Name _____ Test 4 (12/12)
CHEM 0211 (Adv Inorganic) Fall 2012

1. Explain how trimethylamine, $N(CH_3)_3$, can act as a (a. 8 pts) Brønsted-Lowry base and a (b. 8 pts.) Lewis base.

1. _____

2. _____

3. _____

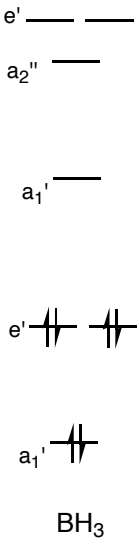
4. _____

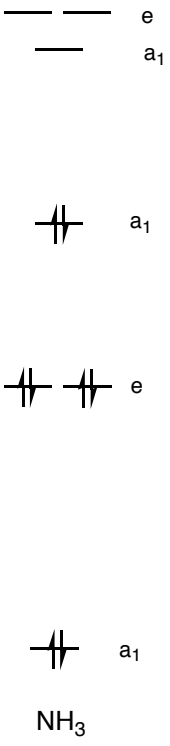
5. _____

6. _____

7. _____

2. MO diagrams for $BH_3$ and $NH_3$ are drawn below.



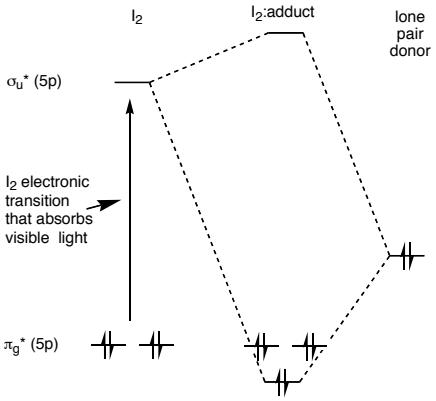

a. (4 pts.) In the reaction of $BH_3$ and $NH_3$ to form $H_3BNH_3$, which molecule acts as the Lewis base?

b. (4 pts.) In the reaction of $BH_3$ with $NH_3$ to form $H_3BNH_3$, which molecule acts as the Lewis acid?

c. (8 pts.) Circle and label (with names) the MO's that participate in the formation of the acid-base adduct.

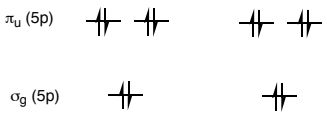
d. (6 pts.) Draw the new MO's that form when the adduct forms. Ignore all MO's not directly involved in adduct formation.

3. Iodine absorbs light because an electron can be promoted from a $\pi_g^*$ orbital to the $\sigma_u^*$ orbital.

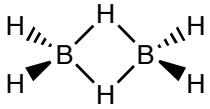



a. (6 pts.) Is the $I_2$ acting as a Lewis acid or a Lewis base? Explain.

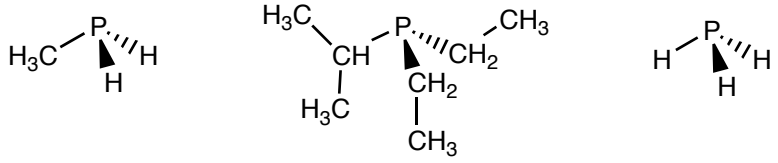
b. (6 pts.) Explain why the color of the light that is absorbed changes when the $I_2$ acceptor-donor complex forms.



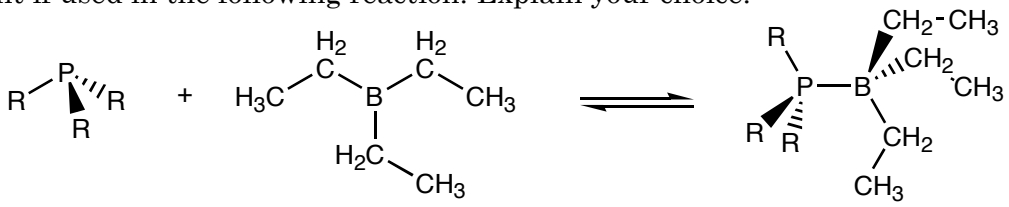

4. (10 pts) Describe the bonding in $B_2H_6$; that is, describe whether the lines in the following structure indicate classical two-center two-electron bonds, and if the don't describe what the lines might mean. It is not necessary to create an MO diagram.



5. a. (8 pts.) Ignoring any solvent effects which of the following molecules would be the best at attracting protons. Explain your choice.



b. (8 pts.) Which of the phosphines below would produce a reaction with the largest equilibrium constant if used in the following reaction. Explain your choice.



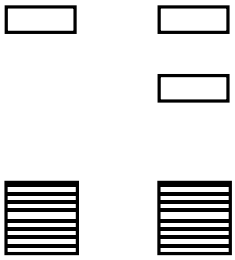
R = Cl, or H, or $CH_2CH_3$

6. In crystals of zinc blende, one of two crystalline forms of ZnS, the zinc atoms occupy tetrahedral holes of a face-centered cubic crystal of sulfide ions.

a. (8 pts.) Describe the environment around each zinc ion; that is, determine how many sulfide ions surround each zinc ion, and draw a 3-D representation (wedge and dashed bond) of a zinc ion and the sulfide ions in the zinc ion's coordination sphere.

b. (8 pts.) Draw a sketch of one face of the unit cell for a zinc blende zinc sulfide crystal. Label the atoms

7. Two energy level diagrams are drawn below. One is a diagram for a semiconductor, the other is a diagram for a doped semiconductor. The empty rectangles represent empty bands, the rectangles with lines indicate bands filled with electrons.



a. (6 pts.) Label the valence and conduction bands in the undoped material.

b. (6 pts.) Is the doped semiconductor an n-type or a p-type semiconductor. Explain your response.

c. (6 pts) If the undoped material is silicon, would the dopant be consistent with a gallium or arsenic dopant?

d. (8 pts.) Describe two ways that a semiconductor can be made to conduct.