D. Structure of Molecules and Molecular Ions

On a separate sheet of paper, set up the following table (with eight columns) for each of the molecules/molecular ions that are assigned to you/your group. The central atom of the molecule/molecular ion is italicized.

Molecule or Molecular Ion	Lewis Structure	Valence Shell Electron Pairs	Bonding Electron Pairs	Nonbonding Electron Pairs	VSEPR Formula	Approx. Bond Angle	Geometric Shape
1. CH_4		4	4	0	AX_4	109.5°	tetrahedral
2. SF_4							
3. H_2O							

1. Complete the table (as outlined above) for the following molecules/molecular ions, all of which obey the Lewis octet rule. Complete those that are assigned by your laboratory instructor.

a. H_3O^+ **b.** NH_3 **c.** NH_4^+ **d.** CH_3^- **e.** SnH_4 **f.** BF_4^- **g.** PO_4^{3-} **h.** PF_3 **i.** AsH_3 **j.** SiF_4 **k.** H_2S **l.** NH_2^-

2. Complete the table (as outlined above) for the following molecules/molecular ions, *none* of which obey the Lewis octet rule. Complete those that are assigned by your laboratory instructor.

a. GaI_3 **b.** PCl_2F_3 **c.** BrF_3 **d.** XeF_2 **e.** XeF_4 **f.** $XeOF_2$ **g.** $XeOF_4$ **h.** SbF_6^- **i.** SF_6 **j.** SnF_6^{2-} **k.** IF_4^- **l.** IF_4^+

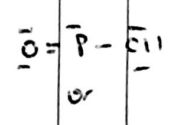
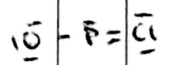
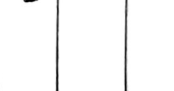
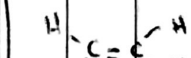
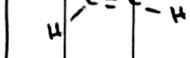
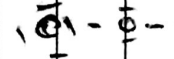
3. Complete the table (as outlined above) for the following molecules/molecular ions. No adherence to the Lewis octet rule is indicated. Complete those that are assigned by your laboratory instructor.

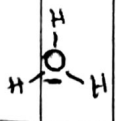
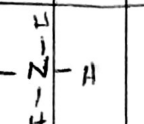
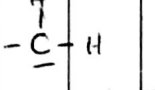
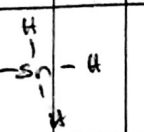
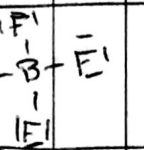
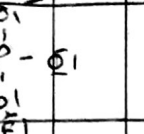
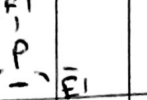
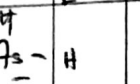
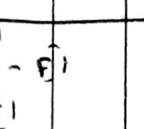
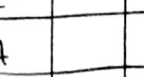
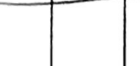
a. AsF_3 **b.** ClO_2^- **c.** CF_3Cl **d.** SnF_2 **e.** SnF_4 **f.** PF_4^+ **g.** PF_5 **h.** SO_4^{2-} **i.** CN_2^{2-} **j.** KrF_2 **k.** TeF_6 **l.** AsF_5

4. Complete the table (as outlined above) for the following molecules/molecular ions. For molecules or molecular ions with two or more atoms considered as central atoms, consider each atom separately in the analysis according to Table D3.3. Complete those that are assigned by your laboratory instructor.

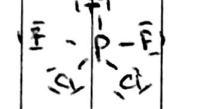
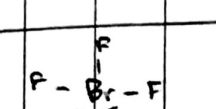
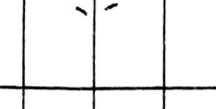
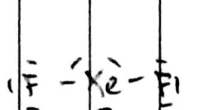
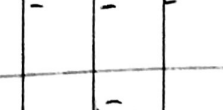
a. $OPCl_3$ **b.** H_2CCH_2 **c.** $CH_3NH_3^+$ **d.** Cl_3CCF_3 **e.** Cl_2O **f.** ClCN **g.** $COCl_2$ **h.** OCCCO **i.** CO_2 **j.** O_3 **k.** NO_3^- **l.** $TeF_2(CH_3)_4$

4.

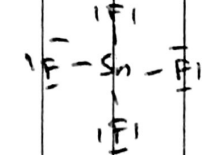
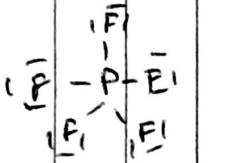
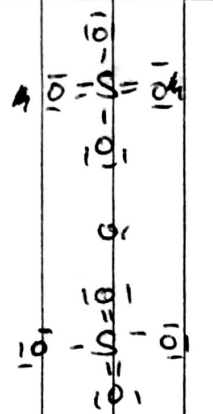
Molecule	Lewis Structure	Valence Shell Electron Pairs	Bonding Electron Pairs	Nonbonding Electron Pairs	VSEPR	Angle	Shape
a) OPCl	 or 	3	2	1	AX_2E_1		
b) H_2CCH_2		3	3	0	AX_3	120°	Trigonal Planar
e) Cl_2O		4	2	2	AX_2E_2	180°	Linear
f) ClCN (16e⁻)		2	2	0	AX_2	180°	Linear
g) $COCl_2$		3	3	0	AX_3	120°	Trigonal Planar
j) O_3		3	2	1	AX_2E_1		Bent
k) NO_3^-		3	3	0	AX_3	120°	Trigonal Planar

	Molecule	Lewis Structure	Valence Shell Electron Pairs	Bonding Electron Pairs	Non-Bonding Electron Pairs	VSEPR Formula	Bond angle	Shape
a)	H_3O^+		4	3	1	AX_3E	< 109.5	~~Tetrahedral~~ Trigonal Pyramidal
b)	NH_3		4	3	1	AX_3E	< 109.5	Trigonal Pyramidal
c)	NH_4^+		4	4	0	AX_4	109.5	Tetrahedral
d)	CH_3^-		4	3	1	AX_3E	< 109.5	Trigonal Pyramidal
e)	SnH_4		4	4	0	AX_4	109.5	Tetrahedral
f)	BF_4^-		4	4	0	AX_4	109.5	Tetrahedral
g)	PO_4^{3-}		4	4	0	AX_4	109.5	Tetrahedral
h)	BPF_3		4	3	1	AX_3E	< 109.5	Trigonal Pyramidal
i)	AsH_3		4	3	1	AX_3E	< 109.5	Trigonal Pyramidal
j)	SiF_4		4	4	0	AX_4	109.5	Tetrahedral
k)	H_2S		4	2	2	AX_2E_2	< 109.5	Bent
	NH_2^-		4	2	2	AX_2E_2	< 109.5	Bent

2.

Molecule	Lewis Structure	Valence shell Electron Pair	Bonding Electron Pair	Nonbonding electron Pair	VSEPR	Angle	Shape
b) PCl_2F_3		5	5	0	AX_5		Trigonal Bipyramidal
c) BrF_3		5	3	2	AX_3E_2		
d) XeF_2		5	2	3	AX_2E_3		
e) XeF_4		6	4	2	AX_4E_2		
i) SF_6		6	6	0	AX_6		

3.

Molecule	Lewis Structure	Valence shell Electron Pairs	Bonding Electron Pairs	Nonbonding Electron Pairs	VSEPR	Angle	Shape
d) SnF_2							
e) SnF_4		4	4	0	AX_4		
g) PF_5		5	5	0	AX_5		
h) SO_4^{2-}		6	6	0	AX_6		