CHEMICAL REACTIONS TOOLBOX

Reactions by periodic table group

IA

$M + H_2O \rightarrow MOH + H_2$

$M + O_2 \rightarrow M_2O$

$M + O_2 \rightarrow M_2O_2$ M = Na, K, Rb, Cs

$M + O_2 \rightarrow MO_2$ M = K, Rb, Cs

IIA

$Be + H_2O \rightarrow NR$

$Mg + H_2O \rightarrow$ steam only

$Ca, Sr, Ba + H_2O \rightarrow M(OH)_2 + H_2$

$Be, Mg + O_2 \rightarrow MO$ at high T only

$Ca, Sr, Ba + O_2 \rightarrow MO$ at room T

$Mg + HX \rightarrow MgX + H_2$

$Ca, Sr, Ba + + HX \rightarrow$ **react with H_2O first** $\rightarrow M(OH)_2 + H_2$**;**

then $M(OH)_2 + HX \rightarrow MX + H_2O$

so *overall*: $Mg + HX \rightarrow MgX + H_2$

IIIA

B: semimetallic; no ionic compounds; NR with H_2O or O_2

Al, Ga, In, Tl: $M + O_2 \rightarrow M_2O_3$

IVA

C = nonmetallic; Si, Ge = semimetallic; rarely form ionic compounds
Sn, Pb = metals, but NR with water

VA

$N_2 + O_2 \rightarrow NO, N_2O, NO_2, N_2O_4, N_2O_5$… etc… depends on the amount of O_2 available

$N_2O_5 + H_2O \rightarrow HNO_3$

$M + N_2 \rightarrow M_3N^{3-}$

$P_4 + O_2 \rightarrow P_4O_6 + P_4O_{10}$

$P_4O_{10} + H_2O \rightarrow H_3PO_4$

CHEMICAL REACTIONS TOOLBOX

Reactions by periodic table group

VIA

O found in elemental state as O_2

S, Se found in elemental state as S_8, Se_8

Important S compounds: H_2S, SO_2, SO_3 – all gases at room temperature

$SO_2 + H_2O \rightarrow H_2SO_3$ $\quad\quad$ $SO_3 + H_2O \rightarrow H_2SO_4$

VIIA

All found as diatomic when elements; never found uncombined in nature.

$X_2 + H_2 \rightarrow 2\ HX$ $\quad\quad$ $HX + H_2O \rightarrow HX_{(aq)}$ "hydrohalic acids"

Form ionic compounds with metals; bond covalently with nonmetals

VIIIA

He, Ne, Ar – NR

Kr, Xe can react with strong oxidizing agents, ex: F_2

Oxides across a period

$Na_2O + H_2O \rightarrow NaOH$

- "alkali" metals

$MgO + H_2O \rightarrow$ NR (insoluble)

- insoluble $\Rightarrow$ alkaline "earth" metals

except… $CaO + H_2O \rightarrow Ca(OH)_2$

} **Basic oxides**

$Al_2O_3 + H_2O \rightarrow$ NR (insoluble)

But…

$Al_2O_3 + HCl \rightarrow AlCl_3 + H_2O$

$Al_2O_3 + NaOH \rightarrow NaAl(OH)_4 + H_2O$

} **Amphoteric oxides**

SiO_2 (sand) $+ H_2O \rightarrow$ NR

$P_4O_{10} + H_2O \rightarrow H_3PO_4$

$SO_3 + H_2O \rightarrow H_2SO_4$

$Cl_2O_7 + H_2O \rightarrow HClO_4$

} **Acidic oxides**