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Name Key (Please Print)

Student Number ______________________

Chem 115 - Section 1
Hour Examination III
December 11, 2006

This test consists of six (6) pages, including this cover page. Be sure your copy is complete before beginning your work. If this test packet is defective, ask for another one.

A separate copy of the periodic table will be distributed with this test packet. Feel free to use it in conjunction with any test question.

DO NOT WRITE BELOW THIS LINE

1.

2.

3.

4.

5.

TOTAL

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1. (36 points; 3 points each) Circle the correct answer to each of the following.

a. The following sets of three digits represent values of n, l, and m_l, respectively. Which set is not permissible?

2, 1, –1 3, 1, 1 2, 1, –2 4, 3, 2 4, 2, 0

b. Which one of the following is not a ground state configuration of an atom?

$[Ne]3s^2 3p^1$ $1s^2 2s^2 2p^3$ $1s^2 2p^3$ $[Ne]3s^1$ $1s^2 2s^2 2p^6$

c. Who proposed that no two electrons in the same atom can have the same complete set of four quantum numbers (n, l, m_l, m_s)?

Pauli Schrödinger Hund deBroglie Heisenberg

d. Which one of the following orbitals has one node?

$4s$ $1s$ $3d_{z^2}$ $2s$ $3d_{xy}$

e. Which one of the following has the largest lattice energy?

ScN CaO K_2O Al_2O_3 BaS

f. Which one of the following configurations would result in a paramagnetic atom or ion?

$1s^2 2s^2 2p^6$ $[Ne]3s^2$ $[Ar]3d^6 4s^2$ $[Ar]3d^{10}$ $[Ar]4s^2$

g. Which one of the following atoms or ions is smallest?

Kr K Fe^{2+} Fe^{3+} Br^-

h. Which one of the following would have the largest first ionization energy?

As Te Br I Ge

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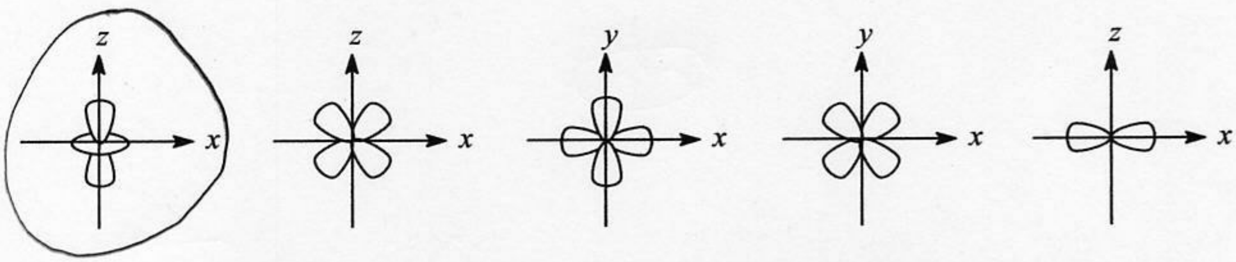
i. Considering the Lewis-dot representations of the following species, in which one would the central atom be considered to be electron deficient?

CO_2 $BeCl_2$ BH_4^- XeF_2 PF_5

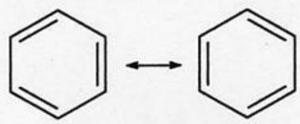
j. Which one of the following represents a $3d_{z^2}$ orbital?



k. Judging from trends in electronegativity, which one of the following bonds would be most polar?

Sn–Cl O–N Br–Br Cl–Br Cl–N

l. The two Kekulé resonance forms of benzene are shown below.



On the basis of these forms, which one of the following best describes the real state of the carbon-carbon bonds in benzene?

All carbon-carbon bonds are the same – about the same length as a C=C double bond.

All carbon-carbon bonds are the same – about the same length as a C–C single bond.

Benzene has two bond lengths – a longer single bond and a shorter double bond.

All carbon-carbon bonds are the same – shorter than a C–C single bond and longer than a C=C double bond.

All carbon-carbon bonds are the same – longer than a C–C single bond and shorter than a C=C double bond.

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2. (15 points; 3 points each) Fill in the blanks with the correct answers. **Do *not* use noble gas core notation; e.g., [Ne], and do not include closed subshells that are not part of the valence configuration.**

a. The symbol for the element whose valence electronic configuration is $4s^2 4p^4$ is Se.

b. The valence configuration of $_{29}Cu$ is $3d^{10} 4s^1$. (OR $4s^1 3d^{10}$)

c. In the space below draw the orbital diagram ("line-and-arrow" notation; e.g., $\underline{\uparrow\downarrow}$) for the valence configuration of $_{26}Fe$. Be sure to label the subshells (e.g., 3*d*, 4*s*).

$$\underbrace{\underline{\uparrow\downarrow}\ \ \underline{\uparrow}\ \ \underline{\uparrow}\ \ \underline{\uparrow}\ \ \underline{\uparrow}}_{3d} \qquad \underset{4s}{\underline{\uparrow\downarrow}}$$

d. The valence configuration of the $_{26}Fe^{2+}$ cation is $3d^6$.

e. The valence configuration of the $_{53}I^-$ anion is $5s^2 5p^6$.

3. (10 points; 5 points each) Write the *complete* electronic configuration ($1s^2 2s^2$...) for each of the following. **Do not use noble gas core notation; e.g., [Ne].** However, you may write these either in aufbau or shell order.

Shell order
$_{52}Te$ $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^4$
$_{83}Bi$ $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 6s^2 6p^3$

Aufbau order
$_{52}Te$ $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^5$
83 Bi $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^3$

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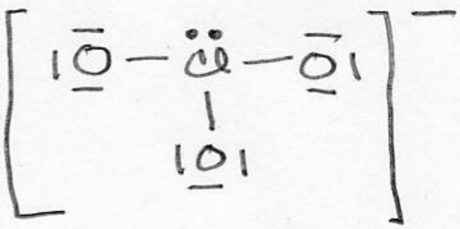
4. (24 points, 8 points each) Draw Lewis dot structures, showing all valence electrons, for each of the following. **Your work should show a count of the total number of valence electrons.** ☞ Note: Atoms whose symbol is indicated with a subscript are separately bonded to the atom immediately following or preceding in the formula. (You do not need to assign formal charges for these.)

a. ClO_3^-

Cl 7
3O 18
− 1
26



b. HONO (The atoms are linked together in the given order.)

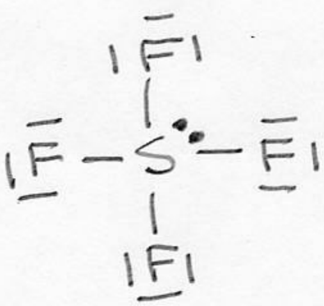
H 1
2O 12
N 5
18

first sketch

final model

c. SF_4

S 6
4F 28
34



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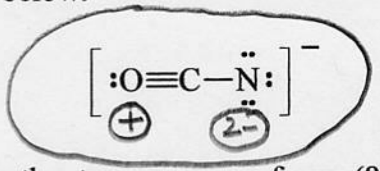
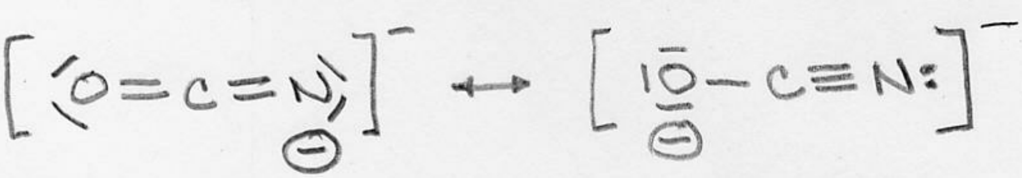
5. (15 points + 4 points bonus) The isocyanate ion, OCN^-, can be represented by three resonance forms, one of which is shown below.



Draw Lewis structures for the other two resonance forms (8 points); assign formal charges for all three forms, *including the form shown above* (4 points); and circle the form that is the *least important* contributor to the resonance description of the bonding in OCN^-. (3 points).



BONUS QUESTIONS (4 points) Carbon suboxide, C_3O_2, is an evil smelling gas. The principal resonance form is

$$:\ddot{O}=C=C=C=\ddot{O}:$$

There are two lesser contributing resonance forms. Draw them with their formal charge assignments.