Non Sibi High School

Andover's Chem 550/580: Advanced Chemistry

Chapter 11, Review Quiz 1 Answers

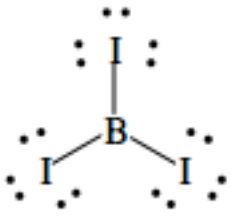
1

Draw the Lewis structure, name the molecular geometry (shape), draw a three-dimensional sketch, and indicate the bond angle for each of the following molecules and ions. Also state whether the neutral molecules are polar or nonpolar.

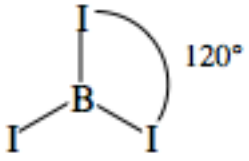
a. BI_3
b. CH_2Br_2
c. FNO
d. H_3O^+
e. OCS
f. $PCl_4{}^+$
g. SF_2

a.

Lewis structure:



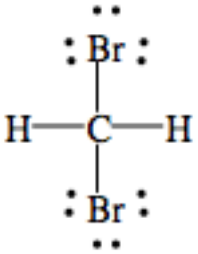
AB_3 = trigonal planar, 3-D sketch:



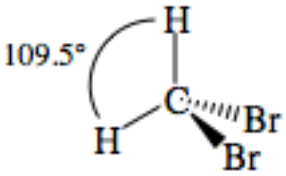
nonpolar molecule

b.

Lewis structure:



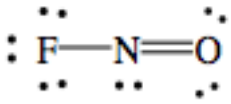
AB_4 = tetrahedral, 3-D sketch:



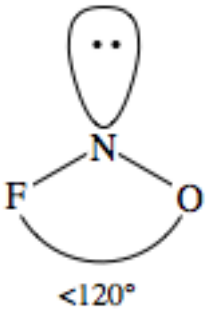
polar molecule (different outer elements)

c.

Lewis structure:



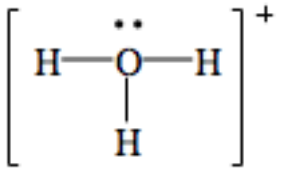
AB_2E_1 = bent, 3-D sketch:



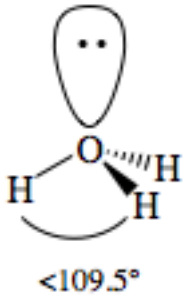
polar molecule

d.

Lewis structure:

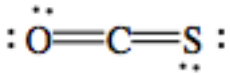


AB_3E_1 = trigonal pyramidal, 3-D sketch:

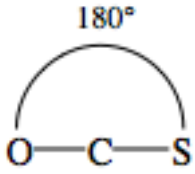


e.

Lewis structure:



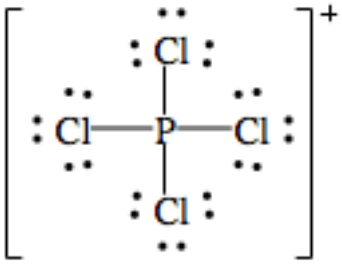
AB_2 = linear, 3-D sketch:



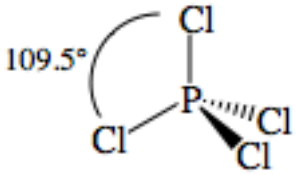
polar molecule (different outer elements)

f.

Lewis structure:

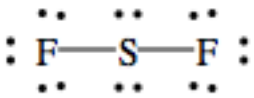


AB_4 = tetrahedral, 3-D sketch:

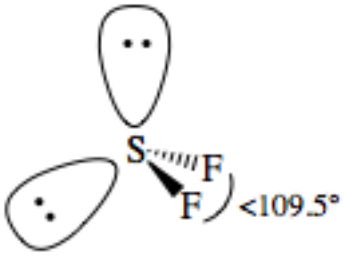


g.

Lewis structure:



AB_2E_2 = bent, 3-D sketch:



polar molecule

2

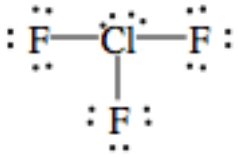
Draw the Lewis structure, name the molecular geometry (shape), draw a three-dimensional sketch, and indicate the ideal bond angle(s) for each of the following

molecules and ions. Also state whether the neutral molecules are polar or non-polar.

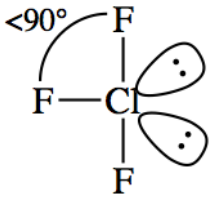
a. ClF_3
b. IF_5
c. KrF_2
d. PCl_4^-
e. SF_5^+
f. SeF_6
g. $XeCl_4$

a.

Lewis structure:



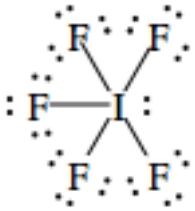
AB_3E_2 = T-shaped, 3-D sketch:



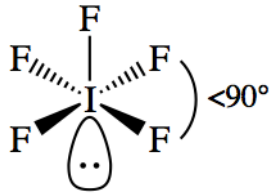
polar molecule

b.

Lewis structure:



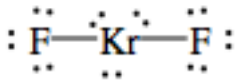
AB_5E_1 = square pyramidal, 3-D sketch:



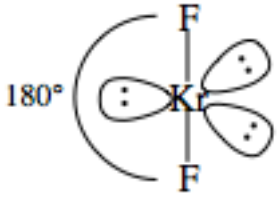
polar molecule

c.

Lewis structure:



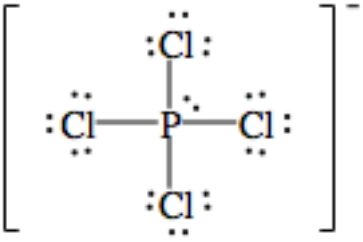
AB_2E_3 = linear, 3-D sketch:



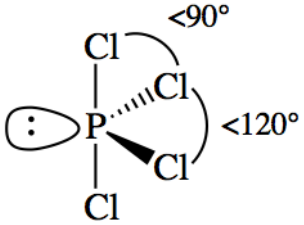
nonpolar molecule

d.

Lewis structure:

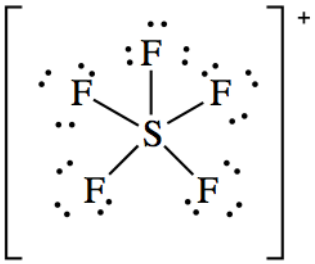


AB_4E_1 = seesaw, 3-D sketch:

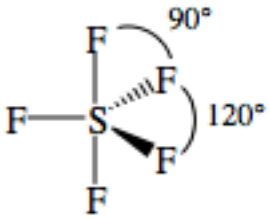


e.

Lewis structure:

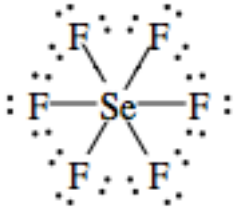


AB_5 = trigonal bipyramidal, 3-D sketch:

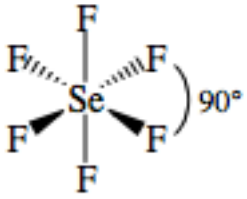


f.

Lewis structure:



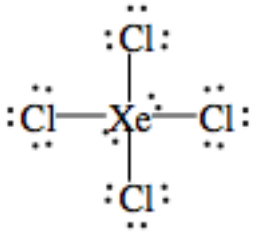
AB_6 = octahedral, 3-D sketch:



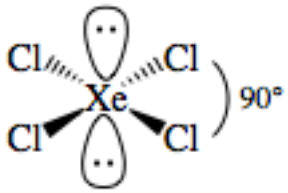
nonpolar molecule

g.

Lewis structure:



AB_4E_2 = square planar, 3-D sketch:



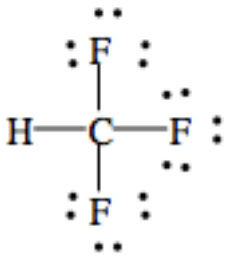
nonpolar molecule

3

Draw the Lewis structure and indicate the center atom hybridization for each of the following molecules and ions:

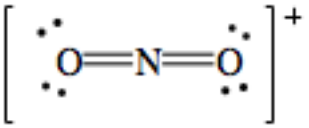
a. CHF_3
b. NO_2^+
c. NO_3^-

a.



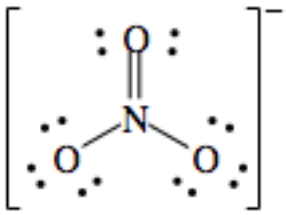
$AB_4 = sp^3$

b.



$AB_2 = sp$

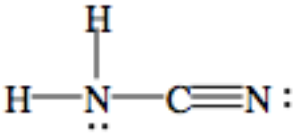
c.



$AB_3 = sp^2$

4

Draw the Lewis structure for NH_2CN that has no formal charges and determine the number of sigma and pi bonds in the molecule.



3 single + 1 triple = 3 σ + 1(1 σ + 2 π) = 4 σ bonds + 2 π bonds

5

a. Write the molecular orbital diagram for F_2 and determine the bond order. Also state whether F_2 is diamagnetic or paramagnetic.

b. Is the bond length of F_2^- shorter or longer than the bond length of F_2? Explain.

a. F_2 has 7 + 7 = 14 valence electrons:

$\uparrow\downarrow$	$\uparrow\downarrow$	$\uparrow\downarrow$	$\uparrow\downarrow$	$\uparrow\downarrow$	$\uparrow\downarrow$	$\uparrow\downarrow$	
σ_{2s}	σ^*_{2s}	σ_{2p}	π_{2p}	π_{2p}	π^*_{2p}	π^*_{2p}	σ^*_{2p}

bond order = 0.5(8-6) = 1
no unpaired electrons = diamagnetic

b. $F_2{}^-$ has one more antibonding σ^*_{2p} electron than F_2, which gives $F_2{}^-$ a bond order of 0.5(8-7) = 0.5. Since $F_2{}^-$ has a lower bond order than F_2, $F_2{}^-$ has a longer bond length than F_2.