Problem 11 #12

Chem 106. J-Term 2003. Exam 1. Januar 10, 2003. 48 pts

Name Key

By submitting this exam, I certify that I have neither given nor received unauthorized aid.

Useful information: $C_f = E_{valence} - (\#_{bonds} + E_{nonbonding})$

(1)(4 points) Which is the most complete and best description of a covalent bond?

(A) a system of two nuclei with a pair of electrons located exactly midway between both nuclei

(B) the attractive force between two atoms of opposite charge

(C) a donor bond in which one atom donates an unshared pair to the other

(D) a system of two nuclei where each atom donates one electron to the other atom, thus forming a bond

(2)(4 points) Which contains both covalent and ionic bonds?

(A) NH_4NO_3 (C) $BaCl_2$

(B) NF_3 (D) CH_2O

(3)(4 points) When two elements unite to form an ionic type of crystal, what is the principal force that holds the particles together?

(A) van der Waals forces (D) metallic bonding

(B) magnetic attraction (E) covalent attraction

(C) electrostatic attraction

(4)(4 points) In the compound PCl_5, what is the hybridization of P?

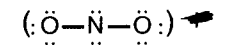
(A) *s* (B) *p* (C) sp^3 (D) sp^3d

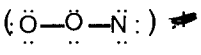
(E) *sp*

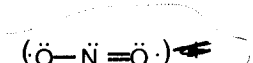
(5)(4 points) Which molecule contains only one unshared pair of valence electrons?

(A) H_2O (B) NH_3 (C) CH_4 (D) NaCl

(6)(4 points) The Lewis structure of NO_2^- is best drawn as

(A) 

(C) 

(B) 

(D)

(7)(4 points) Mark the polarity of each of the following bonds using δ^+ and δ^-.

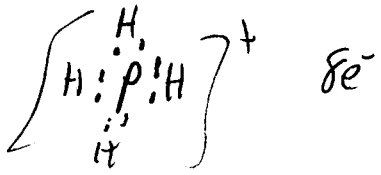
(a) Si-F

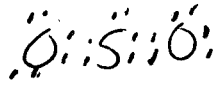
(b) I-Br

(c) C-O

(d) N-C

(8)(4 points) Draw the best Lewis Dot Structure for each of the following compounds

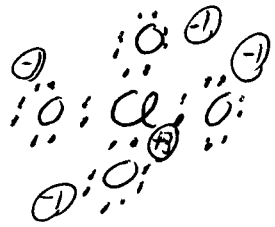
(a) PH_4^+  8e⁻

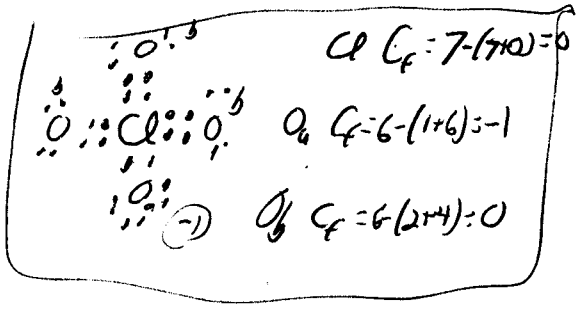
(b) SO_2  18e⁻

(c) NO^-  12e⁻

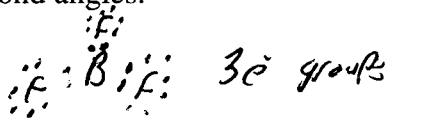
(9)(4 points) Find the Lewis Dot structure with the best formal charge for ClO_4^-. Show the formal charge calculations for both the Cl and O.

Cl 7e⁻
4 O 24e⁻
−1 +1e⁻
32e⁻

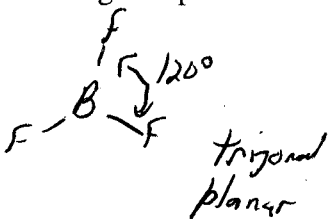


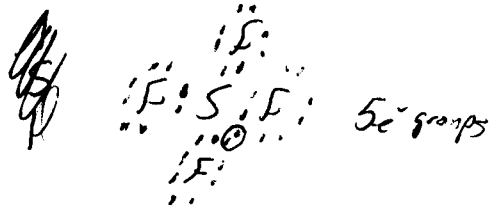


(10)(4 points) List the VSEPR geometries for the following compounds. Draw the structures and indicate the bond angles.

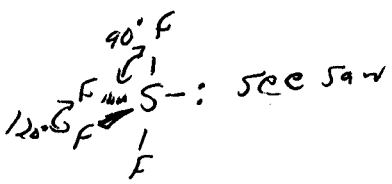
(a) BF_3  3e⁻ groups

24e⁻

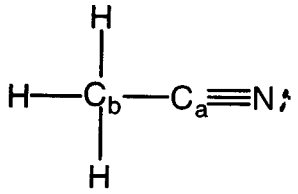


(b) SF_4  5e⁻ groups

34e⁻



(11)(4 points) For the acetonitrile molecule (shown below), list the hybridization for both carbon atoms (C_a and C_b) and the nitrogen atom. Draw a picture of the σ-bonds and separate picture(s) of the π-bond(s).



C_a 2 e^- groups

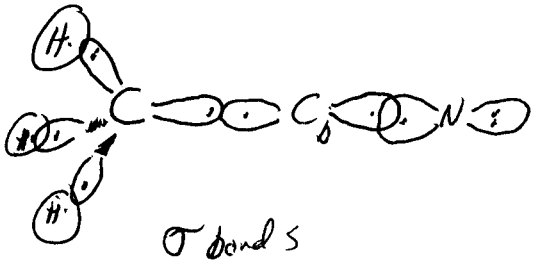
sp

C_b 4 e^- groups

sp^3

N 2 e^- groups

sp



σ bonds

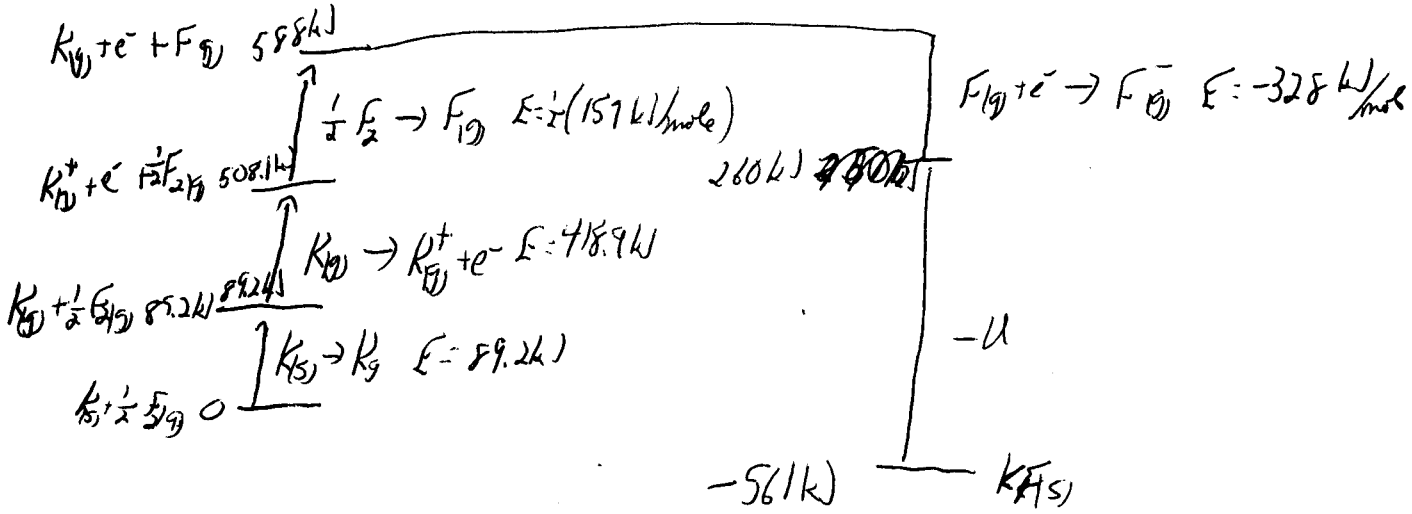
π-bonds

(12)(4 points) Using the data below, construct a Born-Haber cycle for the following reaction and determine the lattice energy, U.

$K_{(s)} + 1/2\ F_{2(g)}$ -----> $KF_{(s)}$ $\Delta E = -561$ kJ

Energy of sublimation of $K_{(s)}$ = 89.2 kJ/mol
Bond dissociation energy of F_2 = 159 kJ/mol
E_{i1} = 418.9 kJ/mol for K
Ei_2 = 3920 kJ/mol for K
E_{ea} = -328 kJ for $F_{(g)}$

$KF_{(s)}$ ---> $K^+_{(g)} + F^-_{(g)}$ E = U



$KF_{(s)} \rightarrow K^+_{(g)} + F^-_{(g)}$ $\Delta E = U$

$\Delta E = E_{final} - E_{initial} = 260\text{kJ} - (-561\text{kJ}) = \boxed{821\text{kJ}}$