CHE 450G Fall 2006
Practical Inorganic Chemistry

Dr. Stephen M. Holmes
15 Chemistry-Physics
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Office hours by appointment

Lecture: 12 – 12:50 PM MW
Where: 103 Chemistry-Physics Bldg.
Lab: 1-3:50 PM MW; CP-36

Teaching Assistants:

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Required Texts

G. S. Girolami, T. B. Rauchfuss, R. J. Angelici *Synthesis and Technique in Inorganic Chemistry*, 3rd Ed.
G. L. Miessler; D. A. Tarr *Inorganic Chemistry, 2nd Ed.*
A. Vincent *Molecular Symmetry and Group Theory*

Supplementary Texts (optional and useful additions to your library):

Z. Szafran; R. M. Pike; M. M. Singh *Microscale Inorganic Chemistry*: *A Comprehensive Laboratory Experience*
F. A. Cotton *Basic Inorganic Chemistry*
K. F. Purcell; J. C. Kotz *An Introduction to Inorganic Chemistry*
D. F. Shriver; P. W. Atkins; C. H. Langford *Inorganic Chemistry, 4th Ed.*
Y. Jean; F. Volatron; J. Burdett *An Introduction to Molecular Orbitals*
F. A. Cotton; G. Wilkinson *Advanced Inorganic Chemistry, 5th Ed.*

Useful Course Information/Helpful Links

General Information: www.chem.uky.edu/courses/CHE450G/
Electronic Course Syllabus: http://www.chem.uky.edu/courses/che450g/handouts/syllabus.html
Laboratory Rules & Safety: http://www.chem.uky.edu/courses/che450g/safety/welcome.htm
Handouts and Instructions: http://www.chem.uky.edu/courses/che450g/handouts/welcome.html
Useful Web Resources: http://www.chem.uky.edu/courses/che450g/web.html
Problem/Homework Sets: http://www.chem.uky.edu/courses/che450g/problems.html
Lab Report Templates:
https://paragon.acs.org/paragon/application?pageid=content&parentid=authorchecklist&mid=mt_ja.html&headername=Manuscript%20Templates%20-%20Journal+of+the+American+Chemical+Society

For additional assistance with writing assignments consult the *Journal of the American Chemical Society* (http://pubs.acs.org/jacs/), instructor (smholm2@uky.edu), and University of Kentucky Writing Center (http://www.uky.edu/UGS/study/).

Grading Distribution

Pursuant to University Regulations: "Our accreditation association and policy of the Graduate School require that there be different assignments and grading criteria for undergraduate students and graduate students in 400G and 500-level courses. For that reason, you will find differences in course requirements and/or grading criteria in this class, posted on the syllabus."

Student	Laboratory Experiments and Reports	Homework	In-Class Quizzes	Exams	Comprehensive Final Exam	Total Possible Points
Undergraduate	**5 × 100 = 500**	**6 × 50 = 300**	**200**	**2 × 300 = 600**	**400**	**2000**
Graduate	**6 × 100 = 600**	**8 × 50 = 400**	**200**	**3 × 300 = 900**	**400**	**2500**

Course Grade = [Acquired Points/Total Possible Points] × 100%:

100% < **A** < 90% < **B** < 80% < **C** < 70% < **D** < 60% < **E**

Scheduled Course Assignments and Policies

University Policy: "Regular course activities, such as homework, in class work, or laboratory practicums may continue as usual. A term paper assigned early in the course can be due during Dead Week, since students would have been informed well in advance. Make-up exams may be given during Dead Week as well. (Dead Week - S.R. 5.2.4.6). *Completion of assigned work for a grade, or class attendance for a grade, in compliance with the prior announcement provisions of SR 5.2.4.1 (RC 11/02/05) is allowed.*"

CHE450G is a four credit hour course and as such will require significant time to (1) learn basics of Inorganic Chemistry theory, (2) perform laboratory experiments, and (3) write and complete formal *J. Am. Chem. Soc.*-style reports (in manuscript format). As a general rule, at least 6 hours per week should be devoted to studying concepts introduced in class and the textbook; homework problem sets are considered in addition to this suggestion and will generally take 2-4 hours if these concepts are understood. Working in groups and scheduling office hours may also aid students in these efforts. Report writing times will depend on the individual but expect to take at least 5-6 hours for the construction of each report. *If work, other courses, and/or other responsibilities will not allow for these time investments, please see the instructor as soon as possible to discuss possible options.*

(1) Exams

Scheduled exams (2, undergraduate; 3, graduate) will consist of roughly 50-70% of problems identical to those appearing in classroom discussions, quizzes, and homework. These exams will be held during evening hours on Thursday evenings (6-8 PM) during the semester. The remainder of the exam material will require that you apply this acquired knowledge to a related problem and determine the correct answer that is consistent with the data. This methodology is intended to encourage "thinking outside the box" and practice deductive reasoning under "real world" settings. The most important outcomes of your efforts is to know the basics of inorganic chemistry, think critically about a particular reaction pathway or set of data, and predict/propose likely outcomes and/or reasons for the observed behavior.

Exam dates: Thursdays, October 12 and November 16, 6-8 PM.

(2) Homework Problem Sets

Approximately six homework sets will be assigned during the semester for undergraduate students; eight for graduate students. These assignments are designed so that you practice and apply knowledge acquired during class and readings outside of class. Some assignments will require more time than others. *Expect to spend at least 2 hours per assignment.*

(3) In-Class Quizzes

In-class quizzes (unannounced, "pop quizzes") are designed to assess your comprehension of assigned reading materials, in-class examples, and inorganic chemistry concepts as they are introduced. These short (5-10 min.) quizzes are intended to keep the class discussions at a reasonable pace, "encourage" student reading outside of class and in-class participation, and allow for feedback concerning comprehension of course topics and material. *Generally, if the quizzes seem exceedingly difficult then you should allocate more time for studying the concepts, visit me during office hours, and/or ask more questions during class. If you have questions your peers almost certain do too.*

(4) Laboratory Experiments and Reports

Six laboratory experiments are scheduled for this semester. These experiments are:

(1) Geometric Isomerism and Optical Isomers of Dichlorobis(ethylenediamine)cobalt(III) Chloride
(2) The Oxidation States of Tin

(3) The Metal-Arene Complex [1,3,5-$C_6H_3(CH_3)_3$]$Mo(CO)_3$
(4) Determination of Δ_o in Cr(III) Complexes
(5) Magnetism: Paramagnetic $Mn(acac)_3$, Magnetic $Cr^{II}_2[Cr^{II}(CN)_6]\cdot nH_2O$, and/or Superconducting $YBa_2Cu_3O_7$
(6) Gold Nanoclusters and Self-Assembled Monolayers

Each experiment should be easily completed within one or two 4 hour laboratory sections. Additional information (experimental modifications and procedures) will be provided later in the semester by the instructor.

A laboratory notebook is required. Appropriate procedures, quantities of reagents, and recorded information is to be kept in you notebook. No laboratory manuals are allowed in the lab and all experimental information and recorded data will be copied to your laboratory notebook. Upon completion of the experiment carbon copies of your notebook pages (stapled) are to be submitted to your teaching assistant before beginning the next experiment. *Failure to follow these guidelines will result in a 10% reduction of your report grade for each experiment.* Helpful hints for constructing and using a laboratory notebook are provided via the link below:

http://www.chem.uky.edu/courses/common/notebook.html

Lecture and Laboratory Attendance

Mandatory attendance in lecture is required (http://www.chem.uky.edu/courses/che450g/handouts/attendance.html). Students who are ≥ 15 minutes late for a class or laboratory session are considered absent. Regular attendance will help you to learn and allow you to ask questions aiding comprehension of the material. Furthermore active participation by all will help everyone to learn the material and decrease study time outside of class (yes, really).

Excused Absences [S.R. 5.2.4.2]

1) serious illness (with documentation)
2) illness or death of family member
3) University-related trips (with documentation)
4) Major religious holidays
5) Other reasonable circumstances (upon instructor consent, ideally in advance)

More than two unexcused absences will result in one percentage point deduction from the final grade average; unexcused absences from the laboratory component are not allowed and "make-up" times are not permitted. See the Official University Absence Policy [S.R. 5.2.4.2] for allowable and excused absences. Such absences are to be discussed with the instructor in advance of the scheduled date. Students who may require special classroom, laboratory, and/or exam accommodations should consult with the instructor and contact the Disability Resource Center (2 Alumni Gym, 257-2754, jkarnes@uky.edu). *If you feel you have a valid reason to miss class other than the 5 reason listed above, you must contact me before you miss the class meeting. I reserve the right to deem this reason valid, or not.*

Laboratory Safety and Attire

Safety is of utmost importance in the laboratory. Shorts, dresses, tank tops, and open-toed shoes are not permitted within the CHE450G laboratory. Laboratory coats and/or aprons are not required but are highly recommended. Food and drink are also forbidden. At all times goggles will be worn within the lab and failure to do so will result in one of the following: (first offense) a verbal warning, (second offense) a 5% reduction of the appropriate report grade, and (3) expulsion from the laboratory; no make-up time will be allowed. Subsequent offenses will require discussions with the Instructor, student, and Chemistry Department chairperson to decide the appropriate measures to be taken.

Laboratory Report Construction

All laboratory reports will adhere to the *Journal of the American Chemical Society* format for ***Full Manuscripts***. **You will submit reports on Experiments 1-5 for credit.** This is a different format than what you may have utilized

in previous Chemistry or Science laboratory classes. For help, consult your Instructor or one of the following websites:

http://www.uky.edu/UGS/study/
http://pubs.acs.org/jacs/
https://paragon.acs.org/paragon/application?pageid=content&parentid=authorchecklist&mid=mt_ja.html&headername=Manuscript%20Templates%20-%20Journal+of+the+American+Chemical+Society

University Policy Statement: Grading Writing Skills: "Helping promote scholarship is more than simply teaching the subject matter -- all students need to improve and refine their skills in verbal and written expression. Regardless of discipline, instructors have the right -and the obligation- to expect that students use English properly in all aspects of the course [S.R. 5.2.4.3]. Instructors can ask students to rewrite papers, make writing style one of the grading criteria, and report a seriously deficient student to his/her college for remedial work."

Your laboratory reports (5 total) will consist of at least 10 basic sections:

(1) Title, Authors, and Affiliation. Describes report contents succinctly, who did the work (you), and where work performed (Department of Chemistry, University of Kentucky).
(2) Abstract. Briefly describes what experiment you did and briefly summarizes data and conclusions. A well-written abstract summarizes your report in a ~5-20 short choppy statements.
(3) Introduction [a.k.a. what others have previously reported; ~ 2 paragraphs]. This is not a summary of the laboratory manual introduction. Literature citations (not Websites) in proper format should also be present.
(4) Motivation [a.k.a. why other than a grade are you writing this document or why should we care?)]. This is again not a summary of the laboratory manual introduction (~ 1-2 paragraphs). Include as a portion of the Introduction section. Literature citations (not Websites) in proper format should also be present.
(5) Experimental Methods. This described what purification techniques for reagents, sources, prior literature synthetic details, and instrumentation (model number and any modifications) was used to prepare/characterize your reaction products. (~ 1-3 paragraphs, abstract style). Literature citations (not Websites) in proper format should also be present.
(6) Results and Discussion. Compares your research findings to the *primary* research literature (i.e. not a Website or lab manual). You should describe what was done, interpret and report your data, and compare your data/conclusions to the primary literature (e.g. published manuscript). Literature citations (not Websites) in proper format should also support your claims. (~ 2-20 pages judgment call, depending on the experimental data and complexity of experiment).
(7) Figures and Schemes. These should include experimental data plots or clearly indicate non-trivial chemical transformations in a graphical format. Acid-base neutralization, salt elimination, distillation apparatus, Schlenk line design, etc. are not useful. For examples consult ***several*** manuscripts that appear in the *Journal of the American Chemical Society*.
(8) Conclusions. You should briefly describe why you performed the experiment, what conclusions were drawn, how they agree with or differ from literature reports, and propose a new avenue for study (a.k.a. future directions). This section will be ~ 1-2 paragraphs in length and is not the same as an abstract.
(9) Acknowledgments. You should thank staff, faculty, and students who assisted with data collection, analysis, or experimental issues. Access to facilities outside CP-36 and their funding sources should also be mentioned.
(10) Supporting Information. Includes trivial calculations, Figures, and any data that does not appear in the manuscript text.

Report Submission

All students are required to submit their reports (5 total) in MS Word (last name_report number.doc) and PDF (last name_report number.pdf) format in a single E-mail to smholm2@uky.edu. Reports that are deemed too large by E-mail servers (e.g. Hotmail) will require reduction of Figures and/or Schemes data size; submissions via UK E-mail servers should not experience this problem. A complete and legible printed paper copy is to be submitted prior to or on the report due date (in class, 12 PM). *If you do not own a copy of Microsoft Word or Adobe Acrobat, this work can be performed on Chemistry/Physics Computer Lab computers (CP-148B).*

Reports submitted after class are considered as "late" and are subject to a 10% penalty immediately. Each subsequent day (starting at 12 PM each day) is assessed an additional 15% penalty. Late reports submitted after two or more days (≥ 48 hours) will not be graded and a grade of "0, zero" will be assigned.

Academic Integrity and Plagiarism

(1) First Offense. The minimum penalty for a first offense is no credit (a "zero" grade) on the assignment. Additional penalties such as extra academic work, reduction of the student letter grade, or assignment of an "E" for the course may be imposed at the discretion of the instructor. An additional "XE" grade penalty (shown permanently on the transcript), suspension, etc. may also be imposed.

(2) Subsequent Offenses. The minimum penalty for a second offense is an "E" grade for the course. A third offense automatically warrants suspension from the university. Further information concerning what constitutes academic integrity, dishonesty, penalties, and the University of Kentucky rationale for this policy may be found at http://www.uky.edu/Ombud.

For additional information consult: http://www.chem.uky.edu/courses/common/plagiarism.html

CHE450G Exam Dates, Tentative Reading/Discussion Topic Dates, and Assignment Due Dates

For updated Lecture Topics, Laboratory schedules, report and homework due dates, and Exam dates regularly refer to www.chem.uky.edu/research/holmes/classes/CHE450G/

Date		Subject to Change Tentative Topics/Order/Assigned Reading/Scheduled Assignment
Wednesday	Aug. 23	Introduction
Monday	Aug. 28	Atomic Structure
Wednesday	Aug. 30	Periodic Trends
Monday	*Sept. 4*	*Labor Day, Academic Holiday*
Wednesday	Sept. 6	Periodic Trends
Monday	Sept. 11	Lewis and VSEPR Structures ***HW 1 Due***
Wednesday	Sept. 13	Group Theory: Symmetry operations
Monday	Sept. 18	Group Theory: Symmetry operations LAB1:Geometric Isomerism and Optical Isomers of Dichlorobis (ethylenediamine)cobalt(III) Chloride
Wednesday	Sept. 20	Point Groups LAB1: Geometric Isomerism and Optical Isomers of Dichlorobis (ethylenediamine)cobalt(III) Chloride
Monday	Sept. 25	Point Groups LAB2: The Oxidation States of Tin
Wednesday	Sept. 27	Reducible Representations ***Report 1 Due: Geometric Isomerism and Optical Isomers of Dichlorobis(ethylenediamine)cobalt(III) Chloride*** LAB2: The Oxidation States of Tin
Monday	Oct. 2	Reducible Representations ***HW 2 Due*** LAB3: The Metal-Arene Complex [1,3,5-$C_6H_3(CH_3)_3$]$Mo(CO)_3$
Wednesday	Oct. 4	Group Theory; IR and Raman LAB3: The Metal-Arene Complex [1,3,5-$C_6H_3(CH_3)_3$]$Mo(CO)_3$
Monday	Oct. 9	Group Theory; IR and Raman ***HW 3 Due*** LAB4: Determination of Δ_o in Cr(III) Complexes
Wednesday	Oct. 11	Catch-up time LAB4: Determination of Δ_o in Cr(III) Complexes
Thursday	***Oct. 12***	***Exam 1, 6-8 PM***
Monday	Oct. 16	Hybridization and Molecular Orbital theory ***Report 2 Due: The Oxidation States of Tin*** LAB5: Magnetism: Paramagnetic $Mn(acac)_3$, Magnetic $Cr^{II}_2[Cr^{II}(CN)_6]\cdot nH_2O$, and/or Superconducting $YBa_2Cu_3O_7$
Wednesday	Oct. 18	Hybridization and Molecular Orbital theory LAB5: Magnetism: Paramagnetic $Mn(acac)_3$, Magnetic $Cr^{II}_2[Cr^{II}(CN)_6]\cdot nH_2O$, and/or Superconducting $YBa_2Cu_3O_7$
Monday	Oct. 23	SALCS: Homo- and heteronuclear diatomic molecules ***HW 4 Due***
Wednesday	Oct. 25	Molecular Orbital Diagrams
Monday	Oct. 30	Molecular Orbital Diagrams ***Report 3 Due: The Metal-Arene Complex [1,3,5-$C_6H_3(CH_3)_3$]$Mo(CO)_3$*** LAB6: Gold Nanoclusters and Self-Assembled Monolayers
Wednesday	Nov. 1	Crystal-Field Splitting Diagrams LAB6: Gold Nanoclusters and Self-Assembled Monolayers

Monday	Nov. 6	Transition Metal MO Diagrams
		Report 4 Due: Determination of Δ_o in Cr(III) Complexes
Wednesday	Nov. 8	Spectrochemical and Nephelauxetic Series
Monday	Nov. 13	Spectrochemical and Nephelauxetic Series
		HW 5 Due
Wednesday	Nov. 15	Catch-up time
Thursday	***Nov. 16***	***Exam 2, 6-8 PM***
Monday	Nov. 20	Metal-Ligand bonding/Ligand Types
		Report 5 Due: Magnetism: Paramagnetic $Mn(acac)_3$, Magnetic $Cr^{II}_2[Cr^{II}(CN)_6]\cdot nH_2O$, and/or Superconducting $YBa_2Cu_3O_7$
Wednesday	Nov. 22	Electron Counting (EAN Rule)
Monday	Nov. 27	Electron counting (non-18 electron)
		HW 6 Due
Wednesday	Nov. 29	Ligand-Field Stabilization Energies
Monday	Dec. 4	Ligand Substitution Reactions
Wednesday	Dec. 6	Ligand Substitution Reactions
Monday	***Dec. 11***	***Final Exam, 10:30 AM***