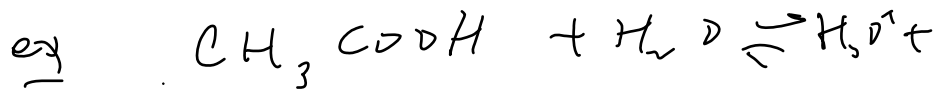


ch 16.8

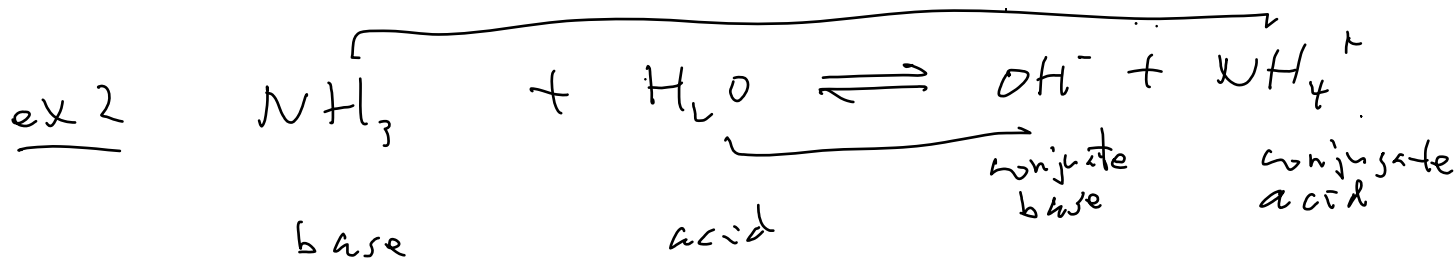
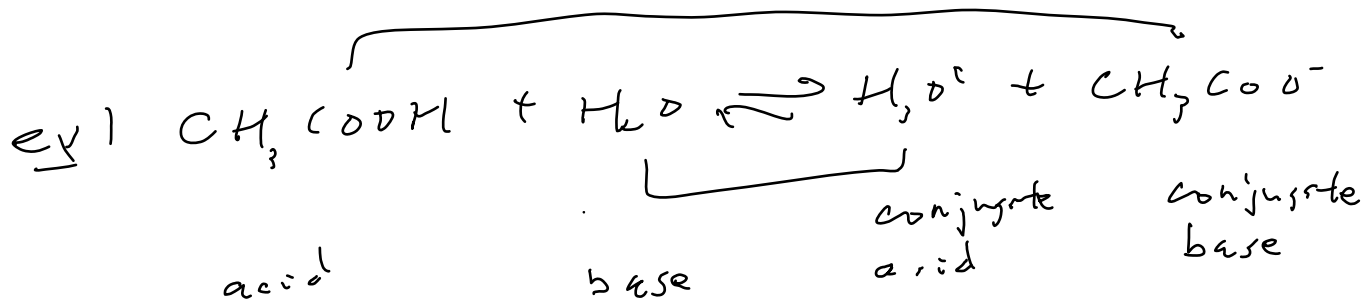
relate K_a & K_b

review: K_a & K_c of a weak acid react with H_2O



K_b : K_c of a weak base react w/ H_2O
ex $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$

background: conjugate pair
- in equilibrium with each other
- differ by H
- one is a base & other is an acid

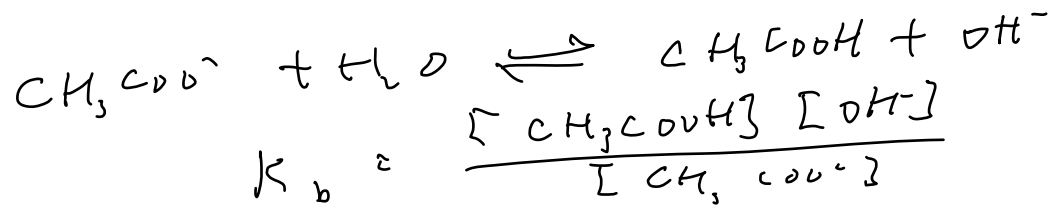
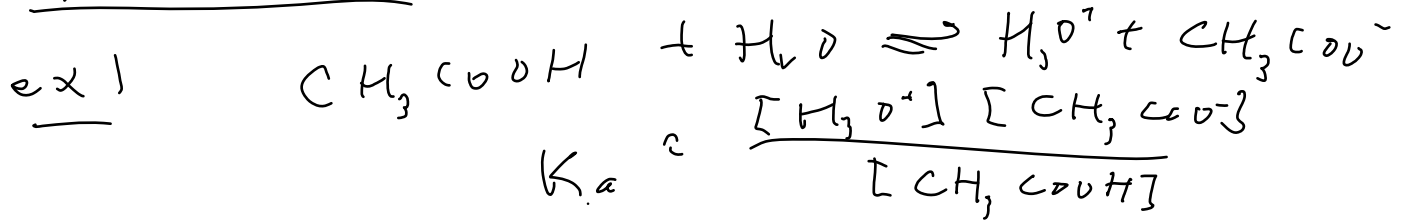


relate K_a & K_b

$$K_a \cdot K_b = K_w$$

conjugate pair

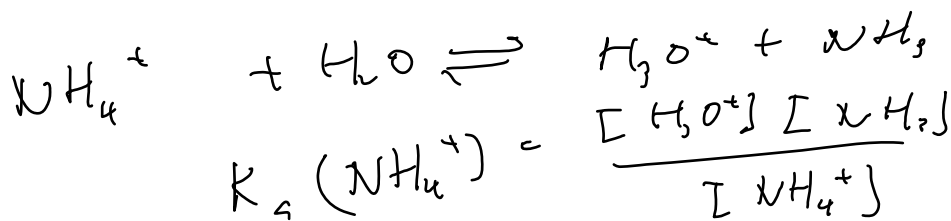
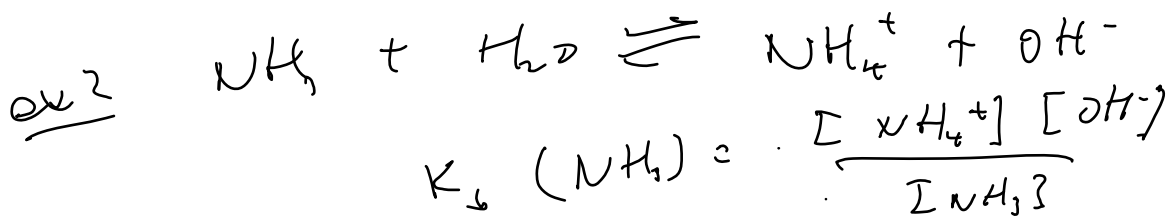
'psuedo. proof'



note: $K_a(\text{CH}_3\text{COOH}) \cdot K_b(\text{CH}_3\text{COO}^-) = K_w?$

$$\frac{[\text{H}_3\text{O}^+][\text{CH}_3\text{COO}^-]}{[\text{CH}_3\text{COOH}]} \cdot \frac{[\text{CH}_3\text{COOH}][\text{OH}^-]}{[\text{CH}_3\text{COO}^-]}$$

$$[\text{H}_3\text{O}^+][\text{OH}^-] = K_w \quad \checkmark$$

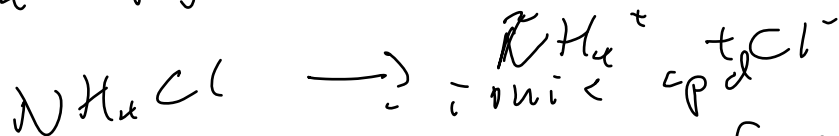


note: $K_b(\text{NH}_3) \cdot K_a(\text{NH}_4^+) = K_w?$

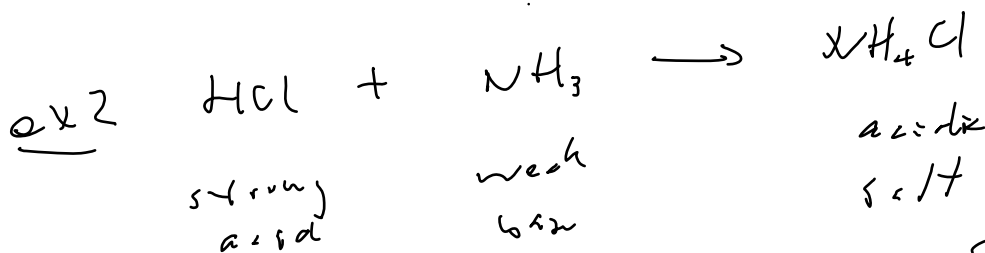
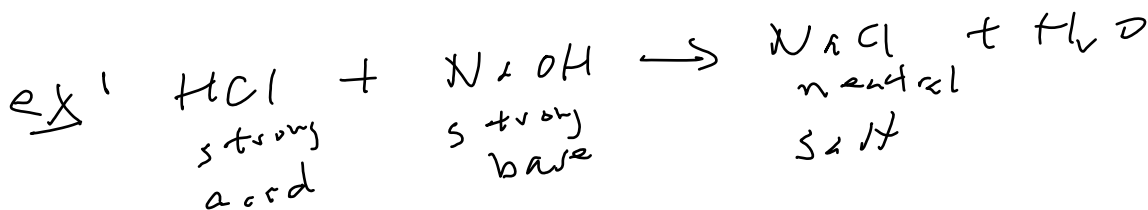
$$\frac{[\text{NH}_4^+][\text{OH}^-]}{[\text{NH}_3]} \cdot \frac{[\text{H}_3\text{O}^+][\text{NH}_3]}{[\text{NH}_4^+]}$$

$$[\text{OH}^-][\text{H}_3\text{O}^+] = K_w \quad \checkmark$$

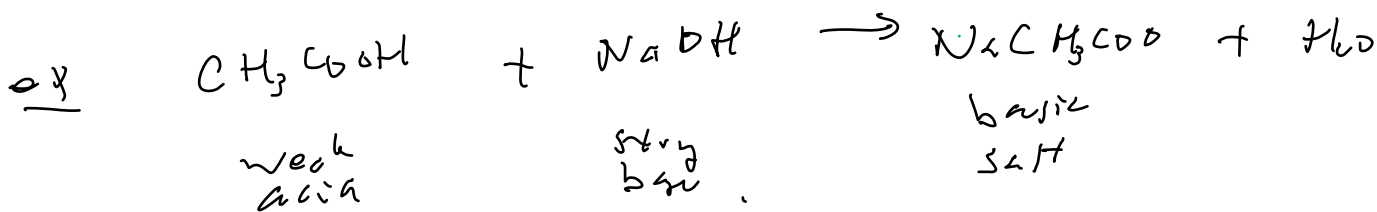
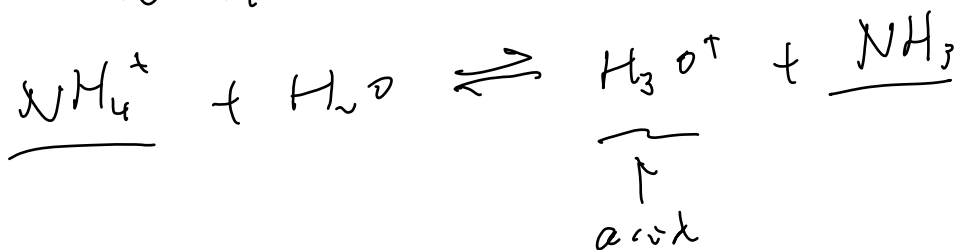
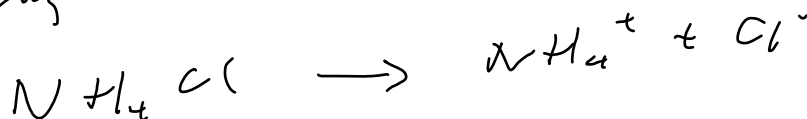
Q1b 1 by NH_4Cl is an acidic salt



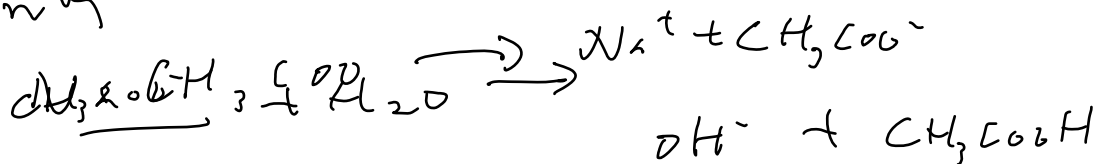
- product of acid-base rx
- cation from base anion from acid

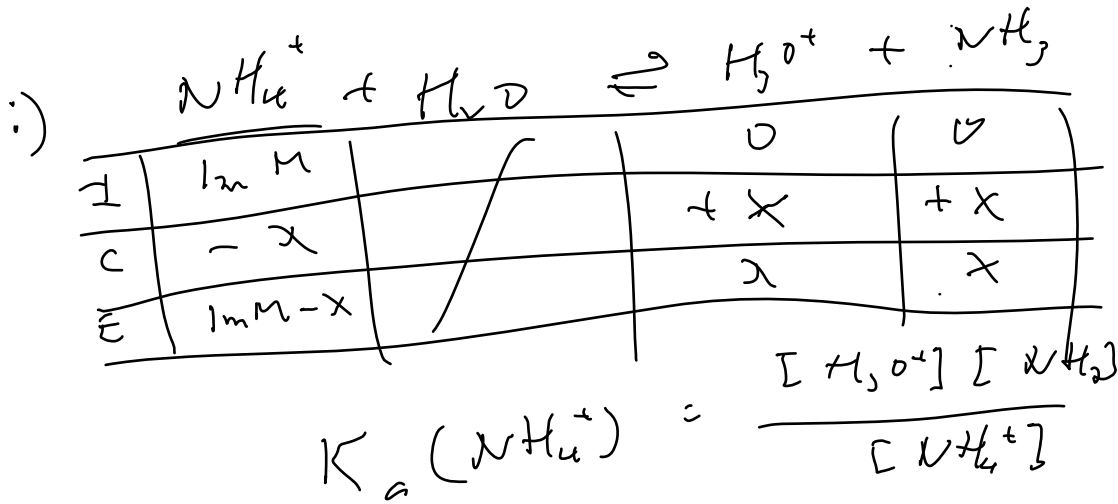


why is it an acidic salt?



why basic salt?





$$= \frac{x^2}{0.001-x}$$

① $\approx \frac{x^2}{0.001}$

ii) $K_a(\text{NH}_4^+) \cdot K_b(\text{NH}_3) = K_w$
 $K_a(\text{NH}_4^+) \cdot 1.8 \cdot 10^{-5} = 10^{-14}$

$K_a(\text{NH}_4^+) \approx 5.56 \cdot 10^{-10}$ ②

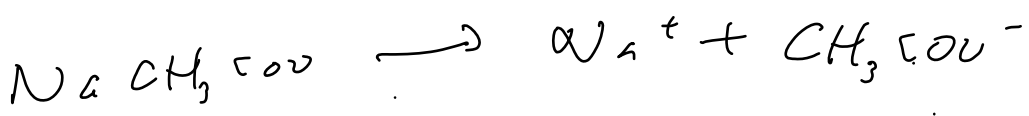
iii) substitute ② into ①

$$5.56 \cdot 10^{-10} = \frac{x^2}{0.001}$$

$$x = \sqrt{5.56 \cdot 10^{-13}} \approx 7.45 \cdot 10^{-7} \text{ M}$$

iv) $\text{pH} = -\log [\text{H}^+] = -\log (7.45 \cdot 10^{-7})$
 ≈ 6.13

② 1mM NaCH_3COO , basic salt



I	1mM		0	0
C	-x		+x	+x
E	1mM-x		x	x

$$K_b(\text{CH}_3\text{COO}^-) = \frac{[\text{OH}^-][\text{CH}_3\text{COOH}]}{[\text{CH}_3\text{COO}^-]}$$

$$\text{①} \quad \approx \frac{x^2}{0.001-x} \approx \frac{x^2}{0.001}$$

$$\text{ii) } K_b(\text{CH}_3\text{COO}^-) \cdot K_a(\text{CH}_3\text{COOH}) = K_w$$

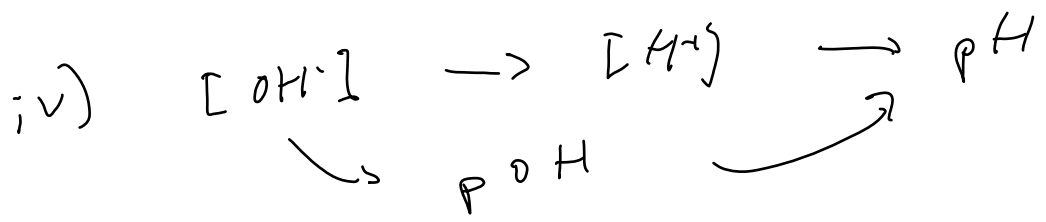
$$K_b(\text{CH}_3\text{COO}^-) \cdot 1.8 \cdot 10^{-5} = 10^{-14}$$

$$K_b(\text{CH}_3\text{COO}^-) \approx 5.56 \cdot 10^{-10} \text{ ②}$$

iii) subst ② into ①

$$5.56 \cdot 10^{-10} = \frac{x^2}{0.001}$$

$$x = \sqrt{5.56 \cdot 10^{-13}} = 7.45 \cdot 10^{-7} \text{ M}$$



$$[\text{OH}^-][\text{H}^+] = 10^{-14}$$

$$(7.45 \cdot 10^{-7})[\text{H}^+] = 10^{-14}$$

$$[\text{H}^+] = 1.34 \cdot 10^{-8} \text{ M}$$

$$\begin{aligned} \text{v)} \quad \text{pH} &= -\log [\text{H}^+] = -\log (1.34 \cdot 10^{-8}) \\ &= 7.87 \end{aligned}$$