Course 343 Lecturer Gellman

Day Wed. Date 9/16/15

Notes Taken By Kirandeep Deol Total # of Pages 3

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Recall: Acid-Base Rxns.

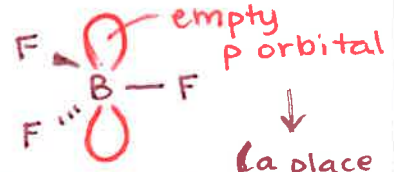
"proton transfer" A-H + :B ⇌ $A:^{\ominus}$ + $H-B^{\oplus}$

($A:^{\ominus}$: conjugate base of A-H; $H-B^{\oplus}$: conjugate acid of :B)

Lewis acids + bases - focus on e⁻ pairs rather than protons (H+)

Lewis acid: e⁻ deficient
Lewis base: e⁻ rich

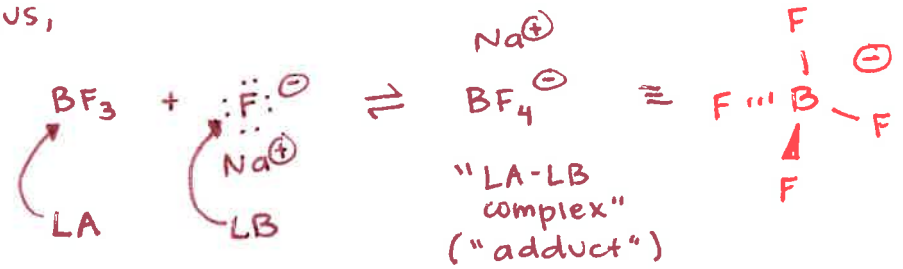
ex. BF_3
Lewis acid
(e⁻ deficient, 6e⁻)



∴ Lewis acid

L.A. can form "complexes" (or "adducts") with Lewis bases
e.g. $:\ddot{F}:^{\ominus}$

Thus,



Mechanism of complex formation

- How do the e⁻ move in this chemical process?

⇒ curved arrows to indicate movement of e⁻'s

- Arrow starts @ e⁻ donor, and ends (arrowhead) @ e⁻ acceptor (L.B ↷ L.A)

Thus,

*Note: Lone pair becomes a bonding pair.

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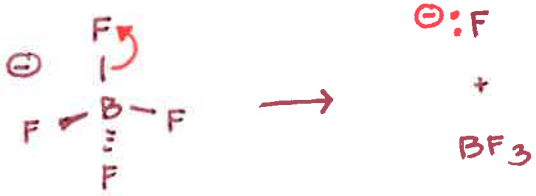
Mechanism of dissociation of LA-LB complex



$\ominus$:F + BF_3

*Note: bonding pair of e⁻ becomes lone pair

Mechanism of a proton transfer acid-base rxn. (Brønsted Lowry acid-base rxns)

H^+ ≡ proton

Ex. NH_4^+ + $:OH^-$ ⇌ $:NH_3$ + $H_2O:$

NH_4^+: Brønsted acid proton donor

$:OH^-$: Brønsted base proton acceptor

Mechanism:

Book: "e⁻ pair displacement" — one lone pair makes a bond ($:OH^-$) while another bond becomes a lone pair ($N \rightleftharpoons H$)

Compare and Contrast: LA/LB vs. Brønsted acid/base (H^+)

- Brønsted acids are always Lewis acids but NOT vice versa. (ie. BF_3 – NO HYDROGEN!)

Extend mechanistic concept from proton transfer rxns to another process, "NUCLEOPHILIC DISPLACEMENT!"

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Ex: nucleophilic displacement

Compare: acid-base rxn

Terminology -

$^{\ominus}:\ddot{O}H$ = Nucleophile = "nucleus loving" (e^- rich)

[related to Brønsted base & Lewis base]

CH_3-Br ≡ electrophile = "e^- loving" (e^- deficient)

[related to Brønsted acid, H_3C-Br vs. $H-Br$]

Strengths of Brønsted acids

Recall pKa scale

consider: $HA + H_2O \rightleftharpoons {}^{\ominus}:A + H_3O^{\oplus}$ $\quad K_{eq} = \dfrac{[A:^{\ominus}][H_3O^{\oplus}]}{[HA][H_2O]}$

Big convention:

$K_a = K_{eq}[H_2O] = \dfrac{[A:^{\ominus}][H_3O^{\oplus}]}{[HA]}$

log scale is most convenient

$pK_a = -\log K_a$

* stronger acid ⇔ lower pKa