Name_____

Topic 4: States

Goals

- ❏ 4.1 - Polarity (*p. 60-62*)
- ❏ 4.2 - Intermolecular Forces (*p. 186-189*)
- ❏ 4.3 - States and Solubility *(p. 167-203)*
- ❏ 4.4 - Synthesis

Date	*Homework*

Topic 4: States

Practice Test

1. Polarity (4.1) _____/ 10

(a) Compare and contrast the polarities of CCl_4 and HCl. Include all partial charges when appropriate.

(b) Compare and contrast the polarities of CCl_4 and CCl_3H. Include all partial charges when appropriate.

(c) Compare and contrast the polarities of H_2O and BH_3. Include all partial charges when appropriate.

(d) Compare and contrast the polarities of O_2 and SO_2. Include all partial charges when appropriate.

(e) Compare and contrast the polarities of CO_2 and CO. Include all partial charges when appropriate.

2. Intermolecular Forces (4.2) _____/10

(a) Draw an interaction diagram between two H_2O molecules. Indicate and label all IMFs.

(b) Draw an interaction diagram between two CH_4 molecules. Indicate and label all IMFs.

(c) Draw an interaction diagram between one H_2O molecule one Na^+ ion and one NO_3^- (show lewis structure for NO_3^-).

(d) Draw an interaction diagram between one NH_3 and one CO molecule. Indicate and label all IMFs.

(e) Draw an interaction diagram between one H_2O molecule, one SO_2 molecule and one N_2 molecule.

3. States and Solubility (4.3)

(a) Justify the below statement using what you know about IMFs.

Water tends to be a liquid where carbon dioxide tends to be a gas at room temperature.

(b) Justify the below statement using what you know about IMFs

Sodium Chloride (Na^+ Cl^- is soluble in ammonia, NH_3, but not in hexane, C_6H_{14})

(c) State whether you agree or disagree with the below statement. Justify your answer using what know about IMFs .

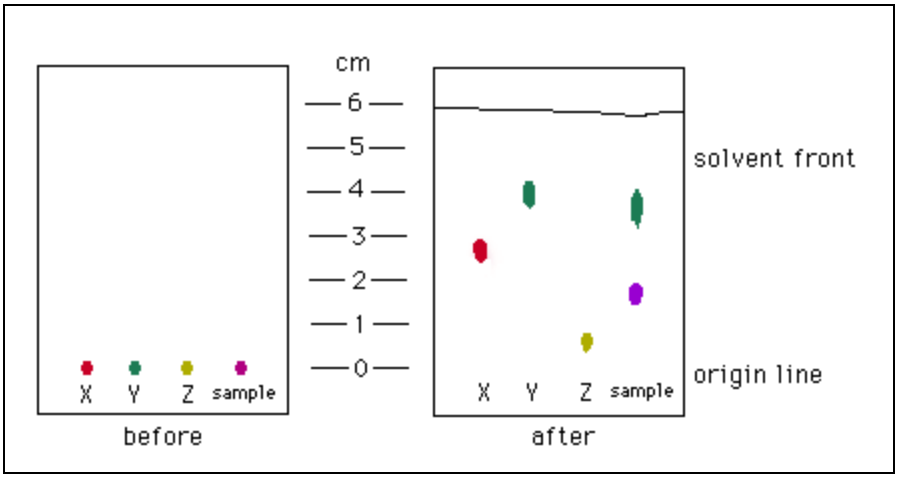
It takes more heat energy to boil (convert from liquid to gas) 100 mL of BH_3 than 100 mL of PH_3.

(d) . Draw a diagram that depicts the boiling (conversion from liquid to gas) of 4 water molecules.

(e) When cooled at a constant rate, which substance will condense (conversion from liquid to solid), methanol, CH_3OH or Water, H_2O. Justify using what you know about IMFs.

4. Synthesis (4.4) _____/10

It was suspected that a particular mixture contained three components: X, Y and Z. To check this, the mixture was analyzed by thin layer chromatography. In this experiment a nonpolar solvent was used with a polar stationary phase. The following results were obtained:



(a) Which suspected components (X, Y or Z) are present in the sample?

(b) Are there other components in the sample?

(c) Which of the suspected components is the most polar? the least polar?

Topic 2: Electrons

Practice Test *(solutions)*

1. Configurations (2.1) _____/ 10

(a) Write the electron configuration for the Sulfur atom. Sulfide ion.

Sulfur, S: $1s^2 2s^2 2p^6 3s^2 3p^4$
Sulfide, S^{2-}: $s^2 2s^2 2p^6 3s^2 3p^6$

(b) Write the electron configuration for the Magnesium atom. Magnesium ion.

Magnesium, Mg: $1s^2 2s^2 2p^6 3s^2$
Magnesium, Mg^{2+}: $s^2 2s^2 2p^6 3s^0$

(c) Write the electron configuration atom for the Chlorine atom. Chloride ion.

Chlorine, Cl: $1s^2 2s^2 2p^6 3s^2 3p^5$
Chloride, Cl^-: $s^2 2s^2 2p^6 3s^2 3p^6$

(d) Write the electron configuration atom for the Potassium atom. Potassium ion.

Potassium, K: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$
Potassium, K^+: $s^2 2s^2 2p^6 3s^2 3p^6 4s^0$

(e) Write the electron configuration for the copper atom and the copper (II) ion.

Copper, Cu: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2\ 3d^9$
Copper, Cu^{2+}: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^0 3d^9$

2. Magnetism (2.2) _____/10

(a) Indicate a nonmetal that is magnetic and a nonmetal that is not magnetic. Explain.

Magnetic: Nitrogen. Paramagnetic (unpaired electrons)
Not Magnetic: Neon. Diamagnetic (no unpaired electrons)

(b) Indicate a metal that is magnetic and a metal that is not magnetic. Explain.

Magnetic: Iron. Paramagnetic (unpaired electrons)
Not Magnetic: Neon. Zinc (no unpaired electrons)

(c) Would steel (iron & carbon) or cobalt make for a better magnetic refrigerator door? Explain.

Steel: More paramagnetic (More unpaired electrons)

(d) Which element, nitrogen or oxygen, would be pulled more towards a magnetic field? Explain.

Nitrogen: More paramagnetic (More unpaired electrons)

(e) Which element, magnesium or aluminum would be pulled more towards a magnetic field? Explain.

Aluminum: More paramagnetic (More unpaired electrons)

3. PES (2.3) _____/10

(a). On the axis below, provide the PES diagrams for O and Ne.

Ne is shifted more towards the higher "Binding Energy".

(b). On the axis below, provide the PES diagrams for Mg and Al

Al is shifted more towards the higher "Binding Energy".

(c) . On the axis below, provide the PES diagrams for Si and Al

Al is shifted more towards the higher "Binding Energy".

(d). Si and C

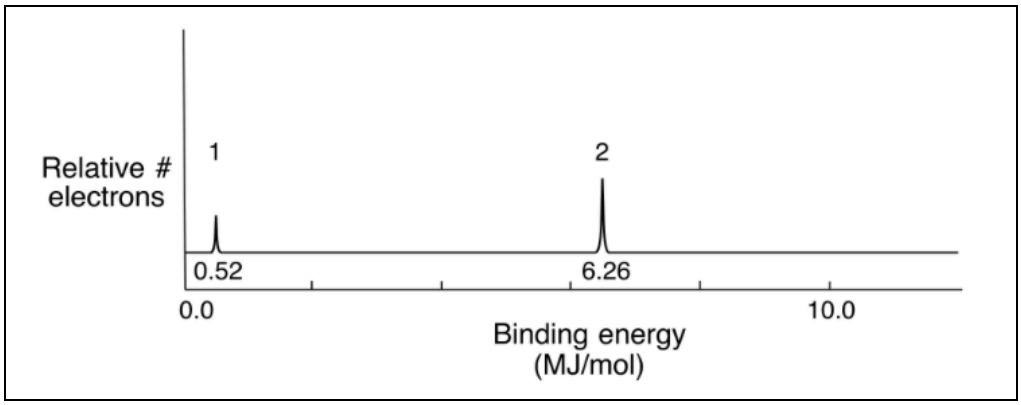
C is shifted more towards the higher "Binding Energy".

(e) On the axis below, provide the PES diagrams for Al and Ar

C is shifted more towards the higher "Binding Energy".

4. Synthesis (2.4) _____/10

The remains of an unknown element “X” are gathered from the scene of a crime. In an attempt to determine the identity of the element, Photoelectron Spectra (PES) data is gathered. The resulting spectra is shown below.



(a) What is the identity of element “X”.

Li

(b) Is element “X” Paramagnetic or Diamagnetic? Explain.

Paramagnetic. It has an unpaired electron.

(c) What charge does the ion of element X form?

1+

(d) Is the the atom or ion of element pulled more towards a magnetic field? Explain.

Atom. Ion has no unpaired electrons.

Day 6

(Synthesis-4.4)

1. Warm Up

2. Activity

a) Procedure

b) Data

c) Criminal

3. Homework

a)

b)

Day 5

(States and Solubility-4.3)

1. Warm Up

2. Activity

a) Conduct lab (Capture time lapse video of Crayola Pen run)

b) Chromatography Drawings

Sharpie Pen	Expo	Crayola	Tatoo	Bic

c) Based on your drawings above, which pen has the most polar pigments? The least? Clearly explain (hint: in each “run” water is the solvent).

3. Homework

1.

2.

3.

4.

Day 1
(Introduction)

Warm Up

1.
2.
3. Partial Positive (____) Partial Negative (___) Example

Activity

Part I: Brown Sand

Instructions

1. Investigate how the dry brown sand.
2. Investigate how the brown sand in interacts with H_2O.
3. Take pictures and record observations below (Words & Diagram)

Words	Diagram

Part II: Blue Sand

Instructions

1. Investigate how the blue brown sand.
2. Investigate how the blue sand in interacts with H_2O.
3. Take pictures and record observations below (Words & Diagram)

Words	Diagram

Part III: Video Sand

Instructions

- After watching the videos, list some potential, tangible applications of “Blue Sand” below.

Part IV: Behavior Hypothesis

Instructions

- Using what you know about water, provide a hypothesis that explains, on a molecular level, the respective behaviors of “Brown” and “Blue” sand with water.

Day 2

(Polary-4.1)

1. Demo

2. Warm Up

Static Rod vs. Water	Static Rod vs. Hexane

3. Activity

Notes

Polar (_____)

1.

2.

3.

Nonpolar (_____)

1.

2.

3.

Intermolecular Forces (IMFs)

**Dipole - Dipole* ( )

London Dispersion ( )

Practice

Moolecule	Polarity	IMF Diagram
H_2O		
CO_2		
CH_2O		
NH_3		
O_2		
BH_3		

HCN		
HF		
CBr_3I		
C_2H_6		

Homework

1.

2.

3.

4.

Day 2

(Ionic Bonding-3.1)

Notes

Practice Problems

Complete the tables below:

1. Show the formation of an ionic compound between Li and S.

PES Diagrams

Li	S

Lewis Dots and Valence e^- Transfer Diagram

Balanced Ionic Compound

2. Show the formation of an ionic compound between Al and P

PES Diagrams

Al	P

Lewis Dots and Valence e^- Transfer Diagram

Balanced Ionic Compound

3. Show the formation of an ionic compound between Na and N

PES Diagrams

Na	N

Lewis Dots and Valence e^- Transfer Diagram

Balanced Ionic Compound

4. Show the formation of an ionic compound between Mg and N.

PES Diagrams

Mg	N

Lewis Dots and Valence e^- Transfer Diagram

Balanced Ionic Compound

5. Show the formation of an ionic compound between Na and F.

PES Diagrams

Na	F

Lewis Dots and Valence e^- Transfer Diagram

Balanced Ionic Compound

Homework

1.

2.

3.

4.

Day 3

(Ionic Bonding-3.1)

Notes

Procedure

Data

Conclusion

Practice Problems

Complete the tables below:

Name	**Cation (+)** *Dots*	*Charge*	**Anion (-)** *Dots*	*Charge*	**Formula**
Sodium Chloride					
Lithium Oxide					
Potassium Phosphide					
Calcium Bromide					
Barium Sulfide					
Magnesium Nitride					
Aluminum Iodide					
Boron Selenide					
Gallium Arsenide					
Strontium Fluoride					
Francium Fluoride					

Homework

1.

2.

3.

4.

Day 4

(Ionic Bonding-3.1)

Notes

Practice Problems

Complete the tables below:

Name	**Cation (+)** *Dots*	*Charge*	**Anion (-)** *Dots*	*Charge*	**Formula**
Sodium Chloride					
Lithium Oxide					
Potassium Phosphide					
Calcium Bromide					
Barium Sulfide					
Magnesium Nitride					
Aluminum Iodide					
Boron Selenide					
Gallium Arsenide					
Strontium Fluoride					
Francium Fluoride					

Homework

1.

2.

3.

4.

Day 4

(Ionic Bonding-3.1)

Notes

Precipitation

Data

Conclusion

1.

2.

3.

4.

5.

6.

7.

8.

Practice Problems

Binary Ionic Compounds

Examples

Rules

"Ide" → _____

Polyatomic Ionic Compounds

Examples

Rules

"ite/ate" → _____

Common Polyatomic Ions	
Nitrite	NO_2^-
Nitrate	NO_3^-
Sulfite	SO_3^{2-}
Sulfate	SO_4^{2-}
Phosphite	PO_3^{3-}
Phosphate	PO_4^{3-}
Carbonate	CO_3^{2-}
Hydroxide	OH^-
Hypochlorite	ClO^-
Chlorite	ClO_2^-
Chlorate	ClO_3^-
Perchlorate	ClO_4^-
Permanganate	MnO_4^-
Acetate	$C_2H_3O_2^-$
Hydrogen carbonate	HCO_3^-
Ammonium	NH_4^+
Iodate	IO_3^-

Complete the table below:

Name	Cation (+)	Anion (-)	Formula
Sodium Chloride			
Lithium Chlorate			
Copper (II) Carbonate			
Calcium Phosphate			
Calcium Phosphide			
Calcium Phosphite			
Iron (III) Nitrite			
Iron (II) Sulfate			
Gallium Sulfite			
Strontium Iodate			
Nickel (I) Iodide			

Homework

1.

2.

3.

4.

Day 5

(Covalent Bonding-3.1)

Notes

Ionic vs. Covalent

Covalent Tattoos

Covalent Construction

Molecule _____

“Tattoo” Drawing

3-Dimensional Model Drawing

Day 6

(Covalent Bonding-3.2)

Notes

Name_____	Name_____
Name_____	Name_____
Name_____	Name_____

Practice Problems

# of Covalent Bonds =

<u>Octet Exceptions</u>

Formula	# Bonds	Lewis Structure
O_2		
H_2		
H_2O		
CO_2		

NH_3		
CH_4		
BCl_3		
SiH_2S		
CBr_4		
PH_3		

OI_2		
HCN		
N_2		
ClSiP		
*CH_4O		

Homework

1.

2.

3.

4.

Day 7

(Covalent Bonding-3.2)

Practice Problems

Formula	# Bonds	Lewis Structure
SO_4^{2-}		
H_3O^+		
NO_2^-		
PO_4^{3-}		
OH^-		

ClO_3^-		
IO_3^-		
PF_4^+		
HCP		
N_2		
SiS_3^{2-}		

Homework

1.

2.

3.

4.

Day 8

(Molecular Geometry-3.3)

Notes

Molecular Geometry Hypothesis

The shape of a covalent compound is caused by…

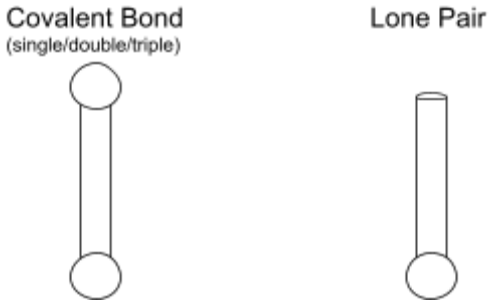
_____ _____ _____ _____ _____ _____ _____

_____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____ _____ _____ _____ _____ _____



Practice Problems

Molecular Geometry	Model	Examples
Linear		
Bent		
Trigonal Planar		
Trigonal Pyramidal		
Tetrahedral		

Formula	# Bonds	Lewis Structure	Magnet Model	Molecular Geometry
H_2				
CO_2				
HCN				
H_2O				
NO_2^-				
SO_2				

CH_2O				
BH_3				
CO_3^{2-}				
H_3O^+				
NH_3				
SO_3^{3-}				

CH_4				
PO_4^{3-}				
NH_4^+				

Homework

1.

2.

3.

4.

Day 2

(Polariy -4.1)

1. Demo

2. Warm Up

Static Rod vs. Water	Static Rod vs. Hexane

3. Activity

Notes

Polar (_____)

1.

2.

3.

Nonpolar (_____)

1.

2.

3.

Intermolecular Forces (IMFs)

**Dipole - Dipole* ( )

London Dispersion ( )

Practice

Moolecule	Polarity	IMF Diagram
H_2O		
CO_2		
CH_2O		
NH_3		
O_2		
BH_3		

HCN		
HF		
CBr_3I		
C_2H_6		

Homework

1.

2.

3.

4.

Day 4

(Solubility & States-4.3)

1. Demo

1) What is inside the bubbles of boiling water? Draw a picture.

2) Explain your observations below using words and a picture.

Words	Pictures

2. Warm Up

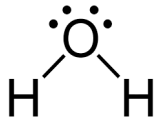
3. Activity

Part I: Pepper

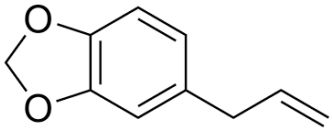
a) Picture

b) Explanation

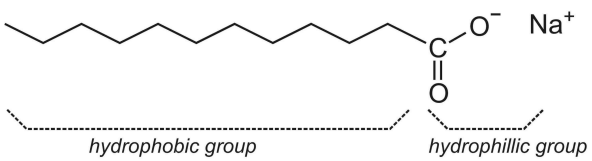
Step 1: Water



Step 2: Pepper



***Step 3**: Detergent*



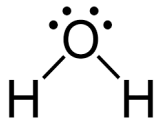
a soap

Part II: Bubbles

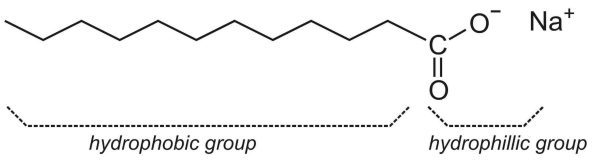
a) Picture

b) Explanation

Step 1: Water

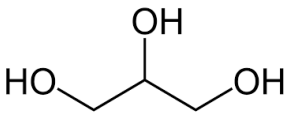


Step 2: Detergent



a soap

Step 3: Glycerine



Part III: Notes

a) Ion - Dipole

b) Solubility Examples (H_2O, NaCl and CO_2)

Moolecule	Polarity	IMF Diagram
H_2O		
CO_2		
CH_2O		
NH_3		
O_2		
BH_3		
HCN		

HF		
CBr_3I		
C_2H_6		

Homework

1.

2.

3.

4.

Day 3

(Intermolecular Forces-4.2)

1. Warm Up

2. Water/Hexane Tube

(a) Pre-Lab Notes

Species	Lewis Structure
H_2O (Water)	
C_6H_{14} (Hexane)	
I_2 (Iodine)	
Copper (II) Nitrate (Ionic)	

(b) Procedure

1. Wear Gloves and goggles.
2. Fill tube ⅓ with DI Water.
3. Fill Tube ⅓ with Hexane.
4. Cap securely and invert-return a few times, and observe.
5. Using tweezers, place 1 crystal of Iodine in tube.
6. Cap securely and invert-return a few times, and observe.
7. Place 1 squirty of Copper (II) Nitrate solution.
8. Cap securely and invert-return a few times, and observe.
9. Draw and label a picture of your observation below

(c) Using what you have learned thus far in Topic 4, hypothesize an explanation for the species found in the top layer and those found in the bottom layer.

3. Homework

1.

2.

3.

4.

Practice Problems

Complete the tables below:

1. Show the formation of an ionic compound between Li and S.

PES Diagrams

Li	S

Lewis Dots and Valence e^- Transfer Diagram

Balanced Ionic Compound

2. Show the formation of an ionic compound between Al and P

PES Diagrams

Al	P

Lewis Dots and Valence e^- Transfer Diagram

Balanced Ionic Compound

3. Show the formation of an ionic compound between Na and N

PES Diagrams

Na	N

Lewis Dots and Valence e^- Transfer Diagram

Balanced Ionic Compound

4. Show the formation of an ionic compound between Mg and N.

PES Diagrams

Mg	N

Lewis Dots and Valence e^- Transfer Diagram

Balanced Ionic Compound

5. Show the formation of an ionic compound between Na and F.

PES Diagrams

Na	F

Lewis Dots and Valence e^- Transfer Diagram

Balanced Ionic Compound

Homework

1.

2.

3.

4.

Day 3

(Ionic Bonding-3.1)

Notes

Procedure

Data

Conclusion

Practice Problems

Complete the tables below:

Name	**Cation (+)** *Dots*	*Charge*	**Anion (-)** *Dots*	*Charge*	**Formula**
Sodium Chloride					
Lithium Oxide					
Potassium Phosphide					
Calcium Bromide					
Barium Sulfide					
Magnesium Nitride					
Aluminum Iodide					
Boron Selenide					
Gallium Arsenide					
Strontium Fluoride					
Francium Fluoride					

Homework

1.

2.

3.

4.

Day 4

(Ionic Bonding-3.1)

Notes

Practice Problems

Complete the tables below:

Name	**Cation (+)** *Dots*	*Charge*	**Anion (-)** *Dots*	*Charge*	**Formula**
Sodium Chloride					
Lithium Oxide					
Potassium Phosphide					
Calcium Bromide					
Barium Sulfide					
Magnesium Nitride					
Aluminum Iodide					
Boron Selenide					
Gallium Arsenide					
Strontium Fluoride					
Francium Fluoride					

Homework

1.

2.

3.

4.

Day 4

(Ionic Bonding-3.1)

Notes

Precipitation

Data

Conclusion

1.

2.

3.

4.

5.

6.

7.

8.

Practice Problems

Binary Ionic Compounds

Examples

Rules

"Ide" → _____

Polyatomic Ionic Compounds

Examples

Rules

"ite/ate" → _____

Common Polyatomic Ions	
Nitrite	NO_2^-
Nitrate	NO_3^-
Sulfite	SO_3^{2-}
Sulfate	SO_4^{2-}
Phosphite	PO_3^{3-}
Phosphate	PO_4^{3-}
Carbonate	CO_3^{2-}
Hydroxide	OH^-
Hypochlorite	ClO^-
Chlorite	ClO_2^-
Chlorate	ClO_3^-
Perchlorate	ClO_4^-
Permanganate	MnO_4^-
Acetate	$C_2H_3O_2^-$
Hydrogen carbonate	HCO_3^-
Ammonium	NH_4^+
Iodate	IO_3^-

Complete the table below:

Name	Cation (+)	Anion (-)	Formula
Sodium Chloride			
Lithium Chlorate			
Copper (II) Carbonate			
Calcium Phosphate			
Calcium Phosphide			
Calcium Phosphite			
Iron (III) Nitrite			
Iron (II) Sulfate			
Gallium Sulfite			
Strontium Iodate			
Nickel (I) Iodide			

Homework

1.

2.

3.

4.

Day 5

(Covalent Bonding-3.1)

Notes

Ionic vs. Covalent

Covalent Tattoos

Covalent Construction

Molecule _____

“Tattoo” Drawing

3-Dimensional Model Drawing

Day 6

(Covalent Bonding-3.2)

Notes

Name_____	Name_____
Name_____	Name_____
Name_____	Name_____

Practice Problems

# of Covalent Bonds =

<u>Octet Exceptions</u>

Formula	# Bonds	Lewis Structure
O_2		
H_2		
H_2O		
CO_2		

NH_3		
CH_4		
BCl_3		
SiH_2S		
CBr_4		
PH_3		

OI_2		
HCN		
N_2		
ClSiP		
*CH_4O		

Homework

1.

2.

3.

4.

Day 7

(Covalent Bonding-3.2)

Practice Problems

Formula	# Bonds	Lewis Structure
SO_4^{2-}		
H_3O^+		
NO_2^-		
PO_4^{3-}		
OH^-		

ClO_3^-		
IO_3^-		
PF_4^+		
HCP		
N_2		
SiS_3^{2-}		

Homework

1.

2.

3.

4.

Day 8

(Molecular Geometry-3.3)

Notes

Molecular Geometry Hypothesis

The shape of a covalent compound is caused by…

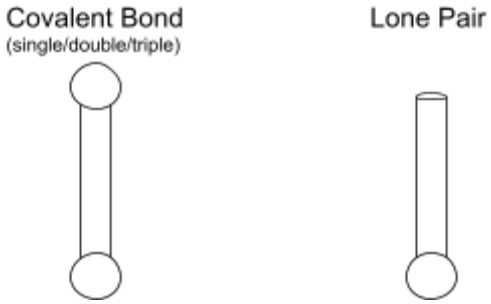
_____ _____ _____ _____ _____ _____ _____

_____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____ _____ _____ _____ _____ _____



Practice Problems

Molecular Geometry	Model	Examples
Linear		
Bent		
Trigonal Planar		
Trigonal Pyramidal		
Tetrahedral		

Formula	# Bonds	Lewis Structure	Magnet Model	Molecular Geometry
H_2				
CO_2				
HCN				
H_2O				
NO_2^-				
SO_2				

CH_2O				
BH_3				
CO_3^{2-}				
H_3O^+				
NH_3				
SO_3^{3-}				

CH_4				
PO_4^{3-}				
NH_4^+				

Homework

1.

2.

3.

4.

Topic 3: Bonding

Practic

Topic 3: Bonding

Practice Test

1. Ionic Bonding (3.1) _____/ 10

(a) Diagram a Lewis Structure that shows formation of an Ionic Compound between Na and P.

(b) Diagram a Lewis Structure that shows formation of an Ionic Compound between Al and Se

(c) Diagram a Lewis Structure that shows formation of an Ionic Compound between Ba and At.

(d) Write a balanced formula for the ionic compound for Iron (II) Nitrate and Iron (III) Nitride

(e) Write the electron configuration for the copper atom and the Lithium Sulfide and Lithium Sulfate

2. Covalent Bonding (3.2)

_____/10

(a) Draw the Lewis Structure for S_3 (no ring)

(b) Draw the Lewis Structure for CS_3^{2-} (C in middle)

(c) Draw the Lewis Structure for BI_3 (O in middle)

(d) Draw the Lewis Structure for PO_2^- (O in middle)

(e) Draw the Lewis Structure for NI_4^+ (O in middle)

3. Molecular Geometry (3.3) _____/10

(a) Identify the shape of the covalent molecules listed below:

H_2O CCl_2O OS_4^{2-} PH_3 CO

(b). Draw the ammonia molecule, NH_3 according to the correct molecular geometry (using appropirate dashes and wedges).