0.15M $Ca(OH)_2$

$Mg^{2+}$ ↘ $Mg(OH)_2$

$Ca^{2+}$ $2\ OH^-$

$[OH^-] = 2[Ca(OH)_2]$

$pH = 14 - pOH$

$[OH^-] = 2 \times (0.15\ M)$

$[OH^-] = 0.30M$

$pOH = -\log(0.30M) = 0.52$

$pH = 14 - 0.52 = 13.48$

$H_2CO_3 \rightleftharpoons HCO_3^- \rightleftharpoons CO_3^{2-}$

$K_{a1}$ $K_{a2}$

$$K_{a1} = \frac{[HCO_3^-][H_3O^+]}{[H_2CO_3]} \approx 10^{-7}$$ } Larger This $H^+$ comes off easier

$H_2CO_3 + H_2O \rightleftharpoons HCO_3^- + H_3O^+$

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$$K_{a2} = \frac{[CO_3^{2-}][H_3O^+]}{[HCO_3^-]} \approx 10^{-11}$$ } smaller $H^+$ held more tightly

$HCO_3^- + H_2O \rightleftharpoons CO_3^{2-} + H_3O^+$

Large Ka → more proton loss/ionization (stronger acid)

$$H_3PO_4 \underset{Ka_1}{\rightleftharpoons} H_2PO_4^- \underset{Ka_2}{\rightleftharpoons} HPO_4^{2-} \underset{Ka_3}{\rightleftharpoons} PO_4^{3-}$$

$$Ka_1 = \frac{[H_2PO_4^-][H_3O^+]}{[H_3PO_4]}$$

$$Ka_2 = \frac{[HPO_4^{2-}][H_3O^+]}{[H_2PO_4^-]}$$

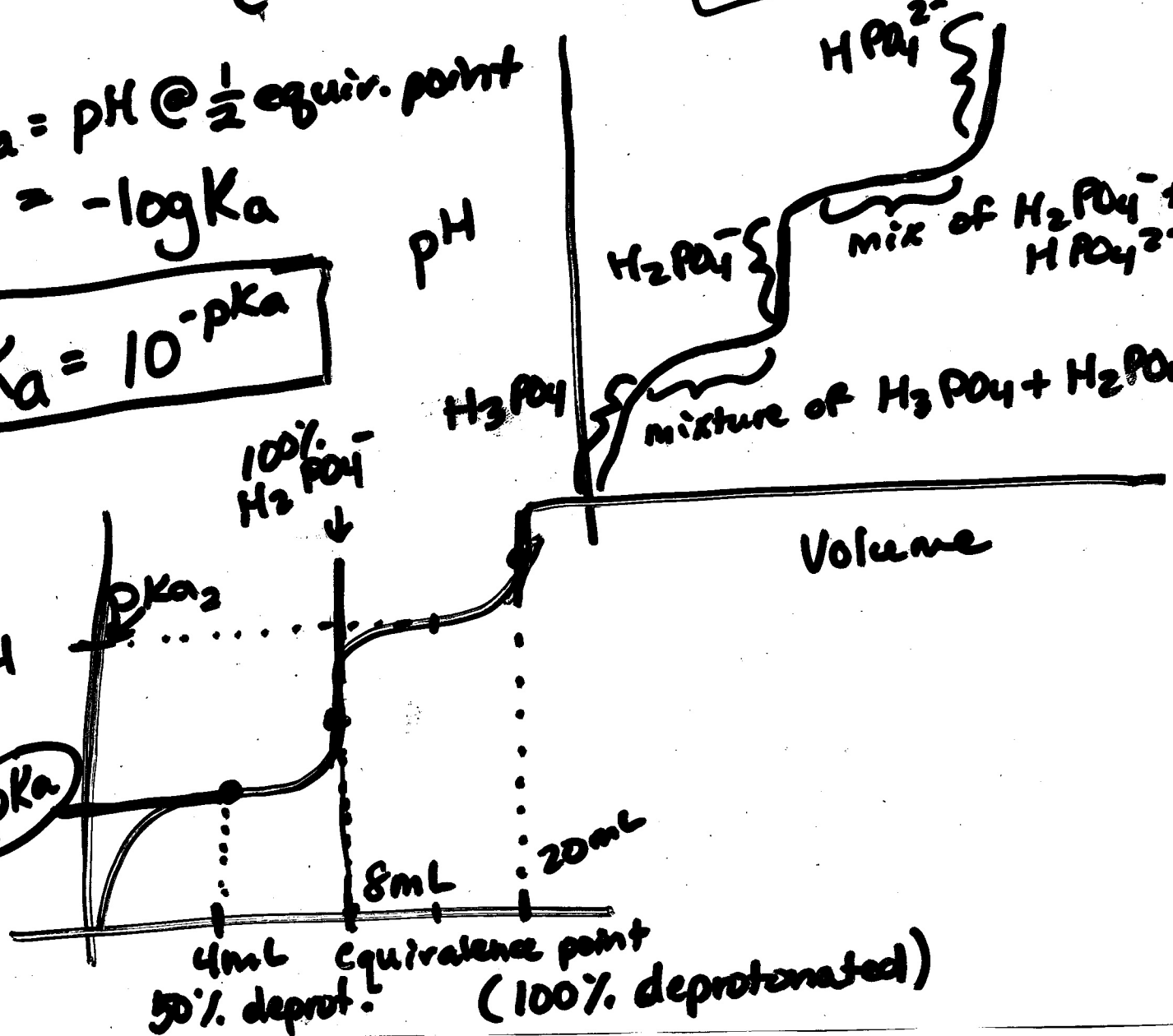
Trend for Polyprotics

$$Ka_1 > Ka_2 > Ka_3$$

$pKa$ = pH @ $\frac{1}{2}$ equiv. point

$= -\log Ka$

$$Ka = 10^{-pKa}$$



$NH_4Cl$

$NH_4^+$ — acidic / weakly

$Cl^-$ — pH neutral

weak acid

$NaCl$

$Na^+$ — pH neutral

$Cl^-$ — pH neutral

$NaOH$ = strong base

$Na^+$ $OH^-$

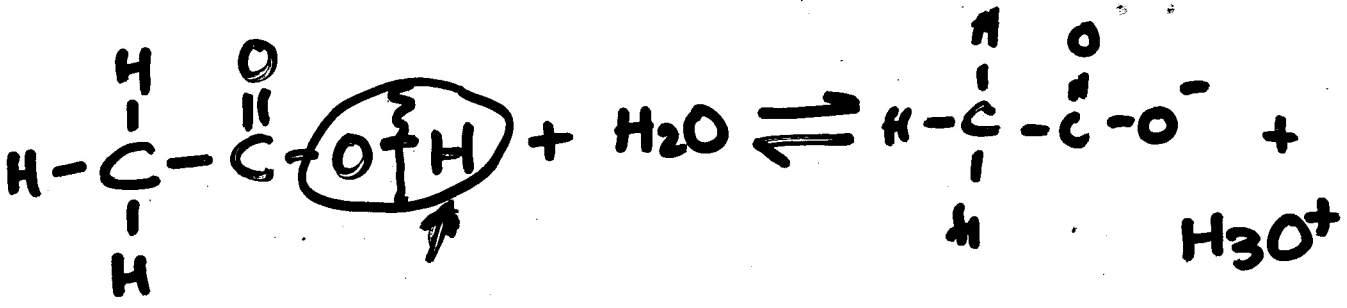
$HCl$ = acid strong

$H^+$ $Cl^-$

pH neutral

| | Cation | Anion | Acid/ Base? |
|---|---|---|---|
| NaCN | $Na^+$ neut. | $CN^-$ w. base | weak base |
| $KNO_3$ | $K^+$ neutral | $NO_3^-$ v. small $K_b$ | very weak base |
| $NH_4Cl$ | $NH_4^+$ w. acid | $Cl^-$ neut. | weak acid |
| $NaHCO_2$ | $Na^+$ neut. | $HCO_2^-$ w. acid | weak acid |
| $Na_2CO_3$ | $Na^+$ neut. | $CO_3^{2-}$ w. base | weak base |
| $NH_4CN$ | $NH_4^+$ w. acid $K_a = 5.6 \times 10^{-10}$ | $CN^-$ w. base $K_b = 2.5 \times 10^{-5}$ | weak base ↗ |

$K_b$ bigger than $K_a$



Acetic acid

| | Bond E | | Ka | |
|---|---|---|---|---|
| | | | | Weak |
| H-F | 569 | ↑ High | $7 \times 10^{-4}$ | |
| H-Cl | | | | Acid strength |
| H-Br | | | | |
| H-I | 297 | Low | $10^{10}$ | ↓ Strong |

High bond E
Harder to break bond

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more electronegative ⇒ Stronger Acid.

H