

CHAPTER 17	Investigation 17.B: Preparing a Buffer and Investigating its Properties	BLM 17.4.5
HANDOUT		

In this investigation, you will first prepare a buffer solution. Then you will compare how the buffer resists a change in pH when an acid or a base is added with how water resists the same changes.

Question

How can you prepare a buffer solution? How much does the pH of a buffer change when a small amount of a strong acid or strong base is added? How much strong acid or base must be added to a buffer solution to change its pH by one unit?

Prediction

- (a) Calculate the volume of 0.20 mol/L NaOH(aq) to make the concentration of OH^- ions equal to half the concentration of ethanoic acid.
- (b) The centre of the buffer region occurs at the half-titration point between a weak acid and a strong base. What volume of 0.20 mol/L NaOH(aq) is required to prepare a buffer solution with 40.0 mL of 0.20 mol/L ethanoic acid?
- (c) Make a reasonable guess as to the pH of the buffer solution.
- (d) Calculate the pH when 1 mL of 0.20 mol/L NaOH(aq) is added to 20 mL of water.

CHAPTER 17	Investigation 17.B: Preparing a Buffer and Investigating its Properties (continued)	BLM 17.4.5
HANDOUT		

(e) Make a reasonable guess as to how the pH of 20 mL of the buffer solution is affected when 1 mL of 0.20 mol/L NaOH(aq) is added.





(f) Repeat your predictions for (d) and (e), substituting 0.20 mol/L hydrochloric acid for the sodium hydroxide.

Safety Precautions



- Sodium hydroxide and hydrochloric acid are corrosive to eyes and skin and harmful if swallowed or inhaled. Wash any spills on your skin or clothing with plenty of cool water. Inform your teacher immediately. Also inform your teacher immediately if you spill hydrochloric acid or sodium hydroxide on the lab bench or floor.
- Dispose of all materials as instructed by your teacher
- Wash your hands when you have completed the investigation.

Materials

- distilled water
- 0.20 mol/L ethanoic acid (acetic acid), $\text{CH}_3\text{COOH}(\text{aq})$
- 0.20 mol/L sodium hydroxide, NaOH(aq)  
- 0.20 mol/L HCl(aq)  
- 50 mL graduated cylinder
- 50 mL beakers (4)
- 100 mL beaker
- universal indicator paper (pH paper)
- pH meter (optional)
- clean straw
- stirring rod
- burettes

CHAPTER 17	Investigation 17.B: Preparing a Buffer and Investigating its Properties (continued)	BLM 17.4.5
HANDOUT		

Procedure

Part 1 Acid Breath

1. Measure 20 mL of distilled water and pour it into a 50 mL beaker.
2. Use universal indicator paper or a pH meter (if available) to measure the pH of the water. Record your results.
3. Use a clean straw to blow into the water for about 2 min. Then record the pH of the solution again.

Part 2 Preparing the Buffer

1. Rinse the graduated cylinder with a few mL of 0.20 mol/L ethanoic acid. Discard the rinse as directed by your teacher. Measure 40 mL of 0.20 mol/L ethanoic acid into a 100 mL beaker.
2. Rinse the graduated cylinder several times with tap water. Then rinse the graduated cylinder using a few mL of 0.20 mol/L NaOH(aq). Discard the rinse as directed by your teacher.
3. Have your teacher check the volume of 0.20 mol/L NaOH(aq) you calculated in (a), under Predictions. After receiving approval, add it to the contents of the beaker from Procedure Step 1 to make the buffer solution.
4. Divide the buffer solution from Procedure Step 3 into three equal portions, using the graduated cylinder and three 50 mL beakers.

Part 3 The Control

1. Give the following table a suitable title.

Volume of NaOH(aq) added (mL)	pH of water + added NaOH(aq)	pH of buffer + NaOH(aq)	pH of buffer + HCl(aq)
0.0			
1.0			
2.0			

CHAPTER 17	Investigation 17.B: Preparing a Buffer and Investigating its Properties (continued)	BLM 17.4.5
HANDOUT		

Volume of NaOH(aq) added (mL)	pH of water + added NaOH(aq)	pH of buffer + NaOH(aq)	pH of buffer + HCl(aq)

2. Measure 20 mL of distilled water and pour it into a 50 mL beaker.
3. Record the pH of the water in the second column of the table (for 0.0 mL of added NaOH), measured with universal indicator paper or with a pH meter (optional).
4. Go to one of the burettes set up by your teacher and add 1.0 mL of NaOH(aq). Stir thoroughly, then measure and record the pH of the solution in the second column.
5. Repeat Procedure Step 4 until the pH of the solution is at least one unit greater than the initial pH.

Part 4 Adding Base to the Buffer

1. Obtain one of the beakers containing buffer solution from Part 2. Measure the pH of the solution and record the value in the third column of the table (for 0.0 mL of NaOH added).
2. Add 1.0 mL of NaOH(aq) to the buffer. Stir thoroughly, then measure and record the pH of the solution in the third column of the table.
3. Repeat Procedure Step 2 until the pH of the solution is at least one unit more than the initial pH.

Part 5 Adding Acid to the Buffer

1. Using a second beaker containing buffer solution, measure the pH of the solution and record the value in the last column of the table (for 0.0 mL HCl added).
2. Add 1.0 mL of HCl(aq) to the buffer. Stir thoroughly, then measure and record the pH of the solution in the last column of the table.
3. Repeat Procedure Step 2 until the pH of the solution is at least one unit less than the initial pH.

CHAPTER 17	Investigation 17.B: Preparing a Buffer and Investigating its Properties (continued)	BLM 17.4.5
HANDOUT		

Part 6 Controlling Acid Breath

1. Obtain the last portion of buffer solution. Use a clean straw to blow into the solution for about 2 min. Then record the pH of the solution.

Analysis

1. The pH of distilled water may not be 7.0. Give reasons why this might be the case.
2. How did the pH of the water change when you blew air into it? Explain by using a chemical equation.
3. What was the effect on pH of blowing air into the buffer solution?
4. Compare the calculated pH when 1 mL of 0.20 mol/L NaOH(aq) was added to 20 mL of water with the value you measured. If different, account for the difference.

