

Chemistry 330 - QUANTITATIVE ANALYSIS

Course Description: Chem 330 is a study of the common techniques and theory of gravimetric, volumetric, electrochemical, optical and chromatographic methods of analysis. Lecture- 3 hours; Laboratory- 2 hours. Laboratory meets four and one-half hours per week. (Fall, Spring, Summer)

Course Information

Room: KTH 4062

M, W, F

11:30 am - 12:25 pm

Professor: Dr. Darwin Dahl KTH 4012 Phone 745-5074

Office hours: 9:30 – 11:30 am Monday and Wednesday and by appointment

Textbook: etext: Quantitative Chemical Analysis, Harris: 10th edition

*This course participates in The WKU Store's **Day One Access** program. Required materials will be delivered to you automatically by enrolling in this course unless you choose to opt-out. By participating in this program, The WKU Store will bill your Student Billing account, and you will see a charge appear under this Term along with Tuition and Fees ("Account Summary by Term" under the Student Services tab) labelled as "The WKU Store Purchases" after the Add/Drop period. For more information on this program or to opt-out of participation, go to the information page, <http://www.wkustore.com/t-day-one-access.aspx>.*

Homework: Achieve (Previously Sapling)

- If **Achieve** is new to you, go to your Blackboard page and follow instructions to use this utility.

Need Help? Technical support team can be reached by phone, chat, or by email via the Student Support Community. To contact support please open a service request by filling out the web form: <https://macmillan.force.com/macmillanlearning/s/contactsupport>

Grading Policy:

Four hour exams will be given during the semester. The lowest exam score will be dropped. A comprehensive final exam will be given and will consist of the ACS Standardized Exam. The following grading policy will be followed:

3 Best hour exams	40%
Homework	10%
Laboratory experiments	35%
Final exam (comprehensive)	15%

Projected grading scale:

88 - 100	A
77 - 87	B
65 - 76	C
52 - 64	D
- 51	F

Absences

No make-up examinations will be scheduled. Should you miss an exam, the grade of 0 will be given. You may use this exam as the one you drop. Laboratory periods are permitted to be re-scheduled provided I am notified beforehand of an excused absence.

Significant Dates:

January 18	Class begins
March 14-18	Spring Break (No Class)
April 5	Last day to drop with a W
February 14	EXAM I
March 11	EXAM II
April 8	EXAM III
April 27	EXAM IV
May 2	FINAL EXAM [10:30 am – 12:30 pm] Comprehensive

Student Learning Objectives:

Students will demonstrate proficiency using chemical knowledge and problem solving skills in the following topics: basic statistics, acid-base chemistry and equilibria, solubility, redox reactions, and separation techniques.

Policies

A. Accommodations: In compliance with University policy, students with disabilities who require academic and/or auxiliary accommodations for this course must contact the Student Accessibility Resource Center located in Downing Student Union, 1074. SARC can be reached by phone number at 270-745-5004 [270-745-3030 TTY] or via email at sarc.connect@wku.edu. Please do not request accommodations directly from the professor or instructor without a faculty notification letter (FNL) from The Student Accessibility Resource Center.

B. Academic Integrity: Academic Dishonesty - Students who commit any act of academic dishonesty may receive from the instructor a failing grade in that portion of the course work in which the act is detected or a failing grade in a course without possibility of withdrawal. The faculty member may also present the case to the Office of the Dean of Student Life for disciplinary sanctions. A student who believes a faculty member has dealt unfairly with him/her in a course involving academic dishonesty may seek relief through the Student Complaint Procedure.

Cheating - No student shall receive or give assistance not authorized by the instructor in taking an examination or in the preparation of an essay, laboratory report, problem assignment or other project, which is submitted for purposes of grade determination.
<http://www.wku.edu/undergradcatalog/>

C. University Attendance Policy: Registration in a course obligates the student to be regular and punctual in class attendance. Excessive absenteeism frequently contributes to poor academic achievement. Excessive absenteeism may result in the instructor's dismissing the student from the class and recording a failing grade, unless the student officially withdraws from the class before the withdrawal deadline. <http://www.wku.edu/undergradcatalog/>

CHEM 330 Course Attendance Policy: Attendance is mandatory.

D. Title IX Misconduct/Assault Statement: Western Kentucky University (WKU) is committed to supporting faculty, staff and students by upholding WKU's Title IX Sexual Misconduct/Assault Policy (#0.2070) at <https://wku.edu/eoo/documents/titleix/wkutitleixpolicyandgrievanceprocedure.pdf> and

Discrimination and Harassment Policy (#0.2040) at https://wku.edu/policies/hr_policies/2040_discrimination_harassment_policy.pdf.

Under these policies, discrimination, harassment and/or sexual misconduct based on sex/gender are prohibited. If you experience an incident of sex/gender-based discrimination, harassment and/or sexual misconduct, you are encouraged to report it to the Title IX Coordinator, Andrea Anderson, 270-745-5398 or Title IX Investigators, Michael Crowe, 270-745-5429 or Joshua Hayes, 270-745-5121. Please note that while you may report an incident of sex/gender based discrimination, harassment and/or sexual misconduct to a faculty member, WKU faculty are “Responsible Employees” of the University and **MUST** report what you share to WKU’s Title IX Coordinator or Title IX Investigator. If you would like to speak with someone who may be able to afford you confidentiality, you may contact WKU’s Counseling and Testing Center at 270-745-3159.

WKU COVID Guidelines:

All students are strongly encouraged to [get the COVID-19 vaccine](#). Out of respect for the health and safety of the WKU community and in adherence with CDC guidelines and practices of all public universities and colleges in [Kentucky](#), the University requires that a cloth face covering (reusable or disposable) that covers both the nose and mouth must be worn at all times when in public areas within all buildings. Students must properly wear face coverings while in class regardless of the room size or the nature of the classroom activities. Students who fail to wear a face covering as required will be in violation of the WKU Student Code of Conduct and will be asked to comply or will face disciplinary action, including possible dismissal from the University. Accommodations can be requested in special cases through the Student Accessibility and Resource Center ([SARC](#)): [270-745-5004](#) (voice), [270-745-3030](#) (TTY), or [270-288-0597](#) (video).

All students must immediately report a positive Covid-19 test result or close contact with a person who has tested positive to the Covid-19 Assistance Line at 270-745-2019. The assistance line is available to answer questions regarding any Covid-19 related issue. This guidance is subject to change based on requirements set forth by public health agencies or the office of the governor. Please refer to the Healthy on the Hill website for the most current information. www.wku.edu/healthyonthehill

Tentative Lecture Schedule

Exam I Material

Chapter 1:	Chemical Measurements -	A review of solutions and their concentrations and stoichiometric calculations. Review of Titrations
Chapter 6:	Chemical Equilibrium-	A review of chemical equilibrium
Chapter 8:	Activity and the Systematic Treatment of Equilibrium	Activity and Activity coefficients in relations to solubilities and Systematic methods for solving multiple-equilibria
Chapter 27:	Gravimetric and Combustion Analysis	Treatment of Gravimetric procedures

Exam II Material

Chapter 4:	Statistics	Statistical treatment of errors
Chapter 9:	Monoprotic Acid/Base Equilibria	Strong acid/base and Weak acid/base equilibria
Chapter 10:	Polyprotic Acid-Base Equilibria	Equilibria involving polyprotic acid-base reactions, buffer solutions and alpha fractions
Chapter 11:	Acid-Base Titrations	Titrations and practical applications

Exam III Material

Chapter 12:	EDTA Titrations	Complex-formation reactions, EDTA equilibria and applications
Chapter 18:	Fundamentals of Spectrometry	Electromagnetic radiation, spectrum
Chapter 19:	Applications of Spectrophotometry	Applications
Chapter 20:	Spectrophotometers	Block diagrams of instrumentation

Exam IV Material

Chapter 14:	Fundamentals of Electrochemistry	Redox, potentials and cells
Chapter 15:	Electrodes and Potentiometry	Indicator and Reference electrodes
Chapter 16:	Redox Titrations	Titration curves and applications
Chapter 23:	An Introduction to Analytical Separations	Chromatography overview
Chapter 24:	Gas Chromatography	Gas Chromatography overview
Chapter 24:	HPLC	HPLC overview

Laboratory Schedule

Text: Procedures in Quantitative Analysis, Dahl et al.

Laboratory Experiments will be located in Blackboard!

Note: Prior to lecture on the day of your scheduled experiment, obtain the necessary standard or unknown and place in the oven to dry. Make sure and record the **unknown #** in your laboratory notebook! *You will need to provide your own safety glasses/goggles. Long pants required: must cover ankles. No open-faced shoes (sandals...) are allowed.*

Lab: W or R 12:40 - 5:10 pm **Room:** OCH 3009

<u>Week of:</u>	<u>TOPIC</u>
Jan. 17	No Lab
Jan. 24	Check-in / Orientation, Glassware Calibration Lab
Jan. 31	Excel Spreadsheet Calculations and Graphing
Feb. 7, 14	Determination of Soda Ash using HCl
Feb. 21	* Potentiometric Analysis of a Phosphoric and Sulfuric Acid Mixture
Feb. 28, Mar. 7	Complexometric Titration of MgO with EDTA
Mar. 14	No Lab: Spring Break
Mar. 21	*Spectrophotometric Analysis of a Permanganate-Dichromate Mixture
Mar. 28	<i>Ion-exchange lab "Self-developed" Formal Report. (Note: lab worth 200 pts)</i>
Apr. 4	*Alcohol Determination by Gas Chromatography
Apr. 11	*Quinine Determination by Molecular Fluorescence
Apr. 18	Check out

*** denotes working with a partner!**

The deadline for laboratory reports will be 1 week after completion of the experiment unless otherwise stated. A penalty of **5% per day** will result for reports turned in late. The procedure for submitting reports will be reviewed in class.

Chem 330 Laboratory

Excel Spreadsheet Exercise: Calculations/Graphing

The intent of these exercises is to familiarize yourself with the use of a spreadsheet and to be able to graph various types of data. The program we will use is excel.

A. Prepare a plot of Density of water vs Temperature.

Referring to the attached handout, reproduce the spreadsheet and corresponding graph after calculating densities. Additionally, generate the best-fit equation for the data obtained. To obtain the equation use *a third-order polynomial* fit and selecting 4 significant digits.

B. pH dependence on the solubility of HgS in water.

Reproduce and complete the spreadsheet below and generate graphs as requested in Part B “Turn in;”

	pH	[H+]	[OH-]	[Hg2+]	[S2-]	[HS-]	[H2S]	<u>C.B.</u> <u>Error</u>	<u>lg[Hg2+]</u>	<u>lg[S2-]</u>	<u>lg[HS-]</u>	<u>lg[H2S]</u>
Ksp=	2											
5.00E-54	3											
Kb ₁ =	4											
0.9	5											
Kb ₂ =	6											
1.10E-07	7											
Kw=	8											
1.00E-14	9											
	10											

Formulas

Turn in:

Part A: -Spreadsheet calculation

-Graph

-Best-fit equation and correlation coefficient (r)

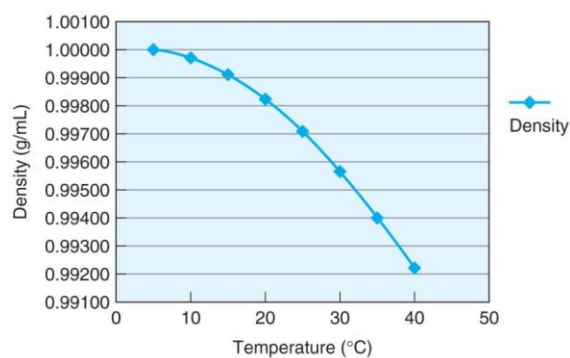
Part B: -Spreadsheet calculation

-Graph (lg [x] vs pH) (all four variables on 1 graph)

-Graph Charge Balance Error vs pH

- report pH at 0 error; **and the corresponding solubility!**

	A	B	C	D	E	F	G	H
1	Calculating Density of H2O with Equation 2-4							
2	(from the delightful book by Dan Harris)							
3								
4	Constants:	Temp (C)	Density (g/mL)					
5	a0 =	5	0.99997					
6	0.99989	10	0.99970					
7	a1 =	15	0.99911					
8	5.3322E-05	20	0.99821					
9	a2 =	25	0.99705					
10	-7.5899E-06	30	0.99565					
11	a3 =	35	0.99403					
12	3.6719E-08	40	0.99223					
13								
14	Formula:							
15	C5 = \$A\$6+\$A\$8*B5+\$A\$10*B5^2+\$A\$12*B5^3							
16								
17								



$$\text{Density (g/mL)} = a_0 + a_1 * T + a_2 * T^2 + a_3 * T^3$$