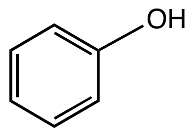
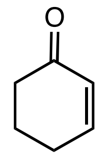
Additional Problems for practice:

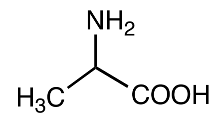
1. Locate and identify the functional groups present in these molecules:

a. 

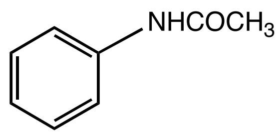

alcohol, aromatic ring

b 

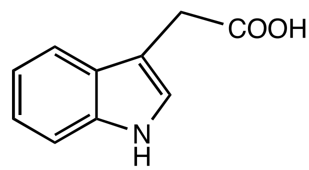

ketone,
alkene

c. 

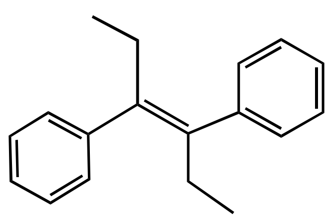

amine,
carboxylic acid

d. 


amide,
aromatic ring

e. 


amine,
carboxylic acid,
aromatic ring

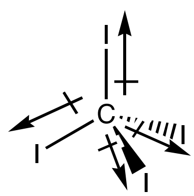
f. 

alkene, aromatic ring

2. Which of the following molecules have polar bonds? Which compounds have a net dipole moment?

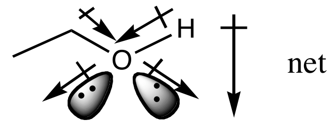
a. $CI_4$ b. $CH_3CH_2OH$ c. $H_3CCOCH_3$ d. $CH_3OCH_3$ e. $CH_3NH_2$

a



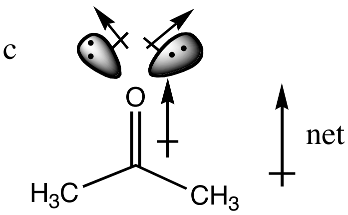
dipoles cancel

b



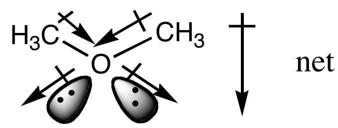

polar

c



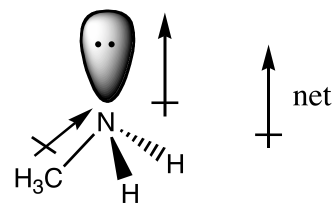

polar

d




polar

e



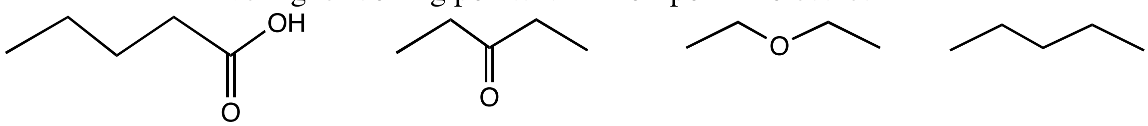

polar

3. Which solvent(s) would one use to dissolve each of the following compounds (choices: water, a polar organic solvent ($CH_3Cl$) or a non-polar organic solvent ($CH_3CH_2CH_2CH_2CH_3$)
a. NaBr water, a strongly polar solvent, is the only solvent from the above which will be able to overcome the lattice energy of NaBr with a favorable enthalpy of solvation (hydration)
b. $(CH_3)_2CHOH$ water is able to hydrogen bond with isopropanol, so water will dissolve isopropanol. Isopropanol is a polar organic solvent, and thus it will likely also dissolve in $CH_3Cl$, whereby dipole-dipole interactions will play a role in solubility
c. $CH_3CH_2OCH_2CH_3$ ether cannot hydrogen bond, so will not be soluble in water. Ether is a polar molecule and so would be expected to dissolve in $CH_3Cl$, whereby dipole-dipole interactions will play a role in solubility. Ether also has solubility in $CH_3CH_2CH_2CH_2CH_3$, a non-polar molecule, whereby London forces (induced-dipole – induced dipole) and entropy will play a role in the solubility
d. $CH_3CO_2CH_2CH_3$ ethyl acetate is an ester; like ether, it is a polar molecule and therefore can dissolve in $CH_3Cl$, whereby dipole-dipole interactions will play a role in solubility. Ethyl acetate also has some solubility in $CH_3CH_2CH_2CH_2CH_3$, a non-polar molecule, whereby London forces (induced-dipole – induced dipole) and entropy will play a large role in the solubility
e. $(CH_3)_2CHCH_2CH_2CH_3$ this alkane is a non-polar molecule and will dissolve only in the non-polar solvent $CH_3CH_2CH_2CH_2CH_3$ . Nothing is gained energetically in this dissolution, as the London forces between solvent-solvent molecules and solute-solute molecules are similar; Entropy is the major driving force for this dissolution

4. Order the following compounds according to their boiling points, from least to greatest:

a. $CH_3CH_2CH_2CH_2CH_3$, $CH_3CH_2OCH_2CH_3$, $CH_3CH_2COCH_2CH_3$, $CH_3CH_2CH_2CH_2COOH$

$CH_3CH_2CH_2CH_2COOH$> $CH_3CH_2COCH_2CH_3$> $CH_3CH_2OCH_2CH_3$> $CH_3CH_2CH_2CH_2CH_3$ note structures of molecules; hydrogen bonding is a strong IM force, leading to higher boiling points. Polar molecules will also have higher boiling points than non-polar molecules

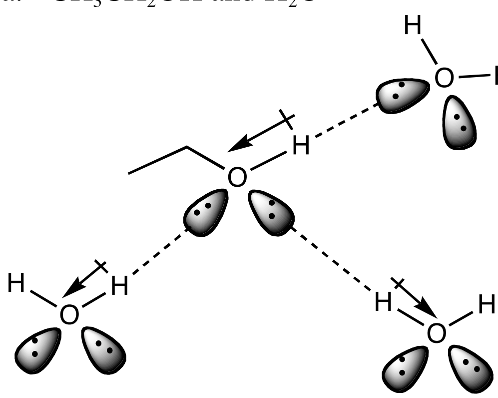



b. $CH_3CH_2CH_2CH_2CH_3$, $(CH_3)_2CH_2CH_2CH_3$, $CH_3C(CH_3)_2CH_3$ Molecules with more surface area will have more opportunity for London forces, thus the straight-chain alkanes usually boil at higher temperatures than the branched alkanes

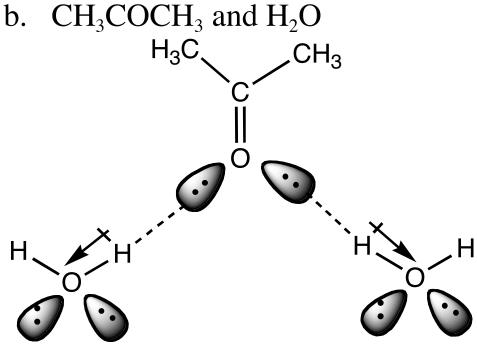
$CH_3CH_2CH_2CH_2CH_3$> $(CH_3)_2CH_2CH_2CH_3$> $CH_3C(CH_3)_2CH_3$

5. Draw a picture illustrating why each of the following pairs are miscible (soluble in each other)

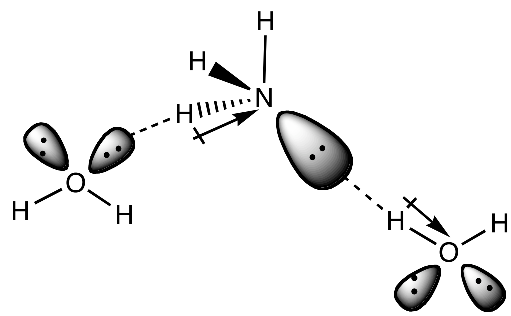
a. $CH_3CH_2OH$ and $H_2O$




b. $CH_3COCH_3$ and $H_2O$




c. $NH_3$ and $CH_3OH$




d. $CCl_4$ and $CH_3CH_2CH_2CH_2CH_3$