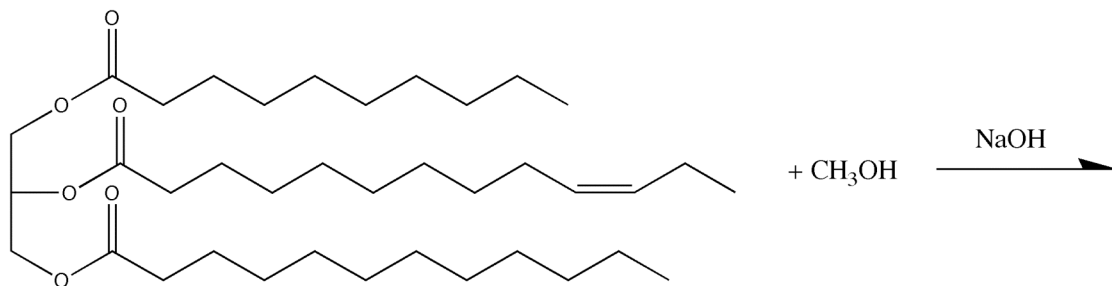


**Sample exam 2 (biodiesel, distillation, chromatography, separation scheme)**

*Closed textbook, reference books; open lab notebooks, class handouts; no collaboration. Answer all questions; there are 50 points possible. You have one hour to complete the exam, after which you may **quietly** (as long as other students are taking the test) inventory your drawer.*

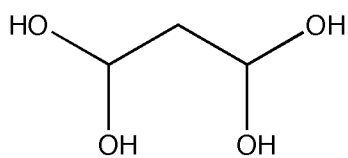
1. a. (6 points) For the triglyceride shown below, write **all** biodiesel products that are possible.



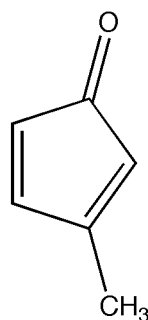
b. (2 points) A student notices that, instead of separating into two layers, the reaction mixture has a large semi-solid white lump floating in the solution. What is the most likely identity of that lump? (You do not have to give the chemical name, just a generic name)

c. (2 points) What deviation from the procedure most likely caused that lump to form?

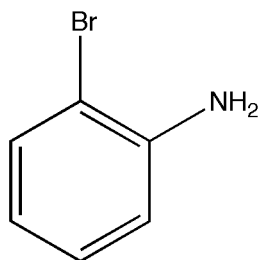
Consider the following compounds:



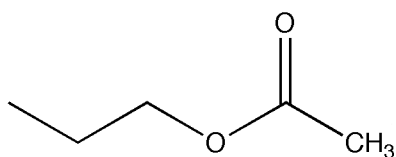
A



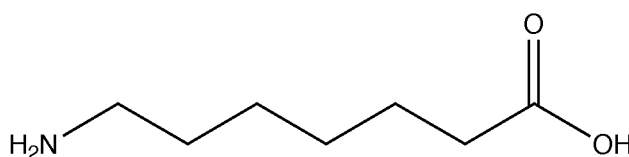
B



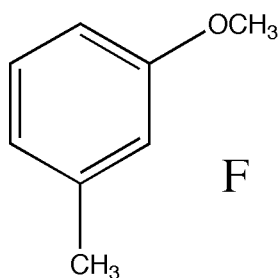
C



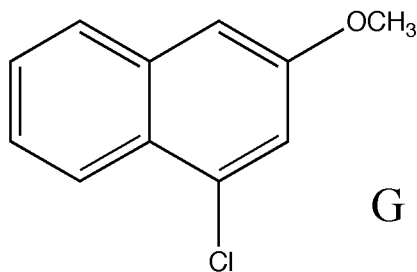
D



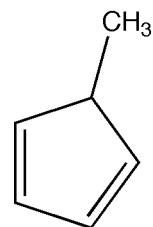
E



F



G



H

2. (2 points) Which compound (write the letter) would be *most* soluble in water? (Only one choice)

3. (2 points) Which compound (write the letter) is the *most* non-polar? (Only one choice)

4. (3 points) Which compound(s) (write the letter(s)) would be insoluble in water but soluble in 1 M HCl?

5. (3 points) For the compound(s) in question 4, draw the **chemical structure** of the soluble version of the compound(s).

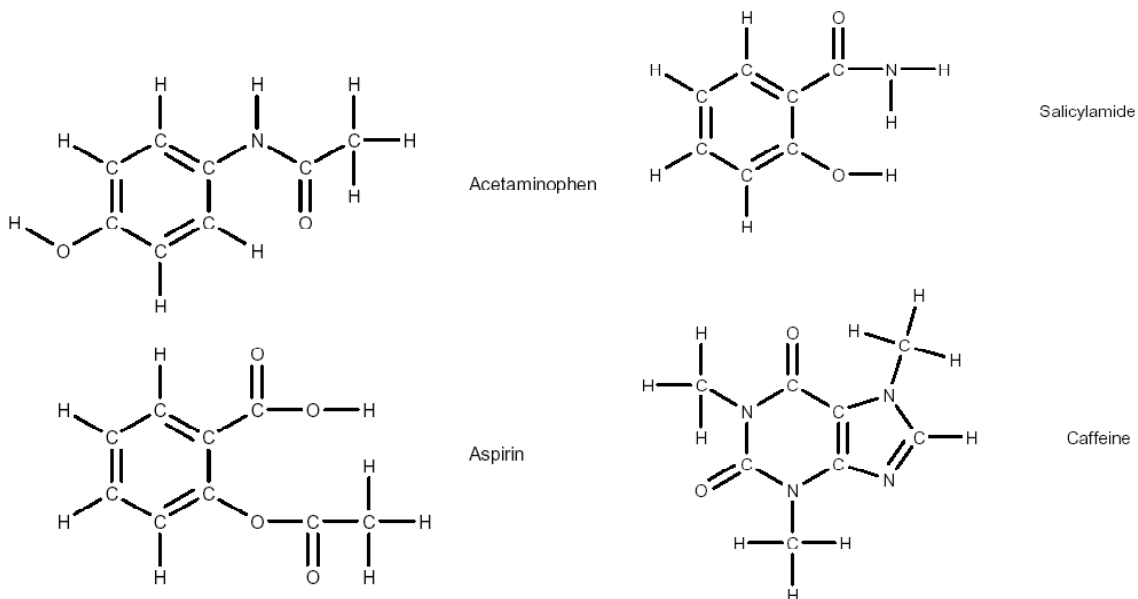
6. A mixture contains **two** of the following: hexane (b.p.  $69^{\circ}\text{C}$ ), benzene (b.p.  $80^{\circ}\text{C}$ ), 2-butanol (b.p.  $99^{\circ}\text{C}$ ) and toluene (b.p.  $110^{\circ}\text{C}$ ).

a. (4 points) Which two compounds should the mixture be made of, in order to get the best possible separation between the two using distillation techniques? Explain your choices.

b. (4 points) Set up a graph of volume (mL) (x-axis) versus temperature ( $^{\circ}\text{C}$ ) (y-axis) for a **fractional distillation** of the mixture in question 6a. Note the boiling points when setting up the y-axis labels. Assume 5 mL of each compound in the mixture.

c. (4 points) So you run the fractional distillation you set up in question 6b and collect a few drops of distillate at 6 mL total distillate. Draw the output of the **gas chromatograph (GC)** run done on this sample. Use big peaks to indicate "more" and little peaks to indicate "less", and place time along the x-axis.

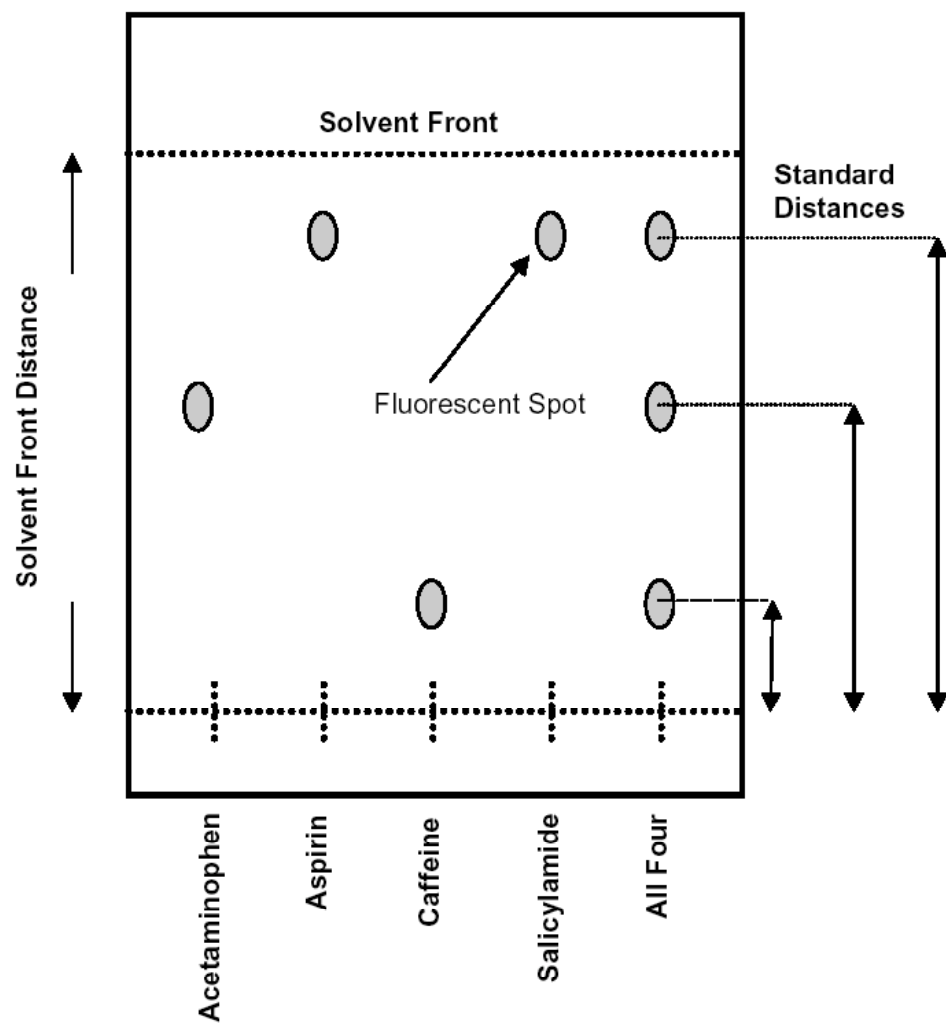
7. The following four substances (all analgesics) are run on a **silica TLC plate** using ethyl acetate with 0.5% glacial acetic acid as a developing solvent. The results of the TLC plate after development are shown on the next page.



a. (2 points) Order the analgesics, from lowest  $R_f$  to highest  $R_f$ . You may use equals signs.

b. (3 points) Using polarity arguments, and understanding the nature of the stationary and mobile phases, explain why aspirin will be found higher up the plate than caffeine.

c. (3 points) As solvents go, ethyl acetate is of intermediate polarity. Why wasn't a more traditional non-polar solvent like hexane used? **Sketch** what a TLC plate, with the same spots as the plate on the next page, might look like using hexane as the developing solvent.



8. (10 points) Draw a **flow chart** to show how to separate the following three compounds from each other. Give enough information so that someone could do it – include stuff like “organic layer”, “aqueous layer”, “anhydrous sodium sulfate” and the names of solvents used, as well as techniques like “extraction” or “crystallization”.

