

Exam 2
Friday, October 14
100 pts

1. (24 pt) Explain each of the following true statements, supporting your answers with diagrams and other supporting information as necessary! Note that it is better to say why your model does not fit the rather than just making up invalid stuff in order to make it agree! (8 pt each)
 - a. The following sizes of +3 metal ions in the 5th period have been observed: Y³⁺ (104 pm), Nb³⁺ (86 pm), Sb³⁺ (90 pm).

 - b. The C-O bond length in the carbonate ion, CO₃²⁻ is longer than that in the acetate ion, CH₃CO₂⁻, but in both cases the O-C-O bond angles are approximately the same.

 - c. The ionization energy of C is greater than that of B, and there is a huge drop in ionization energy as you go from Ne to Na.

2. (18 pts) Draw the **best** inequivalent Lewis dot structures (with equivalent resonance structures if appropriate) for the following molecules and ions. Predict the geometry, draw it in 3-D, label the bond angles. (6 pts each)

Formula	Lewis dot structure(s)	Draw geometry and indicate bond angles	Molecular geometry at each central atom(s)
SeBr ₄			
ONF (N is central atom)			
HCO ₃ ⁻			

3. (12 pt) State whether the following statements are true or false. For the explanation, if it is true, give a short explanation of why it is true. If it is false, explain why it is false by giving a correct statement. (4 pt each)

_____ a. Energy is released when a bond is formed. Explanation:

_____ b. In an equivalent resonance structure, the structure spends equal time in each of the resonance forms. Explanation:

_____ c. The Z_{eff} of the d-block increases as you go left to right because of the increase in shielding. Explanation:

4. (18 pt, 3 pt each) Answer each of the following questions:

_____ The element that has the lowest Z_{eff} in period 5

_____ The direction of the dipole arrow in a B-H bond

_____ Element for which the +1 cation is isoelectronic with Xe

_____ The number of electron domains for the S in SO_3^{2-}

_____ The electron configuration for Rh^{3+}

_____ The element with the highest electron affinity in period 5

5. (9 pt, 3 pt each) Follow the instructions for each part

a. Rank the following in order of increasing size

Sr La Xe Cd Te

b. Rank the following in order of increasing bond length

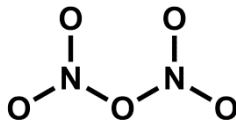
S-S S=S Se-Se O=O

c. List at least two common charges for elements listed based on their electron configurations

In _____ V _____

6. (15 pt) The atoms of N_2O_5 are connected in the manner shown below.

- a. **There are 9 possible resonance contributors that obey the octet rule, but you only need to draw 2!** Please draw a more important resonance structure and a less important resonance structure for N_2O_5 , indicating all formal charges. (6 pt)

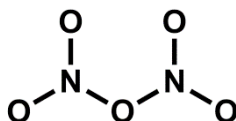


More Important Contributor

Less Important Contributor

b. Why is the less important resonance contributor disfavored for N_2O_5 ? (3 pt)

- c. Careful experiments have shown that N_2O_5 exhibits only two different N–O bond lengths, 1.19 Å and 1.50 Å. In the skeleton below, circle one of the N–O bonds that is 1.19 Å and one that is 1.50 Å and label which is which. Explain briefly. (4 pt)



- d. The N–O–N and O–N–O bond angles have been determined spectroscopically for N_2O_5 . Two important angles are 112° and 133° . Please assign each of these to one of the indicated bonds in the drawing below (2 pt):

