



**OLIMPIADA NAȚIONALĂ DE
CHIMIE
IAȘI, 23-27 aprilie 2025
Ediția a LVIII-a**

**Barem de evaluare și de notare
Proba teoretică
Clasa a IX-a**

Se punctează orice modalitate de rezolvare corectă a cerințelor.

Subiectul I (20 puncte)

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

Fiecare răspuns corect primește **2 puncte**

Subiectul al II-lea (25 puncte)

A. (12 puncte) fiecare răspuns corect primește 1 punct

(1) Li/Na/K; (2) C; (3) K; (4) O; (5) P; (6) Al; (7) He/Ne/Ar/Kr; (8) S; (9) Br; (10) Na; (11) Si; (12) Ge.

B. (13 puncte)

a) $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$ (1p) (0,5p formule chimice, 0,5p coeficienți)

$2\text{Al} + 3\text{Cl}_2 \rightarrow 2\text{AlCl}_3$ (1p) (0,5p formule chimice, 0,5p coeficienți)

$\text{AlCl}_3 + 3\text{NH}_4\text{OH} \rightarrow \text{Al}(\text{OH})_3 + 3\text{NH}_4\text{Cl}$ (1,5p) (1p formule chimice, 0,5p coeficienți)

$2\text{Al}(\text{OH})_3 \rightarrow \text{Al}_2\text{O}_3 + 3\text{H}_2\text{O}$ (1,5p) (1p formule chimice, 0,5p coeficienți)

$\text{Al}_2\text{O}_3 + 2\text{NaOH} + 3\text{H}_2\text{O} \rightarrow 2\text{Na}[\text{Al}(\text{OH})_4]$ (2p) (1p formule chimice, 1p coeficienți)

b) $n \text{ Al}_2\text{O}_3 = 8,16/102 = 0,08 \text{ mol} \Rightarrow n \text{ Al din probă} = 0,16 \text{ mol} \Rightarrow m \text{ Al} = 4,32 \text{ g} \Rightarrow \% \text{ Al} = 90\%$ (3p)

c) $0,08 \text{ mol Al}_2\text{O}_3 \Rightarrow 0,16 \text{ mol NaOH} \Rightarrow m_d = 6,4 \text{ g NaOH} \Rightarrow m_s = 32 \text{ g soluție}$ (3p)

Subiectul al III-lea (25 puncte)

A. (10 puncte)

(1) $\text{CuSO}_4 + 2\text{NH}_3 + 2\text{H}_2\text{O} \rightarrow \text{Cu}(\text{OH})_2 + (\text{NH}_4)_2\text{SO}_4$ (1,5p) (1p formule chimice, 0,5p coeficienți)

(2) $\text{Cu}(\text{OH})_2 + 4\text{NH}_3 \rightarrow [\text{Cu}(\text{NH}_3)_4](\text{OH})_2$ (1,5p) (1p formule chimice, 0,5p coeficienți)

(3) $\text{Cu}^{2+} + 2\text{HCl} \rightarrow \text{CuCl}_2 + 2\text{H}^+$ (1,5p) (1p formule chimice, 0,5p coeficienți)

(4) $\text{CuCl}_2 + \text{Cu} \rightarrow [\text{CuCl}_2]^- + \text{Cu}^+$ (1,5p) (1p formule chimice, 0,5p coeficienți)

soluția substanței B - albastru (1p); soluția substanței D - verde (1p)

configurația cationului Cu^+ : $[\text{Ar}]3d^{10}$ (1p)

precizarea culorii: alb (1p)

B. (15 puncte)

$\text{Fe} + 2\text{AgNO}_3 \rightarrow \text{Fe}(\text{NO}_3)_2 + 2\text{Ag} \downarrow$ (1,5p) (1p formule chimice, 0,5p coeficienți)

$\text{Fe} + \text{Cu}(\text{NO}_3)_2 \rightarrow \text{Fe}(\text{NO}_3)_2 + \text{Cu} \downarrow$ (1,5p) (1p formule chimice, 0,5p coeficienți)

$\text{AgNO}_3 \rightarrow \text{Ag} + \text{NO}_2 \uparrow + 1/2\text{O}_2$ (1,5p) (1p formule chimice, 0,5p coeficienți)

$\text{Cu}(\text{NO}_3)_2 \cdot n\text{H}_2\text{O} \rightarrow \text{CuO} + 2\text{NO}_2 \uparrow + 1/2\text{O}_2 + n\text{H}_2\text{O}$ (1,5p) (1p formule chimice, 0,5p coeficienți)

$x\text{-mol AgNO}_3 \quad y\text{-mol Cu}(\text{NO}_3)_2 \cdot n\text{H}_2\text{O} \quad 170x + (188 + 18n)y = 11,74 \text{ g}$ (1p)

$\text{nr moli Fe consumat} = 0,5x + y \text{ moli} \Rightarrow m_{\text{Fe}} = 28x + 56y$ (1p)

Reziduul metalic depus :

$$5 - (28x + 56y) \text{ g Fe}_{\text{consumat}} + 108x \text{ g Ag} + 64y \text{ g Cu} = 7,56 \text{ g} \quad 80x + 8y = 2,56 \text{ g} \quad (2\text{p})$$

$$\text{Reziduul r\u0103mas con\u0219ine } x \text{ moli Ag \u0219i } y \text{ moli CuO} \quad 108x + 80y = 4,84 \text{ g} \quad (1\text{p})$$

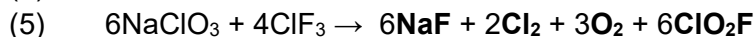
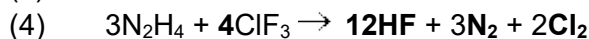
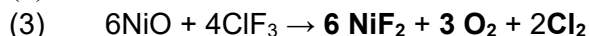
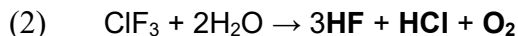
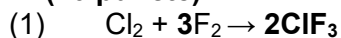
$$x = 0,03 \text{ mol} \quad (1\text{p}) ; y = 0,02 \text{ mol} \quad (1\text{p}) ; n = 8 \quad (1\text{p})$$

Formula cristalohidratului este $\text{Cu}(\text{NO}_3)_2 \cdot 8\text{H}_2\text{O}$ (1p)

Subiectul al IV-lea

(30 puncte)

A. (10 puncte)

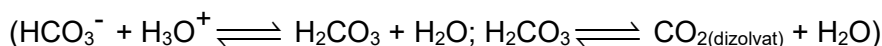
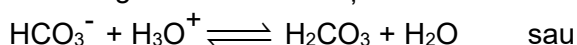


5 ec. x (2p) (1p formule chimice, 1p coeficien\u021bi) = (10p)

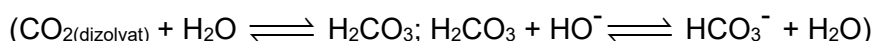
B. (20 puncte)

a)

La ad\u0103ugarea unei cantit\u0103\u021bi limitate de acid: (2p)



La ad\u0103ugarea unei cantit\u0103\u021bi limitate de baz\u0103: (2p)



b)

$$[\text{CO}_{2(\text{dizolvat})}] = K_H \cdot p_{\text{CO}_2} \Rightarrow [\text{CO}_{2(\text{dizolvat})}] = 2,26 \cdot 10^{-7} \text{ mol} \cdot \text{L}^{-1} \cdot \text{Pa}^{-1} \cdot 5,332 \cdot 10^3 \text{ Pa} \Rightarrow$$

$$[\text{CO}_{2(\text{dizolvat})}] = 12,05 \cdot 10^{-4} \text{ mol} \cdot \text{L}^{-1} \quad (3\text{p})$$

c)

$$K_{a1} = \frac{[\text{H}_3\text{O}^+] \cdot [\text{HCO}_3^-]}{[\text{H}_2\text{CO}_3]} \Rightarrow K_{a1} = \frac{[\text{H}_3\text{O}^+] \cdot [\text{HCO}_3^-]}{[\text{CO}_{2(\text{dizolvat})}]} \Rightarrow \frac{[\text{HCO}_3^-]}{[\text{CO}_{2(\text{dizolvat})}]} = \frac{K_{a1}}{[\text{H}_3\text{O}^+]} = \frac{4,5 \cdot 10^{-7}}{3,98 \cdot 10^{-8}} = 11,3 \quad (4\text{p})$$

d)

$$[\text{HCO}_3^-] = 11,3 [\text{CO}_2(\text{diz})]$$

$$11,3 \cdot [\text{CO}_2(\text{diz})] + [\text{CO}_2(\text{diz})] = 2,52 \cdot 10^{-2} \text{ mol} \cdot \text{L}^{-1} \quad (2\text{p})$$

$$[\text{CO}_2(\text{diz})] = 2,52 \cdot 10^{-2} / 12,3 = 0,2 \cdot 10^{-2} \text{ mol} \cdot \text{L}^{-1}$$

$$[\text{HCO}_3^-] = (2,52 \cdot 10^{-2}) - (0,2 \cdot 10^{-2}) = 2,32 \cdot 10^{-2} \text{ mol} \cdot \text{L}^{-1} \quad (2\text{p})$$

e)

$$[\text{CO}_{2(\text{dizolvat})}] = K_H \cdot p_{\text{CO}_2} \Rightarrow 4[\text{CO}_{2(\text{dizolvat})}] = K_H \cdot 4p_{\text{CO}_2} \Rightarrow [\text{CO}_{2(\text{dizolvat})}]_{\text{final}} = 0,8 \cdot 10^{-2} \text{ mol} \cdot \text{L}^{-1} \quad (3\text{p})$$

Explica\u021bie: (pentru reducerea concentra\u021biei de CO_2 dizolvat este nevoie ca volumul de aer expirat s\u0103 creasc\u0103 \u0219i pentru aceasta trebuie ca frecven\u021ba respira\u021biei s\u0103 creasc\u0103 \u00een timpul exerci\u021biului fizic) sau (reducerea pH-ului stimuleaz\u0103 centrul respirator, astfel hiperventila\u021bia elimin\u0103 excesul de CO_2 iar pH-ul cre\u0219te). (2p)

Barem elaborat de:

prof. univ. dr. Ion Ion – Universitatea Na\u021bional\u0103 de \u0218tiin\u021b\u0103 \u0219i Tehnologie Politehnic\u0103 Bucure\u0219ti

prof. Bud Ionel, Colegiul Na\u021bional „Vasile Lucaciu”, Baia Mare

prof. Costeniuc Iuliana, Colegiul Na\u021bional „Grigore Moisil”, Bucure\u0219ti

prof. Sz\u00f6v\u00e9rfi J\u00e1nos, Liceul Teoretic “Bolyai Farkas”, T\u0103rgu Mure\u0219

prof. Mitrescu Elena, Colegiul Na\u021bional Pedagogic „Constantin Cantacuzino”, T\u0103rgovi\u0219te

prof. Popescu Elena Irina, Colegiul Na\u021bional „Ion Luca Caragiale”, Ploie\u0219ti