(8) **Today**

Sections 2.3 - 2.4.9: Buffers and Solubility In the Aqueous World

We will refer back to 2.4.10 and 2.4.11 when looking at proteins

Next Class (9)

Chap 3: Amino Acids, Peptides, and Proteins

(10) **Second Class from Today**

Chap 3: Amino Acids, Peptides, and Proteins

Third Class from Today (11)

Chap 3: Amino Acids, Peptides, and Proteins

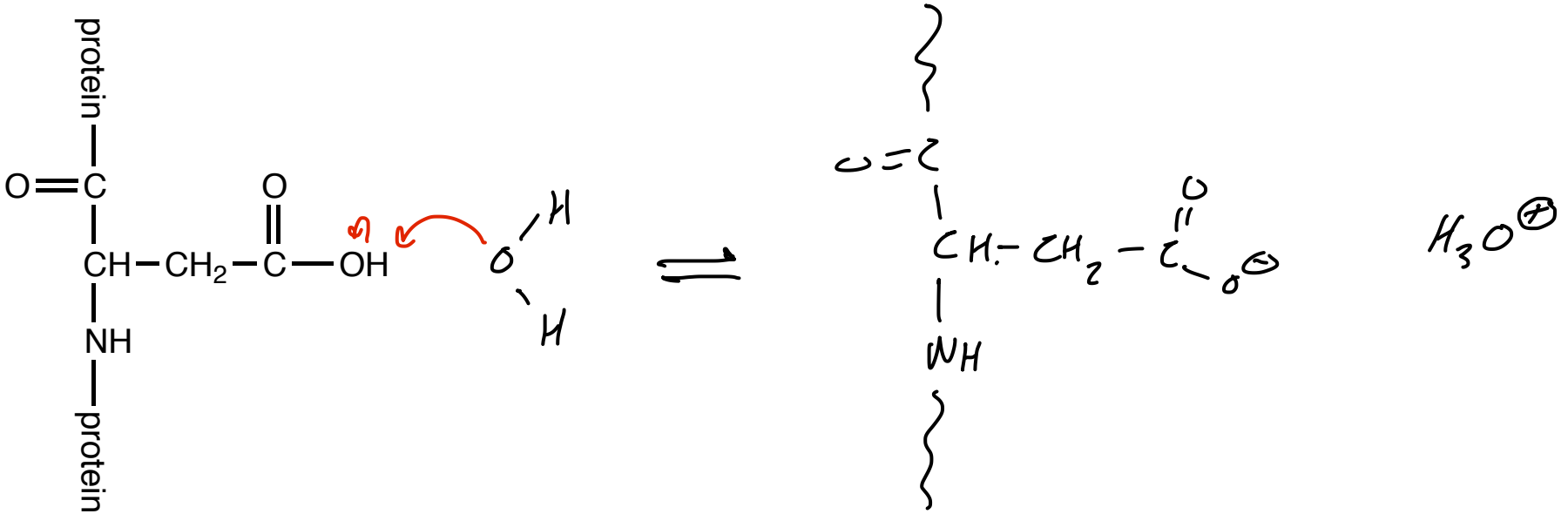
Biochem Test 1 is being rescheduled to Wed. Feb 26

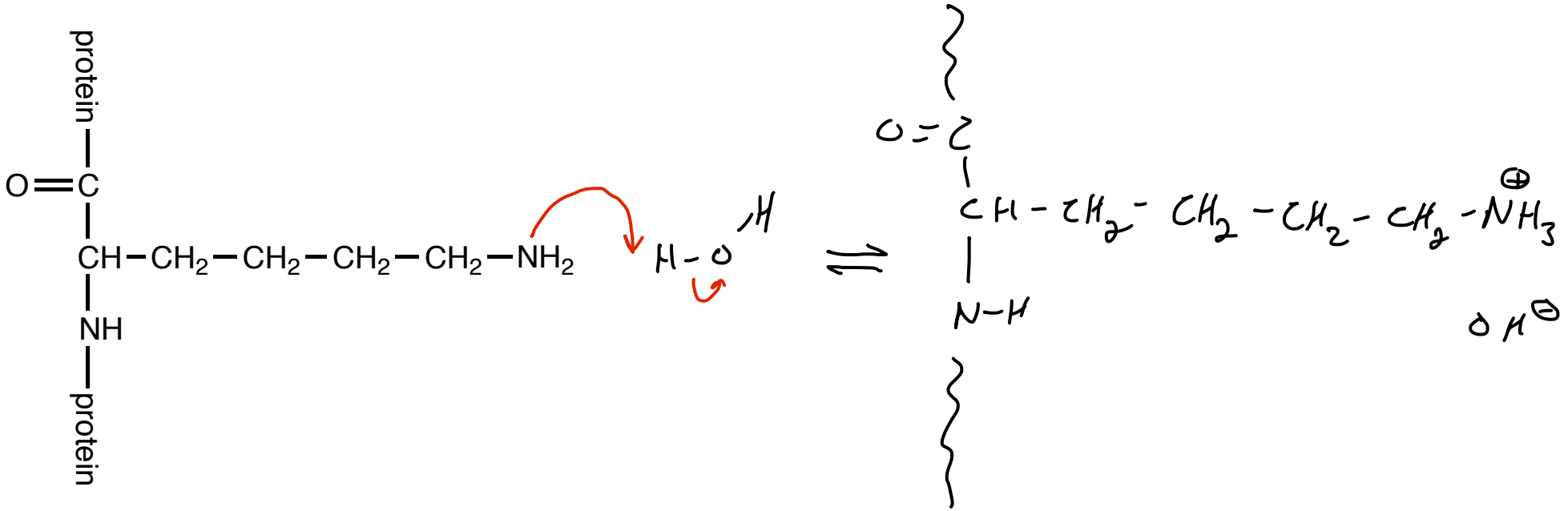
$$\mathbf{pH = pK_a + \log [A^-]/[HA]}$$

$$\mathbf{pH - pK_a = \log [A^-]/[HA]}$$

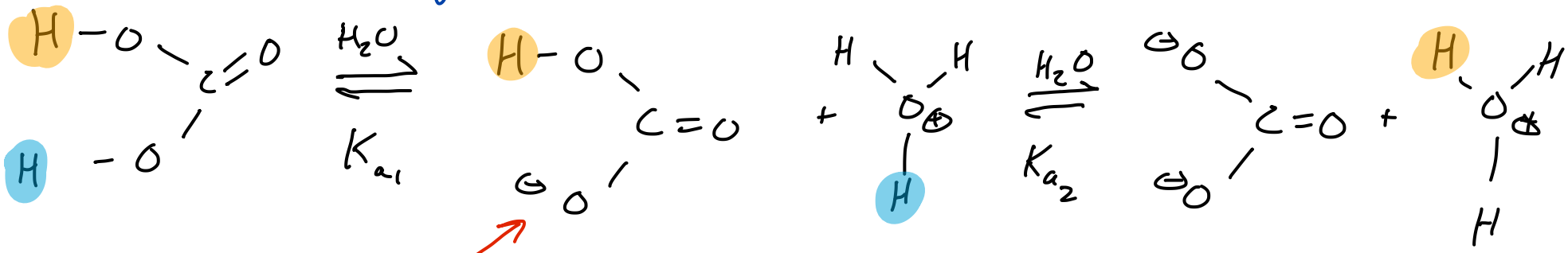
pH is	pH - pK_a	log (A^-/HA)	$\frac{A^-}{HA}$	state
2 units less than pK_a	–2	–2	$10^{-2} = 0.01 = \frac{1}{100}$	~ 99% protonated
pH = pK_a	0	0	$10^0 = 1 = \frac{1}{1}$	50%
2 units more than pK_a	2	2	$10^2 = 100 = \frac{100}{1}$	~ 99% deprotonated

amino NR_3 at least 1 R is C





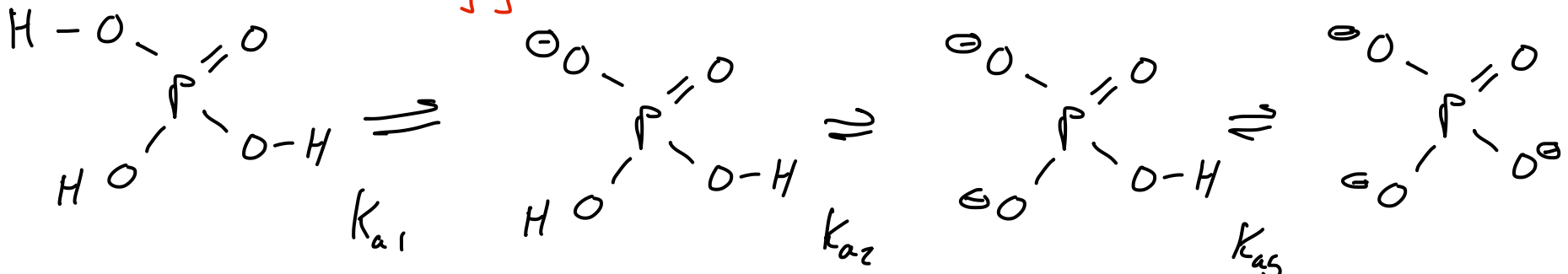
The K_a for the first ionization is larger than the K_a for the second



this is neg so the H^+ would be more strongly attracted

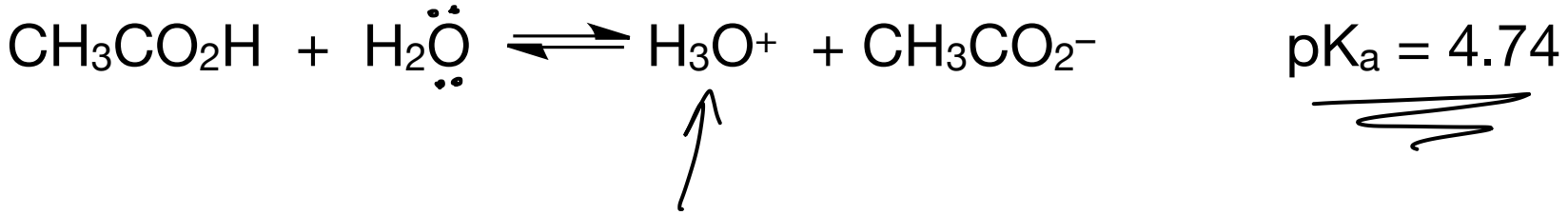
$$K_{a1} > K_{a2}$$

two H_3O^+'s form / for each ionizable H^+

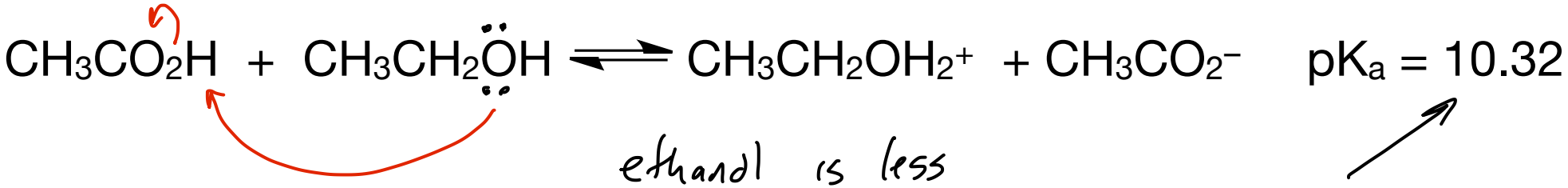


H_3O^+ H_3O^+ H_3O_4

$$K_{a1} > K_{a2} > K_{a3}$$



more polar and dissolved in H_2O:



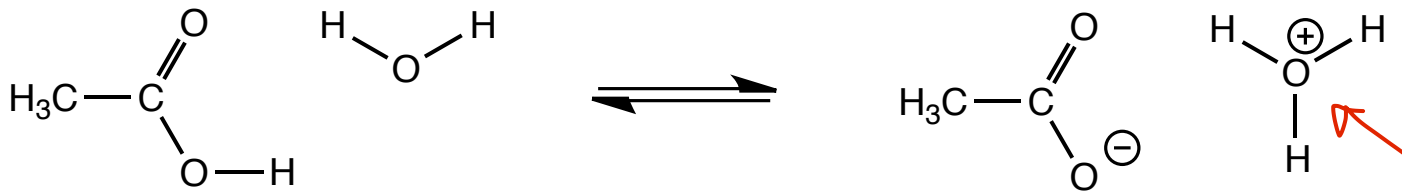
ethanol is less polar than H_2O ethanol can form fewer H bonds

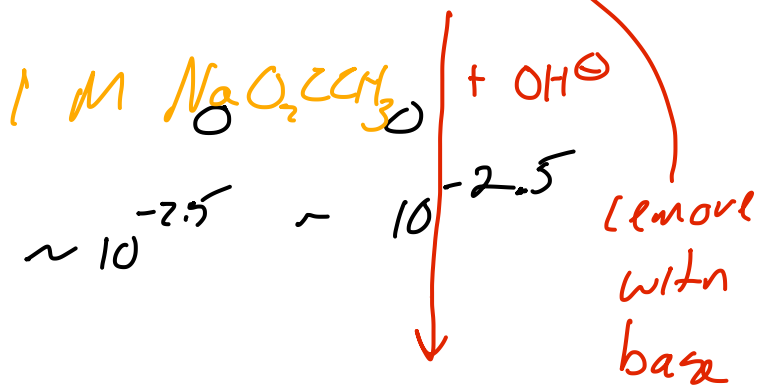
Is CH_3CO_2H more or less acidic when dissolved in CH_3CH_2OH?

Weaker in CH_3CH_2OH

$-\log K_a = pK$

 resist changes in pH





initial 1 M

a little less than 1 M

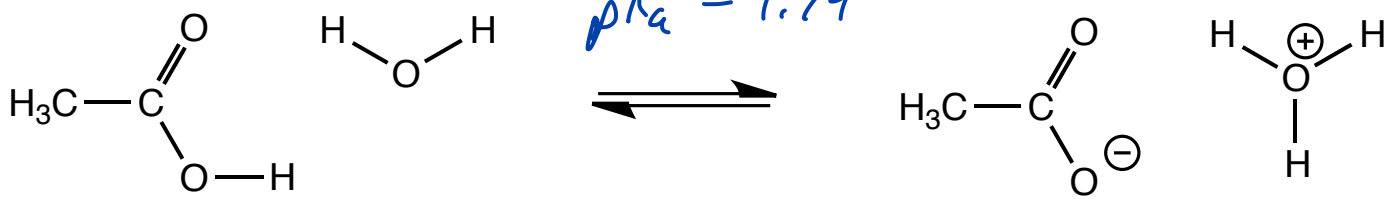
~ 0.998

If a base removes some of the $H_3O^{\oplus}$ the H_2O equilibrium is perturbed, and the rxn will react to minimize the change. In this case more CH_3CO_2H will ionize to replace some of the "missing" $H_3O^{\oplus}$.

Add $H_3O^{\oplus}$.... if only CH_3CO_2H was used to make the soln, there is only a tiny amt. of $CH_3CO_2^{\ominus}$ to react with the $H_3O^{\oplus}$

not a strong acid ... weak acid-base pair

pKa too far off for this system to be a good buffer for biochem



pH = pK$_a$ + log [A$^-$]/[HA]

Starting with both the weak acid & the weak base present means there is plenty of weak acid to react with added base to minimize the change in pH, and there is plenty of weak base present to react with added base and minimize the change in pH.

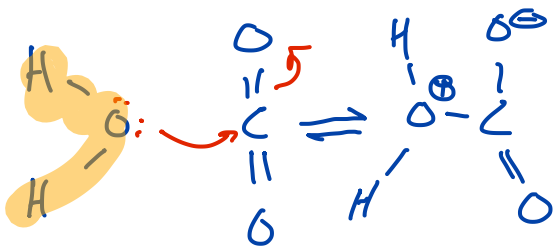
Buffers are most effective at resisting changes in pH in either direction when $[A^-] = [HA]$

When pH = pK$_a$ $[A^-] = [HA]$ so buffers are most effective when the pH is = to the pK$_a$ of the acid

$CO_2(g) + H_2O(l) \rightleftharpoons CO_2(aq) + H_2O(l) \underset{K_2}{\overset{K_1}{\rightleftharpoons}} H_2CO_3(aq) + H_2O(l) \rightleftharpoons HCO_3^-(aq) + H_3O^+(aq)$

$pK_a = 3.6$

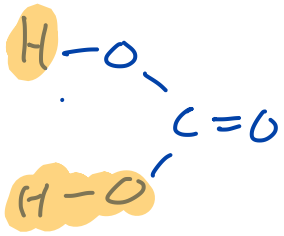
pKa is too far off to be a good buffer



$$pH = -\log\left(\frac{[CO_2]}{[HCO_3^-]}\right) - \log\left(\frac{K_a}{K_2}\right)$$

$$-\log\left(\frac{K_a}{K_2}\right) = 6.3$$

closer to the pH we want to buffer



$pH = -\log(\text{stuff}) + pK_a$

The whole system acting as a buffer gets us to a better "pKa" pH match

This buffer has limited capacity because the "pKa" is 6.3 ... more base present than acid ... so buffer is better at consuming H_3O^+ than it is at replacing it.

Removing/adding CO_2 from/to the system can change the pH