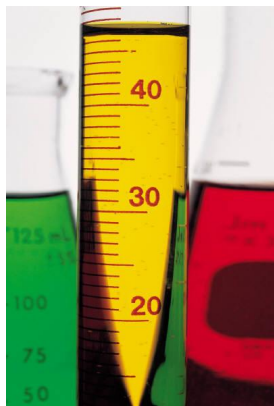


Experiment 4 Acid-Base Titration

CH 204 Fall 2009
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What We Lernd in Skool Last Week

Naming Ionic Compounds

Molecular Equations

Simple Solubility Rules

Spectator Ions and Net Ionic Equations



This Week: Acid-Base Titrations

Acid + Base \longrightarrow Salt + H₂O

At the equivalence point
Moles H⁺ = Moles OH⁻

Titration Setup

Burette containing **NaOH**.

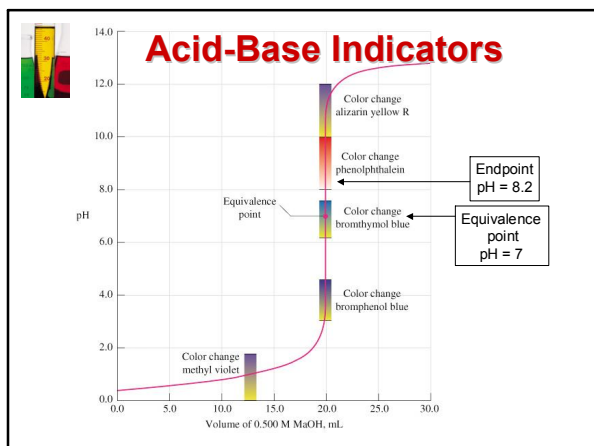
Read all volumes to **0.01 mL!**

Erlenmeyer flask containing acid sample, water, and **two drops of phenolphthalein**.

Phenolphthalein

Colorless below pH 8.2 Pink above pH 8.2

<http://www.chemistry.wustl.edu/~courses/genchem/Labs/AcidBase/phph.htm>





Titration Calculations the E-Z Way

Any time you see the words
titrate, titration, neutralize, neutralization,
end point or equivalence point, think:

$$\text{Moles H}^+ = \text{Moles OH}^-$$

This is the starting point for all the
lab calculations and also for all the
post-lab problems.



Moles H⁺ and Moles Acid

$$\text{Moles H}^+ = (\text{Moles acid} \times \#H \text{ in formula})$$

$$1 \text{ mole HCl} = 1 \text{ mole H}^+$$

$$1 \text{ mole H}_2\text{SO}_4 = 2 \text{ moles H}^+$$

$$1 \text{ mole H}_3\text{PO}_4 = 3 \text{ moles H}^+$$



Calculating Moles of Acid and Base

For two solutions:

$$M_A \times V_A \times \#H \text{ in formula} = M_B \times V_B \times \#OH \text{ in formula}$$

Solid acid, aqueous base:

$$\frac{\text{grams}_A}{\text{MW}_A} \times \#H \text{ in formula} = M_B \times V_B \times \#OH \text{ in formula}$$

Aqueous acid, solid base:

$$M_A \times V_A \times \#H \text{ in formula} = \frac{\text{grams}_B}{\text{MW}_B} \times \#OH \text{ in formula}$$



Experiment 4 Overview

PART 1: STANDARDIZATION OF NaOH

Weigh out about 7 grams of NaOH pellets.
Record this value. You will not use this number in any calculations because the NaOH is impure – not all of this mass is really NaOH.

Dissolve in about 500 mL deionized water.

Clean up any spilled pellets!!



Experiment 4, continued...

PART 1: STANDARDIZATION OF NaOH

Once you have your 500 mL of NaOH solution:

Weigh out 2 grams of KHP powder, dissolve in about 75 ml water, **ADD PHENOLPHTHALEIN**, and titrate (3×).

Calculate the concentration of NaOH using
Moles of H⁺ = Moles of OH⁻



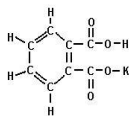
Moles aqueous = Moles solid

$$M_{\text{NaOH}} \times V_{\text{NaOH}} \times 1 = \frac{\text{Mass of KHP}}{\text{MW of KHP}} \times 1$$

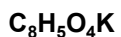
$$M_{\text{NaOH}} = \frac{\text{Mass of KHP}}{\text{MW of KHP} \times V_{\text{NaOH}}}$$



Was ist KHP?



Das ist KHP.
Es ist Potassium Hydrogen Phthalate.



Es gibt keinen Phosphor!



Part Two: A Return to the Potions Lab

Fill out an unknown request slip and get an unknown acid from the stockroom.

Ignore any writing on the bottle.

Identify your unknown acid sample using the qualitative reactions from last week.



Part 3: Titrate Your Unknown

5.00 ml unknown acid, 75 ml water, and **2 drops of phenolphthalein** in a 250 ml flask.

Titrate using NaOH (3×)

In an ideal world, you will get the exact same V_{NaOH} all three times.

Calculate the molarity of your acid.



Moles H⁺ = Moles OH⁻

For HCl and HNO₃,

$$M_{\text{acid}} \times V_{\text{acid}} = M_{\text{NaOH}} \times V_{\text{NaOH}}$$

For H₂SO₄

$$M_{\text{acid}} \times V_{\text{acid}} \times 2 = M_{\text{NaOH}} \times V_{\text{NaOH}}$$

$$V_{\text{acid}} = 5.00 \text{ ml}$$



Part 4: Citric Acid in Juice

Orange or Pineapple
15 ml juice, 60 ml water, and
2 drops of phenolphthalein.

Titrate just once. Solution goes from
yellowish to orangey.



A word about citric acid

That word is triprotic!

1 Mole of citric acid = **3** moles of H⁺

So the number of moles of H⁺ is **3 times**
the number of moles of citric acid:

$$M_{\text{Citric acid}} \times V_{\text{Citric acid}} \times \underline{\mathbf{3}} = M_{\text{NaOH}} \times V_{\text{NaOH}}$$



All your base are belong to us

Leftover NaOH goes into the waste container in the hood.

Keep your unknown acid for now.

DO YOUR CALCULATIONS **BEFORE** YOU DUMP YOUR LEFTOVER BASE!!

If you have time, fill in all the data tables before you leave the lab.



Final Exam Part 3

No calculator this week.

You will need a calculator on every quiz after this one.

Learn your section number and your TA's name!
