Summary:
Lec 8

3 definitions for Acid and Base:

1. Arrhenius:
   - Acid: produce "H^+" → when dissolved in H_2O.
   - Base: produce "OH^-"

2. B.L:
   - Acid: proton "H^+" donor.
   - Base: proton "H^+" acceptor.

Note: $[H^+] = [H_3O^+]$

3. Lewis:
   - Acid: accept ē.
   - Base: ē donate.

* Types of Acids, depending on # of H^+:
  - → monoprotic: HNO_3
  - → polyprotic
    - → diprotic: H_2SO_4.
    - → triprotic: H_3PO_4.

Amphoteric substance: consider neither Acid or Base ⇒ like H_2O

- ↳ can be Acid when Reacts with Base
  ex: $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$ (NH_3 = Base, H_2O = Acid)
- ↳ can be base when Reacts with Acid:
  ex: $HCN + H_2O \rightleftharpoons H_3O^+ + CN^-$ (HCN = Acid, H_2O = Base)

* Note: Amphoteric ≠ amphipathic
  - Amphoteric → Acid OR Base
  - amphipathic → "hydrophilic" "polar" And hydrophobic "non-polar"

Acid and Base strength: → strong Acid and base → dissociate 100% in H_2O.

strong Acid → $HCl \xrightarrow{H_2O} H^+ + Cl^-$ → $[HCl] = [H^+] = [Cl^-]$ → No K_a

strong Base → $NaOH \xrightarrow{H_2O} Na^+ + OH^-$ → $[NaOH] = [Na^+] = [OH^-]$ → No K_b

→ Weak Acid and base: dissociate partially.

weak Acid → $HCN + H_2O \rightleftharpoons H_3O^+ + CN^-$ → $[HCN] \neq [products]$

$[H_3O^+] = [H^+] = [CN^-]$ → there is K_a.

$K_a = \frac{[products]}{[Reactant]} = \frac{[H_3O^+]^2}{[HCN]}$

Weak Base →

$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$

$[NH_3] \neq [OH^-]$ $[NH_4^+] = [OH^-]$ → there is K_b.

$K_b = \frac{[products]}{[Base]} = \frac{[OH^-]^2}{[NH_3]}$

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* as we said about types of Acid:
(mono + poly) protic ⇒ كل ما اعطى الحمض $[H^+]$ لأكثر الهوة رح تنخفض

ex: $H_3PO_4 + H_2O \rightleftharpoons H_2PO_4^- + H_3O^+$ (triprotic Acid, ↑Ka.)
$H_2PO_4^- + H_2O \rightleftharpoons HPO_4^{-2} + H_3O^+$
$HPO_4^{-2} + H_2O \rightleftharpoons PO_4^{-3} + H_3O^+$ (↓Ka.)

⇒ strong Acid + strong Base ⇌ weak base + weak Acid (conjugate / conjugate.)

⇒ Weak Acid + Weak Base ⇌ strong Base + strong Acid

* يعني القاعدة القوية رح تعطي حمض مرافق ضعيف وهكذا.
— يعني علاقة عكسية بين الحمض والقواعد مع المرافق لكل حد.

* As we said ⇒ $K_a = \frac{[H_3O^+]}{[Acid]}$
  - → $K_a > 1$ ⇒ product favored
  - → $K_a < 1$ ⇒ Reactant favored

→ imp Relations → ↑Ka → ↑$[H_3O^+]$ → ↓pKa → ↓pH → strong Acid

$pK_a = -\log K_a$

$pH = -\log H_3O^+$

⇒ $[molarity] = \frac{\#\ mole}{volume}$, $\#\ mole = \frac{mass}{m.w}$ → $mass = M * V * m.w$

* equivalent:
For acids and bases = # of moles ("$1\ HCl = 1[H^+]$", "$1\ H_2SO_4 = 2[H^+]$")

" ions ⇒ $\frac{m.w}{charge}$ ("$Mg^{+2} = \frac{24.3}{2} = 12.15$")

⇒ plz Back to slides or sh 8 to practise

* Normality: $N = n * M$ (n ↳ # of Eq.)

⇒ For titration → # M "Acid" = # M "Base" (same $H^+ = OH^-$)

→ $\frac{M_1 * V_1}{Acid} = \frac{M_2 * V_2}{Base}$

* $K_W = [OH^-][H_3O^+] = 10^{-14}$
  - ↑Ka ↑Acid ↓pH: Acid → $[H_3O^+] > 10^{-7}$
  - water $[H_3O^+] = [OH^-] = 10^{-7}$
  - Base → $[OH^-] > 10^{-7}$: ↑Kb ↑Base ↑pH

Solution — th X ^^