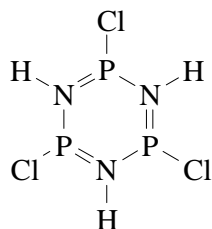


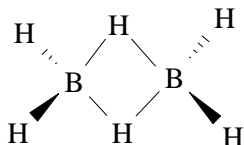
INORGANIC CHEMISTRY FINAL EXAM - *December 18, 1995*

- 1) Generate all symmetry operations associated with a C_3 rotation axis passing through a horizontal mirror plane. What point group does this create? [20 pts]
- 2) For the following molecules and/or ions, show all symmetry elements and identify the point group. [60 pts]

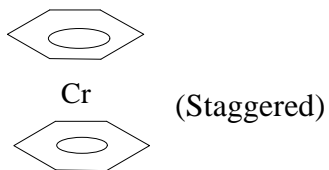
a)



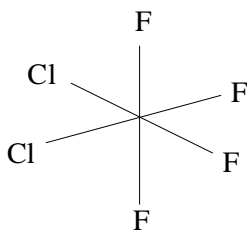
b)



c)

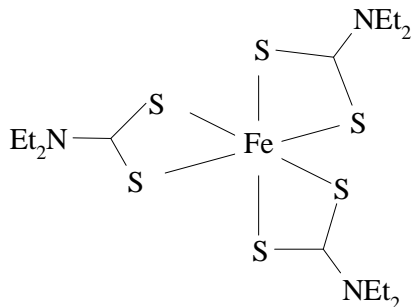


d)



3. Define the following terms. Give at least one example. [100 pts]
- A) electronegativity (contrast Mulliken and Pauling scales)
 - B) interstitial hydride
 - C) Jahn-Teller effect (static and dynamic)
 - D) monoclinic crystal system
 - E) bond dissociation energy
 - F) hexagonal closest packed
 - G) cubic closest packed
 - H) photoelectron spectroscopy
 - I) Berry pseudorotation
 - J) crystal field stabilization energy
4. Why is the trigonal anti-prism coordination geometry much less common than octahedral for the coordination number of six? What type of ligands tend to stabilize the trigonal anti-prism form? [30 pts]
5. Gallium arsenide, GaAs, is an intrinsic semiconductor with a band gap of 1.5eV. [60 pts]
- A. Draw a density of states diagram for GaAs. Be sure to identify and label all essential features.
 - B. Making use of the density of states diagram in part A, explain the origin of electrical conductivity in GaAs. How does the conductivity vary with temperature? How does the temperature dependence in GaAs compare with metallic conduction?
 - C. When traces of either selenium or zinc are added to GaAs, the electrical conductivity increases. In each case,
 - I) Draw a modified density of states diagram
 - II) Explain why the conductivity increases
 - III) determine what new type of semiconductor is formed (Hint: what are the primary charge carriers?)

6. An iron(III) dithiocarbamate, **A**, shows a temperature dependent magnetic moment as shown below. Using a crystal field model, answer the following questions. (You may assume that iron is in a perfect octahedral field.) [60 pts]



A

- A. At the lowest temperature indicated ($\sim 100\text{K}$), what is the electron configuration of the iron? How many unpaired electrons are present?
- B. Why does the magnetic moment of this complex increase with increasing temperature?
- C. How might the magnetic moment of this complex vary with increasing pressure (at constant temperature)? Why?
7. The FH distances are both equal in the linear ion FHF^- , which contains exceptionally strong hydrogen bonds. Write a molecular orbital correlation diagram for this ion, using only p orbitals for the fluorine atom for bonding. [30 pts]
8. Create a Born-Haber cycle for the determination of the lattice energy, ΔH_{lat} , of CaCl_2 , based on known thermodynamic and spectroscopic properties such as ionization potentials, heats of formation, electron affinities, heats of sublimation, etc. Write an expression for ΔH_{lat} in terms of these quantities. [40 pts]

