

Chem 151A, Inorganic Chemistry

Spring 2015

Problem Set #2

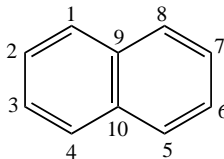
DUE: FRIDAY MAY 8, 2015, 9:30 am

Chem 151A Mail Slot in PSB Mail Room (Next to PSB 238)

20 marks 1. For the following molecules, name the idealized VSEPR geometry and assign the point group: (a) GeH_2D_2 (D = deuterium); (b) AsF_5 ; (c) C_2H_2 ; (d) SiH_3D ; (e) SO_2Cl_2

15 marks 2. List the symmetry elements of the following organic molecules: (a) cyclohexane in the boat conformation; (b) cyclohexane in the chair conformation; (c) biphenyl ($\text{C}_6\text{H}_5\text{-C}_6\text{H}_5$), where the rings are co-planar; (d) biphenyl, where the rings are perpendicular to each other; (e) biphenyl, where the rings define an angle of 45° .

10 marks 3. Naphthalene is shown below. Give its point group, as well as that of all possible isomers of monochloronaphthalene (note: do not duplicate any of your answers! e.g.: 2-monochloronaphthalene is equivalent to 3-, 6- and 7-monochloronaphthalene).



20 marks 4. Determine the point groups and vibrational mode symmetries (Γ_{vib}) for gaseous BF_3 , NF_3 and ClF_3 . Would IR and Raman spectroscopies be able to differentiate between these gases? (Hint: $N = 4$ for each, so they have the same number of vibrational degrees of freedom; also, a doubly degenerate set of vibrations will appear at the same energy in a spectrum.)

10 marks 5. Describe the bonding in $[\text{Ni}(\text{NH}_3)_6]^{2+}$ with each of the following models: (a) valence bond theory; (b) crystal field theory.

10 marks 6. Draw out all the isomers, geometric and optical, of the following: (a) $[\text{Co}(\text{en})_2\text{Cl}_2]$; (b) $[\text{Co}(\text{en})_2(\text{NH}_3)\text{Cl}]^{2+}$; (c) $[\text{Co}(\text{en})(\text{NH}_3)_2\text{Cl}_2]^+$.

15 marks 7. Use crystal field theory to discuss the relative differences in the geometry, color, molar absorptivity and magnetism of the complexes NiCl_4^{2-} and PtCl_4^{2-} .

Total: 100 marks