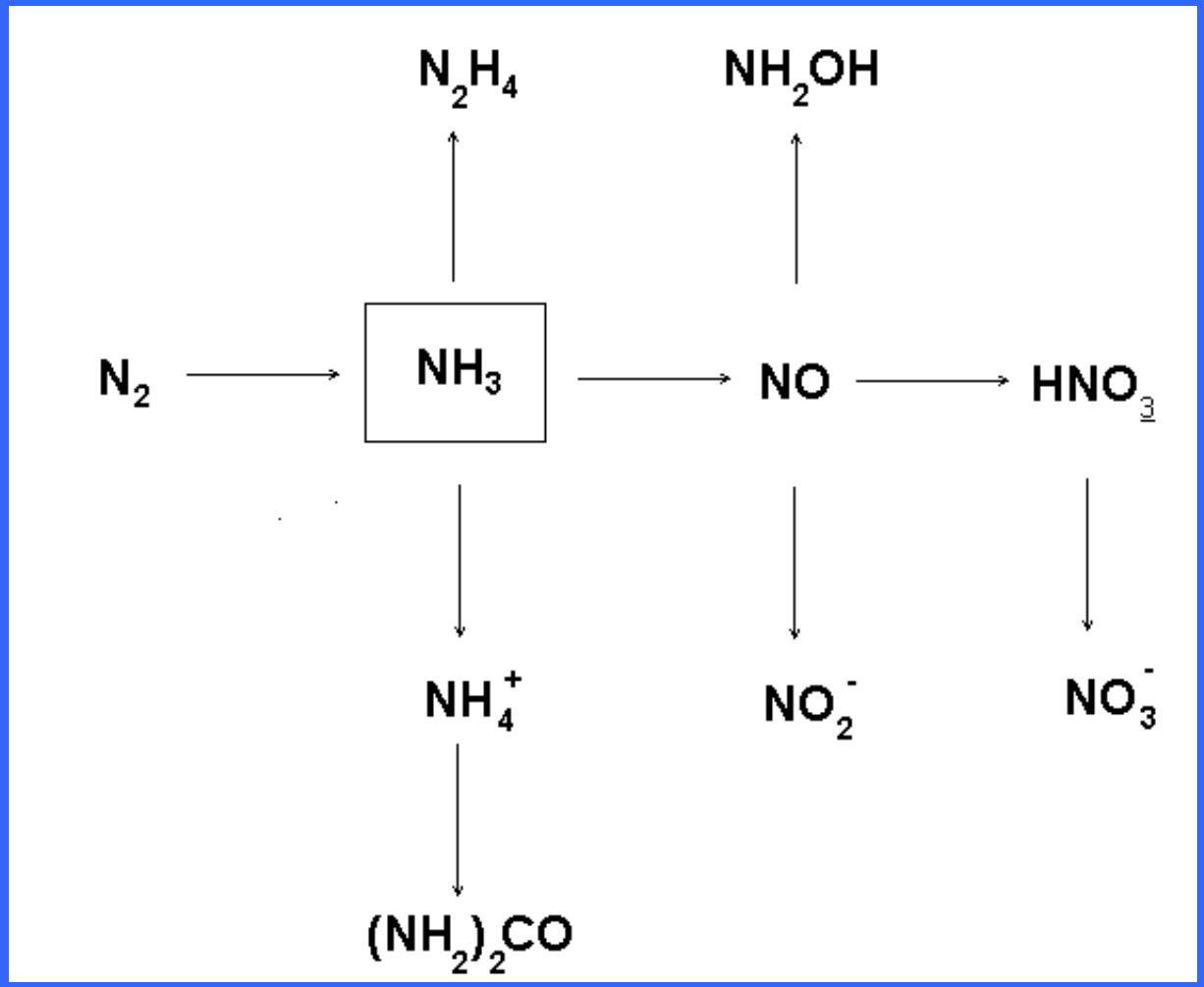
# Iz amonijačnih voda → $(NH_4)_2SO_4$



# SVOJSTVA:

## SVOJSTVA:

$$4\ NH_3 + 3O_2 \cdot \rightarrow\ 2\ N_2 + 6\ H_2O$$

$$4\ NH_3 + 5O_2 \rightarrow\ 4\ NO + 6\ H_2O \quad \Delta_r H = -1170\ jmol^{-1}$$

$$NH_3\ (ag) + H_2O \rightarrow\ NH_4^+\ (ag) + OH^-\ (ag)$$

$$kb = \frac{[NH_4]^+[OH^-]}{[NH_3]} = 1.8*10^{-5}\ \ mol/L$$

$NH_3 \bullet H_2O$ $\qquad\qquad$ $T_t = 194\ K$

$NH_3 \rightarrow NH_2^- + H^+ \rightarrow NH_2^- + 2\ H^+ \rightarrow N^{3-} + 3\ H^+$

$2\ Na + 2\ NH_3 \rightarrow 2\ Na\ NH_2 + H_2$

amidi $MNH_2$

imidi $M_2NH$

nitridi $M_3H$

ionski $Li_3N$

kovalentni AlN

metalni TiN

**$PH_3$**

**Dobivanje:**

$P_4 + 3\ H_2O + 3OH^- \rightarrow PH_3 + 3\ PH_2O_2^-$

$Ca_3P_2 + 6\ H_2O \rightarrow 2\ PH_3 + Ca^{2+} + 6\ OH^-$

**$AsH_3$** dozvoljeno 0.000005 %

$H_3Aso_3 + Zn + 6H^+ \rightarrow AsH_3 + 3\ Zn^{2+}$

$As_2Zn_3 + 6\ HCl \rightarrow 2\ AsH_3 + 3\ ZnCl_2$

$H_2As\text{-}\ AsH_2$ Kakodil

**Kadeova tekučina 1760 god.**

-II $H_2N\text{-}NH_2$ Hidrazin

Dobivanje: $2NH_3 + ClO^- \xrightarrow{OH^-} N_2H_4 + Cl^- + H_2O$

teški metali $\rightarrow$ $N_2$

Mehanizam:

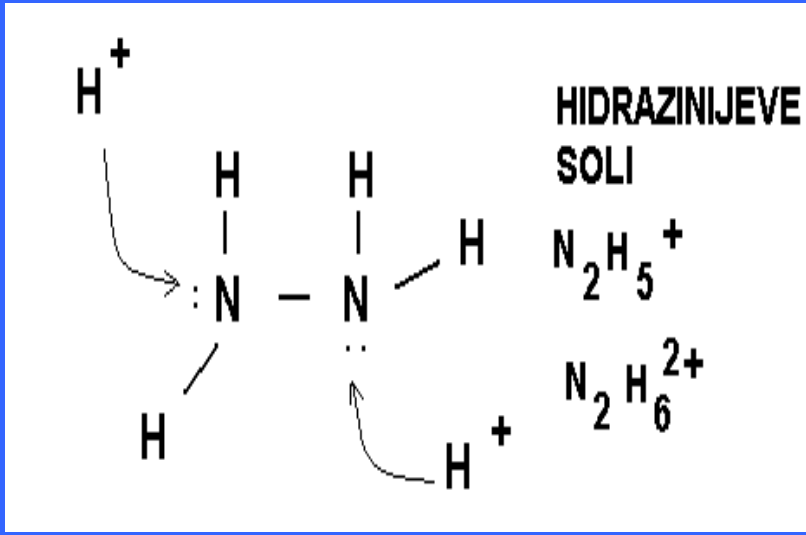
$NH_3 + ClO^- \rightarrow NH_2Cl^- + OH^-$

$NH_2Cl + NH_3 \xrightarrow{\text{sporo}} N_2H_5 + Cl^-$

$N_2H_5^+ + OH^- \xrightarrow{\text{brzo}} N_2H_4 + H_2O$

$N_2H_4 + 2\ NH_2Cl \xrightarrow[Cu^{2+}\ \text{želatina}]{\text{brzo}} 2\ NH_4Cl + N_2$

# Svojstva:




$$3\ N_2H_4 \rightarrow N_2 + 4\ NH_3$$

$N_2H_5^+ + 3\ H^+ + 2e^- \rightarrow 2\ NH_4^+$; $E^0 = 1.24$ V

$N_2 + 5\ H^+ + 4\ e^- \rightarrow N_2H_5^+$; $E^0 = -0.17$V

$N_2 + 4\ H_2O + 4\ e^- \rightarrow N_2H_4 + 4\ OH^-$ $E^0 = -1.15$V

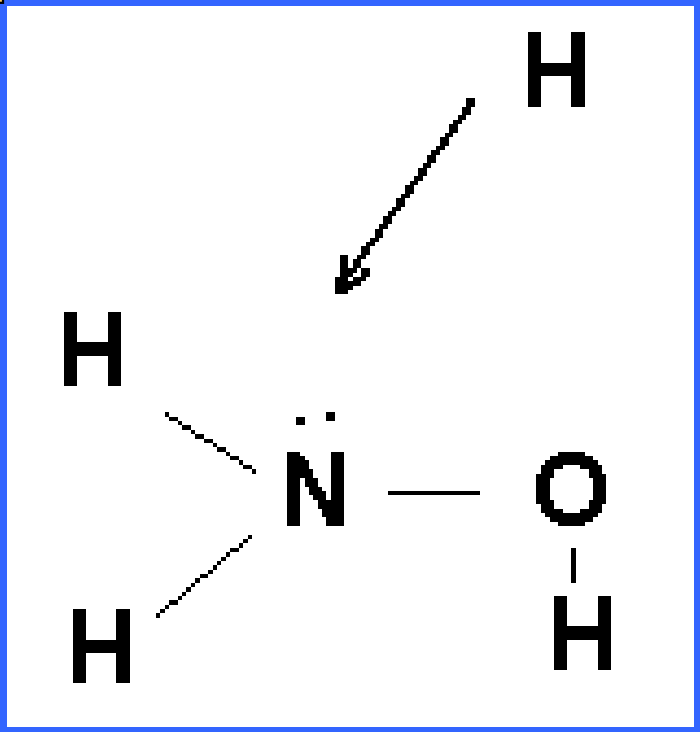
*Raketno gorivo*:

$$N_2H_4 + 2H_2O_2 \xrightarrow{Cu\ 2+} N_2 + 2H_2O$$

$$N_2H_4 + O_2 \rightarrow N_2 + 2\ H_2O$$

$O_2$ Otopljen u vodi

-I $NH_2OH$ $NH_3OH^+$




hidroksilamin

K: $NO_3^- + 7\ H^+ + 6\ e^- \rightarrow NH_2OH + 2\ H_2O$

Pb(Hg)

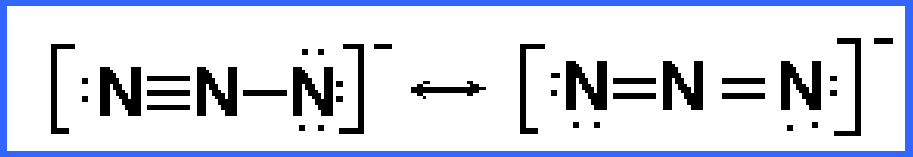
$3\ NH_2OH \rightarrow N_2 + NH_3 + 3H_2O$

$2\ NH_2OH + 2OH^- \rightarrow N_2 + 4\ H_2O + 2e^-$ $\quad E^0 = -3.04V$

**hidroksilamonijeve soli**

$^{-1/3}$ $HN_3$, $N_3^-$ $HN_3 \rightarrow H^+ + N_3^-$

# AZIDI



$N_2H_4 + NaNO_2 \rightarrow NaN_3 + 2\ H_2O$

$$N_2O + 2\ Na_2O + NH_3 \xrightarrow{<190^\circ C} NaN_3 + 3\ NaOH$$

$2\ HN_3 \rightarrow 3\ N_2 + H_2 \qquad \Delta_r H < 0$

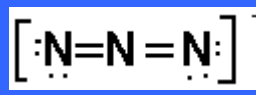
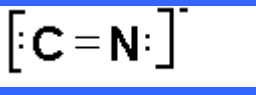
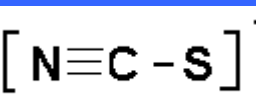
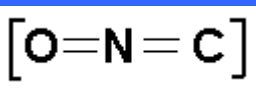
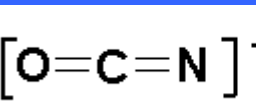
$Pb(N_3)_2$

# Airbag

$$NaN_3 + KNO_3 \longrightarrow N_2$$

# Pseudohalogenidi

| | O | N | S | C |
|---|---|---|---|---|
| $\chi$ | 3.5 | 3 | 2.5 | 2.5 |

| | | |
|---|---|---|
| $N_3^-$ |  | azid |
| $CN^-$ |  | cianid |
| $NCS^-$ |  | tiocianat |
| $ONC^-$ |  | fulminat |
| $OCN^-$ |  | cianat |

## Psudohalogeni

$(CN)_2$, $(SCN)_2$

**Dobivanje:**

$$2\,NH_3 + 2\,CH_4 + 3O_2 \xrightarrow[80\ ^\circ C]{kat} 2\,HCN + 6\,H_2O$$

$$NH_3 + CO \xrightarrow[6oo\ ^\circ C]{kat} HCN + H_2O$$

$$H_2 + 2\,C + N_2 \xrightarrow{1800\ ^\circ C} 2\,HCN$$

**Dob:**

$$NaNH_2 + C \rightarrow NaCN + H_2$$

$$NaCN + H^+ \rightarrow HCN + Na^+$$

$$\underline{HCN} + H_2O \rightarrow H_3O^+ + CN^-$$

$$K_A = 7 \cdot 10^{-10}\ mol/L$$

**Vrlo otrovan**

$$CN^- + H_2O \rightarrow HCN + OH^-$$

$$Ag^+ + 2\ CN^- \rightarrow [\ Ag\ (CN)_2\ ]^-$$

$$2\ CN^- \rightarrow (CN)_2$$

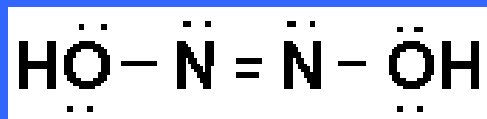
$$(CN)_2 + 2\ OH^- \rightarrow CN^- + OCN^- + H_2O$$

Dob:

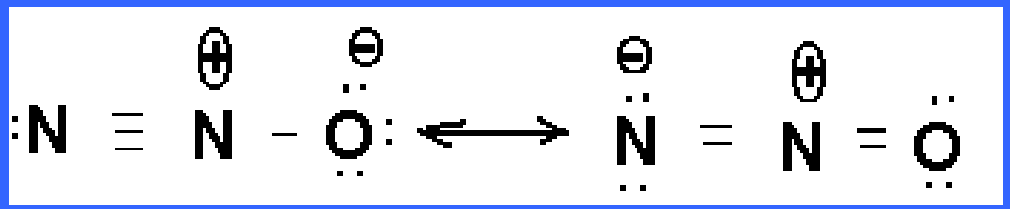
$$CN^- + S \rightarrow CNS^-$$

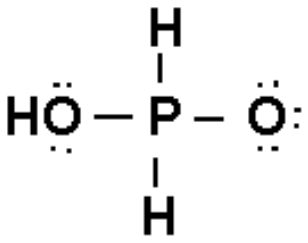
$$Fe^{2+} + 6\ SCN^- \rightarrow [Fe(SCN)_6]^{3-}$$

I $N_2O$,  $H_2N_2O_2$  $HPH_2O_2$



divodikov dioksodinitrat





fosfinska kiselina
dihidridodioksofosforna(I) kiselina

**Dob:** $NH_4NO_3 \rightarrow N_2O + 2\ H_2O$

$2\ N_2O \rightarrow 2N_2 + O_2$

**Dob:** $H_2N_2O_2$

$2\ NO_3^- + 8\ Na + 4\ H_20 \rightarrow N_2O_2^{2-} + 8\ Na^+ + 8\ OH^-$

Hg

$Ag^+$

$\downarrow$ HCl

$H_2N_2O_2 \rightarrow Ag_2N_2O_2$

Eter

$H_2N_2O_2 \rightarrow N_2O + H_2O$

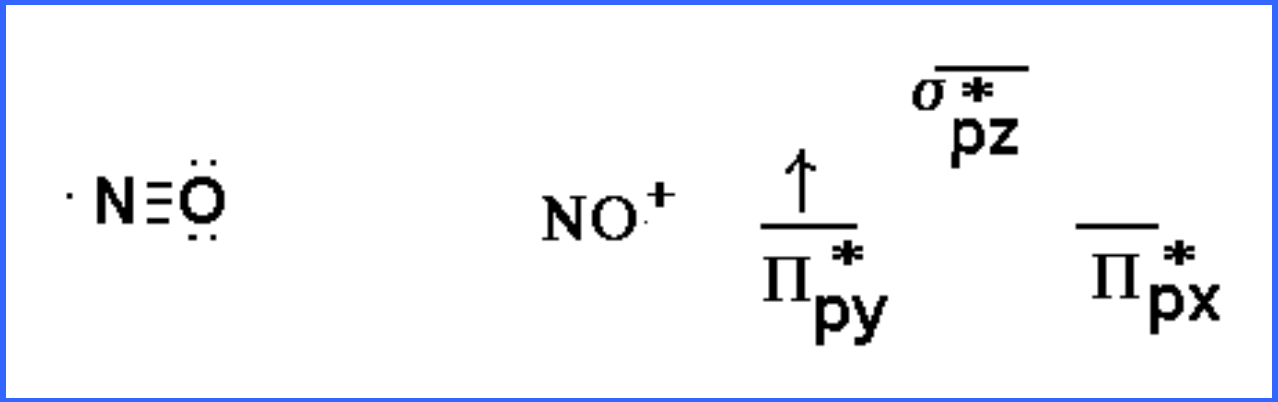
Vodena otopina

$HPH_2O_2 \rightarrow H^+ + PH_2O_2^-$ $K_A \approx 10^{-2}$ mol/L

$PHO_3^{2-} + 2\ H_2O + 2\ e^- \rightarrow PH_2O_2 + 3\ OH^-$ $E^0 = -1.65$ V

$Cu^{2+} + HPH_2O_2 + H_2O \rightarrow Cu + H_2PHO_3 + 2H^+$

# II NO




$N_2 + O_2 \rightarrow 2\ NO$ $\Delta_r H = 180$ kJ/mol

$2\ NO + O_2 \rightarrow 2\ NO_2$

$4\ NH_3 + 5O_2 \rightarrow 4\ NO + 6\ H_2O$

Ostwaldov postupak $\Delta_r H = -1167$ kJ/mol

**Lab.:**

$2\ NO_3^- + 3\ Cu + 8\ H^+ \rightarrow 2\ NO + 3\ Cu^{2+} + 4\ H_2O$

$NO_3^- + 3\ Fe^{2+} + 6\ H^+ \xrightarrow{H_2SO_4} NO + 3\ Fe^{3+} + 3\ H_2O$

$Fe^{2+} + NO \xrightarrow{H_2SO_4} Fe\ NO^{2+}$

$\downarrow \qquad \uparrow$

$NO_3^-$ smeđ

$2\ NO + Cl_2 \rightarrow 2\ NOCl$ nitrozil halogenovodici

# Izosterne molekule

| | $N_2O$ | $CO_2$ |
|---|---|---|
| Broj atoma | 3 | 3 |
| Broj elektrona | 16 | 16 |
| $T_t$ /K | 182 | 217 |
| $T_v$/K | 184 | 195 |

| | $N_2$ | CO |
|---|---|---|
| $T_t$/K | 63 | 68 |
| $T_v$/K | 72 | 82 |

III

$N_2O_3$, $HNO_2$, soli

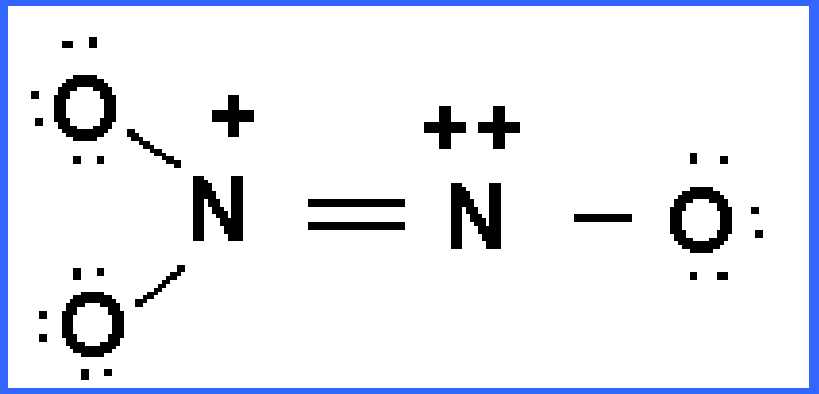
$P_4O_6$, $H_2PHO_3$ soli

$As_4O_6$ $H_3AsO_3$ soli

*$Sb_4O_6$} netopljivi u vodi*

*$Bi_2O_3$} netopljivi u vodi*

$$N_2O_3 \rightarrow NO_2 + NO$$



$$NO + NO_2 + H_2O \rightarrow 2\ HNO_2$$

$N_2O_3$

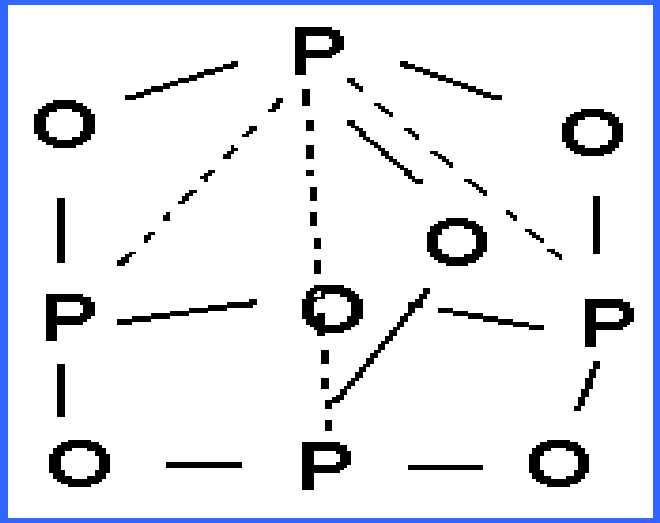
$$3\ HNO_2 \rightarrow NO_3^- + 2\ NO + H^+ + H_2O$$

**soli dob:**

$$NO + NO_2 + 2\ OH^- \rightarrow 2\ NO_2^- + H_2O$$

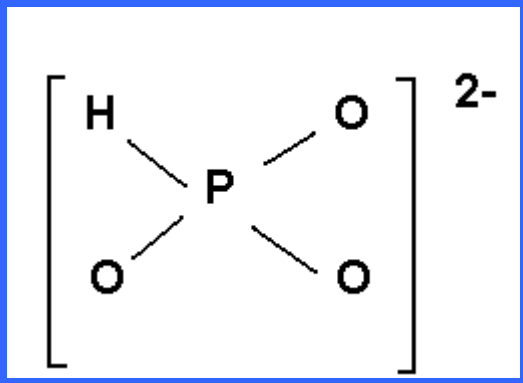
$$2\ Na\ NO_3\ (l) \rightarrow 2\ NaNO_2 + O_2$$

$P_4O_6$
$As_4O_6$
$Sb_4O_6$




$\overset{0}{P_4} + 3\ \overset{0}{O_2} \rightarrow P_4O_6$

$P_4O_6 + 6\ H_2O \xrightarrow{\text{sporo}} 4\ H_3PO_3$




grijanje

$4\ H_2PHO_3 \rightarrow PH_3 + 3\ H_3PO_4$

$\overset{+5}{PO_4}^{3-} + 2\ H_2O + 2\ e^- \rightarrow \overset{+3}{PHO_3}^{2-} + 3\ OH^-$ $E^0 = -1.05V$

$As_4O_6$ vrlo otrovan

1.2g u 100 g $H_2O$

$4\ FeAsS + 10\ O_2 \rightarrow As_4O_6 + 2\ Fe_2O_3 + 4\ SO_2$

*III -I -II 700 C*

*$FeAsS \rightarrow FeS + As$*

$As_4O_6 + 6\ H_2O \rightarrow 4\ H_3ASO_3$

$H_3AsO_3 \rightarrow H^+ + H_2AsO_3^-$ $k_1 = 2.4 \cdot 10^{-10}$ mol/L

$H_3AsO_3 + H^+ \rightarrow H_2AsO_2^+ + H_2O$

$As(OH)_3 \rightarrow As(OH)_2^+ + OH^-$

$\downarrow$

$+ 2H^+$ $As^{3+}$?

$Sb_4O_6$

$4\ Sb + 3\ O_2 \rightarrow Sb_4O_6$

$Sb_4O_6 + 12\ H^+ \rightarrow 4\ Sb^{3+} + 6\ H_2O$

$Sb^{3+} + H_2O \rightarrow SbO^+ + 2\ H^+$

antimonil soli

$SbO^+ + Cl^- \rightarrow SbOCl\ (s)$

$Sb_4O_6 + 4\ OH^- \rightarrow 4\ SbO^{2-} + 2H_2O$

$Sb_4O_6 + 4\ OH^- + 6\ H_2O \rightarrow 4\ Sb(OH)^{4-}$

Antimonat (III)-soli

$2\ Sb^{3+} + 3\ H_2S \rightarrow Sb_2S_3 + 6\ H^+$

narandžast

$Sb_2S_3$ –antimonit- crn

$Sb_2S_3 + 6\ HCl \rightarrow SbCl_3 + 3\ H_2S$

$SbCl_3 + H_2O \rightarrow SbOCl + 2\ HCl$

$SbCl_3 + Cl^- \rightarrow SbCl^{4-}$

$SbO^+ + C_4H_4O_6^{\ 2-} \rightarrow [SbO\ (C_4H_4O_6)]^-$

$[Sb_2\ (C_4H_4O_6)]^{2-}$

tartarat

$$Bi_2O_3 + 6\ H^+ \rightarrow 2\ Bi^{3+} + 3\ H_2O$$

HCl, $HNO_3$

$$Bi^{3+} + H_2O \rightarrow BiO^+ + 2H^+$$

$$BiO^+ + Cl^- \rightarrow BiOCl(s)$$

*ili* $Bi^+ + 3\ OH^- \rightarrow Bi\ (OH)_3$

$$BiO^+ + H_2O + OH^- \rightarrow Bi(OH)_3$$

$$2\ Bi(OH)_3 \rightarrow Bi_2O_3 + 3\ H_2O$$

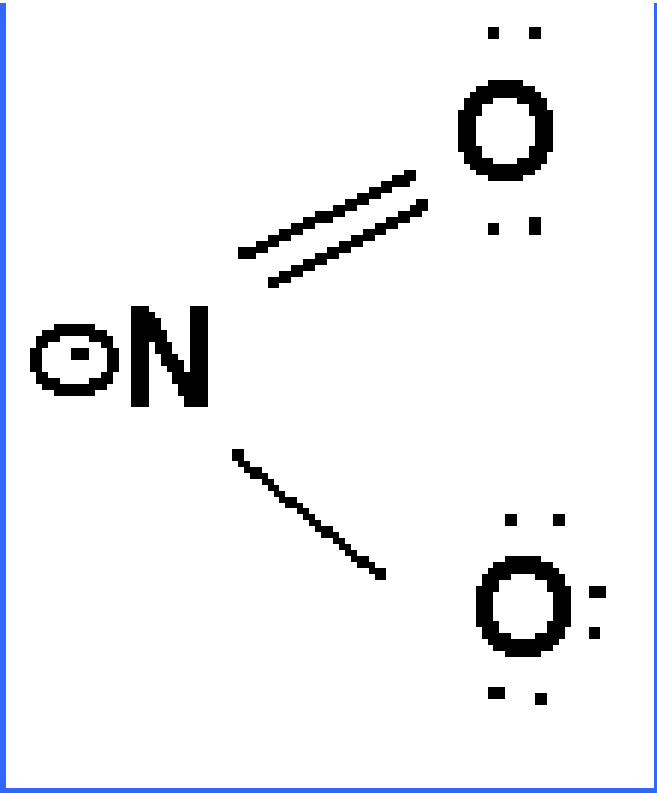
žut

# IV

## $NO_2$

$N_2O_4$

$2\ NO_2 \rightarrow N_2O_4 \quad \Delta_r H < 0$



dob:

$2\ Pb(NO_3)_2 \rightarrow 2\ PbO + 4\ NO_2 + O_2$

THE END