Name _____ Period _____

Partner _____ Date _____

Intermolecular Forces Lab

Station 1: Comparing liquids with hydrogen bonding

There are three flasks at this table containing three different liquids: C_2H_5OH (ethanol), $C_2H_4(OH)_2$ (ethylene glycol) and $C_3H_5(OH)_3$ (glycerine). **Do not** remove the stoppers from the flasks! Test them by swirling the contents and comparing the time it takes for the fluid motion to stop and the difficulty you have in moving the fluid quickly. Also shake the flask and observe how long it takes the bubbles to disappear.

Letter of flask	Results on swirling	Results on shaking
A		
B		
C		

1. Draw a structural formula for each of the three compounds. (Note: the –OH groups will attach to different carbons.)
   C_2H_5OH $C_2H_4(OH)_2$ $C_3H_5(OH)_3$

2. How can you determine by looking at the formula if a molecule can form hydrogen bonds to adjacent molecules?

3. Indicate the number of hydrogen bonds each compound can form:
   Ethanol: _____ Ethylene glycol: _____ Glycerine: _____

4. Identify the liquid in each flask and give your reason(s).

A) _____

B) _____

C) _____

Station 2: Comparing molecules with only dispersion or London forces

You have samples of C_3H_8 (propane), C_6H_{14}(hexane), and $C_{18}H_{38}$ (paraffin). Observe the samples and compare the strength of the dispersion forces between the molecules.

Letter of flask	Physical state of the sample	Relative strength of the intermolecular forces
D		
E		
F		

1. Draw a structural formula for each of the molecules.

C_3H_8 C_6H_{14} $C_{18}H_{38}$

2. Identify each of the samples by letter and give a reason for your choice.

D: _____

E: _____

F: _____

3. In general you can say that as the _____ of a molecular compound increases the dispersion forces will increase.

Station 3: Surface tension and strength of intermolecular forces

There are two test tubes with plastic pipets at this station. Place one drop of each of the liquids on a piece of plastic wrap. The two liquids are H_2O (water) and $C_{12}H_{26}$ (oil).

Observation: Draw a picture of the drops made by each liquid.

H_2O $C_{12}H_{26}$

1. Draw the structural formula for each of the liquids used at this station.

H_2O $C_{12}H_{26}$

2. Identify the type(s) of intermolecular forces found in each of the liquids.

3. What is surface tension? (look up a definition)

4. How does the strength of the intermolecular force relate to surface tension as illustrated by the drops in this experiment?

Station 4 : Using viscosity to compare the attraction between molecules

You will find three test tubes at this station. Each test tube is capped and has a small plastic bead in it. Each test tube has a different liquid. For each liquid, follow these steps:

1. Hold each tube upright until the bead is at the bottom.
2. Simultaneously turn the tubes upside down so that the bead is at the top.
3. Indicate the relative time it takes for each bead to travel to the bottom of the tube – fastest, medium, slowest.
4. Indicate the relative viscosity of the three liquids – most viscous, medium, least viscous.

Observations:

Liquid	Relative rate of bead falling	Relative Viscosity
Motor oil		
Lubricating oil		
Mineral oil		

1. Define viscosity. (look up the definition)

2. Compare the forces of attraction between the molecules for the three liquids. Which has the strongest forces? Which has the weakest forces?

Station 5: Using rate of evaporation to compare attraction between molecules

The person who will be "swiping" the cotton balls should put on a pair of vinyl or latex gloves. Use a cotton ball to wipe each of the three liquids on the chalkboard (all at the same time) and observe the time it takes for each liquid to evaporate. The three liquids are CH_3OH (methanol), C_3H_7OH (rubbing alcohol), and CH_3COCH_3 (acetone). Indicate the relative time it takes each to evaporate – fastest, medium, slowest.

Observations:

Letter of Liquid	Ranking of rate of evaporation
G	
H	
I	

1. Draw a structural formula for each of the three liquids and identify the intermolecular force(s) present in each liquid.

Formula	CH_3OH	C_3H_7OH (the –OH) is on the middle carbon	CH_3COCH_3
Structural formula			
Intermolecular force(s)			

2. Identify the liquids and give a reason for each choice.

   G: _____

   H: _____

   I: _____

3. Why do liquids like methanol, rubbing alcohol, and acetone have odors?

Station 6: "Boiling Cold"

Spray enough of the butane into a baggy so that you have a small pool of liquid. Seal the baggy (try to remove as much air as possible). Place your hand under the corner of the baggy where the liquid is located. What happens? How does it feel?

Observations:

1. Look up the chemical formula and boiling point of butane and draw the structural formula.

   Chemical formula: _____ Boiling point: _____

   Structural formula:

2. In your own words, describe what happens when a liquid boils.

Station 7: How does the drinking bird work?

At this station you will find a drinking bird. Your teacher will get the drinking bird started for you. After observing it for several minutes, write an explanation for what you see happening inside the bird. Your explanation should include answers to these questions: Why must the head of the bird be wet to get the process started? What causes the liquid to rise inside the bird? What causes the bird's head to tip over so that it "drinks" the water? Once the bird "drinks", how is it able to tip back to the upright position again?

Explanation:

This lab was adapted from one designed by the ever amazing Kathy Kitzman of Michigan