Topic 6A - The Nature of Acids and Bases

Acids and Bases

Brønsted-Lowry

Acid: Proton Donor
Base: Proton Acceptor

$$\underset{\text{acid}}{HA} + \underset{\text{base}}{B} \rightarrow \underset{\text{conjugate acid}}{HB^+} + \underset{\text{conjugate base}}{A^-}$$

Strong Acids: $HCl + H_2O \rightarrow H_3O^+ + Cl^-$ $[H_3O^+] >> [HCl]$

Weak Acids: $HF + H_2O \rightleftarrows H_3O^+ + F^-$ $[H_3O^+] << [HF]$

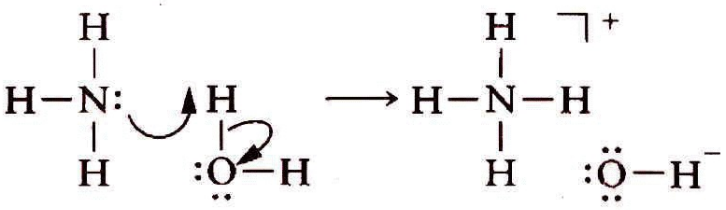
$\{H^+(H_2O)_n\}$

Strong Bases: $O^{2-} + H_2O \rightarrow 2\ OH^-$ $[OH^-] >> [O^{2-}]$

Weak Bases: $NH_3 + H_2O \rightleftarrows NH_4^+ + OH^-$ $[OH^-] << [NH_3]$

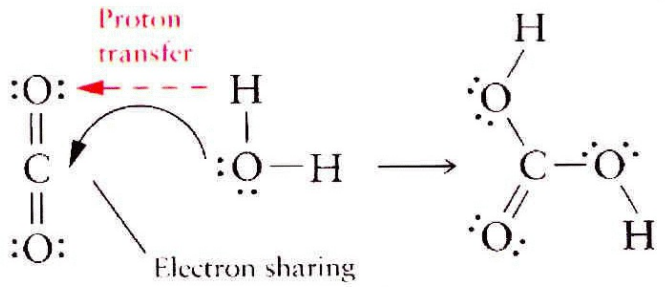
Lewis

Acid: e Pair Acceptor
Base: e Pair Donor



Lewis Base — Lewis Acid

Every Lewis base is also a Brønsted base, but not all Lewis acids are Brønsted acids, since a Lewis acid does not necessarily contain an H-atom:



Lewis Acid

Lewis Base

(H_2CO_3)

Acidic, Basic, and Amphoteric Oxides

Acidic oxides are principally molecular compounds of non-metals that react with water to give a Brønsted acid:

$$SO_2\ (g) + H_2O\ (l) \rightarrow H_2SO_3\ (aq)$$

or with bases to give a salt + H_2O:

$$CO_2\ (g) + 2\ NaOH\ (aq) \rightarrow Na_2CO_3\ (aq) + H_2O\ (l)$$

Basic oxides are typically ionic compounds that react with acids to give a salt + H_2O:

$$CaO\ (s) + 2\ HNO_3\ (aq) \rightarrow Ca(NO_3)_2\ (aq) + H_2O\ (l)$$

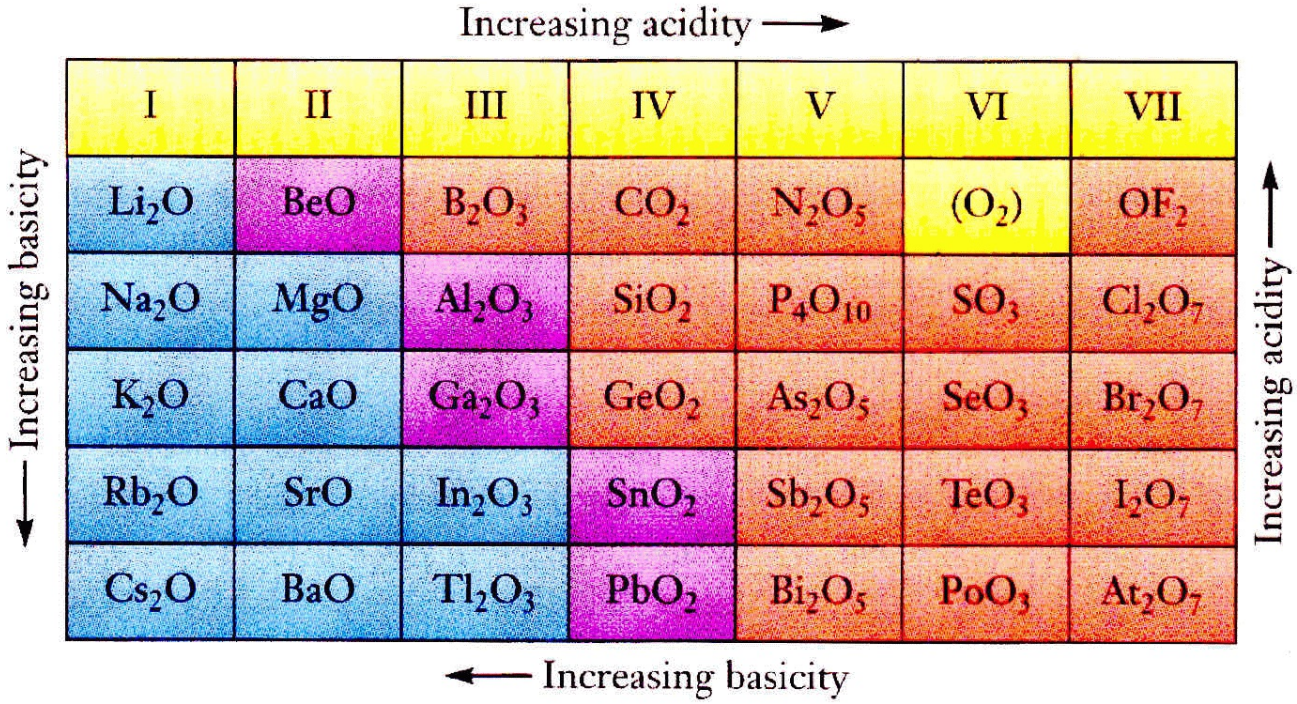
Metal oxides (ionic) :	Basic
Non-metal oxides (molecular) :	Acidic
Metalloid oxides :	Amphoteric

Basic behavior:

$$Al_2O_3\ (s) + 6\ HCl\ (aq) \rightarrow 2\ AlCl_3\ (aq) + H_2O\ (l)$$

Acidic behavior:

$$Al_2O_3\ (s) + 2\ NaOH\ (aq) \rightarrow 2\ Na[Al(OH)_4]\ (aq)$$



I	II	III	IV	V	VI	VII
Li_2O	BeO	B_2O_3	CO_2	N_2O_5	(O_2)	OF_2
Na_2O	MgO	Al_2O_3	SiO_2	P_4O_{10}	SO_3	Cl_2O_7
K_2O	CaO	Ga_2O_3	GeO_2	As_2O_5	SeO_3	Br_2O_7
Rb_2O	SrO	In_2O_3	SnO_2	Sb_2O_5	TeO_3	I_2O_7
Cs_2O	BaO	Tl_2O_3	PbO_2	Bi_2O_5	PoO_3	At_2O_7

FIGURE 10.2 Among the oxides of the main-group elements, acidity tends to increase from left to right and from bottom to top in the periodic table. Oxygen difluoride, however, has only weakly acidic properties.