8.1 Acids + Bases Equilibrium

① Theories

↳ Arrhenius - acids produce hydrogen ions H^+
bases produce hydroxide ions OH^-

↳ Bronsted Lowry - acids are proton donors
bases are proton acceptors

Ex. HCl

Arrhenius: $HCl \rightarrow H^+_{(aq)} + Cl^-_{(aq)}$ looks like dissociation - problem: molecular → ions

cation! Arrhenius: $HCl + H_2O \rightarrow H_3O^+_{(aq)} + Cl^-_{(aq)}$
(hydronium ion)

- ionization
- produces H_3O^+ ions

Bronsted-Lowry: $HCl + H_2O \rightarrow H_3O^+ + Cl^-$

Acid — H^+ — Base! — Conjugate Acid — Conjugate base

HCl and Cl^- is a conjugate acid-base pair
H_2O and H_3O^+ " " " " " "

Ex. NH_3

$NH_3 + H_2O \rightarrow OH^-_{(aq)} + NH_4^+{}_{(aq)}$

Base — Acid — Conjugate Base — Conjugate Acid

Conjugate acid-base pairs: NH_3 and NH_4^+
H_2O and OH^-

★ Substances that can act like a base or an acid are called amphoteric substances
ex. H_2O, HCO_3^-, HSO_4^-, HPO_4^{-2}, $H_2PO_4^{-1}$

Equilibrium is temperature dependent

#1, 2. pg 532. The first equilibrium of acids and bases: K_w

- Water self ionizes

$$H_2O_{(l)} + H_2O_{(l)} \leftrightarrow H_3O^+_{(aq)} + OH^-$$

1×10^{-7} mol/L 1×10^{-7} mol/L

★ @ 25°C

$K_w = [H_3O^+][OH^-]$
$= [1\times10^{-7}\ mol/L]^2$
$= 1\times10^{-14}$

[ ] → pH do −log
pH → [ ] do 10^{-pH}

$-\log(K_w) = -\log[H_3O^+][OH^-]$
$14 = -\log[H_3O^+] + -\log[OH^-]$
$14 = \text{"pH"} + pOH$

Strong Acid + Strong Base Calculation

"Strong" = 100% ionization
★ NO equilibrium

Acids $\xrightarrow{100\%}$ H^+
Bases $\xrightarrow{100\%}$ OH^-

Ex. Pg 535 0.15 mol/L HCl ... Calculate $[OH^-]$? Ex. #19 pg 549

Step 1 - you know it's a strong acid

$HCl \xrightarrow{100\%} H^+ + Cl^-$
0.15 mol/L

$K_w = [H^+][OH^-]$

$\frac{K_w}{[H^+]} = [OH^-]$

$[OH^-] = \frac{1.0\times10^{-14}}{0.15}$
$= 6.7\times10^{-14}$ mol/L

$Ca(OH)_2$ mass ÷ Molar mass
Find moles /L. V = 1 dm³

$Ca(OH)_2 \rightarrow Ca^{+2} + 2OH^-$
[ ] 2 × [Ca

★ OH

$14 = pH + pOH$
$14 - pOH = p$

Questions: pg 537 # 4, 5
540 # 10
546 # 13, 14
549 # 18