

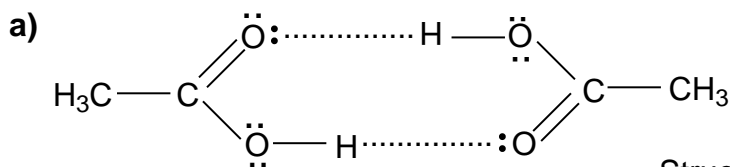
**OLIMPIADA DE CHIMIE**  
etapa județeană/municipiului București  
23 martie 2024  
Clasa a IX-a  
**BAREM DE EVALUARE ȘI DE NOTARE**

Orice modalitate de rezolvare corectă a cerințelor se punctează corespunzător.

**SUBIECTUL I**

**30 de puncte**

**A.....13,5 puncte**



Structura dimerului ..... 1 punct

Explicația ..... 1 punct

b)  $\text{Cs}_2\text{O}$ ,  $\text{Na}_2\text{O}$ ,  $\text{CaO}$ ,  $\text{MgO}$  ..... 2 puncte

Explicarea variației punctelor de topire ..... 1 punct

c)  $\text{Fe}^{3+}$ :  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$  (are 5 electroni necuplați)

$\text{Cr}^{3+}$ :  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3$  (are 3 electroni necuplați)

$\text{Fe}^{2+}$ :  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$  (are 4 electroni necuplați)

$\text{Cr}$ :  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$  (are 6 electroni necuplați)

$\text{Cu}^+$ :  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$  (nu are electroni necuplați) ... 5 configurații x 0,5 p = 2,5 puncte

$\text{Cu}^+$ ,  $\text{Cr}^{3+}$ ,  $\text{Fe}^{2+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Cr}$  ..... 2 puncte

d) (1)  $\text{CCl}_4$  (0,5 p) argumentarea (0,5 p) ..... 1 punct

(2)  $\text{HF}$  (0,5 p) argumentarea (0,5 p) ..... 1 punct

(3)  $\text{HI}$  (0,5 p) argumentarea (0,5 p) ..... 1 punct

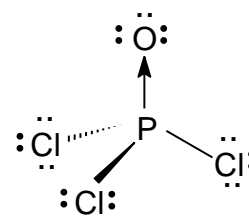
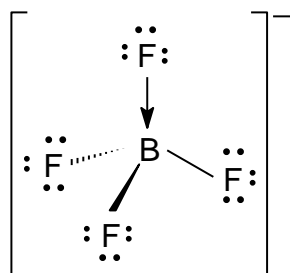
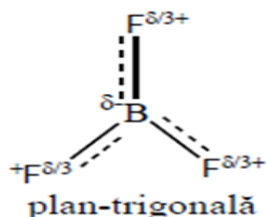
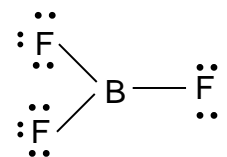
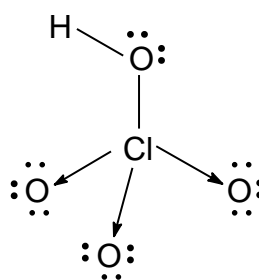
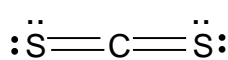
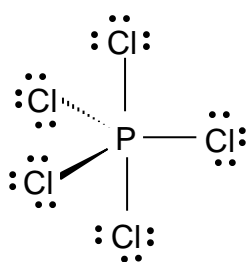
(4)  $\text{ICl}$  (0,5 p) argumentarea (0,5 p) ..... 1 punct

**B. .... 3 puncte**

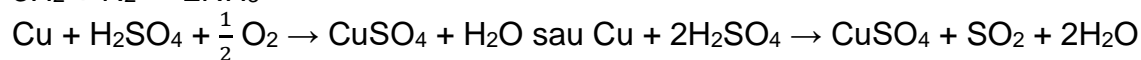
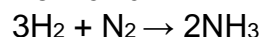
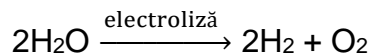
a)  $\text{Cl}^- < \text{Ar} < \text{K}^+$  (1 p) argumentarea (0,5 p) ..... 1,5 puncte

b)  $\text{Fe} < \text{Fe}^{2+} < \text{Fe}^{3+}$  (1 p) argumentarea (0,5 p) ..... 1,5 puncte

**C. 6 structuri x 1 p ..... 6 puncte**



**D. .... 5 puncte**



**E. .... 2,5 puncte**

$S = 1185,88 \text{ L NH}_3/\text{L H}_2\text{O}$  ..... **2,5 puncte**

**SUBIECTUL al II-lea**

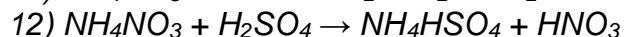
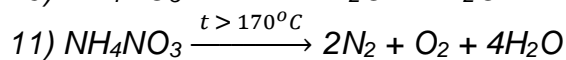
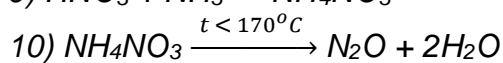
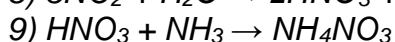
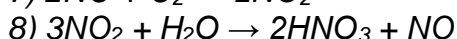
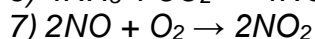
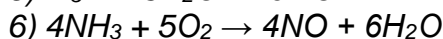
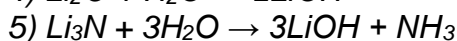
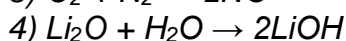
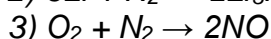
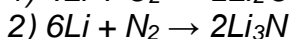
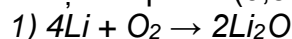
**30 de puncte**

**A. .... 21 puncte**

a) determinarea substanțelor: **h** - LiOH; **l** -  $\text{NH}_4\text{NO}_3$ ; **n** -  $\text{H}_2\text{SO}_4$  ..... **3 x 1p = 3 puncte**

b) identificarea substanțelor: **a** - Li, **b** -  $\text{O}_2$ , **c** -  $\text{Li}_2\text{O}$ , **d** -  $\text{N}_2$ , **e** -  $\text{Li}_3\text{N}$ , **f** - NO, **g** -  $\text{H}_2\text{O}$ , **l** -  $\text{NH}_3$ ,  
**j** -  $\text{NO}_2$ , **k** -  $\text{HNO}_3$ , **m** -  $\text{N}_2\text{O}$ , **o** -  $\text{NH}_4\text{HSO}_4$  ..... **12 x 0,5p = 6 puncte**

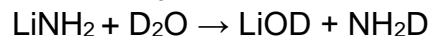
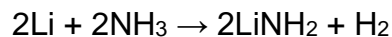
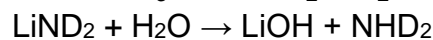
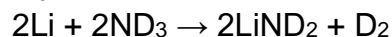
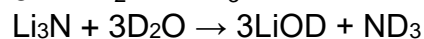
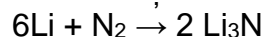
b) 12 ecuații x 1 punct (0,5 p formule; 0,5 p coeficienți) ..... **= 12 puncte**



**B. .... 9 puncte**

a) Scrierea speciilor moleculare:  $\text{ND}_3$ ,  $\text{NHD}_2$ ,  $\text{NH}_2\text{D}$  ..... **3 x 1 p = 3 puncte**

b) Scrierea ecuațiilor reacțiilor ..... **6 ecuații x 1 p (0,5 p formule; 0,5 p coeficienți) = 6 puncte**



**SUBIECTUL al III-lea**

**20 de puncte**

**A. .... 12 puncte**

a) 20%  $\text{SO}_3$  liber în oleum; ..... **3 puncte**

b) masa de  $\text{H}_2\text{SO}_4 = 3200 \text{ g}$ ; masa de  $\text{SO}_3 = 800 \text{ g}$ ;  
masa de  $\text{H}_2\text{SO}_4$  din reacția  $\text{SO}_3$  cu apa =  $980 \text{ g}$ ;  $m_{\text{t H}_2\text{SO}_4} = 4180 \text{ g}$ ; ..... **3 puncte**

c)  $m_{\text{H}_2\text{SO}_4}$  din soluția de  $c = 80\% = 2768 \text{ g}$ ;  $m_{\text{H}_2\text{O}} = 692 \text{ g}$ ;  $V_{\text{H}_2\text{SO}_4 \text{ pur}} = 1504,34 \text{ mL}$ ;  
 $V_{\text{H}_2\text{O}} = 659,04 \text{ mL}$ ;  $V_{\text{total}} = 2163,38 \text{ mL}$ ; Contractia de volum =  $163,38 \text{ mL}$ ; ..... **3 puncte**

d)  $x_{\text{H}_2\text{SO}_4} = 0,423$  ..... **2 puncte**

e)  $c_{\text{M}} = 14,122 \text{ M}$  ..... **1 punct**

**B. .... 8 puncte**

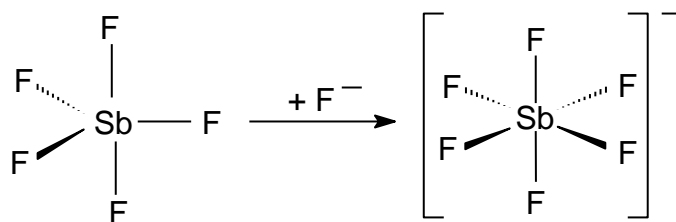
a) cantitatea de NO =  $0,0146 \text{ mol}$  ..... **1 punct**

cantitatea de  $\text{O}_2 = 0,0042 \text{ mol}$  ..... **1 punct**

- ecuația reacției chimice:  $2\text{NO}_{(g)} + \text{O}_{2(g)} \rightarrow \text{N}_2\text{O}_{4(s)}$  ..... 1 punct  
 cantitatea de NO consumată = 0,0084 mol ..... 1 punct  
 numărul de moli de NO în exces = 0,0062 moli ..... 1 punct  
 $p_f = 0,3268 \text{ atm}$  ..... 1 punct  
 b)  $m_{\text{N}_2\text{O}_4} = 386,4 \text{ mg}$  ..... 1 punct  
 c) existența unui electron necuplat în molecula de  $\text{NO}_2$  ..... 1 punct

**SUBIECTUL al IV-lea** **20 de puncte**

- a) Identificarea elementelor **A**, **D** și **E** ..... 3 x 2 p = 6 puncte  
 20 electroni – suma dintre numărul electronilor cationului monovalent și numărul electronilor anionului monovalent  
**A**: Na; **E**: F;  
 $\text{Na}_n[\text{SbF}_6]_m$ ;  
 $m = 1$ ;  $\text{Na}_n[\text{SbF}_6]$ ; pentru  $n = 1$ , **D**: Sb  
 b) formulele chimice ale substanțelor **DE**<sub>5</sub>, **AE** și **A<sub>n</sub>[DE<sub>6</sub>]<sub>m</sub>** ..... 3 x 2 p = 6 puncte  
**DE**<sub>5</sub>:  $\text{SbF}_5$ , **AE**:  $\text{NaF}$ , **A<sub>n</sub>[DE<sub>6</sub>]<sub>m</sub>**:  $\text{Na}[\text{SbF}_6]$   
 c) ecuația reacției de obținere a substanței X ..... 1 punct  
 $\text{SbF}_5 + \text{NaF} = \text{Na}[\text{SbF}_6]$   
 d) natura legăturilor din  $\text{Na}[\text{SbF}_6]$  ..... 2 x 2 p = 4 puncte  
 între  $\text{Na}^+$  și  $[\text{SbF}_6]^-$  ..... legătură ionică  
 în ionul complex  $[\text{SbF}_6]^-$  ..... 5 legături covalente și o legătură covalent coordinativă  
 modelarea formării legăturilor chimice în  $[\text{SbF}_6]^-$  ..... 1 punct



- e) raza anionului  $[\text{SbF}_6]^- = 2,64 \times 10^{-8} \text{ cm}$  ..... 2 puncte

Barem elaborat de:

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