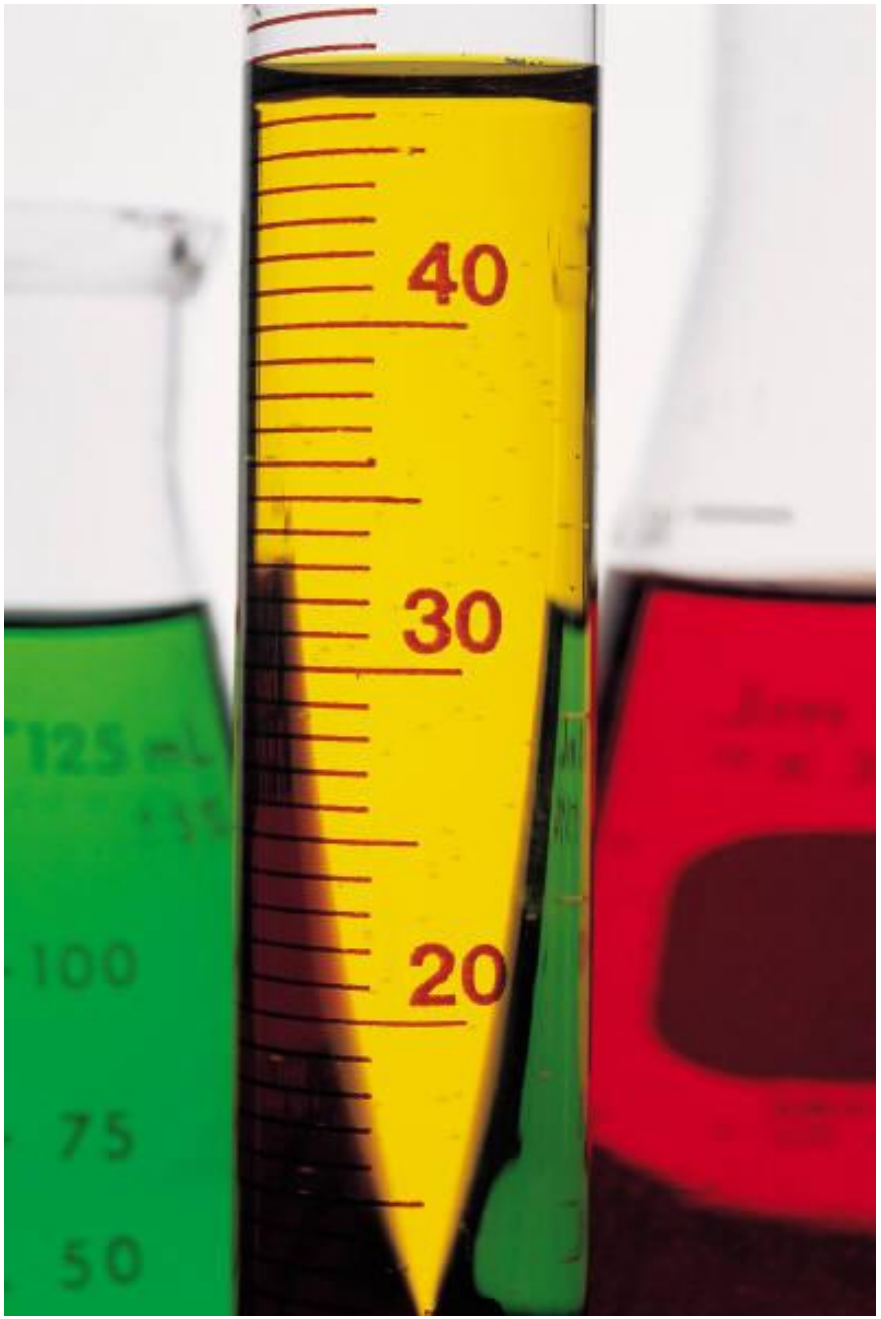
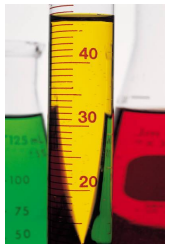
Experiment 4
Acid-Base Titration

CH 204 Fall 2009

Dr. Brian Anderson





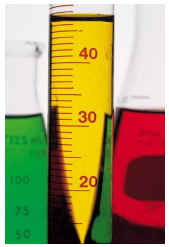
What We Lernd in Skool Last Week

Naming Ionic Compounds

Molecular Equations

Simple Solubility Rules

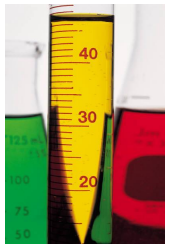
Spectator Ions and Net Ionic Equations



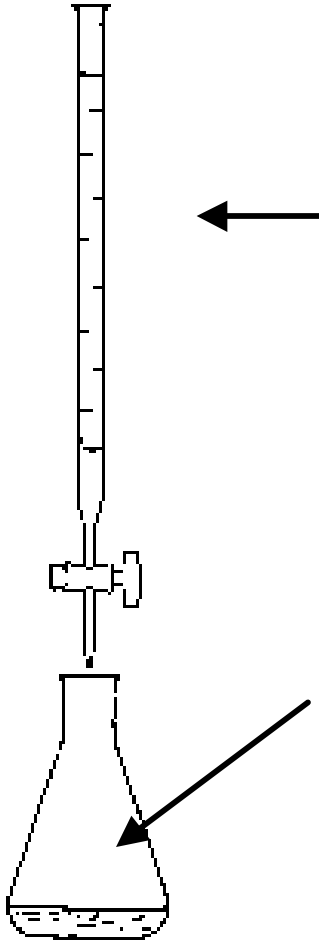
This Week:
Acid-Base Titrations

Acid + Base $\longrightarrow$ Salt + H_2O

At the equivalence point
Moles H^+ = Moles OH^-



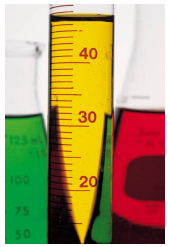
Titration Setup



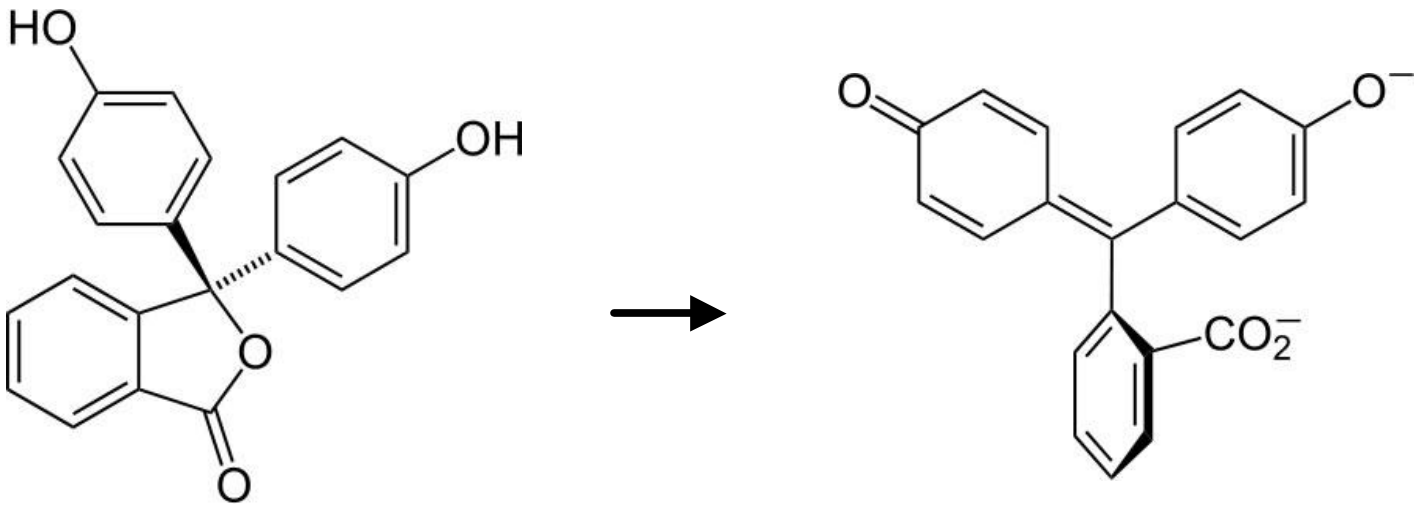
Burette containing NaOH.

Read all volumes to 0.01 mL!

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

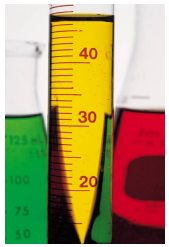


Phenolphthalein

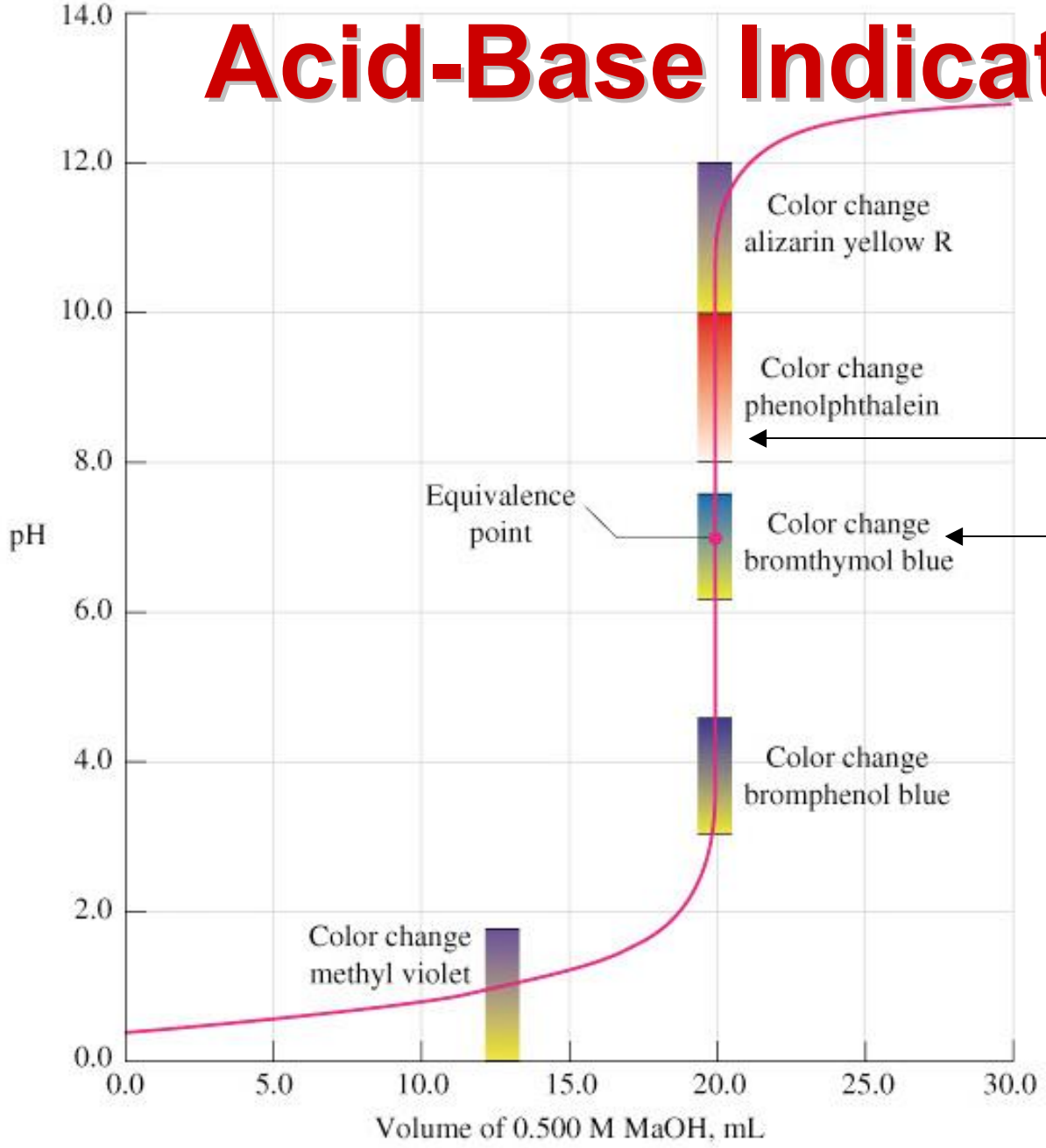


Colorless below pH 8.2 **Pink above pH 8.2**

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

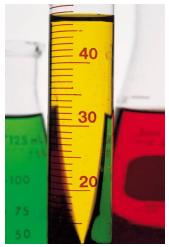


Acid-Base Indicators



Endpoint
pH = 8.2

Equivalence point
pH = 7



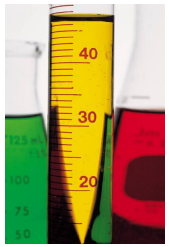
Titration Calculations the E-Z Way

Any time you see the words

***titrate*, *titration*, *neutralize*, *neutralization*, *end point* or *equivalence point*, think:**

Moles H^+ = Moles OH^-

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



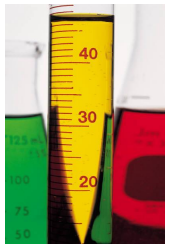
Moles H^+ and Moles Acid

Moles H^+ = (Moles acid × #H in formula)

1 mole HCl = 1 mole H^+

1 mole H_2SO_4 = 2 moles H^+

1 mole H_3PO_4 = 3 moles H^+



Calculating Moles of Acid and Base

For two solutions:

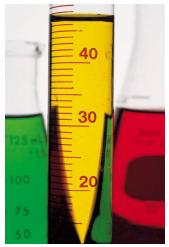
$$M_A \times V_A \times \#H \text{ in formula} = M_B \times V_B \times \#OH \text{ in formula}$$

Solid acid, aqueous base:

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

Aqueous acid, solid base:

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



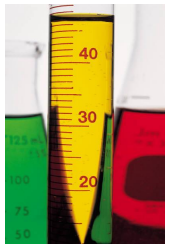
Experiment 4 Overview

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...

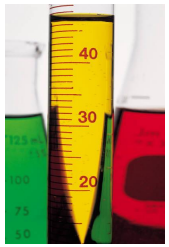
PART 1: STANDARDIZATION OF NaOH

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

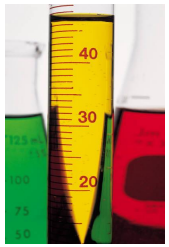
$$\text{Moles of } H^+ = \text{Moles of } OH^-$$



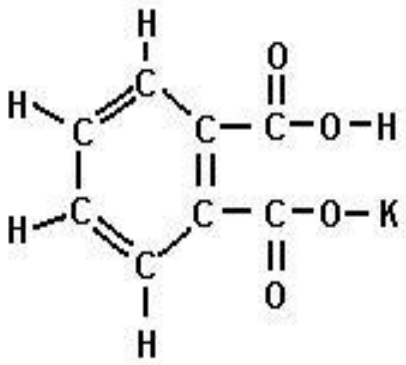
Moles aqueous = Moles solid

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

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



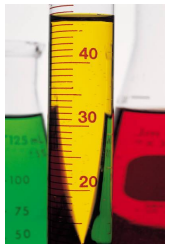
Was ist KHP?



Das ist KHP.
Es ist Potassium Hydrogen Phthalate.

$C_8H_5O_4K$

Es gibt keinen Phosphor!

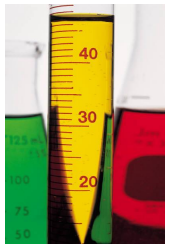


Part Two: A Return to the Potions Lab

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

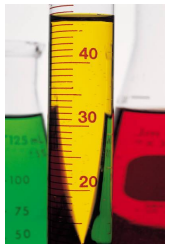
2 drops of phenolphthalein

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^-

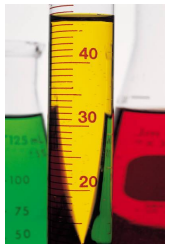
For HCl and HNO_3,

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

For H_2SO_4

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

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



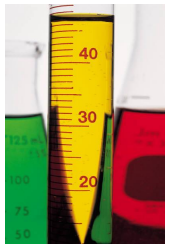
Part 4: Citric Acid in Juice

Orange or Pineapple

15 ml juice, 60 ml water, and

2 drops of phenolphthalein.

Titrate just once. Solution goes from yellowish to orangey.



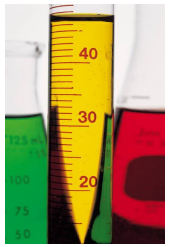
A word about citric acid

That word is *tri*protic!

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:

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



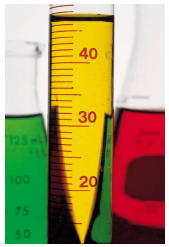
All your base are belong to us

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!