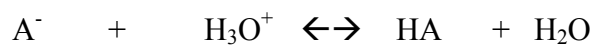
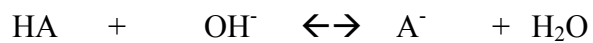


## Lecture Notes Q: Acid-Base Chemistry IV

### 1) The Henderson-Hasselbalch equation



$$1/K_a \gg 1$$



$$K = 1/K_b = K_a/K_w \gg 1$$

**Concept**

I start with 100ml of a buffer solution that is 1M in HAc and 1M in  $\text{Ac}^-$ . To this I will add solid NaOH, such that the volume does not change. If I add 0.010 mole of NaOH to the solution, which of the following is true:

- a)  $[\text{HAc}] = 0.9\text{M}$  and  $[\text{Ac}^-] = 0.9\text{M}$
- b)  $[\text{HAc}] = 0.9\text{M}$  and  $[\text{Ac}^-] = 1.1\text{M}$
- c)  $[\text{HAc}] = 1.1\text{M}$  and  $[\text{Ac}^-] = 0.9\text{M}$
- d)  $[\text{HAc}] = 1.1\text{M}$  and  $[\text{Ac}^-] = 1.1\text{M}$

Consider 100ml of a buffer solution that is 1.0M in HAc and 1.0M in NaAc. What is the pH after addition of 25ml of 1.0M NaOH?

I start with 100ml of a buffer solution that is 1M in HAc and 1M in  $\text{Ac}^-$ . I add 0.010 mole of a strong acid to the solution, which of the following is true:

- a)  $[\text{HAc}] = 0.9\text{M}$  and  $[\text{Ac}^-] = 0.9\text{M}$
- b)  $[\text{HAc}] = 0.9\text{M}$  and  $[\text{Ac}^-] = 1.1\text{M}$
- c)  $[\text{HAc}] = 1.1\text{M}$  and  $[\text{Ac}^-] = 0.9\text{M}$
- d)  $[\text{HAc}] = 1.1\text{M}$  and  $[\text{Ac}^-] = 1.1\text{M}$

## 2) **Making a buffer**

Mix acid (HA) and conjugate base (NaA) together

Mix acid (HA) and strong base (NaOH) together

Mix base (NaA) and strong acid together (HCl) together

A mixture of 50ml of 1M HAc and 50ml of 0.5M NaOH is equivalent to:

- a) a 0.5M solution of NaAc
- b) a 0.25M solution of NaAc
- c) a solution that is 0.5M in HAc and 0.5M in NaAc
- d) a solution that is 0.25M in HAc and 0.25M in NaAc

A mixture of 50ml of 1M NaAc and 50ml of 1M HCl will have the same pH as:

- a) a 0.5M solution of NaAc
- b) a 0.5M solution of HAc
- c) a solution that is 0.5M in HAc and 0.5M in NaAc
- d) a solution that is 0.25M in HAc and 0.25M in NaAc

Will each of the following lead to a buffer solution with  $[\text{Ac}^-] = [\text{HAc}]$ ?

A mixture of 100ml of 1M HAc and 100ml of 1M NaAc      a) yes      b) no

A mixture of 100ml of 1M HAc and 100ml of 1M NaOH      a) yes      b) no

A mixture of 100ml of 1M NaAc and 50ml of 1M HCl      a) yes      b) no

A mixture of 100ml of 1M NaAc and 5ml of 10M HCl      a) yes      b) no

I want to make a solution that will have  $[\text{Ac}^-] = 3[\text{HAc}]$ . I start with 100ml of a 1M HAc solution. How many ml of a 1M NaOH solution should I add?

a) 2.5ml      b) 7.5ml      c) 25ml      d) 75ml