Chem 400
Inorganic Chemistry
Practice Exam 2

1 of 10
2 of 10
3 of 20
4 of 10
5 of 20
6 of 5
7 of 5
8 of 10
9 of 10

∑ of 100

Name ____________________________________________
(please print)
1. Using **balanced** chemical equations, give an explanation for the following observations: AlF$_3$ has only a low solubility in liquid HF, but a combination of NaF and AlF$_3$ leads to dissolution of the reagents ($1^{st}$ equation); when BF$_3$ is added to this solution, a precipitate forms ($2^{nd}$ equation). (10 points)

2. The $\sigma$ bonding in the linear molecule XeF$_2$ may be described as a 3-center, 4-electron bond. If the z axis is assigned as the internuclear axis, use the $p_z$ orbitals on each of the atoms to prepare a molecular orbital description of the sigma bonding in XeF$_2$. (10 points)
3. Suggest likely products for the following reactions (which are balanced on the left-hand side): (2 points each)

a. \(2 \text{XeF}_2 + \text{SbF}_5 \rightarrow\)

b. \(\text{Me}_3\text{SiCl} + \text{Na[C}_5\text{H}_5] \rightarrow\)

c. \(\text{BCl}_3 + 3 \text{C}_2\text{H}_5\text{OH} \rightarrow\)

d. \(\text{^nBuLi} + \text{C}_6\text{H}_6 \rightarrow\)

e. \(2 (\text{CH}_3)_3\text{SnCl} + \text{Mg} \rightarrow\)

f. \[
\begin{array}{c}
\text{B}_2\text{H}_6 + 6 \text{CH}_2=\text{CH}_2 \\
1. \text{THF} \\
2. \text{H}_2\text{O}_2
\end{array}
\rightarrow\]

g. \(\text{PCl}_5 + \text{N}_2\text{H}_4 \rightarrow\)

h. \(2\text{XeF}_6 + \text{SiO}_2 \rightarrow\)

i. \(\text{AlCl}_3 + 3 \text{CH}_3\text{CH}_2\text{MgCl} \rightarrow\)

j. \(2\text{NaOH} + 2\text{F}_2 \rightarrow\)
4. ClO₂ and [ClO₂]⁻ are bent, each with equivalent Cl-O bond lengths: 147 pm in ClO₂ and 157 pm in [ClO₂]⁻. Give a description of bonding in ClO₂ and [ClO₂]⁻ and rationalize the difference in Cl-O bond lengths. Use both resonance structures and MO theory arguments. Draw a representation of the π-molecular orbitals. (10 points)
5. Draw reasonable three-dimensional structures for each of the following inorganic molecules (2 points each)

a. \((\text{CH}_3\text{Li})_4\)

b. \([\text{B}_3\text{O}_6]^{3-}\)

c. \((\text{HBNH})_3\)

d. \([\text{Si}_4\text{O}_{12}]^{8-}\)

e. \(\text{Bi}_2\text{Cl}_9^{2-}\)
f. \([H_2O_4]^+\)

g. \(S_8\)

h. \([S_4]^{2+}\)

i. \((\eta^5-Cp)BeH\)

j. \(Al_2(CH_3)_6\)
6. The triiodide ion, $I_3^-$, is linear, but $I_3^+$ is bent. Explain. (5 points):

7. The sulfur-sulfur distance in $S_2$, the major component of sulfur vapor above ~720 °C, is 189 pm, significantly shorter than the sulfur-sulfur distance of 206 pm in $S_8$. Suggest an explanation for the shorter distance in $S_2$. (5 points)
8. Suggest a **balanced** chemical equation to describe the autodissociation of ICl (1\textsuperscript{st} equation). NaCl behaves as a base in this solvent, while AlCl\textsubscript{3} behaves as an acid. Write **balanced** chemical equations for the dissolution of NaCl in ICl (2\textsuperscript{nd} equation) and AlCl\textsubscript{3} in ICl (3\textsuperscript{rd} equation). (10 points)

9. Describe the bonding in Ga\textsubscript{2}H\textsubscript{6} and Ga\textsubscript{2}Cl\textsubscript{6}. (10 points)