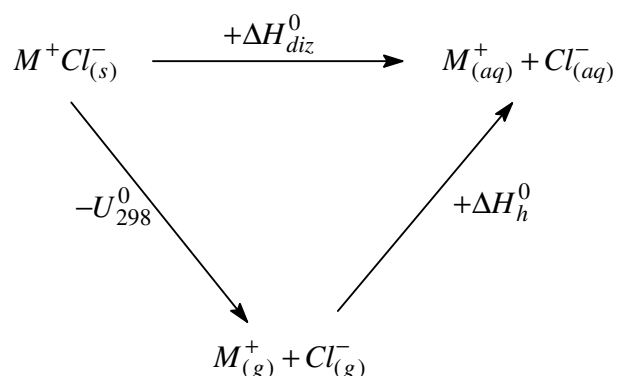


OLIMPIADA DE CHIMIE
 Etapa județeană – 17 ianuarie 2010
 Clasa a XII-a
 Barem de corectare și notare

Subiectul I20 puncte



$$\Delta H_{diz}^0 = -U_{298}^0 + \Delta H_h^0 \Rightarrow \Delta H_h^0 = U_{298}^0 + \Delta H_{diz}^0 \quad (5 \text{ puncte})$$

$$\Delta H_{h(NaCl)}^0 = -774 + 3,79 = -770,21 \text{ kJ / mol}$$

$$n_{NaCl} = 2 \text{ moli} \Rightarrow \Delta H_{hidr.(NaCl)} = 2 \cdot (-770,21) = -1540,42 \text{ kJ} \quad (5 \text{ puncte})$$

$$\Delta H_{h(LiCl)}^0 = -841,8 - 33,89 = -875,69 \text{ kJ / mol}$$

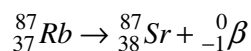
$$n_{LiCl} = 4 \text{ moli} \Rightarrow \Delta H_{hidr.(LiCl)} = 4 \cdot (-875,69) = -3502,76 \text{ kJ} \quad (5 \text{ puncte})$$

$$\Delta H_{h(NaCl)}^0 = -770,21 \text{ kJ / mol}$$

$$\Delta H_{h(LiCl)}^0 = -875,69 \text{ kJ / mol}$$

$$|\Delta H_{h(LiCl)}^0| > |\Delta H_{h(NaCl)}^0| \Rightarrow \text{ionul de } Li^+ \text{ este mai puternic hidratat decât ionul de } Na^+ \quad (5 \text{ puncte})$$

Subiectul al II-lea 20 puncte



$${}^{87}Sr_{(t)} = {}^{87}Sr_{(t=0)} + {}^{87}Sr_{(format)} \quad (3 \text{ puncte})$$

$${}^{87}Sr_{(t)} = {}^{87}Sr_{(t=0)} + {}^{87}Rb_{(t=0)} - {}^{87}Rb_{(t)} \quad (1) \quad (3 \text{ puncte})$$

$$\ln \frac{{}^{87}Rb_{(t=0)}}{{}^{87}Rb_{(t)}} = \lambda \cdot t \Rightarrow {}^{87}Rb_{(t=0)} = {}^{87}Rb_{(t)} \cdot e^{\lambda \cdot t} \quad (2) \quad (3 \text{ puncte})$$

$$\begin{aligned}
 \text{Din (1) + (2)} \Rightarrow {}^{87}Sr_{(t)} &= {}^{87}Sr_{(t=0)} + {}^{87}Rb_{(t)}(e^{\lambda \cdot t} - 1) \quad \left| \cdot \frac{1}{{}^{86}Sr} \right. \\
 \frac{{}^{87}Sr_{(t)}}{{}^{86}Sr} &= \frac{{}^{87}Sr_{(t=0)}}{{}^{86}Sr} + \frac{{}^{87}Rb_{(t)}}{{}^{86}Sr}(e^{\lambda \cdot t} - 1)
 \end{aligned}$$

$$\text{Pentru mineralul A: } 0,699 = \frac{{}^{87}\text{Sr}_{(t=0)}}{{}^{86}\text{Sr}} + 0,004(e^{\lambda \cdot t} - 1) \quad (3)$$

$$\text{Pentru mineralul B: } 0,709 = \frac{{}^{87}\text{Sr}_{(t=0)}}{{}^{86}\text{Sr}} + 0,180(e^{\lambda \cdot t} - 1) \quad (4)$$

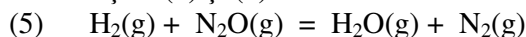
Pentru ambele minerale raportul numeric inițial $\frac{{}^{87}\text{Sr}_{(t=0)}}{{}^{86}\text{Sr}}$ este același și scăzând ecuația (3) din ecuația (4) rezultă: $0,01 = 0,176(e^{\lambda \cdot t} - 1) \Rightarrow (e^{\lambda \cdot t} - 1) = 0,0568 \Rightarrow e^{\lambda \cdot t} = 1,0568 \Rightarrow t = \frac{\ln 1,0568}{\lambda}$ (4 puncte)

$$t_{1/2} = \frac{\ln 2}{\lambda} \Rightarrow \lambda = \frac{\ln 2}{t_{1/2}} = 1,44 \cdot 10^{-11} \text{ ani}^{-1} \quad (3 \text{ puncte})$$

$$t = \frac{\ln 1,0568}{1,44 \cdot 10^{-11}} = 3,8 \cdot 10^9 \text{ ani} \quad (4 \text{ puncte})$$

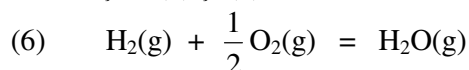
Subiectul al III-lea 25 puncte

Din ecuațiile (1) și (2) rezultă:



$$\Delta H_{c_1(\text{H}_2)} = \frac{1}{3}(\Delta H_1 + \Delta H_2) = -74 \text{ kcal/mol H}_2 \quad (5 \text{ puncte})$$

Din ecuațiile (3) și (4) rezultă:

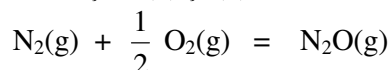


$$\Delta H_{c_2(\text{H}_2)} = \frac{1}{2}(\Delta H_3 + \Delta H_4) = -57,2 \text{ kcal/mol H}_2 \quad (5 \text{ puncte})$$

Arderea în protoxid de azot decurge cu degajarea unei cantități mai mari de căldură decât arderea în oxigen pur. Deci, din punct de vedere energetic, arderea în protoxid de azot e mai avantajoasă.

(3 puncte)

Din ecuațiile (5) și (6) rezultă:



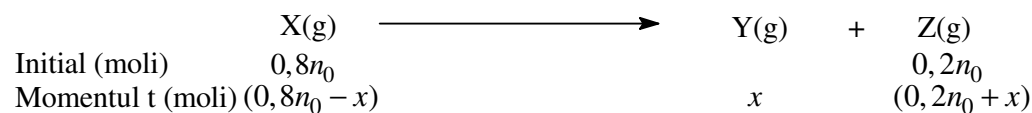
$$\Delta H_r = (-1) \cdot \Delta H_{c_1(\text{H}_2)} + 1 \cdot \Delta H_{c_2(\text{H}_2)} = 74 - 57,2 = +16,8 \text{ kcal} \quad (5 \text{ puncte})$$

$$\Delta H_{f(\text{N}_2\text{O}_{(\text{g})})} = +16,8 \text{ kcal/mol} \quad (3 \text{ puncte})$$

$$\Delta H_{f(\text{N}_2\text{O}_{(\text{g})})} > 0 \Rightarrow \text{N}_2\text{O are stabilitate mică} \quad (4 \text{ puncte})$$

Subiectul al IV-lea 25 puncte

$$\text{Inițial: } n_0 = \frac{pV_0}{RT}; \quad n_{0x} = 0,8 \cdot \frac{pV_0}{RT}; \quad n_{0z} = 0,2 \cdot \frac{pV_0}{RT} \quad (3 \text{ puncte})$$



$$\text{Momentul t: } n = \frac{p \cdot 1,5V_0}{RT} = (n_0 + x) \Rightarrow x = \frac{0,5pV_0}{RT}$$

$$n_X = 0,8n_0 - x = 0,8 \frac{pV_0}{RT} - 0,5 \frac{pV_0}{RT} = 0,3 \frac{pV_0}{RT}$$

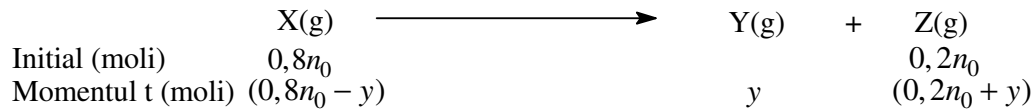
$$C_{0X} = \frac{0,8n_0}{V_0} = \frac{0,8p}{RT}; \quad C_X = \frac{n_X}{V} = \frac{\frac{0,3pV_0}{RT}}{1,5V_0} = \frac{0,2p}{RT} \quad (3 \text{ puncte})$$

$$\ln \frac{C_0}{C} = kt \Rightarrow k = \frac{1}{t} \ln \frac{C_0}{C}$$

$$k = \frac{1}{138,6} \ln 4 = 10^{-2} \text{ min}^{-1} \quad (5 \text{ puncte})$$

$$\text{b) } t_{1/2} = \frac{\ln 2}{k} = 69,3 \text{ min} \quad (4 \text{ puncte})$$

c)



$$n_{am} = n_0 + y = \frac{pV_0}{RT} + y$$

$$n_X = \frac{0,8pV_0}{RT} - y$$

$$V = \frac{n_{am}RT}{p} = V_0 + \frac{yRT}{p}$$

$$\ln \frac{C_0}{C} = kt \Rightarrow C = C_0 \cdot e^{-kt} \Rightarrow C = C_0 \cdot e^{-10^{-2} \cdot 252,5} \Rightarrow C = 0,08C_0 \quad (3 \text{ puncte})$$

$$C_{0X} = \frac{0,8n_0}{V_0} = \frac{0,8p}{RT}$$

$$C_X = \frac{n_X}{V} = \frac{\frac{0,8pV_0}{RT} - y}{V_0 + \frac{yRT}{p}} = 0,08 \frac{0,8p}{RT} \Rightarrow y = \frac{0,691pV_0}{RT} \quad (3 \text{ puncte})$$

$$n_X = \frac{0,8pV_0}{RT} - y = \frac{0,109pV_0}{RT}$$

$$n_Y = y = \frac{0,691pV_0}{RT}$$

$$n_{am} = n_0 + y = \frac{pV_0}{RT} + y = \frac{1,691pV_0}{RT}$$

$$\%X = 6,44\%$$

$$\%Z = 40,86\%$$

$$\%Y = 52,69\% \quad (\text{procente volumetrice}) \quad (4 \text{ puncte})$$