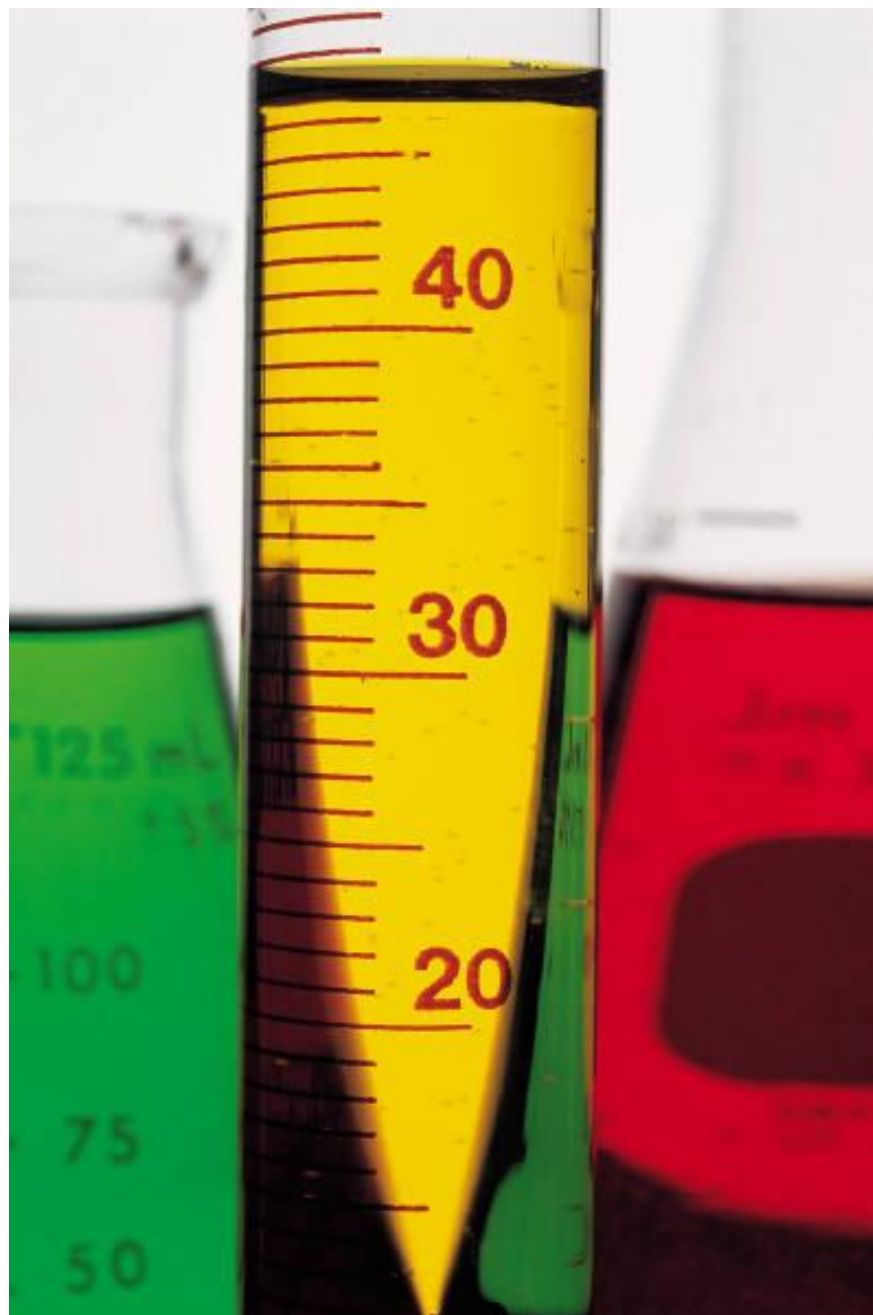


# Experiment 4

## Acid-Base Titration

CH 204 Spring 2009

Dr. Brian Anderson





# **What We Lernd in Skool Last Week**

**Naming Ionic Compounds**

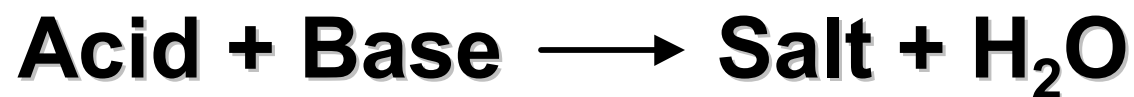
**Molecular Equations**

**Simple Solubility Rules**

**Spectator Ions and Net Ionic Equations**



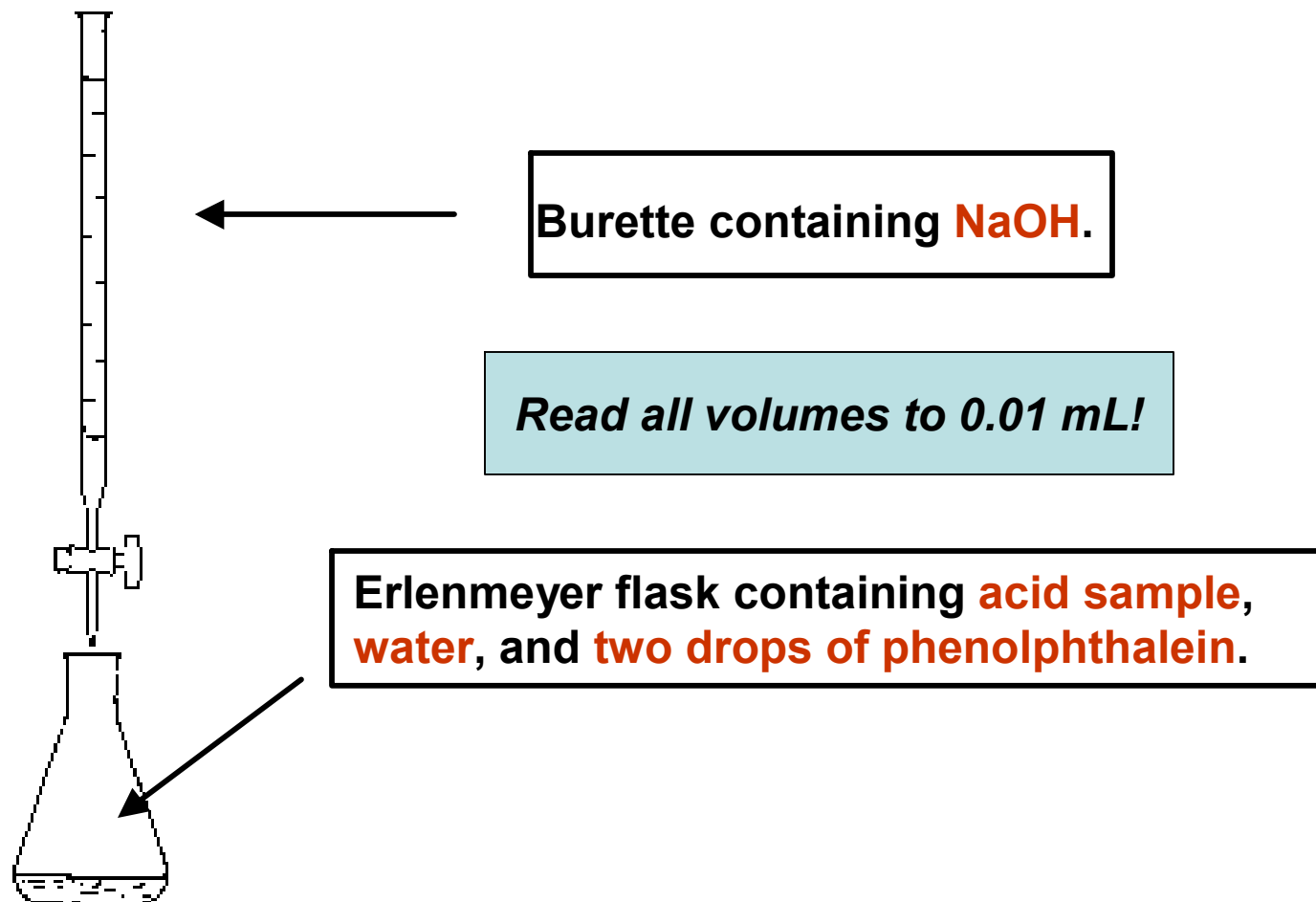
# **This Week: Acid-Base Titrations**



**At the equivalence point  
Moles  $\text{H}^+$  = Moles  $\text{OH}^-$**

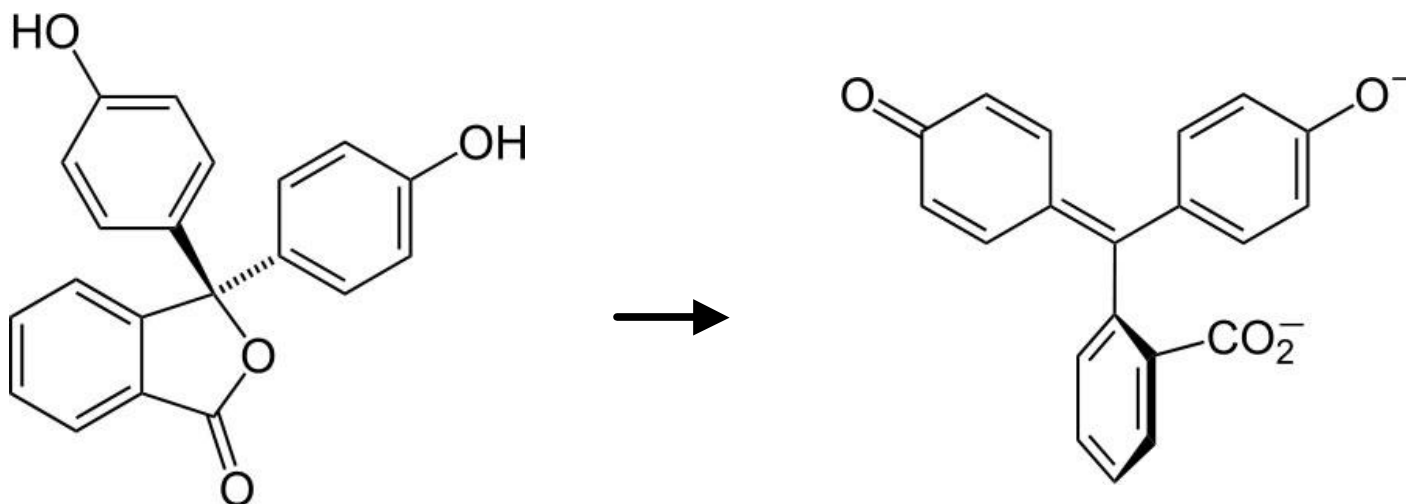


# Titration Setup





# Phenolphthalein



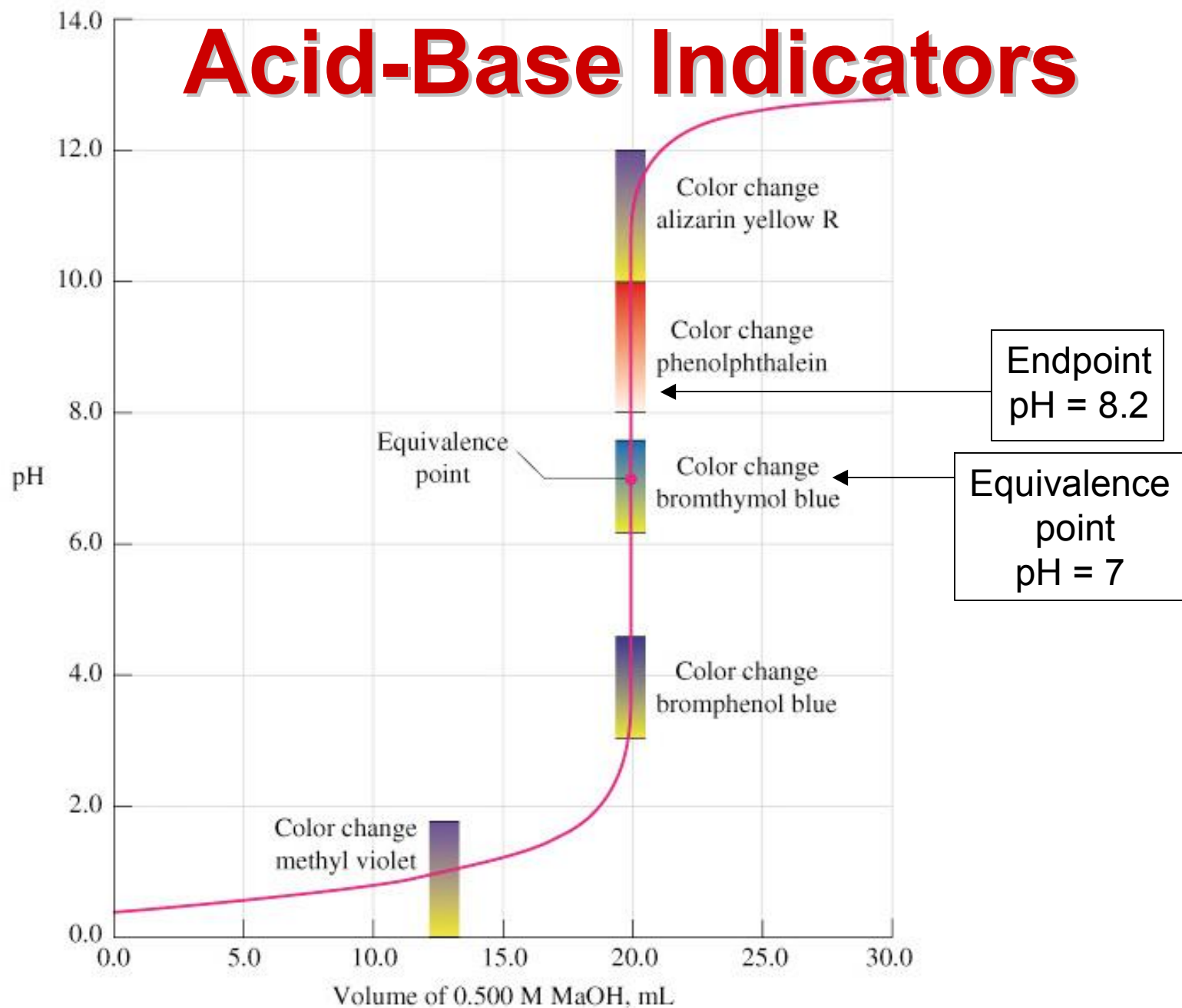
**Colorless below pH 8.2**

**Pink above pH 8.2**

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



# Acid-Base Indicators





# Titration Calculations the E-Z Way

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



This is the starting point for all the lab  
calculations and also for post-lab  
problems 1, 2, 4, and 5.



# Moles H<sup>+</sup> and Moles Acid

**Moles H<sup>+</sup> = (Moles acid × #H in formula)**

**1 mole HCl = 1 mole H<sup>+</sup>**

**1 mole H<sub>2</sub>SO<sub>4</sub> = 2 moles H<sup>+</sup>**

**1 mole H<sub>3</sub>PO<sub>4</sub> = 3 moles H<sup>+</sup>**





# 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

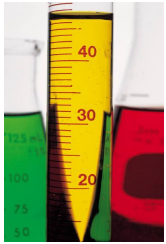




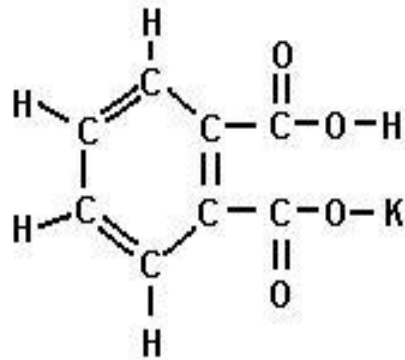
# Moles aqueous = Moles solid

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

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

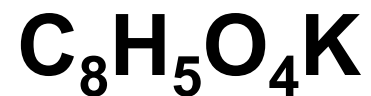


# Was ist KHP?



**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  $V_{\text{NaOH}}$  all three times.**

**Calculate the molarity of your acid.**



**Moles  $H^+$  = Moles  $OH^-$**

**For  $HCl$  and  $HNO_3$ ,**

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

**For  $H_2SO_4$**

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

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





## **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<sup>+</sup>

So the number of moles of H<sup>+</sup> is **3 times** the number of moles of citric acid:





**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!**