Conceptual Chemistry
pH Paper Titrations

Christopher J. Fenk, Claudia Khourey-Bowers,
Donald G. Gerbig, Jr., Gene Easter,
Carol Thombs, Samantha Hubbard,
Scott Spillman, Mark Salzwimmer,
Rachelle Watt & Emilie Hershberger-Kirk
Kent State University

http://personal.tusc.kent.edu/~cfenk/Chemistry/Conceptual_Chemistry.html

Conceptual Chemistry

Conceptual Chemistry is a graduate course offered at Kent State University designed for teachers of grades 4-9 to assist in their understanding of chemistry and to provide concrete ideas that they can take back to their classrooms to teach their students.

Conceptual Chemistry

Participants in this course receive:

- Free tuition and five graduate credit hours from the College of Education of Kent State University.
- Over $850 worth of materials and supplies to take back to the classroom.

Conceptual Chemistry

Funding for this course is provided by a grant from the Ohio Board of Regents *Improving Teacher Quality Program*, which is part of the *No Child Left Behind Act of 2001.*

Activity Objectives

Key Concepts:

- Acids and Bases
- Neutralization Reactions
- Quantitative and Qualitative Analyses
- Having fun with science!

Definitions

Acids
Taste sour, turn litmus paper red and react with some metals releasing hydrogen gas. Examples: citric acid (fruit), ascorbic acid (vitamin C), lactic acid (sour milk), acetic acid (vinegar), phosphoric acid (soda pop).

Bases
Taste bitter, turn litmus paper blue and feel slippery. Ex. ammonia (window cleaner) and NaOH (lye).

Acids and Bases

Acids
Substances that generate protons (H^+ ions) in water. Taste sour, turn litmus paper red and react with some metals releasing hydrogen gas.

Bases
Substances that generate hydroxide ions (OH^- ions in water. Taste bitter, turn litmus paper blue and feel slippery.

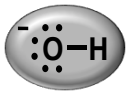
Acid and Base Strength

Acid

$HA_{aq)} \rightarrow H^+_{(aq)} \quad {}^-_{(aq)}$

Base

$MOH_{(aq)} \rightarrow M^+_{(aq)} + OH^-_{(aq)}$



pH and the pH Scale

pH
A measure of aqueous solution acidity.

$$pH = -\log[H^+]$$

pH Scale
A scale ranging from 0 – 14 describing solution acidity for dilute solutions (1 M or less). The lower the pH the greater the acidity.

Acid and Base Reactions

Neutralization

acid + base → salt + water

$HA_{\ )} + MOH_{(aq)} \rightarrow MA_{(aq)} + H_2O_{(l)}$

$HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$

Reactions of Carbonates

$2H^+ + CO_3^{2-} \rightarrow H_2O + CO_2$

$2HCl + Na_2CO_3 \rightarrow 2NaCl + H_2O + CO_2\uparrow$

$HCl + NaHCO_3 \rightarrow KBr + H_2O + CO_2\uparrow$

Acid and Base Measurement

Titration
Method used to determine acid/base content in an unknown sample.

Equivalence Point
Point in a titration where equal amounts of acid and base have reacted.

pH Paper Titrations

Purpose

To demonstrate a novel way to teach acid-base chemistry that requires only inexpensive pH paper, store bought "chemicals" and inexpensive supplies.

pH Paper Titrations

Materials

- 10 ml vinegar
- 1 volumetric pipet
- 20 ml NaHCO3 solution (0.50 *M* baking soda solution)
- 20 ml Na2CO3 solution (0.25 *M* washing soda solution)
- (2) small plastic cups
- 1 pair forceps
- pHydrion Insta-check wide range pH paper (pH 0-13)

pH Paper Titrations

Procedure

1.
2. pHydrion paper.
3. Use forceps to dip the paper into vinegar.
4. **Wait 15 seconds.**
5. Determine pH by comparing to the color-coded chart on the pHydrion container (*½ units o.k.*).
6. Add 0.5 ml $NaHCO_3$ solution to the vinegar and swirl.
7. Record any visual observations followed by recording pH as above.
8. Continue until the pH rises then remains constant.

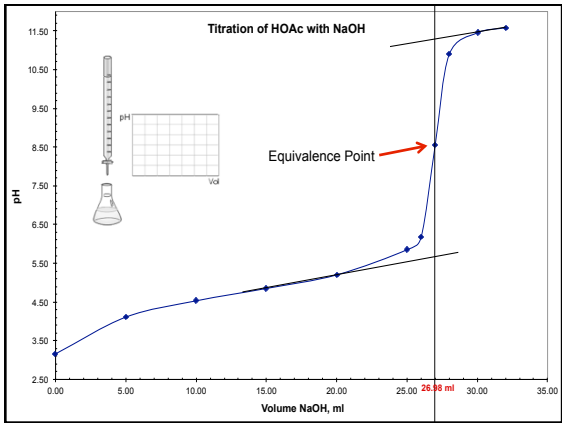
Titration Data Table

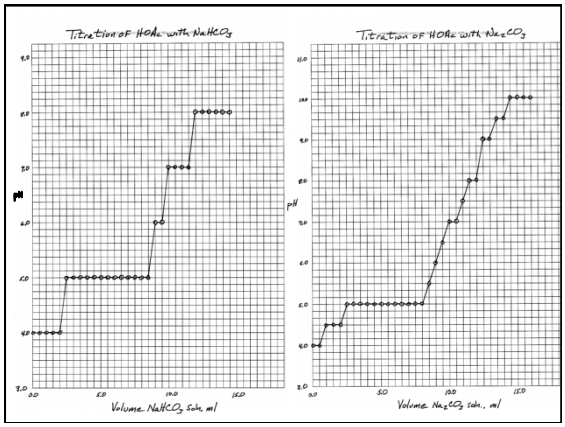
Volume $NaHCO_3$ (ml)	pH strip	pH	Observations
0.0			
0.5			
1.0			
1.5			
2.0			
2.5			
3.0			
3.5			
4.0			
4.5			
5.0			
5.5			
6.0			
6.5			
7.0			
7.5			
8.0			
8.5			
9.0			
9.5			
10.0			

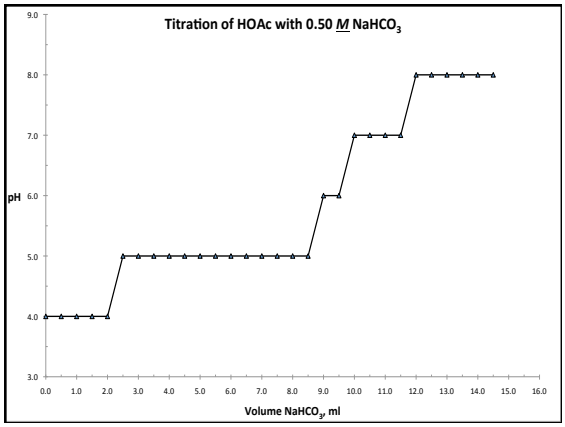
pH Paper Titrations

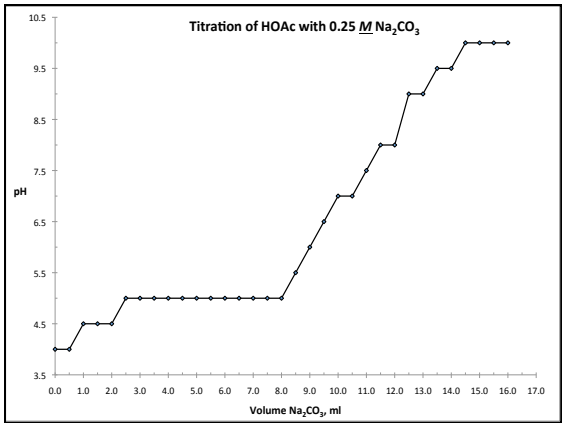
Results

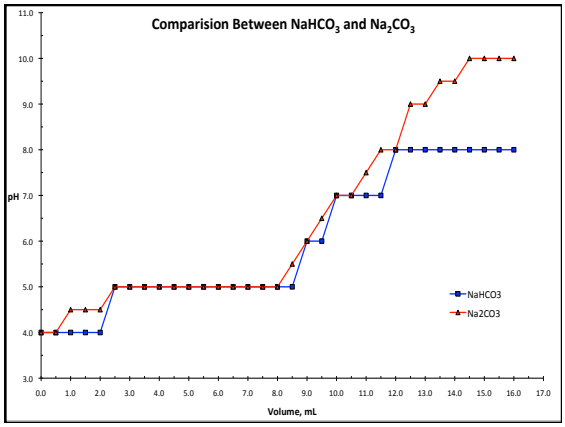
- Construct graphs of the experimental data by hand or using Microsoft Excel.
- Plot pH vs. volume with pH on the y-axis and volume of titrant on the x-axis.
- *For a pH range of 3-9 count 8 blocks on long axis. For a volume range of 0-18 ml count 10 blocks on short axis.*
- Details on how to graph with Excel 2007 are given in the provided handout.











Acid and Base Measurement

Conclusions

- ✓ *Neutralization* occurs when 10-11 ml of base is added.
- ✓ Neutralization occurs at pH 6.5-8.5
- ✓ Na CO is a stronger base than NaHCO
- ✓ When acids are added to carbonate bases a gas is formed (CO).