Name __________________________

Physical Properties

Prelab
There are a vast amount of physical properties. List as many as you can think of. Make sure they are, indeed, physical properties.

In this experiment you will investigate two physical properties. Read through the procedure to determine which one they are.

Part I:

Part II:

Describe how physical properties differ from chemical properties using the phrases intermolecular forces and intramolecular forces.

Problem
How do physical properties relate to intermolecular forces?

Procedure & Data
You will be assigned to complete either Part Ia or Part Ib. Make sure you are by an ice bath if you are assigned to part a and near a hot plate if you are assigned to part b.

Part Ia
1. Obtain a test tube with acetic acid (liquid). Be careful, this is concentrated acid—no water has diluted the acid.
2. Make sure the “graph” display is showing on the GLX, with temperature on the y-axis. Press the “play” button to begin recording data.
3. Submerge the test tube in an ice bath. Watch the test tube as the temperature changes. Use the temperature probe to gently stir the acid to ensure even cooling. Make observations.
4. Press the “play” button to stop data collection once you are certain your sample is frozen. (Hint: how are you certain your sample is frozen?) Remove the test tube from the ice bath.
5. Bring your GLX up to the computer to print the graph.
6. Make sure the temperature probe is clean before leaving the lab.

Part Ib
1. Obtain a test tube with lauric acid (solid).
2. Lower the test tube into the hot water bath and heat until the lauric acid is fully melted.
3. While waiting for your sample to melt, make sure the “graph” display is showing on
the GLX and temperature is on the y-axis.
4. Remove the test tube from the hot water bath and place the temperature probe in the melted lauric acid.
5. Press the “play” button on the GLX to record the temperature of the lauric acid.
6. Gently stir the lauric acid with the temperature probe to ensure even cooling.
7. When you are certain your sample is frozen, press the “play” button on the GLX to end data collection. (Hint: how are you certain your sample is frozen?)
8. Bring your GLX up to the computer to print the graph.
9. Make sure the temperature probe is clean before leaving the lab.

Part II
1. Make sure all test tubes you have are the same. Line up your 14 test tubes side by side so you have a 7x2 grid of test tubes. One row will be water one row will be mineral oil.
2. Put water in seven test tubes so a quarter of the test tube is filled. Do the same with mineral oil in the other seven test tubes. Make sure all test tubes have the same amount of solvent in them. Label each column a – h. Here is what your set up should look like from the top... You can use this diagram as your data table. Put a check mark for soluble and an x for insoluble. Make predictions first, and then begin the experiment using the second data table to record results.

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3. Follow the same instructions twice: once for the water test tubes, once for the mineral oil test tubes.
   a. Add eight drops of tert-butyl methyl ether
   b. Add eight drops of ethanol
   c. Add eight drops of vegetable oil
   d. Add a few granules of copper(II) chloride
   e. Add a few granules of urea
   f. add a few granules of sucrose
   g. add a few granules of ammonium nitrate
   h. add a few granules of naphthalene
4. Mix the contents of each test tube by gently tapping the side of each test tube. Make observations for each test tube. You are testing for solubility, so in your data table make sure to indicate “soluble” or “insoluble” for each test tube.
Analysis

Part I
1. Determine the freezing point of each solution. Find a group who conducted the other part of the experiment from you and cite who you shared data with. Compare your answers to the hint in part 4a/7b. Is this consistent with both groups’ observations?
2. What is the melting point of each substance?
3. Can you use the freezing point data to hypothesize the boiling point of each substance? Explain.
4. You should observe at least two, maybe three distinct areas on your graph. Explain what is happening on the microscopic level during these portions of the graph.
5. At room temperature, lauric acid is a solid, acetic acid is a liquid, and carbon dioxide is a gas. Of these three substances, which has the weakest intermolecular forces based on that information? Explain.
6. It turns out lauric acid and acetic acid have similar intermolecular forces. Provide an alternative reason for their difference in melting points.

Part II
1. Divide the solutes into two or three groups as follows: solutes that dissolved in water, solutes that dissolved in mineral oil, solutes that dissolved in both solvents.
2. What structural characteristics allow for each of the solubilities to take place? Use the Lewis structures on the board to help you with your explanation for a, b, c, e, f, h. You should be able to figure out the Lewis structures for d and g.
3. If you mixed the two solvents, what would happen? Explain.

Conclusion
Answer the problem citing data you collected in this experiment.