Soluzione della 3ª Esercitazione Maggio 2014

1) $CaCO_{3(s)} + 2HBr \rightarrow H_2O + CaBr_{2(aq)} + CO_{2(g)}$ (1:1)

$n_{CO_2} = \frac{pV}{RT} = \frac{(1520/760)\cdot 70}{0.0821 \cdot 298.15} = 5,72 \text{ mol} = n_{CaCO_3}$

$m_{CaCO_3} = n_{CaCO_3} \cdot M = 5,72 \times 100,09 = 572,45 \text{ g}$ $\quad \% = \frac{572,45 \cdot 100}{1000} = 57,24$

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2) $NH_4HS_{(s)} \rightleftharpoons NH_{3(g)} + H_2S_{(g)}$

i	0,2	∅	∅
eq	0,093	0,107	0,107

$n^{\circ}_{NH_4HS} = \frac{10,222 \text{ g}}{51,11 \text{ g/mol}} = 0,2 \text{ mol}$

$n_{NH_4HS} = \frac{4,753 \text{ g}}{51,11 \text{ g/mol}} = 0,093 \text{ mol}$

$K_c = \left(\frac{0,107}{8}\right)^2 = 1,79 \cdot 10^{-4}$

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3) $NH_4Cl \xrightarrow{H_2O} NH_4^+ + Cl^-$ (1:1, Cl^- BDD)

$NH_4^+ + H_2O \rightleftharpoons NH_3 + H_3O^+$ $\quad K_a = 5,5 \cdot 10^{-10}$

$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$ $\quad K_b = 1,8 \cdot 10^{-5}$

$n_{NH_4Cl} = n_{NH_4^+} = x$

$pK_a = 9,26$ (coppia tampone: $8,26 < pH < 10,26$)

$[H_3O^+] = K_a \cdot \frac{[NH_4^+]}{[NH_3]}$ Sostituendo:

$10^{-9,8} = 10^{-9,26} \cdot \frac{x/V}{0,2/V} \rightarrow x = \frac{1}{5} \cdot 10^{-0,54} = 0,058 \text{ mol}$

$m_{NH_4Cl} = n_{NH_4Cl} \cdot M = 0,054 \times 53,49 = 3,085 \text{ g}$

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4) ⊕ $Cl_2 + 2e^- \rightarrow 2Cl^-$

$E = 1,36 + \frac{0,0592}{2} \log \frac{P_{Cl_2}}{[Cl^-]^2} =$

$= 1,36 + \frac{0,0592}{2} \log \frac{0,4}{(0,2)^2} = 1,39 \text{ V}$

$CaCl_2 \xrightarrow{H_2O} Ca^{2+} + 2Cl^-$ (1:2)

0,1 M $\quad$ 0,2 M

⊖ $2H_3O^+ + 2e^- \rightarrow H_2 + 2H_2O$

$E = 0 + \frac{0,0592}{2} \log \frac{[H_3O^+]^2}{P_{H_2}} =$

$= 0 + \frac{0,0592}{2} \log \frac{(10^{-2})^2}{1} = -0,12 \text{ V}$

$HClO_4 + H_2O \rightarrow H_3O^+ + ClO_4^-$

$C = 0,010 > 10^{-7}$

$[H_3O^+] = 10^{-2} \text{ M}$

$\Delta E = 1,39 - (-0,12) = 1,51 \text{ V}$

$E = -0,06 = \frac{0,0592}{2} \log X^2$

$0,06 = 0,06 \text{ pH}$

$\hookrightarrow pH = 1$