

Ministerul Educației, Cercetării, Tineretului și Sportului

OLIMPIADA NAȚIONALĂ DE CHIMIE

EDIȚIA a 44-a

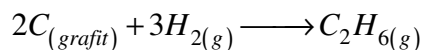
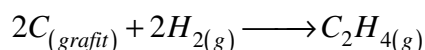
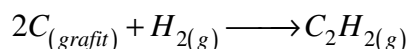
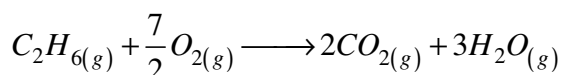
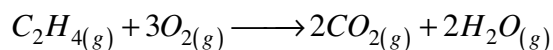
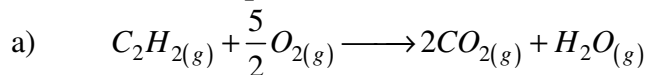
PITEȘTI - 2010

Clasa a XII-a – baremul probei teoretice

Subiectul I – 20 p (2p x 10)

1c; 2d; 3a; 4d; 5a; 6b; 7b; 8e; 9c; 10c.

Subiectul II – 20 p



- 5p

b) $x_{C_2H_2} = 0,2$; $x_{C_2H_4} = 0,25$; $x_{C_2H_6} = 0,55$

- 7p

c) $T_{\max} = 594K$

- 8p

Subiectul III – 20 p

a) $k = 6,29 \cdot 10^{-2} \text{ min}^{-1}$; $t_{1/2} = 11 \text{ min}$

- 5p

b) $0,125 \text{ mol/L}$

- 8p

c) $p = \frac{P_0}{2} (3 - e^{-kt})$

- 7p

Subiectul IV – 30 p

A. a) $(-)Hg_{(l)} / Hg_2Cl_{2(s)} / KCl_{(sat)} // Fe_{(aq)}^{3+}, Fe_{(aq)}^{2+} / Pt(+)$

- 3p

b) $\mathcal{E}_{Fe^{3+}/Fe^{2+}}^0 = 3\mathcal{E}_{Fe^{3+}/Fe}^0 - 2\mathcal{E}_{Fe^{2+}/Fe}^0 = 3 \cdot (-0,036) - 2 \cdot (-0,44) = 0,772 \text{ V}$

- 2p

$\mathcal{E}_{(+)} = \mathcal{E}_{Fe^{3+}/Fe^{2+}}^0 + 0,059 \lg \frac{[Fe^{3+}]}{[Fe^{2+}]}$

- 2p

$\mathcal{E}_{(-)} = \mathcal{E}_{calomel}^0 = 0,244 \text{ V}$

$E = \mathcal{E}_{(+)} - \mathcal{E}_{(-)} = 0,534 \text{ V}$

$E = \mathcal{E}_{Fe^{3+}/Fe^{2+}}^0 - \mathcal{E}_{calomel}^0 + 0,059 \lg \frac{[Fe^{3+}]}{[Fe^{2+}]}$

$\lg \frac{[Fe^{3+}]}{[Fe^{2+}]} = \frac{E + \mathcal{E}_{calomel}^0 - \mathcal{E}_{Fe^{3+}/Fe^{2+}}^0}{0,059} = 0,1$

$$[Fe^{3+}] = [Fe^{2+}] \cdot 10^{0,1} = 0,08 \cdot 1,25 = 0,1 \text{ M} \quad - 3\text{p}$$

B.



$$b) \varepsilon_1 = \varepsilon_{Cu^{2+}/Cu^+}^0 + 0,059 \lg \frac{[Cu^{2+}]}{[Cu^+]}$$

$$K_s(CuCl) = [Cu^+] \cdot [Cl^-] \Rightarrow [Cu^+] = \frac{K_s}{[Cl^-]}$$

$$\varepsilon_1 = \varepsilon_{Cu^{2+}/Cu^+}^0 + 0,059 \lg \frac{[Cu^{2+}] \cdot [Cl^-]}{K_s} = \varepsilon_{Cu^{2+}/Cu^+}^0 - 0,059 \lg K_s + 0,059 \lg [Cu^{2+}] \cdot [Cl^-] \quad - 2\text{p}$$

$$\varepsilon_1 = \varepsilon_1^{0'} + 0,059 \lg [Cu^{2+}] \cdot [Cl^-]$$

$$\varepsilon_1^{0'} = \varepsilon_{Cu^{2+}/Cu^+}^0 - 0,059 \lg K_s$$

$$\varepsilon_2 = \varepsilon_{Cu^+/Cu}^0 + 0,059 \lg [Cu^+] = \varepsilon_{Cu^+/Cu}^0 + 0,059 \lg \frac{K_s}{[Cl^-]}$$

$$\varepsilon_2 = \varepsilon_{Cu^+/Cu}^0 + 0,059 \lg K_s - 0,059 \lg [Cl^-] \quad - 2\text{p}$$

$$\varepsilon_2 = \varepsilon_2^{0'} - 0,059 \lg [Cl^-]$$

$$\varepsilon_2^{0'} = \varepsilon_{Cu^+/Cu}^0 + 0,059 \lg K_s$$

La echilibru: $\varepsilon_1 = \varepsilon_2$

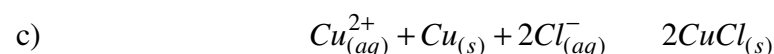
$$K = \frac{1}{[Cu^{2+}] \cdot [Cl^-]^2}$$

$$\varepsilon_1^{0'} + 0,059 \lg [Cu^{2+}] \cdot [Cl^-] = \varepsilon_2^{0'} - 0,059 \lg [Cl^-]$$

$$\varepsilon_1^{0'} = \varepsilon_{Cu^{2+}/Cu^+}^0 - 0,059 \lg K_s = 0,153 - 0,059 \lg 1,9 \cdot 10^{-7} = 0,550 \text{ V}$$

$$\varepsilon_2^{0'} = \varepsilon_{Cu^+/Cu}^0 + 0,059 \lg K_s = 0,521 + 0,059 \lg 1,9 \cdot 10^{-7} = 0,124 \text{ V}$$

$$\varepsilon_1^{0'} - \varepsilon_2^{0'} = 0,059 \lg K \Rightarrow K = 10^{\frac{\varepsilon_1^{0'} - \varepsilon_2^{0'}}{0,059}} = 1,66 \cdot 10^7 \quad - 4\text{p}$$



Inițial (mol/L) 10^{-2} $2 \cdot 10^{-2}$

Echilibru (mol/L) $(10^{-2} - x)$ $(2 \cdot 10^{-2} - 2x)$

$$K = \frac{1}{[Cu^{2+}] \cdot [Cl^-]^2} \Rightarrow K = \frac{1}{(10^{-2} - x)(2 \cdot 10^{-2} - 2x)^2} = 1,66 \cdot 10^7 \Rightarrow (10^{-2} - x)^3 = \frac{1}{66,4 \cdot 10^{-6}}$$

$$(10^{-2} - x) = \sqrt[3]{\frac{1}{66,4 \cdot 10^6}} = 0,246 \cdot 10^{-2} \Rightarrow x \cong 7,5 \cdot 10^{-3} \quad \text{- 4p}$$

La echilibru: $[Na^+] = 2 \cdot 10^{-2} \text{ mol / L}$

$$[SO_4^{2-}] = 10^{-2} \text{ mol / L}$$

$$[Cu^{2+}] = 10^{-2} - 7,5 \cdot 10^{-3} = 2,5 \cdot 10^{-3} \text{ mol / L}$$

- 5 X 0,4p = 2p

$$[Cl^-] = 2 \cdot 10^{-2} - 2 \cdot 7,5 \cdot 10^{-3} = 5 \cdot 10^{-3} \text{ mol / L}$$

$$[Cu^+] = \frac{K_s}{[Cl^-]} = \frac{1,9 \cdot 10^{-7}}{5 \cdot 10^{-3}} = 3,8 \cdot 10^{-5} \text{ mol / L}$$

$$d) \varepsilon_{echilibru} = \frac{\varepsilon_1^{0'} + \varepsilon_2^{0'}}{2} = \frac{0,550 + 0,124}{2} = 0,337 \text{ V} \quad \text{- 4p}$$

Notă: orice variantă corectă de rezolvare se va puncta corespunzător.

Comisie: Adrian Bîrzu, Flavina Stan, Géza Takó, Maria Toma, Vasile Sorohan.