SHAB Principle

From this Principle we can say an acid-base rexn will take place or not.

S → Soft H → Hard A → Acid B → Base.

According to this Principle rexn among the following pair will take place.

- Hard acid + Hard base ⟶ Salt
- Soft acid + Soft base ⟶ Salt ; But
- Hard acid + Soft base ⟶ No salt
- Soft acid + Hard base ⟶ No salt.

Now what are the characteristics of such acid-base. (Bases are donor and Acids are acceptors)

Soft acid → Acceptor atoms are large, low Positively charged and contain unshared pair of electrons in their valence shells (p, d). They have high Polarisability and low electronegativity.

e.g Cu^+, Ag^+, Pd^{2+}, Pt^{2+}, Hg^{2+} : CH_2, I_2, Br_2, BH_3

Hard acid : Acceptor atoms are small, have high Positive charge and do not Possess unshared Pair of electrons in their valence shells. They have low Polarisability and high electronegativity

eg. H^+, Li^+, Na^+, K^+, Mg^{2+}, Al^{3+}, Fe^{3+}, $AlMe_3$, $AlCl_3$, SO_3, $R-\overset{\oplus}{C}=O$, HX, BF_3.

Soft base: They normally have electrons which are easily removed by oxidizing agents and have empty orbitals of low energy. The donor atoms are of low electronegativity and high Polarisability.

eg: $R\ddot{S}H$, $RS^{\ominus}$, $I^{\ominus}$, $R_3\ddot{P}$, $CN^{\ominus}$, $R-\ddot{S}-R$, $H^{\ominus}$, $R^{\ominus}$, CO.

Ref-book → Jerry March, PS Kalis

Hard base: They normally have electrons which are not easily removed by oxidising agents as the donor atoms are of high electronegativity and low Polarisability.

e.g: $\overset{\ominus}{O}H$, $F^{\ominus}$, $ACO^{\ominus}$, $Cl^{\ominus}$, $R-\ddot{O}-H$, $R-\ddot{O}-R$, $\ddot{N}H_3$, $R\ddot{N}H_2$

Application: $BF_3.OEt_2$ and $BF_3.SEt_2$ which one is more stable and why?

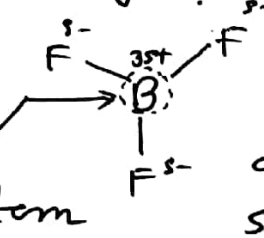
Here BF_3 is hard acid.

again $\ddot{O}Et_2$ → Hard base

$\ddot{S}Et_2$ → soft base

So, $BF_3.OEt_2$ → Hard acid Hard base complex. → More stable

but $BF_3.SEt_2$ → Hard acid-Soft base complex (Less stable).



B atom has no unshared pair of electron

Here acceptor atom B is small and has high +ve charge ($3\delta^+$ on B atom).

electronic configuration → $1s^2 2s^2 2p^1$

Valence shell → 1 1 1 1 1 1 1 1 1

s p

has no unshared pair of elec