CHEM101/3, D1 **MidTerm Review Questions** 2010 10 20
HT

1.) Supply the missing names or formulas:

a. aluminum sulfite

b. chlorous acid

c. $AuBr_3$

d. N_2O_3

2.) A compound contains only C, H and N. Combustion of 2.103 mg of the compound produced 5.840 mg CO_2 and 1.200 mg H_2O. What is the empirical formula of the compound?

3.) Hydrogen cyanide is produced industrially from the reaction of gaseous ammonia,

oxygen and methane: $2\ NH_{3\ (g)} + 3\ O_{2\ (g)} + 2\ CH_{4\ (g)} \rightarrow 2\ HCN_{\ (g)} + 6\ H_2O_{\ (g)}$

If 120 kg of ammonia, 300 kg of oxygen and 150 kg of methane were used, calculate the amount (in kg) of hydrogen cyanide produced assuming the reaction efficiency is 80%.
Use the following molar masses: NH_3 = 17.031 g/mol, O_2 = 32.000 g/mol,
CH_4 = 16.043 g/mol, HCN = 27.026 g/mol, H_2O = 18.016 g/mol

4.) Draw the correct Lewis dot structure and indicate the expected geometry around each central atom. To receive full marks, indicate the number of valence electrons, the number of unshared electrons and formal charges for each atom. If necessary, draw resonance structures.

a. HCO_3^-

b. Briefly explain why the HOH bond angle in water is smaller than the HNH bond angle in ammonia. Indicate which theory you are basing your explanation on.

5.) a. Write the electron configuration for tin.

b. Give the maximum number of e^-'s in an atom that can have these quantum numbers:
n = 5 and $m_\ell = +2$.

c. Find the wavelength corresponding to the removal (to infinity) of an electron in the hydrogen atom that is initially at n = 4.

6.) a. Give/Explain in your words: Hund's rule.

b. Explain the bonding and hybridization in CO_2.

7.) Consider the acetylide anion, C_2^{2-}, and analyze it by various bonding theories.

a. Derive its Lewis structure.

b. What are the number of e^- groups around each C?

c. Are there any formal charges? If so, where?

d. Describe the bonding acc. to the VB theory.

There are two possibilities: with and without hybridization.
Try your hands at both.

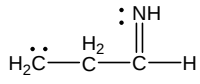
e. Sketch the MO energy diagram, label the energy levels and indicate their occupation by e^-'s.

f. Assess magnetic properties by MO theory.

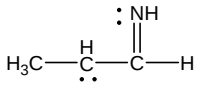
8.) Application of MO theory. For the following species sketch those bonding MO's that are not cancelled by antibonding orbitals,

a. Li_2 b. C_2^{2-}

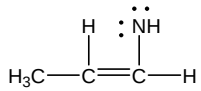
9.) a. Indicate formal charges on the following structures.



a.



b.



c.

b. Which of them are related by resonance. Explain.

c. Which of those related by resonance contributes most to the resonance hybrid?