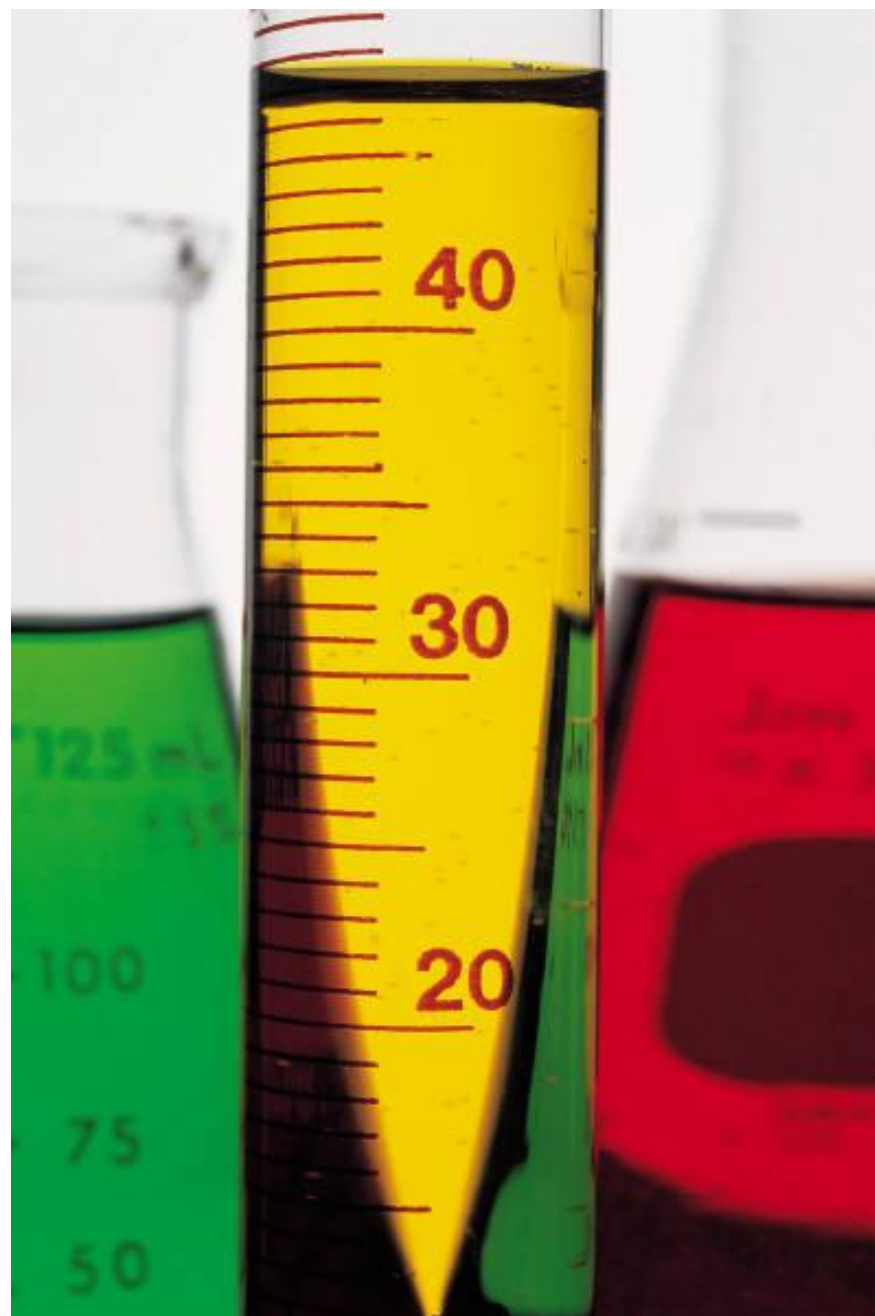


Experiment 4

Acid-Base Titration

CH 204 Spring 2008

Dr. Brian Anderson





Whut We Lernd in Skool Last Week

Molecular Equations

Simple Solubility Rules

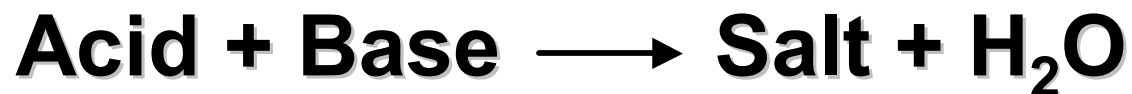
Spectator Ions and Net Ionic Equations

Microscale Techniques



This Week: Acid-Base Titrations

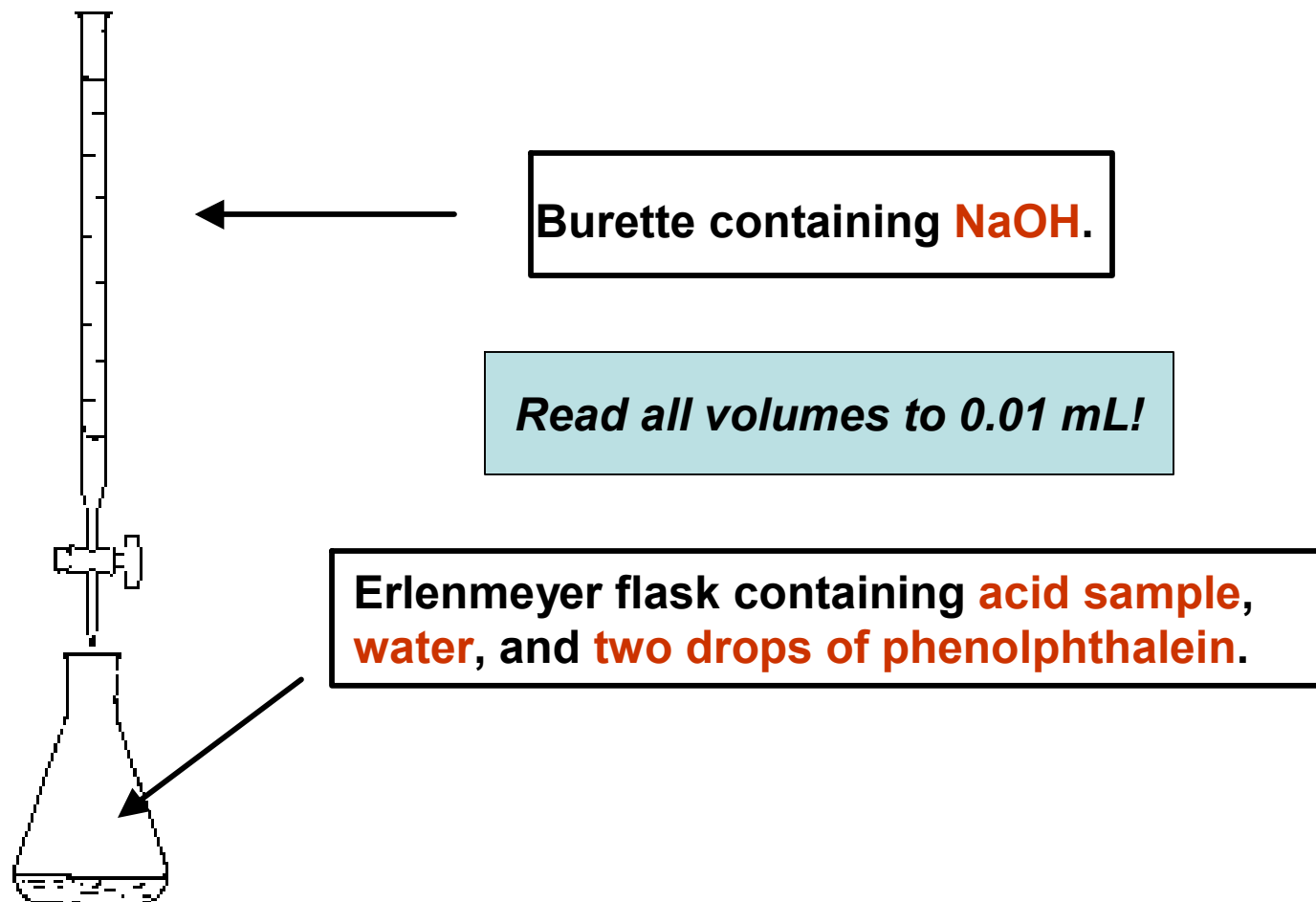
What exactly *is* a titration, anyway?



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

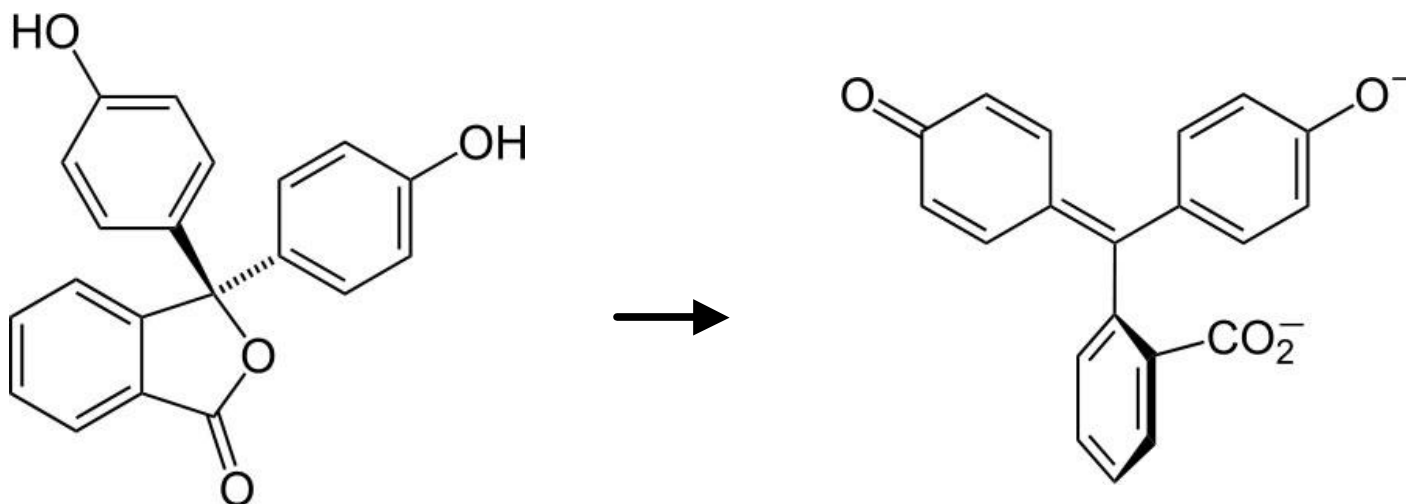


Titration Setup





Phenolphthalein



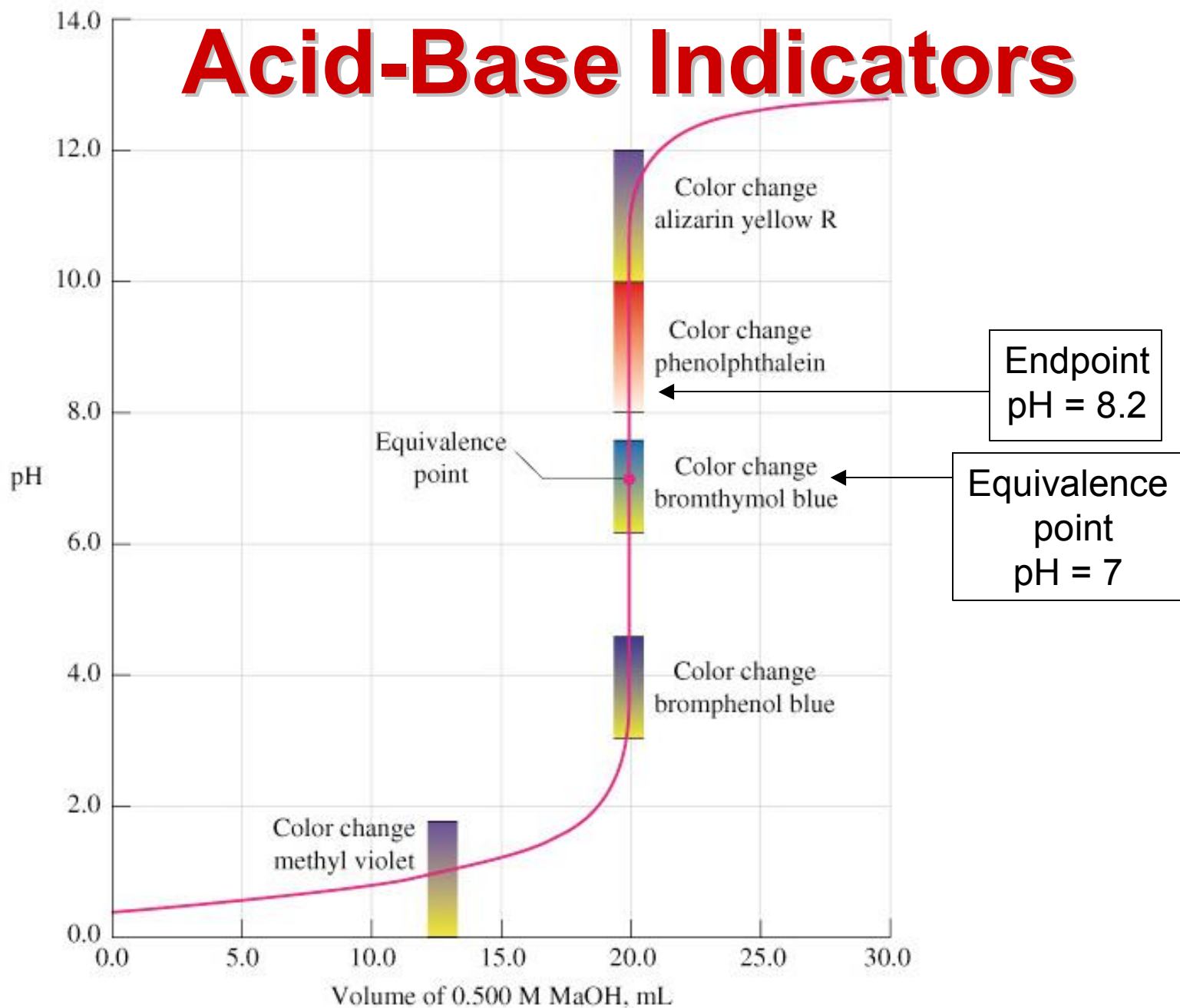
Colorless below pH 8.2

Pink above pH 8.2

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



Acid-Base Indicators





Today: Titration Marathon!

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



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



Experiment 4 Overview

PART 1: STANDARDIZATION OF NaOH

Mix up **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

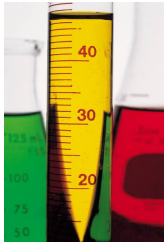




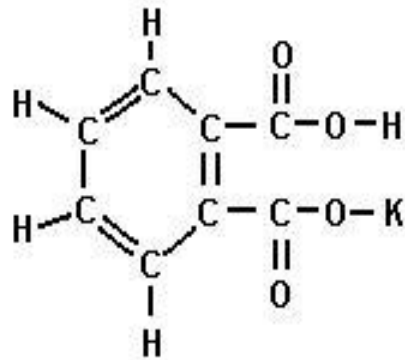
Moles aqueous = Moles solid

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

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

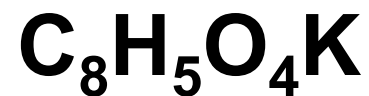


Was ist KHP?



Das ist KHP.

Es ist Potassium Hydrogen Phthalate.



Nicht haben der Phosphorus!



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.**



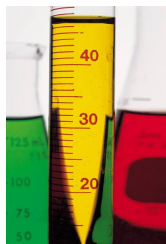
Part 3: Titrate Your Unknown

**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.



General Form for Acid-Base Titrations

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

monoprotic acid/monobasic base

NaOH, moles OH^- = moles NaOH

HCl or **HNO₃**, moles H^+ = moles acid

diprotic acid/dibasic base

H₂SO₄, moles H^+ = 2 x moles acid

Ba(OH)₂, moles OH^- = 2 x moles Ba(OH)₂

triprotic acid

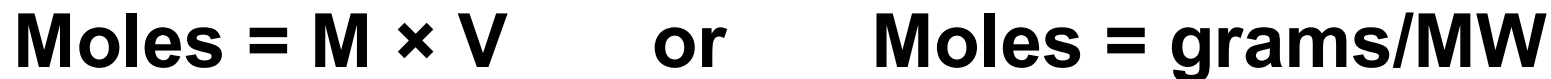
H₃PO₄, moles H^+ = 3 x moles acid

C₃H₅O(COOH)₃, moles H^+ = 3 x moles acid

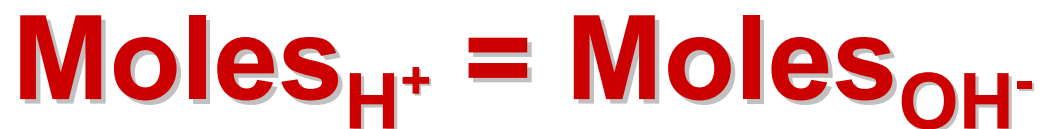


Und so...

**General formula for
titrations/neutralizations:**



Let's try one of these...



For HCl and HNO₃,

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

For H₂SO₄

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

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



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:

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



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!**