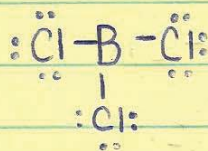


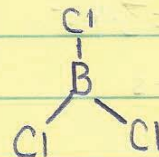
Chapter 3 and Valence Bond Theory

1) a. BCl_3

B Cl_3
 $3 + 3(7) = 24 e^-$
 12 pairs



Geometry: trigonal planar



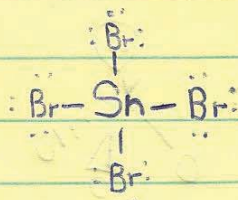
b. BeH_2

$2 + 2(1) = 4 e^-$
 2 pairs

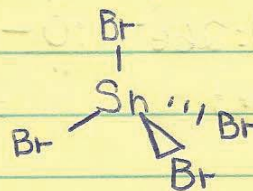
Geometry: linear
 $\text{H}-\text{Be}-\text{H}$

c. SnBr_4

$4 + 4(7) = 32 e^-$
 16 pairs



Geometry: tetrahedral

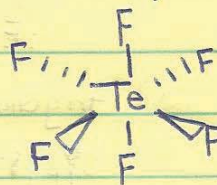


d. TeF_6

$6 + 6(7) = 48 e^-$
 24 pairs

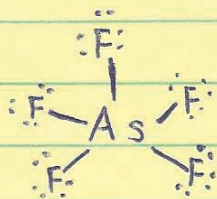


Geometry: Octahedral

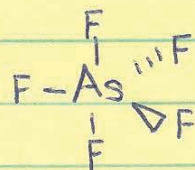


e. AsF_5

$5 + 5(7) = 40 e^-$
 $\Rightarrow 20$ pairs

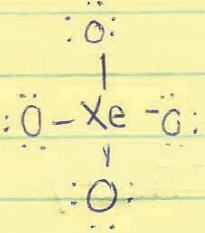


Geometry: trigonal bipyramidal



f. XeO₄

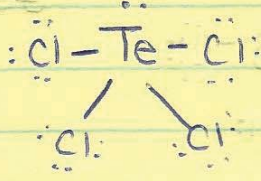
8 + 4(6) = 32e⁻
16 pairs



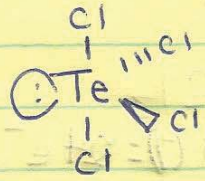
Geometry: tetrahedral

g. TeCl₄

6 + 4(7) = 34e⁻
17 pairs

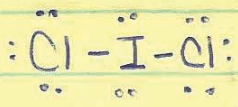


Geometry: See-saw



h. ICl₂⁺

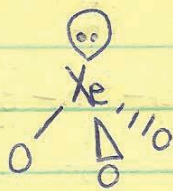
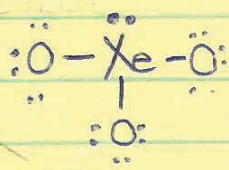
7 + 2(7) - 1 = 20e⁻
10 pairs



Geometry: bent

i. XeO₃

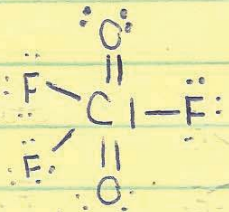
8 + 3(6) = 26e⁻
13 pairs



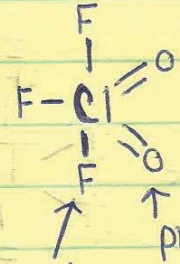
Geometry: Pyramidal

j. ClO₂F₃

7 + 2(6) + 3(7) = 40e⁻
20 pairs



trigonal bipyramidal

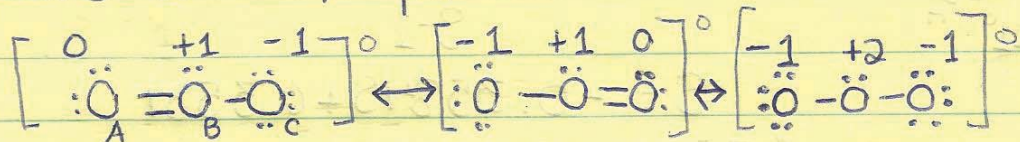


Prefers axial

↑ prefer equatorial

2) O_3

$6 \times 3 = 18e^- \Rightarrow 9 \text{ pairs}$



Formal charge

A: $6 - 4 - 2 = 0$

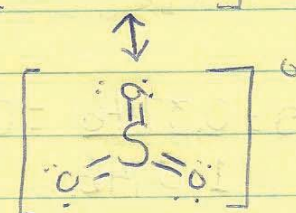
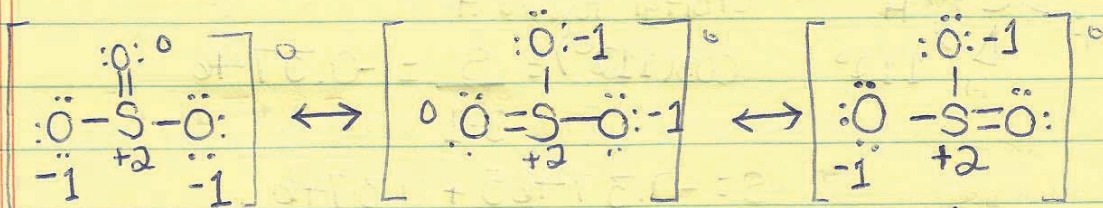
B: $6 - 2 - 3 = +1$

C: $6 - 6 - 1 = -1$

3)

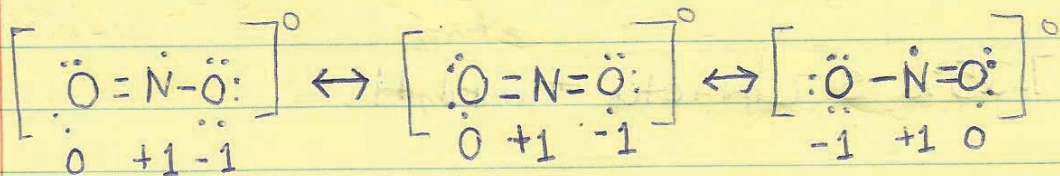
SO_3

$6 + 3(6) = 24e^- \Rightarrow 12 \text{ pairs}$

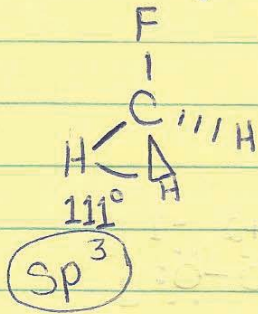


NO_2

$5 + 2(6) = 17e^-$



3) 9. CH₃F



Orbital toward H:

$$\cos(111^\circ) = \frac{S}{S-1} = -0.3584$$

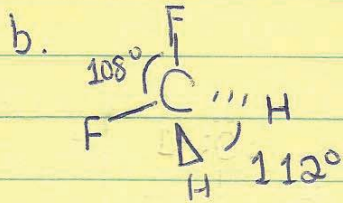
$$S = -0.3584S + 0.3584$$

$$1.3584S = 0.3584$$

$$S = \frac{0.3584}{1.3584} = 0.2638 \Rightarrow 26.4\% \text{ S character}$$

Orbital toward F:

$$3(0.2638) + x = 1 \quad x = 0.2085 \Rightarrow 20.9\% s$$



Orbital toward H:

$$\cos(112^\circ) = \frac{S}{S-1} = -0.3746$$

$$S = -0.3746S + 0.3746$$

$$1.3746S = 0.3746$$

$$S = \frac{0.3746}{1.3746} = 0.2725$$

27.25% s character toward H

Orbital toward F: $\cos(108^\circ) = \frac{S}{S-1} = -0.3090$

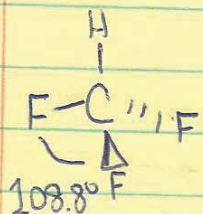
$$S = -0.3090S + 0.3090$$

(5)

$$1.3090 s = 0.3090$$

$$s = \frac{0.3090}{1.3090} = 0.2361 \quad 23.6\% \text{ s character toward F}$$

c. CHF_3



Orbital toward F:

$$\cos(108.8^\circ) = \frac{s}{s-1} = -0.3222$$

$$s = -0.3222s + 0.3222$$

$$1.3222s = 0.3222$$

$$s = \frac{0.3222}{1.3222} = 0.2437 \quad 24.4\% \text{ s character toward F}$$

$$\text{Toward H: } 3(0.2437) + x = 1 \quad x = 0.2689$$

26.9% s character toward H

d. In general, the hybrid orbitals toward F have less s character than do the hybrid orbitals toward H. This is consistent with Bent's rule, which observes that more X substituents are going to bind to hybrid orbitals with less s character.

4) Phosphorus will be more X ~~when~~ binding through its equatorial hybrid orbitals, because those orbitals have s character. The more s character a hybrid orbital has, the more closely the e^- are held to the nucleus.

(6)

5) The addition of some d character will lower the X. Sulfur would be more X if sp^3 .