VSEPR Valence Shell Electron-Pair Repulsion

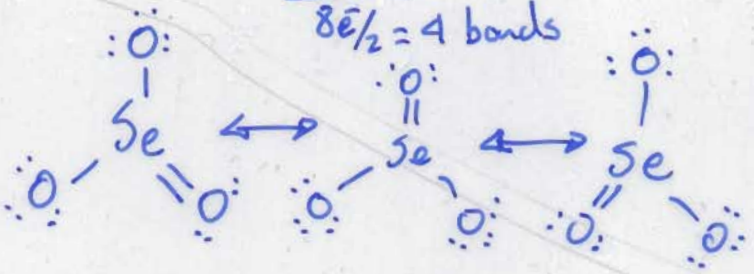
81.

a. SeO_3

$6 + 3(6) = 24e^-$

$4 * 8 = 32e^-$

$8e^-/2 = 4$ bonds



Number of e^- pairs on central atom?

- bonds (single, double, triple) count as one pair.

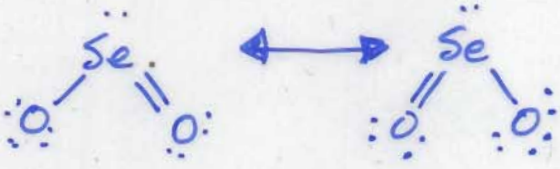
in VSEPR only!!

b. SeO_2

$6 + 2(6) = 18e^-$

$3 * 8 = 24e^-$

$8e^-/2 = 4$ "bonds" {actually 4 electron-pairs}



83. b. ICl_3

Exceptions to Octet Rule!

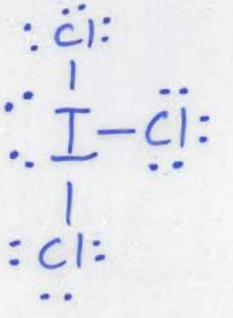
$7 + 3(7) = 28e^-$

$4 * 8 = 32e^-$

$4e^-/2 = 2 \Rightarrow ?$

*Notice, how 3 bonds at least would be needed for skeletal structure

So,



T-shaped

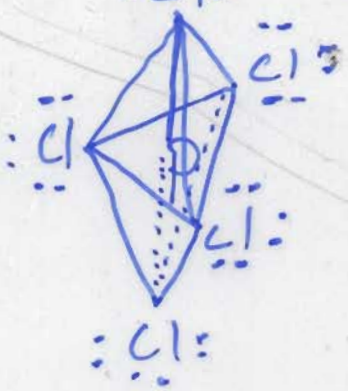
Table 8.6 (Trigonal bypiramida)

83. d. PCl_5

$5 + 7(5) = 40e^-$

$6 * 8 = 48e^-$

$8e^-/2 = 4$ ⇐ Would need @ least 5 bonds so its exception to octet.



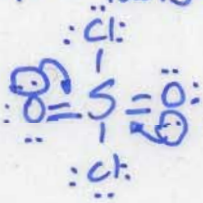
- We can expect for Cl to be giving one e^- per bond & the other given by the P, so, how many electron-pairs around P?
- See table 8.6

Formal Charge F.C.

8.73 Formal Charge = Valence e^- on free atom − # of lone-pair e^- on atom − $\frac{1}{2}$ * # of shared e^- on atom.

e.) SO_2Cl_2

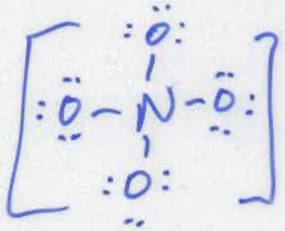
1st lewis



$6+2(6)+2(7) = 32e^- - 40e^- = \frac{8}{2} = 4$ "bonds"

F.C on S $= 6 - 0 - \frac{1}{2} * 8 = +2$

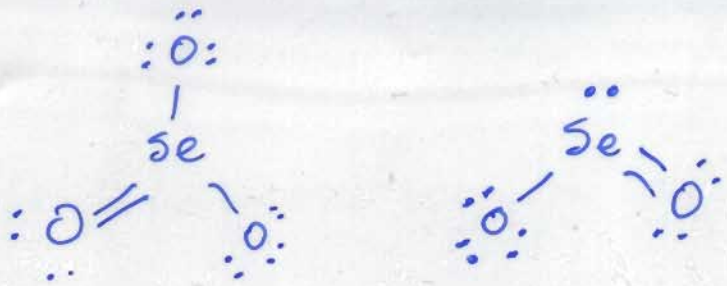
h.) NO_4^{3-}



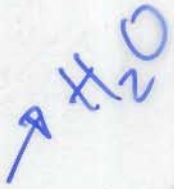
$5+4(6)+3 = 32e^- - 40e^- = 8/2 = 4$ "bonds"

F.C on N $= 5 - 0 - \frac{1}{2} * 8 = +1$

8.85



? which has dipole, where is tail-head?



8.84 If there is overall dipole moment: POLAR molecules.
No overall dipole moment: NON-POLAR molecules.

a. OCl_2

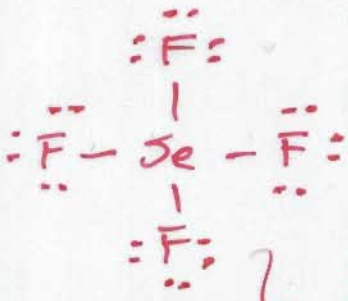
$6 + 7(2) = 20$

$3 \times 8 = 24$

$4 \div 2 = 2$ "bonds"

SO_2

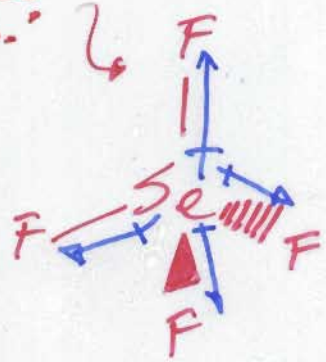
b. NF_3



c. SeF_4 $4 + 4(7) = 32$

$5 * 8 = 40 / 8 \div 2 = 4$ "bond"

8.94 XeF_2Cl_2 cis & trans conformers.



Chapter 9: Hybridization & Localized Electron Model

- Orbital Bonding Model

109.5°, 120°, 180°, $[90^\circ; 120^\circ]$, 90

sp^3, sp^2, sp, dsp^3, d^2sp^3

↓ tetrahedral, trigonal, linear, trigonal bypiramid, octahedral

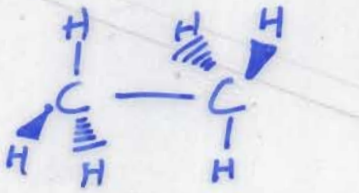
Figure 9.24 Book (Pg. 424)

sp, usually triple bonds → $H-C\equiv C-H$

sp^2, " " double bonds →

sp^3, " " single bonds →

For Hydrocarbons.



Lewis structure, then,

9.) 13, VSEPR, table 8.6 (Page 394)
15, "
17, "
19,

} Correlate with Figure 9.24

21, b ⇒ lone pairs require more space than bonding pairs. Angles < 109.5°

25, ⇒ Fill up with lone-pairs.

29, ⇒ It's a "hydrocarbon" (Heterocyclic Compound)

47, Lewis, VSEPR, Hybridization.

Chapter 10 (Liquids & Solids)

- Intermolecular Forces

→ dipole-dipole → H-bonds

→ induced dipole-dipole →

→ ind. dipole-ind. dipole → London

10.35

Covalent → London dispersion forces.
Ionic → Ionic forces
H-bonding → needs H
Polar covalent → Dipole forces (H-bonds)

10.37

a. Polar, non-polar?
b. On L.D. larger means greater.
c. More H-bonding possible. For H-bonding free e⁻-pairs (lone pairs) are needed.
d. Polar, non-polar?
e. H-bonding.

10.39

a. Polar - non?
b. Ionic
c. Greater Volume, greater L.D. forces, low V.P.
d. Non-polar, small.
e. " "
f. H-bonding.
g. " "

10.43

More H-bonding, more viscocity.

Structures & Types of Solids & Bonding in Metals

10.21 a. crystalline & amorphous solids
b. ionic & molecular solids
c. molecular & network solids — discrete / non-discrete
d. metallic & network solids — delocalized e⁻ / localized e⁻

0.45 Bragg's Equation

$n\lambda = 2d\sin\theta$

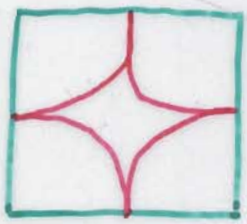
- $\lambda, \theta, n \Rightarrow$ Given
- solve for d

$d = n\lambda / 2\sin\theta$

0.47 & 10.49

Figure 10.9 ⇒ 3 types of unit cell, all CUBIC

simple

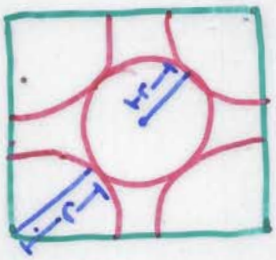


$8\text{ corners} * \frac{1/8\text{ atom}}{\text{corner}} = 1\text{ atom per unit cell}$

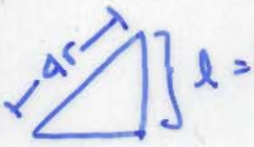
body centered

$8\text{ corners} * \frac{1/8\text{ atom}}{\text{corner}} + 1\text{ atom center} = 2\text{ atoms per unit cell}$

face centered



$8\text{ corners} * \frac{1/8\text{ atom}}{\text{corner}} + 6\text{ faces} * \frac{1/2\text{ atom}}{\text{face}} = 4\text{ atoms per unit cell}$



$l^2 + l^2 = (4r)^2$

$l = r\sqrt{8}$

Ca $r = 197\text{ pm} = 197 \times 10^{-12}\text{ m}$

$l = 197 \times 10^{-12} * \sqrt{8}\text{ m}$

$V = l^3 =$

$\rho_{Ca} = \frac{\text{Mass of 4 atoms of Ca}}{\text{V. of fcc}} = \frac{4\text{ Ca atoms} * \frac{1\text{ mol Ca}}{6.02\times10^{23}\text{ Ca atoms}} * \frac{40.08\text{ g Ca}}{\text{mol Ca}}}{\text{Vol. of f.c.c.}}$

Ir $V = l^3 = (383.3\text{ pm})^3 = (383.3 \times 10^{-12}\text{ m})^3 =$

$\rho_{Ir} = \frac{\text{Mass of 4 atoms of Ir}}{\text{Vol. of f.c.c.}} =$

Planck | Einstein | De Broglie

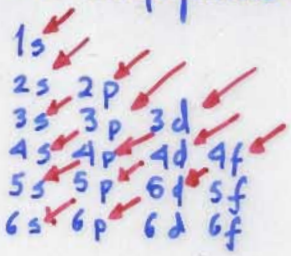
① $E = h\nu$ $\nu = c/\lambda$ ② $E = mc^2$ ① and ② $\lambda = \frac{h}{m \cdot v}$

$\Delta E = -2.178 \times 10^{-18}\ J \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$

$\Delta x \cdot \Delta v \geq h/4\pi$

$n = 1, 2, 3, \ldots$ $l = n-1 = \{0, 1, 2, \ldots\}$ (s p d) $m_l = -l, \ldots, 0, \ldots, l = \{l=2;\ m_l = -2, -1, 0, 1, 2\}$ $m_s = \pm$

Electronic Configurations, Keller's Table { Remember Exceptions like Cu and Cr



$M(g) \rightleftharpoons M^+(g) + e^-$ Ionization (I.E)

$M(g) + e^- \rightleftharpoons M^-(g)$ Affinity (E.A)

$I.E. = -EA$

I.E.; E.A.; E.N.

Coulomb's Law $E = K \frac{Q_1 Q_2}{r_{12}}$ $K = 2.31 \times 10^{-19}\ J \cdot nm$

- Ionic ⟶ non-metal + metal
- Covalent ⟶ non-metals
- Polar Covalent → dipole moments.

Bond Energies & Lattice Energies follow Hess's Law $\Delta H^\circ = \sum \Delta H_{prod} - \sum \Delta H_{react}$.

Lewis Structures A = # valence e^- ± charge B = # e^-, octet

"bonds" = $\frac{|B - A|}{2}$ "bonds" ⇒ electron pairs "free" for making bonds or sometimes staying as lone pairs.

If "bonds" formula not satisfied easily most likely octet exception.

Resonance Structures: always when multiple & single bonds present.

Formal charge determines between various Lewis Str. (e.g. Minimize F.C)

F.C. = Valence e^- on free atom − # of lone pair e^- on atom $-\frac{1}{2}$ * # of shared e^- on atom.

# e^- pairs	Geometrical Arrangement	# lone pairs	Hybridization		angles
2	Linear		sp	∞	180
3	Trigonal Planar		sp^2		120
4	Tetrahedral		sp^3		109.5
5	Trigonal Bipyramidal	3 → Linear 2 → T-shaped 1 → see-saw	dsp^3		90, 120
6	Octahedral	2 → square planar 1 → square pyramid	d^2sp^3		90

* in VSEPR bonds (single, double and triple) count as <u>one</u> e^- pair

Note hybridizations only on atoms <u>not</u> for whole molecule.