Reactions → Inorganic Chemistry

Periodicity

→ reaction of period 3 elements with oxygen.

$2Na + \frac{1}{2} O_2 \rightarrow Na_2O$

$Mg + \frac{1}{2} O_2 \rightarrow MgO$

$2Al + 1\frac{1}{2} O_2 \rightarrow Al_2O_3$

$Si + O_2 \rightarrow SiO_2$

$4P + 5O_2 \rightarrow P_4O_{10}$ (s)

$2P + 1\frac{1}{2} O_2 \rightarrow P_2O_3$ (s)

$S + O_2 \rightarrow SO_2$

$S + 1\frac{1}{2} O_2 \rightarrow SO_3$

→ reaction of sodium and magnesium with water

$2Na\ (s) + 2H_2O\ (l) \longrightarrow 2NaOH\ (aq) + H_2\ (g)$

$Mg\ (s) + 2H_2O\ (l) \longrightarrow Mg(OH)_2\ (aq) + H_2\ (g)$

cold water

$Mg\ (s) + H_2O \longrightarrow MgO\ (s) + H_2\ (g)$

steam

→ reaction of period 3 elements with water

$Na_2O\ (s) + H_2O \rightarrow 2NaOH\ (aq)$

$MgO\ (s) + H_2O \rightarrow Mg(OH)_2$

$Al_2O_3 + H_2O \rightarrow$ No RCN due to Al_2O_3 protective layer.

$SiO_2 + H_2O \rightarrow$ No RCN

$P_4O_{10} + H_2O\ (l) \rightarrow H_3PO_4\ (aq)$

$SO_2 + H_2O \rightarrow H_2SO_3$

$SO_3 + H_2O \rightarrow H_2SO_4$

→ reaction of period-3 elements with acid / base.

$Na_2O\ (s) + H_2SO_4\ (aq) \rightarrow Na_2SO_4\ (aq) + H_2O\ (l)$

$MgO\ (s) + 2HCl\ (aq) \rightarrow MgCl_2 + H_2O$

$Al_2O_3 + H_2SO_4 \rightarrow Al_2(SO_4)_3 + 3H_2O$

$Al_2O_3 + 2NaOH + 3H_2O \rightarrow 2NaAl(OH)_4\ (aq)$

$SiO_2 + NaOH \rightarrow NaSiO_3\ (aq) + H_2O$

$P_4O_{10} + NaOH \rightarrow Na_3PO_4 + H_2O$

$SO_2 + NaOH \rightarrow Na_2SO_3 + H_2O$

$SO_3 + NaOH \rightarrow Na_2SO_4 + H_2O$

→ Reaction of the period 3 elements with chlorine.

$Na^{+} + Cl^{-} \rightarrow NaCl$

$Mg^{2+} + 2Cl^{-} \rightarrow MgCl_2$

$Al^{3+} + 3Cl^{-} \rightarrow AlCl_3$

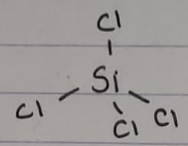
$Al^{6+} + 6Cl^{-} \rightarrow AlCl_6$

$P^{+5} + 5Cl^{-} \rightarrow PCl_5$

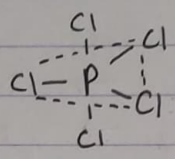
$P^{+3} + 3Cl^{-} \rightarrow PCl_3$

$S^{+2} + 2Cl^{-} \rightarrow SCl_2$

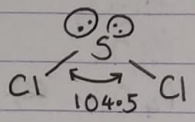
$2S^{+1} + 2Cl^{-} \rightarrow S_2Cl_2$



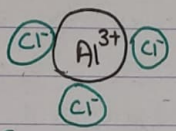
Tetrahedral



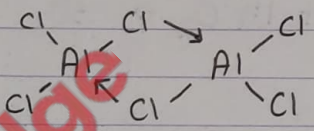
Trigonal Bypyramid



Bent V-shape.



[Ionic]



→ Reaction of period 3 chlorides with water

$NaCl(s) + aq \rightarrow Na^{+}(aq) + Cl^{-}(aq)$

$MgCl_2 + aq \rightarrow Mg^{2+}(aq) + 2Cl^{-}(aq)$

$AlCl_3 + aq \rightarrow$ dissolves.

$Al_2Cl_6 + aq \rightarrow AlCl_3(aq)$

$[Al(H_2O)_6]^{3+} \rightarrow [Al(H_2O)_5(OH)]^{2+} + H^{+}$

$SiCl_4(l) + 2H_2O(l) \rightarrow SiO_2(s) + 4HCl(g)$

$PCl_5(s) + 4H_2O(l) \rightarrow H_3PO_4(aq) + 5HCl$ (white fumes)

$SCl_2 + H_2O \rightarrow H_2SO_4 + HCl$ (white fumes)

Group II - Alkali Earth Metals.

→ Characteristic flames

$Be + \frac{1}{2}O_2 \xrightarrow{\text{burn}} BeO$ (white flame)

$Mg + \frac{1}{2}O_2 \xrightarrow{\text{burn}} MgO$ (bright white flame)

$Ca + \frac{1}{2}O_2 \xrightarrow{\text{burn}} CaO$ (brick red)

$Sr + \frac{1}{2}O_2 \xrightarrow{\text{warm}} SrO$ (scarlet red)

$Ba + \frac{1}{2}O_2 \xrightarrow{RTP} BaO$ (Apple green)

→ Reaction of group 2 elements & oxides with Water.

$MgO_{(s)} + H_2O_{(l)} \longrightarrow Mg(OH)_{2\ (aq)}$

$CaO_{(s)} + H_2O_{(l)} \longrightarrow Ca(OH)_{2\ (s)}$

$Ca(OH)_{2\ (s)} + aq \longrightarrow Ca^{2+}_{(aq)} + 2OH^-_{(aq)}$

$SrO + H_2O \longrightarrow Sr(OH)_2$

$BaO + H_2O \longrightarrow Ba(OH)_2$

$Mg_{(s)} + H_2O_{(g)} \longrightarrow MgO_{(s)} + H_2\uparrow_{(g)}$

$Mg_{(s)} + H_2O_{(l)} \longrightarrow Mg(OH)_2$

$Ca_{(s)} + H_2O_{(l)} \longrightarrow Ca(OH)_{2\ (aq)} + H_{2\ (g)}$

(steam not needed Ca more reactive)

↳ (white cloudy suspension)

$Ba_{(s)} + H_2O \longrightarrow Ba(OH)_{2\ (aq)} + H_{2\ (g)}$

(cold water)

↳ (white cloudy suspension)

$Sr_{(s)} + H_2O \xrightarrow{RTP} Sr(OH)_{2\ (aq)} + H_2$

↳ (white cloudy suspension)

Group 17 elements

→ colors

$F_{2\ (g)}$ (Pale Yellow)

$Cl_{2\ (g)}$ (Green)

$Br_{2\ (l)}$ (Orange brown)

$I_{2\ (s)}$ (Grey - Black)

$I_{2\ (s)} \rightleftharpoons I_{2\ (g)}$

grey-black purple-violet

$I_{2\ (s)} + aq \longrightarrow I_{(aq)}$

grey-black brown

→ Displacement Reaction

$2NaBr_{(aq)} + Cl_{2\ (aq)} \longrightarrow 2NaCl_{(aq)} + Br_{2\ (l)}$

→ Reaction of halogen with hydrogen

H_2 (g) + F_2 (g) → 2 HF (g) reacts explosively in dark & cool

H_2 (g) + Cl_2 (g) → 2 HCl (g) reacts explosivly in sunlight

H_2 (g) + Br_2 (g) → 2 HBr (g) reacts on heating

H_2 (g) + I_2 (g) ⇌ 2HI (g) Equilibrium mixture on heating

→ Test for Halide Ions.

$AgNO_3$ (aq) + Cl^- (aq) → AgCl (s) + NO_3^- (aq) [White ppt]

$AgNO_3$ (aq) + Br^- (aq) → AgBr (s) + NO_3^- (aq) [Cream ppt]

$AgNO_3$ (aq) + I^- (aq) → AgI (s) + NO_3^- (aq) [Yellow ppt]

AgCl (s) + 2NH_3 (aq) → $[Ag(NH_3)_2]^{2+}$ (aq) + Cl^- (aq)

Dissolves

AgBr

partialy dissolves

AgI (s) + NH_3 (aq) → doesn't dissolve

→ Reaction with H_2SO_4

NaCl (s) + H_2SO_4 (l) → $NaHSO_4$ (s) + HCl (g)

(acidic fumes)

NaBr (s) + H_2SO_4 (l) → $NaHSO_4$ (s) + HBr (g)

HBr + H_2SO_4 (l) → Br_2 (g) + SO_2 (g) + H_2O

(reddish - brown)

NaI + H_2SO_4 → $NaHSO_4$ + HI (s)

2HI (g) + H_2SO_4 (l) → I_2 (g) + SO_2 + H_2O

6 HI (g) + H_2SO_4 (l) → 3I_2 (g) + S (s) + 4 H_2O (l)

8 HI (g) + H_2SO_4 (l) → 4 I_2 (g) + H_2S (g) + 4 H_2O

Products: $NaHSO_4$ (s) Nand Hua Swikah

Sulfur (s) Se

SO_2 (g) SOla

I_2 (g) Izat

H_2S (g) Hisab

→ Nitrogen & Sulfur

$NH_4Cl\ (aq) + NaOH\ (aq) \longrightarrow NaCl\ (aq) + NH_3\ (g) + H_2O\ (l)$

→ Habers process.

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

Fe catalyst
450°C
200 atm

→ formation of acid rain (HNO_3)

$N_2 + O_2 \xrightarrow{\Delta H} 2NO$

$NO + O_2 \longrightarrow 2NO_2$

$2NO_2 + H_2O + \frac{1}{2} O_2 \longrightarrow 2HNO_3$

→ making nitrogen based fertilizers.

$NH_3\ (aq) + HNO_3\ (aq) \longrightarrow NH_4NO_3\ (aq)$

$\downarrow \Delta$

$NH_4NO_3\ (l)$

→ Making fertilizers.

$NH_3\ (aq) + HNO_3\ (aq) \longrightarrow NH_4NO_3$

$2NH_3\ (aq) + H_2SO_4\ (aq) \longrightarrow (NH_4)_2SO_4\ (aq)$

$3NH_3\ (aq) + H_3PO_4\ (aq) \longrightarrow (NH_4)_3PO_4\ (aq)$

→ Acid Rain

$N_2 + O_2 \rightarrow 2NO$

$2NO + O_2 \rightarrow 2NO_2$

$SO_2 + NO_2 \rightarrow SO_3 + NO$

$SO_3 + H_2O \rightarrow H_2SO_4$

$NO + \frac{1}{2} O_2 \rightarrow NO_2$

→ CATALYTIC CONVERTER

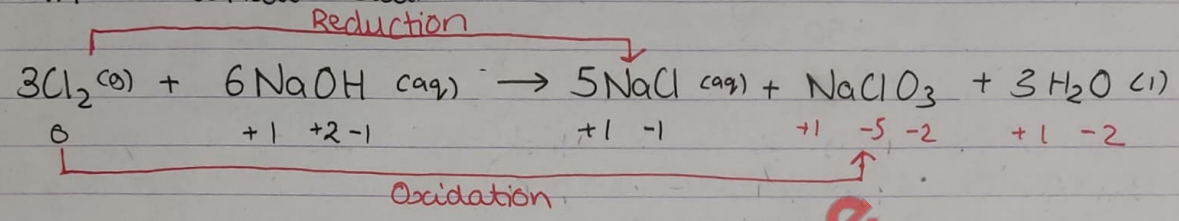
$2NO\ (g) + 2CO\ (g) \xrightarrow{(Pt/Pd)} 2CO_2\ (g) + N_2\ (g)$

→ Disproportionation Reaction [same reagent oxidised & reduced]

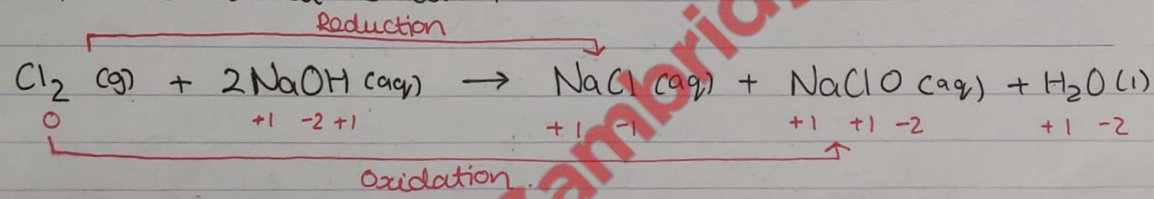
$$\underset{+1\ -1}{H_2O_2} \longrightarrow \underset{+1\ -2}{H_2O} + \underset{0}{\tfrac{1}{2}\ O_2}$$

→ Disproportionation : Reaction of chlorine with NaOH

a) with hot alkali solution.

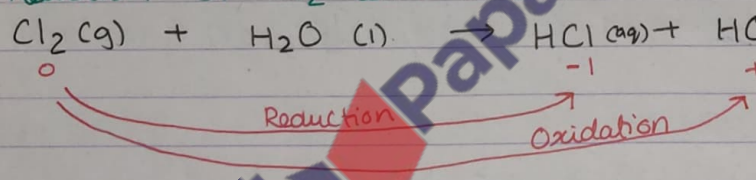


b) with cold alkali solution



mixture of NaCl & NaClO used as a bleaching agent

→ Reaction of Cl_2 with Water



HClO is used as a bleaching agent

$HClO \rightarrow HCl + [O]$

colored substance + [O] → colorless substance.

Bacteria + [O] → kills micro organisms.

[Cl_2 is used as a disinfectant]

→ Reaction of Aluminium with Chlorine.

$2Al\ (s) + 3Cl_2\ (g) \rightarrow 2AlCl_3\ (s)$

white solid

$2Al\ (s) + 3Cl_2\ (g) \rightarrow Al_2Cl_6$

Hot aluminium — white solid

Observation: Yellow color of Cl_2 fades.

Aluminum glows.

White solid forms.