eg. 3 salt of basic ion

$Na_2CO_3 \rightarrow \underbrace{2Na^{1+}}_{\text{inactive}^\star} + \underbrace{CO_3^{2-}}_{\text{active}^\star}$ ★ explain later

→ dissociation! → when you have a salt of a basic ion, you MUST dissociate first

$\underset{b1}{CO_3^{2-}} + \underset{a2}{H_2O} \rightleftharpoons \underset{a1}{HCO_3^{1-}} + \underset{b2}{OH^{1-}}$ ← basic

∴ lies left

eg. 4 amphiprotic substance → goes both ways

$NaHCO_3 \rightarrow \underbrace{Na^{1+}}_{\text{inactive}} + \underbrace{HCO_3^{1-}}_{\text{active}}$ "dissociate"

stronger tendency — amphiprotic

acid $\underset{a2}{HCO_3^{1-}} + \underset{b2}{H_2O} \rightleftharpoons \underset{b1}{CO_3^{2-}} + \underset{a2}{H_3O^{1+}}$ ∴ lies left further

base $\underset{b1}{HCO_3^{1-}} + \underset{a2}{H_2O} \rightleftharpoons \underset{a1}{H_2CO_3} + \underset{b2}{OH^{1-}}$ ∴ lies left

∴ $[OH^{1-}] > [H_3O^{1+}]$

∴ Basic

not as strong tendency

$Al(NO_3)_3 \rightarrow \underbrace{Al^{3+}}_{\text{active}} + \underbrace{3NO_3^{1-}}_{\text{inactive}}$ dissociate

$Al^{3+} + 3H_2O \rightleftharpoons Al(OH)_3 + 3H^{1+}$ ← "the same"

∴ acidic

$Al + 6H_2O \rightleftharpoons Al(OH)_3 + 3H_3O^{1+}$

★ include 3 extra water molecules used to "hold" the proton

cannot do conjugate acid/base pairs on this problem.

Acid-Base Equilibrium

Definitions:

1. Functional (ola)
2. Bronsted Lowry → we will use
3. Lewis (needed for complete picture).

Functional = Behaviour

Acid	Base
• react with metals	• do not react with metals
• feels clean (?)	• feels slippery
• tastes sour	• tastes bitter
• turns litmus red	• turns litmus blue
H^{1+} (in water)	OH^{1-} (in water)

Bronsted → all about the protons

acid = proton donar (H^{1+})

$HCl \rightarrow H^{1+} + Cl^{1-}$

(H^{1+}: donatcable proton)

base = proton acceptor

similar but two steps.

Lewis Acid: (is acidic without having protons)

acid = electron pair acceptor

base = electron pair donar

ex. of acids: BF_3, AsF_5, SF_6, Sn^{2+}, Fe^{2+}, Ag^{1+}

ex of bases → see conjugate bases!

Bronsted Conjugate Acid Base Pair Theory

- For every acid there is a "conjugate base" (subtract H^{1+})
- For every base there is a "conjugate acid" (add H^{1+})
- exist in base

Acid	Conjugate Base
HCl	Cl^{1-}
H_2SO_4	HSO_4^{1-}
HSO_4^{1-}	SO_4^{2-}
SO_4^{2-}	N.A ← must have a hydrogen to take away
HNO_3	NO_3^{1-}
HNO_2	NO_2^{1-}
H_3PO_4	$H_2PO_4^{1-}$
$H_2PO_4^{1-}$	HPO_4^{2-}
HPO_4^{2-}	PO_4^{3-}
PO_4^{3-}	N.A
CH_3COOH	CH_3COO^{1-}
H_2O	OH^{1-}
OH^{1-}	O^{2-}

conjugate pairs

Hilroy

Base	Conjugated Acid
NH_3	NH_4^{1+}
NH_2^{1-}	NH_3
OH^{1-}	H_2O
H_2O	H_3O^{1+} ← hydronium ion
NH_4^{1+}	~~NH_5^{2+}~~ cannot happen → no place to add
H_2SO_4	~~$H_3SO_4^{1+}$~~

$HCl + H_2O \rightleftharpoons Cl^{1-} + H_3O^{1+}$

a1 b2 b1 a2 ← acidic solution

$HNO_3 + H_2O \rightleftharpoons NO_3^{1-} + H_3O^{1+}$

a1 b2 b1 a2

eg. 1 acid.

$HCl + H_2O \rightleftharpoons Cl^{1-} + H_3O^{1+}$

a1 b2 b1 a2

strong acid ★

- identify bases
- choose the ~~better~~ base

- the better base gets the proton. ∴ acidic
∴ lies right ★
understand → H_3O^{1+} = acid / OH^{1-} = base

eg. 2 acid

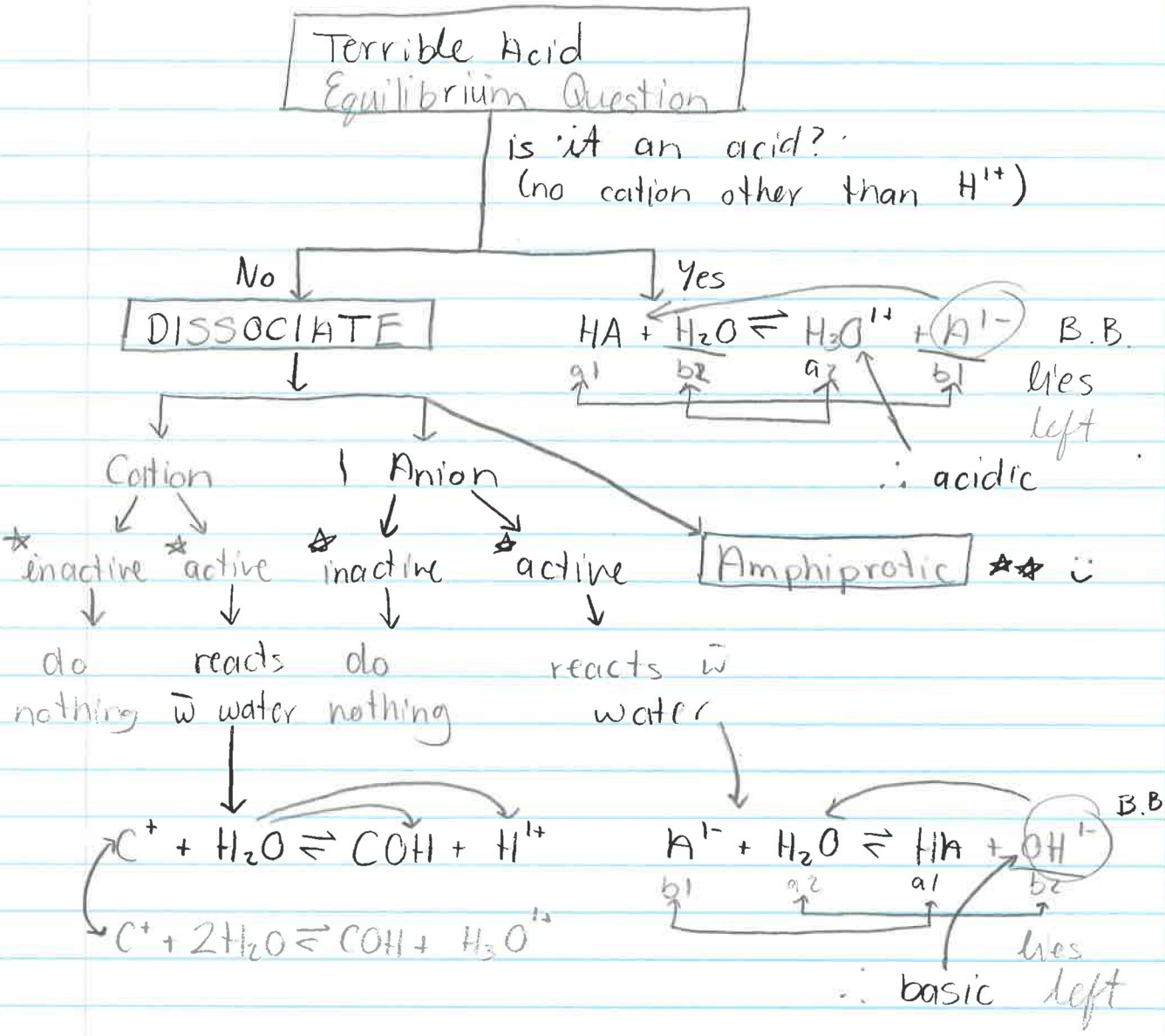
$HCN + H_2O \rightleftharpoons CN^{1-} + H_3O^{1+}$ ∴ acidic

a1 b2 b1 a2

∴ lies left

(more examples on another page

June 17.



Active Cations:
↳ all cations except Li^{1+}, Na^{1+}, K^{1+}, Rb^{1+}, Cs^{1+}, Ba^{2+}

Active Anions:
↳ any anion below the "water line" (on strength of acid & base sheet)
except for SO_4^{2-}