

Chem 360: Inorganic Chemistry Exam/Homework

Due Tuesday 3 April, 2007

1. All work to be done alone.
2. The exam is open book and unrestricted time.
3. No pencil or red pen.

Q.1. Using Wade's rules predict and explain the structures of (a) $B_9C_2H_{11}$ and $[B_9C_2H_{11}]^{2-}$ (10 points)

A.1. (a) closo, (b) nido.

Q.2. Which of each pair will have the strongest Lewis acid-base donor bond? (a) $BF_3 \cdot NH_3$ versus $BCl_3 \cdot NH_3$, (b) $BF_3 \cdot NH_3$ versus $BF_3 \cdot NMe_3$ (10 points)

A.2. (A) $BF_3 \cdot NH_3$, (b) $BF_3 \cdot NMe_3$.

Q.3. What is the density of (a) $Al_2O_3 \cdot 2H_2O$, (b) $Al_2O_3 \cdot H_2O$, and (c) Al_2O_3 ? Explain the trend. (10 points)

A.3. Hydration results in an expanded structure.

Q.4. Aluminum carbide forms from the reaction of Al with carbon at high temperatures, but reacts spontaneously with water. Give the balanced equation including all the products from the reactions. (10 points)

A.4. $4 Al + 3 C \rightarrow Al_4C_3$, $Al_4C_3 + 12 H_2O \rightarrow 3 CH_4 + 4 Al(OH)_3$ (or other oxide/hydroxide)

Q.5. Friedel-Crafts reactions are common in organic chemistry. Which of the following is expected to be a better catalyst? (a) $AlCl_3$ versus $AlBr_3$, (b) $MgCl_2$ versus $AlCl_3$ (10 points)

A.5. (a) and (b) $AlCl_3$.

Q.6. $AlMe_3$ is a dimer in solution. (a) Draw the structure. At room temperature the 1H NMR shows only a single resonance for the CH_3 groups. (b) Why? (15 points)

Q.6. (b) fluxional exchange at room temperature.

Q.7. Suggest a structure for the following. (15 points)

a) $[(tBu)Al(O)]_6$

b) $[(Cl)Al(NMe)]_4$

c) $[\text{HAl}(\text{NMe})_6]$

Q.8. Which of the following pairs would be expected to be more stable? (15 points)

- a) AlCl_3 versus AlCl
- b) PbCl_4 versus PbCl_2
- c) PCl_5 versus BiCl_5

Q.8. (a) AlCl_3 , (b) PbCl_2 , (c) PCl_5 .

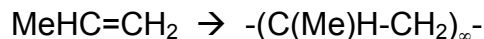
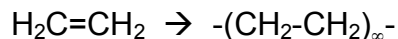
Q.9. COBr_2 reacts with water what are the products? (5 points)

$\text{CO}_2 + \text{HBr}$

Q.10. CO reacts with alkali metals (strong reducing agents, i.e., add an electron to something) to form a di-anion. What is it and using VSEPR what is its structure? (10 points)

Q.10. $^-\text{O}-\text{C}\equiv\text{C}-\text{O}^-$

Q.11. Ethylene and propylene are known to polymerize by the following reaction:



CS_2 also polymerizes in a similar manner. What is the structure of the polymer formed? (10 points)

Q.12. Use VSEPR to predict the structures of (a) SbCl_3 , (b) $\text{SbCl}_3 \cdot \text{NMe}_3$, and (c) $\text{SbCl}_3(\text{NMe}_3)_2$. (15 points).

Q.12. (a) tetrahedral (trigonal pyramid), (b) trigonal bipyramid (see saw), (c) octahedral.