Stereochemistry Lab Teacher Notes **Chemistry 20**

Name _____ Partner _____

Purpose: To use the VSEPR theory to predict shapes around central atoms of molecular compounds & polyatomic ions
Don't be afraid to spend 3 or 4 eighty minute periods on this. Time spent here will pay off later in the course!! And in chemistry 30 when you do the organic section!

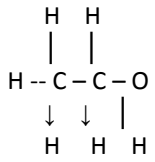
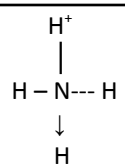
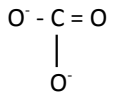
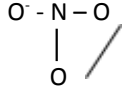
Procedure:
Use the model kits provided to build 3-D models of the following molecular compounds.
Fill in all the missing areas of the observation table. Your textbook may be of help. (See pages 85 ➜ 112) – these pages are based on the Nelson book. If you have a different text, then adjust the page numbers

Observations: Enlarge this chart and fill in all spaces. (2 marks per line) (1/2 mark will be subtracted for every error per line)
In the stereo chemical formula line:
Remember that – means 'in the plane', ---- means 'up towards you' , and ↓ means 'down away from you'

	Empirical formula / Molecular formula	Lewis Diagram Show valence e^- only	Stereo-chemical formula		Central Atom(s) – lone pairs	Central Atoms(s) – bonding e^-	shape(s) around each central atom	Bond dipoles	Polar or Non-polar
1	$NH_{3(g)}$	N has 5 valence e^-, H has 1 valence e^-	H -- N – H | H Another stereo diagram would have the left hand H pointing away from you		N – one lone pair	N – 3 bonding electrons	Pyramidal	N ↔ H nitrogen is more electronegative unbalanced dipole	Polar
2	$C_2Cl_{4(g)}$	Note the double bond between the two carbons. Carbon acts like it is bonding in three directions instead of four directions	Cl – C = C – Cl | | Cl Cl Bond angles should all be 120°		C atoms have 0 – lone pairs	Both C atoms have – 4 bonding electrons – but only 3 directions	Trigonal planar	C ↔ C no dipole C↔ Cl Chlorine is more electronegative Dipoles cancel	Non polar
3	$CF_{4(g)}$	C has 4 valence electrons F has 7 valence electrons	F | F – C --- F ↓ F		Carbon has 0 lone pairs	Carbon has 4 bonding electrons	Tetra hedral	F ↔ C Fluorine is more electronegative Dipoles cancel	Non polar

	Empirical formula / Molecular formula	Lewis Diagram Show valence e^- only	Stereo-chemical formula		Central Atom(s) – lone pairs	Central Atoms(s) – bonding e^-	shape(s) around each central atom	Bond dipoles	Polar or Non-polar
4	$OCl_{2(g)}$	O has 6 valence e- Cl has 7 valence e^-	Cl – O | Cl		Oxygen has 2 lone pairs	Oxygen has 2 bonding electrons	Angular, bent, v-shaped	O↔ Cl Oxygen is slightly more electronegative than chlorine Unbalanced dipole	Polar
5	$C_2F_{2(g)}$	C has 4 valence e- F has 7 valence e^-	F – C ≡ C – F		Carbon has 0 lone pairs	Carbon has 4 bonding e^-, but they all go in one direction	Linear	F↔ C Fluorine is more electronegative Dipoles cancel	Non polar
6	$HOF_{(l)}$	H has 1 valence e^- O has 6 valence e F has 7 valence e^-	H – O | F		Oxygen has 2 lone pairs	Oxygen has 2 bonding electrons	Angular, Bent, v-shaped	O↔ H Oxygen is more electronegative O↔ F Fluorine is more electronegative	polar
7	$NHF_{2(g)}$	N has 5 valence e^- H has 1 valence e^- F has 7 valence e^-	F – N – H | F		Nitrogen has one lone pair	Nitrogen has 3 bonding e^-	Pyramidal	N↔ F Fluorine is more electronegative N↔ H Nitrogen is more electronegative	polar
8	$C_2IBr_{(l)}$	C has 4 valence e^- I and Br both have 7 valence e^-	Br – C ≡ C – I		Both C atoms have 0 lone pairs	Both C atoms have – 4 bonding electrons – but only 2 directions	Linear	C↔ Br Br is more electronegative C↔ I I is slightly more electronegative	polar
8	$C_2IBr_{(l)}$	C has 4 valence e^- I and Br both have 7 valence e^-	Br – C ≡ C – I		Both C atoms have 0 lone pairs	Both C atoms have – 4 bonding electrons – but only 2 directions	Linear	C↔ Br Br is more electronegative C↔ I I is slightly more electronegative	polar

	Empirical formula / Molecular formula	Lewis Diagram Show valence e^- only	Stereo-chemical formula		Central Atom(s) – lone pairs	Central Atoms(s) – bonding e^-	shape(s) around each central atom	Bond dipoles	Polar or Non-polar
9	$CHClBr_{2(l)}$	C- 4 valence e^- H – 1 valence d^- Cl and Br – 7 valence e^-	Br | H – C--- Br ↓ Cl		C has 0 lone pairs	C has 4 bonding e^-	tetrahedral	C↔ Br Br is more electronegative C↔ Cl Chlorine is more electronegative C↔ H C is more electronegative	polar
10	$C_2HF_{3(l)}$	C – 4 valence e^- H – 1 valence e^- F – 7 valence e^-	F – C = C – F | | H F		C has 0 lone pairs	C has 4 bonding e-, but 3 directions	Trigonal planar	C↔ H C is more electronegative C↔ F Fluorine is more electronegative	polar
11	$H_2O_{2(l)}$	H – 1 valence e^- O – 6 valence e^-	H – O | O – H Can also be a 'boat shape'		O has 2 lone pairs	O has 2 bonding e^-	Angular, bent, v-shaped	O↔ H Oxygen is more electronegative	polar
12	$CO_{2(g)}$	C – 4 valence e^- O – 6 valence e^-	O = C = O		C has 0 lone pairs	C has 4 bonding e^-	Linear	C↔ O Oxygen is more electronegative Dipole cancel	Non polar
13	$N_2H_3F_{(g)}$	N – 5 valence e^- H – 1 valence e^- F – 7 valence e^-	H –N – N ➔F ↓ | H H		N has 1 lone pair	N has 3 bonding e-	Pyramidal and pyramidal	N↔ H Nitrogen is more electronegative N↔ N no dipole N ↔ F Fluorine is more electronegative	polar

	Empirical formula / Molecular formula	Lewis Diagram Show valence e^- only	Stereo-chemical formula		Central Atom(s) – lone pairs	Central Atoms(s) – bonding e^-	shape(s) around each central atom	Bond dipoles	Polar or Non-polar
14	$C_2H_5OH_{(l)}$	C – 4 valence e^- O – 6 valence e^- H – 1 valence e^-			C has 0 lone pairs O has 2 lone pairs	C – 4 bonding e^- O – 2 bonding e-	Tetrahedral Tetrahedral Angular or bent or v-shaped	C↔ O Oxygen is more electronegative O↔ H Oxygen is more electronegative H↔ C C is more electronegative	polar
15	$NH_4^+{}_{(aq)}$	N – 5 valence e^- H – 1 valence e^-			N has 1 lone pair	N – 3 bonding e^- One coordinate covalent bond with the H^+	Tetrahedral	N↔ H Nitrogen is more electronegative	So polar that it forms an ion
16	$CO_3^{2-}{}_{(aq)}$	C has 4 valence e- O has 6 valence e^- O^- has 7 valence e^-			C – 0 lone pairs O – 2 lone pairs O^- has 2 lone pairs	C – 4 bonding e^- O – 2 bonding e^- O^- has 1 bonding e^-	Trigonal pyramidal	C↔ O O is more electronegative C↔ O^- O^- is more electronegative	So polar that it forms an ion
17	$NO_3^-{}_{(aq)}$	N – 5 valence e^- O – 6 valence e^- O^- 7 valence e^-			N – 1 lone pair O – 2 lone pairs O^- has 2 lone pairs	N – 3 bonding e^- O – 2 bonding e^- O^- has 1 bonding e^-	Around N – pyramidal Around O – bent, angular or v-shaped	N↔ O O is more electronegative N↔ O^- O^- is more electronegative	So polar that it forms an ion

1. Identify molecules (compounds or polyatomic ions) with multiple bonds: C_2Cl_4, C_2F_2, C_2IBr, C_2HF_3, CO_2, CO_3^{2-}

   - Multiple bonds make the reagent less stable
   - Multiple bonds bring the atoms closer together

2. Identify the molecule(s) with coordinate covalent bonds. NH_4^+

3. Based on given states, which molecules have the strongest bonds? All the liquids

4. Based on given states, which molecules have the weakest bonds? All the gases

5. Do questions 9, 10, and 11 from pages 100 ➜ 101 of your text. (Attach a piece of paper please)

6. Glucose has MANY isomers. Sketch three different line diagrams for glucose.