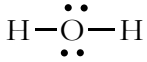
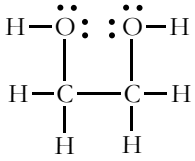
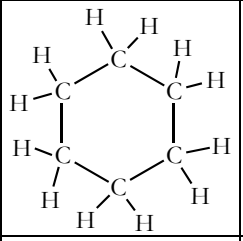
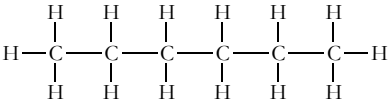
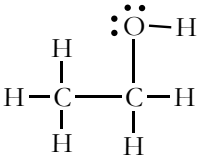
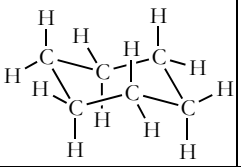
Lab [20 pts]
Polarity and Solubility
Chem 1

Name _____
Lab Partner(s) _____
Period_____ Date_____

Purpose: (1) To observe the solubility of liquids and solids.
(2) To make a connection between a substance's polarity and its solubility.
(3) To formulate a molecular model which helps to explain solubility.
(4) To predict the polarity of an unknown substance based on our model.

Part I: Determining polarities based on molecular structures. Do in PENCIL!!!!!

a) [3 pts] Fill in the following chart by drawing the 3D diagrams (remember Chapter 9!) below. Draw the correct δ+/δ– (don't use arrows) symbols on the polar bonds in the 3D diagrams. Only label bonds with *significant* electronegativity differences (ΔEN > 0.4).

	Water	**Ethylene Glycol**	**Cyclohexane**	**Hexane**	**Ethanol**
Lewis Dot					
3D Diagram w/ δ+/δ–					
Polarity (%)					

b) [2 pts] Rank these liquids as best you can, according to their polarities by placing each of them appropriately on this polarity "number line same spot."

- You will not be able to differentiate between nonpolar covalent molecules—just write all nonpolar molecules at the same spot on the line.
- To differentiate between slightly polar covalent, polar covalent and very polar covalent, look at the **percentage of the bonds that have partial charges.** (#polar bonds/total bonds).

nonpolar covalent	slightly polar covalent (≤25%)	polar covalent	very polar covalent (≥75%)	ionic

Part II: **Data Collection: Solubility of Five Liquids, NaCl and I_2 (as a demo)** [2 pts]

	Water	**Ethylene Glycol**	**Cyclohexane**	**Hexane**	**Ethanol *(dry tt)***
Water					
Ethylene Glycol					
Cyclohexane					
Hexane					
NaCl (s)					
I_2 (s)					

Part III: Making a Hypothesis using just your data concerning the LIQUIDS
Compare the polarities of the five liquids (Part I) with the solubility results of the five liquids (Part II). Try to look for patterns. Then, make a HYPOTHESIS or generalization that is able to PREDICT the solubility of the liquids from their polarities. This must be a GENERAL statement with No EXCEPTIONS.

Hypothesis: [1 pt] Two substances will be soluble if _____

_____

Part IV: TESTING YOUR HYPOTHESIS (Solubility of NaCl and I_2)

1) [1 pt] What is the polarity of NaCl?_____ *Write in NaCl appropriately on the polarity number line above.*
2) [1 pt] Look at your solubility data. Is NaCl more soluble in water or in ethylene glycol? _____ Use the polarity of each liquid and your hypothesis to explain why.

3) [1 pt] What is the polarity of I_2?_____ *Write in I_2 appropriately on the polarity number line above.*
4) [1 pt] Make a prediction: In which liquid(s) should I_2 be most soluble? _____ Least? _____ Explain:

5) [1 pt] Look at the solubility of I_2. Does hypothesis fit data results? _____ Explain:

Part V: TESTING an UNKNOWN -- PUTTING YOUR HYPOTHESIS TO WORK:

1) Get an unknown substance from me. What is your unknown number?_____. Also record below.
2) Obtain a test tube rack and five small dry, clean test tubes. Obtain the 5 dropper bottles of the 5 liquids.
   - Cyclohexane and hexane must be disposed of in the WASTE bottle. Other liquids may go down sink.

LIQUID UNKNOWNS: Put in 2-3 dropperfuls of your liquid into each test tube. Add 2-3 dropperfuls of correct solvent. Put on a stopper and shake. Let the liquids settle and observe whether they are soluble or insoluble. *(If there is a line about halfway down, there are two layers and the liquids are INSOLUBLE.*
SOLID UNKNOWNS: Put a pea size amount of the solid unknown into each small test tube. Add about 2 -3 dropperfuls of correct solvent into the different test tubes and record what you see happening. Determine how much solid has dissolved (*all, most, some, none*?).

3) [2 pts] Record your solubility data here. (Soluble? slightly soluble? insoluble?)

	water	**ethylene glycol**	**cyclohexane*(waste)***	**Hexane *(waste)***	**Ethanol *(dry tt)***
Unknown #					

Part VI: Analysis of Unknown

1) [1 pt] Based on your solubility data, what is the polarity of your unknown? _____
   (nonpolar covalent, slightly polar covalent, polar covalent, very polar covalent, or ionic)

2) [1 pt] Now look at the compounds on the board and deduce which unknown is probably yours. You and your partner should come to me and tell me your unknown #, its polarity and what you think it is. Once I confirm your unknown, write the name of your unknown on the polarity number line on the front and copy down the 3D structure of your unknown on top of the next page.

- If your unknown is covalent, write in any partial charges on the 3D structure. If none, write "NONE"
- If your unknown is ionic, show the Lewis dot structure as we did in Chapter 8. *(Write all atoms separately, put in valence electrons, show transfer of electrons using arrows, and show ions formed with correct charges.*)

3) [1 pt] You have already determined the polarity of your unknown based on its solubility results. Now, imagine you have NOT tested the solubility of your unknown. Explain how you would be able to determine your unknown's polarity by just knowing its structure. *[First, is your unknown ionic or covalent? Second, if it is covalent, is it non-polar, slightly polar, polar or very polar? How do you know?]* Your answers should be based on metals/nonmetals and a discussion of either full charges, partial charges? Some or lots of partial charges?

4) [1 pt] Draw two molecules of your unknown, and write in any partial or full charges. Next, show how the two molecules are attracted to each other by drawing a dotted line between the molecules. What type of intermolecular force best describes what is happening between your two unknown molecules ie, dispersion, dipole-dipole, hydrogen bonding or ionic? Explain your decision.

5) [1 pt] Finally, show a molecule of your unknown with at least two H_2O molecules. If your unknown is soluble in H_2O, show how the charges or partial charges are attracted to the $\delta+$ and the $\delta-$ ends of the H_2O molecule. If your unknown is not soluble in H_2O, show how two H_2O molecules are more attracted to each other and act to keep the nonpolar molecule away.