化學反應圖解

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化學反應圖解

內容提要 本書採用圖解的方式，把各種化學元素及其重要化合物的存在、製備、性質、鑑別方法、應用等等，簡單明白地表示出來，並寫出有關的化學反應方程式，可以作爲複習化學的參考書，也可以作爲備隨時檢查的化學反應手冊。

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說　明

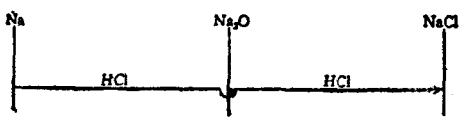
各元素的名稱，記號，在週期表中屬於那一類，原子價爲多少等，均列於各該圖表的第一行中。第二行是"存在"，但這裏所包括的，僅有一些存在於自然界中的普通化合物，而且此種化合物的名稱，除了特殊的以外，均沒有寫在表上。

各元素的各重要化合物，依各化合物中該元素原子價的多少爲次序而自左方排至右方。若某元素有氫化物，必將氫化物排於表的最左方，因爲氫化物中此元素的原子價是負的原子價。其次，爲單獨的元素（此時的原子價爲零），更次，則爲氧化物，因爲氧化物中此元素的原子價是正原子價。

從某一分子式畫出的垂直線，即表示此分子式所代表的化合物。和此線接連的他直線，如箭頭向着垂直線，表示此化合物的製造方法。反之，如箭頭向外，則表示此化合物能參加的化學反應。每一垂直線最下部的數目，表示此垂直線所代表的化合物中該元素的原子價。

如有二直線，彼此並無關係，而必須相交通過時，則依下法表示：

又如，鈉或氧化鈉和鹽酸作用，均能變爲氯化鈉，則依下法表示：



這又表示鈉與鹽酸作用，並不能發生氧化鈉。

不安定的化合物，及不能單獨存在的分子式，均寫在括號［　］中

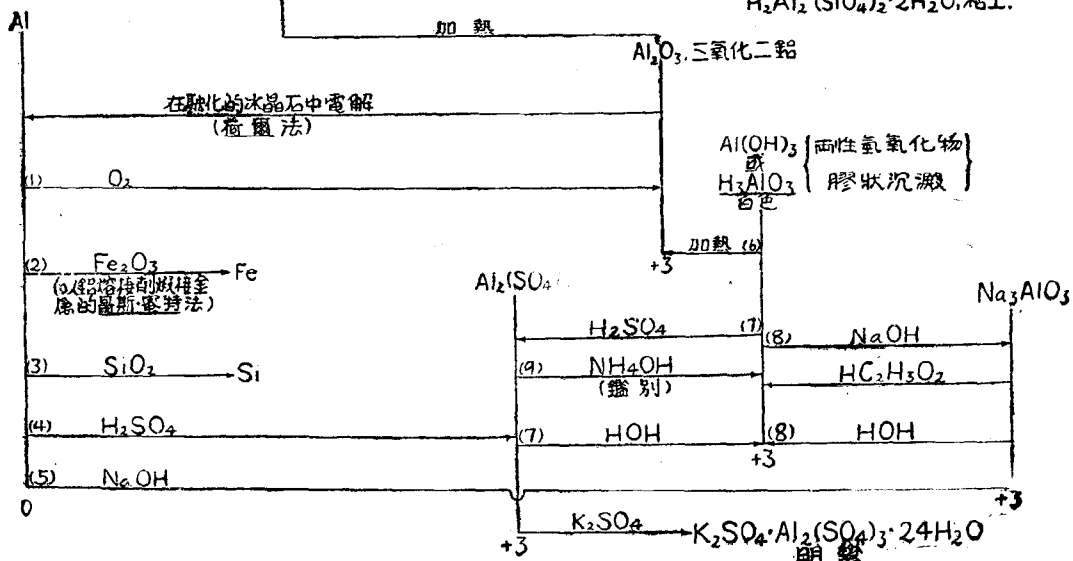
每一箭頭尾端，均註有一個數目，此數目表示此作用的方程式在方程式表中的號碼。

此表依各元素英名首字的次序排列。

想知道各化合物的中名或英名，可參考後面附錄着的各化合物的英名中名及分子式對照表。這表是譯者編入的。

鋁 Al.　　第三類，原子價 +3

存在：$Al_2O_3 \cdot 2H_2O$,水礬土礦; Al_2O_3,剛玉; Na_3AlF_6,冰晶石; $KAlSiO_4$,雲母; $KAlSi_3O_8$長石; $H_2Al_2(SiO_4)_2 \cdot 2H_2O$,粘土.



鋁的方程式

(1) $4Al+3O_2 \rightarrow 2Al_2O_3$

(2) $2Al+Fe_2O_3 \rightarrow Al_2O_3+2Fe$

(3) $4Al+3SiO_2 \rightarrow 2Al_2O_3+3Si$

(4) $2Al+3H_2SO_4 \rightarrow Al_2(SO_4)_3+3H_2$

(5) $2Al+6NaOH \rightarrow 2Na_3AlO_3+3H_2$

(6) $2Al(OH)_3 \rightarrow Al_2O_3+3H_2O$

(7) $\underline{2Al(OH)_3}+3H_2SO_4 \rightleftarrows Al_2(SO_4)_3+6HOH$

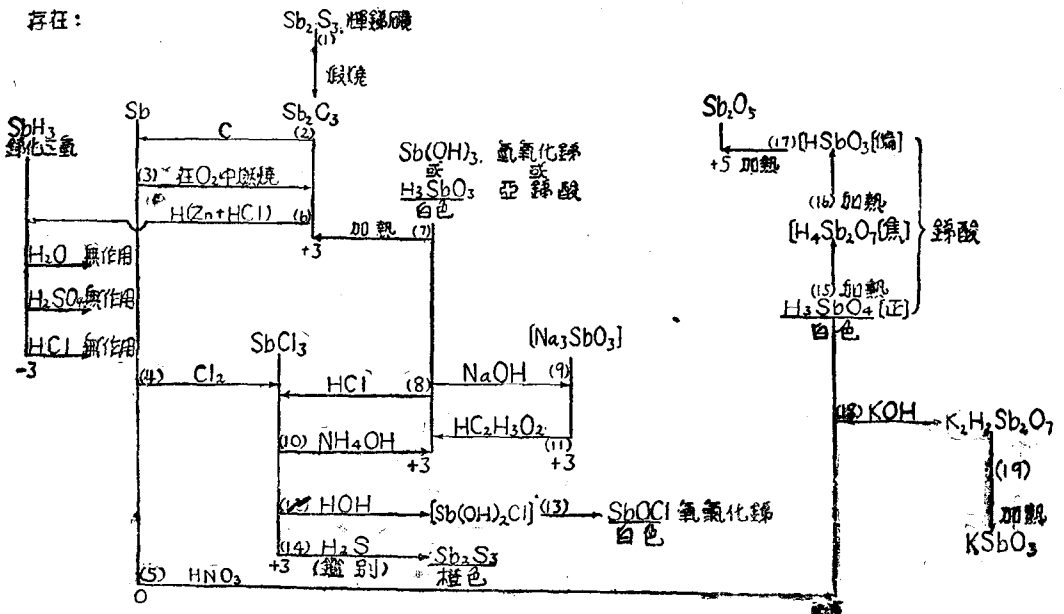
(8) $\underline{H_3AlO_3}+3NaOH \rightleftarrows Na_3AlO_3+3HOH$

(9) $Al_2(SO_4)_3+6NH_4OH \rightarrow \underline{2Al(OH)_3}+3(NH_4)_2SO_4$

(10) $Na_3AlO_3+3HC_2H_3O_2 \rightarrow \underline{H_3AlO_3}+3NaC_2H_3O_2$

銻, Sb.　　第五類, 原子價 −3, +3, 及 +5.

存在：



銻的方程式

(1) $2Sb_2S_3 + 9O_2 \rightleftarrows 2Sb_2O_3 + 6SO_2$

(2) $Sb_2O_3 + 3C \rightarrow 2Sb + 3CO$

(3) $4Sb + 3O_2 \rightarrow 2Sb_2O_3$

(4) $2Sb + 3Cl_2 \rightarrow 2SbCl_3$

(5) $10HNO_3 \rightarrow 5H_2O + 10NO + 15O$

$6Sb + 15O \rightarrow 3Sb_2O_5$

$3Sb_2O_5 + 9H_2O \rightarrow 6H_3SbO_4$

$6Sb + 10HNO_3 + 4H_2O \rightarrow 6H_3SbO_4 + 10NO$

(6) $6Zn + 12HCl \rightarrow 6ZnCl_2 + 12H$

$Sb_2O_3 + 12H \rightarrow 2SbH_3 + 3H_2O$

$Sb_2O_3 + 6Zn + 12HCl \rightarrow 2SbH_3 + 6ZnCl_2 + 3H_2O$

(7) $2Sb(OH)_3 \rightleftarrows Sb_2O_3 + 3H_2O$

(8) $Sb(OH)_3 + 3HCl \rightleftarrows SbCl_3 + 3HOH$

(9) $H_3SbO_3 + 3NaOH \rightleftarrows Na_3SbO_3 + 3HOH$

(10) $SbCl_3 + 3NH_4OH \rightarrow Sb(OH)_3 + 3NH_4Cl$

(11) $Na_3SbO_3 + 3HC_2H_3O_2 \rightarrow H_3SbO_3 + 3NaC_2H_3O_2$

(12) $SbCl_3 + 2HOH \rightleftarrows Sb(OH)_2Cl + 2HCl$

(13) $Sb(OH)_2Cl \rightleftarrows SbOCl + H_2O$

(14) $2SbCl_3 + 3H_2S \rightarrow Sb_2S_3 + 6HCl$

(15) $2H_3SbO_4 \rightleftarrows H_4Sb_2O_7 + H_2O$

(16) $H_4Sb_2O_7 \rightleftarrows 2HSbO_3 + H_2O$

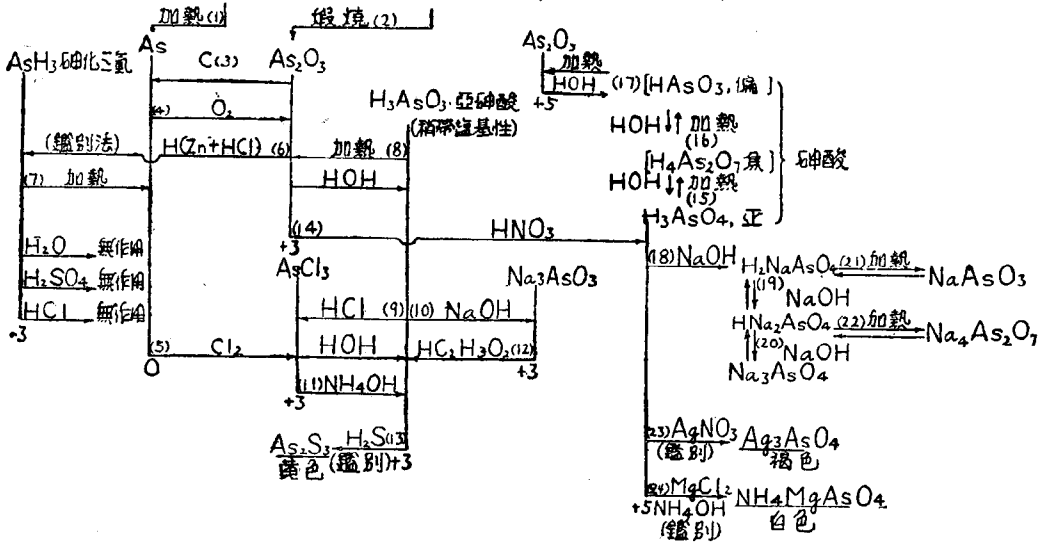
(17) $2HSbO_3 \rightleftarrows Sb_2O_5 + H_2O$

(18) $2H_3SbO_4 + 2KOH \rightarrow K_2H_2Sb_2O_7 + 3H_2O$

(19) $K_2H_2Sb_2O_7 \rightleftarrows 2KSbO_3 + H_2O$

砷, AS. 第五類, 原子價 −3, +3, 及 +5

存在: $FeAsS$, 硫砷鉄礦; As_2S_3 雄黃; As_2O_3 砒霜; As_2S_2 雌雄石.



砷的方程式

(1) $FeAsS \rightarrow FeS + As$

(2) $2As_2S_3 + 9O_2 \rightarrow 2As_2O_3 + 6SO_2$

(3) $As_2O_3 + 3C \rightarrow 2As + 3CO$

(4) $4As + 3O_2 \rightarrow 2As_2O_3$

(5) $2As + 3Cl_2 \rightarrow 2AsCl_3$

(6) $6Zn + 12HCl \rightarrow 6ZnCl_2 + 12H$

$As_2O_3 + 12H \rightarrow 2AsH_3 + 3H_2O$

$As_2O_3 + 6Zn + 12HCl \rightarrow 2AsH_3 + 6ZnCl_2 + 3H_2O$

(7) $2AsH_3 \rightarrow 2As + 3H_2$

(8) $As_2O_3 + 3H_2O \rightleftarrows 2H_3AsO_3$

(9) $As(OH)_3 + 3HCl \rightleftarrows AsCl_3 + 3HOH$

(10) $H_3AsO_3 + 3NaOH \rightleftarrows Na_3AsO_3 + 3HOH$

(11) $AsCl_3 + 3NH_4OH \rightarrow \underline{As(OH)_3} + 3NH_4Cl$

(12) $Na_3AsO_3 + 3HC_2H_3O_2 \rightarrow \underline{H_3AsO_3} + 3NaC_2H_3O_2$

(13) $2H_3AsO_3 + 3H_2S \rightarrow \underline{As_2S_3} + 6H_2O$

(14) $4HNO_3 \rightarrow 2H_2O + 4NO + 6O$

$3As_2O_3 + 6O \rightarrow 3As_2O_5$

$3As_2O_5 + 9H_2O \rightarrow 6H_3AsO_4$

$3As_2O_3 + 4HNO_3 + 7H_2O \rightarrow 6H_3AsO_4 + 4NO$

(15) $2H_3AsO_4 \rightleftarrows H_4As_2O_7 + H_2O$

(16) $H_4As_2O_7 \rightleftarrows 2HAsO_3 + H_2O$

(17) $2HAsO_3 \rightleftarrows As_2O_5 + H_2O$

(18) $H_3AsO_4 + NaOH \rightleftarrows H_2NaAsO_4 + HOH$

(19) $H_2NaAsO_4 + NaOH \rightleftarrows HNa_2AsO_4 + HOH$

(20) $HNa_2AsO_4 + NaOH \rightleftarrows Na_3AsO_4 + HOH$

(21) $H_2NaAsO_4 \rightleftarrows NaAsO_3 + H_2O$

(22) $2HNa_2AsO_4 \rightleftarrows Na_4As_2O_7 + H_2O$

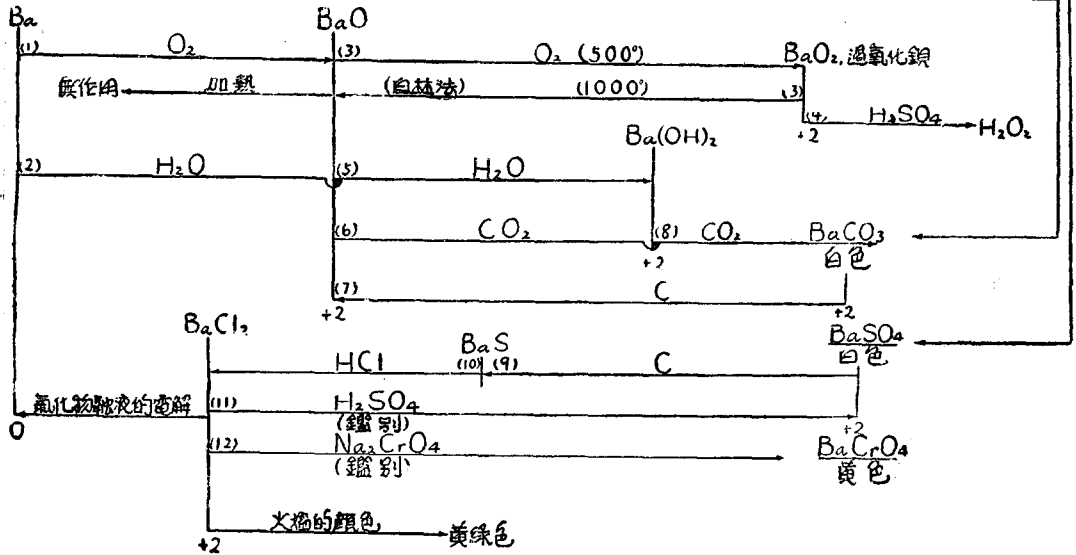
(23) $H_3AsO_4 + 3AgNO_3 \rightarrow \underline{Ag_3AsO_4} + 3HNO_3$

(24) $H_3AsO_4 + MgCl_2 + 3NH_4OH \rightarrow \underline{NH_4MgAsO_4} + 2NH_4Cl + 3H_2O$

鋇, Ba　　第二類, 原子價 +2

存在：

$BaCO_3$, 毒重石；　$BaSO_4$, 重晶石.



鋇的方程式

(1) $2Ba+O_2 \rightarrow 2BaO$

(2) $Ba+2HOH \rightarrow Ba(OH)_2+H_2$

(3) $2BaO+O_2 \rightleftarrows 2BaO_2$

(4) $BaO_2+H_2SO_4 \rightarrow \underline{BaSO_4}+H_2O_2$

(5) $BaO+H_2O \rightleftarrows Ba(OH)_2$

(6) $BaO+CO_2 \rightleftarrows BaCO_3$

(7) $BaCO_3+C \rightarrow BaO+2CO$

(8) $Ba(OH)_2+CO_2 \rightarrow \underline{BaCO_3}+H_2O$

(9) $BaSO_4+4C \rightarrow BaS+4CO$

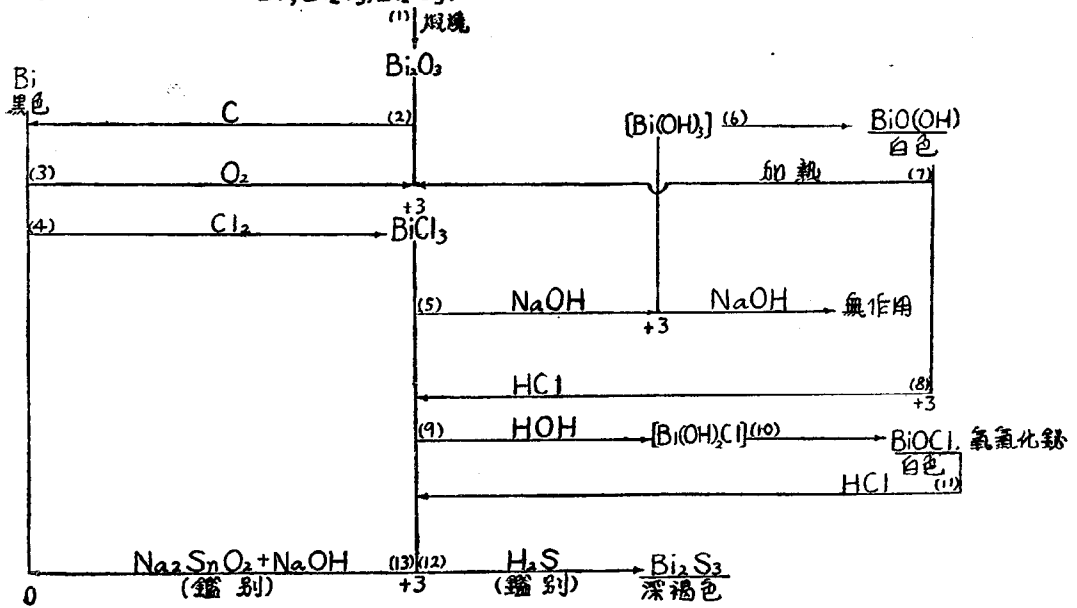
(10) $BaS+2HCl \rightarrow BaCl_2+H_2S$

(11) $BaCl_2+H_2SO_4 \rightarrow \underline{BaSO_4}+2HCl$

(12) $BaCl_2+Na_2CrO_4 \rightarrow \underline{BaCrO_4}+2NaCl$

鉍, Bi.　　第五類, 原子價 +3.

存在:　　Bi; Bi_2O_3; Bi_2S_3.



鉍的方程式

(1) $2Bi_2S_3+9O_2 \rightarrow 2Bi_2O_3+6SO_2$

(2) $Bi_2O_3+3C \rightarrow 2Bi+3CO$

(3) $4Bi+3O_2 \rightarrow 2Bi_2O_3$

(4) $2Bi+3Cl_2 \rightarrow 2BiCl_3$

(5) $BiCl_3+3NaOH \rightarrow [Bi(OH)_3]+3NaCl$

(6) $[Bi(OH)_3] \rightleftarrows \underline{BiO(OH)}+H_2O$

(7) $2BiO(OH) \rightleftarrows Bi_2O_3+H_2O$

(8) $\underline{BiO(OH)}+3HCl \rightleftarrows BiCl_3+2H_2O$

(9) $BiCl_3+2HOH \rightleftarrows [Bi(OH)_2Cl]+2HCl$

(10) $[Bi(OH)_2Cl] \rightleftarrows \underline{BiOCl}+H_2O$

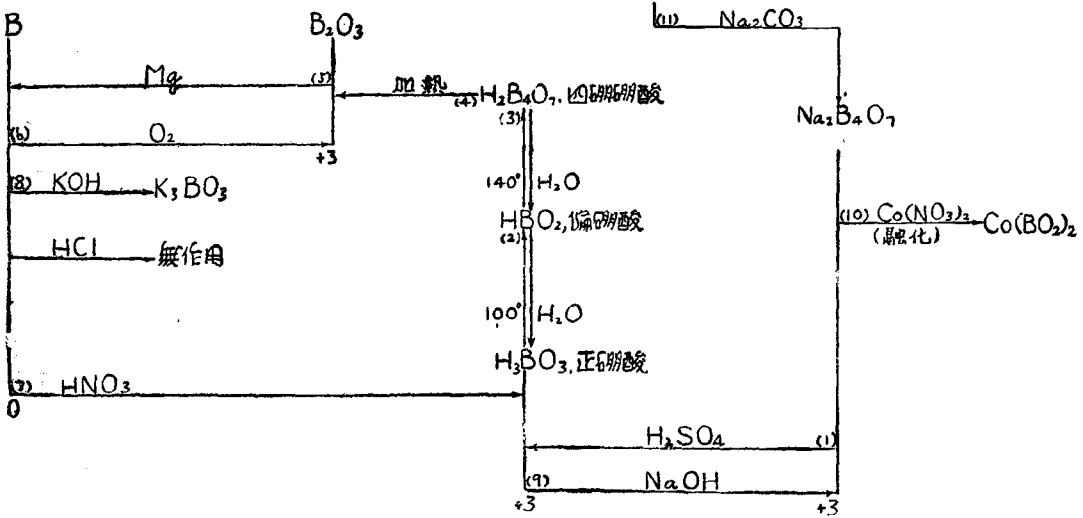
(11) $\underline{BiOCl}+2HCl \rightleftarrows BiCl_3+H_2O$

(12) $2BiCl_3+3H_2S \rightarrow \underline{Bi_2S_3}+6HCl$

(13) $2BiCl_3+3Na_2SnO_2+6NaOH \rightarrow \underline{2Bi}+3Na_2SnO_3+6NaCl+3H_2O$

硼, B.　　第三類, 原子價 +3.

存在：　H_3BO_3, 硼酸; $Na_2B_4O_7$, 硼砂; $Ca_2B_6O_{11}$, 硼酸鈣礦.



硼的方程式

(1) $Na_2B_4O_7+H_2SO_4+5H_2O \rightarrow 4H_3BO_3+Na_2SO_4$

(2) $H_3BO_3 \rightleftarrows HBO_2+H_2O$

(3) $4HBO_2 \rightleftarrows H_2B_4O_7+H_2O$

(4) $H_2B_4O_7 \rightleftarrows 2B_2O_3+H_2O$

(5) $B_2O_3+3Mg \rightarrow 2B+3MgO$

(6) $4B+3O_2 \rightarrow 2B_2O_3$

(7) $2HNO_3 \rightarrow H_2O+2NO+3O$

$2B+3O \rightarrow B_2O_3$

$B_2O_3+3H_2O \rightarrow 2H_3BO_3$

$3B+2HNO_3+2H_2O \rightarrow 2H_3BO_3+2NO$

或 $B+HNO_3+H_2O \rightarrow H_3BO_3+NO$

(8) $2B+6KOH \rightarrow 2K_3BO_3+3H_2$

(9) $4H_3BO_3+2NaOH \rightarrow Na_2B_4O_7+7H_2O$

(10) $2Na_2B_4O_7 \rightarrow 4NaBO_2+2B_2O_3$

$2Co(NO_3)_2 \rightarrow 2CoO+4NO_2+O_2$

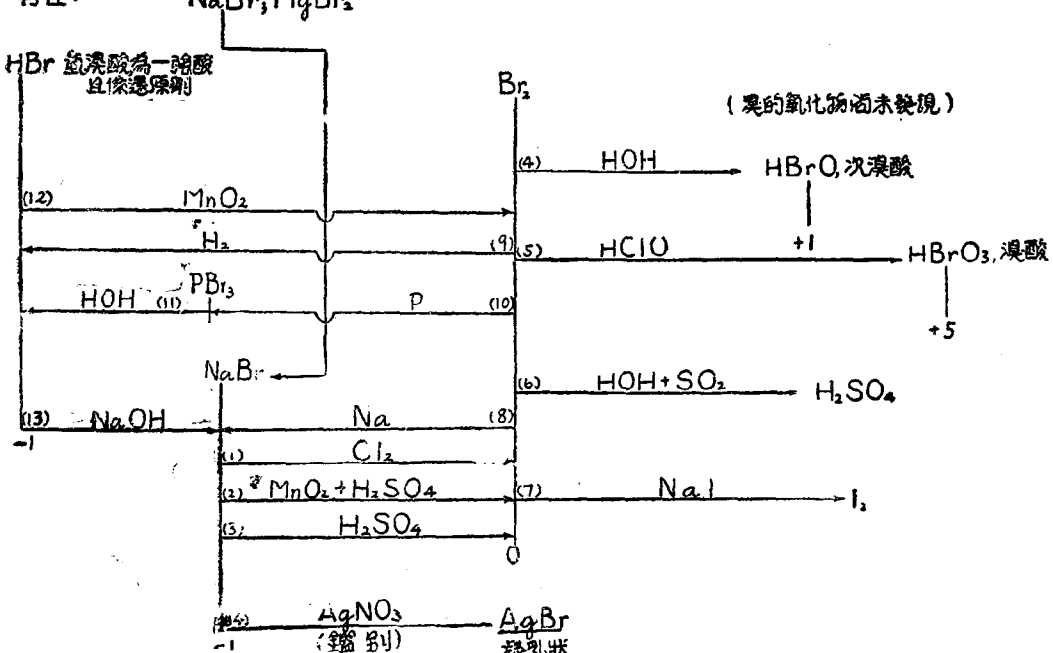
$2CoO+2B_2O_3 \rightarrow 2Co(BO_2)_2$

$2Na_2B_4O_7+2Co(NO_3)_2 \rightarrow 4NaBO_2+O_2+2Co(BO_2)_2+4NO_2$

(11) $2Ca_2B_6O_{11}+4Na_2CO_3+H_2O \rightarrow 3Na_2B_4O_7+2NaOH+4CaCO_3$

溴, Br　　第七類，原子價 -1, +1 及 +5.

存在：　$NaBr, MgBr_2$



溴的方程式

(1) $2NaBr + Cl_2 \rightarrow 2NaCl + Br_2$

(2) $MnO_2 \rightarrow MnO + O$

$2NaBr + H_2SO_4 \rightarrow Na_2SO_4 + 2HBr$

$2HBr + O \rightarrow H_2O + Br_2$

$MnO + H_2SO_4 \rightarrow MnSO_4 + H_2O$

$2NaBr + MnO_2 + 2H_2SO_4 \rightarrow Br_2 + MnSO_4 + Na_2SO_4 + 2H_2O$

(3) $H_2SO_3 \rightarrow H_2O + SO_2 + O$

$2NaBr + H_2SO_4 \rightarrow Na_2SO_4 + 2HBr$

$2HBr + O \rightarrow Br_2 + H_2O$

$2NaBr + 2H_2SO_4 \rightarrow Br_2 + Na_2SO_4 + SO_2 + 2H_2O$

(4) $Br_2 + HOH \rightleftarrows HBr + HBrO$

(5) $5HClO \rightarrow 5HCl + 5O$

$Br_2 + 5O \rightarrow Br_2O_5$

$Br_2O_5 + H_2O \rightarrow 2HBrO_3$

$Br_2 + 5HClO + H_2O \rightarrow 2HBrO_3 + 5HCl$

(6) $Br_2 + H_2O \rightarrow 2HBr + O$

$O + SO_2 \rightarrow SO_3$

$SO_3 + H_2O \rightarrow H_2SO_4$

$Br_2 + SO_2 + 2H_2O \rightleftarrows 2HBr + H_2SO_4$

(7) $Br_2 + 2NaI \rightarrow 2NaBr + I_2$

(8) $Br_2 + 2Na \rightarrow 2NaBr$

(9) $Br_2 + H_2 \rightleftarrows 2HBr$

(10) $3Br_2 + 2P \rightarrow 2PBr_3$

(11) $PBr_3 + 3HOH \rightarrow 3HBr + H_3PO_3$

(12) $MnO_2 \rightarrow MnO + O$

$2HBr + O \rightarrow Br_2 + H_2O$

$MnO + 2HBr \rightarrow MnBr_2 + H_2O$

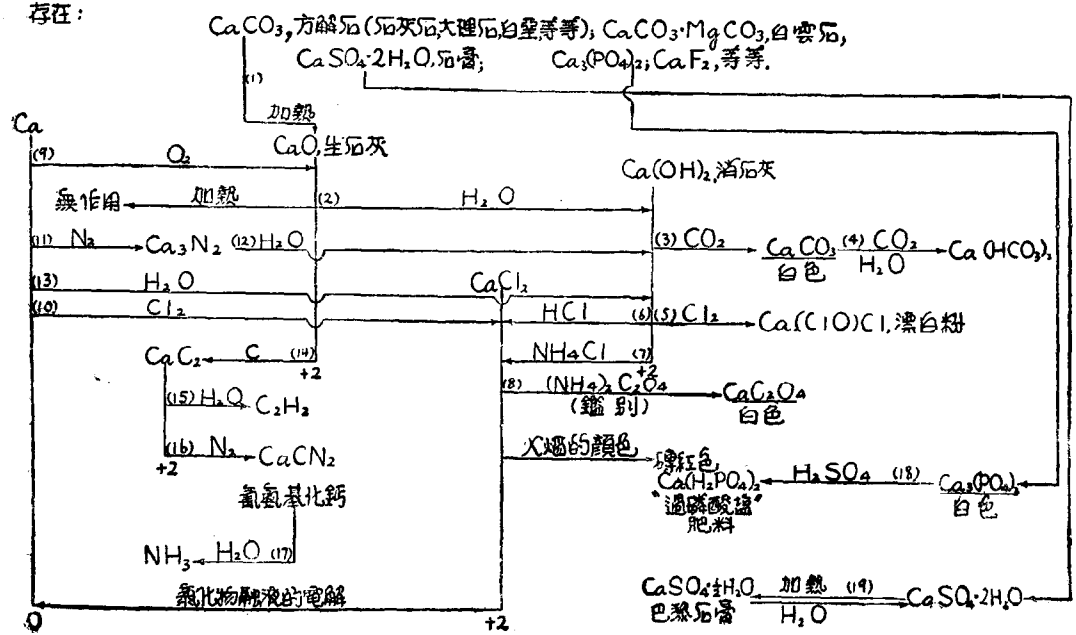
$4HBr + MnO_2 \rightarrow Br_2 + MnBr_2 + 2H_2O$

(13) $HBr + NaOH \rightarrow NaBr + HOH$

(14) $NaBr + AgNO_3 \rightarrow AgBr + NaNO_3$

鈣, Ca.　　第二類, 原子價 +2.

存在：



鈣的方程式

(1) $CaCO_3 \rightleftarrows CaO+CO_2$

(2) $CaO+H_2O \rightleftarrows Ca(OH)_2$

(3) $Ca(OH)_2+CO_2 \rightarrow \underline{CaCO_3}+H_2O$

(4) $\underline{CaCO_3}+H_2O+CO_2 \rightleftarrows Ca(HCO_3)_2$

(5) $Ca(OH)_2+Cl_2 \rightarrow Ca(ClO)Cl+H_2O$

(6) $Ca(OH)_2+2HCl \rightarrow CaCl_2+2HOH$

(7) $Ca(OH)_2+2NH_4Cl \rightarrow CaCl_2+2NH_4OH$

(8) $CaCl_2+(NH_4)_2C_2O_4 \rightarrow \underline{CaC_2O_4}+2NH_4Cl$

(9) $2Ca+O_2 \rightarrow 2CaO$

(10) $Ca+Cl_2 \rightarrow CaCl_2$

(11) $3Ca+N_2 \rightarrow Ca_3N_2$

(12) $Ca_3N_2+6HOH \rightarrow 3Ca(OH)_2+2NH_3$

(13) $Ca+2HOH \rightarrow Ca(OH)_2+H_2$

(14) $CaO+3C \rightarrow CaC_2+CO$

(15) $CaC_2+2HOH \rightarrow Ca(OH)_2+C_2H_2$

(16) $CaC_2+N_2 \rightarrow CaCN_2+C$

(17) $CaCN_2+3H_2O \rightarrow CaCO_3+2NH_3$

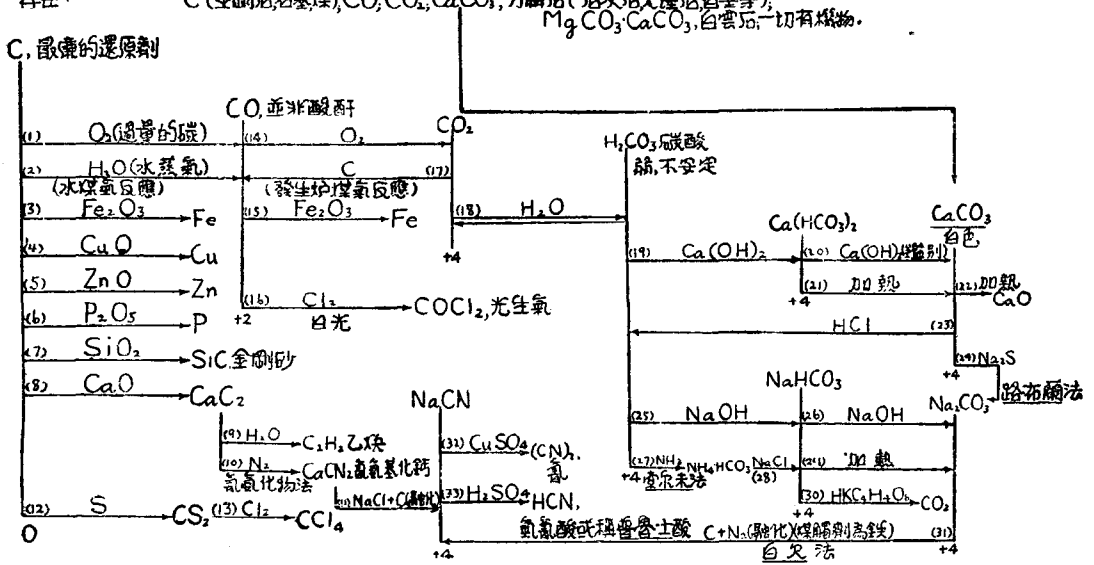
(18) $Ca_3(PO_4)_2+2H_2SO_4 \rightarrow Ca(H_2PO_4)_2+2CaSO_4$

(19) $CaSO_4 \cdot 2H_2O \rightleftarrows CaSO_4 \cdot \frac{1}{2}H_2O+1\frac{1}{2}H_2O$

或 $2CaSO_4 \cdot 2H_2O \rightleftarrows (CaSO_4)_2 \cdot H_2O+3H_2O$

(無機化合物). 第四類, 原子價 +2及+4

存在: C(金剛石,石墨,煤), CO, CO_2, $CaCO_3$, 方解石(石灰石大理石,白堊等), $MgCO_3 \cdot CaCO_3$, 白雲石, 一切有機物.



碳的方程式

(1) $2C+O_2 \rightarrow 2CO$

(2) $C+H_2O \rightarrow CO+H_2$

(3) $3C+Fe_2O_3 \rightarrow 3CO+2Fe$

(4) $C+CuO \rightarrow CO+Cu$

(5) $C+ZnO \rightarrow CO+Zn$

(6) $5C+P_2O_5 \rightarrow 5CO+2P$

(7) $3C+SiO_2 \rightarrow 2CO+SiC$

(8) $3C+CaO \rightarrow CaC_2+CO$

(9) $CaC_2+2HOH \rightarrow C_2H_2+Ca(OH)_2$

(10) $CaC_2+N_2 \rightarrow CaCN_2+C$

(11) $CaCN_2+C+2NaCl \rightarrow 2NaCN+CaCl_2$

(12) $C+2S \rightarrow CS_2$

(13) $CS_2+3Cl_2 \rightarrow CCl_4+S_2Cl_2$

(14) $2CO+O_2 \rightarrow 2CO_2$

(15) $3CO+Fe_2O_3 \rightarrow 3CO_2+2Fe$

(16) $CO+Cl_2 \rightarrow COCl_2$

(17) $CO_2+C \rightarrow 2CO$

(18) $CO_2+H_2O \rightleftarrows H_2CO_3$

(19) $2H_2CO_3+Ca(OH)_2 \rightarrow Ca(HCO_3)_2+2HOH$

(20) $Ca(HCO_3)_2+Ca(OH)_2 \rightarrow \underline{2CaCO_3}+2HOH$

(21) $Ca(HCO_3)_2 \rightleftarrows \underline{CaCO_3}+H_2O+CO_2$

(22) $CaCO_3 \rightleftarrows CaO+CO_2$

(23) $\underline{CaCO_3}+2HCl \rightarrow CaCl_2+H_2O+CO_2$

(24) $CaCO_3+Na_2S \rightarrow Na_2CO_3+\underline{CaS}$

(25) $H_2CO_3+NaOH \rightleftarrows NaHCO_3+HOH$

(26) $NaHCO_3+NaOH \rightleftarrows Na_2CO_3+HOH$

(27) $H_2CO_3+NH_3 \rightleftarrows NH_4 \cdot HCO_3$

(28) $NH_4HCO_3+NaCl \rightarrow \underline{NaHCO_3}+NH_4Cl$

(29) $2NaHCO_3 \rightleftarrows Na_2CO_3+CO_2+H_2O$

(30) $NaHCO_3+HKC_4H_4O_6 \rightarrow CO_2+H_2O+NaKC_4H_4O_6$

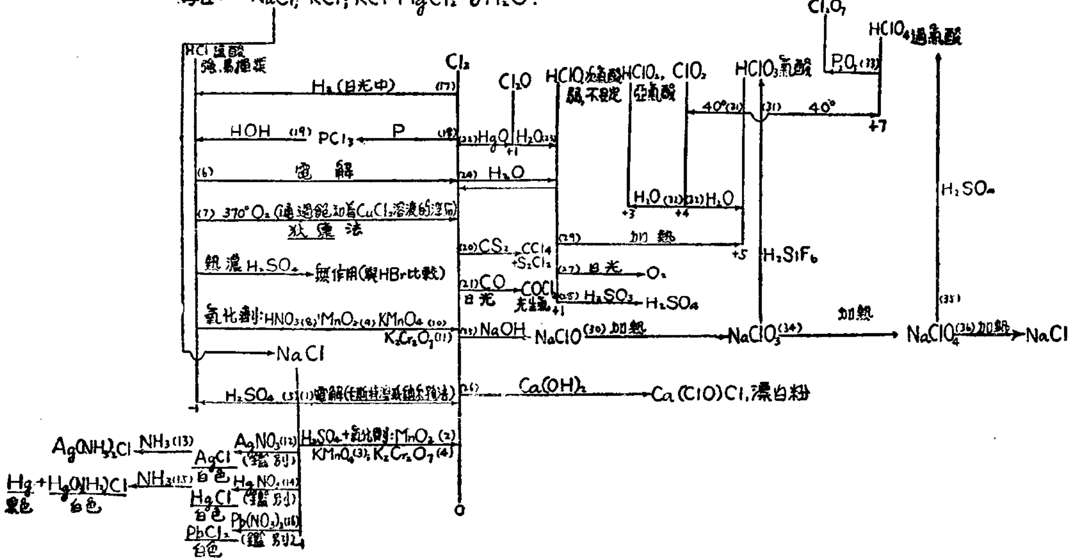
(31) $Na_2CO_3+4C+N_2 \rightarrow 2NaCN+3CO$

(32) $4NaCN+2CuSO_4 \rightarrow \underline{2CuCN}+(CN)_2+2Na_2SO_4$

(33) $2NaCN+H_2SO_4 \rightarrow 2HCN+Na_2SO_4$

氯, Cl　第七類，原子價 −1, +1, +3, +4, +5 及 +7.

存在：　NaCl; KCl; KCl·$MgCl_2$·6H_2O.



氯的方程式

(1) 陰極：$NaOH+H_2\cdot H_2$
陽極：Cl_2

(2) $MnO_2 \rightarrow MnO+O$
$2NaCl+H_2SO_4 \rightarrow Na_2SO_4+2HCl$
$2HCl+O \rightarrow H_2O+Cl_2$
$MnO+H_2SO_4 \rightarrow MnSO_4+H_2O$
$2NaCl+MnO_2+2H_2SO_4 \rightarrow Cl_2+Na_2SO_4+MnSO_4+2H_2O$

(3) $2KMnO_4 \rightarrow K_2O+2MnO+5O$
$10NaCl+5H_2SO_4 \rightarrow 10HCl+5Na_2SO_4$
$10HCl+5O \rightarrow 5H_2O+5Cl_2$
$K_2O+H_2SO_4 \rightarrow K_2SO_4+H_2O$
$2MnO+2H_2SO_4 \rightarrow 2MnSO_4+2H_2O$
$10NaCl+2KMnO_4+8H_2SO_4 \rightarrow 5Cl_2+5Na_2SO_4+K_2SO_4+2MnSO_4+8H_2O$

(4) $K_2Cr_2O_7 \rightarrow K_2O+Cr_2O_3+3O$
$6NaCl+3H_2SO_4 \rightarrow 3Na_2SO_4+6HCl$
$6HCl+3O \rightarrow 3Cl_2+3H_2O$
$K_2O+H_2SO_4 \rightarrow K_2SO_4+H_2O$
$Cr_2O_3+3H_2SO_4 \rightarrow Cr_2(SO_4)_3+3H_2O$
$6NaCl+K_2Cr_2O_7+7H_2SO_4 \rightarrow 3Cl_2+3Na_2SO_4+K_2SO_4+Cr_2(SO_4)_3+7H_2O$

(5) $2NaCl+H_2SO_4 \rightleftarrows 2HCl+Na_2SO_4$

(6) 陰極：H_2；陽極：Cl_2

(7) $4HCl+O_2 \rightarrow 2Cl_2+2H_2O$

(8) $2HNO_3 \rightarrow H_2O+2NO+3O$
$6HCl+3O \rightarrow 3Cl_2+3H_2O$
$6HCl+2HNO_3 \rightarrow 3Cl_2+2NO+4H_2O$

(9) $MnO_2 \rightarrow MnO+O$
$2HCl+O \rightarrow Cl_2+H_2O$
$MnO+2HCl \rightarrow MnCl_2+H_2O$
$4HCl+MnO_2 \rightarrow Cl_2+MnCl_2+2H_2O$

(10) $2KMnO_4 \rightarrow K_2O+2MnO+5O$
$10HCl+5O \rightarrow 5Cl_2+5H_2O$
$K_2O+2HCl \rightarrow 2KCl+H_2O$
$2MnO+4HCl \rightarrow 2MnCl_2+2H_2O$
$16HCl+2KMnO_4 \rightarrow 5Cl_2+2KCl+2MnCl_2+8H_2O$

(11) $K_2Cr_2O_7 \rightarrow K_2O+Cr_2O_3+3O$
$3O+6HCl \rightarrow 3Cl_2+3H_2O$
$K_2O+2HCl \rightarrow 2KCl+H_2O$
$Cr_2O_3+6HCl \rightarrow 2CrCl_3+3H_2O$
$K_2Cr_2O_7+14HCl \rightarrow 3Cl_2+2KCl+2CrCl_3+7H_2O$

(12) $NaCl+AgNO_3 \rightarrow AgCl+NaNO_3$

(13) $AgCl+2NH_3 \rightarrow Ag(NH_3)_2Cl$

(14) $NaCl+HgNO_3 \rightarrow HgCl+NaNO_3$

(15) $2HgCl+2NH_3 \rightarrow Hg+Hg(NH_2)Cl+NH_4Cl$

(16) $2NaCl+Pb(NO_3)_2 \rightarrow PbCl_2+2NaNO_3$

(17) $H_2+Cl_2 \rightleftarrows 2HCl$

(18) $3Cl_2+2P \rightarrow 2PCl_3$

(19) $PCl_3+3HOH \rightarrow 3HCl+H_3PO_3$

(20) $3Cl_2+CS_2 \rightarrow CCl_4+S_2Cl_2$

(21) $CO+Cl_2 \rightarrow COCl_2$

(22) $2Cl_2+HgO \rightarrow Cl_2O+HgCl_2$

(23) $Cl_2O+H_2O \rightleftarrows 2HClO$

(24) $Cl_2+HOH \rightleftarrows HCl+HClO$

(25) $Cl_2+2NaOH \rightarrow NaCl+NaClO+H_2O$

(26) $Cl_2+Ca(OH)_2 \rightarrow Ca(ClO)Cl+H_2O$

(27) $2HClO \rightarrow 2HCl+O_2$

(28) $HClO+H_2SO_3 \rightarrow HCl+H_2SO_4$

(29) $3HClO \rightarrow HClO_3+2HCl$

(30) $3NaClO \rightarrow NaClO_3+2NaCl$

(31) $3HClO_2 \rightarrow 2ClO_2+HClO_4+H_2O$

(32) $2ClO_2+H_2O \rightarrow HClO_2+HClO_3$

(33) $2HClO_4+P_2O_5 \rightarrow Cl_2O_7+2HPO_3$

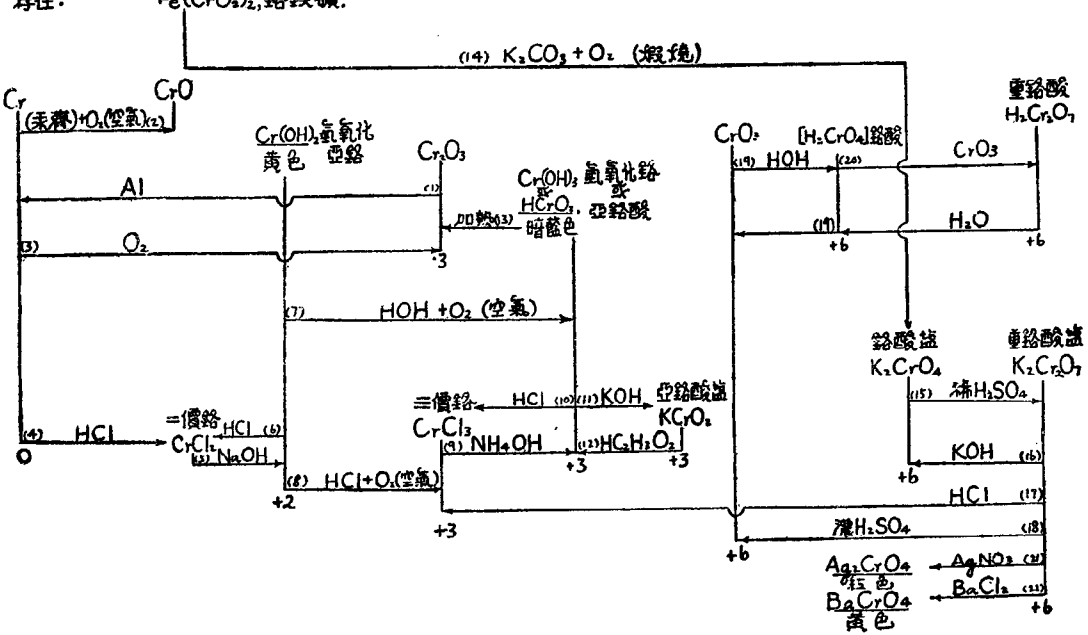
(34) $2NaClO_3 \rightarrow NaClO_4+NaCl+O_2$

(35) $2NaClO_4+H_2SO_4 \rightarrow Na_2SO_4+2HClO_4$

(36) $NaClO_4 \rightarrow NaCl+2O_2$

鉻, Cr. 第六類, 原子價 +2, +3, 及 +6.

存在: $Fe(CrO_2)_2$, 鉻鐵礦.



鉻的方程式

(1) $Cr_2O_3+2Al \rightarrow 2Cr+Al_2O_3$

(2) $2Cr+O_2 \rightarrow 2CrO$

(3) $4Cr+3O_2 \rightarrow 2Cr_2O_3$

(4) $Cr+2HCl \rightarrow CrCl_2+H_2$

(5) $CrCl_2+2NaOH \rightarrow Cr(OH)_2+2NaCl$

(6) $Cr(OH)_2+2HCl \rightarrow CrCl_2+2HOH$

(7) $4Cr(OH)_2+2H_2O+O_2 \rightarrow 4Cr(OH)_3$

(8) $4CrCl_2+4HCl+O_2 \rightarrow 4CrCl_3+2H_2O$

(9) $CrCl_3+3NH_4OH \rightarrow Cr(OH)_3+3NH_4Cl$

(10) $Cr(OH)_3+3HCl \rightleftarrows CrCl_3+3HOH$

(11) $HCrO_2+KOH \rightleftarrows KCrO_2+HOH$

(12) $KCrO_2+HC_2H_3O_2 \rightarrow HCrO_2+KC_2H_3O_2$

(13) $2Cr(OH)_3 \rightleftarrows Cr_2O_3+3H_2O$

(14) $4Fe(CrO_2)_2+8K_2CO_3+7O_2 \rightarrow 8K_2CrO_4+2Fe_2O_3+8CO_2$

(15) $2K_2CrO_4+H_2SO_4 \rightarrow 2[KHCrO_4]+K_2SO_4$

$2[KHCrO_4] \rightleftarrows K_2Cr_2O_7+H_2O$

$2K_2CrO_4+H_2SO_4 \rightarrow K_2Cr_2O_7+K_2SO_4+H_2O$

(16) $K_2Cr_2O_7+H_2O \rightleftarrows 2[KHCrO_4]$

$2[KHCrO_4]+2KOH \rightarrow 2K_2CrO_4+2HOH$

$K_2Cr_2O_7+2KOH \rightarrow 2K_2CrO_4+HOH$

(17) $K_2Cr_2O_7 \rightarrow K_2O+Cr_2O_3+3O$

$3O+6HCl \rightarrow 3H_2O+3Cl_2$

$K_2O+2HCl \rightarrow 2KCl+H_2O$

$Cr_2O_3+6HCl \rightarrow 2CrCl_3+3H_2O$

$K_2Cr_2O_7+14HCl \rightarrow 2CrCl_3+3Cl_2+2KCl+7H_2O$

(18) $K_2Cr_2O_7+H_2SO_4 \rightarrow H_2Cr_2O_7+K_2SO_4$

$H_2Cr_2O_7 \rightarrow H_2O+2CrO_3$

$K_2Cr_2O_7+H_2SO_4 \rightarrow 2CrO_3+K_2SO_4+H_2O$

(19) $CrO_3+H_2O \rightleftarrows H_2CrO_4$

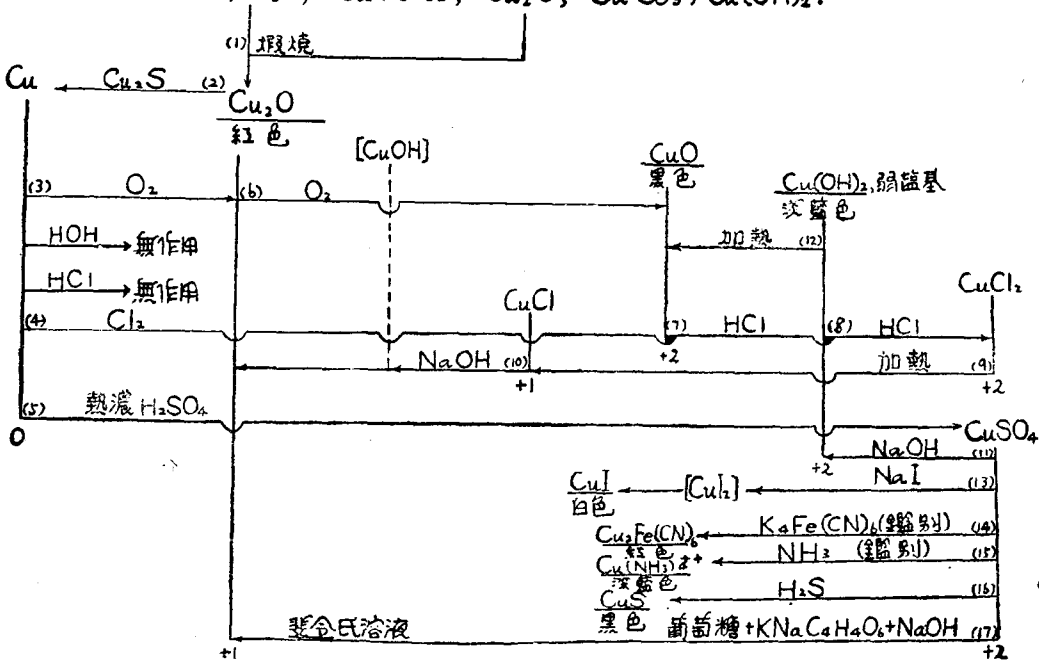
(20) $H_2CrO_4+CrO_3 \rightleftarrows H_2Cr_2O_7$

(21) $K_2Cr_2O_7+H_2O+4AgNO_3 \rightarrow 2Ag_2CrO_4+2HNO_3+2KNO_3$

(22) $K_2Cr_2O_7+H_2O+2BaCl_2 \rightarrow 2BaCrO_4+2HCl+2KCl$

. 銅, Cu　　第一類, 原子價 +1 及 +2.

存在: Cu; Cu_2S; $CuFeS_2$; Cu_2O; $CuCO_3$; $Cu(OH)_2$.



銅的方程式

(1) $2Cu_2S+3O_2 \rightarrow 2Cu_2O+2SO_2$

(2) $Cu_2S+2Cu_2O \rightarrow 6Cu+SO_2$

(3) $4Cu+O_2 \rightarrow 2Cu_2O$

(4) $Cu+Cl_2 \rightarrow CuCl_2$

(5) $H_2SO_4 \rightarrow H_2O+SO_2+O$

$Cu+O \rightarrow CuO$

$CuO+H_2SO_4 \rightarrow CuSO_4+H_2O$

$Cu+2H_2SO_4 \rightarrow CuSO_4+SO_2+2H_2O$

(6) $2Cu_2O+O_2 \rightarrow 4CuO$

(7) $CuO+2HCl \rightarrow CuCl_2+H_2O$

(8) $Cu(OH)_2+2HCl \rightarrow CuCl_2+2HOH$

(9) $2CuCl_2 \rightarrow 2CuCl+Cl_2$

(10) $2CuCl+2NaOH \rightarrow 2[CuOH]+2NaCl$

$2[CuOH] \rightarrow Cu_2O+H_2O$

$2CuCl+2NaOH \rightarrow Cu_2O+2NaCl+H_2O$

(11) $CuSO_4+2NaOH \rightarrow Cu(OH)_2+Na_2SO_4$

(12) $Cu(OH)_2 \rightarrow CuO+H_2O$

(13) $2CuSO_4+4NaI \rightarrow 2[CuI_2]+2Na_2SO_4$

$2[CuI_2] \rightarrow 2CuI+I_2$

$2CuSO_4+4NaI \rightarrow 2CuI+I_2+2Na_2SO_4$

(14) $2CuSO_4+K_4Fe(CN)_6 \rightarrow Cu_2Fe(CN)_6+2K_2SO_4$

(15) $CuSO_4+4NH_3 \rightarrow Cu(NH_3)_4SO_4$

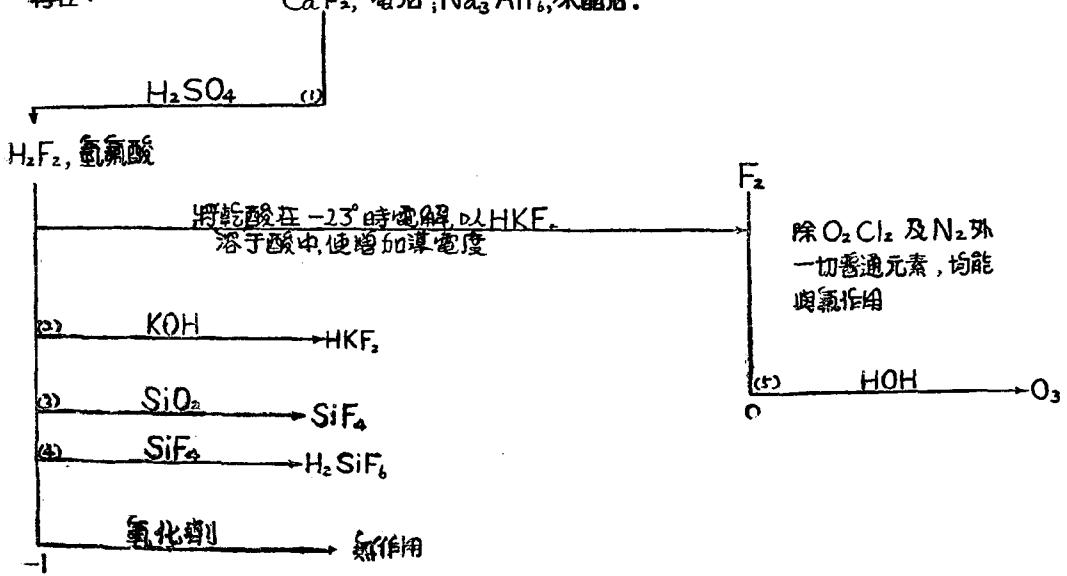
(16) $CuSO_4+H_2S \rightarrow CuS+H_2SO_4$

(17) $2CuSO_4+4NaOH+C_6H_{12}O_6 \rightarrow Cu_2O+2Na_2SO_4+C_6H_{12}O_7+2H_2O$

*此反應常能發生 CuS 的沈澱，故知當時必有一部分 H_2SO_4 還原而成 H_2S。

氟, F.　　第七類, 原子價 −1.

存在：　　CaF_2, 螢石 ; Na_3AlF_6, 冰晶石.



氟的方程式

(1) $CaF_2+H_2SO_4 \rightarrow H_2F_2+CaSO_4$

(2) $H_2F_2+KOH \rightleftarrows HKF_2+HOH$

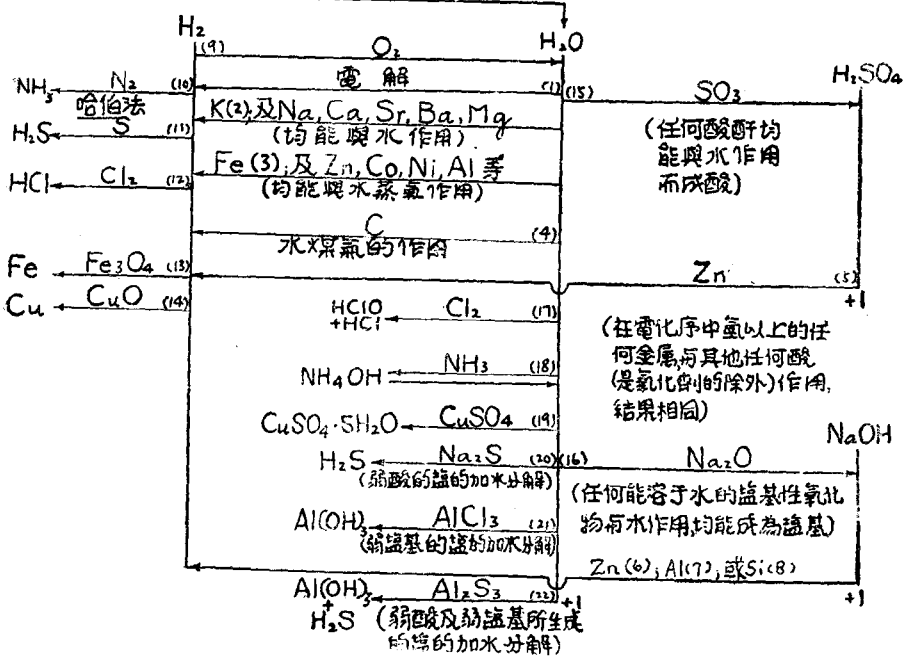
(3) $2H_2F_2+SiO_2 \rightarrow \overline{SiF_4}+2H_2O$

(4) $H_2F_2+SiF_4 \rightarrow H_2SiF_6$

(5) $3F_2+3H_2O \rightarrow 3H_2F_2+O_3$

氫，H.　　第一類，原子價 +1.

存在：H_2O; H_2 (甚少)；礦物如粘土，$H_2Al_2(SiO_4)_2 \cdot H_2O$ 等等；有機物



氫的方程式

(1) 陽極：O_2

陰極：H_2

(2) $2K+2HOH \rightarrow 2KOH+H_2$

(3) $3Fe+4H_2O \rightleftarrows Fe_3O_4+4H_2$

(4) $H_2O+C \rightarrow H_2+CO$

(5) $H_2SO_4+Zn \rightarrow H_2+ZnSO_4$

(6) $2NaOH+Zn \rightarrow H_2+Na_2ZnO_2$

(7) $6NaOH+2Al \rightarrow 3H_2+2Na_3AlO_3$

(8) $2NaOH+H_2O+Si \rightarrow 2H_2+Na_2SiO_3$

(9) $2H_2+O_2 \rightleftarrows 2H_2O$

(10) $3H_2+N_2 \rightleftarrows 2NH_3$

(11) $H_2+S \rightleftarrows H_2S$

(12) $H_2+Cl_2 \rightarrow 2HCl$

(13) $4H_2+Fe_3O_4 \rightleftarrows 4H_2O+3Fe$

(14) $H_2+CuO \rightarrow H_2O+Cu$

(15) $H_2O+SO_3 \rightleftarrows H_2SO_4$

(16) $H_2O+Na_2O \rightarrow 2NaOH$

(17) $H_2O+Cl_2 \rightleftarrows HCl+HClO$

(18) $H_2O+NH_3 \rightleftarrows NH_4OH$

(19) $5H_2O+CuSO_4 \rightleftarrows CuSO_4 \cdot 5H_2O$

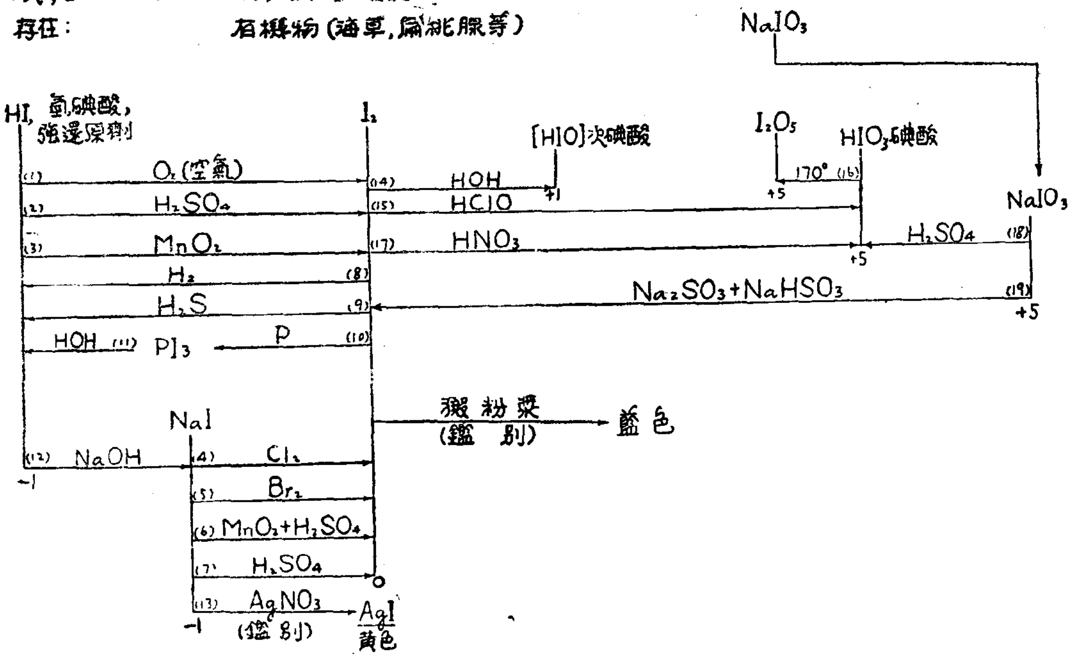
(20) $2HOH+Na_2S \rightleftarrows H_2S+2NaOH$

(21) $3HOH+AlCl_3 \rightleftarrows 3HCl+\underline{Al(OH)_3}$

(22) $6HOH+Al_2S_3 \rightleftarrows 3H_2S+\underline{2Al(OH)_3}$

碘，I.　　第七類，原子價 -1 +1 及 +5.

存在：　　有機物(海草，扁桃腺等)



碘的方程式.

(1) $4HI+O_2 \rightarrow 2I_2+2H_2O$

(2) $H_2SO_4 \rightarrow H_2S+4O$

$8HI+4O \rightarrow 4I_2+4H_2O$

$8HI+H_2SO_4 \rightarrow 4I_2+H_2S+4H_2O$

(3) $MnO_2 \rightarrow MnO+O$

$2HI+O \rightarrow I_2+H_2O$

$MnO+2HI \rightarrow MnI_2+H_2O$

$4HI+MnO_2 \rightarrow I_2+MnI_2+2H_2O$

(4) $2NaI+Cl_2 \rightarrow I_2+2NaCl$

(5) $2NaI+Br_2 \rightarrow I_2+2NaBr$

(6) $MnO_2 \rightarrow MnO+O$

$2NaI+H_2SO_4 \rightarrow 2HI+Na_2SO_4$

$2HI+O \rightarrow I_2+H_2O$

$MnO+H_2SO_4 \rightarrow MnSO_4+H_2O$

$2NaI+MnO_2+2H_2SO_4 \rightarrow I_2+Na_2SO_4+MnSO_4+2H_2O$

(7) $H_2SO_4 \rightarrow H_2S+4O$

$8NaI+4H_2SO_4 \rightarrow 8HI+4Na_2SO_4$

$8HI+4O \rightarrow 4I_2+4H_2O$

$8NaI+5H_2SO_4 \rightarrow 4I_2+4Na_2SO_4+H_2S+4H_2O$

(8) $H_2+I_2 \rightleftarrows 2HI$

(9) $I_2+H_2S \rightleftarrows 2HI+S$

(10) $3I_2+2P \rightarrow 2PI_3$

(11) $PI_3+3HOH \rightarrow 3HI+H_3PO_3$

(12) $HI+NaOH \quad NaI+HOH$

(13) $NaI+AgNO_3 \rightarrow \underline{AgI}+NaNO_3$

(14) $I_2+HOH \rightleftarrows HI+HIO$

(15) $I_2+5HClO+H_2O \rightarrow 2HIO_3+5HCl$

(16) $2HIO_3 \rightleftarrows I_2O_5+H_2O$

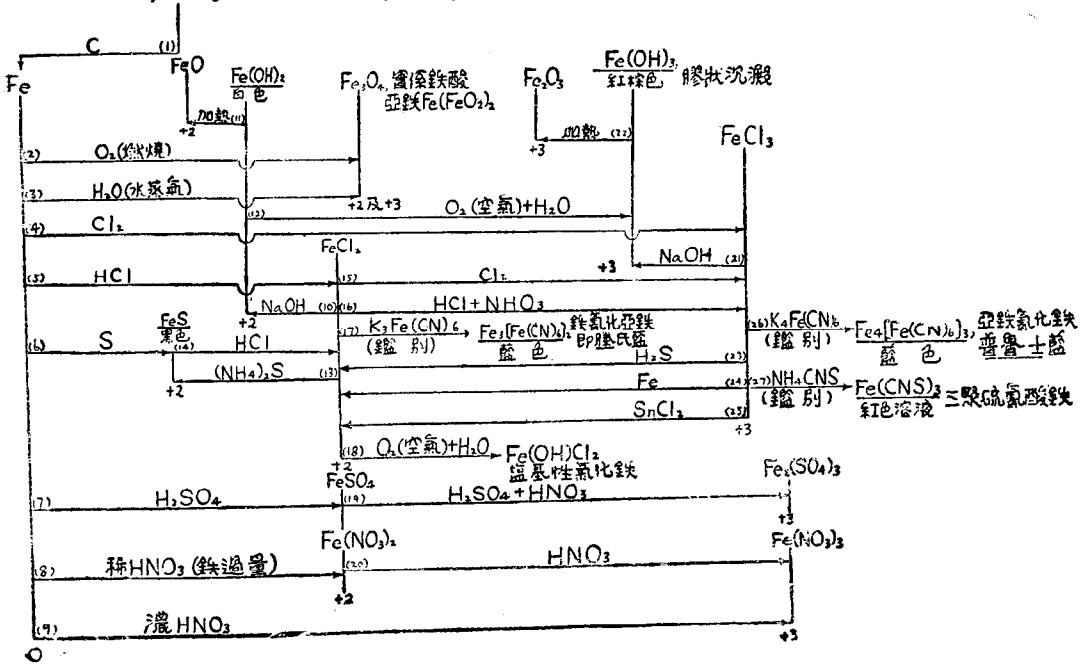
(17) $3I_2+10HNO_3 \rightarrow 6HIO_3+10NO+2H_2O$

(18) $2NaIO_3+H_2SO_4 \rightarrow 2HIO_3+Na_2SO_4$

(19) $2NaIO_3+3Na_2SO_3+2NaHSO_3 \rightarrow I_2+5Na_2SO_4+H_2O$

鐵，Fe.　第八類，原子價 +2 及 +3.

存在：Fe；Fe_2O_3 赤鐵礦；$2Fe_2O_3 \cdot 3H_2O$；Fe_3O_4 磁鐵礦；$FeCO_3$；FeS_2 黃鐵礦；有機物(血素，葉綠素).

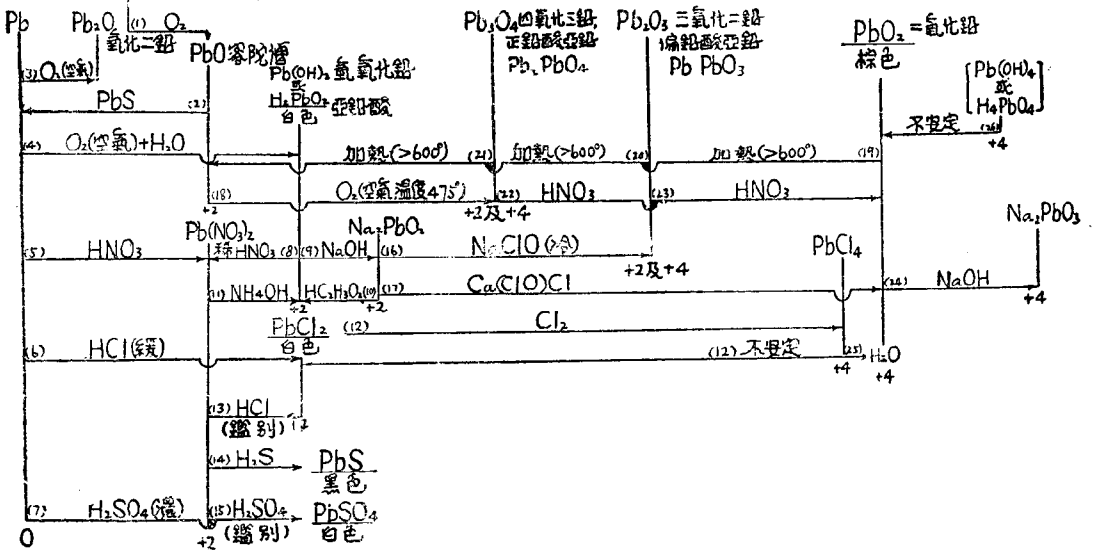


鉄的方程式

(1) $Fe_2O_3+3C \rightarrow 2Fe+3CO$
(2) $3Fe+2O_2 \rightarrow Fe_3O_4$
(3) $3Fe+4H_2O \rightleftarrows Fe_3O_4+4H_2$
(4) $2Fe+3Cl_2 \rightarrow 2FeCl_3$
(5) $Fe+2HCl \rightarrow FeCl_2+H_2$
(6) $Fe+S \rightarrow FeS$
(7) $Fe+H_2SO_4 \rightarrow FeSO_4+H_2$
(8) $2HNO_3 \rightarrow H_2O+2NO+3O$
$3Fe+3O \rightarrow 3FeO$
$3FeO+6HNO_3 \rightarrow 3Fe(NO_3)_2+3H_2O$
$3Fe+8HNO_3 \rightarrow 3Fe(NO_3)_2+2NO+4H_2O$
(9) $2HNO_3 \rightarrow H_2O+2NO+3O$
$2Fe+3O \rightarrow Fe_2O_3$
$Fe_2O_3+6HNO_3 \rightarrow 2Fe(NO_3)_3+3H_2O$
$2Fe+8HNO_3 \rightarrow 2Fe(NO_3)_3+2NO+4H_2O$
(10) $FeCl_2+2NaOH \rightarrow Fe(OH)_2+2NaCl$
(11) $Fe(OH)_2 \rightarrow FeO+H_2O$
(12) $4Fe(OH)_2+2H_2O+O_2 \rightarrow 4Fe(OH)_3$
(13) $FeCl_2+(NH_4)_2S \rightarrow FeS+2NH_4Cl$
(14) $FeS+2HCl \rightleftarrows FeCl_2+H_2S$
(15) $2FeCl_2+Cl_2 \rightarrow 2FeCl_3$
(16) $2HNO_3 \rightarrow H_2O+2NO+3O$
$6HCl+3O \rightarrow 6Cl+3H_2O$
$6FeCl_2+6Cl \rightarrow 6FeCl_3$
$6FeCl_2+6HCl+2HNO_3 \rightarrow 6FeCl_3+2NO+4H_2O$
(17) $3FeCl_2+2K_3Fe(CN)_6 \rightarrow Fe_3[Fe(CN)_6]_2+6KCl$
(18) $4FeCl_2+2H_2O+O_2 \rightarrow 4Fe(OH)Cl_2$
(19) $2HNO_3 \rightarrow H_2O+2NO+3O$
$3H_2SO_4+3O \rightarrow 3H_2O+3SO_4$
$6FeSO_4+3SO_4 \rightarrow 3Fe_2(SO_4)_3$
$6FeSO_4+2HNO_3+3H_2SO_4 \rightarrow 3Fe_2(SO_4)_3+2NO+4H_2O$
(20) $2HNO_3 \rightarrow H_2O+2NO+3O$
$6HNO_3+3O \rightarrow 3H_2O+6NO_3$
$6Fe(NO_3)_2+6NO_3 \rightarrow 6Fe(NO_3)_3$
$6Fe(NO_3)_2+8HNO_3 \rightarrow 6Fe(NO_3)_3+2NO+4H_2O$
(21) $FeCl_3+3NaOH \rightarrow Fe(OH)_3+3NaCl$
(22) $2Fe(OH)_3 \rightarrow Fe_2O_3+3H_2O$
(23) $2FeCl_3+H_2S \rightarrow 2FeCl_2+2HCl+S$
(24) $2FeCl_3+Fe \rightarrow 3FeCl_2$
(25) $2FeCl_3+SnCl_2 \rightarrow 2FeCl_2+SnCl_4$
(26) $4FeCl_3+3K_4Fe(CN)_6 \rightarrow Fe_4[Fe(CN)_6]_3+12KCl$
(27) $FeCl_3+3NH_4CNS \rightarrow Fe(CNS)_3+3NH_4Cl$

鉛, Pb.　　第四類, 原子價 (+1), +2, 及 +4.

存在: PbS, 方鉛礦; $PbSO_4$, $PbCO_3$.



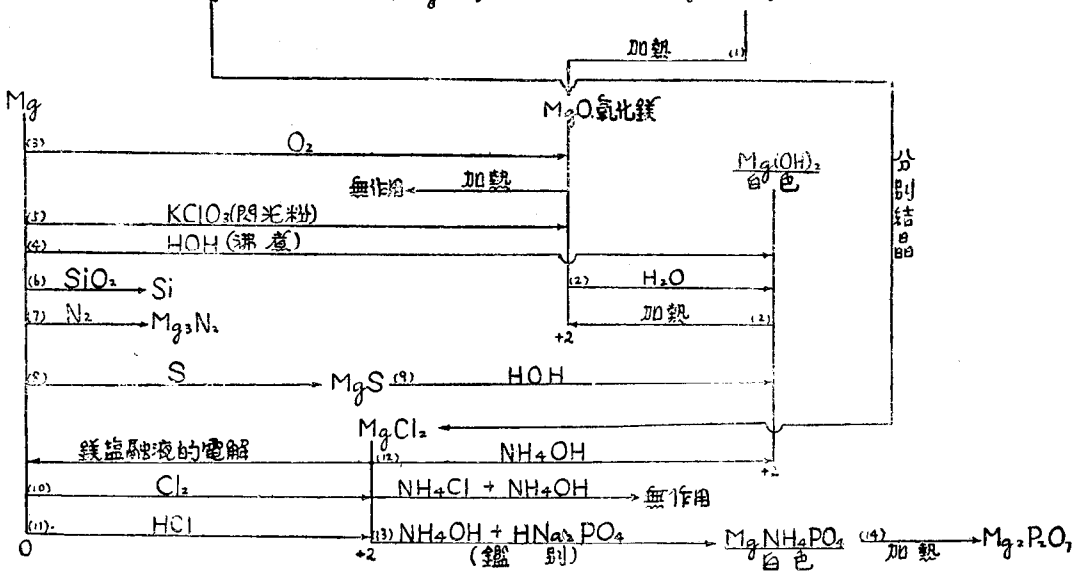
化學反應圖解

鉛的方程式

(1) $2PbS+3O_2 \rightarrow 2PbO+2SO_2$
(2) $PbS+2PbO \rightarrow 3Pb+SO_2$
(3) $4Pb+O_2 \rightarrow 2Pb_2O$
(4) $2Pb+2H_2O+O_2 \rightarrow 2Pb(OH)_2$
(5) $2HNO_3 \rightarrow H_2O+2NO+3O$
$3O+3Pb \rightarrow 3PbO$
$3PbO+6HNO_3 \rightarrow 3Pb(NO_3)_2+3H_2O$
$3Pb+8HNO_3 \rightarrow 3Pb(NO_3)_2+4H_2O+2NO$
(6) $Pb+2HCl \rightarrow \underline{PbCl_2}+H_2$
(7) $Pb+H_2SO_4 \rightarrow \underline{PbSO_4}+H_2$
(8) $\underline{Pb(OH)_2}+2HNO_3 \rightleftarrows Pb(NO_3)_2+2HOH$
(9) $\underline{H_2PbO_2}+2NaOH \rightleftarrows Na_2PbO_2+2HOH$
(10) $Na_2PbO_2+2HC_2H_3O_2 \rightarrow \underline{H_2PbO_2}+2NaC_2H_3O_2$
(11) $Pb(NO_3)_2+2NH_4OH \rightarrow \underline{Pb(OH)_2}+2NH_4NO_3$
(12) $PbCl_2+Cl_2 \rightleftarrows PbCl_4$
(13) $Pb(NO_3)_2+2HCl \rightarrow \underline{PbCl_2}+2HNO_3$
(14) $Pb(NO_3)_2+H_2S \rightarrow \underline{PbS}+2HNO_3$
(15) $Pb(NO_3)_2+H_2SO_4 \rightarrow \underline{PbSO_4}+2HNO_3$
(16) $2Na_2PbO_2+NaClO+2H_2O \rightarrow \underline{Pb_2O_3}+4NaOH+NaCl$
(17) $Na_2PbO_2+Ca(ClO)Cl+H_2O \rightarrow \underline{PbO_2}+2NaOH+CaCl_2$
(18) $6PbO+O_2 \rightleftarrows 2Pb_3O_4$
(19) $2PbO_2 \rightarrow 2PbO+O_2$
(20) $2Pb_2O_3 \rightarrow 4PbO+O_2$
(21) $2Pb_3O_4 \rightleftarrows 6PbO+O_2$
(22) $Pb_3O_4+4HNO_3 \rightarrow 2Pb(NO_3)_2+\underline{PbO_2}+2H_2O$
(23) $Pb_2O_3+2HNO_3 \rightarrow Pb(NO_3)_2+\underline{PbO_2}+H_2O$
(24) $PbO_2+2NaOH \rightarrow Na_2PbO_3+H_2O$
(25) $PbCl_4+2H_2O \rightarrow \underline{PbO_2}+4HCl$
(26) $[Pb(OH)_4] \rightarrow \underline{PbO_2}+2H_2O$

鎂 Mg 第二類 原子價 +2

存在： $KCl{\cdot}MgCl_2{\cdot}6H_2O$,白鹵鹽; $MgCO_3$, $CaCO_3$白雲石, $MgCO_3$; $MgSO_4H_2O$,的酸鹽



鎂的方程式

(1) $MgCO_3 \rightleftarrows MgO+CO_2$

(2) $Mg(OH)_2 \rightleftarrows MgO+H_2O$

(3) $2Mg+O_2 \rightarrow 2MgO$

(4) $Mg+2HOH \rightarrow Mg(OH)_2+H_2$

(5) $3Mg+KClO_3 \rightarrow 3MgO+KCl$

*(6) $2Mg+SiO_2 \rightarrow 2MgO+Si$

(7) $3Mg+N_2 \rightarrow Mg_3N_2$

(8) $Mg+S \rightarrow MgS$

(9) $MgS+2HOH \rightarrow \underline{Mg(OH)_2}+H_2S$

(10) $Mg+Cl_2 \rightarrow MgCl_2$

(11) $Mg+2HCl \rightarrow MgCl_2+H_2$

(12) $MgCl_2+2NH_4OH \rightarrow \underline{Mg(OH)_2}+2NH_4Cl$

(13) $MgCl_2+NH_4OH+HNa_2PO_4 \rightarrow \underline{MgNH_4PO_4}+2NaCl+H_2O$

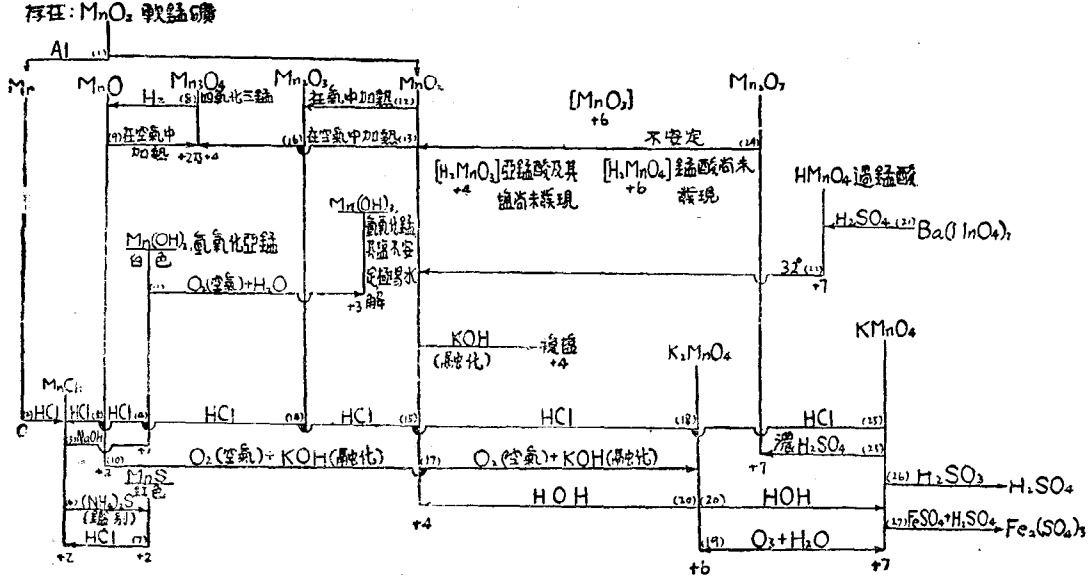
(14) $MgNH_4PO_4 \rightleftarrows MgHPO_4+NH_3$

$2MgHPO_4 \rightleftarrows Mg_2P_2O_7+H_2O$

* 同時略有 Mg_2Si 生成。

錳, Mn. 第七類, 原子價 +2, +3, +4, +6, 及 +7。

存在: MnO_2 軟錳礦

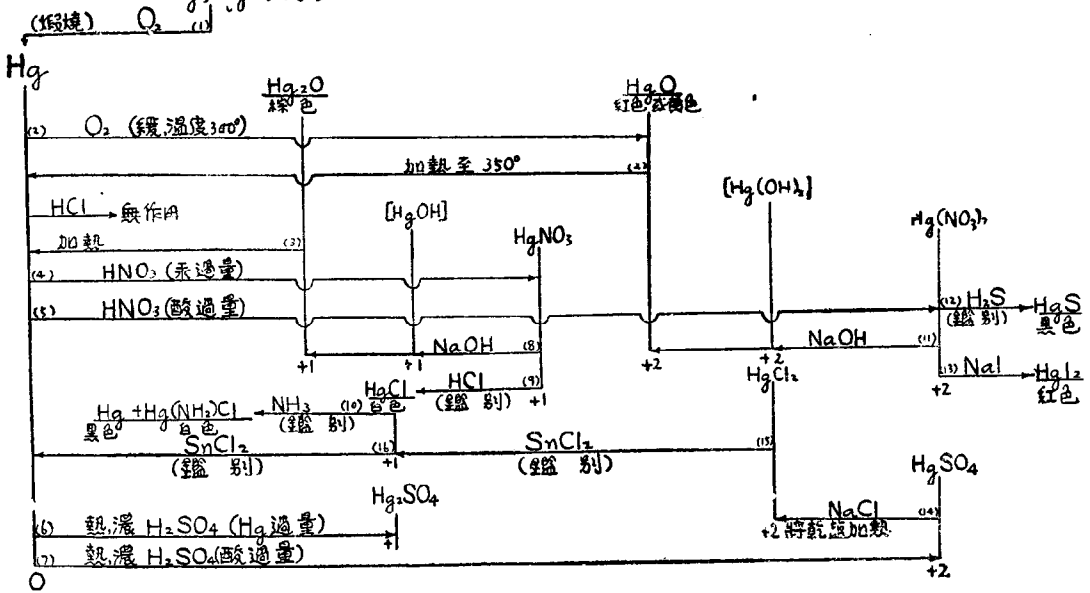


錳的方程式

(1) $3MnO_2+4Al \rightarrow 3Mn+2Al_2O_3$
(2) $Mn+2HCl \rightarrow MnCl_2+H_2$
(3) $MnCl_2+2NaOH \rightarrow Mn(OH)_2+2NaCl$
(4) $Mn(OH)_2+2HCl \rightarrow MnCl_2+2HOH$
(5) $MnO+2HCl \rightarrow MnCl_2+H_2O$
(6) $MnCl_2+(NH_4)_2S \rightarrow MnS+2NH_4Cl$
(7) $MnS+2HCl \rightleftarrows MnCl_2+H_2S$
(8) $Mn_3O_4+H_2 \rightarrow 3MnO+H_2O$
(9) $6MnO+O_2 \rightarrow 2Mn_3O_4$
(10) $MnO+2KOH+O_2 \rightarrow K_2MnO_4+H_2O$
(11) $4Mn(OH)_2+2H_2O+O_2 \rightarrow 4Mn(OH)_3$
(12) $4MnO_2 \rightarrow 2Mn_2O_3+O_2$
(13) $3MnO_2 \rightarrow Mn_3O_4+O_2$
(14) $Mn_2O_3 \rightarrow 2MnO+O$
$O+2HCl \rightarrow H_2O+Cl_2$
$2MnO+4HCl \rightarrow 2MnCl_2+2H_2O$
$Mn_2O_3+6HCl \rightarrow 2MnCl_2+3H_2O+Cl_2$
(15) $MnO_2 \rightarrow MnO+O$
$O+2HCl \rightarrow H_2O+Cl_2$
$MnO+2HCl \rightarrow MnCl_2+H_2O$
$MnO_2+4HCl \rightarrow MnCl_2+Cl_2+2H_2O$
(16) $6Mn_2O_3 \rightarrow 4Mn_3O_4+O_2$
(17) $2MnO_2+4KOH+O_2 \rightarrow 2K_2MnO_4+2H_2O$
(18) $K_2MnO_4 \rightarrow K_2O+MnO+2O$
$2O+4HCl \rightarrow 2H_2O+2Cl_2$
$K_2O+2HCl \rightarrow 2KCl+H_2O$
$MnO+2HCl \rightarrow MnCl_2+H_2O$
$K_2MnO_4+8HCl \rightarrow MnCl_2+2KCl+2Cl_2+4H_2O$
(19) $2K_2MnO_4+O_2+H_2O \rightarrow 2KMnO_4+O_2+2KOH$
(20) $3K_2MnO_4+2H_2O \rightarrow 2KMnO_4+MnO_2+4KOH$
(21) $Ba(MnO_4)_2+H_2SO_4 \rightarrow BaSO_4+2HMnO_4$
(22) $4HMnO_4 \rightarrow 4MnO_2+2H_2O+3O_2$
(23) $2KMnO_4+H_2SO_4 \rightarrow Mn_2O_7+K_2SO_4+H_2O$
(24) $2Mn_2O_7 \rightarrow 4MnO_2+3O_2$
(25) $2KMnO_4 \rightarrow K_2O+2MnO+5O$
$5O+10HCl \rightarrow 5H_2O+5Cl_2$
$K_2O+2HCl \rightarrow 2KCl+H_2O$
$2MnO+4HCl \rightarrow 2MnCl_2+2H_2O$
$2KMnO_4+16HCl \rightarrow 2MnCl_2+2KCl+5Cl_2+8H_2O$
(26) $2KMnO_4 \rightarrow K_2O+2MnO+5O$
$5O+5H_2SO_3 \rightarrow 5H_2SO_4$
$K_2O+H_2SO_4 \rightarrow K_2SO_4+H_2O$
$2MnO+2H_2SO_4 \rightarrow 2MnSO_4+2H_2O$
$2KMnO_4+5H_2SO_3 \rightarrow 2MnSO_4+K_2SO_4+2H_2SO_4+3H_2O$
(27) $2KMnO_4 \rightarrow K_2O+2MnO+5O$
$5O+5H_2SO_4 \rightarrow 5H_2O+5SO_4$
$10FeSO_4+5SO_4 \rightarrow 5Fe_2(SO_4)_3$
$K_2O+H_2SO_4 \rightarrow K_2SO_4+H_2O$
$2MnO+2H_2SO_4 \rightarrow 2MnSO_4+2H_2O$
$2KMnO_4+10FeSO_4+8H_2SO_4 \rightarrow 2MnSO_4+K_2SO_4+5Fe_2(SO_4)_3+8H_2O$

汞, Hg. 第二類，原子價 +1 及 +2.

存在: Hg; HgS, 辰砂.



化學反應圖表

汞的方程式

(1) $HgS+O_2 \rightarrow Hg+SO_2$

(2) $2Hg+O_2 \rightleftarrows 2HgO$

(3) $2Hg_2O \rightarrow 4Hg+O_2$

(4) $2HNO_3 \rightarrow H_2O+2NO+3O$

$6Hg+3O \rightarrow 3Hg_2O$

$3Hg_2O+6HNO_3 \rightarrow 6HgNO_3+3H_2O$

$6Hg+8HNO_3 \rightarrow 6HgNO_3+2NO+4H_2O$

(5) $2HNO_3 \rightarrow H_2O+2NO+2O$

$3Hg+3O \rightarrow 3HgO$

$3HgO+6HNO_3 \rightarrow 3Hg(NO_3)_2+3H_2O$

$3Hg+8HNO_3 \rightarrow 3Hg(NO_3)_2+2NO+4H_2O$

(6) $H_2SO_4 \rightarrow H_2O+SO_2+O$

$2Hg+O \rightarrow Hg_2O$

$Hg_2O+H_2SO_4 \rightarrow Hg_2SO_4+H_2O$

$2Hg+2H_2SO_4 \rightarrow Hg_2SO_4+SO_2+2H_2O$

(7) $H_2SO_4 \rightarrow H_2O+SO_2+O$

$Hg+O \rightarrow HgO$

$HgO+H_2SO_4 \rightarrow HgSO_4+H_2O$

$Hg+2H_2SO_4 \rightarrow HgSO_4+SO_2+2H_2O$

(8) $2HgNO_3+2NaOH \rightarrow 2[HgOH]+2NaNO_3$

$2[HgOH] \rightarrow Hg_2O+H_2O$

$2HgNO_3+2NaOH \rightarrow Hg_2O+2NaNO_3+H_2O$

(9) $HgNO_3+HCl \rightarrow HgCl+HNO_3$

(10) $2HgCl+2NH_3 \rightarrow Hg+HgNH_2Cl+NH_4Cl$

(11) $Hg(NO_3)_2+2NaOH \rightarrow [Hg(OH)_2]+2NaNO_3$

$[Hg(OH)_2] \rightarrow HgO+H_2O$

$Hg(NO_3)_2+2NaOH \rightarrow HgO+2NaNO_3+H_2O$

(12) $Hg(NO_3)_2+H_2S \rightarrow HgS+2HNO_3$

(13) $Hg(NO_3)_2+2NaI \rightarrow HgI_2+2NaNO_3$

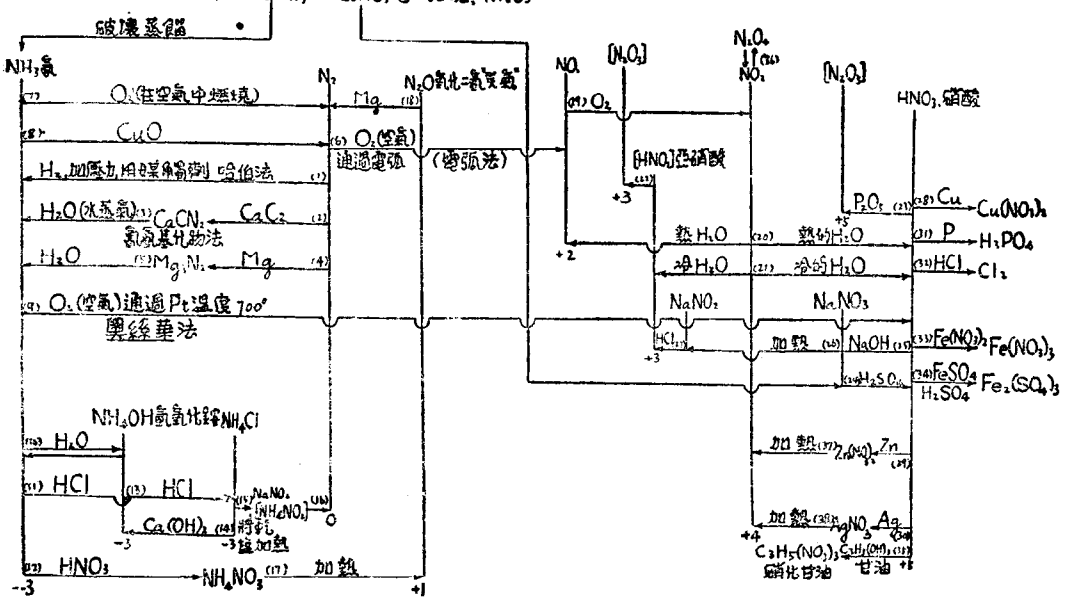
(14) $HgSO_4+2NaCl \rightarrow HgCl_2+Na_2SO_4$

(15) $2HgCl_2+SnCl_2 \rightarrow 2HgCl+SnCl_4$

(16) $2HgCl+SnCl_2 \rightarrow 2Hg+SnCl_4$

氮, N. 第五類, 原子價 −3, +3, 及 +5 [(+1), (+2), (+4)]。

存在: N_2(空氣) NH_3 有機物質分解, $NaNO_3$ 智利硝石; KNO_3



氮的方程式

(1) $N_2+3H_2 \rightleftarrows 2NH_3$
(2) $N_2+CaC_2 \rightarrow CaCN_2+C$
(3) $CaCN_2+3H_2O \rightarrow 2NH_3+CaCO_3$
(4) $N_2+3Mg \rightarrow Mg_3N_2$
(5) $Mg_3N_2+6HOH \rightarrow 2NH_3+3Mg(OH)_2$
(6) $N_2+O_2 \rightleftarrows 2NO$
(7) $4NH_3+3O_2 \rightarrow 2N_2+6H_2O$
(8) $2NH_3+3CuO \rightarrow N_2+3Cu+3H_2O$
(9) $NH_3+2O_2 \rightarrow HNO_3+H_2O$
(10) $NH_3+H_2O \rightleftarrows NH_4OH$
(11) $NH_3+HCl \rightleftarrows NH_4Cl$
(12) $NH_3+HNO_3 \rightarrow NH_4NO_3$
(13) $NH_4OH+HCl \rightarrow NH_4Cl+HOH$
(14) $2NH_4Cl+Ca(OH)_2 \rightarrow 2NH_4OH+CaCl_2$
(15) $NH_4Cl+NaNO_2 \rightarrow [NH_4NO_2]+NaCl$
(16) $[NH_4NO_2] \rightarrow N_2+2H_2O$

$NH_4Cl+NaNO_2 \rightarrow N_2+NaCl+2H_2O$

(17) $NH_4NO_3 \rightarrow N_2O+2H_2O$
(18) $N_2O+Mg \rightarrow N_2+MgO$
(19) $2NO+O_2 \rightleftarrows 2NO_2$
(20) $3NO_2+H_2O \rightarrow 2HNO_3+NO$
(21) $2NO_2+H_2O \rightarrow HNO_3+HNO_2$
(22) $2HNO_2 \rightleftarrows N_2O_3+H_2O$
(23) $2HNO_3+P_2O_5 \rightarrow 2HPO_3+N_2O_5$
(24) $2NaNO_3+H_2SO_4 \rightarrow 2HNO_3+Na_2SO_4$
(25) $HNO_3+NaOH \rightarrow NaNO_3+HOH$
(26) $2NaNO_3 \rightarrow 2NaNO_2+O_2$
(27) $NaNO_2+HCl \rightarrow HNO_2+NaCl$
(28) $2HNO_3 \rightarrow H_2O+2NO+3O$
$3O+3Cu \rightarrow 3CuO$
$3CuO+6HNO_3 \rightarrow 3Cu(NO_3)_2+3H_2O$

$3Cu+8HNO_3 \rightarrow 3Cu(NO_3)_2+2NO+4H_2O$

(29) $HNO_3+H_2O \rightarrow NH_3+4O$
$4O+4Zn \rightarrow 4ZnO$

3

$4ZnO+8HNO_3 \rightarrow 4Zn(NO_3)_2+4H_2O$
$NH_3+HNO_3 \rightarrow NH_4NO_3$

$4Zn+10HNO_3 \rightarrow 4Zn(NO_3)_2+NH_4NO_3+3H_2O$

(30) $2HNO_3 \rightarrow H_2O+2NO+3O$
$6Ag+3O \rightarrow 3Ag_2O$
$3Ag_2O+6HNO_3 \rightarrow 6AgNO_3+3H_2O$

$8HNO_3+6Ag \rightarrow 6AgNO_3+2NO+4H_2O$

(31) $10HNO_3 \rightarrow 5H_2O+10NO+15O$
$6P+15O \rightarrow 3P_2O_5$
$3P_2O_5+9H_2O \rightarrow 6H_3PO_4$

$6P+10HNO_3+4H_2O \rightarrow 10NO+6H_3PO_4$

(32) $2HNO_3 \rightarrow H_2O+2NO+3O$
$3O+6HCl \rightarrow 3Cl_2+3H_2O$

$2HNO_3+6HCl \rightarrow 2NO+3Cl_2+4H_2O$

(33) $2HNO_3 \rightarrow H_2O+2NO+2O$
$2O+6HNO_3 \rightarrow 6NO_2+3H_2O$
$6Fe(NO_3)_2+6NO_2 \rightarrow 6Fe(NO_3)_3$

$6Fe(NO_3)_2+8HNO_3 \rightarrow 6Fe(NO_3)_3+2NO+4H_2O$

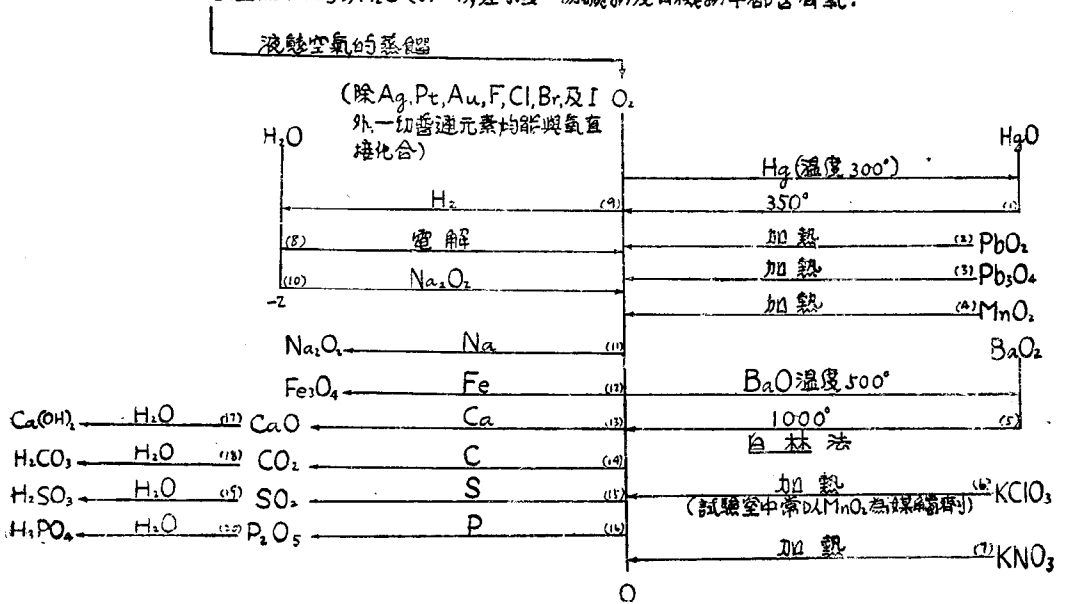
(34) $2HNO_3 \rightarrow H_2O+2NO+3O$
$3O+3H_2SO_4 \rightarrow 3H_2O+3SO$
$6FeSO_4+3SO \rightarrow 3Fe_2(SO_4)_3$

$6FeSO_4+2HNO_3+3H_2SO_4 \rightarrow 3Fe_2(SO_4)_3+2NO+4H_2O$

(35) $C_3H_5(OH)_3+3HNO_3 \rightarrow C_3H_5(NO_3)_3+3HOH$
(36) $2NO_2 \rightleftarrows N_2O$
(37) $2Zn(NO_3)_2 \rightarrow 2ZnO+4NO$
(38) $2AgNO_3 \rightarrow 2Ag+2NO_2+O_2$

氧, O.　　第六類, 原子價 -2.

存在: O_2(空氣中有之); H_2O (8/9); 差不多一切礦物及有機物中都含有氧.



氧的方程式

(1) $2HgO \rightleftarrows 2Hg+O_2$

(2) $2PbO_2 \rightleftarrows 2PbO+O_2$

(3) $2Pb_3O_4 \rightleftarrows 6PbO+O_2$

(4) $3MnO_2 \rightleftarrows Mn_3O_4+O_2$

(5) $2BaO_2 \rightleftarrows 2BaO+O_2$

(6) $2KClO_3 \rightarrow 2KCl+3O_2$

(7) $2KNO_3 \rightarrow 2KNO_2+O_2$

(8) 陽極：O_2

陰極：H_2

(9) $2H_2+O_2 \rightleftarrows 2H_2O$

(10) $2H_2O+2Na_2O_2 \rightarrow 4NaOH+O_2$

(11) $2Na+O_2 \rightarrow Na_2O_2$

(12) $3Fe+2O_2 \rightarrow Fe_3O_4$

(13) $2Ca+O_2 \rightarrow 2CaO$

(14) $C+O_2 \rightarrow CO_2$

(15) $S+O_2 \rightarrow SO_2$

(16) $4P+5O_2 \rightarrow 2P_2O_5$

(17) $CaO+H_2O \rightleftarrows Ca(OH)_2$

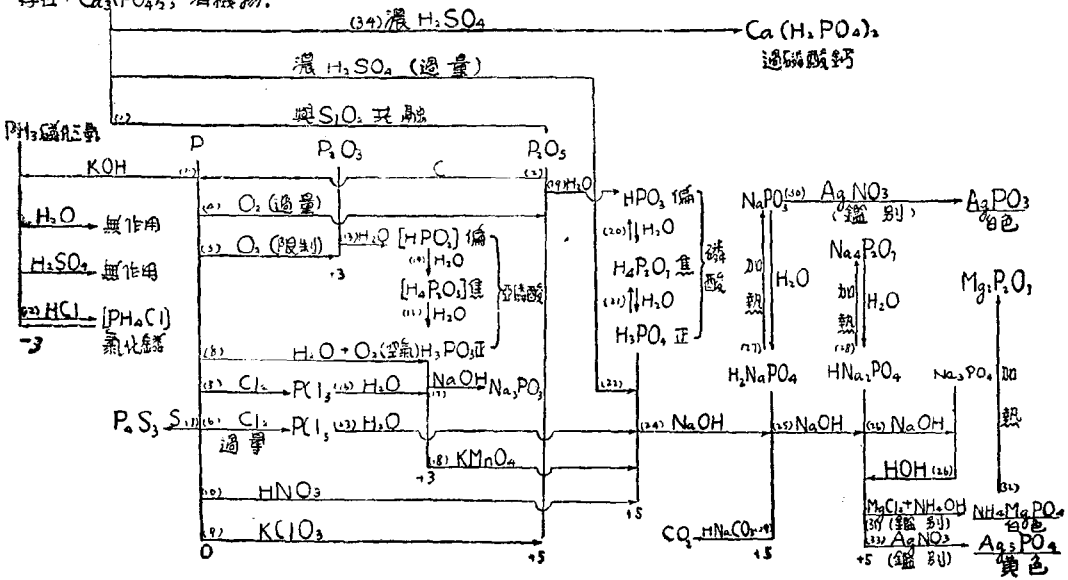
(18) $CO_2+H_2O \rightleftarrows H_2CO_3$

(19) $SO_2+H_2O \rightleftarrows H_2SO_3$

(20) $P_2O_5+3H_2O \rightleftarrows 2H_3PO_4$

磷, P. 第五類, 原子價 -3 +3 及 +5.

存在 $Ca_3(PO_4)_2$, 有機物.

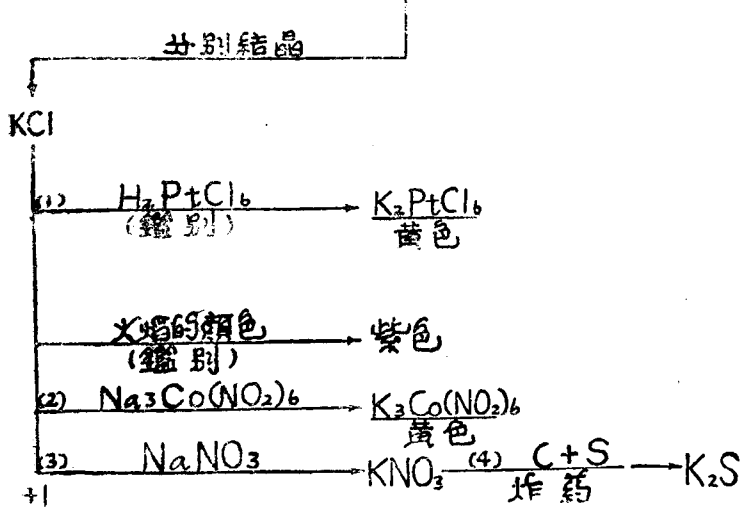


磷的方程式

(1) $Ca_3(PO_4)_2+3SiO_2 \rightarrow 3CaSiO_3+P_2O_5$
(2) $P_2O_5+5C \rightarrow 2P+5CO$
(3) $4P+3O_2 \rightarrow 2P_2O_3$
(4) $4P+5O_2 \rightarrow 2P_2O_5$
(5) $2P+3Cl_2 \rightarrow 2PCl_3$
(6) $2P+5Cl_2 \rightarrow 2PCl_5$
(7) $4P+3S \rightarrow P_4S_3$
(8) $4P+3O_2+6H_2O \rightarrow 4H_3PO_3$
(9) $6P+5KClO_3 \rightarrow 3P_2O_5+5KCl$
(10) $10HNO_3 \rightarrow 5H_2O+10NO+15O$
$15O+6P \rightarrow 3P_2O_5$
$3P_2O_5+9H_2O \rightarrow 6H_3PO_4$
$6P+10HNO_3+4H_2O \rightarrow 6H_3PO_4+10NO$
(11) $4P+3KOH+3H_2O \rightarrow PH_3+3KH_2PO_2$
(12) $PH_3+HCl \rightleftarrows PH_4Cl$
(13) $P_2O_3+H_2O \rightleftarrows [2HPO_2]$
(14) $[2HPO_2]+H_2O \rightleftarrows [H_4P_2O_5]$
(15) $[H_4P_2O_5]+H_2O \rightleftarrows 2H_3PO_3$
(16) $PCl_3+3HOH \rightarrow H_3PO_3+3HCl$
(17) $H_3PO_3+3NaOH \rightleftarrows Na_3PO_3+3HOH$
(18) $6KMnO_4 \rightarrow 3K_2O+6MnO+15O$
$15H_3PO_3+15O \rightarrow 15H_3PO_4$
$3K_2O+3H_3PO_4 \rightarrow 3HK_2PO_4+3H_2O$
$6MnO+4H_3PO_4 \rightarrow 2Mn_3(PO_4)_2+6H_2O$
$6KMnO_4+15H_3PO_3 \rightarrow 8H_3PO_4+3HK_2PO_4+2Mn_3(PO_4)_2+9H_2O$
(19) $P_2O_5+H_2O \rightleftarrows 2HPO_3$
(20) $2HPO_3+H_2O \rightleftarrows H_4P_2O_7$
(21) $H_4P_2O_7+H_2O \rightleftarrows 2H_3PO_4$
(22) $Ca_3(PO_4)_2+3H_2SO_4 \rightarrow 2H_3PO_4+3CaSO_4$
(23) $PCl_5+4H_2O \rightarrow H_3PO_4+5HCl$
(24) $H_3PO_4+NaOH \rightarrow H_2NaPO_4+HOH$
(25) $H_2NaPO_4+NaOH \rightleftarrows HNa_2PO_4+HOH$
(26) $HNa_2PO_4+NaOH \rightleftarrows Na_3PO_4+HOH$
(27) $H_2NaPO_4 \rightleftarrows NaPO_3+H_2O$
(28) $2HNa_2PO_4 \rightleftarrows Na_4P_2O_7+H_2O$
(29) $H_2NaPO_4+HNaCO_3 \rightarrow HNa_2PO_4+H_2O+CO_2$
(30) $NaPO_3+AgNO_3 \rightarrow AgPO_3+NaNO_3$
(31) $HNa_2PO_4+MgCl_2+NH_4OH \rightarrow NH_4MgPO_4+HOH+2NaCl$
(32) $2NH_4MgPO_4 \rightarrow Mg_2P_2O_7+2NH_3+H_2O$
(33) $HNa_2PO_4+3AgNO_3 \rightarrow Ag_3PO_4+2NaNO_3+HNO_3$

鉀，K.　　第一類，　原子價 +1.　鉀的各種反應及化合物，與鈉大致相同，在此僅列一簡表，指出其不同之處.

存在：　　KCl; $KCl\cdot MgCl_2\cdot bH_2O$; KNO_3; 矽酸鹽(長石，雲母等)，海草



鉀的方程式

(1) $2KCl + H_2PtCl_6 \longrightarrow \underline{K_2PtCl_6} + 2HCl$

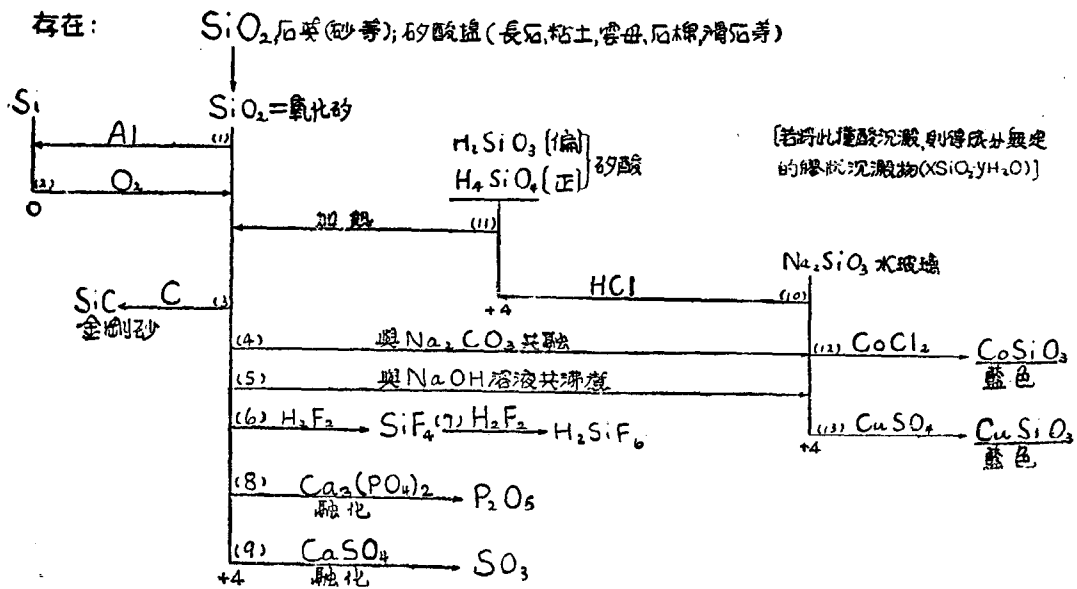
(2) $3KCl + Na_3Co(NO_2)_6 \longrightarrow \underline{K_3Co(NO_2)_6} + 3NaCl$

(3) $KCl + NaNO_3 \rightleftharpoons KNO_3 + \underline{NaCl}$

(4) $2KNO_3 + 3C + S \longrightarrow K_2S + 3CO_2 + N_2$

矽, Si. 第四類, 原子價 +4.

存在: SiO_2石英(砂等); 矽酸鹽(長石,粘土,雲母,石棉,滑石等)



矽的方程式

(1) $3SiO_2+4Al \rightarrow 3Si+2Al_2O_3$

(2) $Si+O_2 \rightarrow SiO_2$

(3) $SiO_2+3C \rightarrow SiC+2CO$

(4) $SiO_2+Na_2CO_3 \rightarrow Na_2SiO_3+CO_2$

(5) $SiO_2+2NaOH \rightarrow Na_2SiO_3+H_2O$

(6) $SiO_2+2H_2F_2 \rightarrow SiF_4+2H_2O$

(7) $SiF_4+H_2F_2 \rightarrow H_2SiF_6$

(8) $3SiO_2+Ca_3(PO_4)_2 \rightarrow 3CaSiO_3+P_2O_5$

(9) $SiO_2+CaSO_4 \rightarrow CaSiO_3+SO_3$

(10) $Na_2SiO_3+2HCl \rightarrow \underline{H_2SiO_3}+2NaCl$

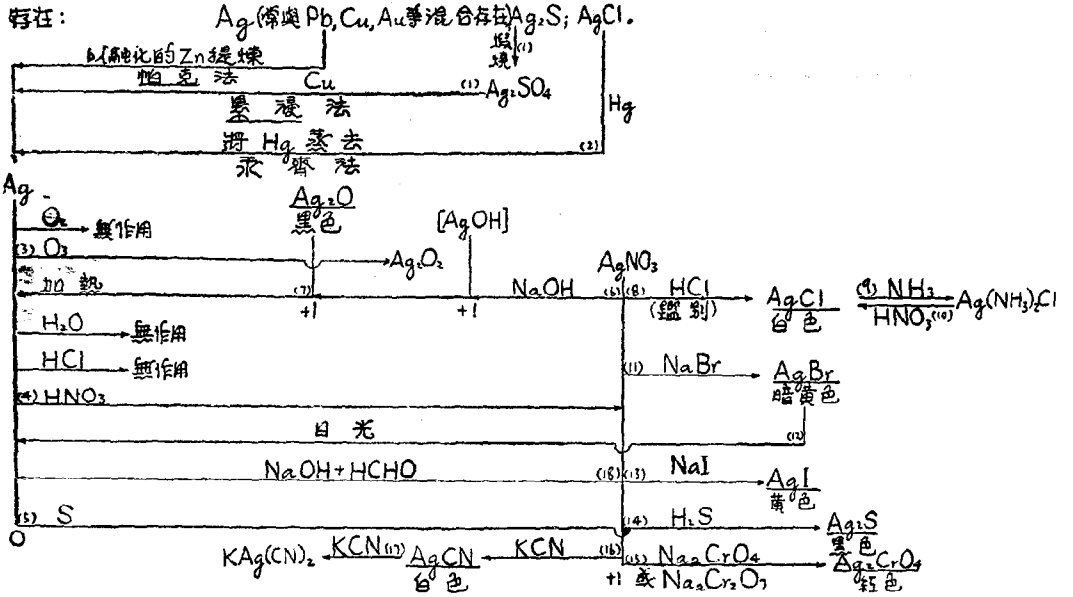
(11) $H_2SiO_3 \rightarrow H_2O+SiO_2$

(12) $Na_2SiO_3+CoCl_2 \rightarrow \underline{CoSiO_3}+2NaCl$

(13) $Na_2SiO_3+CuSO_4 \rightarrow \underline{CuSiO_3}+Na_2SO_4$

銀, Ag. 第一類, 原子價 +1.

特性:



銀的方程式

(1) $Ag_2S+2O_2 \rightarrow Ag_2SO_4$

$Ag_2SO_4+Cu \rightarrow 2Ag+CuSO_4$

(2) $AgCl+Hg \rightarrow Ag+HgCl$

(3) $6Ag+2O_3 \rightarrow 3Ag_2O_2$

(4) $2HNO_3 \rightarrow H_2O+2NO+3O$

$6Ag+3O \rightarrow 3Ag_2O$

$3Ag_2O+6HNO_3 \rightarrow 6AgNO_3+3H_2O$

$6Ag+8HNO_3 \rightarrow 6AgNO_3+2NO+4H_2O$

(5) $2Ag+S \rightarrow Ag_2S$

(6) $2AgNO_3+2NaOH \rightarrow 2[AgOH]+2NaNO_3$

$2[AgOH] \rightleftarrows Ag_2O+H_2O$

$2AgNO_3+2NaOH \rightarrow Ag_2O+2NaNO_3+H_2O$

(7) $2Ag_2O \rightarrow 4Ag+O_2$

(8) $AgNO_3+HCl \rightarrow AgCl+HNO_3$

(9) $AgCl+2NH_3 \rightarrow Ag(NH_3)_2Cl$

(10) $Ag(NH_3)_2Cl+2HNO_3 \rightarrow AgCl+2NH_4NO_3$

(11) $AgNO_3+NaBr \rightarrow AgBr+NaNO_3$

(12) $2AgBr \rightarrow 2Ag+Br_2$

(13) $AgNO_3+NaI \rightarrow AgI+NaNO_3$

(14) $2AgNO_3+H_2S \rightarrow Ag_2S+2HNO_3$

(15) $2AgNO_3+Na_2CrO_4 \rightarrow Ag_2CrO_4+2NaNO_3$

或 $4AgNO_3+Na_2Cr_2O_7+H_2O \rightarrow 2Ag_2CrO_4+2NaNO_3+2HNO_3$

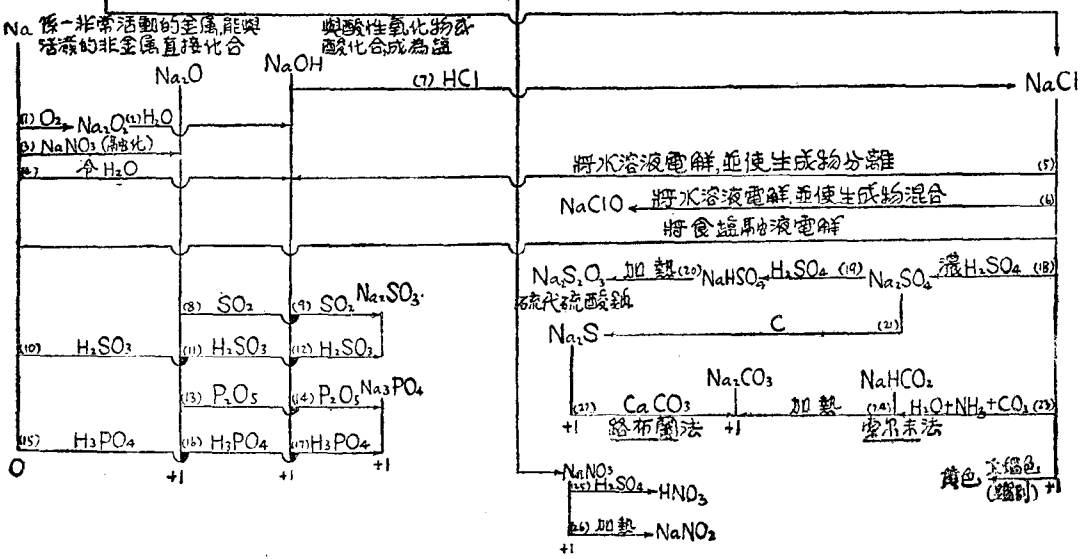
(16) $AgNO_3+KCN \rightarrow AgCN+KNO_3$

(17) $AgCN+KCN \rightarrow KAg(CN)_2$

(18) $4AgNO_3+4NaOH+HCHO \rightarrow 4Ag+4NaNO_3+CO_2+3H_2O$

鈉，Na.　　第一類，原子價 +1.

存在：NaCl.　$NaNO_3$，智利硝石；$Na_2B_4O_7$；Na_3AlF_6 等



鈉的方程式

(1) $2Na+O_2 \rightarrow Na_2O_2$

(2) $2Na_2O_2+2H_2O \rightarrow 4NaOH+O_2$

(3) $10Na+2NaNO_3 \rightarrow 6Na_2O+N_2$

(4) $2Na+2HOH \rightarrow 2NaOH+H_2$

(5) 陰極：$NaOH$; H_2
陽極：Cl_2

(6) 初次產物 (見(5)的反應)
$2NaOH+Cl_2 \rightarrow NaCl+NaClO+H_2O$

(7) $NaOH+HCl \rightarrow NaCl+HOH$

(8) $Na_2O+SO_2 \rightarrow Na_2SO_3$

(9) $2NaOH+SO_2 \rightarrow Na_2SO_3+H_2O$

(10) $2Na+H_2SO_3 \rightarrow Na_2SO_3+H_2$

(11) $Na_2O+H_2SO_3 \rightarrow Na_2SO_3+H_2O$

(12) $2NaOH+H_2SO_3 \rightleftarrows Na_2SO_3+2HOH$

(13) $3Na_2O+P_2O_5 \rightarrow 2Na_3PO_4$

(14) $6NaOH+P_2O_5 \rightarrow 2Na_3PO_4+3H_2O$

(15) $6Na+2H_3PO_4 \rightarrow 2Na_3PO_4+3H_2$

(16) $3Na_2O+2H_3PO_4 \rightarrow 2Na_3PO_4+3H_2O$

(17) $3NaOH+H_3PO_4 \rightarrow Na_3PO_4+3HOH$

(18) $2NaCl+H_2SO_4 \rightarrow Na_2SO_4+\underline{2HCl}$

(19) $Na_2SO_4+H_2SO_4 \rightarrow 2HNaSO_4$

(20) $2HNaSO_4 \rightleftarrows H_2O+Na_2S_2O_7$

(21) $Na_2SO_4+4C \rightarrow Na_2S+4CO$

(22) $Na_2S+CaCO_3 \rightarrow Na_2CO_3+\underline{CaS}$

(23) $NH_3+CO_2+H_2O \rightleftarrows NH_4 \cdot HCO_3$
$NaCl+NH_4HCO_3 \rightarrow \underline{NaHCO_3}+NH_4Cl$

(24) $2NaHCO_3 \rightleftarrows Na_2CO_3+H_2O+CO_2$

(25) $2NaNO_3+H_2SO_4 \rightarrow Na_2SO_4+\underline{2HNO_3}$

(26) $2NaNO_3 \rightarrow 2NaNO_2+O_2$

鍶, Sr.　第二類，原子價 +2.

鍶的各種反應與鋇大致相同，在此僅將鍶的鑑別法列于表中

存在：　$SrCO_3$, $SrSO_4$.

$SrCl_2$.

(1) Na_2CO_3 → $SrCO_3$ 白色

(2) Na_2SO_4 → $SrSO_4$ 白色

火焰的顏色 (鑑別) → 紅色

+2

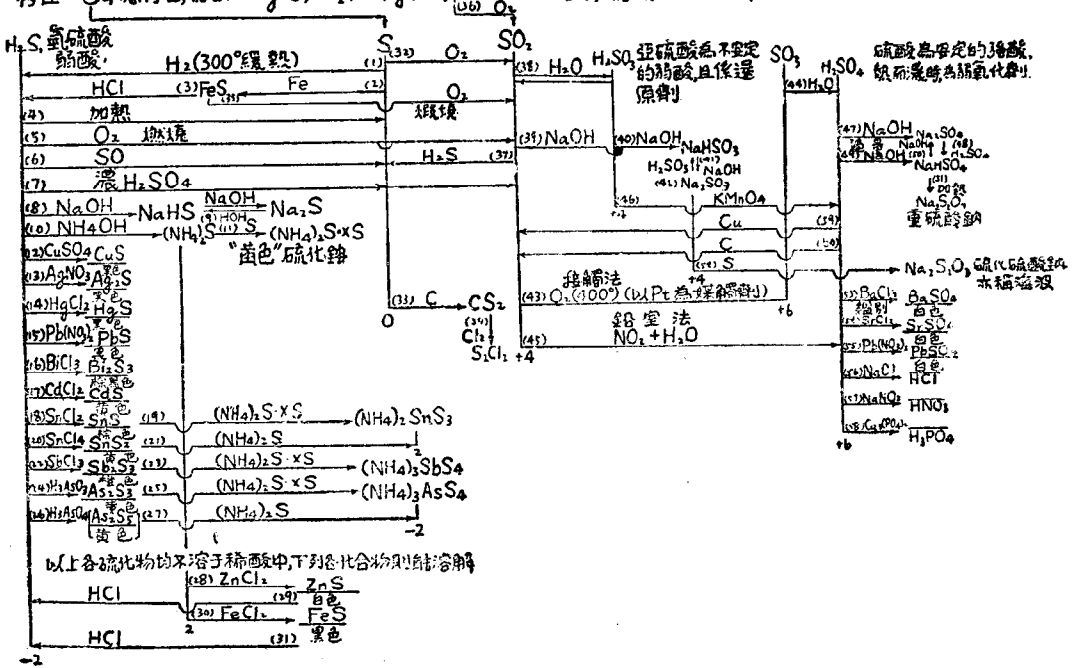
鍶的方程式

(1) $SrCl_2 + Na_2CO_3 \longrightarrow \underline{SrCO_3} + 2\,NaCl$

(2) $SrCl_2 + Na_2SO_4 \longrightarrow \underline{SrSO_4} + 2\,NaCl$

硫, S. 第六類, 原子價 -2, +4, 及 +6.

存在: S單獨存在; 硫化物 Ag_2S, Cu_2S, PbS, HgS, ZnS, FeS_2 $CuFeS_2$ 等; 硫酸鹽 $CuSO_4 2H_2O$, $BaSO_4$ 等.



硫的方程式

(1) $H_2+S \rightleftarrows H_2S$
(2) $Fe+S \rightarrow FeS$
(3) $FeS+2HCl \rightleftarrows H_2S+FeCl_2$
(4) $H_2S \rightleftarrows H_2+S$
(5) $2H_2S+3O_2 \rightarrow 2H_2O+2SO_2$
(6) $2H_2S+SO_2 \rightarrow 3S+2H_2O$
(7) $H_2S+H_2SO_4 \rightarrow S+SO_2+2H_2O$
(8) $H_2S+NaOH \rightleftarrows NaHS+HOH$
(9) $NaHS+NaOH \rightleftarrows Na_2S+HOH$
(10) $H_2S+2NH_4OH \rightleftarrows (NH_4)_2S+2HOH$
(11) $(NH_4)_2S+xS \rightarrow (NH_4)_2S \cdot xS$
(12) $H_2S+CuSO_4 \rightarrow \underline{CuS}+H_2SO_4$
(13) $H_2S+2AgNO_3 \rightarrow \underline{Ag_2S}+2HNO_3$
(14) $H_2S+HgCl_2 \rightarrow \underline{HgS}+2HCl$
(15) $H_2S+Pb(NO_3)_2 \rightarrow \underline{PbS}+2HNO_3$
(16) $3H_2S+2BiCl_3 \rightarrow \underline{Bi_2S_3}+6HCl$
(17) $H_2S+CdCl_2 \rightarrow \underline{CdS}+2HCl$
(18) $H_2S+SnCl_2 \rightarrow SnS+2HCl$
(19) $\underline{SnS}+(NH_4)_2S_2 \rightarrow (NH_4)_2SnS_3$
(20) $2H_2S+SnCl_4 \rightarrow \underline{SnS_2}+4HCl$
(21) $\underline{SnS_2}+(NH_4)_2S \rightarrow (NH_4)_2SnS_3$
(22) $3H_2S+2SbCl_3 \rightarrow \underline{Sb_2S_3}+6HCl$
(23) $\underline{Sb_2S_3}+3(NH_4)_2S+2S \rightarrow 2(NH_4)_3SbS_4$
(24) $3H_2S+2H_3AsO_3 \rightarrow \underline{As_2S_3}+6H_2O$
(25) $\underline{As_2S_3}+3(NH_4)_2S+2S \rightarrow 2(NH_4)_3AsS_4$
(26) $5H_2S+2H_3AsO_4 \rightarrow \underline{[As_2S_3]}+8H_2O$
(27) $\underline{[As_2S_3]}+3(NH_4)_2S \rightarrow 2(NH_4)_3AsS_4$
(28) $(NH_4)_2S+ZnCl_2 \rightarrow \underline{ZnS}+2NH_4Cl$
(29) $\underline{ZnS}+2HCl \rightleftarrows H_2S+ZnCl_2$
(30) $(NH_4)_2S+FeCl_2 \rightarrow \underline{FeS}+2NH_4Cl$
(31) $\underline{FeS}+2HCl \rightleftarrows H_2S+FeCl_2$
(32) $S+O_2 \rightarrow SO_2$
(33) $2S+C \rightarrow CS_2$
(34) $CS_2+3Cl_2 \rightarrow S_2Cl_2+CCl_4$
(35) $4FeS+7O_2 \rightarrow 2Fe_2O_3+4SO_2$
(36) $4FeS_2+11O_2 \rightarrow 8SO_2+2Fe_2O_3$
(37) $2H_2S+SO_2 \rightarrow 3S+2H_2O$
(38) $SO_2+H_2O \rightleftarrows H_2SO_3$
(39) $SO_2+NaOH \rightarrow NaHSO_3$
(40) $H_2SO_3+NaOH \rightleftarrows NaHSO_3+HOH$
(41) $NaHSO_3+NaOH \rightleftarrows Na_2SO_3+HOH$
(42) $Na_2SO_3+H_2SO_3 \rightleftarrows 2NaHSO_3$
(43) $2SO_2+O_2 \rightarrow 2SO_3$
(44) $SO_3+H_2O \rightarrow H_2SO_4$
(45) $SO_2+NO_2+H_2O \rightarrow H_2SO_4+NO$
(46) $2KMnO_4 \rightarrow \cancel{K_2O}+\cancel{2MnO}+\cancel{5O}$

$\cancel{5O}+5H_2SO_3 \rightarrow 5H_2SO_4$

$\cancel{K_2O}+H_2SO_4 \rightarrow K_2SO_4+H_2O$

$\cancel{2MnO}+\cancel{2H_2SO_4} \rightarrow 2MnSO_4+2H_2O$

$5H_2SO_3+2KMnO_4 \rightarrow 2H_2SO_4+K_2SO_4+2MnSO_4+3H_2O$

(47) $H_2SO_4+2NaOH \rightarrow Na_2SO_4+2HOH$
(48) $Na_2SO_4+H_2SO_4 \rightarrow 2NaHSO_4$
(49) $H_2SO_4+NaOH \rightarrow NaHSO_4+HOH$
(50) $NaHSO_4+NaOH \rightarrow Na_2SO_4+HOH$
(51) $2NaHSO_4 \rightarrow Na_2S_2O_7+H_2O$
(52) $Na_2SO_3+S \rightarrow Na_2S_2O_3$
(53) $H_2SO_4+BaCl_2 \rightarrow \underline{BaSO_4}+2HCl$
(54) $H_2SO_4+SrCl_2 \rightarrow \underline{SrSO_4}+2HCl$
(55) $H_2SO_4+Pb(NO_3)_2 \rightarrow \underline{PbSO_4}+2HNO_3$
(56) $H_2SO_4+2NaCl \rightarrow Na_2SO_4+2HCl$
(57) $H_2SO_4+2NaNO_3 \rightarrow Na_2SO_4+2HNO_3$
(58) $3H_2SO_4+Ca_3(PO_4)_2 \rightarrow 3CaSO_4+2H_3PO_4$
(59) $H_2SO_4 \rightarrow H_2O+SO_2+\cancel{O}$

$\cancel{O}+Cu \rightarrow \cancel{CuO}$

$\cancel{CuO}+H_2SO_4 \rightarrow CuSO_4+H_2O$

$Cu+2H_2SO_4 \rightarrow CuSO_4+SO_2+2H_2O$

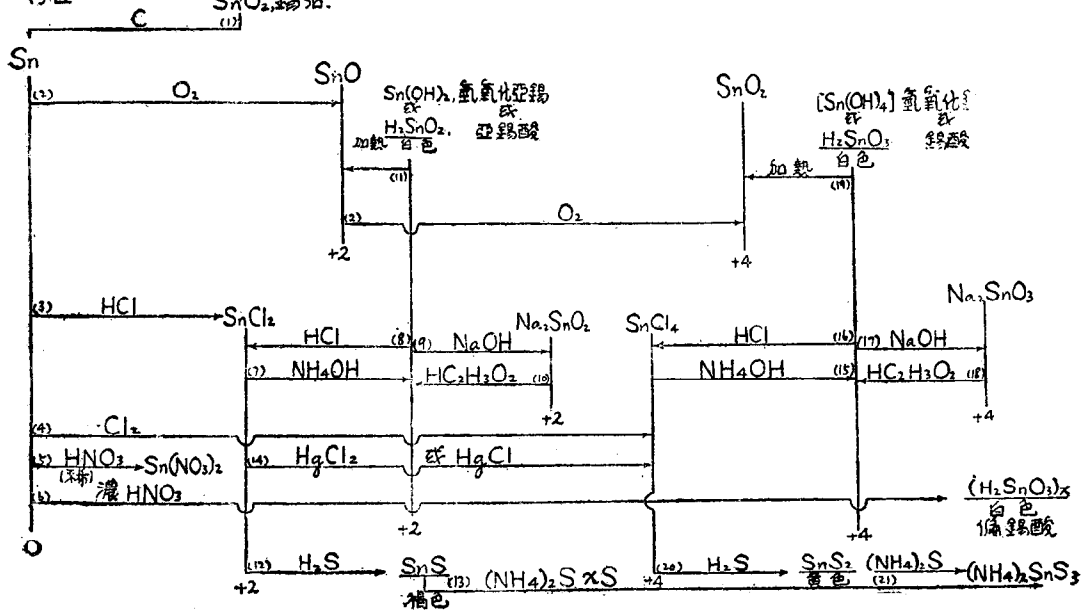
(60) $2H_2SO_4 \rightarrow 2H_2O+2SO_2+\cancel{2O}$

$\cancel{2O}+C \rightarrow CO_2$

$2H_2SO_4+C \rightarrow 2SO_2+CO_2+2H_2O$

錫, Sn. 第四類, 原子價 +2, 及 +4.

存在: SnO_2, 錫石.



錫的方程式

(1) $SnO_2+2C \rightarrow Sn+2CO$

(2) $2Sn+O_2 \rightarrow 2SnO$

$2SnO+O_2 \rightarrow 2SnO_2$

(3) $Sn+2HCl \rightarrow SnCl_2+H_2$

(4) $Sn+2Cl_2 \rightarrow SnCl_4$

(5) $HNO_3+H_2O \rightarrow NH_3+4O$

$4O+4Sn \rightarrow 4SnO$

$4SnO+5HNO_3 \rightarrow 4Sn(NO_3)_2+\frac{1}{3}H_2O$

$NH_3+HNO_3 \rightarrow NH_4NO_3$

$4Sn+10HNO_3 \rightarrow 4Sn(NO_3)_2+NH_4NO_3+3H_2O$

(6) $4HNO_3 \rightarrow \frac{1}{2}H_2O+4NO_2+2O$

$2O+Sn \rightarrow SnO_2$

$SnO_2+H_2O \rightarrow H_2SnO_3$

$Sn+4HNO_3 \rightarrow H_2SnO_3+4NO_2+H_2O$

(7) $SnCl_2+2NH_4OH \rightarrow Sn(OH)_2+2NH_4Cl$

(8) $Sn(OH)_2+2HCl \rightleftarrows SnCl_2+2HOH$

(9) $H_2SnO_2+2NaOH \rightleftarrows Na_2SnO_2+2HOH$

(10) $Na_2SnO_2+2HC_2H_3O_2 \rightarrow H_2SnO_2+2NaOH$

(11) $Sn(OH)_2 \rightarrow SnO+H_2O$

(12) $SnCl_2+H_2S \rightarrow SnS+2HCl$

(13) $SnS+(NH_4)_2S+S \rightarrow (NH_4)_2SnS_3$

(14) $SnCl_2+2HgCl_2 \rightarrow SnCl_4+2HgCl$

$SnCl_2+2HgCl \rightarrow SnCl_4+2Hg$

(15) $SnCl_4+4NH_4OH \rightarrow H_2SnO_3+4NH_4Cl+H_2O$

(16) $H_2SnO_3+4HCl \rightleftarrows SnCl_4+3H_2O$

(17) $H_2SnO_3+2NaOH \rightleftarrows Na_2SnO_3+2HOH$

(18) $Na_2SnO_3+2HC_2H_3O_2 \rightarrow H_2SnO_3+2NaC_2H_3O_2$

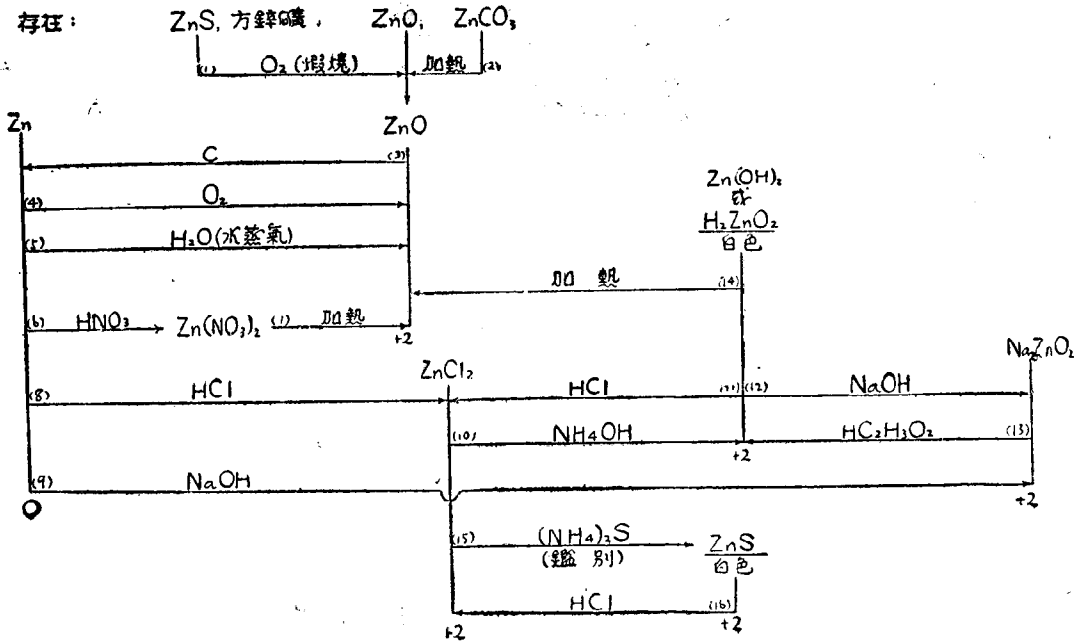
(19) $H_2SnO_3 \rightarrow SnO_2+H_2O$

(20) $SnCl_4+2H_2S \rightarrow SnS_2+4HCl$

(21) $SnS_2+(NH_4)_2S \rightarrow (NH_4)_2SnS_3$

鋅 Zn.　　第二類，原子價 +2.

存在：　ZnS, 方鋅礦，　ZnO,　$ZnCO_3$



鋅的方程式

(1) $2ZnS+3O_2 \rightarrow 2ZnO+2SO_2$

(2) $ZnCO_3 \rightarrow ZnO+CO_2$

(3) $ZnO+C \rightarrow Zn+CO$

(4) $2Zn+O_2 \rightarrow 2ZnO$

(5) $Zn+H_2O \rightarrow ZnO+H_2$

(6) $HNO_3+H_2O \rightarrow NH_3+4O$

$4O+4Zn \rightarrow 4ZnO$

$4ZnO+8HNO_3 \rightarrow 4Zn(NO_3)_2+4H_2O$

$NH_3+HNO_3 \rightarrow NH_4NO_3$

$4Zn+10HNO_3 \rightarrow 4Zn(NO_3)_2+NH_4NO_3+3H_2O$

(7) $2Zn(NO_3)_2 \rightarrow 2ZnO+4NO_2+O_2$

(8) $Zn+2HCl \rightarrow ZnCl_2+H_2$

(9) $Zn+2NaOH \rightarrow Na_2ZnO_2+H_2$

(10) $ZnCl_2+2NH_4OH \rightarrow \underline{Zn(OH)_2}+2NH_4Cl$

(11) $\underline{Zn(OH)_2}+2HCl \rightleftarrows ZnCl_2+2HOH$

(12) $\underline{H_2ZnO_2}+2NaOH \rightleftarrows Na_2ZnO_2+2HOH$

(13) $Na_2ZnO_2+2HC_2H_3O_2 \rightarrow \underline{H_2ZnO_2}+2NaC_2H_3O_2$

(14) $Zn(OH)_2 \rightarrow ZnO+H_2O$

(15) $ZnCl_2+(NH_4)_2S \rightarrow \underline{ZnS}+2NH_4Cl$

(16) $\underline{ZnS}+2HCl \rightleftarrows ZnCl_2+H_2S$

英名中名及分子式對照表

Aluminium	鋁	**Al**
Alum	明礬	$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$
Aluminium chloride	氯化鋁	$AlCl_3$
,, hydroxide	氫氧化鋁	$Al(OH)_3$
,, oxide (Corundum)	氧化鋁 (剛玉)	Al_2O_3
,, sulfate	硫酸鋁	$Al_2(SO_4)_3$
,, sulfide	硫化鋁	Al_2S_3
Bauxite	水礬土礦	$Al_2O_3 \cdot 2H_2O$
Clay	黏土	$H_2Al_2(SiO_4)_2 \cdot 2H_2O$
Cryolite	冰晶石	Na_3AlF_6
Feldspar	長石	$KAlSi_3O_8$
Mica	雲母	$KAlSiO_4$
Sodium ortho-aluminate	正鋁酸鈉	Na_3AlO_3
Antimony	銻	**Sb**
,, hydride (stibine)	銻化三氫 (銻毒氣)	SbH_3
,, hydroxide	氫氧化銻	$Sb(OH)_3$
,, pentoxide	五氧化二銻	Sb_2O_5
,, trichloride	三氯化銻	$SbCl_3$
,, trioxide	三氧化二銻	Sb_2O_3
Antimonyl chloride	氧氯化銻	$SbOCl$
Dipotassium pyroantimonate	焦銻酸二鉀	$K_2H_2Sb_2O_7$
Meta-antimonic acid	偏銻酸	$HSbO_3$
Ortho-antimonic acid	正銻酸	H_3SbO_4
Potassium meta-antimonate	偏銻酸鉀	$KSbO_3$
Pyro-antimonic acid	焦銻酸	$H_4Sb_2O_7$
Stibnite	輝銻礦	Sb_2S_3

Arsenic	砷	**As**
Ammonium magnesium arsenate	砷酸鎂銨	NH_4MgAsO_4
Arsenic pentoxide	五氧化二砷	As_2O_5
Arsenious acid	亞砷酸	H_3AsO_3
,, hydride (Arsine)	砷化三氫 (砷毒氣)	AsH_3
,, hydroxide	三氫氧化砷	$As(OH)_3$
,, oxide (Arsenite)	三氧化二砷 (砒霜)	As_2O_3
,, sulfide (*Orpiment*)	三硫化二砷 (雄黃)	As_2S_3
,, trichloride	三氯化砷	$AsCl_3$
Arsenopyrite	硫砷鐵礦	$FeAsS$
Meta-arsenic acid	偏砷酸	$HAsO_3$
Ortho-arsenic acid	正砷酸	H_3AsO_4
Pyro-arsenic acid	焦砷酸	$H_4As_2O_7$
Realgar	雞冠石	As_2S_2
Silver arsenate	砷酸銀	Ag_3AsO_4
Sodium arsenate, tribasic	砷酸鈉	Na_3AsO_4
,, ,, dibasic	砷酸氫二鈉	Na_2HAsO_4
,, ,, monobasic	砷酸二氫鈉	NaH_2AsO_4
,, arsenite	亞砷酸鈉	Na_3AsO_3
,, meta-arsenate	偏砷酸鈉	$NaAsO_3$
,, pyro-arsenate	焦砷酸鈉	$Na_4As_2O_7$
Barium	鋇	**Ba**
,, carbonate (Witherite)	碳酸鋇 (毒重石)	$BaCO_3$
,, chloride	氯化鋇	$BaCl_2$
,, chromate	鉻酸鋇	$BaCrO_4$
,, hydroxide	氫氧化鋇	$Ba(OH)_2$
,, mono-sulfide	硫化鋇	BaS
,, oxide	氧化鋇	BaO
,, peroxide	過氧化鋇	BaO_2
,, permanganate	過錳酸鋇	$Ba(MnO_4)_2$

Barium sulfate (Barite)	硫酸鋇 (重晶石)	$BaSO_3$
Bismuth	鉍	**Bi**
,, hydroxide	氫氧化鉍	$Bi(OH)_3$
,, oxychloride	氧氯化鉍	BiOCl
,, oxyhydroxide	氧氫氧化鉍	BiO(OH)
,, trichloride	三氯化鉍	$BiCl_3$
,, trioxide	三氧化二鉍	Bi_2O_3
,, trisulfide	三硫化二鉍	Bi_2S_3
Boron	硼	**B**
Borax	硼砂	$Na_2B_4O_7$
Boric acid	硼酸	H_3BO_3
Boron oxide	氧化硼	B_2O_3
Cobaltous metaborate	偏硼酸鈷	$Co(BO_2)_2$
Colemanite	硼酸鈣鑛	$Ca_2B_6O_{11}$
Metaboric acid	偏硼酸	HBO_2
Orthoboric acid	正硼酸	H_3BO_3
Tetraboric acid	四硼硼酸	$H_2B_4O_7$
Bromine	溴	**Br**
Bromic acid	溴酸	$HBrO_3$
Hydrogen bromide	溴化氫 (氫溴酸)	HBr
Hypobromous acid	次溴酸	HBO
Magnesum bromide	溴化鎂	$MgBr_2$
Phosphorous tribromide	三溴化磷	PBr_3
Silver bromide	溴化銀	AgBr
Sodium bromide	溴化鈉	NaBr
Calcium	鈣	**Ca**
Calcium acid carbonate	酸性碳酸鈣	$Ca(HCO_3)_2$
,, carbonate	碳酸鈣	$CaCO_3$

Calcium carbide	碳化鈣	CaC_2
,, chloride	氯化鈣	$CaCl_2$
,, cyanamide	氰氨基化鈣	$CaCN_2$
,, fluoride (Fluorspar)	氟化鈣 (螢石)	CaF_2
,, hybroxide	氫氧化鈣 (消石灰)	$Ca(OH)_2$
,, nitride	二氮化三鈣	Ca_3N_2
,, oxalate	草酸鈣	CaC_2H_4
,, oxide	氧化鈣	CaO
,, phosphate	磷酸鈣	$Ca_3(PO_4)_2$
,, silicate	矽酸鈣	$CaSiO_3$
,, sulfate	硫酸鈣	$CaSO_4$
,, sulfide	硫化鈣	CaS
,, superphosphate	過磷酸鈣	$Ca(H_2PO_4)_2$
Colemanite	硼酸鈣鑛	$Ca_2B_6O_{11}$
Bleaching powder	漂白粉	$CaOCl_2$
Dolomite	白雲石	$CaCO_3 \cdot MgCO_3$
Gypsum	石膏	$CaSO_4 \cdot 2H_2O$
Plaster of Paris	燒石膏	$CaSO_4 \cdot \frac{1}{2}H_2O$

Carbon	碳	**C**
Acetylene	乙炔	C_2H_2
Ammonium acid carbonate	酸性碳酸銨	NH_4HCO_3
Calcium acid carbonate	酸性碳酸鈣	$Ca(HCO_3)_2$
,, carbide	碳化鈣	CaC_2
,, cyanamide	氰氨基化鈣	$CaCN_2$
Carbon dioxide	二氧化碳	CO_2
,, disulfide	二硫化碳	CS_2
,, monoxide	一氧化碳	CO
,, tetrachloride	四氯化碳	CCl_4
Carbonic acid	碳酸	H_2CO_3
Cyanogen	氰	$(CN)_2$

Glycerine	甘油	$C_3H_5(OH)_3$
Glucose	葡萄糖	$C_6H_{12}O_6$
Hydrocyanic acid (Prussic acid)	氫氰酸(普魯士酸)	HCN
Nitroglycerine	硝化甘油	$C_3H_5(NO_3)_3$
Phosgene	光生氣	$COCl_2$
Potassium acid tartrate	酸性酒石酸鉀	$KHC_4H_4O_6$
Silicon carbide	碳化矽	SiC
Sodium acid carbonate	酸性碳酸鈉	$NaHCO_3$
,, carbonate	碳酸鈉	Na_2CO_3
,, cyanide	氰化鈉	NaCN
Chlorine	氯	**Cl**
Carnallite	白鹵鹽	$KCl \cdot MgCl_2 \cdot 6H_2O$
Chloric acid	氯酸	$HClO_3$
Chlorine dioxide	二氧化氯	ClO_2
Chlorine heptoxide	七氧化二氯	Cl_2O_7
,, monoxide	一氧化二氯	Cl_2O
Chlorous acid	亞氯酸	$HClO_2$
Cupric chloride	氯化銅	$CuCl_2$
Hydrochloric acid	鹽酸	HCl
Hypochlorous acid	次氯酸	HClO
Perchloric acid	過氯酸	$HClO_4$
Phosgene	光生氣	$COCl_2$
Phosphorous trichloride	三氯化磷	PCl_3
Potassium chloride	氯化鉀	KCl
Sodium chlorate	氯酸鈉	$NaClO_3$
,, chloride	氯化鈉	NaCl
,, hypochlorite	次氯酸鈉	NaClO
,, perchlorate	過氯酸鈉	$NaClO_4$
Chronum	鉻	**Cr**
Barium chromate	鉻酸鋇	$BaCrO_4$

Chromic acid	鉻酸	H_2CrO_4
Chromic chloride	三氯化鉻	$CrCl_3$
,, hydroxide	三氫氧化鉻	$Cr(OH)_3$
,, oxide	三氧化二鉻	Cr_2O_3
,, sulfate	硫酸鉻	$Cr_2(SO_4)_3$
Chromite	鉻鐵鑛	$Fe(CrO_2)_2$
Chromium trioxide	三氧化鉻	CrO_3
Chromous chloride	二氯化鉻	$CrCl_2$
,, hydroxide	二氫氧化鉻	$Cr(OH)_2$
,, oxide	一氧化鉻	CrO
Dichromic acid	重鉻酸	$H_2Cr_2O_7$
Patassium chromate	鉻酸鉀	K_2CrO_4
,, chromite	亞鉻酸鉀	$KCrO_2$
,, dichromate	重鉻酸鉀	$K_2Cr_2O_7$
Silver chromate	鉻酸銀	Ag_2CrO_4

Copper	**銅**	**Cu**
Ammonio-cupric sulfate	硫酸四氨銅	$Cu(NH_3)_4SO_4$
Cupric chloride	氯化銅	$CuCl_2$
,, ferrocyanide	亞鐵氰化銅	$Cu_2Fe(CN)_6$
,, hydroxide	氫氧化銅	$Cu(OH)_2$
,, oxide	氧化銅	CuO
,, silicate	矽酸銅	$CuSiO_3$
,, sulfate	硫酸銅	$CuSO_4$
,, sulfide	硫化銅	CuS
Cuprous chloride	氯化亞銅	$CuCl$
,, cyanide	氰化亞銅	$CuCN$
,, iodide	碘化亞銅	CuI
,, oxide	氧化亞銅	Cu_2O
,, sulfide	硫化亞銅	Cu_2S

Flourine	**氟**	**F**
Cryolite	冰晶石	Na_3AlF_5
Fluorspar	氟化鈣	CaF_2
Hydrofluoric acid	氫氟酸	H_2F_2
Hydrofluosilicic acid	氫氟矽酸	H_2SiF_6
Potassium acid fluoride	酸性氟化鉀	HKF_2
Silicon fluoride	氟化矽	SiF_4
Hydrogen	**氫**	**H**
Acetic acid	醋酸	$HC_2H_3O_2$
Antimonic acid	銻酸	H_3SbO_4
Antimonous acid	亞銻酸	H_3SbO_3
Arsenous acid	亞砷酸	H_3AsO_3
Bromic acid	溴酸	$HBrO_3$
Carbonic acid	碳酸	H_2CO_3
Chloric acid	氯酸	$HClO_3$
Chlorous acid	亞氯酸	$HClO_2$
Chromic acid	鉻酸	H_2CrO_4
Chromous acid	亞鉻酸	$HCrO_2$
Clay	黏土	$H_2Al_2S_2O_8 \cdot 2H_2O$
Dichromic acid	重鉻酸(一縮二鉻酸)	$H_2Cr_2O_7$
Hydrocyanic acid (Prussic acid)	氫氰酸(普魯士酸)	HCN
Hydrochloroplatinic acid	氫氯鉑酸	H_2PtCl_6
Hydrofluoric acid	氫氟酸 (氟化氫)	H_2F_2
Hydrofluosilic acid	氫氟矽酸	H_2SiF_6
Hydroiodic acid	氫碘酸 (碘化氫)	HI
Hydrobromic acid	溴化氫	HBr
Hydrochloric acid	氯化氫	HCl
Hybrogen peroxide	過氧化氫	H_2O_2
Hypobromous acid	次溴酸	HBrO
Hypochlorous acid	次氯酸	HClO

Hypoiodous acid	次碘酸	HIO
Iodic acid	碘酸	HIO_3
Meta-antimonic acid	偏銻酸	$HSbO_3$
Meta-arsenic acid	偏砷酸	$HAsO_3$
Metaboric acid	偏硼酸	HBO_2
Metadisilicic acid	偏二矽酸	$H_2Si_2O_5$
Metaphosphoric acid	偏磷酸	HPO_3
Metaphosphorous acid	偏亞磷酸	HPO_2
Metasilicic acid	偏矽酸	H_2SiO_3
Nitric acid	硝酸	HNO_3
Nitrous acid	亞硝酸	HNO_2
Ortho-arsenic acid	正砷酸	H_3AsO_4
Ortho-boric acid	正硼酸	H_3BO_3
Ortho-disilicic acid	正二矽酸	$H_6Si_2O_7$
Orthophosphoric acid	正磷酸	H_3PO_4
Orthophosphorous acid	正亞磷酸	H_3PO_3
Orthosilicic acid	正矽酸	H_4SiO_4
Permanganic acid	過錳酸	$HMnO_4$
Pyro-arsenic acid	焦砷酸	$H_4As_2O_7$
Pyrophosphoric acid	焦磷酸	$H_4P_2O_7$
Pyrophosphorous acid	焦亞磷酸	$H_4P_2O_5$
Pyrosulfuric acid	焦硫酸	$H_2S_2O_7$
Stannic acid	錫酸	H_2SnO_3
Stannous acid	亞錫酸	H_2SnO
Sulfuric acid	硫酸	H_2SO_4
Sulfurous acid	亞硫酸	H_2SO_3
Tetraboric acid	四硼硼酸	$H_2B_4O_7$
Thiosulfuric acid	硫代硫酸	$H_2S_2O_3$
Trisilicic acid	三矽酸	$H_4Si_3O_8$
Water	水	H_2O

Iodine	碘	**I**
Hydiodic acid	氫碘酸	HI
Iodic acid	碘酸	HIO_3
,, pentoxide	五氧化二碘	I_2O_5
Phosphorous triodide	三碘化磷	PI_3
Silver iodide	碘化銀	AgI
Sodium iodate	碘酸鈉	$NaIO_3$
Iron	鐵	**Fe**
Arsenopyrite	硫砷鐵鑛	FeAsS
Chromite	鉻鐵鑛	$Fe(CrO_2)_2$
Ferric chloride	氯化鐵	$FeCl_3$
,, ferrocyanide (Prussian blue)	亞鐵氰化鐵(普魯士藍)	$Fe_4[Fe(CN)_6]_3$
,, hydroxide	氫氧化鐵	$Fe(OH)_3$
,, nitrate	硝酸鐵	$Fe(NO_3)_3$
,, oxide (Hematite)	三氧化二鐵(赤鐵鑛)	Fe_2O_3
,, thiocyanate	三聚硫氰酸鐵	$Fe(CNS)_3$
,, sulfate	硫酸鐵	$Fe_2(SO_4)_3$
Ferrous carbonate	碳酸亞鐵	$FeCO_3$
,, chloride	氯化亞鐵	$FeCl_2$
,, ferricyanide (Turubuell's blue)	鐵氰化亞鐵(滕氏藍)	$Fe_3[Fe(CN)_6]_2$
,, hydroxide	氫氧化亞鐵	$Fe(OH)_2$
,, oxide	一氧化鐵	FeO
,, nitrate	硝酸亞鐵	$Fe(NO_3)_2$
,, sulfate	硫酸亞鐵	$FeSO_4$
,, sulfide	硫化亞鐵	FeS
Ferrous-ferri oxide (magnetite)	四氧化三鐵(磁鐵鑛)	Fe_3O_4
Potassium ferricyanide	鐵氰化鉀	$K_3Fe(CN)_6$
,, ferrocyanide	亞鐵氰化鉀	$K_4Fe(CN)_6$

Pyrite	黃鐵鑛	FeS_2
Lead	鉛	**Pb**
Lead dioxide	二氧化鉛	PbO_2
,, monoxide (Litharge)	氧化鉛(密陀僧)	PbO
,, suboxide	氧化二鉛	Pb_2O
,, trioxide	三氧化二鉛	Pb_2O_3
Plumbic chloride	氯化鉛	$PbCl_2$
,, hydroxide	氫氧化鉛	$Pb(OH)_2$
,, nitrate	硝酸鉛	$Pb(NO_3)_2$
,, sulfate	硫酸鉛	$PbSO_4$
,, sulfide (Galena)	硫化鉛(方鉛鑛)	PbS
,, tetrachloride	四氯化鉛	$PbCl_4$
Red lead	鉛丹(四氧化三鉛)	Pb_3O_4
Magnesium	鎂	**Mg**
Dolomite	白雲石	$MgCO_3 \cdot CaCO_3$
Magnesia	苦土	MgO
Magnesium ammonium phosphate	磷化銨鎂	$MgNH_4PO_4$
,, acid phosphite	亞磷酸氫鎂	$MgHPO_3$
,, bromide	溴化鎂	$MgBr_2$
,, carbonate	碳酸鎂	$MgCO_3$
,, chloride	氯化鎂	$MgCl_2$
,, hydroxide	氫氧化鎂	$Mg(OH)_2$
,, oxide	氧化鎂	MgO
,, nitride	氮化鎂	Mg_3N_2
,, pyrophosphate	焦磷酸鎂	$Mg_2P_2O_7$
,, sulfide	硫化鎂	MgS
Manganese	錳	**Mn**
Manganete heptoxide	七 化二錳	Mn_2O_7

Manganese monoxide	一氧化錳	MnO
,, trioxide	三氧化二錳	Mn_2O_3
Manganic hydroxide	三氫氧化錳	$Mn(OH)_3$
Manganous bromide	溴化錳	$MnBr_2$
,, chloride	氯化錳	$MnCl_2$
,, hydroxide	二氫氧化錳	$Mn(OH)_2$
,, iodide	碘化錳	MnI_2
,, orthomanganite	四氧化三錳	Mn_3O_4, (Mn_2MnO_4)
,, phosphate	磷酸錳	$Mn_3(PO_4)_2$
,, sulfate	硫酸錳	$MnSO_4$
,, sulfide	硫化錳	MnS
Permanganic acid	過錳酸	$HMnO_4$
Potassium manganate	錳酸鉀	K_2MnO_4
,, permanganate	過錳酸鉀	$KMnO_4$
Pyrolusite(Manganese dioxide)	軟錳鑛(二氧化錳)	MnO_2
Mercury	汞	**Hg**
Mercury-ammonium chloride	氯化銨汞	$Hg(NH_2)Cl$
Mercuric chloride	氯化汞	$HgCl_2$
,, iodide	碘化汞	HgI_2
,, nitrate	硝酸汞	$Hg(NO_3)_2$
,, oxide	氧化汞	HgO
,, sulfate	硫酸汞	$HgSO_4$
,, sulfide	硫化汞	HgS
Mercurous chloride	氯化亞汞	HgCl
,, oxide	氧化亞汞	Hg_2O
,, nitrate	硝酸亞汞	$HgNO_3$
,, sulfate	硫酸亞汞	Hg_2SO_4
Nitrogen	氮	**N**
Ammonia	氨	NH_3

Ammoninm acid carbonate	酸性碳酸銨	$NH_4 \cdot HCO_3$
,, chloride	氯化銨	NH_4Cl
,, chromate	鉻酸銨	$(NH_4)_2CrO_4$
Ammonium hydroxide	氫氧化銨	NH_4OH
,, magnesium arsenate	砷酸鎂銨	NH_4MgAgO_4
,, magnesium phosphate	磷酸鎂銨	NH_4MgPO_4
,, nitrate	硝酸銨	NH_4NO_3
,, nitrite	亞硝酸銨	NH_4NO_2
,, poly-sulfide	多硫硫化銨	$(NH_4)_2S \cdot S_x$
,, sulfate	硫酸銨	$(NH_4)_2SO_4$
,, sulfide	硫化銨	$(NH_4)_2S$
,, sulfocyanate	硫氰酸銨	NH_4CNS
,, thio-antimonate	硫銻酸銨	$(NH_4)_3SbS_4$
,, thio-arsenate	硫砷酸銨	$(NH_4)_3AsS_4$
,, thio-stannate	硫錫酸銨	$(NH_4)_2SnS_3$
Nitrogen pentoxide	五氧化二氮	N_2O_5
,, peroxide	二氧化氮	NO_2
,, trioxide	三氧化二氮	N_2O_3
Nitric oxide	一氧化氮	NO
Nitrous oxide	氧化亞氮	N_2O

氮的其他化合物，請查閱其他各欄：例如 $NaNO_3$ 可查 Na 化合物一欄；$C_3H_5(OH)_3$，可查 C 化合物一欄.

Oxygen	氧	**O**

氧的各種化合物，請查閱其他各欄：例如 P_2O_5 可查 P 化合物一欄；$KClO_3$ 可查 K 化合物一欄.

Phosphorus	磷	**P**
Ammonium magnesium phosphate	磷酸鎂銨	$MgNH_4PO_4$
Calcium superphosphate	過磷酸鈣	$Ca(H_2PO_4)_2$
Magnesium pyrophosphate	焦磷酸鈣	$Mg_2P_2O_7$

Metaphosphoric acid	偏磷酸	HPO_3
Orthophosphoric acid	正磷酸	H_3PO_4
Phosphonium chloride	氯化鏻	PH_4Cl
Phosphorus hydride (Phosphine)	磷化三氫(磷毒氣)	PH_3
,, pentachloride	五氯化磷	PCl_5
,, pentoxide	五氧化二磷	P_2O_5
,, sesquisulfide	三硫化四磷	P_4S_3
,, trichloride	三氯化磷	PCl_3
,, trioxide	三氧化二磷	P_2O_3
Potassium	鉀	**K**
Carnallite	白鹵鹽	$KCl \cdot MgCl_2 \cdot 6H_2O$
Dipotassium pyroantimonate	焦銻酸二鉀	$K_2H_2Sb_2O_7$
Feldspar	長石	$KAlSi_3O_8$
Mica	雲母	$KAlSiO_4$
Potassium acetate	醋酸鉀	$KC_2H_3O_2$
,, acid chromate	酸性鉻酸鉀	$KHCrO_4$
,, ,, fluoride	酸性氟化鉀	KHF_2
,, ,, tartrate	酸性酒石酸鉀	$KHC_4H_4O_6$
,, alum	明礬	$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24\,H_2O$
,, borate	硼酸鉀	K_3BO_3
,, carbonate	碳酸鉀	K_2CO_3
,, chlorate	氯酸鉀	$KClO_3$
,, chloride	氯化鉀	KCl
,, chloroplatinite	氯亞化鉀	K_2PtCl_6
,, chromite	亞鉻酸鉀	$KCrO_2$
,, chromate	鉻酸鉀	K_2CrO_4
,, cobaltinitrate	鈷亞硝酸鉀	$K_3Co(NO_2)_6$
,, cyanite	氰化鉀	KCN
,, dichromate	重鉻酸鉀	$K_2Cr_2O_7$

Potassium dihydrogen phosphate	磷酸二氫鉀	KH_2PO_4
,, ferricyanide	鐵氰化鉀	$K_3Fe(CN)_6$
,, ferrocyanide	亞鐵氰化鉀	$K_4Fe(CN)_6$
Potassium hydroxide	氫氧化鉀	KOH
,, acid hypophosphite	酸性次磷酸鉀	KH_2PO_2
,, iodide	碘化鉀	KI
,, manganate	錳酸鉀	K_2MnO_4
,, metantimonate	偏銻酸鉀	$KSbO_3$
,, nitrate	硝酸鉀	KNO_3
,, nitrite	亞硝酸鉀	KNO_2
,, oxide	氧化鉀	K_2O
,, permanganate	過錳酸鉀	$KMnO_4$
,, silver cyanide	氰化銀鉀	$KAg(CN)$

Silicon	矽	**Si**
Calcium silicate	矽酸鈣	$CaSiO_3$
Cobaltous silicate	矽酸鈷	$CoSiO_3$
Cupric silicate	矽酸銅	Na_2SiO_3
Hydrofluosilicic acid	氫氟矽酸	H_2SiF_6
Metasilicic acid	偏矽酸	H_2SiO_2
Silicon carbide (carborumdum)	碳化矽 (金剛砂)	SiC
,, dioxide	二氧化矽	SiO_2
,, fluoride	氟化矽	SiF_4

Silver	銀	**Ag**
,, arsenate	砷酸銀	Ag_3AsO_4
,, bromide	溴化銀	$AgBr$
,, chloride	氯化銀	$AgCl$
,, chromate	鉻酸銀	Ag_2CrO_4
,, cyanide	氰化銀	$AgCN$
,, diammochloride	氯化二氨銀	$Ag(NH_3)_2Cl$

Silver iodide	碘化銀	AgI
,, metaphosphate	偏磷酸銀	$AgPO_3$
,, nitrate	硝酸銀	$AgNO_3$
Silver oxide	氧化二銀	Ag_2O
,, peroxide	過氧化銀	Ag_2O_2
,, phosphate	磷酸銀	Ag_3PO_4
,, sulfate	硫酸銀	Ag_2SO_4
sulfide	硫化銀	Ag_2S
Sodium	鈉	**Na**
Cryolite	冰晶石	Na_3AlF_6
Disodium hydrogen phosphate	磷酸氫二鈉	Na_2HPO_4
Sodium acetate	醋酸鈉	$NaC_2H_3O_2$
,, acid carbonate	酸性碳酸鈉	$NaHCO_3$
,, ,, sulfate	酸性硫酸鈉	$NaHSO_4$
,, ,, sulfite	酸性亞硫酸鈉	$NaHSO_3$
,, antimonite	亞銻酸鈉	Na_3SbO_3
,, bromide	溴化鈉	NaBr
,, carbonate	碳酸鈉	Na_2CO_3
,, chlorate	氯酸鈉	$NaClO_3$
,, chloride	氯化鈉	NaCl
,, chromate	鉻酸鈉	Na_2CrO_4
,, cobaltic nitrite	亞硝酸鈷鈉	$Na_3Co(NO_2)_6$
,, cyanide	氰酸鈉	NaCN
,, dihydrogen phosphate	磷酸二氫鈉	NaH_2PO_4
,, disulfate	重硫酸鈉	$Na_2S_2O_7$
,, hypochlorite	次氯酸鈉	NaClO
,, pyro-arsenate	焦砷酸鈉	$Na_4As_2O_7$
,, hydroxide	氫氧化鈉	NaOH
,, iodate	碘酸鈉	$NaIO_3$
,, iodide	碘化鈉	NaI

Sodium metarsenate	偏砷酸鈉	$NaAsO_2$
,, metaphosphate	偏磷酸鈉	$NaPO_3$
,, nitrate (Chili-saltpeter)	硝酸鈉(智利硝石)	$NaNO_3$
Sodium nitrite	亞硝酸鈉	$NaNO_2$
,, ortho-aluminate	正鋁酸鈉	Na_3AlO_3
,, oxide	氧化鈉	Na_2O
,, perchlorate	過氯酸鈉	$NaClO_4$
,, peroxide	過氧化鈉	Na_2O_2
,, phosphate	磷酸鈉	Na_3PO_4
,, phosphite	亞磷酸鈉	Na_3PO_3
,, plumbate	鉛酸鈉	Na_2PbO_3
,, plumbite	亞鉛酸鈉	Na_2PbO_2
,, pyrophosphate	焦磷酸鈉	$Na_4P_2O_7$
,, silicate	矽酸鈉	Na_2SiO_3
,, stannate	錫酸鈉	Na_2SnO_3
,, stannite	亞錫酸鈉	Na_2SnO_2
,, sulfate	硫酸鈉	Na_2SO_4
,, sulfide	硫化鈉	Na_2S
,, sulfite	亞硫酸鈉	Na_2SO_3
,, tetraborate (Borax)	四硼硼酸鈉(硼砂)	$Na_2B_4O_7$
,, thiosulfate	硫代硫酸鈉	$Na_2S_2O_3$
,, zincate	鋅酸鈉	Na_2ZnO_2
Strontium	鍶	**Sr**
,, carbonate	碳酸鍶	$SrCO_3$
,, chloride	氯化鍶	$SrCl_2$
,, sulfate	硫酸鍶	$SrSO_4$
Sulfur	硫	**S**
,, dioxide	二氧化硫	SO_2
,, monochloride	二氯化二硫	S_2Cl_2

Sulfur trioxide	三氧化硫	SO_3

其他硫化物，請查閱其他各欄：例如 $Na_2S_2O_3$ 可閱 Na 化合物欄；$(NH_4)_2S \cdot S_x$ 可閱 N 化合物欄.

Tin	錫	**Sn**
Ammonium thiostannate	硫錫酸銨	$(NH_4)_2SnS_3$
Stannic acid	錫酸	H_2SnO_3
Stannic chloride	四氯化錫	$SnCl_4$
,, hydroxide	氫氧化錫	$Sn(OH)_4$
,, oxide (Cassiterite)	二氧化錫 (錫石)	SnO_2
,, sulfide	二硫化錫	SnS_2
Stannous chloride	二氯化錫	$SnCl_2$
,, hydroxide	氫氧化亞錫	$Sn(OH)_2$
,, nitrate	硝酸亞錫	$Sn(NO_3)_2$
,, oxide	一氧化錫	SnO
,, sulfide	一硫化錫	SnS
Sodium stannate	錫酸鈉	Na_2SnO_3

Zinc	鋅	**Zn**
Sodium zincate	鋅酸鈉	Na_2ZnO_2
Zinc carbonate	碳酸鋅	$ZnCO_3$
,, chloride	氯化鋅	$ZnCl_2$
,, hydroxide	氫氧化鋅	$Zn(OH)_2$
,, nitrate	硝酸鋅	$Zn(NO_3)_2$
,, oxide	氧化鋅	ZnO
,, sulfide (Sphalerite)	硫化鋅 (方鋅鑛)	ZnS
Zinc acid	鋅酸	H_2ZnO_2