Announcements – Lecture XIV – Tuesday, June 9th

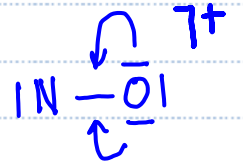
1. Fourth Lab: Today, 1:30-4:30, ISB 155B
2. Exam II: Friday, June 13th, In Class

Quiz 11 Class #: ____ Last Name: _____

1. Draw the Lewis structure for the following molecules:

a) NO^+

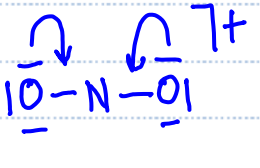
N: 5
O: 6
+: -1
10
1XBP -2
8
3XLP -6
2
1XLP -2
0



Bond Order = 3

b) NO_2^+

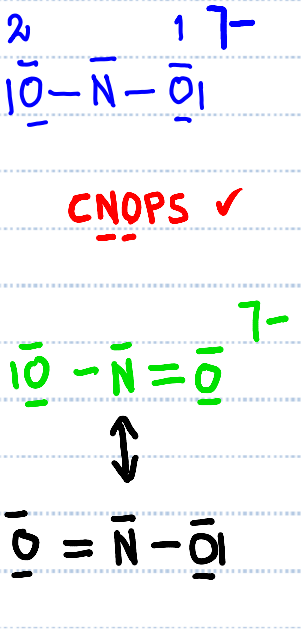
N: 5
O: 2x6
+: -1
16
2XBP -4
12
6XLP -12
0



Bond Order = 2

c) NO_2^-

N: 5
O: 2x6
-: 1
18
2XLP -4
14
6XLP -12
2
1XLP -2
0



Bond Order = 1.5

Average Single Bond Lengths (Picometers)

	H	C	N	O	F	Si	P	S	Cl	Br	I
H	74	110	98	94	92	145	138	132	127	142	161
C		154	147	143	141	194	187	181	176	191	210
N			140	136	134	187	180	174	169	184	203

2. Which of the above molecules would have a bond length > 115 pm C

Average Multiple Bond Lengths (Picometers)

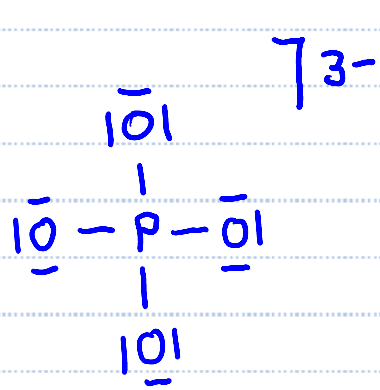
C = O	122	C ≡ O	113
N = O	115	N ≡ O	108

8.4 Electron Distribution in Molecules

C: Resonance Structures, Formal Charge – Refining Structures

PO_4^{3-} *(Octet Rule)*

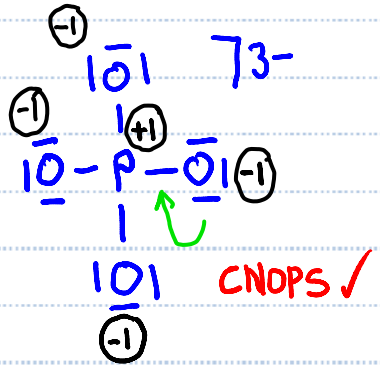
P: 5
O: 4x6
3-: 3
32
4xBP: -8
24



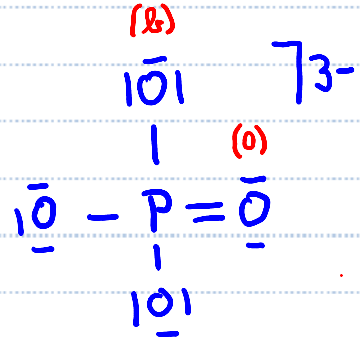
FORMAL CHARGE CHECK ?

O: 6 − 6 − ½(2) = −1
P: 5 − 0 − ½(8) = +1

PO_4^{3-} *(Minimal Formal Charge)*



CNOPS ✓



FORMAL CHARGE CHECK ?

O(0): 6 − 4 − ½(4) = 0
O(b): 6 − 6 − ½(2) = −1
P: 5 − 0 − ½(10) = 0

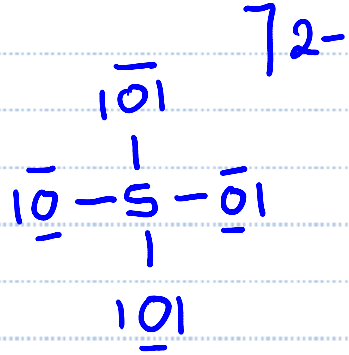
How about Resonance Structures ? ✓

8.4 Electron Distribution in Molecules

C: Resonance Structures, Formal Charge – Refining Structures

SO_4^{2-} *(Octet Rule)*

S: 6
O: 4x6
2-: 2
32
4xBP -8
24

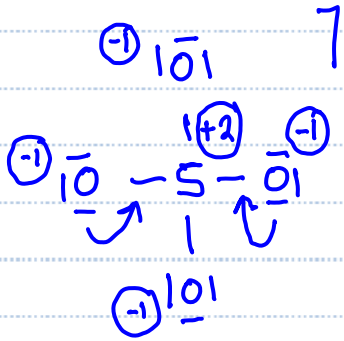


FORMAL CHARGE CHECK

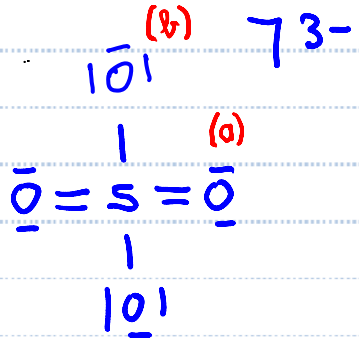
S: $6 - 0 - \frac{1}{2}(8) = +2$

O: $6 - 6 - \frac{1}{2}(2) = -1$

SO_4^{2-} *(Minimal Formal Charge)*



ENOPS ✓



FORMAL CHARGE CHECK

O(a): $6 - 4 - \frac{1}{2}(4) = 0$

O(b): $6 - 6 - \frac{1}{2}(2) = -1$

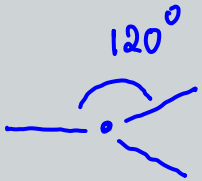
S: $6 - 0 - \frac{1}{2}(12) = 0$

How about Resonance Structures? ✓

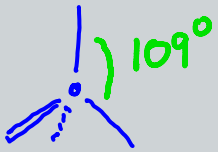
8.5 Valence-Shell Electron-Pair Repulsion and Molecular Shape

A: VSEPR and Electron-Pair Geometry

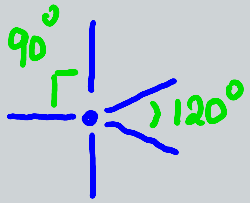
Linear



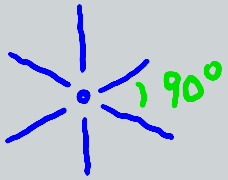
Trigonal planar



Tetrahedron



Trigonal bipyramid



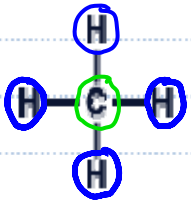
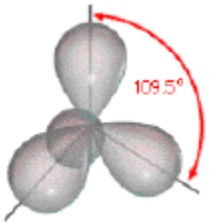
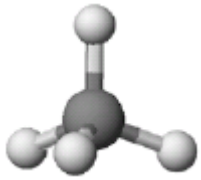
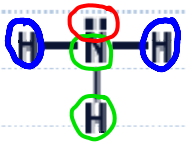
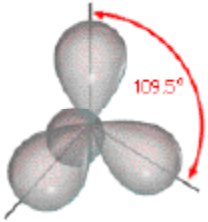
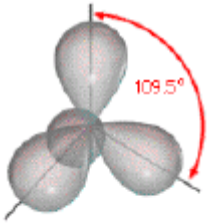
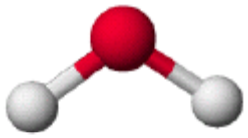
Octahedron

8.5 Valence-Shell Electron-Pair Repulsion and Molecular Shape

B: Electron Pair Geometries – Molecular Geometries

Tetrahedron

X + E = 4

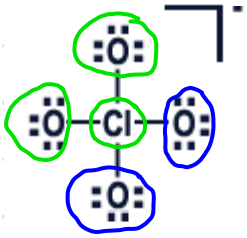
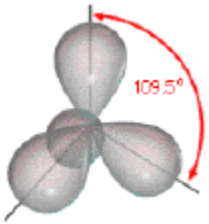
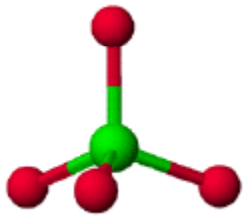
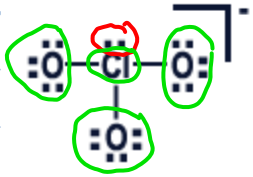
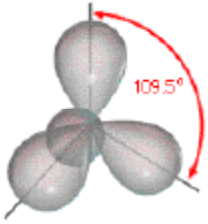
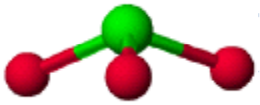
Lewis Structure	Class	Electron Pair Geometry	Molecular Geometry	Bond Angles
CH_4 	AX_4E_0	 TETRAHEDRON	 TETRAHEDRON	~109°
NH_3 	AX_3E_1	 TETRAHEDRON	 TRIGONAL PYRAMID	~109°
H_2O 	AX_2E_2	 TETRAHEDRON	 BENT/ANGULAR (109°)	~109°

8.5 Valence-Shell Electron-Pair Repulsion and Molecular Shape

B: Electron Pair Geometries – Molecular Geometries

Tetrahedron

X+E = 4

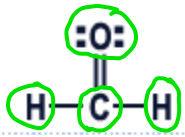
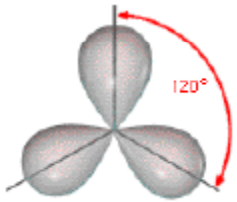
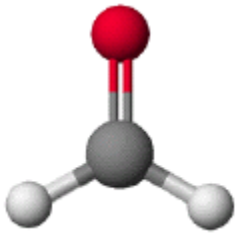
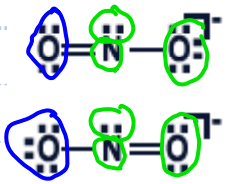
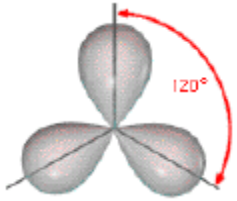
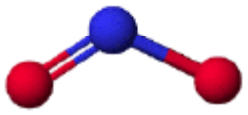
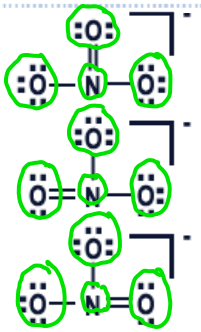
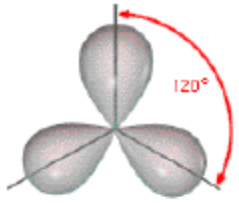
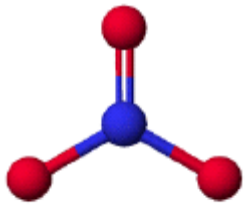
Lewis Structure	Class	Electron Pair Geometry	Molecular Geometry	Bond Angles
ClO_4^- 	AX_4E_0	 TETRAHEDRON	 TETRAHEDRON	~109°
ClO_3^- 	AX_3E_1	 TETRAHEDRON	 TRIGONAL PYRAMID	~109°

8.5 Valence-Shell Electron-Pair Repulsion and Molecular Shape

B: Electron Pair Geometries – Molecular Geometries

Trigonal Planar

X+E=3

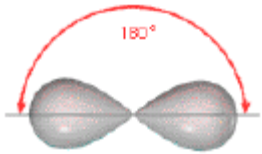
Lewis Structure	Class	Electron Pair Geometry	Molecular Geometry	Bond Angles
H_2CO 	AX_3E_0	 TRIGONAL PLANAR	 TRIGONAL PLANAR	120°
NO_2^- 	AX_2E_1 AX_2E_1	 TRIGONAL PLANAR	 BENT/ANGULAR (120°)	120°
NO_3^- 	AX_3E_0 AX_3E_0 AX_3E_0	 TRIGONAL PLANAR	 TRIGONAL PLANAR	120°

8.5 Valence-Shell Electron-Pair Repulsion and Molecular Shape

B: Electron Pair Geometries – Molecular Geometries

Linear

X+E=2

Lewis Structure	Class	Electron Pair Geometry	Molecular Geometry	Bond Angles
HCN				
H—C≡N:	AX_2E_0	 LINEAR	 LINEAR	180°