**Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Period\_\_\_\_\_\_Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**BONDING BOTTLES & IMF LAB**

*Adapted from Flinn Scientific*

***Introduction:***

Use simple tests of common laboratory chemicals to demonstrate the properties of LDF and hydrogen bonding

***Materials:***

glycerol, n-heptane, n-pentane, n-pentanol, propane, propane, n-propanol, propylene glycol, Glass bottles, rubber stobbers, Parafilm, Erlenmeyer Flasks.

***Safety Preactions****:*

n-Heptane is a dangerous fire risk, a flammable liquid and slightly toxic by inhalation. n-Amyl alcohol is a moderate fire risk; slightly toxic by ingestion and inhalation; severe body tissue irritant. Glycerin should not contact chromium trioxide, potassium chlorate or potassium permanganate as it may cause an explosion. Some people are allergic to glycerin and may experience irritation to skin and eyes. Isopropyl alcohol is a flammable liquid; fire hazard; slightly toxic by ingestion and inhalation. Pentane is a flammable liquid and narcotic in high concentrations Wear chemical splash goggles, chemical-resistant gloves and a chemical-resistant apron. Wash hands thoroughly with soap and water before leaving the laboratory. Follow all laboratory safety guidelines. Please review current Material Safety Data Sheets for additional safety, handling and disposal information.

**Preparation (already done on your lab table)**:

1. Obtain 6 Erlenmeyer Flasks & Label flasks.
2. Pour 50 mL of each liquid into each flask.
3. Insert a rubber stopper into each flask & cover tightly with parafilm

**Procedure: (Note: it may be helpful to look at the chart with the chemical formulas)**

Part I: Comparing Pentane & Pentanol

1. Take the pentane and pentanol flasks and set them next to each other.
2. Complete the swirl test. To do this carefully hold one flasks in each hand (with the bottoms of the flasks still touching the lab tables) and swirl with the same force. You are looking to see how quickly the flasks will “settle down”. Observe the results below:
3. Complete the shake test. To do t his, carefully hold one flask in each hand with your thumb on the stopper and gently shake up and down. You are looking to see if bubbles form. Observe the results below:

Part II: Comparing Heptane and Pentane

1. Take the heptane and pentane flasks and set them next to each other.
2. Complete the swirl test and observe results:
3. Complete the shake test and observe results:

Part III: Comparing n-propanol, propylene glycol, glycerol

1. Take the above flasks and set them next to each other
2. Complete the swirl test. Observe results below:
3. Complete the shake test. Observe results below:
4. Observe the viscosities of each flasks. Record observations below:
5. Compare the viscosity of pentane (MW=72) and propylene glycol (MW=76)

Part IV: Dropper Bottles & Surface Tension.

1. Go to the station of dropper bottles.
2. Observe the surface tension of each sample by placing no more than 3 drops of each sample on a slide. You should rinse off the slide when you are done & dry.

Part V: States of Matter, Boiling Point, & Density

1. Use the chart to try to explain the different states of matter, boiling points, and densities associated with each substance.

**DATA/RESULTS:**

You should make some sort of data chart for Parts I-III. (Sections IV & V are for discussion only)

**Discussion Questions:**

1. What intermolecular forces were present in each substance?
2. Why did the propane flask contain no liquid? How is this related to intermolecular forces?
3. Why did pentane and pentanol have different results for the swirl and shake test with respect to IMF?
4. Explain your observations comparing heptanes and pentane with respect to IMF?
5. During part III, all three flasks had 3 carbon chains, why did each experience different results of the shake and swirl test with respect to IMF?
6. Explain the viscosity observations of propanol, propylene glycol, and glycerol.
7. Explain your results comparing the viscosity of pentane & propylene glycol.
8. Which substance had the most surface tension? Least? WHY?
9. Explain how intermolecular forces affect the state of matter, boiling point, and density of each substance.
10. Glycerol is used in the food industry as a low carb diet sweetener instead of sucrose and sometimes used as a preservative. Using your knowledge of intermolecular forces, explain why glycerol would be better in low fat diets than sucrose. Also, why would glycerol be a good preservative? (THIS WILL REQUIRE YOU TO USE OUTSIDE SOURCES, SO CITE THEM!)