Exam 2 Friday, March 23 100 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 sizes of elements generally decrease as you go from left to right across the periodic table, however they hardly change at all as you go across the f-block.

b. The bond angles between the central atom and its surrounding atoms is smaller in NF_3 than it is in NF_4^+ . For IF_2^- the bond angle is greater than in IF_3 .

c. The thiocyanate ion (SCN⁻) has a CN bond length of 115 pm. For comparison a normal CN single bond is 147 pm, a CN double bond is 128 pm and a CN triple bond is 112 pm.

2. (24 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. (8 pts each)

Formula	Lewis dot structure(s)	Draw geometry and indicate bond angles	Molecular geometry at each central atom(s)	Hybridiz. at each central atom	Polar or non- polar
SeBr₄					
HCIO ₃					
TeF₅⁻					

- 3. (6pt)
 - a. Is energy released or absorbed from the surroundings when a covalent bond is broken? (3 pt)
 - b. From a fundamental physical standpoint why do atoms share electrons with each other? (use more than just an energy argument) (3 pt)

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- 4. (12 pt, 2 pt each) Answer each of the following questions:
 - _____a. Trend in Zeff as you go down the periodic table
 - b. The hybridization of an atom with one lone pair and three bonded atoms
 - _____c. The most electronegative element in group IA
 - _____ d. The electrons removed when forming Tc^{3+} (Z=43)
 - _____ e. An element with a negative value of electron affinity
 - _____f. The steric number/#of electron domains for the central atom in NO2-
- 5. (13 pt total)
 - a. Draw a sketch of a $4d_{yz}$ orbital, labeling the axes clearly. Label any angular and radial nodes. (6 pt)

b. Draw a radial probability diagram for a 4d_{yz} orbital with axes and any nodes appropriately labeled. (4 pt)

c. Add a plot of a 3s orbital to the radial probability diagram above. Use a dotted line (or another color!) to distinguish it from the plot in part b. (3 pt)

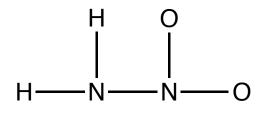
- 6. (3 pt each, 9 pts total) Circle the appropriate answer(s) as indicated below:
 - a. The atom with the lowest first ionization energy
 - S CI Se Ar
 - b. The largest size

Rb⁺ Kr Se²⁻ Zr²⁺

c. Molecules that have tetrahedral electron domain (steric number) geometries

 $SF_4 NF_4^+ NH_3 H_2O$

7. (12 pt) The molecule NH₂NO₂, nitramide is used I explosives such as RDX and HMX. It has the following **skeleton** structure:



a. Complete a valid Lewis dot structure for it and label any formal charges, label all bonds as σ and π . Indicate the hybridization, geometry and bond angles of **all central atoms**. (5 pt)

b. Do a full valence bond description of the molecule (7 pt)