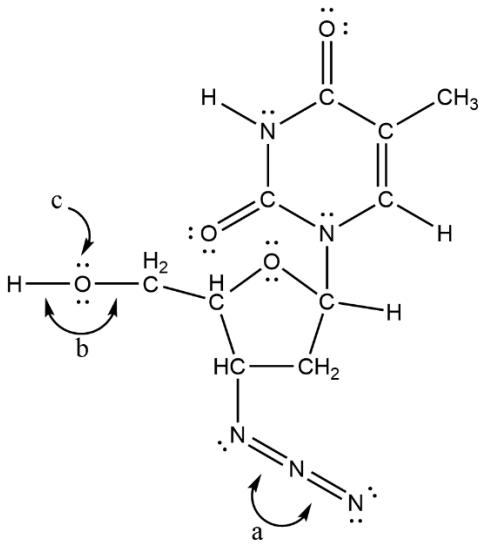
CHEM 103
R&R 16
24 June 2024
Adapted from a 28 June 2021 document

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?

b. How many carbon atoms are sp^2 hybridized?

c. Which atom is sp hybridized?

d. How many σ bonds are there in the molecule?

e. How many π bonds are there in the molecule?

f. What is the bond angle marked (a)?

g. What is the bond angle marked (b)?

h. What is the hybridization of atom (c)?

i. What is the bond order of the central N in (a)?

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	COF_2	$SOCl_2$	C_2H_2

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

a. NH_3 b. H_2S c. OCS

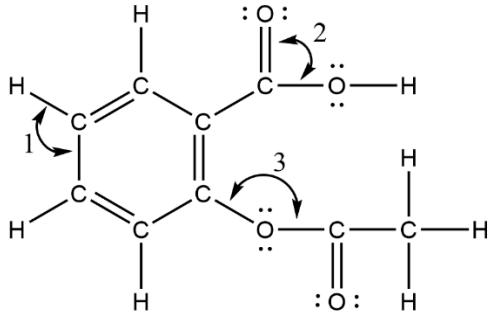
d. POF_3 e. SO_3 f. CS_2

g. C_2H_4 h. $SOCl_2$ i. SiF_4

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

$$CH_4\ (g) + O_2\ (g) \rightarrow CH_3OH\ (g)$$

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

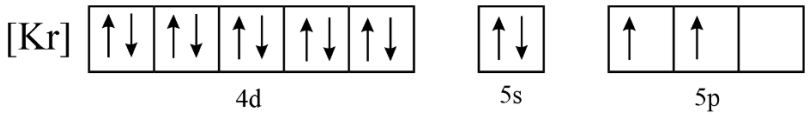


a. What are the approximate values of the bond angles labeled 1, 2, and 3?

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

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

6. What is a possible set of quantum number 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

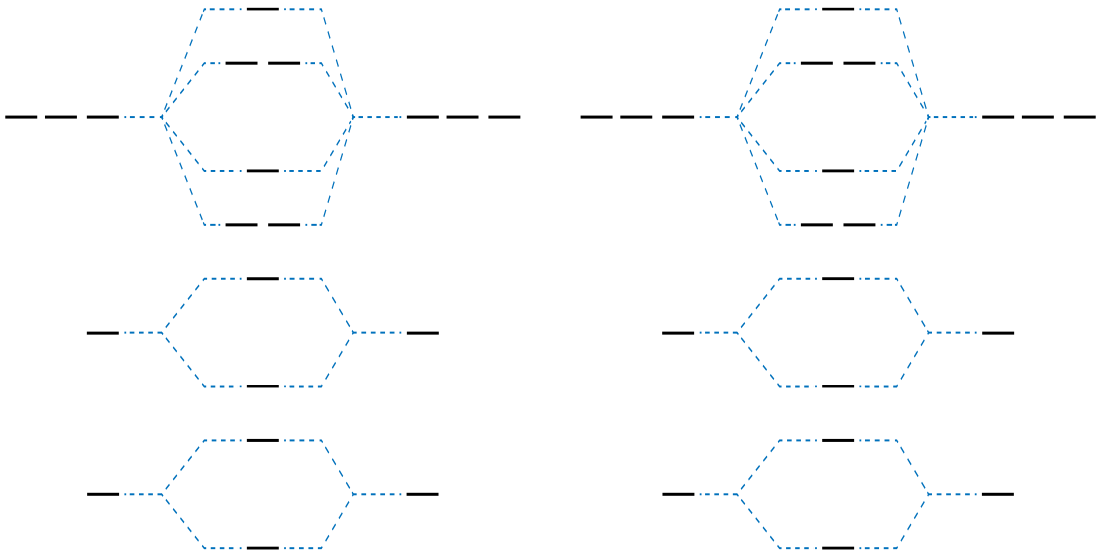
What element is this? _____

7. Using the molecular orbital (MO) model:

a. Label each orbital and fill in the MO diagram.

b. Calculate each bond order.

Li_2 N_2



(Diagram sourced from https://ch301.cm.utexas.edu/imfs/#mo/mo-theory-all.php)