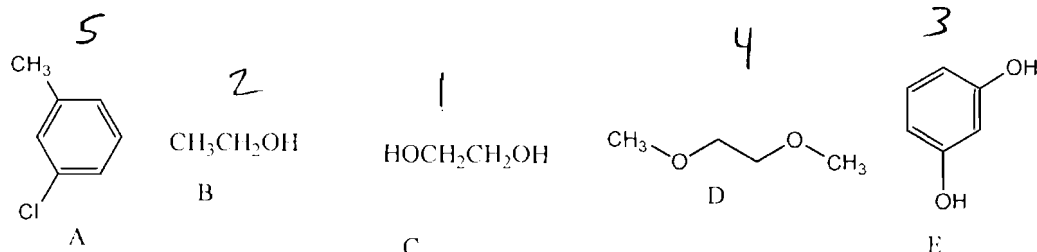


1. (8 pts) Rank the compounds (A-E) below in order of solubility/miscibility **in water** (1=most soluble 5=least soluble)



2. (4 pts) 25 mL of water is mixed with 2 mL of Acetone. Which, acetone or water is considered the **solvent**?

water

3. Using the solubility data for the solubility of sulfanilamide in the solvent ethanol (boiling point 78 °C) is shown below. Using this data calculate questions a and below.

Temp	Solubility (g/mL)
78 °C	.25 g/mL
60 °C	.20 g/mL
50 °C	.15 g/mL
40 °C	.11 g/mL
30 °C	0.8 g/mL
20 °C	0.04 g/mL
10 °C	0.03 g/mL
0 °C	0.01 g/mL

a. (5 pts) How much boiling ethanol (78 °C) would be required to dissolve 5 g of Sulfanilamide?

$$5g \left( \frac{1 \text{ mL}}{0.25g} \right) = 20 \text{ mL}$$

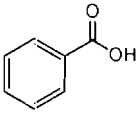
b. (5 pts) Using the amount of boiling ethanol used in a) above, how much sulfanilamide would crystallize if you cooled the solution to 0 °C?

$$20(0.01g) = 0.2g \text{ remains in solution}$$

$$5g - 0.2g = 4.8g \text{ crystallized}$$

c. (4 pts) How many grams of sulfanilamide could you recrystallized with 8 mL of ethanol?

$$8 \text{ mL} \left( \frac{0.25 \text{ mL}}{1 \text{ mL}} \right) = 2g$$

4. (6 pts) Circle the solvent(s) that Benzoic acid(  ) would be soluble in:

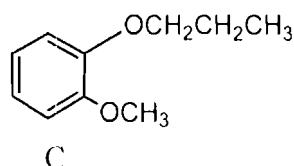
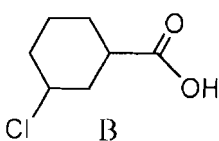
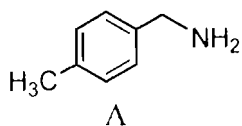
Water

diethyl ether (ether)

2M NaOH,

3M HCl

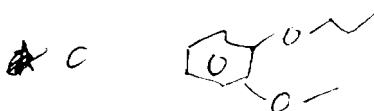
5. You have the mixture of A, B and C dissolved in ether and carry out an extraction.



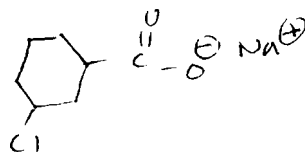
You first add 1 M NaOH to the ether layer shake, let the layers separate and remove the 1M NaOH from the ether layer. You then add 1M HCl to the ether layer, shake, let the layers separate and remove the 1M HCl layer.

Once this extraction is complete draw the chemical structures that are in the ether, 1M NaOH and 1M HCl layers. Be sure to draw the chemical structures that are in each layer—not just the letter that refers to the structure.

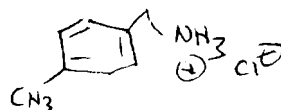
a) (3 pts) Ether layer:



b) (4 pts) 1M NaOH layer



c) (4pts) 1M HCl layer



d) (4 pts) If you wanted to precipitate out the compound in the 1M NaOH layer what would you do? Add 6M HCl → reform B and with ppt

6. (4 pts) What will be the consequence(s) of recrystallizing a compound in water but adding water at 60 °C instead of boiling (100 °C). (Assume all other parts of the procedure are done correctly) Circle all that apply:

- a) The product would be impure.
- b) Low % recovery — too much solvent added at 60°.
- c) Will cool down too quickly causing bad crystal formation.
- d) Impurities may co-crystallize
- e) The crystals may contain an unpleasant odor.
- f) There will be no consequence in doing it this way.

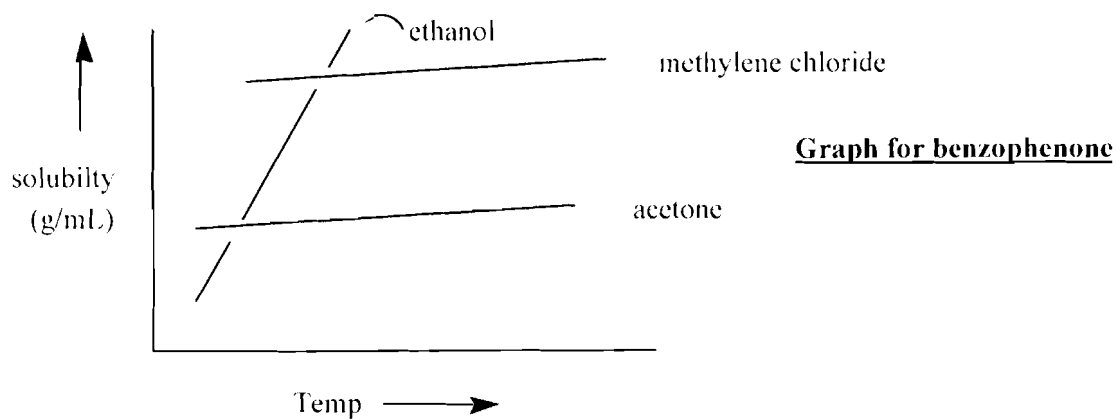
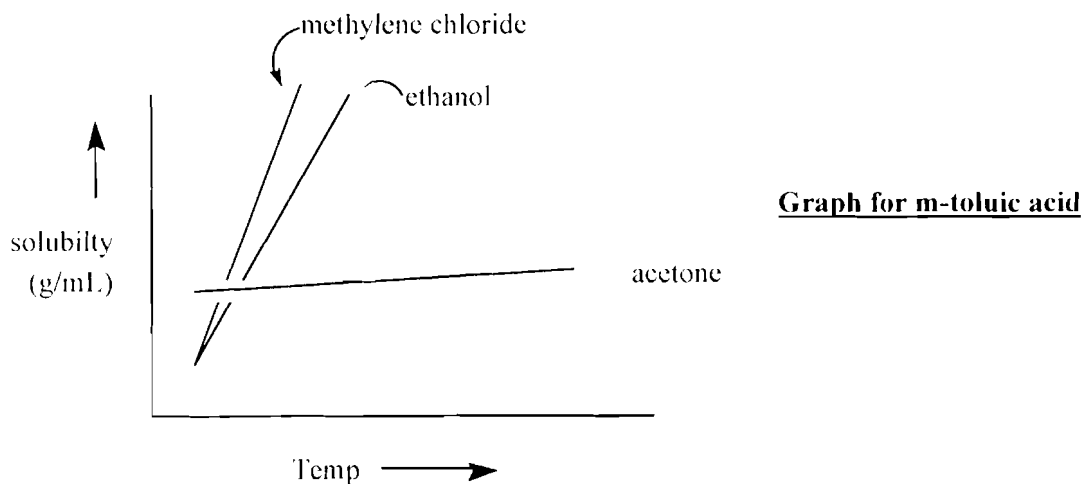
7. Shown below are two graphs showing solubility vs temperature. The upper graph is the solubility of m-toluic acid in 3 solvents; methylene chloride, acetone and ethanol. The bottom graph shows the solubility behavior of benzophenone in methylene chloride, acetone and ethanol. Use these graphs to answer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

a) (5 pts) List the solvent(s) that you could use to recrystallize both Toluic acid and Benzophenone.

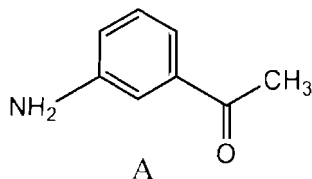
Ethanol

b) (3 pts) For Benzophenone for which solvent(s) could you say that it was "insoluble hot and insoluble cold"?

Acetone

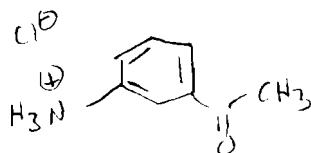


For question 8 a-c, refer to compound A shown below.



8. You dissolve 0.5 grams of A in 2 mL of methylene chloride ( $\text{CH}_2\text{Cl}_2$ ). You add 2 mL of 1 M HCl 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) (4 pts) Draw the structure of the compound that is dissolved in the 1 M HCl layer.



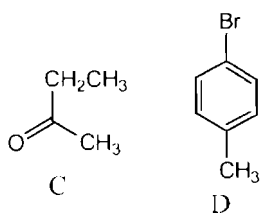
b) (4 pts) If this mixture was extracted with water instead of 1M HCl, how much of A would you find in the methylene chloride layer: (circle one of the 3 answers)

1) less than 0.05 g, 2) 0.05g or 3) more than 0.05 g.

c) (4 pts) If this mixture was extracted with 1M NaOH instead of 1M HCl, how much of A would you find in the methylene chloride layer: (circle one of the 3 answers)

1) less than 0.05 g, 2) 0.05g or 3) more than 0.05 g.

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



(C) — more polar → more in H<sub>2</sub>O layer — larger value

10. (5 pts) A faulty recrystallization procedure is given below in which there is one procedural error. Point out this error and explain what is wrong with it. Also make the appropriate correction to the procedure.

Propanol, heated to boiling, is slowly added to an impure sample of toluic acid until all of the solid just dissolves. The solution is then slowly cooled to 25 C. The solvent is then removed by centrifugation. The boiling point of propanol is 97° C and the melting point of toluic acid is 110° C.

cool to 0°C — get more crystals

Extra Credit: (2 pts)

Interpret the following Narudin Story:

A Neighbor asked Nasrudin how old he was.

'40' said Nasrudin

'But you said the same last time I asked you two years ago'

'Yes, I always stand by what I have said'

You are as ~~young~~ young as you feel!

or.

what is eternal/timeless?