AP Chemistry Lab: Properties of Liquids and Solids NAME:

Background:

The Intermolecular Forces (forces between molecules) are weaker than Intramolecular Forces (The Chemical Bonds within an Individual Molecule). This distinction is the reason we define the molecule in the first place. The properties of matter result from the properties of the individual molecule (resulting from chemical bonding) and how the molecules act collectively (resulting from intermolecular forces).

Now, as these things increase in strength it becomes harder to remove the molecules from each other. Therefore, one would expect the melting and boiling points to be higher for those substances which have strong intermolecular forces. We know that it takes energy to go from a solid to a liquid to a gas. This energy is directly related to the strength of attraction between molecules in the condensed phases. Since energy is directly proportional to the temperature, the above trends ought to hold true.

The physical properties of melting point, boiling point, vapor pressure, evaporation, viscosity, surface tension, and solubility are related to the strength of attractive forces between molecules. The amount of "stick togetherness" is important in the interpretation of the various properties listed above.

There are four types of intermolecular forces. Most of the intermolecular forces are identical to bonding between atoms in a single molecule. Intermolecular forces just extend the thinking to forces **between** molecules and follows the patterns already set by the bonding within molecules.

Experimental Procedures:

Surface Tension Analysis: Obtain three pennies, three plastic pipettes, and the three stock substances. Count how many drops of each can “stack up” on a penny.

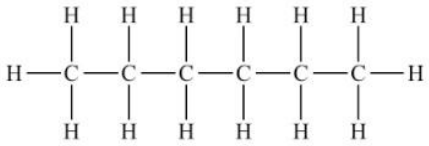
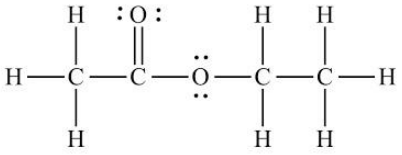
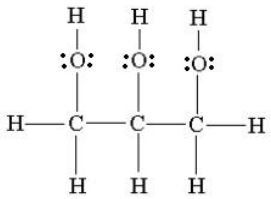
Viscosity Analysis: Flip test tubes containing each liquid with a marble inside. Time how long it takes the marble to fall through the liquid.

Vapor Pressure / Evaporation Rate Analysis: Obtain three cotton swabs, a stopwatch (you may use the one on your cell phone) and the three stock substances.Develop a procedure to determine their difference in evaporation rate or vapor pressure.

Miscibility / Solubility Analysis: Observe prepared mixtures of each of the three substances in two different solvents: (1) water and (2) mineral oil.

Lab Analysis:

1. Complete the data table that summarizes the results of each test for the three different substances.
2. Identify the intermolecular forces present in each of the three substances (list all IMF present).
3. Connect the role of intermolecular forces to the identity of each liquid (X, Y, and Z). Use in your explanation all the tests that apply: a)viscosity b)surface tension c)evaporation d)miscibility
4. The boiling points expected for X, Y, and Z are 137ºC, 36.1ºC and 102ºC (in no particular order). Match the boiling point to the appropriate compound.
5. Predict the expected experimental results if the following liquids were used: a)hydrogen peroxide (H_2O_2)b)bromine (Br_2)

		
Hexane	**Ethyl Acetate**	**Glycerin**

Data

1 = highest, 3 = lowest	Substance X	Substance Y	Substance Z
Viscosity “rank”			
Surface Tension “rank”			
Evaporation “rank”			
Miscibility (p/np)			
Formula			
Lewis Structure			
IMFs present			
Boiling Point match			

Predicted Results

formula	H_2O_2	Br_2
Lewis Structure		
IMFs present		
Viscosity “rank”		
Surface Tension “rank”		
Evaporation “rank”		
Miscibility (p/np)		