

Chemistry 336

INORGANIC CHEMISTRY

Spring 2022

INSTRUCTOR:

Dr. Ben Lovaasen – SCI 326 – Ext.7444

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Office Hours: MW 9:00—10:30a, R 8:00—11:00a

COURSE MATERIALS:

*Inorganic Chemistry*, Housecroft and Sharpe, 5<sup>th</sup> ed. (2018)

A Google Drive folder

Schoology

symotter.org

TIME/PLACE:

MWF 11:35—12:45 p.m.; SCI 302

### **Course Outcomes:**

Students who complete this course will:

- 1) know and be able to apply fundamental knowledge from topics in Inorganic Chemistry.
- 2) have mastered fundamental laboratory techniques in Inorganic Chemistry, including synthetic techniques unique to Inorganic Chemistry
- 3) be able to relate chemical properties and chemical relativities of Inorganic materials to their electronic structure.
- 4) be able to effectively communicate the results of an Inorganic synthesis and analysis using the conventions of chemical communication.
- 5) possess the tools and foundational background to explore in-depth topics in Inorganic Chemistry.

This course aligns well with Chemistry Department learning outcomes 1, 2, and 3:

- 1) Chemistry Knowledge – students will know and be able to apply fundamental knowledge in five core areas of chemistry (organic, inorganic, analytical, physical, biochemical)
- 2) Laboratory Skills – students will have mastered essential laboratory techniques and procedures
- 3) Scientific Communication – students will have developed the ability to clearly communicate scientific ideas in both written and oral formats

### **Course Description:**

Inorganic chemistry involves the study of all compounds that do not include C–H bonds, which are the domain of organic chemistry. This leads to an incredible diversity that ranges from the chemistry of gemstones and ores, to dyes and catalysts, to simple table salt. Some inorganic compounds are stable on a geologic time scale, and others are highly reactive in the presence of O<sub>2</sub>, water, light, heat or other stimuli. Due to the tremendous breadth of Inorganic Chemistry, this course is not designed to be comprehensive, but merely to provide tools that will enable to the student to explore the aspects of creation that they find most intriguing.

To tackle such a large topic, we will divide this course up into three sections. These sections are the fundamentals of chemistry, general topics in chemistry, topics unique to Inorganic Chemistry.

The fundamentals of chemistry include: atomic structure, molecular structure, molecular symmetry, group theory in chemistry.

General topics in chemistry include: acids and bases, redox chemistry.

Topics unique to inorganic chemistry include: solid state structures, coordination chemistry, organometallic chemistry, and main group descriptive chemistry.

### **Course Policies:**

#### **Accommodations**

Accommodations will be made for students with learning disabilities. Please alert the instructor in advance of any exams if special accommodations are necessary.

Wheaton College is committed to providing reasonable accommodations for students with disabilities. Any student with a documented disability needing academic adjustments is requested to contact the Academic and Disability Services Office as early in the semester as possible. Please call 630.752.5941 or send an e-mail to [jennifer.nicodem@wheaton.edu](mailto:jennifer.nicodem@wheaton.edu) for further information.

#### **Academic Honesty**

All work that you hand in is expected to be an accurate representation of a student's own effort and level of understanding. If it is suspected that this does not describe any work submitted by a student then the policies and procedures outlined in the Student Handbook will be followed. The likely result will be that any work that was determined not to be the student's own original work will result in a zero for the assignment. Any repeat offenses will result in failure of the course. Any discussion of exams or quizzes with a student who has not yet taken that exam or quiz is considered academic dishonesty.

#### **Attendance**

Attendance is expected, but unexpected circumstances occasionally arise. If these circumstances lead to your absence from class you will be held responsible for everything covered in class. Make-up exams will only be given for extenuating circumstances, or if a student arranges a change in exam date in advance.

## **Classroom Participation**

*Classroom participation is enthusiastically welcomed!* Please feel free to get my attention at appropriate times and in appropriate ways as the situation arises. This course will be better with your participation.

## **Collaboration**

Discussion with both students and faculty alike are often the best way to learn chemistry. *Therefore, it is encouraged that you study in groups or discuss particularly challenging homework problems with other students in the class.* There is a fine line between collaboration and copying. Each student is expected to come to the final answers for homework questions on his or her own.

## **Course Development**

The VIPEr Fellows project is supported by a 5-year grant from the National Science Foundation's Improving Undergraduate STEM Education (IUSE) program. A primary project goal is to develop, test, and refine a flexible, foundation-level inorganic chemistry course based on classroom observations, analysis of student work, surveys of students, and interviews with faculty. Your instructor has been chosen as a VIPEr Fellow (cohort 2) for AY21-23, and as such, there will be several surveys and recorded sessions that accompany this project. If you have any questions, please refer to the Participant Notice for Students form or ask your instructor. The research team will analyze this data to study the effects that student-centered active learning pedagogies and support from a community of practice has on student learning and instructional practice.

## **Office Hours**

Office hours are available at the times posted above by appointment. Office hours will be conducted in person. Sign up for office hours on Microsoft Bookings. You may sign up for up to 2x 15 minute slots/week. A link to my bookings page is available on Schoology.

## **Technology**

The last thing we need in our life right now is more communications technology. Don't bring your laptop to class; keep your phone put away during class, or better yet, keep it at home.

## **Course Work:**

### **Overview**

For academic discourse, spoken and written, the faculty expects students to use gender inclusive language for human beings.

Throughout this course, you will engage with the subject of Inorganic Chemistry through:

- Readings
- Lectures
- Problem Sets
- Laboratory
- Exams (3 section exams and a final exam)

These tools are meant to build on each other. The best way to succeed in this class is to keep up with the coursework and material *as it is being presented*. Reading will be your first exposure to material. Lectures will be used to emphasize material *you already learned during your reading*, presenting it in a new (and exciting!) way. Problem sets will allow you to apply this material to a multitude of circumstances and lab will give you real-world experience with chemical topics. If your grade begins to suffer it is usually due to performance on cumulative assignments (exams, etc.). The best way to prevent this is to focus on the fundamentals (readings, note-taking, asking questions in class!).

You will be given a numerical score that evaluates your performance on each element of this course. An overall score will be calculated according to the final rubric:

Laboratory	20%
Homework	15%
Section Exams	45%
Final Exam	20%

Again, each assignment is given a *score*, not a grade! Your final grade is assigned based on this score. While each assignment is graded on the same scale, some are easier than others. The best way to monitor your performance in this class is to use the final score rubric (above) to calculate your predicted final score and then compare it to the chart below. In the chart below, I have listed the low score cutoff for a certain grade. With it, I include the Wheaton College Faculty Handbook definitions of what a grade says about a student's performance. This rubric is a guide, but the instructor reserves the right to adjust each grade on this scale (not likely by more than 2%) to account for year-to-year fluctuations in exam difficulty, course structure, etc.

A	90%	Distinctive
A-	85%	Superior
B+	80%	Superior
B	75%	Superior
B-	70%	Acceptable
C+	65%	Acceptable
C	60%	Acceptable
C-	55%	Inadequate
D	45%	Inadequate
F	<45%	Failing

## Homework

Homework assignments are due *at the beginning of class* on the day they are assigned. All assignments must be on *one side* of a sheet of paper, trimmed to remove any frills or fringes, and stapled. Late assignments will be accepted up to 5 calendar days late with a penalty of 10% per late day.

HMWK 1: 1.9, 12, 14, 15, 18, 22, 25, 30, 32, 34, 43b

HMWK 2: 2.5, 9, 10, 19, 22, 26, 28, 29, 31

HMWK 3: 3.5, 8, 10, 13, 21, 23b,c,d,e, 25, 28 (only use functions for Al-Cl stretches), 32, 42a,b,c, 43

HMWK 4: 5.9, 10, 14, 17b, 23, 24, 27

HMWK 5: 6.1, 2, 4, 6, 9, 11, 14a, 17a, 26, 34b,c

HMWK 6: 7.1, 3, 4, 11, 15, 16, 28, 29; 8.3, 6, 15, 24, 32

HMWK 7: 19.7, 8, 10, 17a,b,c, 24, 25a; 20.2, 3, 5, 6, 26, 36a,b

HMWK 8: 24.1a,b, 2, 3a,b,d, 10, 14, 22, 24

HMWK 9: See handout on schoology

## Reading Assignments

Lectures will roughly follow the schedule outlined. The appropriate readings for each day are listed in the schedule below.

## Exams

There will be three section exams that will make up the “exam” grade for this course. Each exam is written to test the material covered in the previously untested sections. Each exam may draw on previously tested topics as foundational material, but care will be taken to keep each exam focused on new material. Students who expect to miss an exam should schedule a makeup date. Make up exams will be administered *before* the scheduled exam date, and should be scheduled at least 1 week prior to the exam. Students who cannot take an exam due to an emergency situation should alert the instructor as soon as possible, before the scheduled exam time. Students who miss exams for non-emergency situations without prior arrangements, may not be allowed to take the exam, or may take it for significantly reduced credit at the instructor's discretion.

## Final Exam

Your final exam is scheduled on Thursday, May 5<sup>th</sup> from 10:30 a.m.—12:30 p.m. The final exam will be the ACS Foundations of Inorganic Chemistry exam. Exam must be taken as scheduled unless prior permission is granted based on college-wide policy.

## Lab

Lab experiments will be performed using the lab handouts found on Schoology. A separate lab syllabus will be distributed during the lab.

## Tentative Schedule

Date	Topic/Chapter	Homework
1/10/22	Introduction/Review	
1/12/22	Basic concepts: Atoms/Ch. 1	
1/14/22	Basic concepts: Atoms/Ch. 1	
1/17/22	<b>MLK Day—No class</b>	
1/19/22	Basic concepts: Atoms/Ch. 1	
1/21/22	Basic concepts: Atoms/Ch. 1	
1/24/22	Basic concepts: Molecules/Ch. 2	HMWK 1 Due
1/26/22	Basic concepts: Molecules/Ch. 2	
1/28/22	Basic concepts: Molecules/Ch. 2	
1/31/22	Basic concepts: Molecules/Ch. 2	
2/2/22	Intro to molecular symmetry/Ch. 3	HMWK 2 Due
2/4/22	Intro to molecular symmetry/Ch. 3	
2/7/22	Intro to molecular symmetry/Ch. 3	
2/9/22	Bonding in polyatomic mol/Ch. 5	HMWK 3 Due
2/11/22	<b>Exam 1 (Ch. 1-3)</b>	
2/14/22	Bonding in polyatomic mol/Ch. 5	
2/16/22	Bonding in polyatomic mol/Ch. 5	
2/18/22	Structures of metals and salts/Ch. 6	HMWK 4 Due
2/21/22	<b>President's Day—No class</b>	
2/23/22	Structures of metals and salts/Ch. 6	
2/25/22	Structures of metals and salts/Ch. 6	
2/28/22	Acids and Bases in aq soln/Ch. 7	HMWK 5 Due

3/2/22	Acids and Bases in aq soln/Ch. 7	
3/4/22	Acids and Bases in aq soln/Ch. 7	
3/7–3/11	<b>Spring Break. Woo.</b>	
3/14/21	Reduction and Oxidation/Ch. 8	
3/16/21	Reduction and Oxidation/Ch. 8	
3/18/21	Reduction and Oxidation/Ch. 8	
3/21/21	Coordination Chemistry/Ch 19, 20.1–20.5	HMWK 6 Due
3/23/21	<b>Exam 2 (Ch. 5–8)</b>	
3/25/21	Coordination Chemistry/Ch 19, 20.1–20.5	
3/28/21	Coordination Chemistry/Ch 19, 20.1–20.5	
3/30/21	Organometallic Chemistry/Ch. 24	HMWK 7 Due
4/1/21	Organometallic Chemistry/Ch. 24	
4/4/21	Organometallic Chemistry/Ch. 24	
4/6/21	Organometallic Chemistry/Ch. 24	
4/8/21	Introduction to Descriptive Chemistry	HMWK 8 Due
4/11/21	Hydrogen/Ch. 10	
4/13/21	Electron Deficient Chemistry/Ch. 11, 12, 13	
<b>4/15/21</b>	<b>Good Friday—No class</b>	
4/18/21	Electron Deficient Chemistry/Ch. 11, 12, 13	
4/20/21	Electron Sufficient Chemistry/Ch. 14	
4/22/21	Electron Rich Chemistry/Ch. 15, 16	
4/25/21	Electron Rich Chemistry/Ch. 15, 16	
4/27/21	Halogens/Ch. 17	HMWK 9 Due (in Lab)
4/29/21	<b>Exam 3 (everything else)</b>	
<b>Final Exam: Thursday, May 5<sup>th</sup> from 10:30 a.m.—12:30 p.m.</b>		