

# Advanced Inorganic Chemistry

## Final Exam Study Guide

The final (250 points) will be composed of two parts:

- The ACS inorganic exam (60 multiple choice questions, 2 points each, graded out of 80 points)
- Another portion, similar to the regular exams (170 points)

On the in-house final, there will be some short answer questions, similar to 3-6 point questions on previous exams. The remaining problems will present an inorganic chemical system, then ask you several questions about that system. The questions will be likely to cover a range of topics and will focus on concepts on this study guide. For example, I might present the formula and structure of a coordination compound from the literature and then ask you to do several things. These might include: naming the compound, calculating the spin only magnetic moment, discussing the strong/weak field characteristics of the ligands, identifying the point group and asking about how you would expect the geometry to differ from ideality. Expect a mix of coordination compounds, solid state compounds, at least one organometallic compound. For this part, it would be best to know the basic stuff cold (naming, geometries, point groups, counting electrons (charges, d count), for example).

### Chapter 2

- wavefunctions, radial and angular functions, nodes (definition, angular and radial), quantum numbers
- electron filling:  $\Pi_e$ ,  $\Pi_c$

### Chapter 3

- Lewis dot structures and geometry predictions (including deviations from “ideal” shapes) taking into account electron pair repulsions (lone-pair, bonding-pair, multiple bonds), and when expanded shells are possible.

### Chapter 4

- assigning point groups
- forming reducible representations
- decomposing reducible reps into irreps
- vibrations (total and just for a specific type, like C=O)
- ir/raman active vibrations

### Chapter 5

- SALCs
- HOMO/LUMO definitions
- MO diagrams for small systems, using symmetry labels to form MO diagrams

### Chapter 6

- hard and soft acids and bases and hard/hard, soft/soft and hard/soft interactions
- Lewis acids and bases.

Next Page ⇒

## Chapter 7

- crystal classes and Bravais lattices
- common simple lattice types
- coordination numbers and empirical formulas
- lattice enthalpy
- insulators, semiconductors, conductors (band structures, temp and resistivity)
- p and n type semiconductors and doping
- definition of a superconductor

## Chapter 8

- caged boranes - closo, nido, arachno
- bonding in main group compounds: bond orders, types of bonds ( $\sigma$ ,  $\pi$ )

## Chapter 9

- naming coordination compounds (know simple ligands, such as  $F^-$ ,  $Cl^-$ ,  $CN^-$ ,  $CO$ ,  $H_2O$ ,  $NH_3$ ,  $SCN^-$ , etc. Longer ones, like acac or bipy will be given if called for.)
- isomers: cis/trans, mer/fac.
- common geometries for each coordination number (3-6)
- types of compounds which tend to have low or high coordination numbers

## Chapter 10

- crystal field/ligand field theory: octahedral/tetrahedral splitting, relative magnitudes, CFSE/LFSE
- determining the number of valence d electrons in a metal ion
- high spin complexes, low spin complexes, spin-only magnetic momenta
- ligands as  $\pi$  donors/acceptors, weak/strong field ligands

## Chapter 11

- microstate tables for 2 electrons, finding term symbols, determining ground state terms
- selection rules - allowed electronic transitions
- how to use Tanabe-Sugano diagrams

## Chapter 12

- labile and inert complexes: definitions, general rules
- substitution mechanisms (+ likely ones for octahedral, square planar)
- trans effect (order for  $CN^-$ ,  $CO$ ,  $Cl^-$ ,  $NH_3$ ,  $H_2O$ )
- inner and outer sphere mechanisms

## Chapter 13

- 18 electron rule
- common ligands and electron counting
- hapticity and bridging notation and structure (e.g.  $\eta_5$  and  $\mu_2$ )
- determining bond order for metal-metal bonds
- ligands, backbonding, bond strength/length/vib.freq.

## Chapter 14

- ligand substitution
- oxidative addition, reductive elimination
- CO insertion
- 1,2-insertion reactions
- $\beta$  hydride elimination