Chem 201 lecture 1a

Orientation
Syllabus
Review of unit conversion
Stoichiometry
Brief pointers on Lab Expts: Ca

What to expect in Chem 201

What is Chem 201 lab like?
-overall lab driven, but lecture is key.
-both lecture and lab are challenging
-self reliance: flowchart, preparation, organization
-lab skills: accuracy & precision
-schedule: strict adherence to scheduled expts. (-1)
-data collection rule: pencil only, directly in notebook.(-5)
-group and individual responsibility: safety & clean up
-up to date notebooks properly formatted at all times (-10)

Requirements

Textbook: Quantitative Chemical Analysis 7th edition
by DC Harris, W H Freeman & Co
Lab: 7 lab protocols downloaded from website

Prerequisite: You have passed Chem 101, 102 and 103

If you have NOT passed these classes, talk to me before it's too late.

Attendance

Attendance in all lectures is expected.
We will record attendance. But attendance is usually not a factor in your grade.
Unannounced quizzes (often bonus) will be given to help provide chances for problem solving practice.
Absence during Exams: No make up exams. Absences must be documented or you'll receive zero for the exam.

What I expect from you…

Be punctual for each class. Inactivate cellphones.
Respect what I or your fellow students say.
Come prepared to discuss the day's assignments.
Concentrate exclusively on Quant during class hours.
Study for about 10-20 hours per week or more.

Have detailed flowcharts done in lab.
Adhere to lab timetable and deadlines.
Strictly follow safety procedures in lab. Help clean up.
Always have notebook, pencil, adhere to data collection rules.

You can expect from me:

-to be punctual and prepared for each class.
-Give each student a fair share of my attention.
-Prepare you fully for your quizzes and exams.
-Grade you fairly on accurate measurements.
-Return graded work within a reasonable time.
-Help you succeed in this class.
-Be present to help you during office hours.
-Be available by appointment (if offc hrs inconv.).
-Try to answer your questions specially on lecture material.

Contact information, etc.

About me: Dr. Greg Santillan, PS 610, tel (323)343-2313

Offc hours: MTWF 1140am-1240pm. Or by appointment

gsantil@calstatela.edu (write:"Chem 201-your name")

Website: www.calstatela.edu/dept/chem/10summer/201/

Textbook: Harris, Quantitative Chemical Analysis, 7th ed.

bcs.whfreeman.com/qca7e/ (give my email address)

READ THE ENTIRE SYLLABUS!

Immediate Lab sched

Tuesday	Thursday
June 22 -lab check in	24 - Ca Expt (1)
28 Ca (2); Quiz (Ca); HW#1	July 1 Expt #2(1), Quiz #2; Results (Ca)
6 Expt #2(1), HW#2; Formal rep (Ca)	8 Expt #3(1), Quiz #3 ; Results (Exp2)
13 Expt #3(2), HW#3	15 Expt #4(1), Quiz #4 ; Results (Exp3) **EXAM #1**

Quantitative Analysis

What's the difference between "qualitative" & "quantitative?"

What's important in quantitative analysis?

Why is quantitative analysis before organic chem important?

Give examples where quantitative analysis is used

General approach to measurements

Involves *aliquots* (precise measured amounts)
Involves *sampling* (random,homogeneous)

Steps:
1. Formulate goal-what to measure?
2. Select analytical technique
3. Collect samples
4. Prepare the samples
5. Make replicate measurements; average
6. Conclusion & assessment

Review:Units and conversions

Give examples of SI units

Give examples of prefixes

Conversions of units:

Use: unknown=given x (conversion factor(s)).

Convert 2 dozen 4 leaf clovers to # of petals

#petals = 2 dozen clovers x12/doz x 4 petals/clover

= 96 petals

An example

How many moles of Mn are present in a 0.500 g sample of steel containing 0.94% Mn? (AW=54.9)

What is the *given*? Usually the *given* is not a ratio

Yes! 0.500 g steel

What's the *unknown?* Yes again! #mol Mn

What are the conversion factor(s)?

0.94g/100g & 1mol/54.9g

Continuation…

Set up the equation:

$$\# \text{ mol Mn} = 0.500\text{g steel} \frac{0.94\text{g Mn}}{100\text{g steel}} \frac{1.00 \text{ mole Mn}}{54.9\text{g Mn}}$$

$\#\text{mol Mn} = 8.56\times10^{-5}$ mol

Do your best to follow this approach, being careful to write in all the units whenever needed. Check that all units cross out to give the final unit desired.

Another example

A 0.300 g nickel ore (ie mixture) sample is dissolved in acid and the nickel is selectively reprecipitated as the red complex $Ni(dimethylglyoxime)_2$. If the dried $Ni(DMG)_2$ has a mass of .200 g, what is the %composition of Ni in the original ore? (MWs: $Ni(DMG)_2$ = 288.94 and Ni = 58.69 g)

What's unk? %Ni

What's given? 0.300g Ni ore & .200g $Ni(DMG)_2$

Continuation…

Definition of percent composition, %Ni:

$$\%\text{ Ni} = \frac{\text{g Ni}}{\text{g Ni ore}} \times 100\% = \frac{0.200 \text{ g Ni(DMG)}_2}{0.300 \text{ g Ni ore}} \times 100\%$$

$$= \frac{0.200 \text{ g Ni(DMG)}_2 \frac{1\text{molNi(DMG)}_2}{288.94\text{gNi(DMG)}_2} \frac{1\text{molNi}}{1\text{molNi(DMG)}_2} \frac{58.69\text{gNi}}{1\text{molNi}}}{0.300 \text{ g Ni ore}} \times 100\%$$

%Ni = 13.5 %

Pay attention to significant figures!

Continuation…Introducing the *Gravimetric Factor*

The previous slide showed the step by step approach.

When you use your calculator, you don't actually enter in all those "1"'s…

Gravimetric factor

$$\%\text{ Ni} = \frac{0.200 \text{ g Ni(DMG)}_2 \frac{58.69\text{gNi}}{288.94\text{gNi(DMG)}_2}}{0.300 \text{ g Ni ore}} \times 100\%$$

Gravimetric Factor (GF) = 58.69/288.94 in this case!

Brief pointers on lab experiments

All the lab protocols are posted in the website:

www.calstatela.edu/dept/chem/10summer/201

Download these protocols

Pay attention to the policies on laboratory practice

Determine YOUR sequence of lab experiments. (it depends on your locker #.)

Pay careful attention to the instructions!

First Experiment: Calcium Exp

This is a complexometric type of titration. "titrimetric analysis"

The titration reaction is: $Ca^{2+} + EDTA^{4-} \text{--->} Ca(EDTA)^{2-}$

It's a "one-to-one" titration! $M_{Ca}V_{Ca} = M_{EDTA}V_{EDTA}$

To determine M_{Ca} (in ppm), you need V_{Ca}, M_{EDTA}, V_{EDTA}.

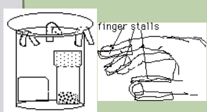
Prep. EDTA solution (≈ 0.01M); To know M_{EDTA} accurately…

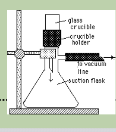
standardize it by titrating a *known* Ca^{2+} primary standard sol'n.

1° standard: need 0.5 g $CaCO_3$ *dried to constant weight* (heated and weighed until Δmass <0.0004g for 2 subsequent weighings)

Calcium

Typical flow chart
(outline only)





Calcium Exp: prep $CaCO_3$ std

To get [EDTA] accurately, standardize it by titrating against a *known* Ca^{2+} *primary standard* sol'n.

Primary standard: 0.5 g $CaCO_3$ *dried to constant weight* (heated and weighed until Δmass <0.0004g for 2 subsequent weighings)

For example: 0.4895 g of $CaCO_3$

Dissolve in 1-2 mL of conc. HCl and dilute to 0.5000L (500mL) to get: $[CaCO_3] = \frac{0.4895g(1/100.1g)}{0.500L} = 0.009780$ M

Calcium Day 2 : Standardize

Standardize EDTA:

Titrate 3 aliquots of 25-mL of $CaCO_3$ standard with EDTA.

Calculate [EDTA]: Say, $V_{EDTA} = 22.0$ mL

$M_{EDTA}V_{ep} = M_{CaCO3}V_{CaCO3}$

In this example: $M_{EDTA} = (0.009780M)(25.0mL)/22.0mL$

$M_{EDTA} = 0.1111$ M

Calcium Day 2 : Titrate unk.

Obtain 175 mLs of unknown Ca solution.

Titrate three(3) aliquots of 50-mL of unknown with EDTA.

Calculate $[CaCO_3]$: Say, $V_{EDTA} = 28.5$ mL

$M_{EDTA}V_{ep} = M_{CaCO3}V_{CaCO3}$

In this example: $M_{CaCO3} = (0.009780M)(28.5mL)/50.0mL$

$M_{CaCO3} = 0.005575$ M

Calcium: Calc ppm $CaCO_3$

In this example: $M_{CaCO3} = (0.009780M)(28.5mL)/50.0mL$

$M_{CaCO3} = 0.005575$ M

Note: 1 ppm = 1 mg/L

So ppm $CaCO_3$ = 0.005575 mol/L (100.1g/mol)(10^3mg/g)

= 558.0 ppm $CaCO_3$

Review: Concentration units

Molar (M) = #mol solute/L (of solution)
Molal (m) = # mol solute/Kg (of solvent)

$$\%(w/w) = \frac{\text{g solute}}{\text{g solution}} \times 100\%$$

$$\text{or equivalently, } \%(w/w) = \frac{\text{g solute}}{\text{100 g solution}}$$

$$\%(v/v) = \frac{\text{mL solute}}{\text{100 mL solution}}$$

$$\%(w/v) = \frac{\text{g solute}}{\text{100 mL solution}}$$

Review: ppm

$$ppm = \frac{g\ solute}{g\ solution} x10^6 \quad \text{or equivalently,}$$

$$ppm = \frac{g\ solute}{10^6 g\ solution}$$

For aqueous solutions it's convenient to derive:

$$ppm = \frac{g\ solute}{10^6 g\ solution} x \frac{10^{-3}}{10^{-3}} = \frac{10^{-3}\ g\ solute}{10^3\ g\ solution}$$

$$= \frac{mg\ solute}{10^3 g\ solution \frac{1mL}{g} \frac{1L}{10^3 mL}} = \frac{mg\ solute}{L\ solution}$$

More concentration units: N

$$\text{Normality} = \frac{\#\ \text{mole-equivalents solute}}{\text{L solution}}$$

What's the normality of 0.35 M H_2SO_4?

#N = 0.35 M H_2SO_4 x (2N/1M) = 0.70 N H_2SO_4

What's M for 0.25 N HCl? 0.25 M HCl!

Example of preparing a diluted solution from a stock solution.

Prepare 500mLs of 0.1 M HNO_3 . Stock is 15.8 M HNO_3.

Anyone remember the equation to use?

$M_1V_1 = M_2V_2$ For example: 1=conc. 2 = diluted

What to solve for?

$V_1 = M_2V_2/M_1$ =(.1M)(500mL)/(15.8M) = 3 mLs (1 sig.fig.)

Measure 3 mLs of stock HNO_3 and add to it enough water to reach a total volume of 500 mLs

Usually add acid to water but here it's dilute acid so it's OK.

Concentrations of lab stocks

C onc of	H_2SO_4 =	18 M	=	36 N H_2SO_4
	HCl =	12 M	=	12 N HCl
	HNO_3 =	16M	=	16 N
	NH_4OH =	15 M	=	15 N

Note that NH_3 solutions are often labelled NH_4OH (ammonium hydroxide). Why do you think so?

Sample calculation: ppm

Titration of Ca^{2+} using the hexadentate ligand, EDTA involves a 1:1 titration. If 35.0 mL of Ca^{2+} unknown sol'n requires 24.0mLs of 0.014 M EDTA, what is the concentration of Ca^{2+} in unknown (as ppm $CaCO_3$)?

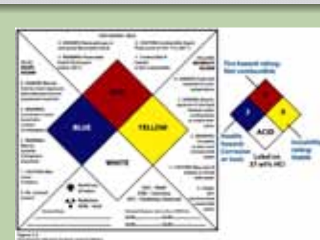
At e.p. #mol Ca^{2+} =# mol EDTA; $M_{ca} = M_{EDTA}V_{EDTA}/V_{CaCO3}$

$$ppm\ CaCO_3 = \frac{M_{EDTA}V_{EDTA}}{V_{CaCO3}} \frac{(gCaCO_3)}{mol} \frac{(10^3 mg)}{g}$$

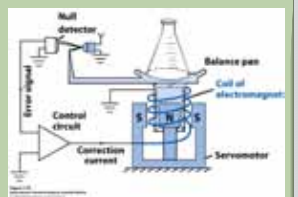
$$ppm\ CaCO_3 = \frac{(0.014mol/L)(24.0mL)}{(35.0mL)} \frac{100.1g}{mol} \frac{10^3 mg}{g} = 960\ ppm$$

Chemical Hazards Label

Chemicals containers have chemical hazards label



Electronic Digital balance



Note that electronic balances use a magnet in its mechanism.