This exam consists of 4 pages. Make sure you have one of each. Print your name at the top of each page now. A fifth page contains a periodic chart, some bond energy data, and some electronegativities. You may tear it off and use it for scratch paper. Show your work on calculations, including unit conversions, and give answers in the correct units and appropriate number of significant figures. In problems involving molecular and formula weights, you may use values rounded to the nearest 0.1 amu.

If anything confuses you or is not clear, raise your hand and ask!

(4) 1. Give the symbol for the atoms with the following electron configurations.

- [Ne]3s²3p²
- [He]2s²2p⁵
- [Ar]4s²3d⁸
- [Kr]5s²4d⁷

(4) 2. Give the electron configuration for the following atoms or ions.

- Na
- Ti
- Fe²⁺
- O²⁻

(4) 3. Circle the smallest and put an X through the largest atom or ion in each of the following lists.

(a) Cr  Li  N  Rb
(b) Cl⁻  S²⁻  Ca²⁺  K⁺¹

(6) 4. For each of the following sets of atoms, circle the atom with the lowest ionization energy, and put an X through the one with the largest ionization energy.

(a) K  Li  Be  Cs
(b) C  Li  Na  O
(c) In  Al  P  Cl

(4) 5. For each of the following pairs of ionic compounds, circle the one with the greater lattice energy.

(a) LiCl and LiBr
(b) MgO and MgF₂
(c) NaF and MgF₂
(d) NaI and KI

PLEASE NOTE: The final exam for the course is a block exam, given from 3-5 pm Wednesday, Dec 12. It is not given at the time for 8 am MWF classes.
6. Circle the oxides from the following list which will react with water to form an acid solution:

NO$_2$  SO$_2$  Fe$_2$O$_3$  BaO  Li$_2$O

7. For each of the following covalent bonds, put an arrow over the bond indicating the direction of polarity (the arrow pointing to the negative end). If the bond is completely non-polar, so indicate. Circle the most polar bond in the list, and mark with an x the least polar bond on the list.

Cl-O  C-F  H-S  P-Cl  C-O

8. Draw two resonance structures for the each of the following molecules or ions, without expanding any octets, and indicate the formal charge on each atom in each structure:

HCO$_2$\(^{-1}\) (H attached to C)  SO$_3$

9. Calculate \(\Delta H\) for the following reactions using the table of bond energies on the last page. Show your work. (All reactants and products in the gaseous state).

(a) CO  +  2 H$_2$  \(\rightarrow\) CH$_3$OH

(b) CH$_4$  +  2 O$_2$  \(\rightarrow\) CO$_2$  +  2 H$_2$O
(16) 10. For each of the following compounds or ions, draw the best Lewis dot structure. (If more than one resonance structure is "best", draw only one). The central atom is underlined. Give the electron pair geometry and the molecular geometry about the central atom.

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11. Draw **three** resonance structures for $\text{NC}_2\text{S}^{-1}$ (carbon is the central atom). Calculate the formal charge on each atom in each structure. Circle the structure which you believe is the **best** of the three.

12. Below is a Born-Haber diagram describing how one can calculate the lattice energy of $\text{KBr}_\text{(s)}$. Given the following information, fill in the blanks in the diagram with the appropriate energy quantity (showing the correct sign for the arrow direction), then calculate the lattice energy and place that value in the correct blank as well.

- Heat of formation of $\text{KBr}_\text{(s)} = -393.8 \text{ kJ/mol}$
- Ionization energy of $\text{K}_\text{(g)} = +419 \text{ kJ/mol}$
- Electron affinity of $\text{Br}_\text{(g)} = -325 \text{ kJ/mol}$
- Bond energy of $\text{Br}_2\text{(g)} = 193 \text{ kJ/mol}$
- Heat of sublimation of $\text{K}_\text{(s)} = 89.2 \text{ kJ/mol}$
- Heat of vaporization of $\text{Br}_2\text{(l)} = 30.9 \text{ kJ/mol}$

\[
\begin{align*}
\text{K}^+(\text{g}) + \text{Br}^-\text{(g)} + \text{e}^- & \quad \text{_____ kJ} \\
\text{K}\text{(g)} + \text{Br}\text{(g)} & \quad \text{_____ kJ} \\
\text{K}\text{(g)} + \frac{1}{2}\text{Br}_2\text{(g)} & \quad \text{_____ kJ} \\
\text{K}_\text{(s)} + \frac{1}{2}\text{Br}_2\text{(g)} & \quad \text{_____ kJ} \\
\text{K}_\text{(s)} + \frac{1}{2}\text{Br}_2\text{(l)} & \quad \text{_____ kJ} \\
\text{KBr}_\text{(s)} & \quad \text{_____ kJ}
\end{align*}
\]
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