

CH301 Worksheet 6: What can you find out about structure and bonding by creating 3 dimensional structures of molecules?

Explanation of columns:

- A Compound name or structure
- B Creating a 2D Lewis Structure: Create symmetrical layout of atoms and assign EN values to each atom
- C Creating a 2D Lewis Structure: Calculate $\Delta EN > 1.5$, bond is ionic. If $\Delta EN < 1.5$, bond is covalent.
- D Creating a 2D Lewis Structure: How many valence electrons?
- E Creating a 2D Lewis Structure: Does structure follow octet rule or is it hypervalent, hypervalent or radical?
- F Creating a 2D Lewis Structure: Do you need to add electron pairs to the center atom to make resonance, double or triple bonds?
- G Creating a 2D Lewis Structure: Draw Lewis dot structure
- H Creating a 3D Lewis Structure: Count number of regions of electron density around central atom
- I-K Creating a 3D Lewis Structure: Determine electronic geometry, hybridization bond angle from regions of electron density
- L-N Creating a 3D Lewis Structure: Distinguish bonding and nonbonding electron pairs around central atom to determine molecular geometry
- O-P Creating a 3D Lewis Structure: Draw VSEPR 3-D structure first with all valence electrons and then displaying the dipoles from ΔEN
- Q,R Creating a 3D Lewis Structure: First count number of σ and pi bonds in molecule, then use $\Sigma \Delta EN = 0$ or $\Sigma \Delta EN \neq 0$ to determine molecular polarity

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Molecular formula	Initial layout EN values	Ionic or Covalent	# valence e-	Hypo, hyper or octet?	Multiple bonds or resonance	2-D Lewis dot Structure	# e- rich regions	Elec. geometry	Hybridization	Bond angle	Bonding pairs	Unbonded pairs	Molecular geom.	3-D VSEPR structure	VSEPR with dipoles	How many sigma and pi bonds?	Polar or non polar
H ₂ O	2.2 H 3.5 O	C	8	Octet	NO	H-O-H	4	tetrahedral	sp ³	105.5°	2	2	AB ₂			2σ	Polar
NH ₃	2.2 H 3 N	C	8	Octet	NO		4	tetrahedral	sp ³	109.5°	3	1	AB ₃			3σ	Polar
I ₅	I < 3 I < 3 I < 3	C	22	Hyper	NO		5	trigonal bipyramidal	3 dsp	180° 90° 120°	2	3	AB ₅		no dipoles ΔEN = 0	2σ	non polar
SO ₂ *	3.5 S 3.5 O	C	18	Octet	resonance		3	trigonal planar	sp ²	120°	2	1	AB ₂			2σ 1π	Polar

* you can make an argument for hypervalent w/ 14 no resonance