Chem 106, Exam 2. J-Term 2005

Name Key

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

Bond Order = $\frac{E_{bonding} - E_{antibonding}}{2}$

9 points

(1) Calculate the lattice energy for NaH using the information below.

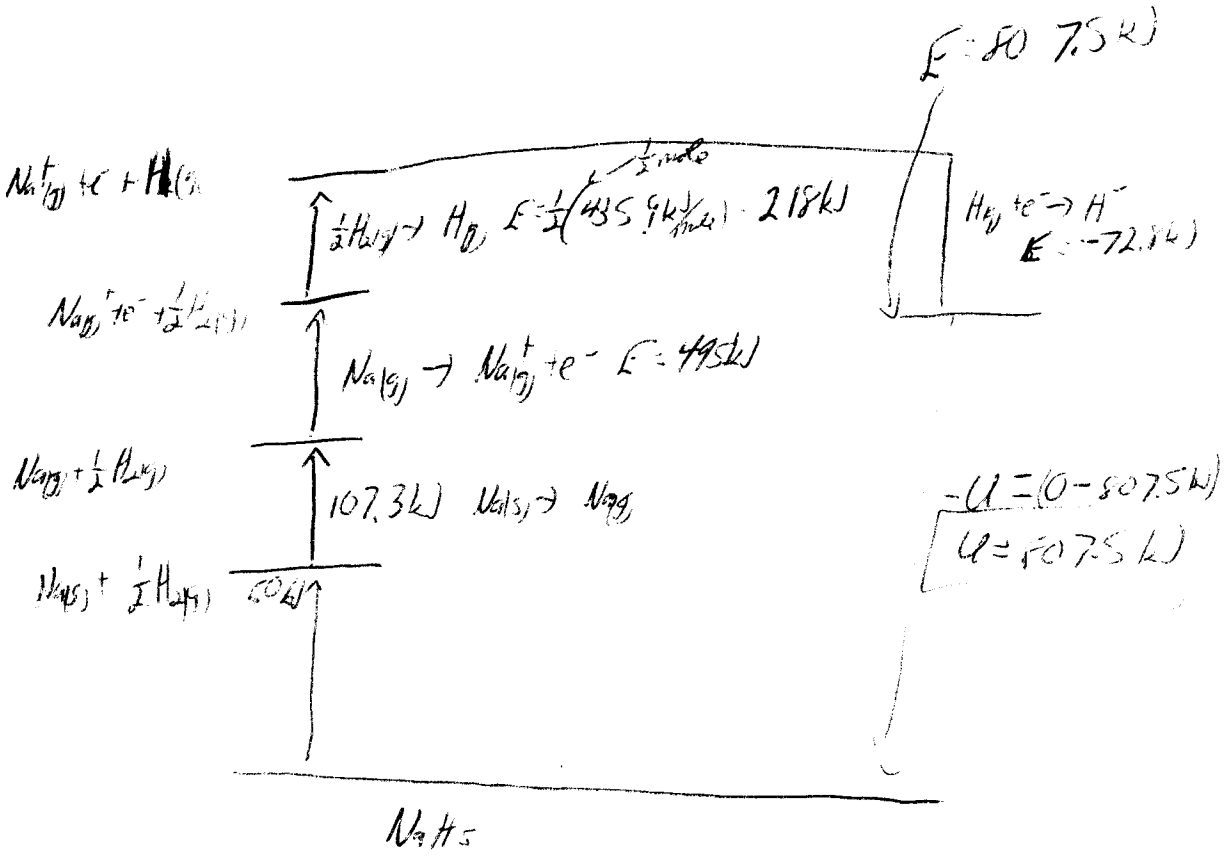
$Na(s) + 1/2H_2(g) \longrightarrow NaH(s)$ $\Delta H = -60kJ$

$Na(s) \longrightarrow Na(g)$ $\Delta H = 107.3 kJ/mole$

E_{i1} = 495.8 kJ/mole for Na

E_{EA} = -72.8 kJ/mol for H

BDE = 435.9 kJ/mol for H-H bonds



+4 (2) Indicate the polarity of each bond with δ^+ and δ^-.

(a) $\delta^+\ \delta^-$ P-Cl

(b) $\delta^+\ \delta^-$ Te-Br

(c) $\delta^-\ \delta^+$ N-Si

(d $\delta^-\ \delta^+$ As-Ga

+4 (3) Place the following in order of increasing first ionization energy

Ga, Ca, Al , O, S

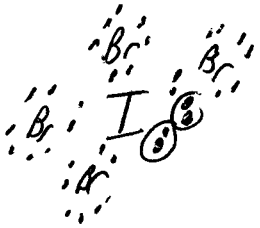
Ca, Ga, Al, S, O,

+12 (4) Draw the best Lewis dot structures for the following compounds

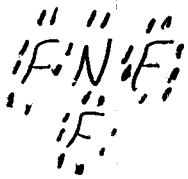
(a) SF_6

(b) IBr_4^-

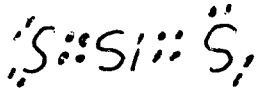
I 7e⁻
4Br 28e⁻
-1 1e⁻
36e⁻



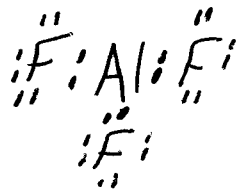
(c) NF_3



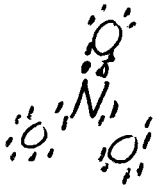
(d) SiS_2



(e) AlF_3



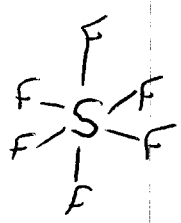
(f) NO_3^-



(5) Draw the VSEPR geometry for the following compounds and indicate the name of the geometry

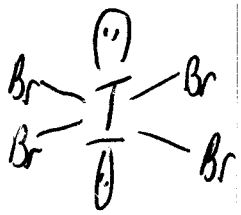
(12)

(a) SF_6



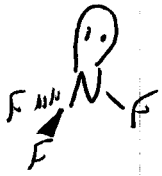
octahedral

(b) IBr_4^-



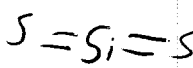
square planar

(c) NF_3



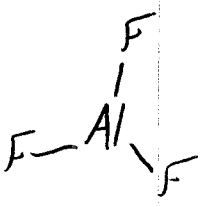
pyramidal

(d) SiS_2



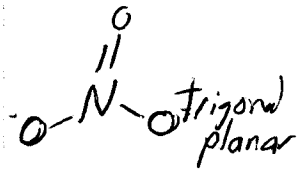
linear

(e) AlF_3



trigonal planar

(f) NO_3^-



(+5) (6) Give the hybridization of the orbitals of the central atom in each of the following compounds.

(a) SF_6 sp^3d^2

(b) IBr_4^- sp^3d^2

(c) NF_3 sp^3

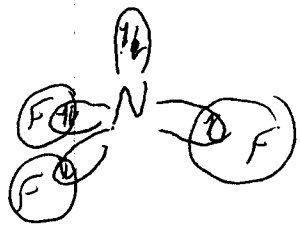
~~(d) SiS_2 sp~~

(e) AlF_3 sp^2

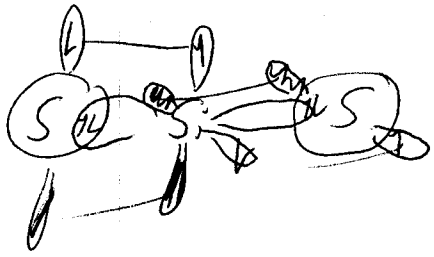
(f) NO_3^- sp^2

(+4) (7) Draw a valence bond sketch for each of the following compounds

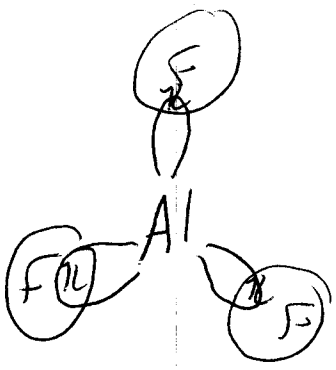
(a) NF_3



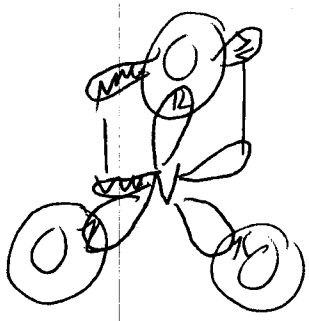
(b) SiS_2



(c) AlF_3



(d) NO_3^-



(8) What are some of the advantages of using Valence Bond Theory to describe bonding in a compound instead of Molecular Orbital Theory? (4)

It is simpler & faster.

(9) What are some of the advantages of using Molecular Orbital Theory to describe bonding in a compound instead of Valence Bond Theory? (4)

It describes delocalized orbitals & some other properties better.

Use the attached molecular orbital diagrams to answer the following questions

(10) Write out the molecular orbital electron configuration for the following species.

(a) NO^+ $10e^-$ $2\sigma^2 2\sigma^{*2} 3\sigma^2 1\pi^4$

(b) O_2 $12e^-$ $2\sigma^2 2\sigma^{*2} 3\sigma^2 1\pi^4 1\pi^{*2}$

(c) B_2 $6e^-$ $2\sigma^2 2\sigma^{*2} 3\sigma^2$

(11) What is the bond order in each of the following species?

(a) NO^+ $\frac{8-2}{2} = 3$

(b) O_2 $\frac{8-4}{2} = 2$

(c) B_2 $\frac{4-2}{2} = 1$

(12) Arrange the following in order of bond length (shortest to longest) and indicate the reason.

C_2^{2-}, C_2, and C_2^+

C_2^{2-} $10e^-$ $2\sigma^2 2\sigma^{*2} 3\sigma^2 1\pi^4$ $BO = \frac{8-2}{2} = 3$

C_2 $8e^-$ $2\sigma^2 2\sigma^{*2} 3\sigma^2 1\pi^2$ $BO = \frac{6-2}{2} = 2$

C_2^+ $7e^-$ $2\sigma^2 2\sigma^{*2} 3\sigma^2 1\pi^1$ $BO = \frac{5-2}{2} = \frac{3}{2}$

$C_2^{2-} < C_2 < C_2^+$