Design a Buffering System Formal Report

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Introduction:

Purpose: The purpose of this lab is to make a buffer solution that has an assign pH from the teacher assistances, and to determine the Ka for the experiment.

Background: A buffer is an aqueous solution that has a highly stable pH. The pH of the buffer will not change drastically when an acid or base is being introduced to the buffer. A buffer is made by mixing a certain amount of a weak acid or weak base together with its conjugate acid or base. A weak acid and its conjugate can be remained in the same solution without neutralizing one or the other.

(about.com)

When a strong base is added to the buffer solution, the weak acid in the buffer solution will give up its in order to transform the group into water and the conjugate base ex: HA+🡪+. Since the group consumed by this reaction, the pH of the solution will only change slightly.

When a strong acid is added to the buffer solution, the conjugate base in the buffer solution will react with the from the strong acid to form the weak acid HA, ex: +🡪HA. The from the strong acid reacts with the conjugate base instead of reacting with water to form, so the pH only changes slightly.

(Chemcollective.org)

Use of buffer in the Lab:

+🡪++

Types of Buffers:

Two types of buffer are acid buffer and base buffer.

Acid buffer: pH is < 7 at 298k, a large amount of weak acid is present in the buffer solution which is given by the equation: pH=pKa + log (salt/acid)

Basic buffer: pH is > 7 at 298k, a large amount of weak base is present in the buffer solution which is given by the equation: pOH= pKb+ long (salt/base)

(ustudy.in)

Examples of buffers:

🡪+

Henderson-Hasselbalch equation:

pH=pKa +log()

Procedure:

Part I: Determining the Ka

1. Student required 4.00 ml of 3M of acetic acid to make a 100 ml of solution.
2. Student weighted out 1.63 g of sodium acetate
3. Student then added 4.00 ml of 3 M acetic acid and 1.63 g of sodium acetate into the volumetric flask mixed the solution thoroughly.
4. Finally student filled the solution with tap water to the mark of volumetric flask to make a 100 ml of buffer solution. Small portion of the buffer was taken to test the pH.

Part II: Making a 0.1M buffer.

1. Student acquired 4.00 ml of 3 M of acetic acid
2. Student weighted out 3.98 g of sodium acetate
3. Student then added both 4.00 ml of 3 M acetic acid and 3.98 g of sodium acetate into the volumetric flask mixed the solution thoroughly.
4. Student then filled the solution with tap water to the mark of volumetric flask to make a 100 ml of assign buffer solution. Less than 25 ml of the solution is taken to test the assign pH.

Part III: adding acid and base to a buffer

1. Student separated the solution into two beakers with 25 ml each.
2. Student used a 1.00 ml volumetric pipet, added 1.00 ml of 0.1 M HCl to one of the 25 ml solution, mixed the solution. Then is taken to test the pH of the added acid buffer solution.
3. Student used a 1.00 ml volumetric pipet, added 1.00 ml of 0.1 M NaOH to one of the 25 ml solution, missed the solution. Then is take to test the pH of the added base buffer solution.

Calculation:

Part I:

Volume acid used:

C1\*V1=C2V2

3 M \* X ml= 0.12 M \* 100 ml

X= 4 ml

Mass Base Used:

0.12 M= x moles/ 0.1 L

X= 0.12 mole

Mass= mole \* the molecular weigh

Mass= 0.12 mole \* 136g/mole

Mass=1.63 g

Calculated Ka:

pH=pKa +log()

4.41= pKa + log (0.12/0.12)

4.41= pKa+0

pKa= 4.41

Ka=

Ka=3.89\*

Part II:

Volume of acid used:

C1\*V1=C2V2

3 M \* X ml= 0.12 M \* 100 ml

X= 4 ml

Mass of Base used:

pH=pKa +log()

4.8= 4.41+log(xM/0.12M)

x= 0.29M

0.29 M= xmole/ 0.1L

X=3.98g

Part III:

Added acid

pH=pKa +log()

X=4.83+ log()

X=4.77

Added base

pH=pKa +log()

x=4.83+log()

x=4.91

Discussion:

Part I: The official pKa of acetic acid is 4.74. Compare to student’s calculated pKa 4.41, which was within 7% of errors.

Part II: The assigned pH of the solution was 4.8, and student has made the solution with the pH of 4.83. The error was less 1%. The possible sources of error were too much of sodium acetate added to the solution, which made the buffer more basic.

Part III: The predicted pH value after acid added was 4.77, the actual pH was 4.79. The prediction makes sense, because the pH of the buffer solution changed only slightly when an acid was being introduced to the system.

The predicted pH value after base added was 4.91, the actual pH was 4.85. The prediction makes sense also, because the pH of the buffer solution changed slightly when a base is being introduced to the system.

DI water was suggested for next experiment, because student used tap water to mix up the solution, which gave the solution an extra unstable factor that tap water may or may not contain any kind of extra materials.

Conclusion:

The experiment took quite a while to complete, however the result was expected. Most of the predicted values were less than 10 % margin. Due to the Henderson-Hasselbalch equation, the part two pH value came close to the actual assigned value, it was only 0.03 different. All of the prediction values after an acid or base added to the solution were accurate, due to the definition of a buffer, which the buffer changed slightly when an acid or base was added.

Work Sited

<http://www.ustudy.in/node/8589>

<http://chemistry.about.com/od/acidsbase1/a/buffers.htm>

http://chemcollective.org/activities/tutorials/buffers/buffers3