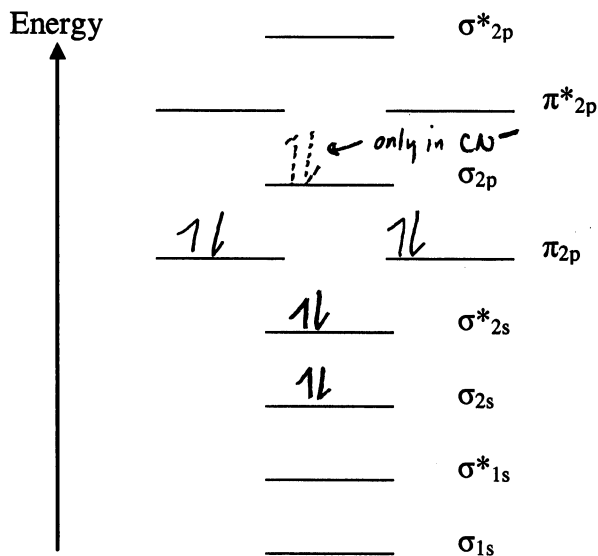


Key

1. Assume that the energy-level diagram given at right applies to the ions CN^+ and CN^- .

- $8e^-$ $10e^-$
- a. Which ion has the stronger carbon to nitrogen bond?
 CN^- with B.O. of $\frac{1}{2}(8-2) = 3$ (CN^+ is $\frac{1}{2}(6-2) = 2$)
- b. Is either of the ions paramagnetic? Explain.

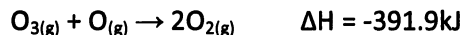
No. Both ions have all paired electrons.



2. Hydrogen forms ionic compounds with certain metals in which it is present as the hydride ion, H^- . Determine the electron affinity of H through a Born-Haber calculation, using a lattice energy of -812 kJ/mol NaH and the following data: Enthalpy of sublimation of Na = $+107 \text{ kJ/mol}$; 1st ionization energy of Na = $+496 \text{ kJ/mol}$; the bond dissociation energy of hydrogen gas is 436 kJ/mol ; enthalpy of formation of $NaH_{(s)} = -56.27 \text{ kJ/mol}$

$$- \left[+107 + (+496) + \frac{1}{2}(436) + 56.27 \right] + 812 = -65.27 \approx \boxed{-65 \text{ kJ/mol}}$$

3. In the stratosphere, the reaction of ozone (O_3) and atomic oxygen helps to maintain the heat balance on Earth:



Given that the bond energy of $O_2 = +498 \text{ kJ/mol}$, estimate the bond energy in the O_3 molecule.



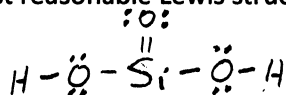
$$\sum BE_{\text{reactants}} - \sum BE_{\text{products}}$$

$$BE_{\text{Ozone total}} - BE_{O_2} = -391.9 \text{ kJ}$$

$$BE_{\text{Ozone total}} = -391.9 \text{ kJ} + (498 \text{ kJ} \times 2) = 604.1 \text{ kJ}$$

Each Bond is $\frac{1}{2}$ that or $\boxed{302 \text{ kJ/mol}}$

4. Write the most reasonable Lewis structure for H_2SiO_3 .



What is the formal charge on the silicon?

$$4 - 0 - \frac{1}{2}(8) = 0$$

What is the molecular geometry with respect to the silicon?

Trigonal planar (120°)

What is the hybridization on the silicon atom?

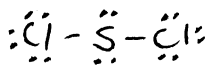
sp^2

How many sigma and pi bonds exist in the molecule (VSEPR)?

$5\sigma, 1\pi$

5. Does the predicted shape of the Cl-S-Cl bond angle in sulfur dichloride agree with the experimental angle of 103° ?

Explain.



yes. Pure tetrahedral would be 109.5° . Tetrahedral bent would push bonding angles slightly together so this bond angle is reasonable

6. In both of the ions, ICl_2^+ and ICl_2^- , an iodine atom is bonded to two Cl atoms. Do you expect the same hybridization scheme for the central I atom in each case? Explain.

No. in ICl_2^+ I is sp^3 hybridized. In ICl_2^- , I is sp^3d hybridized.

