo un eccesso di $H^+ = 1,6 \cdot 10^{-3} \text{ mol}$

$$[H^+] = \frac{1,6 \cdot 10^{-3} \text{ mol}}{0,05 \text{ l}} = 0,032 \text{ M}$$

$$pH = -\log(0,032) = 1,49$$

96) $M_{\text{soluzione}} = 1 \cdot 10^{-7} \text{ M}$



$$[H^+] = 1 \cdot 10^{-7} \text{ mol l}^{-1} + \frac{1 \cdot 10^{-14} \text{ mol}^2 \text{ l}^{-2}}{1 \cdot 10^{-7} \text{ mol l}^{-1}} = 2 \cdot 10^{-7} \text{ M}$$

$$pH = -\log(2 \cdot 10^{-7}) = 6,69$$

97) 50,7 ml di HCl $\%p = 37,00\%$ $d = 1,160 \text{ g ml}^{-1}$
 H_2O $V = 1 \text{ l}$

$$m_{\text{HCl (soluzione)}} = V \cdot d = 50,7 \text{ ml} \cdot 1,160 \text{ g ml}^{-1} = 58,812 \text{ g}$$

$$m_{\text{HCl}} = 58,812 \text{ g} \cdot \frac{37}{100} = 21,76 \text{ g}$$

$$PM_{\text{HCl}} = 36,45 \text{ g mol}^{-1}$$

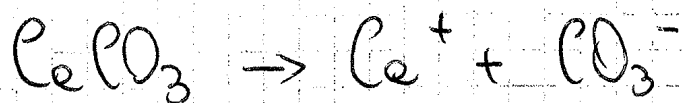
$$n_{\text{HCl}} = \frac{21,76 \text{ g}}{36,45 \text{ g mol}^{-1}} = 0,59 \text{ mol}$$

$$M = \frac{n_{\text{HCl}}}{V} = \frac{0,59 \text{ mol}}{1 \text{ l}} = 0,59 \text{ M}$$

$$pH = -\log(0,59) = 0,22$$

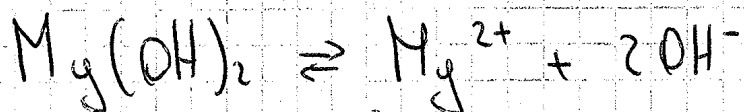
$$(20) \quad S = \cancel{9} \cdot 10^{-5} \text{ mol l}^{-1} \text{ di } \text{CeCO}_3$$

$$K_{ps} = ?$$



$$K_{ps} = [\text{Ce}^+][\text{CO}_3^-] = S \cdot S = S^2 = 8,10 \cdot 10^{-9}$$

$$(21) \quad K_{ps} = 1,2 \cdot 10^{-11} \text{ di } \text{Mg(OH)}_2$$



$$K_{ps} = [\text{Mg}^{2+}][\text{OH}^-]^2 = S \cdot (2S)^2 = 4S^3 = 1,2 \cdot 10^{-11}$$

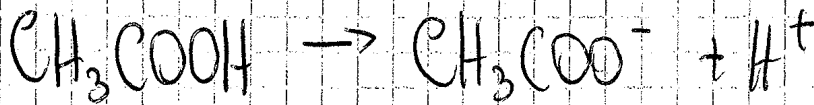
$$\Rightarrow S = \sqrt[3]{\frac{1,2 \cdot 10^{-11}}{4}} = 1,44 \cdot 10^{-4}$$

$$[\text{OH}^-] = 2S = 2,88 \cdot 10^{-4} \text{ M}$$

$$\text{pOH} = -\log(2,88 \cdot 10^{-4}) = 3,54$$

$$\text{pH} = 14 - 3,54 = 10,46$$

③ 0,1 M di CH_3COOH $K_a = 1,8 \cdot 10^{-5}$
 pH = ?



	CH_3COOH	CH_3COO^-	H^+
Concent. Iniziale	0,1	-	-
Concent. Equil.	$0,1 - x$	x	x

$$K_a = \frac{[\text{CH}_3\text{COO}^-][\text{H}^+]}{[\text{CH}_3\text{COOH}]} \approx \frac{x^2}{0,1 - x}$$

x è molto piccola, per cui $0,1 - x \approx 0,1$

$$\Rightarrow K_a = \frac{x^2}{0,1} \Rightarrow 0,1 \cdot 1,8 \cdot 10^{-5} = x^2 \Rightarrow x = 1,341 \cdot 10^{-3}$$

$$\text{pH} = -\log(1,341 \cdot 10^{-3}) = 2,87$$