**Experiment 10: Molecular Model and Structure**

Date: 11/11/2020 Instructor: Dr. Gaumani Gyanwali

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20/20

**Objective:**

1. To understand the concept of electron pair geometry, molecular geometry, and hybridization in molecules.
2. To use molecular models to analyze covalent bonding, shape, geometry, and Lewis structure of covalent molecules.

**Materials:**

- Molecular bonding kit

**Procedure:**

In all parts, first the Lewis structure was obtained by counting the total valence electrons, determining the number of bonds, using the Octet rule, and determining the central atoms. After doing so, the number of bonded atoms and number of electron pairs observed in the Lewis structure were added together to find the steric number. Next, the molecular model was designed by using the molecular bonding kit. When used, the different colors of spheres represented different elements and the sticks represented the type of bond. When completed, this was sketched onto the data sheet. Then, the electron pair geometry and the molecular geometry was figured by using table 10.1. Finally, if applicable, the hybridization around the central atom was figured by referring to table 10.2.

**Observations:**

When using the molecular bonding kit, I realized that some colors of atoms did not have enough spaces for more bonds to join. Therefore, after Part B: Molecules with electron pairs, things started to get a little confusing when sketching the molecular model. However, I was able to figure this anyways by referring to figure 8.13 by comparing the steric number. This also helped me figure the molecular geometry.

**Discussion:**

When completing part D: Molecules with two central atoms and hybridization, I found that it was sort of confusing because of the types of bonds that were used. To find this, I kept in mind that that all the carbon atoms had to be octet, but the hydrogen atoms did not. When completed, I was able to determine the steric number a little differently from the parts A, B, and C since there was more than 1 central atom.

**Conclusions:**

All in all, by understanding the concept of electron pair geometry, molecular geometry, and hybridization in molecules of all parts, I was able to use the molecular bonding kit to analyze covalent bonding, shape, and geometry of covalent molecules. In part A for example, carbon

dioxide has 1 carbon as the central atom and has two oxygen atoms bonded to it. Therefore, the steric number is 4. When sketching the model, there is a double bond on each side of the central carbon atom connecting each oxygen atom. The electron pair geometry and molecular geometry are both linear when referring to table 10.1. Next, in part B, chlorine pentafluoride has 1 central chlorine atom with 5 fluorine atoms bonded to it. When adding the 5 bonded atoms and the 1 electron pair, the steric number is equal to 6. When sketching the model, there are 5 single bonds connecting the fluorine's to the central chlorine atom with a central electron pair on the chlorine atom. The electron pair geometry and molecular geometry are both triagonal bipyramid when referring to table 10.1. Next, in part C, $SiBr_2$ has 1 central silicon atom with 4 bromine atoms bonded to it. When adding the 4 bonded atoms and the 1 electron pair, the steric number is equal to 5. When sketching the model, there are 4 single bonds connecting the bromines to the central silicon atom. The electron pair geometry is tetrahedral when referring to table 10.1, which makes the hybridization around the central atom $S^1P^3$. Lastly, in part D, $C_2H_6$ has 2 central carbon atoms with 3 hydrogen atoms bonded to each one. The 4 bonded atoms make steric number equal to 4. When sketching the model, there are 7 single bonds connecting each hydrogen atom to a carbon atom. The electron pair geometry is tetrahedral when referring to table 10.1, which makes the hybridization around the central atom ~~$S^1P^3$~~. $sp^3$

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Pre-laboratory Questions

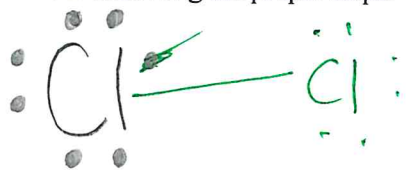
*Complete this page before coming to the lab. Read the information given to answer the following questions.*

Q1. What are bond pairs and what are lone pairs of electrons?

bond pairs - electrons used for bonding 2 electrons.

lone pairs - electrons not used for bonding.

Q2. Draw Lewis structure of a chlorine molecule following the proper steps.



Q3. What is hybridization? Does the shape of a molecule depend on hybridization?

hybridization is the mixing of atomic orbitals of the same atom to balance the energy & electron distribution before bonding w/ another atom. hybridization defines shape.

Q4. What is the effect on the shape of the molecule, if the central atom has a lone pair of electrons than when it does not have a lone pair?

When it has alone pair, it repels other pairs. When it doesn't, it is normal. Lone pairs influence bond angles and molecular shape.

Q5. What is the steric number of the central atom in the following molecules?

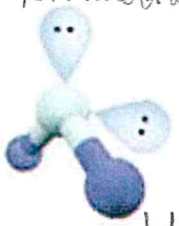
tetrahedral

A 4

tetrahedral

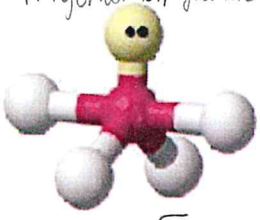
B 4

tetrahedral



C 4

trigonal bipyramid



D 5

*Instructor's approval* CG

Date Samantha Workman

Name 11/11/2020

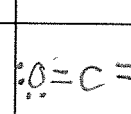
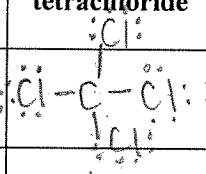
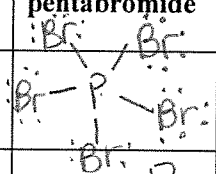
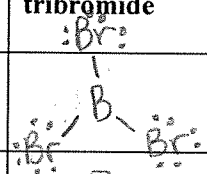
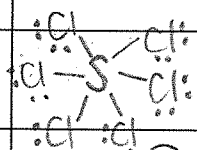
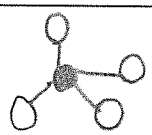
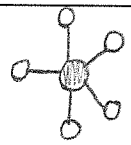
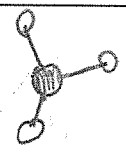
Lab Partner N/A

## Experiment 10 | Molecular Model and Structure

### Data Sheet

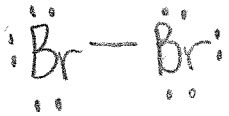
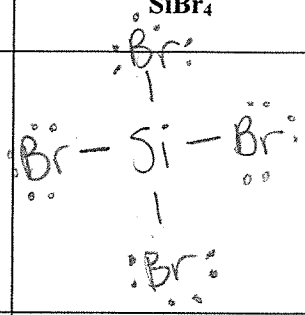
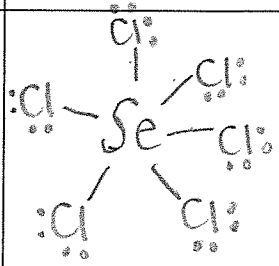
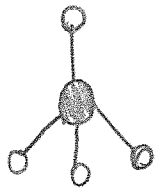
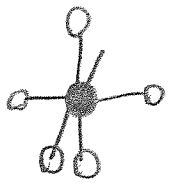
**Part A: Molecules with no electron pairs**

35+5=40 −10 30 21+3=24 −10 13 42+6=48 −13 24

| Compound | Carbon dioxide | Carbon tetrachloride | Phosphorus pentabromide | Boron tribromide | Sulfur hexachloride |
|---|---|---|---|---|---|
| Lewis Structure |  |  |  |  |  |
| Central Atom (A) | C | C | P | B | S |
| Number of Bonded Atoms (X) | 4 | 4 | 5 | 3 | 6 |
| Number of Electron pairs (E) | none | none | none | none | none |
| Steric number | 4 | 4 | 5 | 3 | 6 |
| Sketch of Molecular Model | |  |  |  | |
| Electron Pair Geometry | linear | tetrahedral | triagonal bipyramid | triagonal planar | octahedral |
| Molecular Geometry | linear | tetrahedral | triagonal bipyramid | triagonal planar | octahedral |

**Part C: Molecules with one central atom and hybridization**

28+4=32−8=24 42+6=48−12=24

| Compound | $Br_2$ 14−2=12 | $SiBr_4$ | $SeCl_6$ |
|---|---|---|---|
| Lewis Structure |  |  |  |
| Central Atom | none | Si | Se |
| Number of Bonded Atoms X | 2 | 4 | 6 |
| Number of Electron pairs E | 0 | 0 | 0 |
| Steric number X+E | 2 | 4 | 6 |
| Sketch of Molecular Model | |  |  |
| Molecular Geometry of central atom | linear | tetrahedral | octahedral |
| Hybridization around the central atom | $s^1p^1$ | $s^1p^3$ | $s^1p^3d^2$ |