

Chemistry 730
Coordination and Organometallic Chemistry
Fall 2017

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Time: 11:00-12:15 TTh Malott 3059

This course covers fundamental aspects of chemical bonding, group theory, coordination, organometallic, and bioinorganic chemistry.

Office Hours: Open door policy, but it often helps to touch bases beforehand.

Assigned Text: *Inorganic Chemistry, Principles of Structure and Reactivity* by J. E. Huheey, E. A. Keiter, and R. L. Keiter

Suggested Reading: R. A. Crabtree *"The Organometallic Chemistry of the Transition Metals"*, 3rd or 6th Ed., Wiley, NY, 2014. ISBN: 9781118138076

Assignments: Reading assignments will include chapters from the texts and other assignments, such as journal articles, seminars, web-sites.

Problem sets will be given to support lectures, usually in conjunction with text chapters. They will be collected and will be due (handed in) approximately one week after material is covered in class (specific dates will be announced during lectures).

Grading: Problem Sets: 10% of grade - Graded on a scale of 1 - 10 based on 10 being perfect. Homework should be neatly handwritten (or typed), with all work and reasoning shown. DO NOT hand in homework that is torn from notebooks with spiral edges nor homework that is not neatly stapled. Homework handed in late will result in grade reduction depending on degree of lateness, and homework not handed in will result in a grade of zero for that problem set. Sloppy, hard to read homework may be returned without grading or at the very least points will be deducted.

Three in-class exams: 20% each (dates and times TBA). Exams will roughly align with the three parts of the course outlined below.

Final Exam: 30%. Students averaging above 90% on the three in-class exams will be given the option to be exempt from the final exam!

Important Notes: *Helpful hints and material not in the text will be covered in the lectures.* For this reason, it is **expected** that you attend lectures. Anyone caught cheating on any exam, or in handing in duplicate homework, will receive a zero for that work. The instructor reserves the right to report any incident of academic misconduct, including evidence of plagiarism.

Part I. Basic Bonding and Group Theory

Chapter 1: What is Inorganic Chemistry? A background of what inorganic comprises chemistry. **Read on your own.**

Chapter 2: The Structure of the Atom. Review of orbital shapes and quantum numbers; orbital filling of electrons; the periodic table; shielding; and periodic properties. Problems: 2, 3, 6, 10, 19, 20, 23, 24.

Chapter 3: Symmetry and Group Theory. Description of symmetry elements, symmetry operations, and point groups; introduction to character tables and their uses. Problems 1-3, 9, 10, 15, 28, 29.

Chapter 4. Bonding Models in Inorganic Chemistry 1. Ionic Bonding. Diatomic and multi-ionic interactions. **Quick review.**

Chapter 5. Bonding Models in Inorganic Chemistry 2. The Covalent Bond. Lewis dot structures, hybridization, homo- and heteronuclear diatomic molecules. **Quick review.**

Chapter 6: Valence Shell Electron Pair Repulsion Theory. Quick review. You will be expected to know this for General Chemistry courses as a GTA.

Problems Chapters 5 and 6: Determine Lewis dot diagrams and predict the structure using VSEPR Theory for SiCl_4 , OF_2 , SCl_2 , PbCl_2 , TaCl_5 , BrF_4^+ , $\text{In}(\text{CH}_3)_3$, BeCl_2 , SbF_4^- , PH_3 , H_3O^+ , PCl_5 , XeOF_4 , N_2O , SF_4 .

Chapter 7. The Solid State. The Band Theory as a description of insulating, semiconducting and conducting solids. **Quick review.**

Chapter 8. Chemical Forces. van der Waals forces (London dispersion forces) and hydrogen bonding, and a comparison of the energies of the types of chemical forces. **Quick review.**

Part II. Coordination Chemistry.

Chapter 11: Bonding, Spectra, and Magnetism. Introduction to coordination chemistry including coordination numbers, ligands, nomenclature, crystal field and molecular orbital theories. Basic principles of electronic spectra and magnetism. Problems 1-4, 7, 8, 11, 12, 20, 21, 23, 24, 32, 35.

Chapter 12: Coordination Chemistry: Structure. A survey of coordination numbers and geometries, and descriptions of types of isomerism, the chelate and macrocyclic effects. Problems 1, 9, 10, 11, 12.

Chapter 13: Coordination Chemistry: Reactions, Kinetics, and Mechanisms. Mechanisms of square planar and octahedral substitution reactions and electron transfer mechanisms. Problems 1-3, 8, 9, 11, 15, 17, 19, 24-28, 30.

Part III. Organometallic Chemistry, Catalysis, and Bioinorganic Chemistry

Chapter 15. Organometallic Chemistry. The 18-electron rule, metal carbonyl complexes, carbon π -bonds, and other metal carbon compounds. Introduction to classes of catalytic reactions. Selected readings from Crabtree and assigned organometallic papers/reviews. Problems will be assigned later.

Chapter 19. Bioinorganic Chemistry – time permitting. A description of the importance of inorganic coordination chemistry in biological systems. Survey of different types of metalloproteins and metalloenzymes and their functions. Selected readings from papers/reviews will be assigned.