Covalent Bonding & Molecular Compounds Problems Review
PSI Chemistry ***Name_____***

Properties of Ionic and Covalent Materials

Classwork:

1. Explain why metals conduct in the solid state while ionic substances do not.
2. Explain why ionic substances can conduct in the liquid state
3. Which bond is more covalent in character: C-H or O-H? Explain.
4. Explain why molecular compounds have lower melting points than do ionic, metallic, or covalent network substances.
5. Describe two ways the bonding in a metallic crystal is different than that in a molecular crystal.
6. The melting point of NaF is 993 C while H_2O melts at 0 C. Explain the difference in these melting points in terms of the bonding found within each substance.
7. The melting point of tin is roughly 230 C. Tin was a widely used metal in ancient times. Explain why the melting point made tin relatively easy to obtain.
8. What determines whether the bond between two atoms will be more ionic or covalent in character?

Homework:

1. Of the two materials, NaCl or Al, which is likely to conduct only in the liquid state? Explain your answer.
2. Rank the following bonds from most ionic to least ionic ionic: Ga-O, C-O, C-F, Na-O.
3. Which of the two substances would have the higher MP: CH_4 or C? Explain your answer.
4. Carbon dioxide (CO_2) has very different properties compared to MgO. Account for this by explaining the difference in bonding within each substance.
5. Why does an ionic bond form between lithium and flourine atoms but not between two flourine atoms?
6. Octane (C_3H_8) is a liquid at room temperature while $MgCl_2$ is a solid. Account for this difference using an analysis of the bonding within each substance.
7. What makes metals such as silver (Ag) excellent conductors of electricity while substances like diamond (C) do not conduct appreciably.

Naming Binary Molecular Compounds

Classwork

1. What is the name of the compound N_2F_4?

2. What is the name of the compound CO?

3. What is the name of the compound SF_6?

4. What is the name of the compound P_4O_{10}?

5. What is the formula of the compound Carbon Dioxide?

6. What is the formula of the compound Nitrogen Triflouride?

7. What is the formula of the compound Dinitrogen Trisulfide?

8. What is the formula of the compound Iodine Pentaflouride?

Homework

1. What is the name of the compound SCl_4?

2. What is the name of the compound Si_2Br_6?

3. What is the name of the compound H_2S?

4. What is the name of the compound Cl_2O_6?

5. What is the formula of the compound Dinitrogen Pentoxide?

6. What is the formula of the compound Hexaboron Silicide?

7. What is the formula of the compound Sulfur Trioxide?

8. What is the formula of the compound Hydrogen Monochloride?

Lewis Dot Structures

Classwork

1. Draw the Lewis Dot Structure for the compound N_2F_4?

2. Draw the Lewis Dot Structure for the compound CO?

3. Draw the Lewis Dot Structure for the compound SF_6?

Homework

1. Draw the Lewis Dot Structure for the compound SCl_4?

2. Draw the Lewis Dot Structure for the compound Si_2Br_6?

3. Draw the Lewis Dot Structure for the compound H_2S?

Resonance

Classwork

1. Draw the Lewis Dot Structure for CO_3^{-2}

a. How many resonance structures does carbonate have?

b. Draw one of carbonate's resonance structures.

c. How do the bond lengths within the carbonate structure compare?

2. Draw the Lewis Dot Structure for O_3

a. How many resonance structures does Ozone have?

b. Draw one of Ozone's resonance structures.

Homework

1. Draw the Lewis Dot Structure for NO_2^-

a. How many resonance structures does Nitrite have?

b. Draw one of Nitrite's resonance structures.

2. Draw the Lewis Dot Structure for NO_3^-

a. How many resonance structures does Nitrate have?

b. Draw one of Nitrate's resonance structures.

c. How do the bond lengths within the nitrate ion compare?

VSEPR Numbers, Geometry, Hybridization, and Bond Angles

Classwork

1. Consider N_2F_4

a. What are the VSEPR Numbers around either Nitrogen atom?

b. What is the Electron Domain Geometry (EDG) around either Nitrogen atom?

c. What is the Electron Domain Geometry (EDG) around any Flourine atom?

d. What is the Molecular Domain Geometry (MDG) around either Nitrogen atom?

e. What is the hybridization on each N atom?

f. What would be the expected bond angles?

2. Consider CO

a. What are the VSEPR Numbers around the Oxygen atom?

b.What is the Electron Domain Geometry (EDG) around the Carbon atom?

c.What is the Electron Domain Geometry (EDG) around the Oxygen atom?

d. What is the Molecular Domain Geometry (MDG) of the molecule?

3. Consider SF_6

a. What are the VSEPR Numbers of the molecule?

b.What is the Electron Domain Geometry (EDG) around the Sulfur atom?

c. What is the Electron Domain Geometry (EDG) around the Fluorine atom?

d. What is the Molecular Domain Geometry (MDG) of the molecule?

4. Consider CO_3^{-2}

a. What are the VSEPR Numbers of the ion?

b. What is the Electron Domain Geometry (EDG) around the Carbon atom?

c. What is the Electron Domain Geometry (EDG) around a single bonded Oxygen atom?

d. What is the Electron Domain Geometry (EDG) around a double bonded Oxygen atom?

e.What is the Molecular Domain Geometry (MDG) of the ion?

f. What would be the expected hybridization of the carbon atom?

g. What would be the expected bond angles?

5. Consider O_3

a. What are the VSEPR Numbers of the molecule?

b. What is the Electron Domain Geometry (EDG) around the central Oxygen atom?

c. What is the Electron Domain Geometry (EDG) around a single bonded Oxygen atom?

d. What is the Electron Domain Geometry (EDG) around a double bonded Oxygen atom?

e. What is the Molecular Domain Geometry (MDG) of the molecule?

f. What would be the expected hybridization of the central oxygen atom?

g. What would be the expected bond angles between the atoms?

Homework

1. Consider SCl_4

a. What are the VSEPR Numbers of the molecule?

b. What is the Electron Domain Geometry (EDG) around the Sulfur atom?

c. What is the Electron Domain Geometry (EDG) around any Chlorine atom?

d. What is the Molecular Domain Geometry (MDG) of the molecule?

2. Consider Si_2Br_6

a. What are the VSEPR Numbers around either Silicon atom?

b. What is the Electron Domain Geometry (EDG) around the either Silicon atom?

c.What is the Electron Domain Geometry (EDG) around any Bromine atom?

d. What is the Molecular Domain Geometry (MDG) around either Silicon atom?

3. Consider H_2S

a. What are the VSEPR Numbers of the molecule?

b. What is the Electron Domain Geometry (EDG) around the Sulfur atom?

c. What is the Electron Domain Geometry (EDG) around the Hydrogen atom?

d. What is the Molecular Domain Geometry (MDG) of the molecule?

e. What would be the expected hybridization of the S atom?

f. What would be the expected bond angles within the molecule?

4. Consider NO_2^-

a. What are the VSEPR Numbers of the ion?

b. What is the Electron Domain Geometry (EDG) around the Nitrogen atom?

c. What is the Electron Domain Geometry (EDG) around a single bonded Oxygen atom?

d. What is the Electron Domain Geometry (EDG) around a double bonded Oxygen atom?

e.What is the Molecular Domain Geometry (MDG) of the ion?

f. What is the expected hybridization of the N atom?

g. What would be the expected bond angles?

5. Consider NO_3^-

a.What are the VSEPR Numbers of the ion?

b.What is the Electron Domain Geometry (EDG) around the Nitrogen atom?

c.What is the Electron Domain Geometry (EDG) around a single bonded Oxygen atom?

d.What is the Electron Domain Geometry (EDG) around a double bonded Oxygen atom?

e. What is the Molecular Domain Geometry (MDG) of the ion?

Polarity

Classwork

1. Consider N_2F_4

a. Is the N-F Bond Polar? Explain

b. Is the N-N Bond Polar? Explain

c. Is the molecule Polar? Explain

2. Consider CO

a. Is the C-O Bond Polar? Explain

b. Is the molecule Polar? Explain

3. Consider SF_6

a. Is the S-F Bond Polar? Explain

b. Is the molecule Polar? Explain

4. Consider CO_3^{-2}

a. Is the C-O bond Polar? Explain

b. Is the C=O bond Polar? Explain

c. Is the molecule Polar? Explain

5. Consider O_3

a. Is the O-O bond Polar? Explain

b. Is the O=O bond Polar? Explain

c. Is the molecule Polar? Explain

6. Explain why CH_3Cl is polar while CCl_4 is not.

Homework

1. Consider SCl_4

a. Is the S-Cl bond Polar? Explain

b. Is the molecular Polar? Explain

2. Consider Si_2Br_6

a. Is the Si-Si Bond Polar? Explain

b. Is the Si-Br Bond Polar? Explain

c. Is the molecule Polar? Explain

3. Consider H_2S

a. Is the H-S Bond Polar? Explain

b. Is the molecule Polar? Explain

4. Consider NO_2^-

a. Is the N-O bond Polar? Explain

b. Is the N=O bond Polar? Explain

c. Is the molecule Polar? Explain

5. Consider NO_3^-

a. Is the N-O bond Polar? Explain

b. Is the N=O bond Polar? Explain

c. Is the molecule Polar? Explain

6. Which molecule, H2S or H2O would be more polar and explain why.

ANSWERS:

Properties of Ionic and Covalent Materials

Classwork:

1. Metals have loosely bound electrons which can be easily moved while the electrons in an ionic compounds are tightly bound to the nuclei and not easily moved.
2. The charges are free to move since the primary ionic bonds have been broken..
3. C-H, because the electronegativity difference is smaller between the atoms.
4. Molecular compounds are bonded together by relatively weak intermolecular forces compared to the others which are held together by strong covalent or ionic forces.
5. In metals, the atoms are combined covalently to make a giant crystal with loosely bound electrons. Molecular compounds are comprised of many small molecules held together with relatively weak intermolecular forces.
6. NaF is held together by strong ionic forces while water is comprised of individual molecules held together by weak intermolecular forces. .
7. The furnaces did not need to be as hot to isolate the metal from the ore.
8. The electronegativity difference - the greater the difference, the more ionic the bond.

Homework:

1. NaCl - because it is ionic and the ions must be able to move to conduct.
2. Na-O, Ga-O, C-F, C-O
3. C, as it is a covalent network crystal held together by strong covalent bonds whereas CO2 is molecular and held together by weak intermolecular forces.
4. MgO is ionic while CO2 is molecular, thereby explaining why MgO has a high melting point and can conduct while CO2 melts at low temperature and does not readily conduct.
5. The electronegativity difference between flourine atoms is zero causing the electrons to be shared while the difference is enormous between Lithium and flourine.
6. Octane is molecular and held together by weak intermolecular forces while MgCl2 is ionic and held together by strong ionic bonds.
7. Silver is a metallic compound where the electrons are held loosely whereas C(diamond) is held together by covalent network bonds and the electrons are tightly held between the atoms.

Naming Binary Molecular Compounds

Classwork

1. Dinitrogen Tetraflouride

2. Carbon Monoxide
3. Sulfur Hexaflouride
4. Tetraphosphorus Decoxide

5. CO_2
6. NF_3
7. N_2S_3
8. IF_5

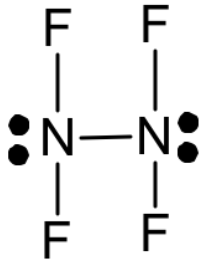
Homework

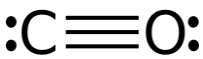
1. Sulfur Tetrachloride
2. Disilicone Hexabromide
3. Dihydrogen Monosulfide
4. Dichlorine Hexoxide
5. N_2O_5
6. B_6Si
7. SO_3
8. HCl

Lewis Dot Structures

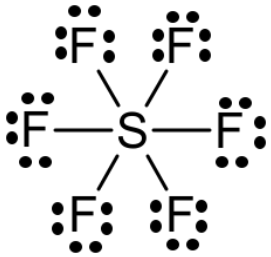
Classwork

1.

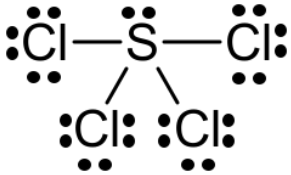


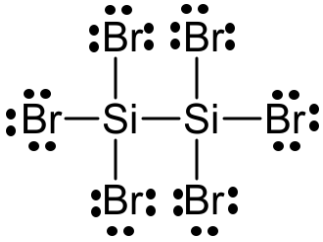
2. 

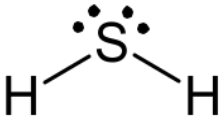
3.



Homework:

1. 

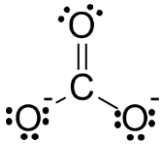
2. 

3. 

Resonance

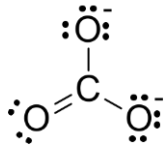
Classwork

1.



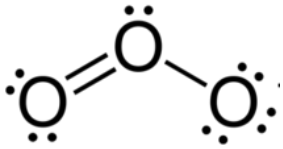
a. 3

b.



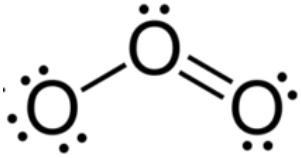
c. The bonds would all be the same length as the electrons are evenly distributed across all bonds.

2.



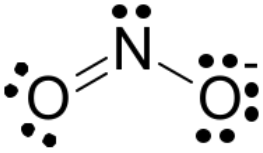
a. 2

b.



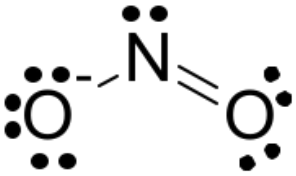
Homework

1.

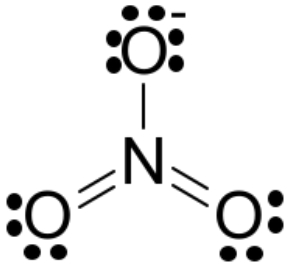


a. 2

b.

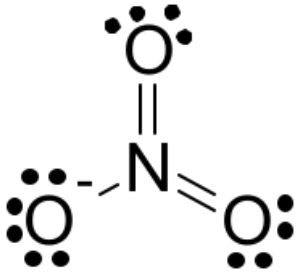


2.



a. 3

b.



c. The bonds would be of equal lengths as the electrons are distributed evenly across all of the bonds.

VSEPR Numbers and Geometry

Classwork

1. Consider N_2F_4

a. 431

b. Tetrahedral

c. Tetrahedral

d. Trigonal Pyramidal

e. sp3

f. 107 degrees

2. Consider CO

a. 211

b. Linear

c. Linear

d. Linear

3. Consider SF_6

a. 660

b. Octahedral

c. Tetrahedral

d. Octahedral

4. Consider CO_3^{-2}

a. 330

b. Trigonal Planar

c. Tetrahedral

d. Trigonal Planar

e. Trigonal Planar

f. sp2

g. 120 degrees

5. Consider O_3

a. 321

b. Trigonal Planar

c. Tetrahedral

d. Trigonal Planar

e. Bent

f. sp2

g. 117 degrees

Homework

1. Consider SCl_4

a. 541

b. Trigonal Bipyramidal

c. Tetrahedral

d. See Saw

2. Consider Si_2Br_6

a. 440

b. Tetrahedral

c. Tetrahedral

d. Tetrahedral

3. Consider H_2S

a. 422

b. Tetrahedral

c. Linear

d. bent

e. sp3

f. 104.5

4. Consider NO_2^-

a. 321

b. Trigonal Planar

c. Tetrahedral

d. Trigonal Planar

e. Bent

f. sp2

g. 117 degrees

5. Consider NO_3^-

a. 330

b. Trigonal Planar

c. Tetrahedral

d. Trigonal Planar

e. Trigonal Planar

Polarity

Classwork

1. Consider N_2F_4

a. Yes, F is more electronegative then N

b. No, Both atoms are equally electronegative

c. Yes, due to the asymmetrical shape and nature of the bonds the molecule is polar

2. Consider CO

a. Yes, O is more electronegative then C

b. Yes, due to the shape and nature of the bonds the molecule is polar

3. Consider SF_6

a. Yes, F is more electronegative then S

b. No, due to the symmetrical shape of the molecule

4. Consider CO_3^{-2}

a. Yes, O is more electronegative then C

b. Yes, O is more electronegative then C

c. No, ions are charged and strictly speaking cannot have a dipole moment.

5. Consider O_3

a. No, Both atoms are equally electronegative

b. No, Both atoms are equally electronegative

c. Yes, because of the unbalanced nature of the oxygens, the central oxygen looses more electrons then the other 2 oxygens. This means that the central oxygen must be considered LESS electronegative ONLY because of the strange nature of the bonds here. The molecule is asymmetrical with the unbonded pair creating an area of dense negative charge.

6. Although both molecules contain polar bonds, it is the asymmetrical arrangement of the atoms in CH_3Cl that creates a dipole moment.

Homework

1.Consider SCl_4

a. Yes, Cl is more electronegative then S

b. No, due to the symmetrical shape of the molecule

2. Consider Si_2Br_6

a. No, Both atoms are equally electronegative

b. Yes, Br is more electronegative then Si

c. No, due to the symmetrical shape of the molecule

3. Consider H_2S

a. Yes, S is more electronegative then H, but only slightly

b. Yes, due to the asymmetrical shape and nature of the bonds the molecule is polar, but only slightly

4. Consider NO_2^-

a. Yes, it is slightly polar because of an electronegativity difference greater than 0.4

b. Yes, it is slightly polar because of an electronegativity difference greater than 0.4

c. Yes, due to the asymmetrical shape and nature of the bonds the molecule is polar

5. Consider NO_3^-

a. Yes, it is slightly polar because of an electronegativity difference greater than 0.4

b. Yes, it is slightly polar because of an electronegativity difference greater than 0.4

c. No, due to the symmetrical shape of the molecule, that said, the concept of polarity does not really make sense when applied to ions as they are already charged.

6. Both are asymmetrical and polar but H2S only slightly as the electronegativity difference is not that great. Water has a much larger electronegativity difference between the oxygen and hydrogen and has the larger dipole.