

Today

More Fun with Acids and Bases

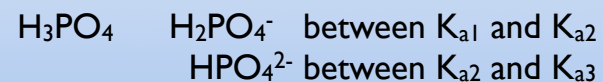
Things everyone should know something about

Quiz

First some language for the quiz

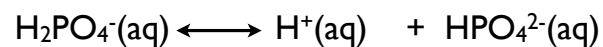
Amphiprotic Acids

These are the species that are partially protonated in a polyprotic acid



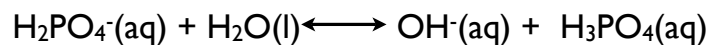
Language for weak acids

Ionization



for amphiprotic, the species is an acid

Hydrolysis (reaction with water)



for amphiprotic, the species is a base

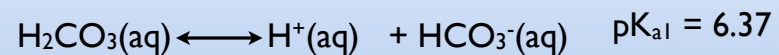
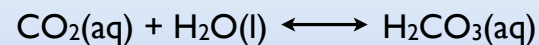
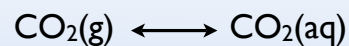
Breathing Demo

What is happening in the solution?

- A. CO₂ is dissolving and hydrolyzing making H₂CO₃
- B. O₂ is dissolving making excess OH⁻
- C. N₂ is dissolving making the HNO₃
- D. the indicator dye is reacting with the N₂

The solution is getting acidic from the CO₂ in people's breath

Reactions for this equilibrium



When the pH is around 7
only K_{a1} is relevant

Who cares?

Rising CO₂ levels are making the oceans more and more acidic
(they are still all slightly basic)

Previously lots of CO₃²⁻ species
(the other end of the equilibrium)

Adding CO₂ slowly shifts equilibrium to the acid end

More fun with carbonates

What is happening?

Adding an acid to the HCO_3^-

- A. makes H_2CO_3 which is exothermic and causes the water to boil
- B. makes H_2CO_3 which forms CO_2
- C. makes CO_3^{2-} which is exothermic and causes the water to boil
- D. makes H_2CO_3 which forms in soluble $\text{Na}_2(\text{CO}_2)_3$

Increasing the H^+ concentration
protonates the HCO_3^- making
 H_2CO_3 which decomposes into H_2O and CO_2

Why does it work with a weak acid?

- A. the pK_a of acetic acid is greater than the pK_{a1} for H_2CO_3
- B. the pK_a of acetic acid is smaller than the pK_{a1} for H_2CO_3
- C. the pK_a of acetic acid is equal than the pK_{a1} for H_2CO_3

H_2CO_3 is very weak base $\text{pK}_{a1} = 6.37$
Acetic Acid is a stronger weak acid $\text{pK}_a = 4.75$

$$K_w = K_a K_b = 10^{-14} (25^\circ\text{C})$$

$$[\text{H}^+] = (K_a C_{\text{HA}})^{0.5} \quad [\text{OH}^-] = (K_b C_{\text{B}})^{0.5}$$

$$[\text{H}^+] = (K_{a1} K_{a2})^{0.5} \quad [\text{OH}^-] = (K_{b1} K_{b2})^{0.5}$$

$$[\text{H}^+] = C_A \quad [\text{OH}^-] = C_B$$

$$[\text{H}^+] = K_A (C_a / C_b) \quad [\text{OH}^-] = K_B (C_b / C_a)$$

$$\text{pK}_a = \log K_a \quad \text{pOH} = \log [\text{OH}^-]$$

$$\text{pH} = \log [\text{H}^+] \quad \text{pH} + \text{pOH} = 14 (25^\circ\text{C})$$