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[TP] Use formal charge to determine the group number of the atom Z in the molecular ion shown.

11%	1.	2A (12)
9%	2.	3A (13)
17%	3.	4A (14)
39%	4.	5A (15)
20%	5.	6A (16)
3%	6.	7A (17)
1%	7.	further information needed

$$\left[\ddot{\text{O}}=\ddot{\text{Z}}-\ddot{\text{O}}: \right]^{-}$$

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Lecture 7 CH131 Fall 2020
Tuesday, September 29, 2020

- Lewis diagrams
- Shapes and polarity of molecules

Next lecture: Begin ch9 (9.1–9.)

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Lewis diagram of acetic acid, CH_3COOH

- skeleton
- # of e's that we have = 24
- # of e's that we "need" = 40
- shared = 40 - 24 = 16

$4 \times 2 + 4 \times 8 = 8 + 32 = 40$
 $4 \times 1 + 2 \times 4 + 2 \times 6 = 4 + 8 + 12 = 24$

"need" so that each H can have $\geq e^-$, and all other atoms have 8.

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Lewis diagram of acetic acid, CH_3COOH

- skeleton
- e's we have = 4 + 8 + 12 = 24
- e's needed: 8 + 32 = 40
- e's shared single = needed - have = 40 - 24 = 16
- share e' in single pairs
- share remaining e' to make multiple pairs
- assign remaining e' as unshared pairs

$24 - 16 = 8 e^- = 4 \text{ pairs}$
 $-1 + 1 = 0$

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Lewis diagram of acetic acid, CH_3COOH

0. skeleton
1. e's we have = $4 + 8 + 12 = 24$
2. e's needed: $8 + 32 = 40$
3. e's shared single
= needed - have = $40 - 24 = 16$
4. e's shared multiple
= shared single - shared = $16 - 14 = 2$
5. e's unshared lone
= have - shared = $24 - 16 = 8$

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Lewis diagram of acetic acid, CH_3COOH

0. skeleton
1. e's we have = $4 + 8 + 12 = 24$
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= needed - have = $40 - 24 = 16$
4. e's shared multiple
= shared single - shared = $16 - 14 = 2$
5. e's unshared lone
= have - shared = $24 - 16 = 8$
6. formal charge determines "best" place for shared double pair

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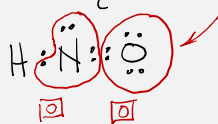
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Formal charge determines "best" structure

41. Determine the formal charges on all the atoms in the following Lewis diagrams.

$\text{H}-\ddot{\text{N}}=\ddot{\text{O}}$ and $\text{H}-\ddot{\text{O}}=\ddot{\text{N}}$
Which one would best represent bonding in the molecule HNO?

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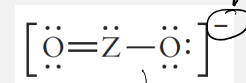
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[TP] Use formal charge to determine the group number of the atom Z in the molecular ion shown.

- | | | |
|-----|----|----------------------------|
| 1% | 1. | 2A (12) |
| 1% | 2. | 3A (13) |
| 2% | 3. | 4A (14) |
| 82% | 4. | 5A (15) |
| 13% | 5. | 6A (16) |
| 1% | 6. | 7A (17) |
| 0% | 7. | further information needed |



Handwritten calculation: $0 + 8 + (-1) = -1$

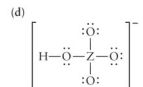
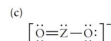
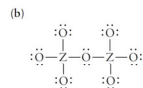
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Formal charge determines "best" structure

43. In each of the following Lewis diagrams, Z represents a main-group element. Name the group to which Z belongs in each case and give an example of such a compound or ion that actually exists.



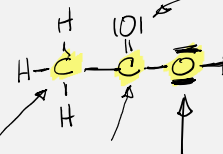
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Shape of acetic acid, CH_3COOH

Steric number $\rightarrow$ Geometry $\rightarrow$ Shape



4+0=4 3+0=3 2+2=4
 SN=4, geometry tetrahedral
 SN=3, geometry trigonal planar
 Trick question!!!

Central atoms
 Steric number =
 # of attached atoms
 +
 # of lone pairs

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TABLE 3.8
Molecular Shapes Predicted by the Valence Shell Electron-Pair Repulsion Theory

Molecule	Steric Number	Predicted Geometry	Example
AX_2	2	Linear	CO_2
AX_3	3	Trigonal planar	BF_3
AX_4	4	Tetrahedral	CF_4
AX_5	5	Trigonal bipyramidal	PF_5
AX_6	6	Octahedral	SF_6

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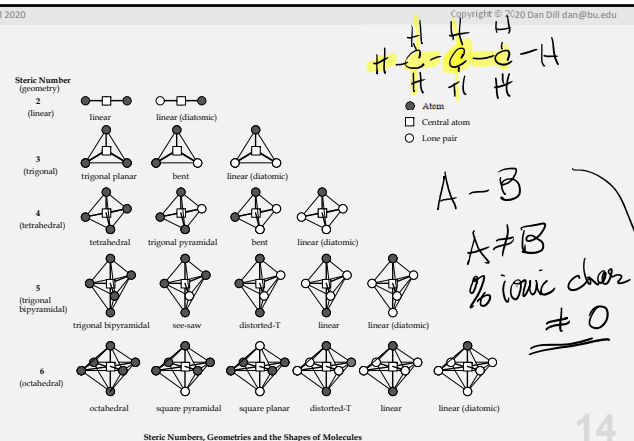
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Table 3-8, p. 119

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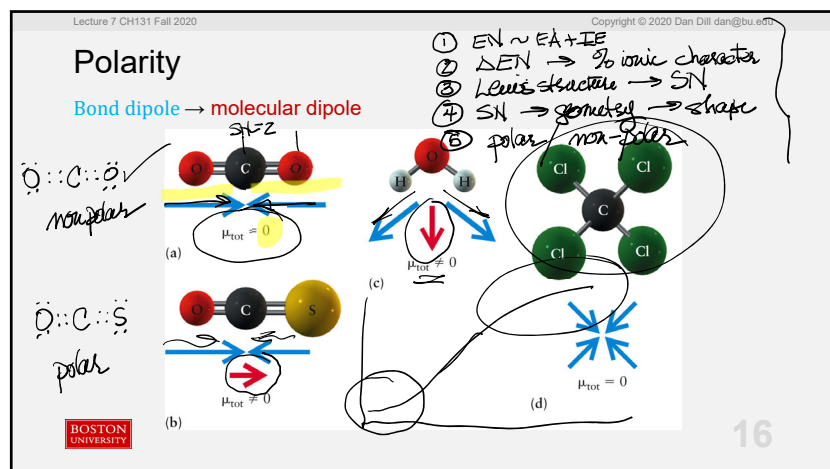


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Steric Numbers, Geometries and the Shapes of Molecules

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