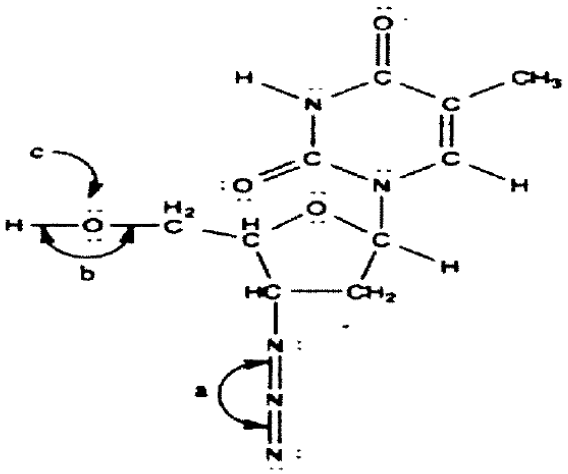
General Chemistry
PLI #16

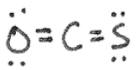
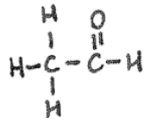
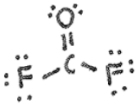
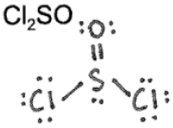
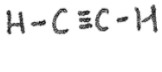
June 28, 2021

1. **One of the first drugs to be approved for use in treatment of HIV/AIDS was azidothymidine (AZT). The complete Lewis structure of AZT is shown below:**

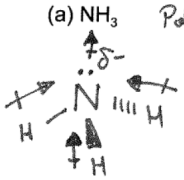


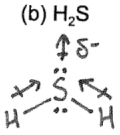
   a. **How many carbon atoms are sp^3 hybridized?** 6
   b. **How many carbon atoms are sp^2 hybridized?** 4
   c. **Which atom is sp hybridized?** Central N in N=N=N
   d. **How many σ bonds are there?** 33
   e. **How many π bonds are in the molecule?** 5
   f. **What is the bond angle marked a?** 180°
   g. **What is the bond angle marked b?** <109.5° (104.5°)
   h. **What is the hybridization of atom c?** sp^3
   i. **What is the bond order of the central N in a?** 2

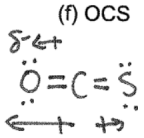
2. **Each of the following molecules contains at least one multiple (double or triple) covalent bond. Give a plausible Lewis structure for:**

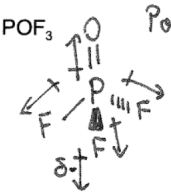
OCS	CH_3CHO	F_2CO	Cl_2SO	C_2H_2
				

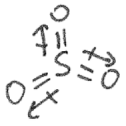
3. Which of the following molecules would you expect to be polar?

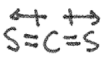
(a) NH_3 Polar 

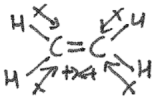
(b) H_2S Polar 

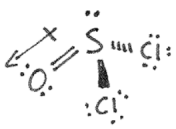
(f) OCS Polar 

(e) POF_3 Polar 

(d) SO_3 Nonpolar 

(e) CS_2 Nonpolar 

(c) C_2H_4 Nonpolar 

(g) $SOCl_2$ Polar 

(h) SiF_4 Nonpolar 

4. Estimate ΔH_{rxn} for the following unbalanced reaction using bond dissociation enthalpy values.

$$2\boldsymbol{CH_4}(\boldsymbol{g}) + \boldsymbol{O_2}(\boldsymbol{g}) \rightarrow 2\boldsymbol{CH_3OH}(\boldsymbol{g})$$

$$\Delta H_{rxn} = \Sigma_{\Delta H\ bonds\ broken} - \Sigma_{\Delta H\ bonds\ formed}$$

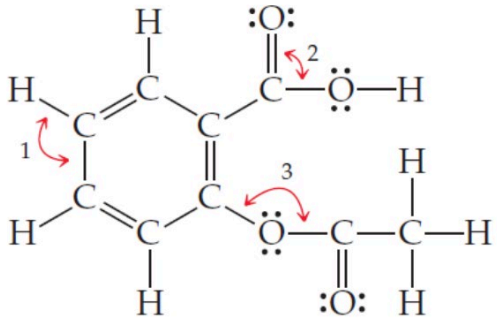
$$\Delta H_{rxn} = \big(8(C-H) + (O=O)\big) - (6(C-H) + (C-O) + (O-H))$$

$$\Delta H_{rxn} = \left(8\left(413\frac{kJ}{mol}\right) + \left(498\frac{kJ}{mol}\right)\right) - \left(6\left(413\frac{kJ}{mol}\right) + 2\left(358\frac{kJ}{mol}\right) + 2\left(463\frac{kJ}{mol}\right)\right)$$

$$\Delta H_{rxn} = 3802\frac{kJ}{mol} - 4120\frac{kJ}{mol}$$

$$\Delta H_{rxn} = -318\frac{kJ}{mol}$$

5. **Acetylsalicylic acid, better known as aspirin, has the Lewis structure:**



   a. **What are the approximate values of the bond angles labeled 1, 2, and 3?**

      1: 120°
      2: 120°
      3: <109.5° (104.5°)

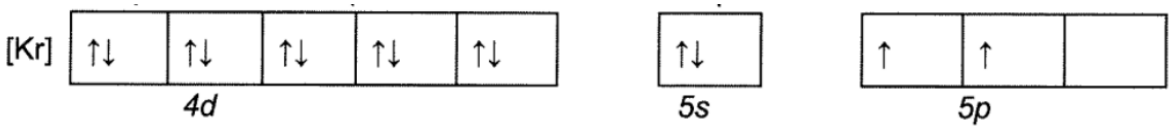
   b. **What hybrid orbitals are used about the central atom of each of these angles?**

      1: 3 sp^2 hybrid orbitals
      2: 3 sp^2 hybrid orbitals
      3: 4 sp^3 hybrid orbitals

   c. **How many σ bonds are in the molecule? How many?**

      21 σ bonds, 5 π bonds

6. **What is a possible set of quantum numbers for an unpaired electron in the orbital box diagram below?**



   a. n=1, l=1, m_l = -1, m_s = +½
   b. n=4, l=2, m_l = -1, m_s = -½
   c. n=5, l=2, m_l = -2, m_s = +½
   d. n=5, l=0, m_l = 0, m_s = -½
   e. n=5, l=1, m_l = -1, m_s = +½

What element is this? Sn

7. **Using the molecular orbital (MO) Model, please:**
   a) **Label each orbital and fill in the MO diagram**
   b) **Calculate the bond order**

   Bond order: ½(bonding e^- - anti-bonding e^-)

   Li_2: ½(2 -0)=1

   N_2: ½(6-0)=3

Li_2

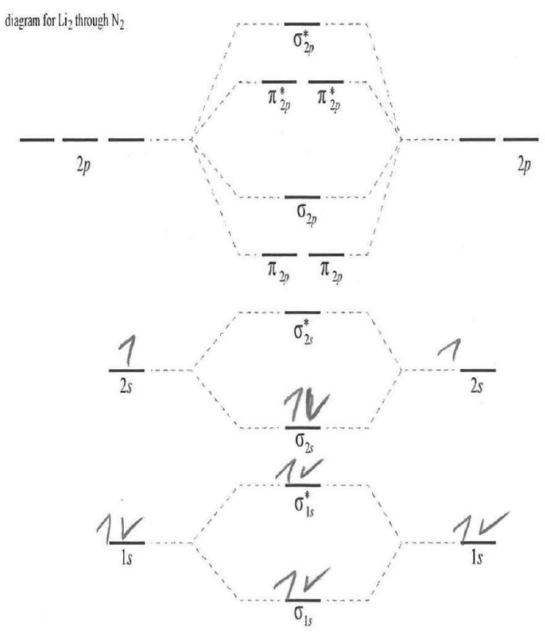
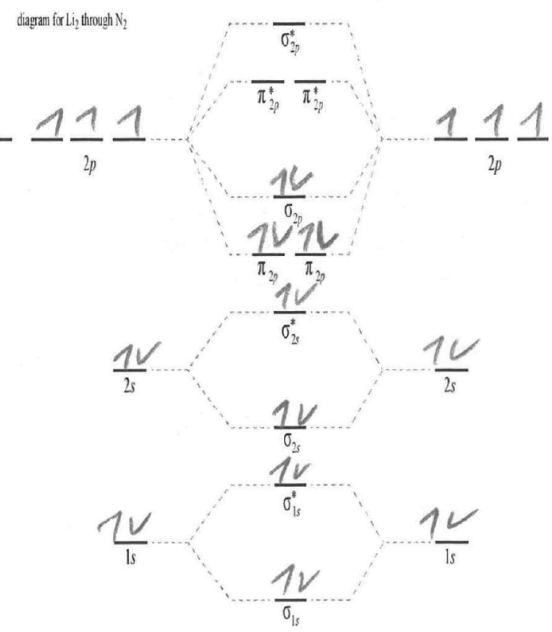


diagram for Li_2 through N_2
σ^*_{2p}
π^*_{2p} π^*_{2p}
2p
2p
σ_{2p}
π_{2p} π_{2p}
σ^*_{2s}
2s
2s
σ_{2s}
σ^*_{1s}
1s
1s
σ_{1s}

N_2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σ^*_{2p}
π^*_{2p} π^*_{2p}
2p
2p
σ_{2p}
π_{2p} π_{2p}
σ^*_{2s}
2s
2s
σ_{2s}
σ^*_{1s}
1s
1s
σ_{1s}