The Relationship Between Intermolecular Forces And Physical Properties

Purpose: to demonstrate that an understanding of intermolecular forces can assist in predicting the physical properties of compounds. Work with your lab partner to complete the prelab and then the lab.

Prelab: Complete rows C – H in the chart below. Note: for structural diagrams, the place where two lines meet represents a carbon atom (i.e. cyclohexane and paradichlorobenzene each have 6 carbon atoms in a ring, glucose has 6 carbon atoms in a row). After finishing your predictions, hand in 1 sheet per group.

Safety: Cyclohexane and paradichlorobenzene (PDCB) smell bad and are toxic. When using these chemicals, work as close to the fumehood as possible. Also, use very small quantities of each. At the end of the lab these chemicals should be placed in the "organic waste" container at the front of the room.

Materials: Gather together the following: a metal spot plate, a plastic spot plate, a test tube rack from your lab station, 7 test tubes with 7 stoppers, a conductivity tester with 9-volt battery, a hot plate, a plastic eyedropper, a 50 mL beaker, and cyclohexane. Clean tubes with a test tube brush and some of the cleaning solution provided. Add distilled water (located in the rear of the lab) to the beaker. On the metal spot plate place the following chemicals (about ½ spoonful for each): $CaCl_2$, glucose, and PDCB. Keep a record of which chemical you placed which well). Label the test tubes 1-7 with tape & a ballpoint pen.

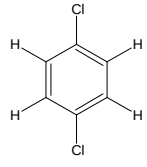
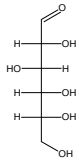
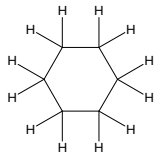
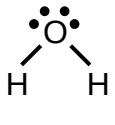
Procedure:

1. Turn on the hot plate. Put the metal spot plate (with chemicals) on the hot plate. ***Place the opening of the fumehood directly over (5 cm above) the PDCB*** (elevate hotplate with textbooks if necessary). Record the relative temperature at which chemicals melt (low, intermediate, or high). Turn off the hot plate when 2 of the 3 chemicals have melted (i.e. one of the chemicals will not melt).
2. Using the eyedropper, add distilled water to tubes 1 – 4 (the water level should be about 2 cm deep). Add cyclohexane to tubes 5 – 7. Work directly under the fumehood when dispensing cyclohexane.
3. Add the missing solute to test tube 1, as indicated in the chart below (use about ½ scoop of solid). Stopper and mix. Record your observations (as J and/or K in the chart below). Repeat for tubes 2-7.

Tube #	1	2	3	4	5	6	7
Solvent	water	water	water	water	cyclohexane	cyclohexane	cyclohexane
Solute	PDCB	glucose	$CaCl_2$	cyclohexane	PDCB	glucose	$CaCl_2$

4. Test the electrical conductivity of PDCB, glucose & $CaCl_2$ **in water only** (in other words, tubes 1-3). Start by carefully pouring some of the mixture into a well in the plastic spot plate. Test with your conductivity meter (the light will go on if the solution conducts electricity). Record your observations.

Clean up: All mixtures should be placed in the "organic waste" container. Wash test tubes, stoppers, and spot plates with a test-tube brush & the cleaning solution provided. ***Rinse tubes well***. Return equipment.

A. Chemical	PDCB	glucose	$CaCl_2$	cyclohexane	water
B. Structure			$[Ca]^{2+}[Cl]_2^-$		
C. ΔEN and % ionic character of molecule's most polar bond					
D. Polarity of molecule based on part C (ionic, polar, non-polar)*					

*Recall: ΔEN 0-0.5 = non-polar, 0.5-1.7 = polar, 1.7+ = ionic

Prediction					
E. Melting point (low, inter, high)					
F. Soluble in water? (y/n)					
G. Soluble in cyclohexane? (y/n)					
H. Conductivity in water?(x/✓)					
Actual					
I. Melting point					
J. Soluble in water? (y/n)					
K. Soluble in cyclohexane? (y/n)					
L. Conductivity in water?(x/✓)					