

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<sup>-</sup> 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.

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(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







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5. Compare your estimate of the pH of the buffer solution with the value you measured. If it is outside the range you estimated, explain the difference.
  
6. Use a spreadsheet program to graph the data in your table. Compare the effect on pH of adding base to water with the effect of adding the same amount of base to the buffer. Compare the effect on pH of adding acid to the buffer solution with the effect of adding the same amount of base to the buffer solution.

### Conclusion

7. Write a statement about the effect of adding small amounts of either an acid or a base to a buffer solution.

### Extension

8. How could you prepare a buffer solution that is basic? If time permits, obtain the reactants from your teacher and test your prediction.