

EXAM FOUR
CHM 203 (Dr. Mattson)
10 NOVEMBER 2010

Print your name:

Signature:

Instructions: Show all work whenever a calculation is required! You will receive credit for how you worked each problem as well as for the correct answer. If you need more space, you may use the back of your periodic table — Write: "See PT" in box and then attach the periodic table. **BOX YOUR ANSWERS!** Write legibly.

1. (2 pts) What 3rd row element would you expect to have the following sequence of ionization energies? $E_{i1} = 578$, $E_{i2} = 1817$, $E_{i3} = 2745$, $E_{i4} = 11575$, $E_{i5} = 14830$, $E_{i6} = 18376$ and $E_{i7} = 23293$ kJ/mol

Circle: Na Mg Al Si P S Cl Ar

2. (5 pts) Check the appropriate box after each of the following substances as being polar covalent-molecular, non-polar covalent-molecular, or ionic.

| | Polar Cov-Molec | Non-polar Cov-Molec | Ionic |
|--------------------|-----------------|---------------------|-------|
| A. Br ₂ | | | |
| B. KBr | | | |
| C. FCl | | | |
| D. CO | | | |
| E. H ₂ | | | |

3. (4 pts) The electronegativity of H is 2.1, similar to that of boron (2.0). Circle the most polar bond in each group.

- A. C-H C-N C-F
 B. F-F F-Cl F-Br
 C. Si-O C-S
 D. H-H H-N H-O

4. (12 pts) Sketch Lewis dot structures for the following compounds and ions.

| | |
|----------------------------------|----------------------------------|
| A. SH ₃ ⁺ | B. SiH ₄ |
| C. C ₂ H ₄ | D. H ₂ O ₂ |
| E. BF ₄ ⁻ | F. CO ₂ |

5. (3 pt) Sketch the Lewis dot structure for the carbonate ion and indicate how many total resonance forms are present. (Sketch only one.)

6. (3 pt) Sketch the Lewis dot structure for the nitrite ion, NO₂⁻, and indicate the formal charge for each atom present.

7. (6 pt) Sketch the Lewis dot structure for the SeF₂, SeF₄, and SeF₆. Assign ABE formulas to each.

8. (6 pts) Determine the shape of the following molecules or ions. Refer to Lewis structures previously sketched in earlier problems.

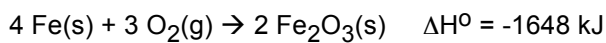
| | |
|----------------------------------|---------------------------------|
| A. SH ₃ ⁺ | B. SiH ₄ |
| C. SeF ₆ | D. NO ₂ ⁻ |
| E. CO ₃ ⁻² | F. CO ₂ |

9a. (4 pts) Butynal has the formula C_4H_4O and the atoms are connected C-C-C-C-O. Sketch a structure for the molecule (with O on the right) by providing multiple bonds and lone pairs where needed. Note: 3 H atoms are bonded to the first C and one is bonded to the fourth C atom.

9b. (4 pts) List the geometries of each carbon atom in the structure of butynal in the same order you have sketched them in 9a.

9c. (4 pts) Give the hybridization for each carbon atom in the structure of butynal in the same order you have sketched them in 9a.

10a. (4 pts) Consider the reaction below to answer the question that follows.

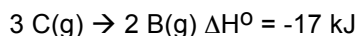
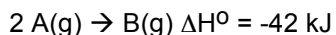


How much heat is released when 2.2 g of iron is combusted in excess oxygen?

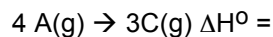
10b. (2 pt) Is the equation in 10a the same as the one that is used to define ΔH_f° ? If not, why not?

- A. Yes
- B. No, the equation needs to be divided by 2
- C. No, the reactants must be ions
- D. No, all reactants and products must be gases.

11. (3 pts) Given:

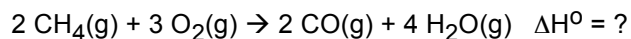


Calculate ΔH° for the reaction:



12. (4 pts) Use the ΔH_f° data to calculate ΔH° for the reaction that follows the table.

| | ΔH_f° (kJ/mol): |
|-------------------------|------------------------------|
| $\text{CH}_4\text{(g)}$ | -75 |
| CO(g) | -111 |
| $\text{H}_2\text{O(g)}$ | -242 |



13. (3 pts) Calculate q for a reaction performed in a calorimeter, given that the contents of the calorimeter had a mass of 56.0 g and warmed up 5.2 deg. The contents were mostly water and so assume the specific heat to be 4.18 J/g deg.

14. (3 pts) Sodium has a molar heat capacity of 28.2 J/mol deg. Convert this to specific heat in units of J/g deg.

15. (8 pts) Nomenclature. Name the following covalent-molecular compounds. Print!

a. N_2O_4

b. CO

c. SO_3

d. BrF_5

e. XeF_4

f. NI_3

g. ClO_2

h. BF_3

Print your name below:

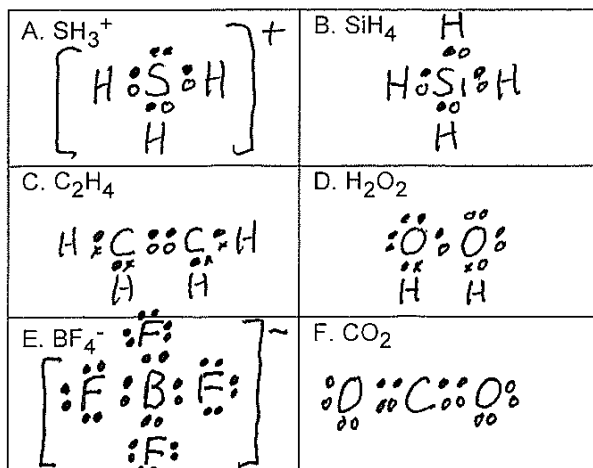
For DocM to complete:

Subtotal from exam: _____

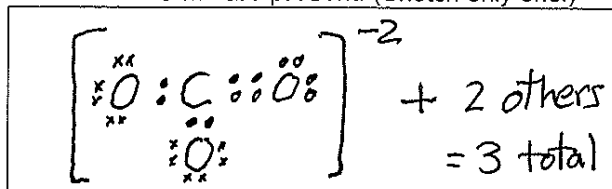
Homework: (20 max) _____

Answers:

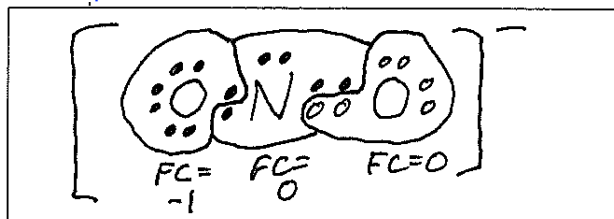
- Al
- A. Non-polar Cov-Molec; B. Ionic; C. Polar Cov-Molec; D. Polar Cov-Molec; E. Non-polar Cov-Molec
- A. C-F; B. F-Br; C. Si-O; D. H-O
- (12 pts) Sketch Lewis dot structures for the following compounds and ions.



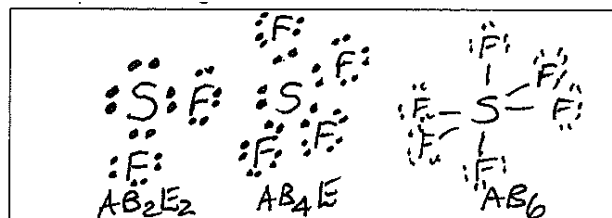
- (3 pt) Sketch the Lewis dot structure for the carbonate ion and indicate how many total resonance forms are present. (Sketch only one.)



- (3 pt) Sketch the Lewis dot structure for the nitrite ion, NO_2^- , and indicate the formal charge for each atom present.



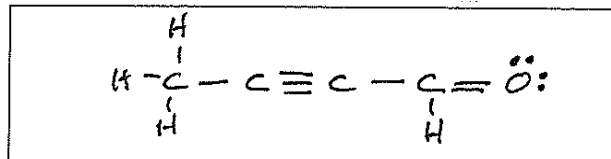
- (6 pt) Sketch the Lewis dot structure for the SeF_2 , SeF_4 , and SeF_6 . Assign ABE formulas to each.



- A. SH_3^+ trigonal pyramid

- SiH_4 tetrahedral
- SeF_6 octahedral
- NO_2^- bent
- CO_3^{2-} trigonal plane
- CO_2 linear

- (4 pts) Butynal has the formula $\text{C}_4\text{H}_4\text{O}$ and the atoms are connected C-C-C-C-O. Sketch a structure for the molecule (with O on the right) by providing multiple bonds and lone pairs where needed. Note: 3 H atoms are bonded to the first C and one is bonded to the fourth C atom.



- tetrahedral; linear; linear; trigonal plane

- sp^3 ; sp ; sp ; sp^2

- 10a. $q = -16 \text{ kJ}$; 10b. B

- Be sure to show your work here! Recopy the equations into the space provided:



- $\Delta H^\circ = -1040 \text{ kJ}$

- Either: $q_{\text{cal}} = 1220 \text{ J}$ or $q_{\text{rxn}} = -1220 \text{ J}$

- 1.23 J/g deg.

-

a. N_2O_4 dinitrogen tetroxide

b. CO carbon monoxide

c. SO_3 sulfur trioxide

d. BrF_5 bromine pentafluoride

e. XeF_4 xenon tetrafluoride

f. NI_3 nitrogen triiodide

g. ClO_2 chlorine dioxide

h. BF_3 boron trifluoride