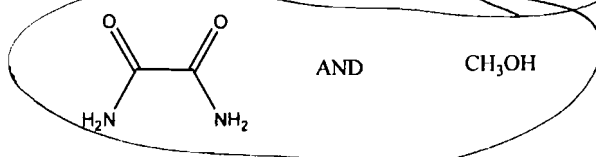
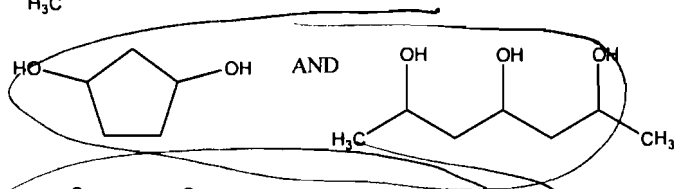
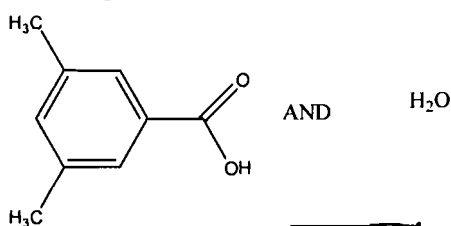
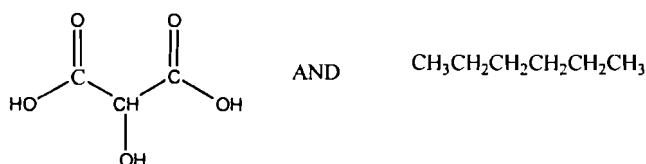
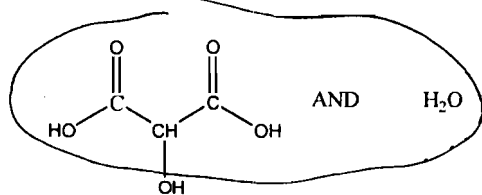


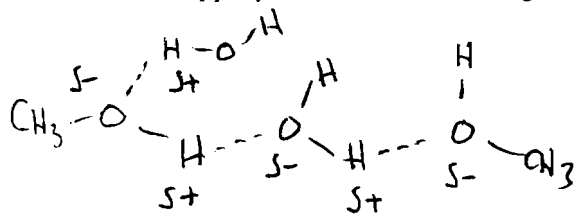
Key

CHEM 238 sample EXAM #1

1. (15 pts) Circle the pairs of compounds below that would be miscible (soluble) with each other.



2. (6 pts) Water and methanol ( $CH_3OH$ ) are miscible solvents. Draw the hydrogen bonding interaction that would occur when these two solvents are mixed together. Be sure to draw in the appropriate  $\delta +$  and  $\delta -$  charges on the appropriate atoms.



3. (4 pts) 50 mg of sulfanilamide is dissolved into 15 mL of water. Which, sulfanilamide or water, is considered the solute?

Sulfanilamide is the solute.

4. Using the solubility data for the solubility of biphenyl in the solvent methanol is shown below. Using this data calculate questions a and b below.

Temp	Solubility (g/mL)
60 °C	0.5 g/ml
50 °C	0.4 g/mL
40 °C	0.3 g/mL
30 °C	0.2 g/mL
20 °C	0.1 g/mL
10 °C	0.04 g/mL

a. (5 pts) How much methanol would be required to dissolve 1.5 g of biphenyl. At 60 °C.

$$1.5 \text{ g} \left( \frac{1 \text{ mL}}{0.5 \text{ g}} \right) = 3 \text{ mL}$$

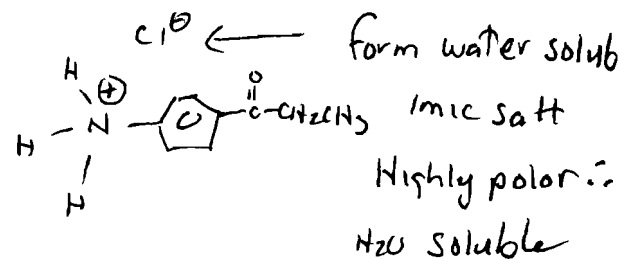
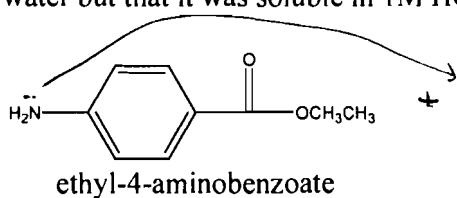
b. (5 pts) How much biphenyl would remain in solution if it were cooled to 20 °C?

$$3 \text{ mL} \left( \frac{0.1 \text{ g}}{1 \text{ mL}} \right) = 0.3 \text{ g}$$

5. (5 pts) Why is it important to cool the solution **slowly** during crystallization?

To avoid the rapid formation of the crystals - rapid formation would lead to impurities being trapped in the crystal lattice.

6. (6 pts) In the solubility lab, explain why ethyl 4-aminobenzoate was not soluble in water but that it was soluble in 1M HCl?



Normally too non-polar (due to aromatic ring) to be soluble in water but --- add 1M HCl

7. Shown below are two graphs showing solubility vs temperature. The upper graph is the solubility of m-toluic acid in 3 solvents; methylene chloride, acetone and ethanol. The bottom graph shows the solubility behavior of benzophenone in methylene chloride, acetone and ethanol. Use these graphs to answer a, b and c.

a) (4 pts) List the solvent(s) that you could use to recrystallize m-toluic acid.

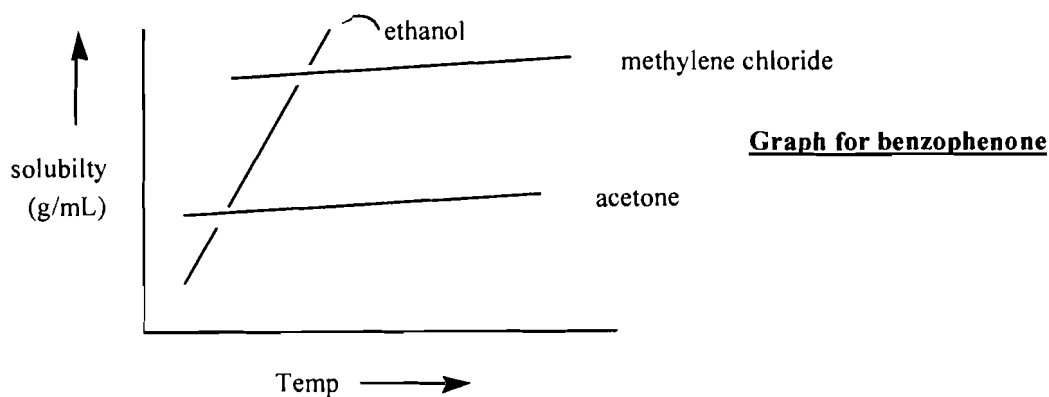
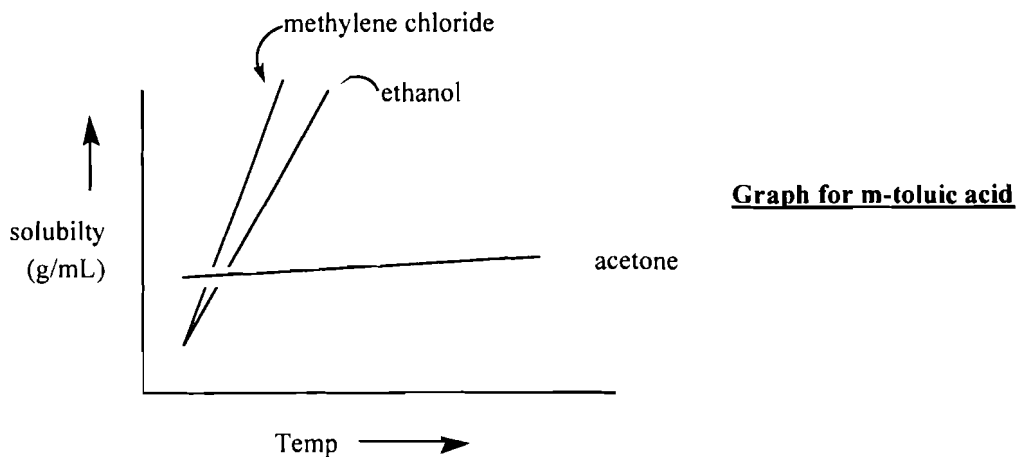
*methylene chloride and ethanol - steep graph means Soluble Hot/insoluble cold.*

b) (4 pts) For Benzophenone, for which solvent could you say that it was "soluble hot and insoluble cold"?

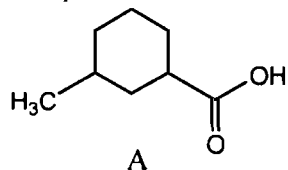
*ethanol*

c) (4 pts) For Benzophenone, for which solvent could you say that it was "insoluble hot and soluble cold"?

*acetone.*



For question 8 a-d, refer to compound A shown below.

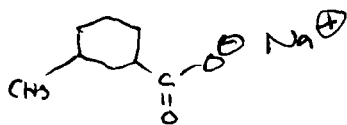


8. You dissolve 0.25 grams of A in 2 mL of methylene chloride ( $\text{CH}_2\text{Cl}_2$ ). You add 5 mL of 1 M NaOH and shake. You let the layers separate and you evaporate the methylene chloride layer and you find it contains 0.05 g of A.

a. (6 pts) What is the distribution coefficient (K) for A between methylene chloride and 1M NaOH. Assume that the methylene chloride solubility term will be in the denominator (bottom).

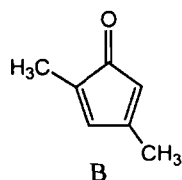
$$\frac{0.2 \text{ g}}{0.05 \text{ g}} = (4) = K$$

b. (5 pts) Draw the chemical structure of the compound that is dissolved in 1 M NaOH.



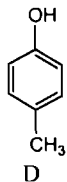
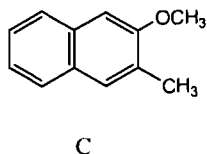
c. (4 pts) Would you predict that the distribution coefficient (K) for A between methylene chloride and water would be smaller, larger or the same as compared with your answer in 8a? (for A between methylene chloride and 1M NaOH.) *-smaller - A not as soluble in water - not ionic*

d. (3 pts) Comparing K values of compound B, (shown below) with compound A: Do you think that compound B would have a larger, smaller or the same distribution coefficient (K) as compound A in question 8 a? (Methylene chloride solubility term is in the denominator).



*Smaller - would be more soluble in  $\text{CH}_2\text{Cl}_2$  than 1M NaOH  
not an acid  $\therefore$  not soluble in 1M NaOH*

9. (4 pts) Which compound, C or D, would have the largest distribution coefficient (K) between methanol and hexane? (the methanol solubility term is in the denominator).



*(C) more non-polar  $\therefore$  more soluble in Hexane  $\therefore$  larger K*