OXIDES, CONTINUED

acidic oxide + base → salt + H_2O

$SO_{3(s)}$ + $NaOH_{(aq)}$ → H_2O + $Na_2SO_{4(aq)}$

$SO_{3(s)}$ —H_2O→ H_2SO_4 —NaOH→ Na_2SO_4

basic oxide + acid → salt + H_2O

$K_2O_{(s)}$ + $HCl_{(aq)}$ → H_2O + KCl

K_2O —H_2O→ KOH —HCl→ KCl

BASIC/AMPHOTERIC HYDROXIDES

IA, IIA (except Be) ⟹ basic hydroxides

Amphoteric Hydroxides ⟹ all insoluble in H_2O

$Be(OH)_2$, $Al(OH)_3$, $Sn(OH)_2$, $Pb(OH)_2$, $Cr(OH)_3$, $Cu(OH)_2$, $Zn(OH)_2$, $Cd(OH)_2$

$Cr(OH)_{3(s)}$ + $3H^+_{(aq)}$ → $3H_2O$ + Cr^{3+}

$Cr(OH)_{3(s)}$ + $OH^-_{(aq)}$ → $Cr(OH)_4^-{}_{(aq)}$

"complex ion"

OXIDES, CONTINUED

acidic oxide + base → salt + H_2O

$SO_{3(g)} + NaOH_{(aq)} \rightarrow H_2O + Na_2SO_{4(aq)}$

$SO_{3(g)} \xrightarrow{H_2O} H_2SO_4$ (then $H_2SO_4 + NaOH_{(aq)}$)

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basic oxide + acid → salt + H_2O

$K_2O_{(s)} + HCl_{(aq)} \rightarrow H_2O + KCl$

$K_2O \xrightarrow{H_2O} KOH$ (then $KOH + HCl_{(aq)}$)

BASIC/AMPHOTERIC HYDROXIDES

IA, IIA (except Be) ⟹ basic hydroxides

Amphoteric hydroxides ⇒ all insoluble in H_2O

$Be(OH)_2$, $Al(OH)_3$, $Sn(OH)_2$, $Pb(OH)_2$, $Cr(OH)_3$, $Cu(OH)_2$, $Zn(OH)_2$, $Cd(OH)_2$

$Cr(OH)_{3(s)} + 3H^+_{(aq)} \rightarrow 3H_2O + Cr^{3+}$

$Cr(OH)_{3(s)} + OH^-_{(aq)} \rightarrow Cr(OH)_4^-{}_{(aq)}$

↓ "complex ion"

amphoteric anions in H_2O

Is an aqueous solution of HSO_3^- acidic or basic?

$HSO_3^- + H_2O \rightleftharpoons H_3O^+ + SO_3^{2-}$

$HSO_3^- + H_2O \rightleftharpoons H_2SO_3 + OH^-$

H_2SO_3 $K_a = 1.3 \times 10^{-2}$ ⟹ HSO_3^- $K_b = \frac{10^{-14}}{1.3 \times 10^{-2}} = 7.7 \times 10^{-13}$

HSO_3^- $K_a = 6.3 \times 10^{-8}$

aqueous soln = ACIDIC

pH NaHS? ACIDIC BASIC

H_2S $K_a = 9.5 \times 10^{-8}$ K_b $HS^- = 1.1 \times 10^{-7}$

HS^- $K_a = 1 \times 10^{-19}$

Lewis Acid/Base Theory

Lewis Base → a substance that can "donate" an e^- pair → form a "coordinate covalent bond"

always B/L bases too

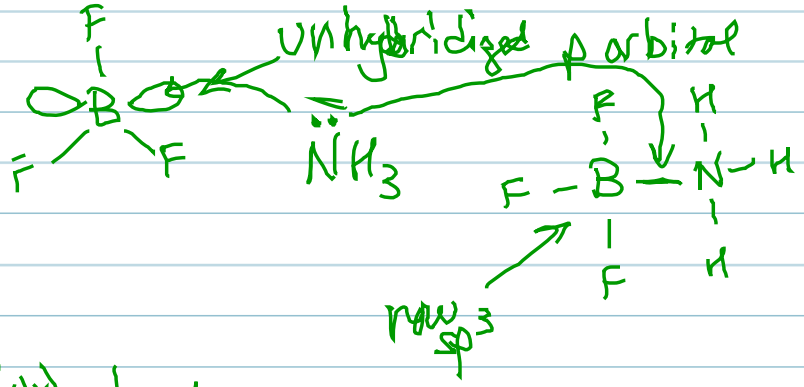
$:\ddot{O}H^-$ NH_3

Lewis Acid → a substance that can "accept" an e^- pair (from a Lewis Base) to form the coordinate covalent bond

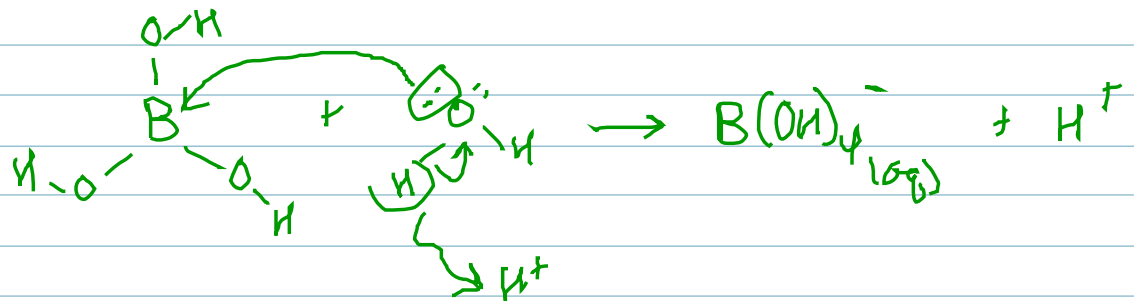
usually reserved for substances that do this but not release an H^+

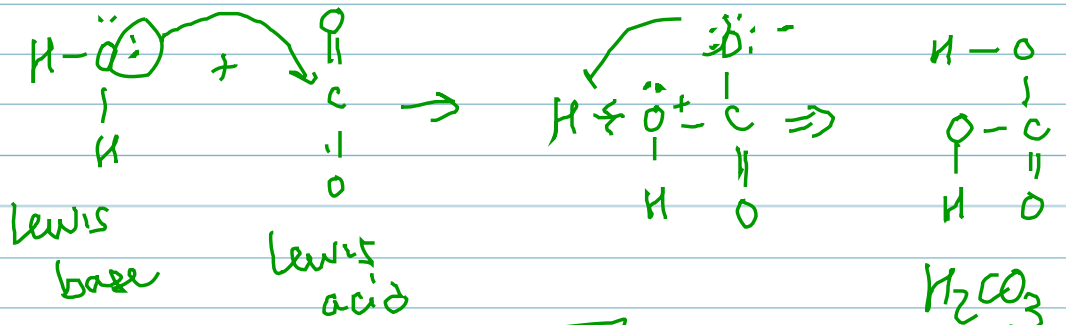
$H^+ \leftarrow :\ddot{O}-H^-$ $H-\ddot{O}-H$

BF_3 sp^2 hybridization

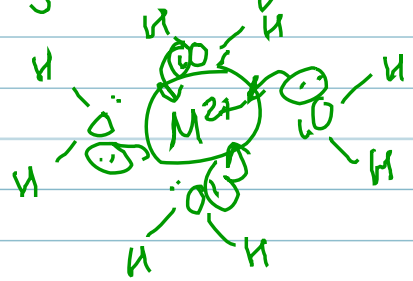


$B(OH)_3$ boric acid





Hydration of metal ions



$H_2CO_3 \rightarrow H^+ + HCO_3^-$

4–6 H_2O's per M^+

(Ag^+ → always 2)