Investigation 4.2.1

Three-Dimensional Shapes

Submitted by: Steven Phang, Santiago Valdes

Submitted to: Mr. Romano

Course: SCH 4UP

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**Purpose**

To test understanding of the VSEPR theory and three dimensional structure of molecules.

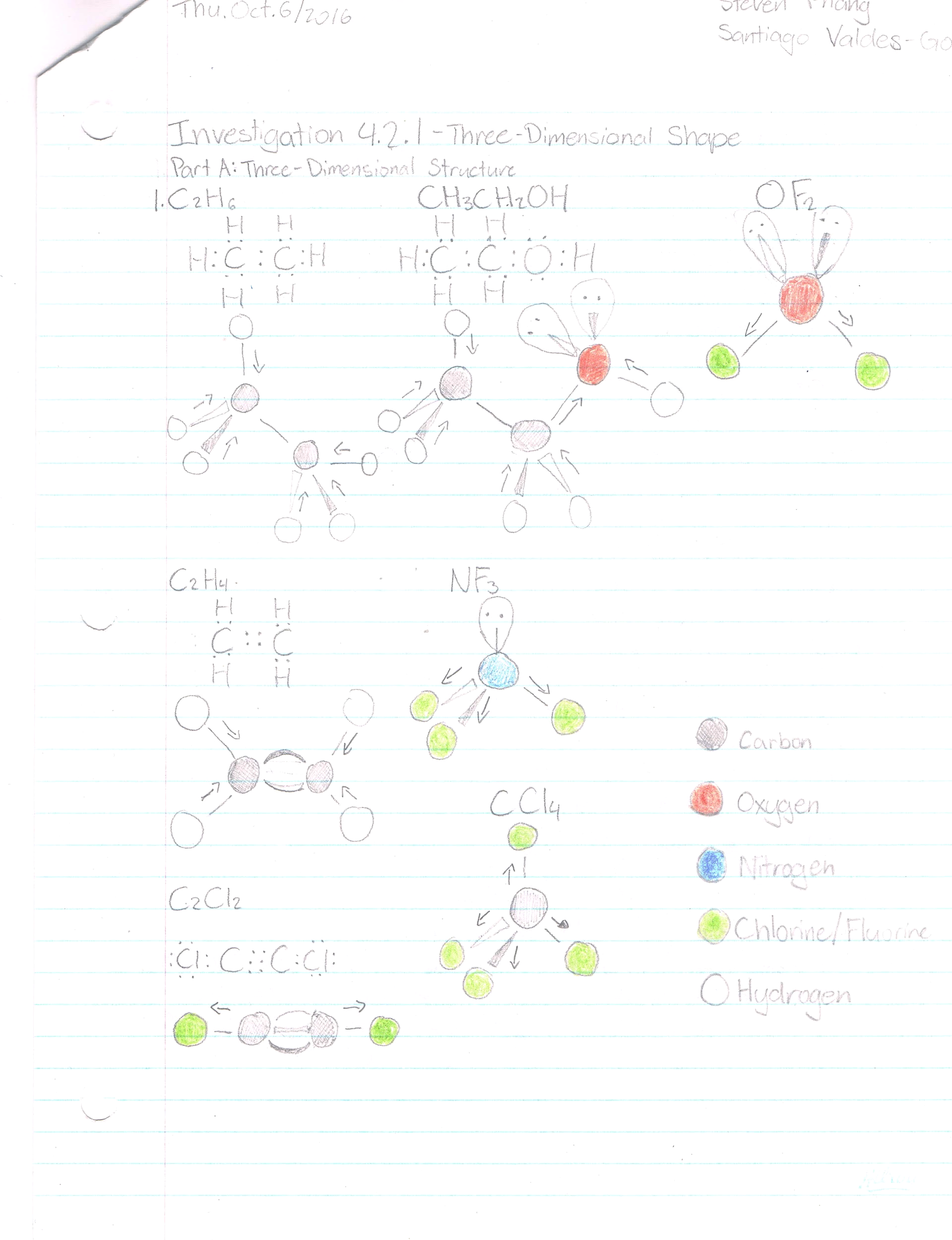
**Materials**

Refer to page 255 in the textbook.

**Procedure**

Refer to page 255 in the textbook.

**Observations**



**Analyze and Evaluate**

1. C2H6 - Tetrahedral

C2H4 - Trigonal planar

C2Cl2 - Linear

CH3CH2OH - Tetrahedral, angular

NF3 - Pyramidal

CCl4 - Tetrahedral

OF2 - Angular

1. OF2, CH3CH2OH, NF3, CCl4
2. OF2, CH3CH2OH, NF3, CCl4
3. It may be difficult to determine whether a molecule is polar since the shapes and the directions of the elections can be difficult to visualize.

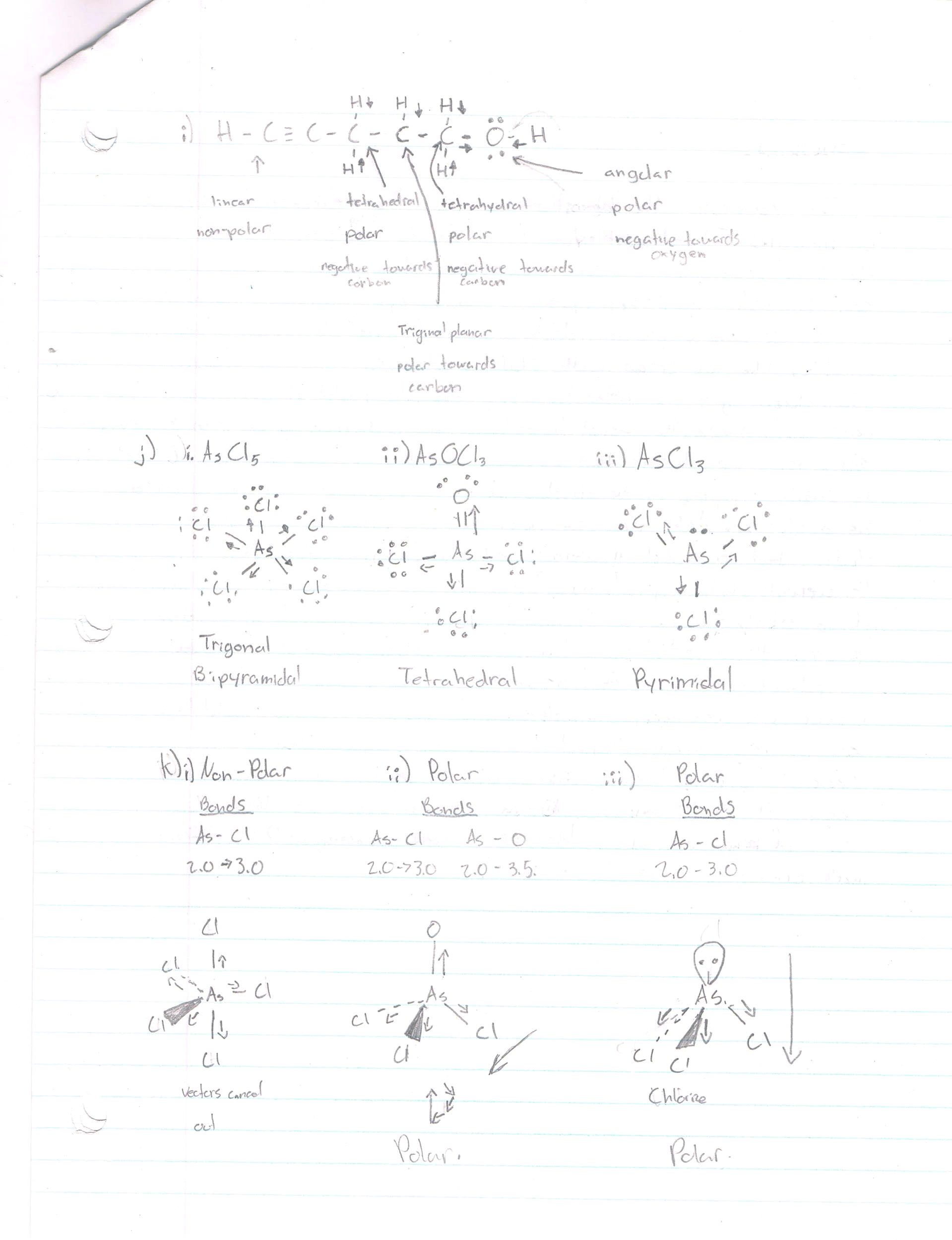
Polarity of Molecules

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Molecule Name** | **Shape** | **Bond Angle** | **Bonds** | **Molecule** |
| C2H6 | Tetrahedral | 109 | Polar and nonpolar (C-C) | non-polar |
| C2H4 | Trigonal planar | 120 | Polar and nonpolar (C-C) | non-polar |
| C2Cl2 | Linear | 180 | Polar and nonpolar (C-C) | polar |
| CH3CH2OH | Tetrahedral and angular | 109 and 105 | Polar and non-polar (C-C) | polar |
| NF3 | Pyramidal | 107 | polar | polar |
| CCl4 | Tetrahedral | 109 | polar | non-polar |
| OF2 | Angular | 105 | polar | Polar |

1. The predictions were correct to the polar and nonpolar molecules.
2. Polarity of Molecules

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Molecule Name** | **Shape** | **Bond Angle** | **Bond** | **Molecule** |
| PH3 | pyramidal | 109 | nonpolar | polar |
| CH3OH | Tetrahedral and angular | 109 and 105 | polar | Polar |
| CH3COOH | Tetrahedral, trigonal planar and angular | 109, 120 and 105 | polar | polar |
| BF3 | Trigonal planar | 120 | polar | nonpolar |

1. The molecules that would best orientate itself through a magnetic field would be the polar molecules (CH3OH, CH3COOH, PH3). They have an atom which contains a higher electronegativity, pulling towards one side of the molecule. This causes one side of the atom to be negative, allowing it to be attracted to the positive field.



**Conclusion**

In conclusion, the lab illustrated the three-dimensional structures of molecules. It aided the visual understanding of how such molecules can be polar and nonpolar. The lab also gave a visual representations on the shape of the molecule’s structure and the angles created between the bonds. The lab began with drawing out the predictions of the molecules given. By using the Lewis dot diagram, the types of bonds and bond placements can easily be identified allowing for the visual transition from Lewis dot diagram to a three-dimensional structure. After the structures were predicted, physical models of the structure were created using a modelling kit and predictions were used as guidelines. After these structure have been properly constructed, the molecule polarity was predicted. This was done by finding the elements’ electronegativities and finding out whether one molecule had a stronger electronegativity than the other. Once this was completed the “vectors” of the polarity were connected to see whether or not there would be a significant final vector indicating that the molecule was polar. Molecules with asymmetric shapes were generally polar whereas symmetrical shapes were generally non-polar. A possible source of error in this lab is that a piece in the modeling kit may have been incorrectly colour coded changing the number of bonds that element could have made. When constructing the molecules three-dimensional structure one would have used an incorrect piece leading to inaccurate polarity and three-dimensional structure. Another possible error would be an incorrect Lewis dot diagram. This may have caused a mistake in the shape and amount of bonds in a three - dimensional structure, causing the diagram and the model to be incorrect.