

### Lewis Acids and Bases:

- concept by G.N. Lewis (1923)

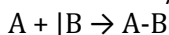
→ classification is independent of protons and therefore more general (in comparison to the Brønstedt-Lowry concept)

#### - Definitions:

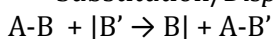
- *Lewis Acid A*: electron pair acceptor
- *Lewis Base B*: electron pair donor
- *Acid-Base-Complex: A-B*

#### - Reactions of Lewis Acids and Bases:

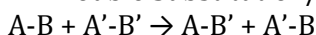
- *Addition/Complex formation*



- *Substitution/Displacement reaction*



- *Double Substitution/Metathesis reaction*



→ qualitative classification in "hard" and "soft" to predict the equilibrium of a reaction or the stability of a certain compound

### HSAB/Pearson Concept:

- concept by R.G. Pearson (1963): **Hard and Soft Acids and Bases**

#### - Definitions:

- *hard acids*: small size, low polarizability, high positive charge  
e.g.  $H^+$ ,  $Li^+$ ,  $Al^{3+}$ ,  $BF_3$
- *soft acids*: larger in size, high polarizability, low positive charge  
e.g.  $Cu^+$ ,  $Ag^+$ ,  $Hg^+$ ,  $BH_3$
- *hard bases*: high electronegativity, low polarisability, higher oxidation state  
e.g.  $OH^-$ ,  $F^-$ ,  $NH_3$ ,  $O^{2-}$
- *soft bases*: low electronegativity, high polarisability, lower oxidation state  
e.g.  $I^-$ ,  $CN^-$ ,  $S^{2-}$ ,  $C_6H_6$

#### - Interactions:

- **hard - hard /soft - soft interactions are stronger than hard - soft interactions**  
→ combinations **hard + hard** and **soft + soft** are favoured
- bond between hard acid and hard base: ionic character
- bond between soft acid and soft base: covalent character

### Chemical consequences of HSAB concept:

- explanation for Goldschmidt classification of elements and their terrestrial distribution

e.g. the oxide  $Al_2O_3$  is much more often found in nature than the sulphide  $Al_2S_3$

→ reason: hard acid ( $Al^{3+}$ ) tends to bind the hard base ( $O^{2-}$ ) and not with the soft base ( $S^{2-}$ )

### Literature:

D. Shriver, P. Atkins, Inorganic Chemistry 3<sup>rd</sup> edition, Oxford University Press, 2002.

R.G. Pearson, *Survey Progr. Chem.* **1969**, 5, 1-52.

Questions:

- 1) Explain the main differences between Brønstedt-Lowry and Lewis concept of acids and bases!
- 2) What types of fundamental reactions are existing for Lewis acid and bases?