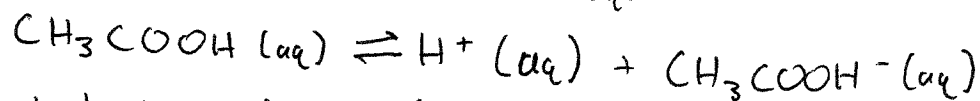
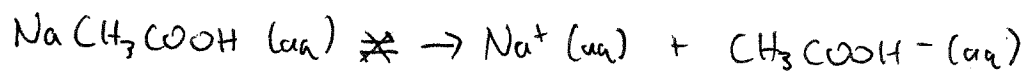


Common Ion Effect

- assume soln. of acetic acid @ equilibrium



- What happens if we add solid sodium acetate?



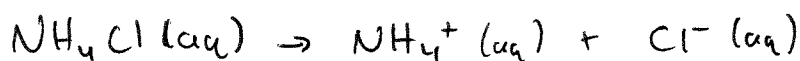
- The presence of acetate from sodium acetate in an acetic acid soln. will shift the equilibrium, according to Le Chatelier's Principle

The soln. is less acidic.

- assume soln. of ammonia happily @ equilibrium



- What happens if add solid ammonium chloride?



- presence of ammonium from ammonium chloride in an ammonia soln. will shift equilibrium left.

The soln. is less basic.

Common Ion Effect

- The shift in equilibrium that occurs by adding a compound that has an ion in common with the dissolved substance.
- The presence of a common ~~acid~~ ion suppresses the ionization of a weak acid or base
- (It can also affect solubility, as ^{we} will see later)

BUFFERS !

pH of 1.0L of 0.30M acetic acid sh. before and after adding 0.30 ml sodium acetate? (2)

$$\text{Before: } K_a = 1.8 \times 10^{-5} = \frac{[H^+][CH_3COO^-]}{[CH_3COOH]} = \frac{x^2}{0.30 - x}$$

ignore x in denominator $\rightarrow x = 2.3 \times 10^{-3} M = [H^+]$, pH = 2.63

After:

	$[CH_3COOH] (M)$	$H^+ (M)$	$[CH_3COO^-] (M)$
I	0.30	0	0.30
C	-x	+x	+x
E	0.30 - x	x	0.30 + x

$$K_a = 1.8 \times 10^{-5} = \frac{[H^+][CH_3COO^-]}{[CH_3COOH]} = \frac{x(0.30 + x)}{0.30 - x}$$

Assume that x is small compared to 0.30.

$$1.8 \times 10^{-5} = \frac{x(0.30)}{(0.30)}$$

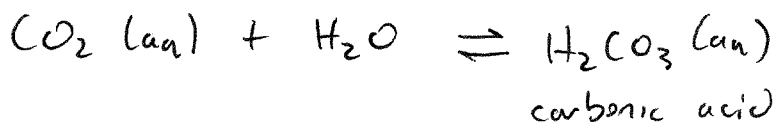
$$x = 1.8 \times 10^{-5} = [H^+]$$

$$\text{pH} = 4.78$$

- Sol. is less acidic after adding the common ion acetate
- The acid dissociates less because of the common ion

Acid-Base Homeostasis

- If you burn 2,500 calories/day, you are producing 1 mole of CO_2 per hour.

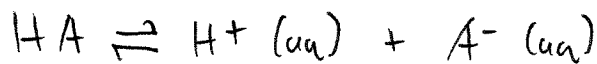


- If your blood volume is 4 liters, this is 0.25 M acid added to your bloodstream per hour!

Acid-Base Buffers

(3)

- A buffer is a mixture of a weak acid and its conjugate base.
- Adding a small amount of H^+ or OH^- reacts only slightly with one component of the buffer, so the pH doesn't change that much



weak acid, conjugate base

- insignificant change in pH
- ① Add OH^- , reacts with HA
 $HA + OH^- \rightarrow A^- + H_2O$ neutralization
 - ② Add H^+ , reacts with A^-
 $A^- + H^+ \rightarrow HA$ remove H^+ from soln.

Henderson - Hasselbalch Equation

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

- take $-\log$ of both sides: $-\log K_a = -\log [H^+] + -\log \frac{[A^-]}{[HA]}$

- Rearrange: $-\log [H^+] = -\log K_a + \log \frac{[A^-]}{[HA]}$

- Simplify: $pH = pK_a + \frac{\log [A^-]}{[HA]}$

~~$pH = pK_a$~~

$$\boxed{pH = pK_a + \log \frac{[A^-]}{[HA]}}$$

What is it good for?

- ① To calculate the pH of soln. when $[HA]$, $[A^-]$, and pK_a are known.
- ② To calculate the pK_a of any weak acid when $[HA]$, $[A^-]$, and pH are known
- ③ To calculate the ratio of HA to A^- needed to construct a buffer system at a specific pH.