Announcements – Lecture XX – Tuesday, Nov 24th

1. Final Lab – Saturday, December 5th … 1-4pm … ISB 155/160 (A-E)

   a) Print lab prior to coming to lab -- use the 'Print Friendly Version' located on the top left hand side of the page – this is the version that contains the 'Data Sheet' that you will hand in upon completing the lab.

   b) The pre-lab quiz associated with this lab is the 'TA Evaluation' that that can be found in your Class Owls. Completing this by Friday, December 11th is equivalent to a perfect quiz score.

2. Third Exam – Tuesday December 8th – 1:00-2:15pm – In Class
   3 or 4 questions will be taken from Lab Owls 3, 4 and 5.

3. 

   iClicker:
   Choose any letter: A-E

8.10 What Are Buffers? – How Do They Resist Drastic pH Changes

Addition of Strong Acid – H_3O^+

1M CH_3CO_2H / 1M $CH_3CO_2^-$

weak acid — conjugate base

H_3O^+

SA + WB = 100%

$$H_3O^+ + CH_3CO_2^- = H_2O(l) + CH_3CO_2H(aq)$$

Buffer base — Buffer acid

OVERALL CHANGES:

- $[CH_3CO_2^-]$: ↓ … reacts with the added H_3O^+.
- $[CH_3CO_2H]$: ↑ … product of the reaction that removed H_3O^+.
- $[H_3O^+]$: ↑ … not by much … a result of the $[CH_3CO_2H]$↑.
- pH : ↓ … not by much.

Addition of Strong Base – OH^-

1M CH_3CO_2H / 1M $CH_3CO_2^-$

weak acid   conjugate base

OH^- WA + SB = 100%

$$OH^- + CH_3CO_2H(aq) \rightleftharpoons H_2O(l) + CH_3CO_2^-$$

Buffer acid   Buffer base

Overall Changes:

$[CH_3CO_2H]$: ↓ … Reacts with the added OH^-.

$[CH_3CO_2^-]$: ↑ … product of the reaction that removed the OH^-.

$[OH^-]$: ↑ … not by much … a result of the $[CH_3CO_2^-]$ ↑.

pH: ↑ … Not by much.

A buffer solution made from HF and KF has a pH = 2.84.
Addition of OH- will cause –

1. Increase significantly
2. Increase slightly
3. Decrease significantly
4. Decrease slightly
5. Increase
6. Decrease

a) pH ? 2 Adding base will cause the solution to become more basic.

b) pOH ? 4 $[OH^-]\uparrow$: $pOH = -\log_{10}[OH^-]$ will $\downarrow$

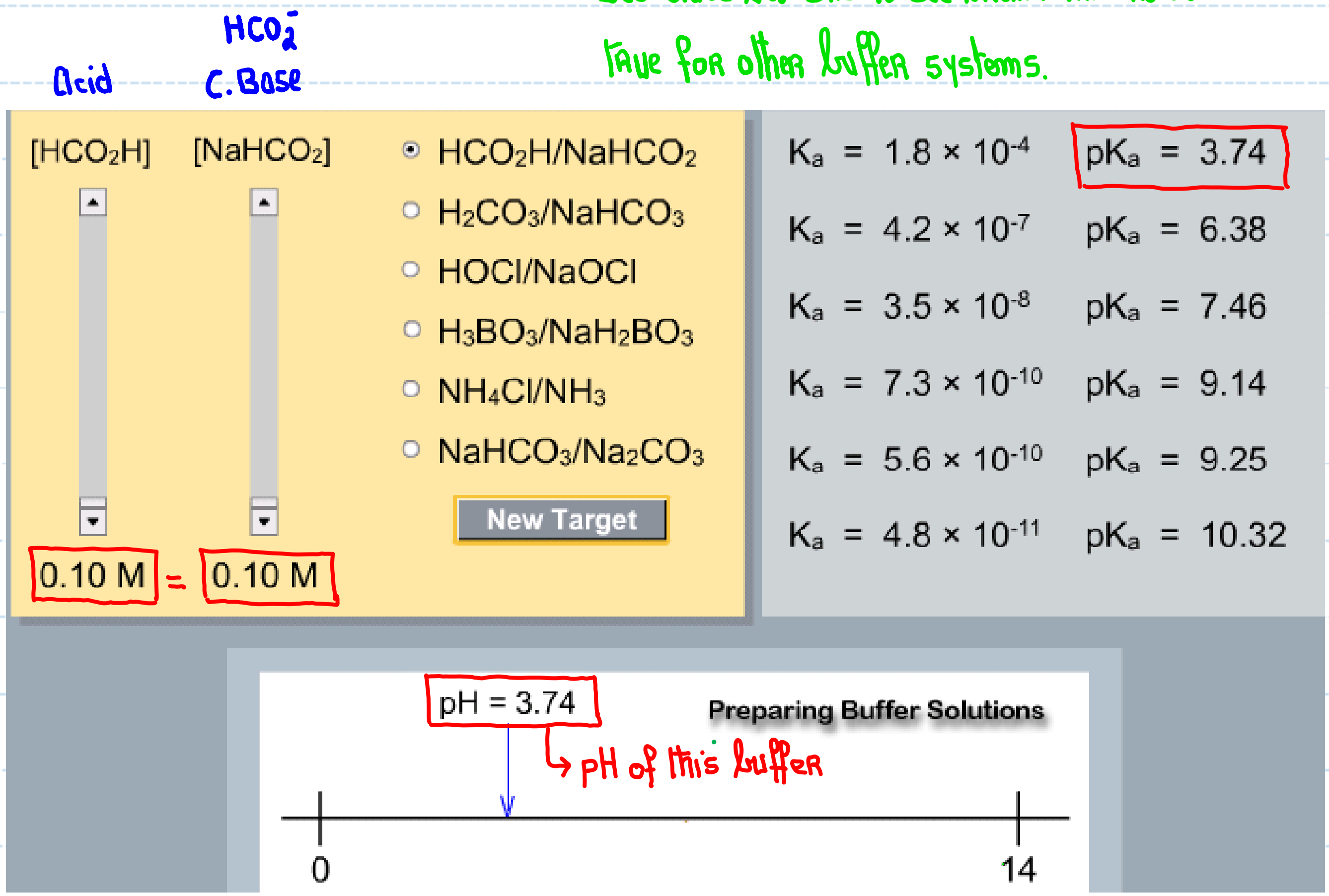
c) [HF] ? 6 $HF(aq) + OH^- = H_2O(l) + F^-$

Buffer acid Buffer base

d) $\frac{[F^-]}{[HF]}$? 5 See c). $[HF]\downarrow$, $[F^-]\uparrow$

See class web site to see whether this holds true for other buffer systems.

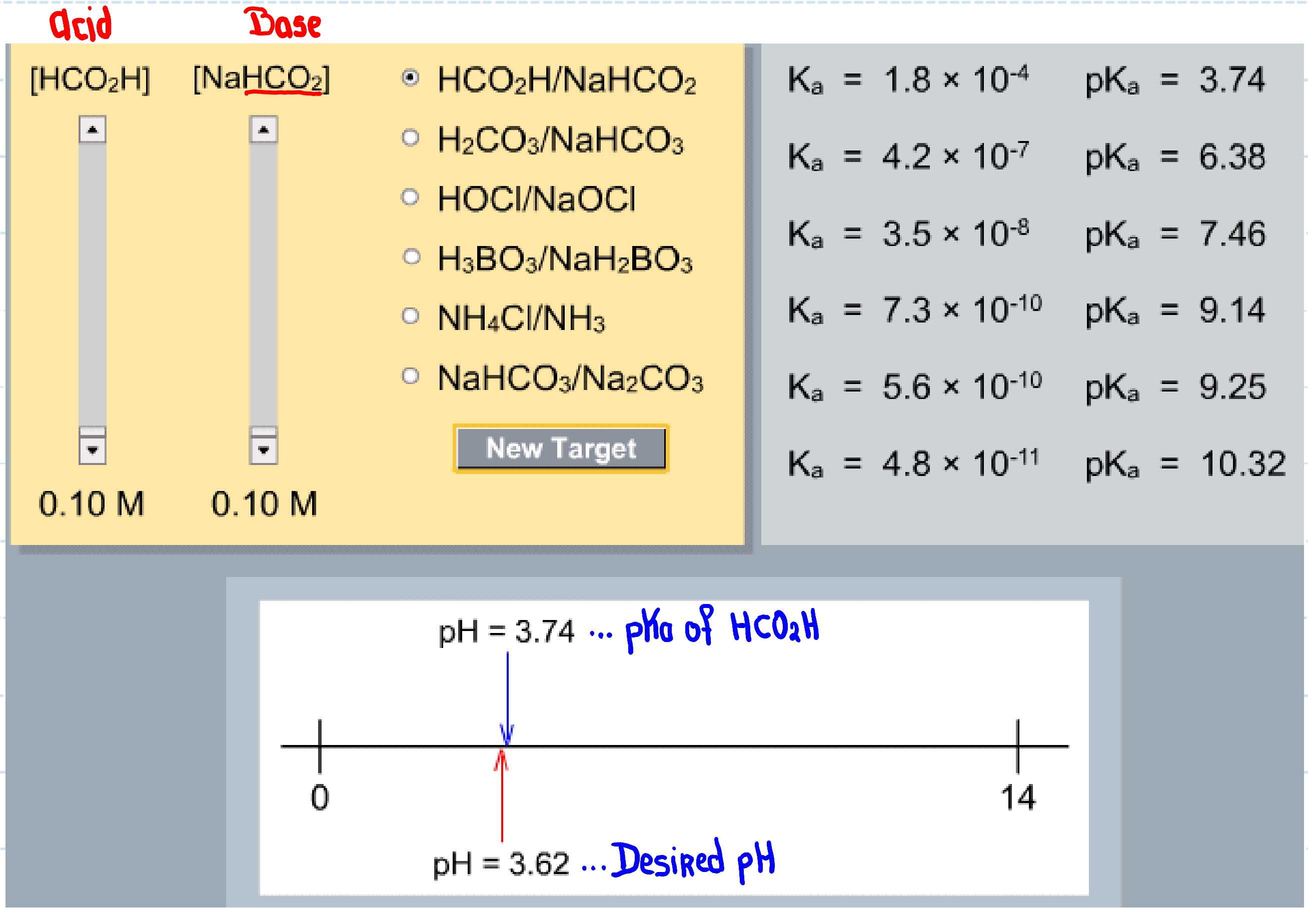
When [Acid] = [C.Base], the pH of the Buffer is equal to the pKa of the Buffer acid.



When choosing a buffer system one usually selects one whose pKa is closest to the desired pH.

9.10 What Are Buffers? – Making an Optimal Buffer Solution

Adjusting the pH of a Buffer



Since the desired pH is more acidic than the pKa ... increase the concentration of the buffer acid

$[HCO_2H]\uparrow$, pH $\downarrow$

$[HCO_2^-]\uparrow$, pH $\uparrow$

8.10 What Are Buffers? – Identifying Buffer Solutions

How many of the following aqueous solutions are buffers? 2

a) 0.24 M HI + 0.18 M NaI — X : HI is a strong acid.

d) 0.10 M CH_3COOH + 0.18 M CH_3COOK — ✓ : Weak acid, CH_3COOH / Conjugate base, CH_3COO^-

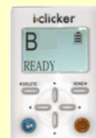
c) 0.27 M NH_4Br + 0.31 M NH_3 — ✓ : Weak acid, NH_4^+ / Conjugate base, NH_3

b) 0.34 M NH_4NO_3 + 0.39 M $NaNO_3$ — X : NO_3^- is not the conjugate base of NH_4^+

8.10 What Are Buffers? – How Do They Resist Drastic pH Changes

A 1L solution contains 0.25 mol of NaCN and 0.15 mol of HCN.

1. Increase significantly
2. Increase slightly
3. Decrease significantly
4. Decrease slightly
5. Increase
6. Decrease



a) Addition of 0.1 mol of HCl will case the [HCN] to – 5.

$H_3O^+ + CN^- = HCN_{(aq)} + H_2O_{(l)}$

b) Addition of 0.1 mol of HCl will case the pOH to – 2.

pH ↓ slightly ... pH + pOH = 14 ... pOH ↑ slightly.

c) Addition of 0.1 mol of NaOH will case the [HCN] to – 6.

$OH^- + HCN_{(aq)} = H_2O_{(l)} + CN^-$

d) Addition of 0.2 mol of NaOH will case the pH to – 1.

Buffer capacity exceeded ... [HCN] = 0.15 ... $[OH^-] = 0.2$