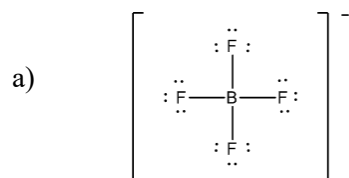
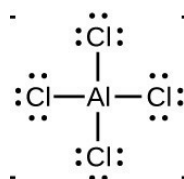


**Chapters 10 – 12: This review goes over important concepts needed for your exam but is not exhaustive of everything you need to know and should be used as a supplement (not the sole resource) to your own studying.**

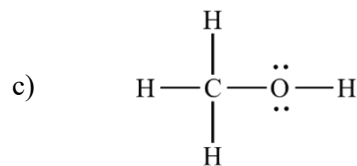
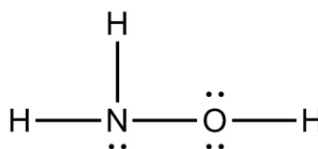
1. Which of the following Lewis structures is incorrect?



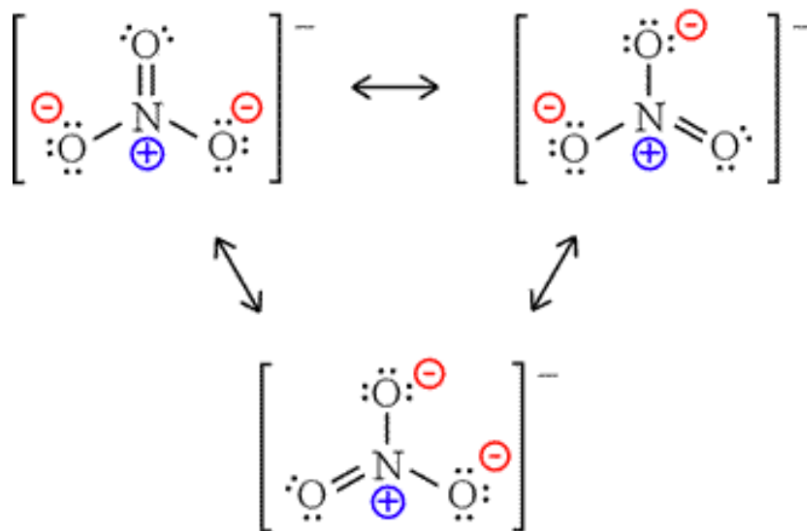
d)



e)



2. Draw  $\text{NO}_3^-$  and its resonance structures. Calculate its formal charges.



3. Which of the following are exceptions to the octet rule?

I.  $\text{PCl}_5$  II.  $\text{BeCl}_2$  III.  $\text{CH}_4$  IV.  $\text{SF}_6$  V.  $\text{H}_2\text{O}$

a) I, III, V

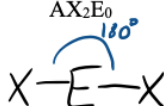
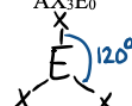

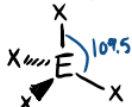


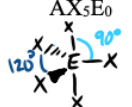
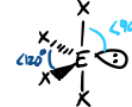







b) I, II, IV

c) II, IV

d) I, II, V

e) II, III, IV

4. VSEPR Theory. Fill in the following chart including the structure, bond angles, shape name, and  $\text{AX}_y\text{E}_z$  format.

VSEPR Geometries					
Electron Pairs ↓	0 Lone Pair	1 Lone Pair	2 Lone Pairs	3 Lone Pairs	4 Lone Pairs
2	Linear $180^\circ$ $\text{AX}_2\text{E}_0$ 				
3	Trigonal Planar $120^\circ$ $\text{AX}_3\text{E}_0$ 	Bent $<120^\circ$ $\text{AX}_2\text{E}_1$ 			
4	Tetrahedral $109.5^\circ$ $\text{AX}_4\text{E}_0$ 	Trigonal Pyramidal $<109.5^\circ$ $\text{AX}_3\text{E}_1$ 	Bent $<<109.5^\circ$ $\text{AX}_2\text{E}_2$ 		
5	Trigonal Bipyramidal $90^\circ$ & $120^\circ$ $\text{AX}_5\text{E}_0$ 	Seesaw $<90^\circ$ & $<120^\circ$ $\text{AX}_4\text{E}_1$ 	T-Shaped $<90^\circ$ $\text{AX}_3\text{E}_2$ 	Linear $180^\circ$ $\text{AX}_2\text{E}_3$ 	
6	Octahedral $90^\circ$ $\text{AX}_6\text{E}_0$ 	Square Pyramidal $<90^\circ$ $\text{AX}_5\text{E}_1$ 	Square Planar $90^\circ$ $\text{AX}_4\text{E}_2$ 	T-Shaped $<90^\circ$ $\text{AX}_3\text{E}_3$ 	Linear $180^\circ$ $\text{AX}_2\text{E}_4$ 

5. Name to electron geometry, molecular geometry, and bond angles for the following compounds:

a) H<sub>2</sub>O

tetrahedral, bent,  $<<109.5$

b) ICl<sub>2</sub>

trigonal bipyramidal, linear, 180

c) SF<sub>4</sub>

trigonal bipyramidal, seesaw,  $<90$  &  $<120$

d) BeCl<sub>2</sub>

linear, linear, 180

e) CO<sub>3</sub><sup>2-</sup>

trig planar, trig planar, 120

6. Which of the following molecules are polar?

I.  $\text{NH}_3$    II.  $\text{BF}_3$    III.  $\text{COS}$    IV.  $\text{XeF}_4$    V.  $\text{IF}_5$

a) I, III, V

b) I, II, III

c) II, III, V

d) All

e) None

7. Which of the following is a nonpolar molecule with polar covalent bonds?

a)  $\text{Cl}_2$

b)  $\text{SOCl}_2$

c)  $\text{BeBr}_2$

d)  $\text{NH}_3$

e)  $\text{H}_2\text{O}$

8. How many  $\sigma$  bonds are in this molecule?

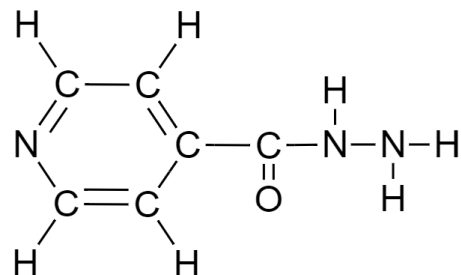
a) 20

b) 36

c) 17

d) 19

e) 16



9. For the previous structure, what are the hybridizations of the C, N, and O atoms?

a) C:  $sp^2$ ; N (ring):  $sp^2$ ; N:  $sp^3$ ; O:  $sp^2$

b) C (ring):  $sp^3$ ; C (other):  $sp^2$ ; N (all):  $sp^2$ ; O:  $sp^2$

c) C:  $sp^2$ ; N:  $sp^2$ ; O:  $sp^2$

d) C:  $sp^3$ ; N (ring):  $sp^2$ ; N:  $sp^3$ ; O:  $sp^2$

10. Which of the following statements is/are likely true:

a)  $\text{NH}_3$  should have a higher boiling point than  $\text{CH}_4$

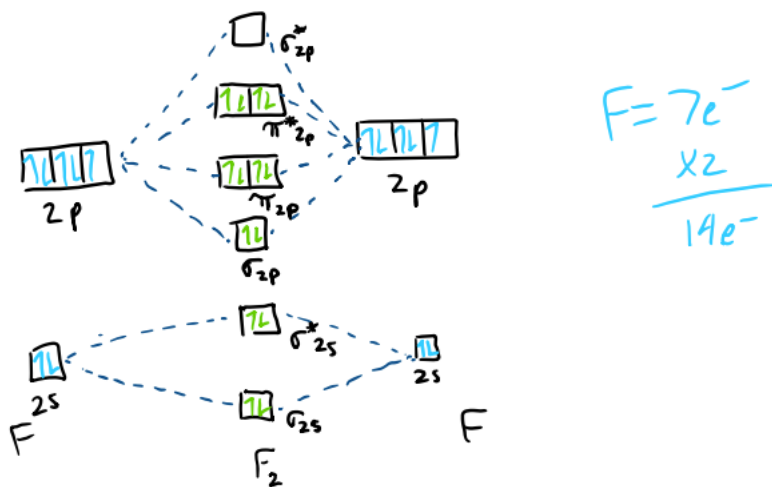
b)  $\text{PH}_3$  should have a higher boiling point than  $\text{NH}_3$

c)  $\text{SO}_2$  should have a higher boiling point than  $\text{CO}_2$

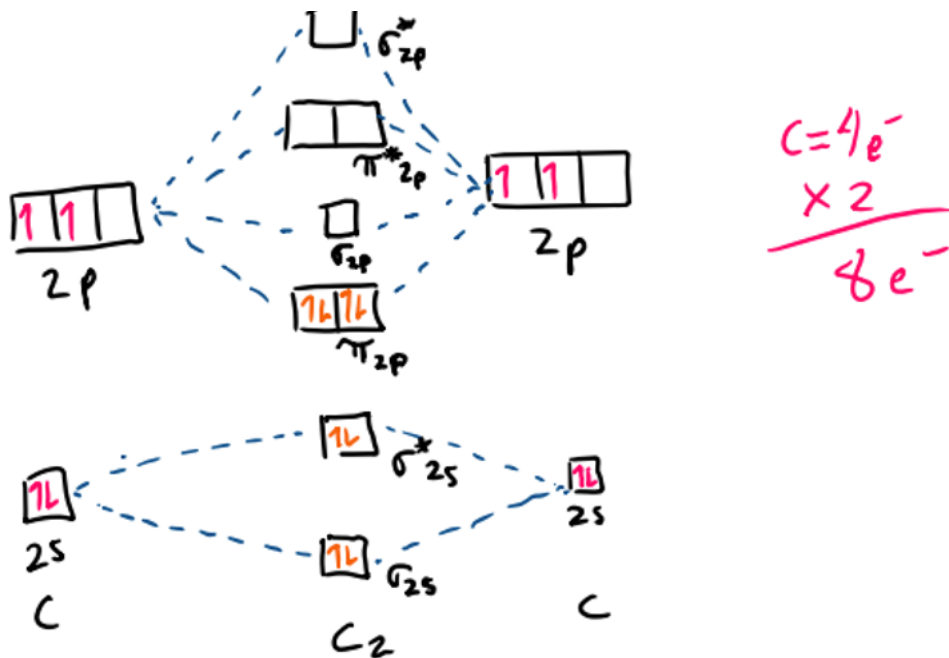
d) A and C

e) All of the above

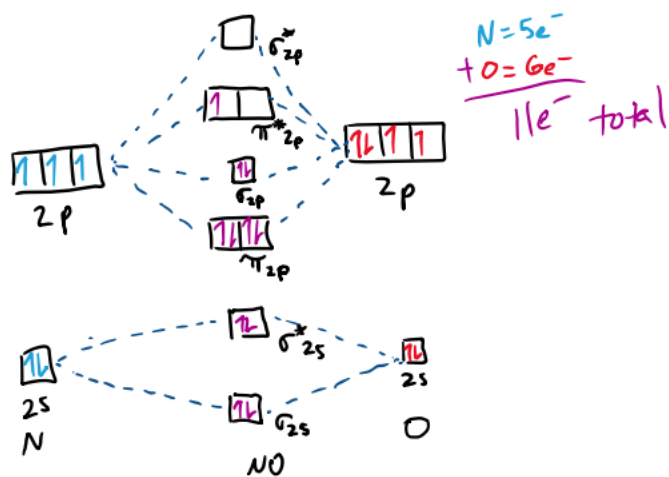
11. Draw the molecular orbital diagram for F<sub>2</sub>.



12. Draw the molecular orbital diagram for C<sub>2</sub>.



13. Draw the MO for NO.



14. Which of the following is true about  $\sigma$  bonding and  $\pi$  bonding.

- I. A single bond has 1  $\sigma$  bond.
- II. A single bond has 1  $\pi$  bond.
- III. A double bond has 1  $\sigma$  bond and 1  $\pi$  bond.
- IV. A double bond has 2  $\pi$  bonds.
- V. A double bond has 2  $\sigma$  bonds.
- VI. A triple bond has 3  $\pi$  bonds.
- VII. A triple bond has 1  $\sigma$  and 2  $\pi$  bonds.
- VIII. A triple bond has 3  $\sigma$  bonds.

a) II, III, V, VIII

**b) I, III, VII**

c) I, V, VI

d) II, IV, VIII

e) I, IV, VI

15. Which hybridization will a molecule with a trigonal bipyramidal electron-group arrangement have?

a) sp

b)  $sp^2$

c)  $sp^3$

**d)  $sp^3d$**

e)  $sp^3d^2$

16. According to MO theory, which of the following dicarbon species is expected to have the shortest bond length.

Use the following valence MO order:  $\sigma_{2s} < \sigma_{2s}^* < \pi_{2py} = \pi_{2pz} < \sigma_{2px} < \pi_{2py}^* = \pi_{2pz}^* < \sigma_{2px}^*$

- a)  $C_2^+$       b)  $C_2^{2-}$       c)  $C_2$       d)  $C_2^-$       e) They all have the same length

17. Calculate the heat needed to convert 10.0 g of solid bromine from  $-7.2^\circ\text{C}$  to  $70.0^\circ\text{C}$ . Which of the following steps requires the most heat energy: melting the solid bromine, heating the liquid bromine from its melting point to its boiling point, **boiling the bromine**, or heating the gaseous bromine from its boiling point to  $70.0^\circ\text{C}$ ?

Melting point for bromine  $-7.2^\circ\text{C}$ , heat of fusion for bromine = 66.15 J/g; specific heat of liquid bromine = 0.474 J/g $^\circ\text{C}$ ; boiling point for bromine =  $58.7^\circ\text{C}$ , heat of vaporization for bromine = 193.21 J/g, specific heat of gaseous bromine = 0.225 J/g $^\circ\text{C}$ .

**= 2,931.4 J**

18. Which response correctly identifies all the interactions that might affect the properties of  $\text{BF}_3$ ?

- A) dispersion force, ion-ion interaction  
B) hydrogen bonding force, dispersion force      C) permanent dipole force  
D) permanent dipole force, dispersion force      **E) dispersion force**

19. Which response has the following substances arranged in order of **increasing** boiling point?

Ar,  $\text{NaClO}_3$ ,  $\text{H}_2\text{O}$ ,  $\text{H}_2\text{Se}$

- A)  $\text{NaClO}_3 < \text{H}_2\text{O} < \text{H}_2\text{Se} < \text{Ar}$       B)  $\text{NaClO}_3 < \text{H}_2\text{Se} < \text{H}_2\text{O} < \text{Ar}$   
C)  $\text{Ar} < \text{NaClO}_3 < \text{H}_2\text{Se} < \text{H}_2\text{O}$       D)  $\text{Ar} < \text{H}_2\text{O} < \text{H}_2\text{Se} < \text{NaClO}_3$   
**E)  $\text{Ar} < \text{H}_2\text{Se} < \text{H}_2\text{O} < \text{NaClO}_3$**

20. Which of the following solutions is matched with its correct intermolecular force between solute and solvent?

- A)  $\text{NH}_3$  and  $\text{F}_2$ : hydrogen bonding      B)  $\text{CH}_2\text{F}_2$  and  $\text{CH}_2\text{O}$ : dispersion  
**C)  $\text{Cl}_2$  and  $\text{PH}_3$ : dipole-induced dipole**      D)  $\text{HF}$  and  $\text{NH}_3$ : dipole-dipole  
E)  $\text{PH}_3$  and  $\text{H}_2\text{O}$ : dispersion

21. A certain metal has a specific gravity of 10.200 at  $25^\circ\text{C}$ . It crystallizes in a body-centered cubic arrangement with a unit cell edge length of 3.147 Å. Determine the atomic weight, the identity of the metal, and the radius of the atom in Å.

**Atomic weight: 95.7 g/mol**

**Metal: Mo**

**Radius: 1.37 Å**