Chem 130 – Second Exam

Name________________________________

On the following pages you will find questions covering various topics ranging from the structure of molecules, ions, and solids to different models for explaining bonding. Read each question carefully and consider how you will approach it before you put pen or pencil to paper. If you are unsure how to answer one question, then move on to another question; working on a new question may suggest an approach to the one that is more troublesome. If a question requires a written response, be sure that you answer in complete sentences and that you directly and clearly address the question.

Partial credit is willingly given on all problems so be sure to answer all questions!

Question 1 _____/28	Question 4 _____/12
Question 2 _____/12	Question 5 _____/12
Question 3 _____/12	Question 6 _____/12

Question 7 _____/12

Total _____/100

Potentially useful equations and constants are provided here. A periodic table is provided separately.

Potentially Useful Equations

$c = \lambda\nu$ $\quad E = h\nu$ $\quad KE = h\nu - BE$

$$\frac{1}{\lambda} = 1.09737\times10^{-2}\ \text{nm}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$V \propto \frac{Q_+Q_-}{d}$$

$$\text{AVEE} = \frac{xIE_s + yIE_p + zIE_d}{x + y + z}$$

(valence shell electrons only)

$$FC_a = V_a - N_a - \frac{B_a}{2}$$

$$\delta_a = V_a - N_a - B_a\left(\frac{EN_a}{EN_a + EN_b}\right)$$

Potentially Useful Constants

$c = 2.998\times10^{8}$ m/s $\quad h = 6.626\times10^{-34}$ Js $\quad N_A = 6.022\times10^{23}$ mol^{-1}

Please write neatly!

Problem 1. For each of the following molecules or ions, draw any <u>one</u> valid Lewis structure of your choosing (it need not be the "best" structure). Provide the name for the bonding geometry around the underlined central atom, predict whether the molecule or ion is polar (P) or non-polar (NP), and provide the idealized bond angle(s) for the stated bond; if there is more than one unique bond angle in your structure, then give the idealized bond angle for each.

Molecule or Ion	Lewis Structure	Bonding Geometry	Polar or Non-Polar?	Ideal Bond Angle(s) for …
$\underline{Be}F_4^{2-}$				…a F–Be–F bond is….
$\underline{Xe}F_4$				…an F–Xe–F bond is….
$\underline{Cl}F_3$				…an F–Cl–F bond is….
$\underline{C}O_3^{2-}$				…an O–C–O bond is…

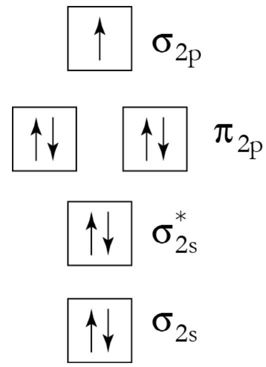
Problem 2. The elements Z and X form the ions ZX_5^- and X_3^-, each consisting of single bonds only. There are five electron domains around both the Z in ZX_5^- and the central X in X_3^-. Identify elements Z and X and, in no more than three sentences, clearly explain your reason for selecting these elements. Note: there are several possible elements for Z and for X; however, you need only provide one example for each.

Problem 3. When drawing a Lewis structure sometimes we must choose between a structure that minimizes formal charges and a structure that satisfies the octet rule. Draw two Lewis structures for the sulfite ion, SO_3^{2-}, one that minimizes formal charges and one that satisfies the octet rule. Annotate both structures by specifying the formal charge on each element, by circling any element that does not satisfy the octet rule, and by reporting the bond order between sulfur and oxygen.

Lewis structure that minimizes formal charges	Lewis structure that satisfies the octet rule

Problem 4. The Lewis structure for the ion OCN^- has a single bond between oxygen and carbon and a triple bond between carbon and nitrogen. Describe the O–C bond and the C≡N bond in this ion using the valence bond (hybrid orbital) model. Please limit your answer to no more than four sentences.

Problem 5. The picture to the right shows a portion of the molecular orbital diagram for the neutral molecule CX, where C is carbon and X is an element in the periodic table's second row. Identify X? What is the bond order between C and X? Is CX capable of interacting with an applied magnetic field? Explain your answers to these questions in no more than three sentences.

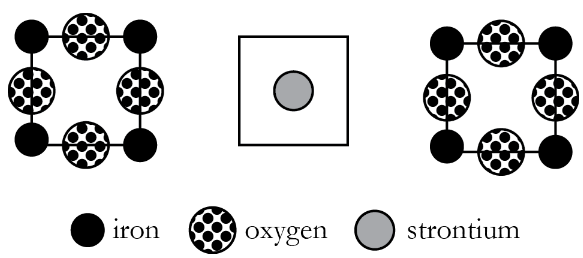


Problem 6. For the ionic compounds KF, CsI, and CaO, identify the one with the lowest melting point and the one with the highest melting point. In no more than three sentences, explain how you arrived at these assignments.

the compound with the lowest melting point is: _____

the compound with highest melting point is: _____

Problem 7. Shown left-to-right below are cross-sections at $z = 0$, $z = 0.5$, and $z = 1$ through the unit cell of a mineral containing iron (Fe), oxygen (O), and strontium (Sr).



What is the empirical formula for this compound? Place your answer in the space below and indicate how you arrived at this formula by annotating the figure above to show the contribution of each different atom. Based on your empirical formula, what is the oxidation state of iron in this compound?

This unit cell is defined in terms of iron. What is the unit cell's lattice structure?

Relative to the unit cell's lattice structure, in what type of hole is strontium found?

To how many oxygens is each iron coordinated? Justify your answer in one sentence or by sketching a picture.