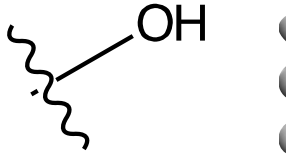
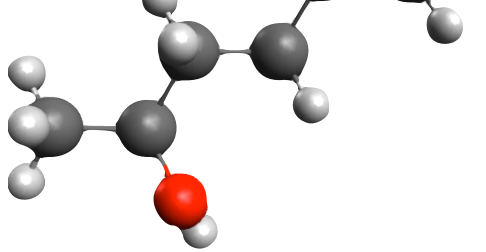
Ex02

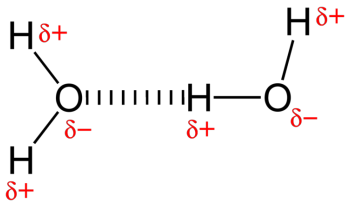
Organic Properties

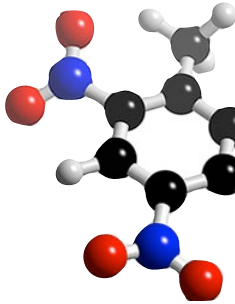
- Physical Properties
  - Alkanes
  - Alcohols (hydroxy group)
  - Aldehydes & Ketones (carbonyl)



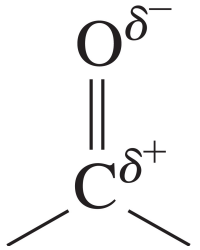


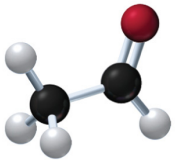
- The Experiment
  - 02 Solubility: Part A, B, C, & D

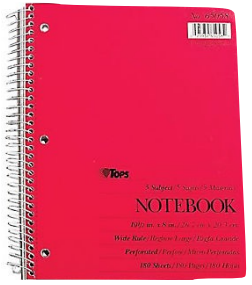


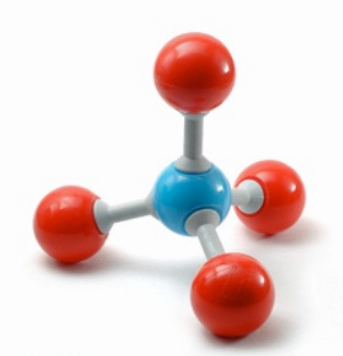


- For Next Week



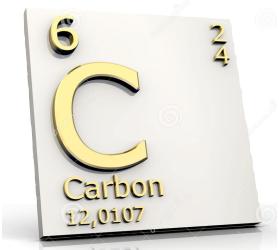




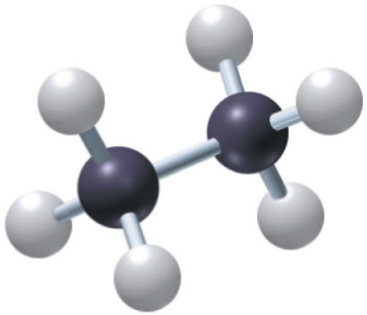


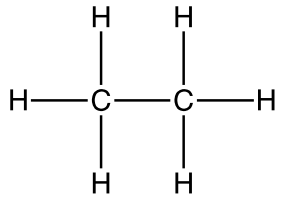
Carbon

- Carbon is on the sweet spot in the periodic table.
  - It has an electronegativity of 2.5
    - Aggressive enough that it predominantly forms covalent bonds.
    - Complacent enough it doesn't seek out more aggressive elements.
    - It ends up on the bottom of the dog pile bonding with other carbons.
    - Hydrogen fills in any open valence.

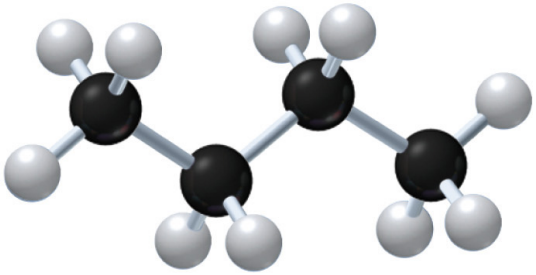


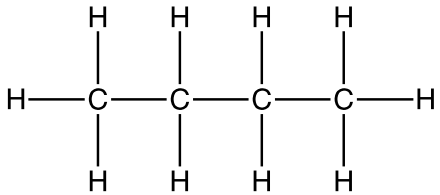
C_2H_6



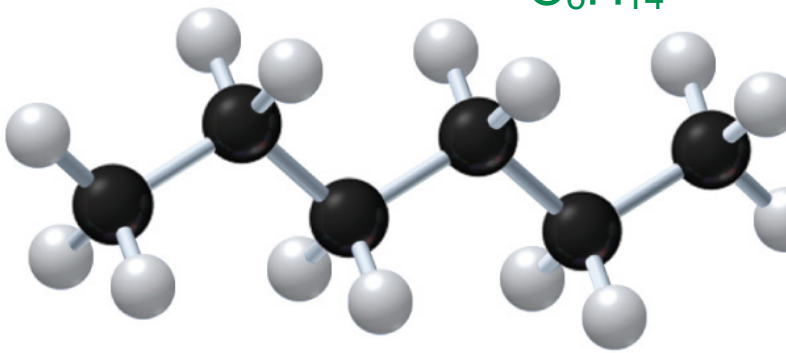


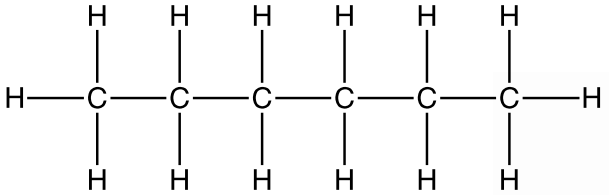
C_4H_{10}

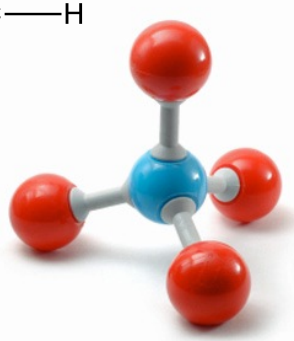




C_6H_{14}

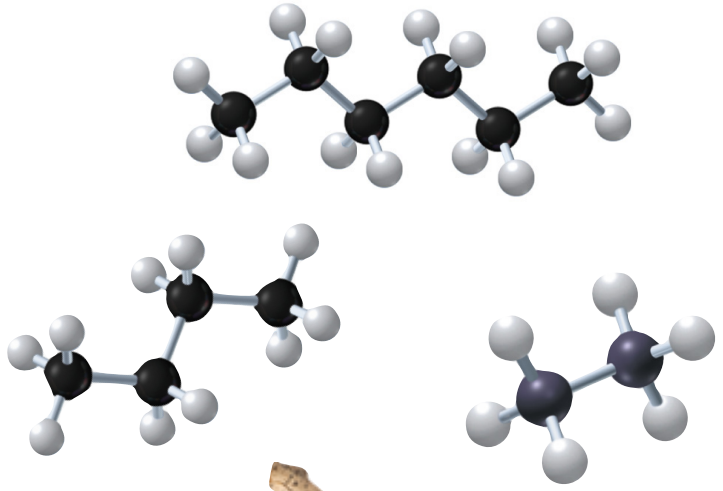


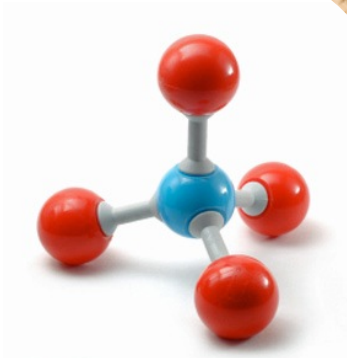




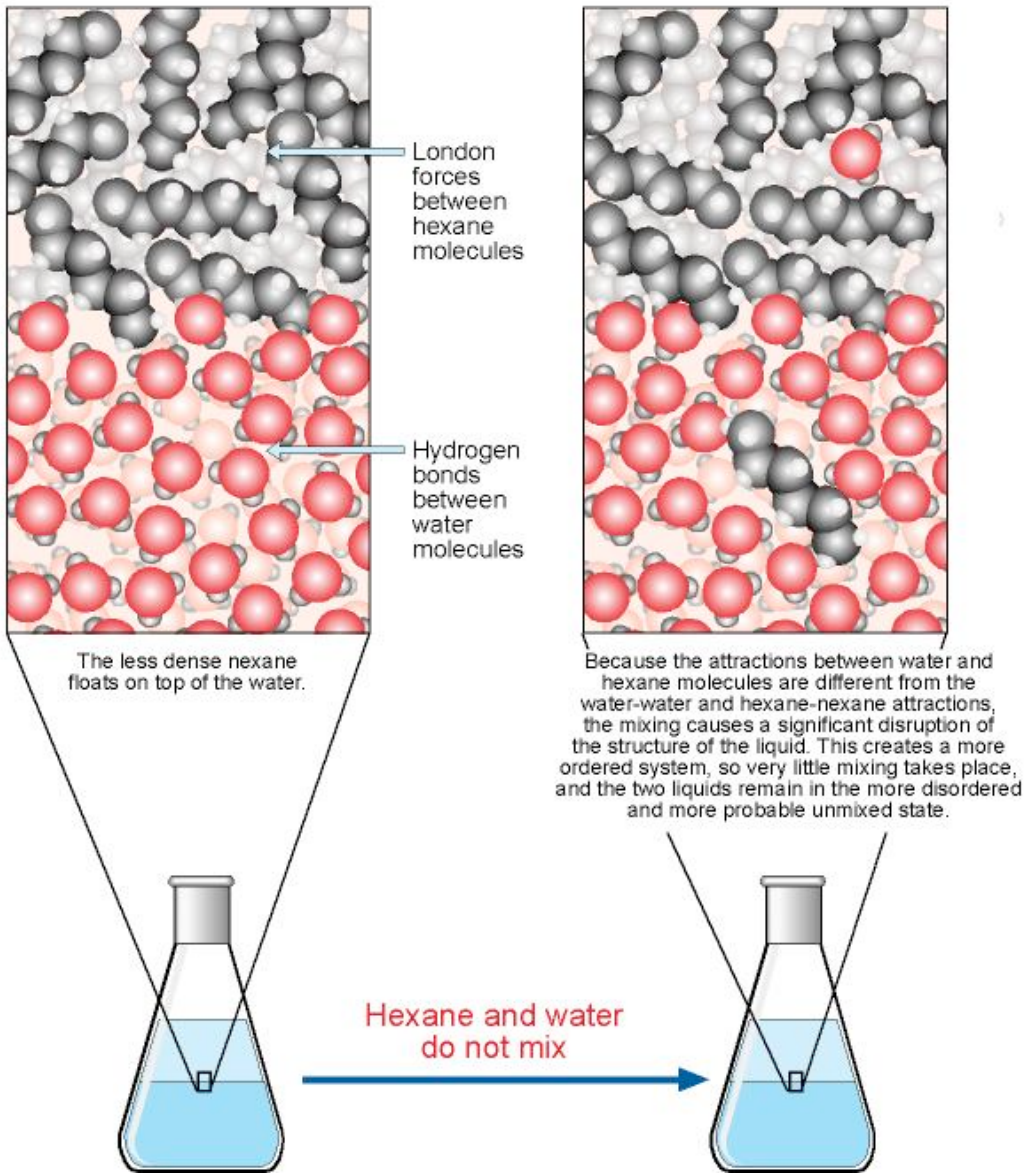
Alkane Properties

- Alkanes are the zero point for organic chemistry.
- They have the least intermolecular forces.
- Which explains their relative physical properties.
  - Lowest boiling points.
  - Lowest melting points.
  - Low hardness.
  - Low viscosity.
    - … all go up with increasing mass but is still lower than most other classes of organic molecule.
  - Alkanes also tend to have low density.
- They have nothing interesting on the molecule to work with.
- Like a stick.
- And like a stick the only interesting chemical property is you can burn it.
  - Alkanes are flammable.
- They make good fuels (octane, propane, butane…)





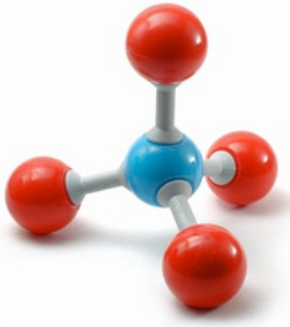
Solubility



- Alkanes mix fine with other alkanes.
- But substances that have more intermolecular forces, prefer to bind with themselves—excluding alkanes.
- Water enjoys:
  - Dispersion forces
  - Dipole-dipole forces
  - Hydrogen bonding

- So water excludes alkanes.
- Oil and water don't mix.
- Alkanes are not soluble in water.

  (and water like substances)



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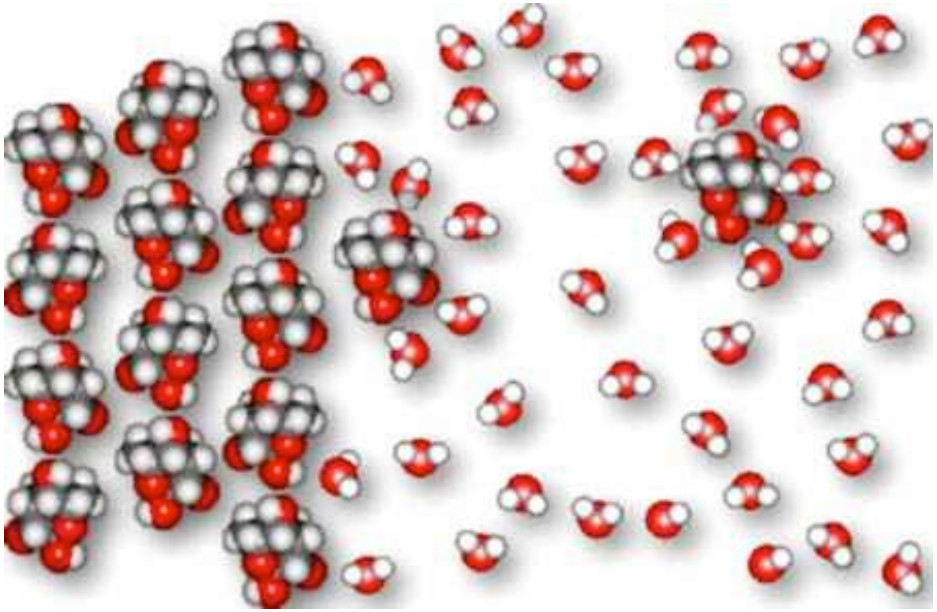

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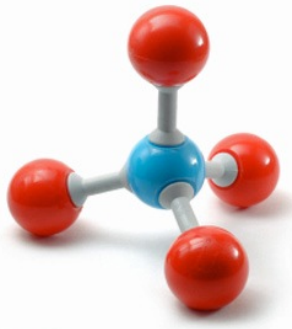

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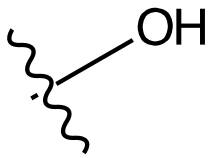
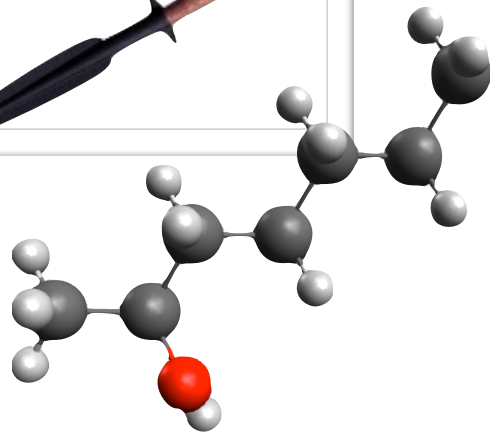
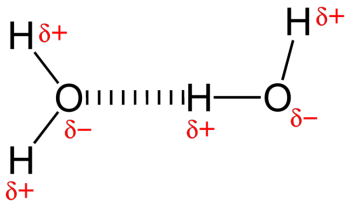
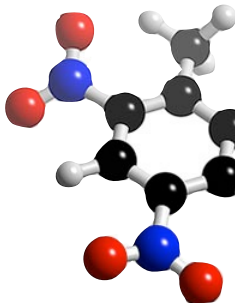
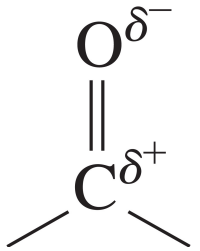
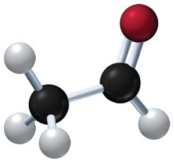


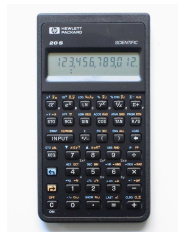


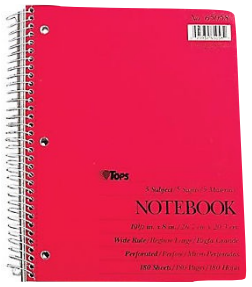


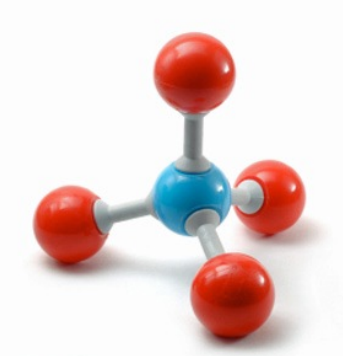




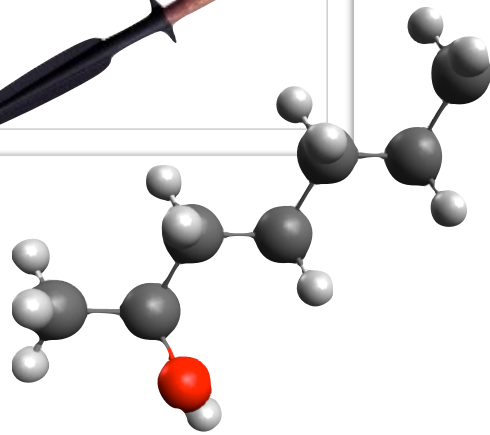




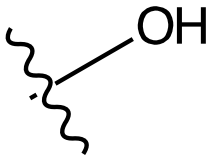


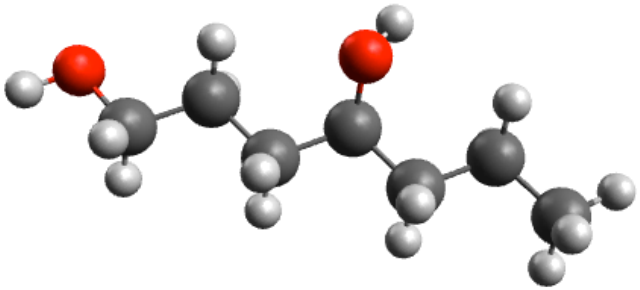


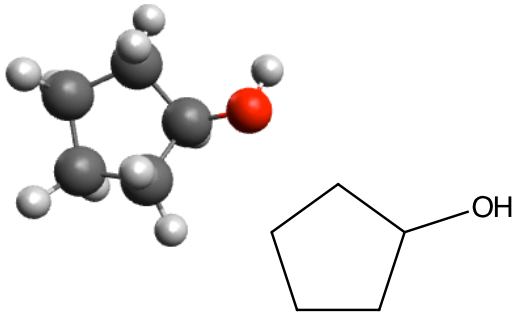
Alcohol

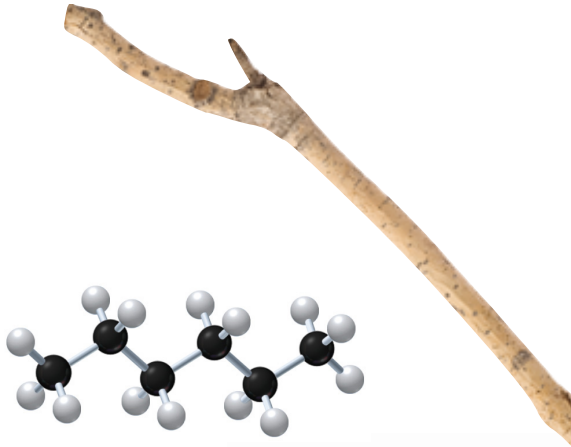


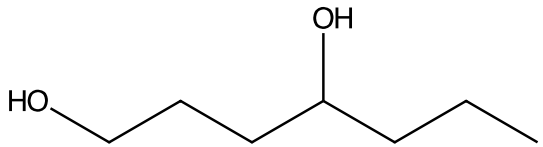
- Organic molecules and the substances they define them can add remarkable new properties by attaching just a few atoms.
- You can add a new function to your stick by attaching a bronze spear head, steel hook or bone handle.
- Same with a molecular stick.
- Adding a single oxygen atom to a molecule turns an alkane into an alcohol.

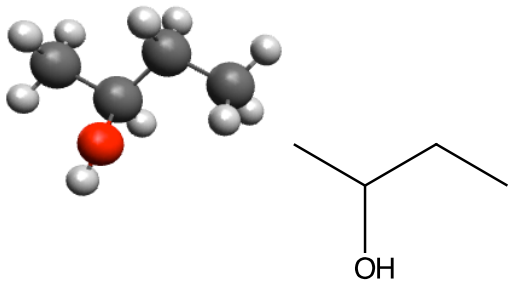


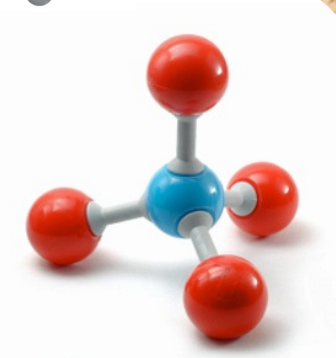








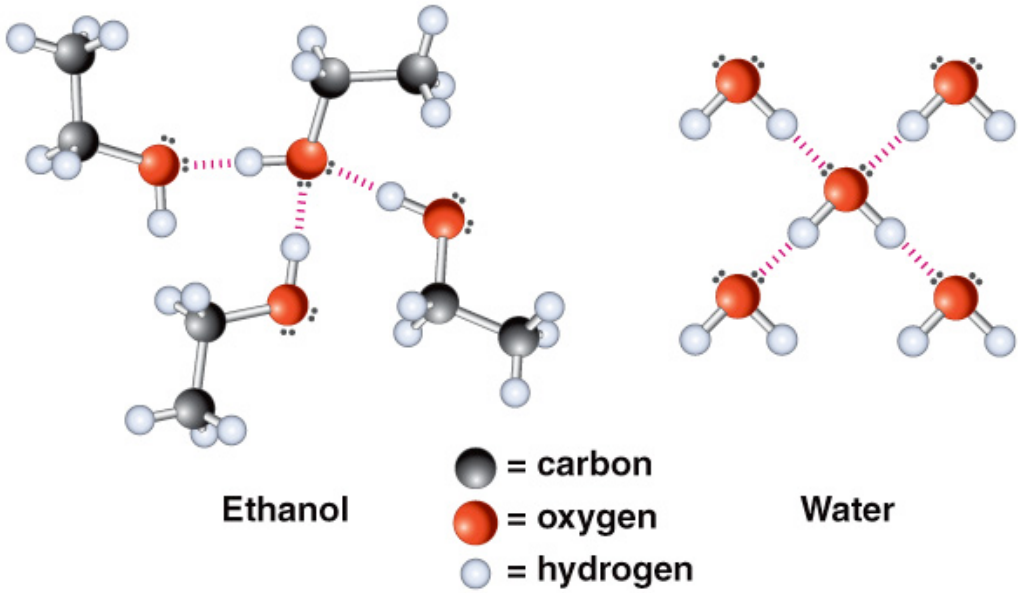


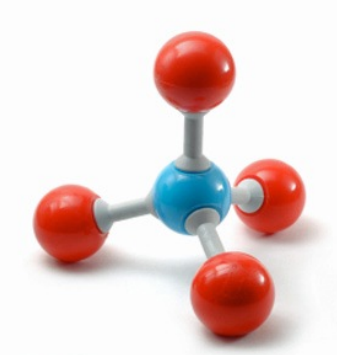


Alcohol Properties

- Adding that hydroxy group (OH) to an alkane, let's alcohol's stick to each other with new and stronger intermolecular forces.
  - Dipole-dipole forces
  - Hydrogen bonding

- What do you think that does to physical properties like melting point, boiling point, viscosity?





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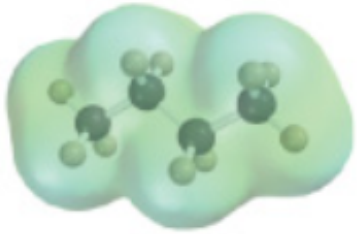
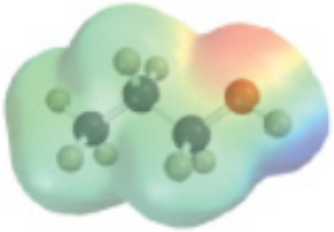




most # of IMF:

- dispersion forces
- dipole-dipole
- hydrogen bonding

least # of IMF:

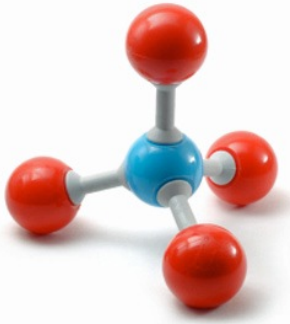
- dispersion forces

$CH_3CH_2CH_2CH_3$

Butane, bp 0°C

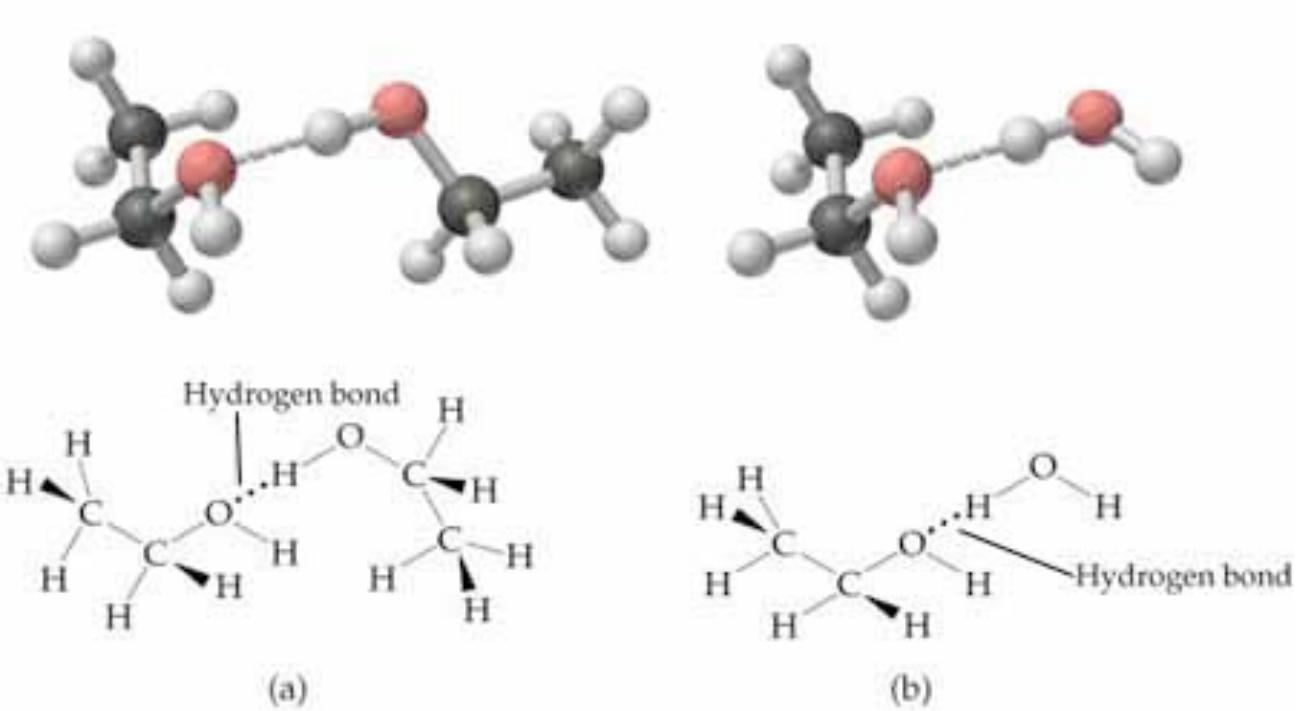
$CH_3CH_2CH_2OH$

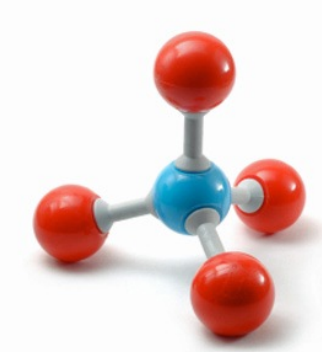
Propanol, bp 97°C



Solubility

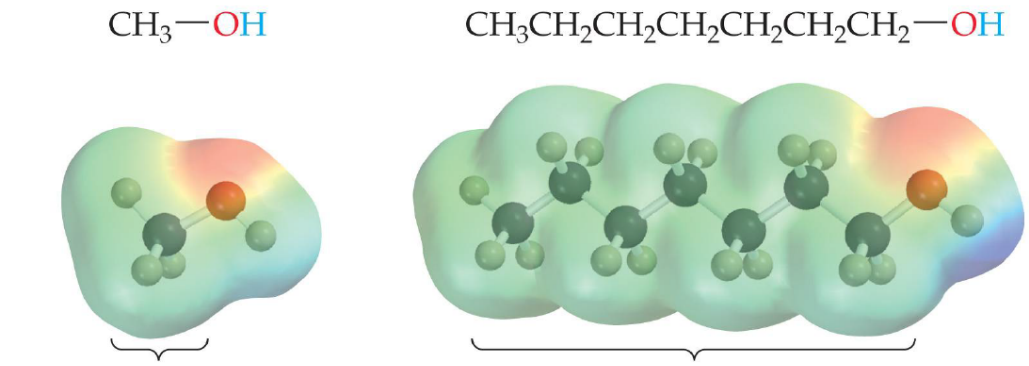
- That hydroxy group that increases the stickiness between alcohol molecules also let's them stick to water.
- Which increases the water solubility of those molecules.
- Oil and water don't mix. Vodka and water do.
  - Alcohols are much more soluble in water than alkanes.





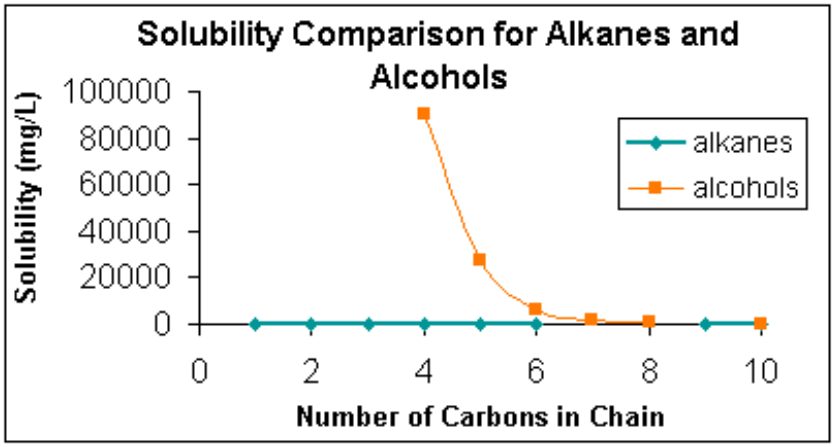
Varying Solubility

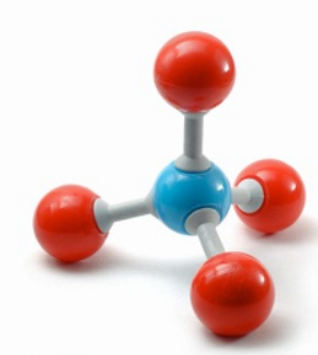
- Different alcohols have greater or lesser “greasy” parts.
- The more greasy an alcohol is, the less soluble it will be in water.
  - The water will be fine with the hydroxy end, it will try to push out the alkane end.
  - The bigger the alkane part, the less likely the substance overall will be soluble.



Methanol: has a small organic part and is therefore water-like.

1-Heptanol: has a large organic part and is therefore alkane-like.





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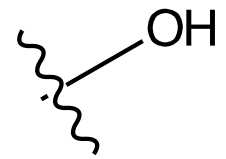
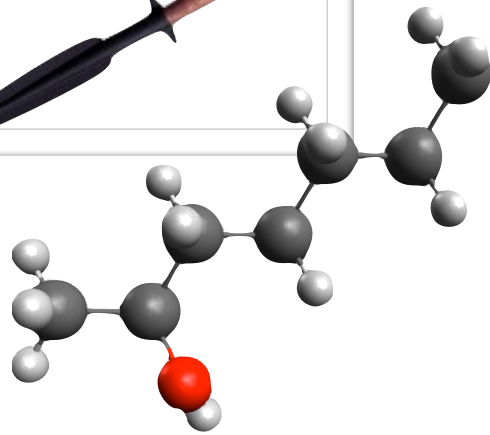
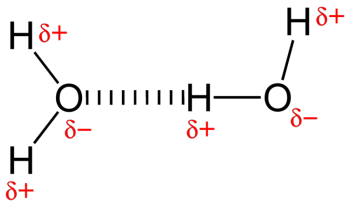
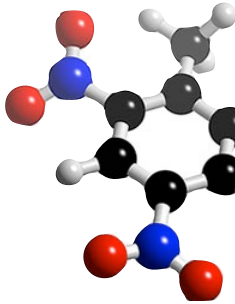
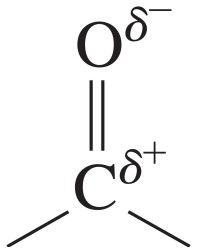
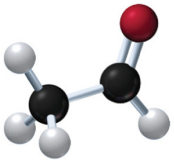


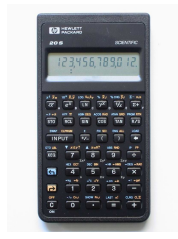


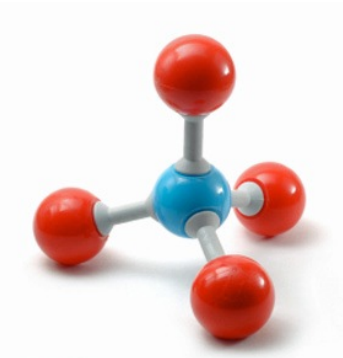








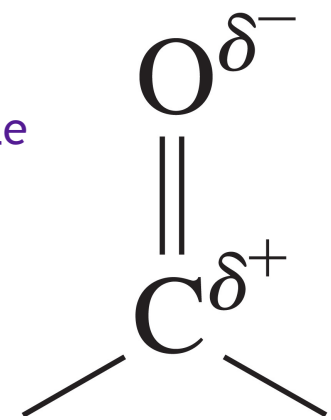


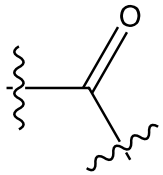


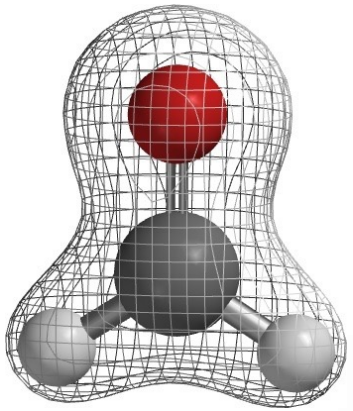
The Carbonyl Group

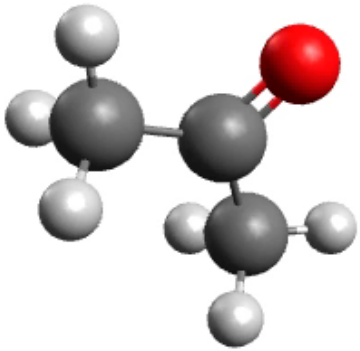
- A carbonyl group is an oxygen double bonded to a carbon skeleton.
- The the carbonyl group is present in and responsible for the chemistry of many classes of organic compound including:
  - Ketones
  - Aldehydes
  - Carboxylic Acids

    … and more we'll talk about later.

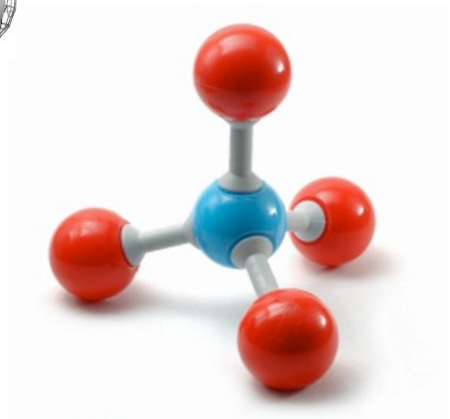






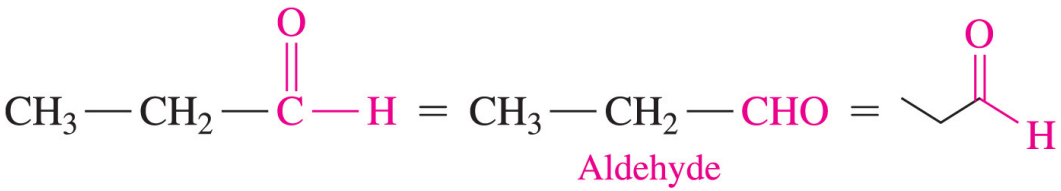


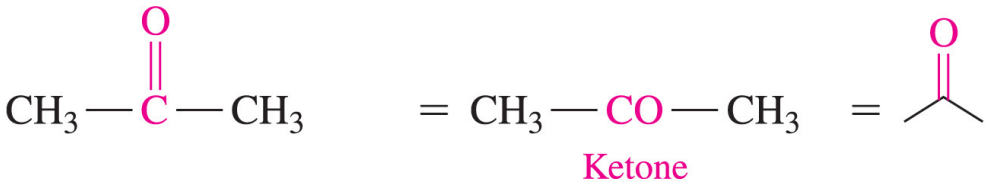
- The carbon in a carbonyl group is sp^2.
- The bonds to it form a trigonal planar shape.
- The double bond allows electron density to shift easily between the oxygen and carbon.
  - If a hydroxy group is a bronze spear head, a carbonyl is a pulley or hinge.
  - Alkanes are the stone age, Alcohols the bronze, and carbonyls take us to the industrial age of molecules.

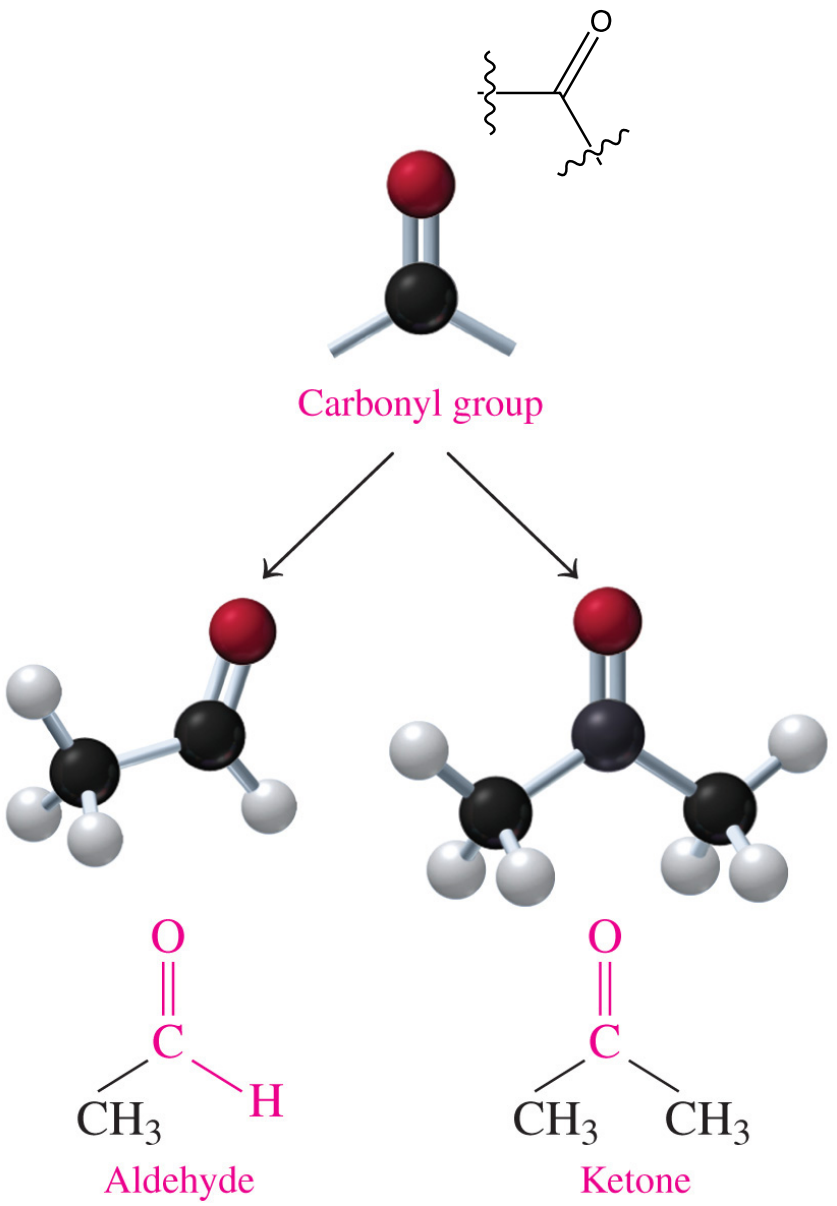


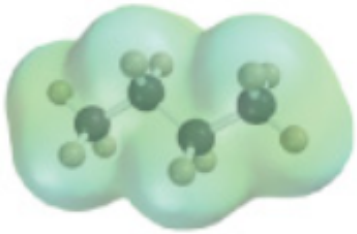
Ketones & Aldehydes

- The ketone family includes any substances that have a carbonyl group attached to two carbons.
- The aldehyde family includes any substances that a hydrogen attached to the carbonyl.



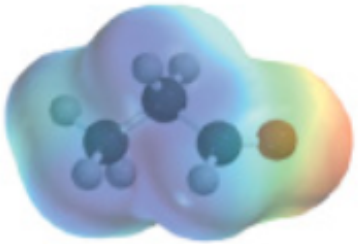






$CH_3CH_2CH_2CH_3$

Butane, bp 0°C

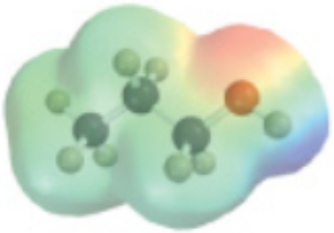


$CH_3CH_2\overset{\overset{O}{\|}}{C}H$

Propanal, bp 50°C

$CH_3\overset{\overset{O}{\|}}{C}CH_3$

Acetone, bp 56°C



$CH_3CH_2CH_2OH$

Propanol, bp 97°C

least # of IMF:

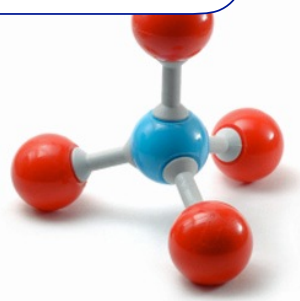
- dispersion forces

middle # of IMF:

- dispersion forces
- dipole-dipole

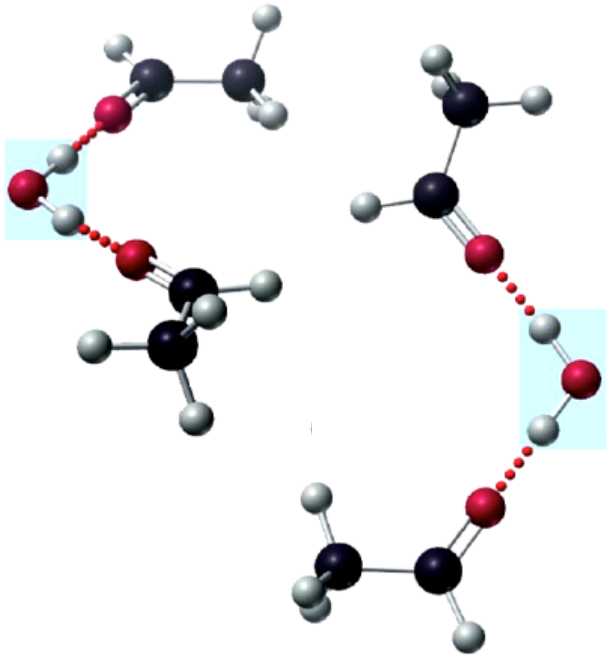
most # of IMF:

- dispersion forces
- dipole-dipole
- hydrogen bonding

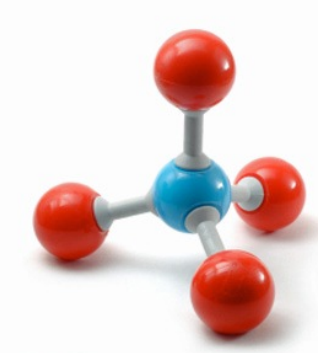


Water Solubility

- Carbonyls can't be a hydrogen donor
  (no hydrogen an oxygen, nitrogen or fluorine).
- But they can be involved in hydrogen bonding.
- And they create a substantial dipole.



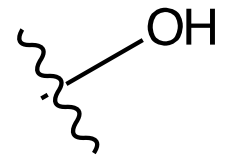
- Aldehydes and ketones have solubility in water.
  (about the same as alcohols)

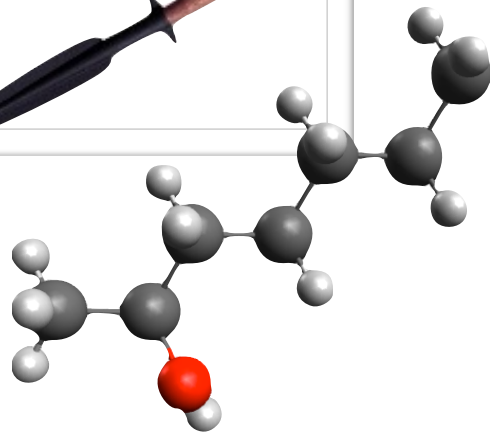


Ex02

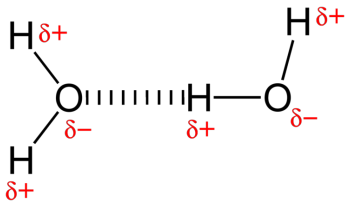
Organic Properties

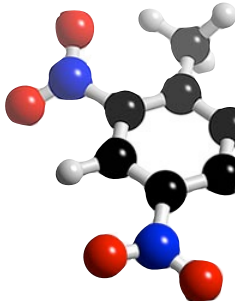
- Physical Properties
  - Alkanes
  - Alcohols (hydroxy group)
  - Aldehydes & Ketones (carbonyl)

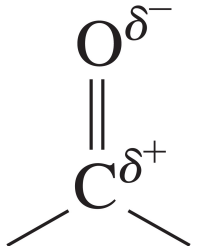


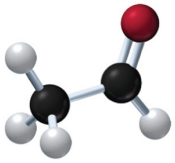


- The Experiment
  - Part A, B, C, D, and E

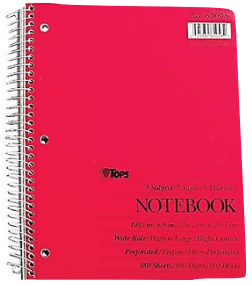


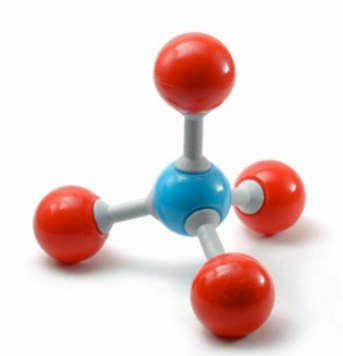






- For Next Week

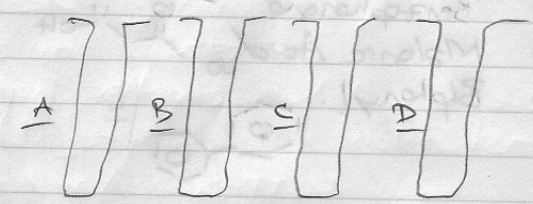




PROCEDURES

PART A – SOLUBILITY of SOLIDS

Benzophenone: ①

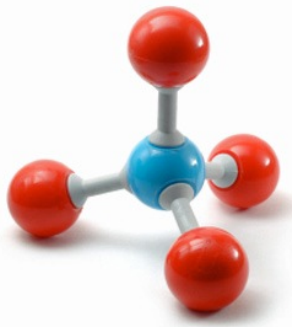


- Prepare hot water bath.
- Add 40mg (+/- 1-2mg) ① to each tube.
- For tubes A-C, one at a time
  - Add 1 mL of respective solvent (H_2O, CH_3OH, Hexane)
- twirl SOLUTION w/ curved end of spatula for 60 seconds.

Decide: it
- dissolves completely
- dissolves some
- not dissolves.

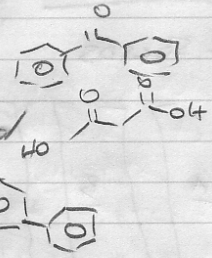
- If it does not dissolve completely,
  - let settle
  - draw off solution w/ Pipet
  - put solution in new tube,
  - Boil off soln to see if some material dissolved.

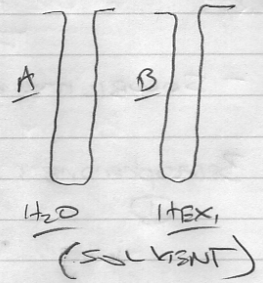
- Repeat w/ ② & ③ using same solvents.



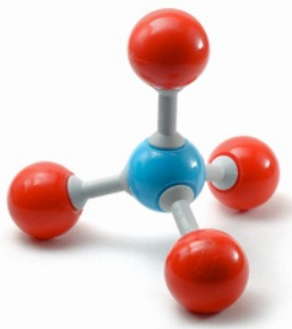
PART B

	Sample
(4)	Benzophenone
(5)	Malonic Acid
(6)	Biphenyl



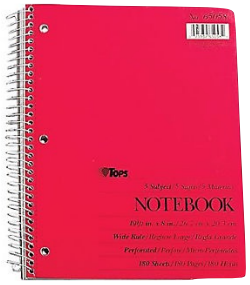


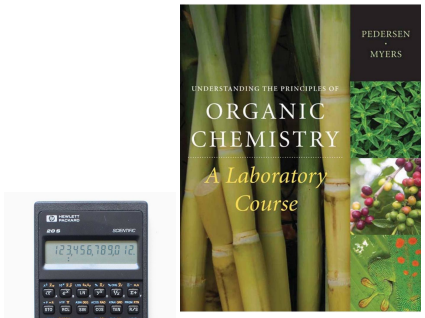
- Add 1mL of solvent (H_2O or Hex) to two test tubes.
- Add sample dropwise to solvent
  - watch liquid to see if bilayer forms
  - swirl after each drop
  - 20 drops
  - decide if mixture is
    SOLUBLE, PARTIALLY SOLUBLE,
    NOT SOLUBLE



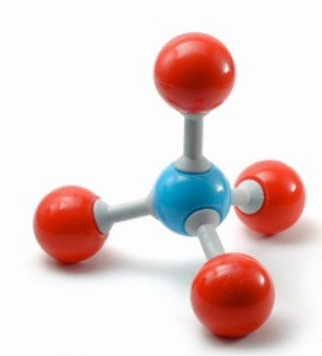
Next Meeting

- For next Meeting:
  - Bring to class:
    - Notebook
      - You will not be turning in notebooks, but this permanent record of your preparations, observations and notes will be essential to success in this class.
    - Textbook, calculator, pencils (yes, you can use pen)
    - Safety Glasses
      (you cannot participate without them)
  - Read through and take notes on:
    - Experiment 03: Crystallization
    - Technique 08: Filtration (8.3 and 8.5)
    - Technique 09: Melting Point (physical properties)
    - Technique 11: Crystallization
  - Produce and bring to class:
    - Your pre-lab for exp 03 (p273)
    - Your procedure summary for exp 03

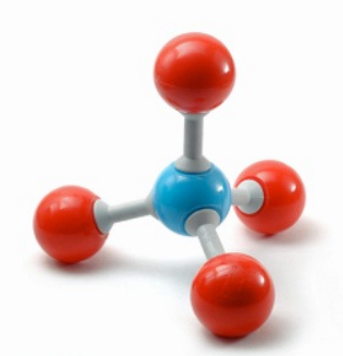


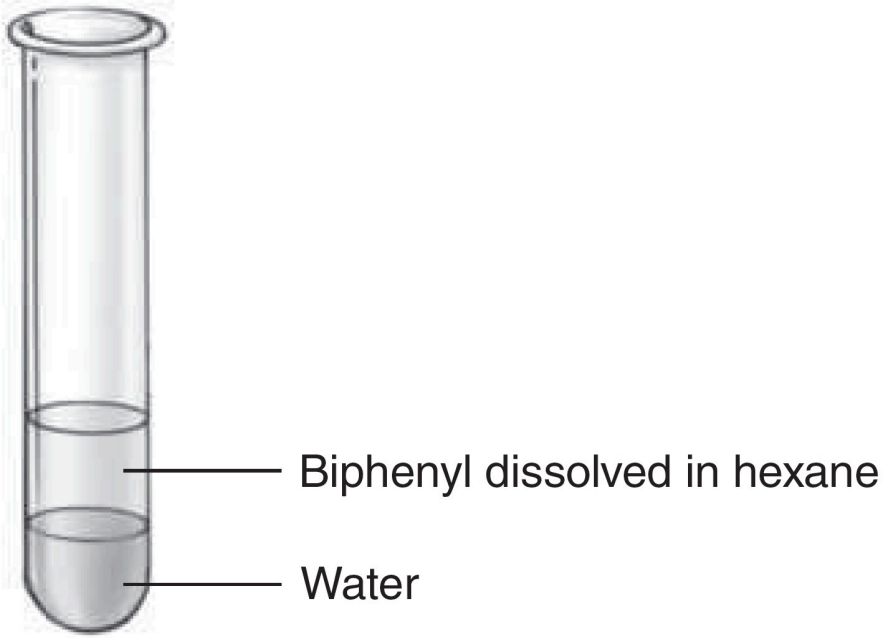


We will start with a quiz about the experiment and reading.



Questions?




Biphenyl dissolved in hexane
Water