Soluzione della Prova Scritta del 12 Febbraio 2019

1) $4PH_3 + 8O_2 \rightarrow P_4O_{10} + 6H_2O$ $\quad PH_3$ è in difetto $\rightarrow n_{H_2O} = \frac{3}{2} n_{PH_3}$

$n_{PH_3} = \frac{pV}{RT} = \frac{310,5\,l \cdot 3\,atm}{0,0821 \cdot 378,15} = 30,00\,mol$; $m_{H_2O} = n_{H_2O} \cdot M = \frac{3}{2} \cdot 30 \cdot 18,02 = \underline{811,00\,g}$

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2) $2NaHCO_{3(s)} \rightleftharpoons Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(g)}$

a	ϕ	ϕ	ϕ
$a-2x$	x	x	x

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$p_{TOT} = p_{CO_2} + p_{H_2O}$

$\rightarrow p_{CO_2} = p_{H_2O} = \frac{1}{2} p_{TOT}$

$K_p = p_{CO_2} \cdot p_{H_2O} = \left(\frac{1}{2} p_{TOT}\right)^2$

$\Delta n = 2 \rightarrow K_C = K_p (RT)^{-2} = \frac{\frac{1}{4} p_{TOT}^2}{(0,0821 \cdot 423,15)^2} = \underline{6,71 \cdot 10^{-4}}$

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3) $NH_4ClO_4 \rightarrow \underset{AD}{NH_4^+} + \underset{BOD}{ClO_4^-}$; $NH_4^+ + H_2O \rightleftharpoons NH_3 + H_3O^+$; $K_a = \frac{K_w}{K_b} =$

1:1

$C_a = C = 0,05\,M$

$[H_3O^+] = \frac{K_w}{[H_3O^+]} + \frac{CK_a}{[H_3O^+] + K_a}$ $\quad = \frac{10^{-14}}{1,8 \cdot 10^{-5}} = 5,5 \cdot 10^{-10} \ll 10^{-7}$

$[H_3O^+]^2 - K_w - CK_a = 0 \rightarrow [H_3O^+] = \sqrt{K_w + CK_a} =$ $\quad CK_a = 0,05 \cdot 5,5 \cdot 10^{-10} = 2,75 \cdot 10^{-11} \gg 10^{-14}$

$[H_3O^+] \cong \sqrt{CK_a} = 5,24 \cdot 10^{-6}\,M \rightarrow \underline{pH = 5,3}$

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4) $K_2SO_4 \rightarrow \underset{AD}{2K^+} + \underset{BOD}{SO_4^{2-}} \rightarrow [H_3O^+] = [OH^-] = 10^{-7}\,M$; elettrolisi dell'acqua:

$\ominus\ 4H_2O + 4e^- \rightarrow 2H_2 + 4OH^-$; $\oplus\ 6H_2O \rightarrow O_2 + 4e^- + 4H_3O^+$

2:1 → $n_{H_2} = \frac{1}{2} n_{e^-}$

1:4 → $n_{O_2} = \frac{1}{4} n_{e^-}$

$n_{e^-} = \frac{Q}{F} = \frac{I \cdot t}{F}$

$n_{H_2} = \frac{I \cdot t}{2F} = \frac{0,2 \cdot 7200}{2 \cdot 96486} = 0,00746\,mol$; $n_{O_2} = \frac{I \cdot t}{4F} = \frac{0,2 \cdot 7200}{4 \cdot 96486} = 0,00373\,mol$