Preparation of Buffer Solutions

Name

Date of Work

***TOTAL: 45 points***

**CHM 116 POST-LAB**

**Preparation of Buffer Solutions**

1. (2 points) Insert ONE picture of yourself in full PPE here (**include the can or bottle of cola**).

*\*\*Remember to (1) show your full body so that we see you are wearing shoes; (2) wear your safety glasses, buttoned lab coat, and gloves; (3) cover your lower legs and ankles (socks are required, even in Arizona); (4) tie back long hair in a ponytail or a bun; (5) remove jewelry.*

**Insert Picture Here**

1. (1.5 points) Enter your data for the preparation of the sodium acetate solution (Table 1 from your procedure) below.

**Note:** *You will need to show your calculation for the concentration (in M) of the sodium acetate solution in Question 3.*

**Table 1.** Sodium Acetate Solution Data

|  |  |  |
| --- | --- | --- |
| **Mass of Sodium Acetate**  **(g)** | **Volume of Sodium Acetate**  **(mL)** | **Concentration of Sodium Acetate Solution**  **(M)** |
|  |  |  |

1. (one point) Calculate the concentration (in molarity) the sodium acetate solution in **Table 1** (*Question 2 above*). **Show your work and include units.**

*Solve here:*

1. **(3 points) Insert pictures** of your pH meter (in each buffer) showing the pH of each buffer solution you prepared (*the pH values in the pictures should match the measured values in Table 2*). Be sure to **include a figure legend below each picture or a single figure legend for the set of pictures** (remember to indicate the measured pH value in the figure legend as well as making sure it is visible in the picture).

**Buffer A**

**Buffer C**

**Buffer B**

**Buffer E**

**Buffer D**

1. (5 points) Enter your data for the acetate buffer solutions A, B, C, D and E (Table 2 from your procedure) below.

**Note:** *You will need to show your calculations for the pH of each buffer solution in Question 6 and your calculations for percent error for each buffer solution in Question 7.*

**Table 2.** Measured pH Values and Predicted (Calculated) pH Values

for CH3COOH/ CH3COONaBuffers

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Buffer** | **Volume of Acetic Acid**  **(mL)** | **Volume of Sodium Acetate**  **(mL)** | **Measured pH** | **[CH3COOH]** | **[CH3COONa]** | **Calculated pH** | **Percent Error** |
| **A** | **6** | **6** |  |  |  |  |  |
| **B** | **10** | **2** |  |  |  |  |  |
| **C** | **7** | **5** |  |  |  |  |  |
| **D** | **5** | **7** |  |  |  |  |  |
| **E** | **2** | **10** |  |  |  |  |  |

1. **(1.25 points) Show your work** for the following calculations:
   1. Determine the concentration (in molarity) of acetic acid, [CH3COOH], in each of the five buffers. These are just dilution calculations.

*HINT: Your stock CH3COOH solution 4.5% w/w is equal to* ***0.75 M****.*

*Solve here:*

Calculated [CH3COOH] for:

**Buffer A:**

**Buffer B:**

**Buffer C:**

**Buffer D:**

**Buffer E:**

1. (1.25 points) Determine the concentration of sodium acetate, [CH3COONa], in each of the five buffers. These are just dilution calculations

*HINT: You calculated the concentration of your stock CH3COONa solution in Question 3.*

*Solve here*

**Calculated [CH3COONa] for:**

**Buffer A:**

**Buffer B:**

**Buffer C:**

**Buffer D:**

**Buffer E:**

1. **(2.5 points) Show your work (and include units)** for the calculations using the Henderson-Hasselbalch equation to determine the ***calculated pH*** of each acetate buffer solution.

*Hint: The pKa* *of acetic acid is 4.75.*

*Solve here*

**Calculated pH for:**

**Buffer A:**

**Buffer B:**

**Buffer C:**

**Buffer D:**

**Buffer E:**

1. **(2.5 points) Show your work** for the calculations of percent error between the two pH columns (*Calculated pH* and *Measured pH*) in Table 2. **Discuss** TWO possible sources of error that may have contributed to your measured (experimental) pH value not being the same as your calculated (theoretical) pH value.

*Hint: “Human error” is NOT an acceptable source of error as it is too vague. Be specific as to the errors you, as the human, may have made during the experiment that resulted in a measure pH value that differed from the calculated pH value for each buffer.*

*Solve here*

**Percent Error for:**

**Buffer A:**

**Buffer B:**

**Buffer C:**

**Buffer D:**

**Buffer E:**

**Two Sources of Error:**

1. (3 points) Enter your data for the change in pH of buffers F and H upon the addition of acid (Table 3 from your procedure) below.

**Table 3.** Change in pH of Buffers F and H Upon Addition of Cola

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Buffer** | **pH**  **(0 mL cola)** | **pH**  **(5 mL cola)** | **pH**  **(10 mL cola)** | **pH**  **(20 mL cola)** |
| **F** |  |  |  |  |
| **H** |  |  | **--** | **--** |

1. **(1 point) Insert** pictures of your pH meter showing the pH of Buffer F with 5 mL of cola and of Buffer H with 5 mL of cola (*the pH value in the picture should match the measured value in Table 3*). Be sure to **include a figure legend** below the picture (remember to indicate the measured pH value in the figure legend as well as making sure it is visible in the picture).

**Buffer H w/5 mL cola**

**Buffer F w/5 mL cola**

1. **(3 points) Enter** your data for the change in pH of buffers G and I upon the addition of base (Table 4) below.

**Table 4.** Change in pH of Buffers G and I Upon Addition of Borax Solution

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Buffer** | **pH**  **(0 mL borax soln)** | **pH**  **(5 mL borax soln)** | **pH**  **(10 mL borax soln)** | **pH**  **(20 mL borax soln)** |
| **G** |  |  |  |  |
| **I** |  |  | **--** | **--** |

1. **(1 point) Insert** pictures of your pH meter showing the pH of Buffer G with 10 mL and 20 mL of borax (*the pH values in the pictures should match the measured values in Table 4*). Be sure to **include a figure legend** below each picture (remember to indicate the measured pH value in the figure legend as well as making sure it is visible in the picture).

**Buffer G w/20 mL borax**

**Buffer G w/10 mL borax**

1. **(3 points) Insert** pictures of your pH meter showing the pH of Buffer G with 5 mL of borax and of Buffer I with 5 mL of borax (*the pH value in the picture should match the measured value in Table 4*). Be sure to **include a figure legend** below the picture (remember to indicate the measured pH value in the figure legend as well as making sure it is visible in the picture).

**Buffer I w/5 mL borax**

**Buffer G w/5 mL borax**

1. (1 point) Do Buffers F or G reach capacity when mixed with cola or borax, respectively? If so, at what volume of added acid or base? **Explain each in 1 – 2 sentences**.

*Solve here*

Buffer F w/ cola:

Buffer G w/ borax:

1. (3 points) What happens when cola or borax is added to water? Is water a good buffering system? **Explain why or why not in 2 – 3 sentences.**

*Solve here:*

Cola to water:

Borax to water:

Explanation:

1. **(5 points) Putting it all together!** Identify TWO systems or applications in which buffers are important, making sure to specify the chemical compounds involved in the buffers. **Explain the importance** of each buffering system in 2 – 3 sentences and **include the reference** for each.

*Solve here:*

**Application 1:**

**Source:**

**Application 2:**

**Source:**

**116 Online Lab Notebook Entry ( 5 Points)**

**Purpose/Goal of Experiment:**

**Planned Observations:**

**Experiment Title:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Date of Experiment:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Student Name:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Qualitative/ Quantitative Observations:**

**Data/Calculations:**

**Conclusion:**