Baltic Chemistry Competition

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2011
3RD ROUND, PROBLEMS

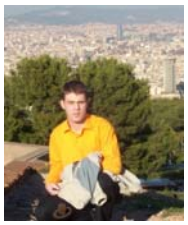
Solve all or some of the problems given on the next pages and write your full solutions in *MS Word, Excel*documents or *.pdf files. It is also acceptable if you scan your material and insert as picture in mentioned file formats.

If there are some explanations required, write them in English.Please, send your answers to:kimijas_olimpiades@inbox.lv**till 28.02.2011. at24:00** (Latvian time; UTC+2). Answers sent after this deadlinewill not be graded.

File name must consist from your name, last name(in English) and country, for example,*John_Black_England.doc* (or *.docx etc.). If you do not name the file as described you will receive 3 point penalty. For all the correctly solved problems you can get the maximum of 30 points. The exact amount of points for each task is given at the top of each problem.

All the students who will be taking part in at least one round may participate in the final round, which will be held on the web on **20.03.2011**. During the final round you will have to solve the multiple-choice test. More information can be foundin BCC regulations.

Competition organizers and problem authors:



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Good luck with problem solving! ☺

If you have any questions, you can address them to us in English by sending them to: kimijas_olimpiades@inbox.lv
Feel free to ask!

Problem 1 (Latvia)

Acetic acid and trichloroacetic acid (5 points)

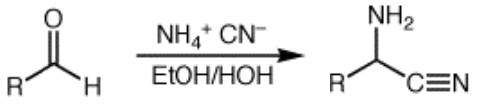
Acidity can be described with following constants pK_a = 4.75 for acetic acid and pK_a = 0.70 for trichloroacetic acid.

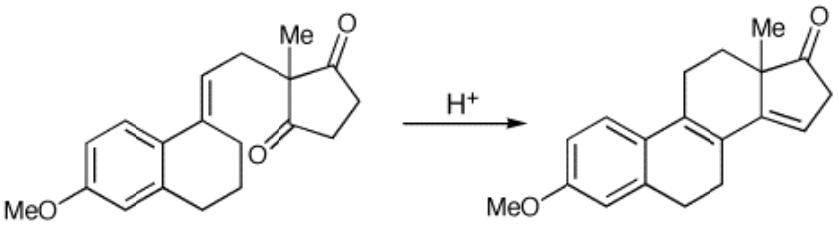
1. *Explain such adifferencein pKa's of these two acids.*
2. *Calculate the pH of 0.17 M acetic acid aqueous solution.*
3. *Calculate the pH of 0.15 M sodium acetate solution. Do Na^+ ions have any contribution to the resulting pH value?*
4. *Small amount of sodium acetate was dissolved in 2 L of distilled water. Measured pH was 7.8. How manygrams of sodium acetate were dissolved?*
5. *How manygrams of sodium trichloroacetate theoretically would be necessary to maintain pH of 7.8 in 2 L of distilled water? Can it be done practically? Can sodium trifluoroacetatebe usedinsteadto maintain pH of 7.8 in 2 L of distilled water?*

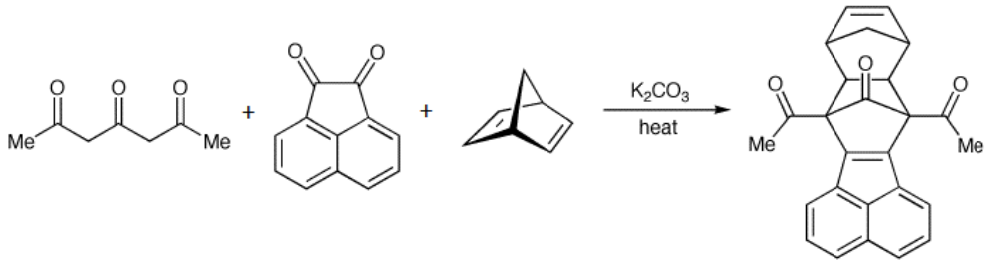
Problem 2 (Estonia)

Some organic mechanisms(8 points)

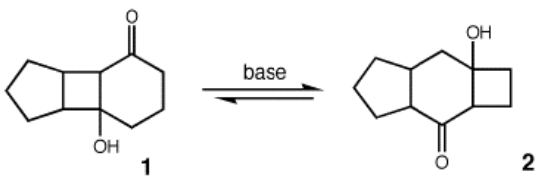
Drawplausible mechanisms for the following reactions:







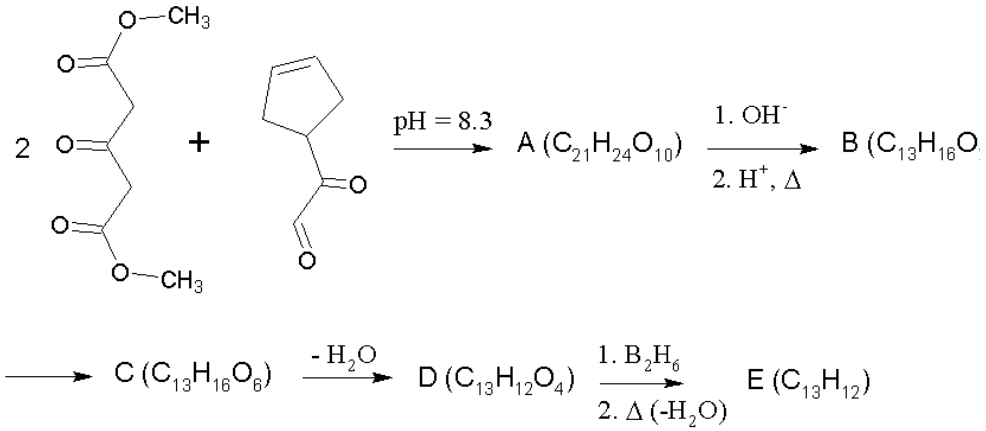
Ketones **1** and **2** are readily interconverted upon treatment with base. Write mechanism, which explains following transformation.



Problem 3 (Estonia)

Quite symmetric product(8 points)

Compounds **A**-**C**possess a mirror symmetry while substances **D** and **E** are even more symmetrical.



Write the structures of compounds **A**-**E**.

Problem 4 (Lithuania)

Chanel №5(9 points)

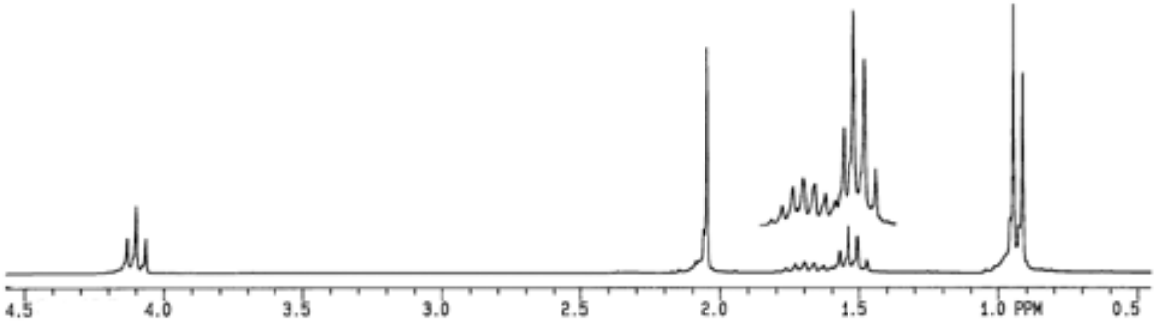
In 1937the theory was proposed that explainedhow the smell is sensed by the nosethat reacts to vibrations of different frequencies, just like our eyes or ears do.

1) *How does the nose react to different vibration frequencies and how is it able to identify so many different fragrances?*

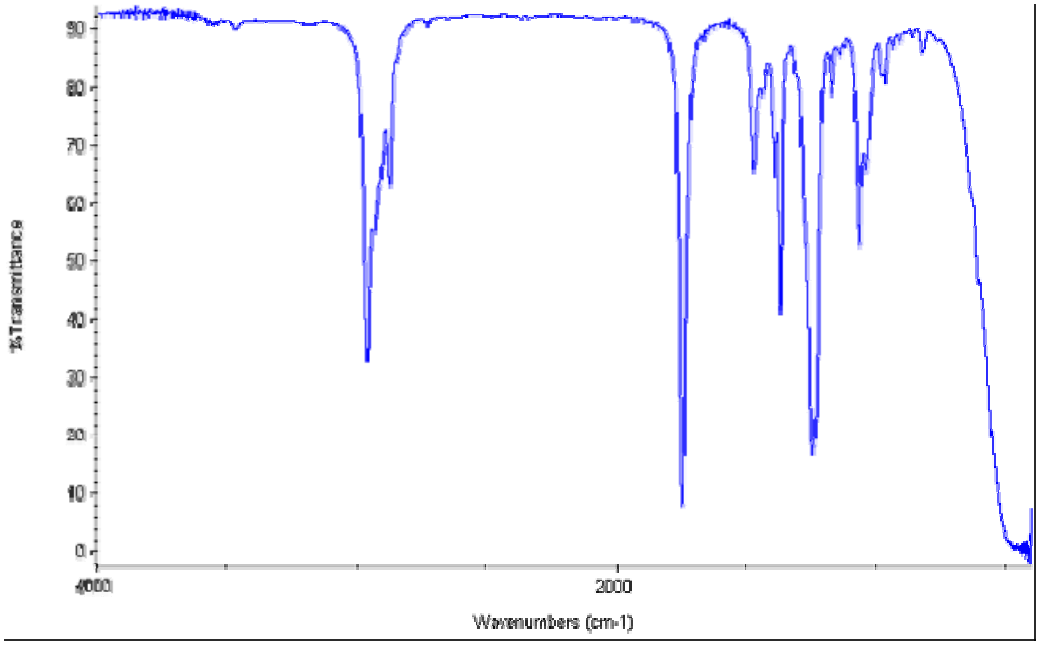
Since you already know how materials create the sense of smell,

2) Why some volatile substances do not have smell?

This theory makes perfumers'work quite easy. Once the mechanism is understood, any fragrance and smell can be producedsynthetically withsuch accuracythat human nose is unable to distinguishoriginal smell from an artificial one. Now,trytobea perfumer.



3) Identify the compound**A** from the given spectra. Offer three more compounds that would have essentially the same smell as the given. Provide the scheme for the synthesis of this compound using alkanes as starting materials.

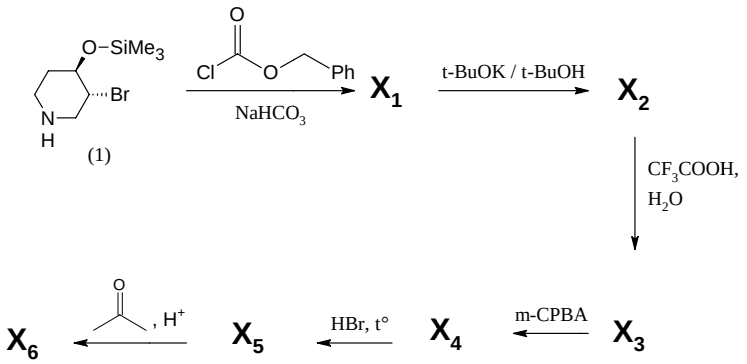


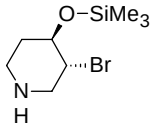
Even if this sounds very simple, it gets more complicated when creating perfumes. Perfumesusually have complex smells with different nuancesand strength. Thus, to make a good perfume, one must take into account the strengthof smell.

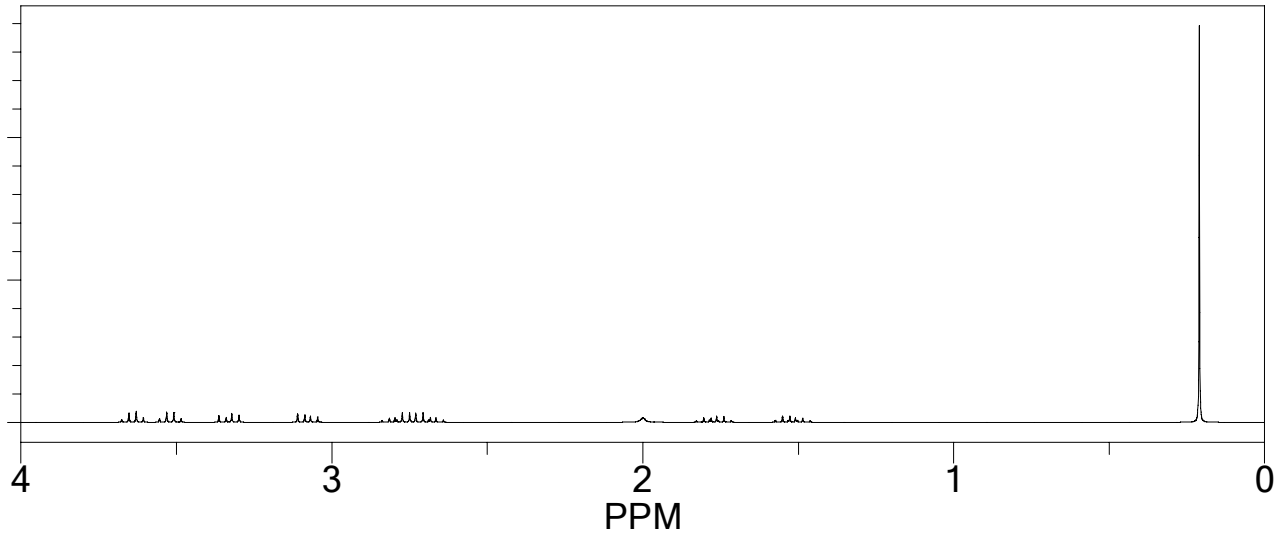
4) Why particular molecules (for example, vanillin, indole, thiols, etc.) have a strong smell while other do not?

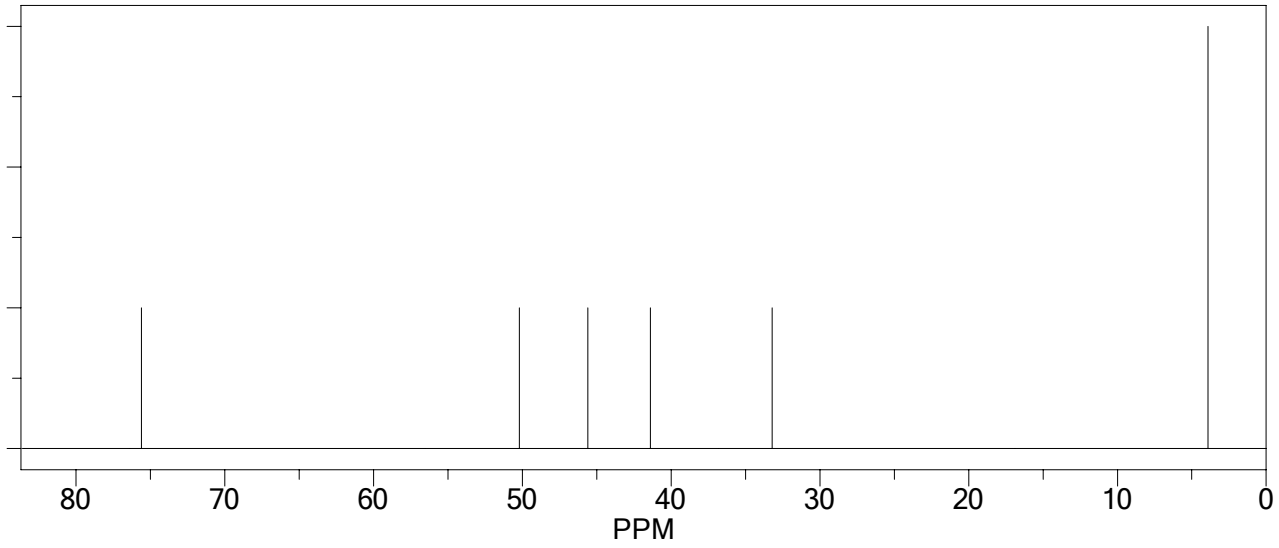
Unfortunately, our nose is not the best tool foridentifying unknown materials, which we make in laboratory, thus, we need to be able to use other, greater tools,for exampleH-NMR and C-NMR. These techniques make it possible to identify many organic structures. Therefore, it is crucial that every chemist knows how to use this powerful tool.

5) You are given the starting material, a chain of reactions, and spectra of every intermediate product. Identify X's and assign spectra.

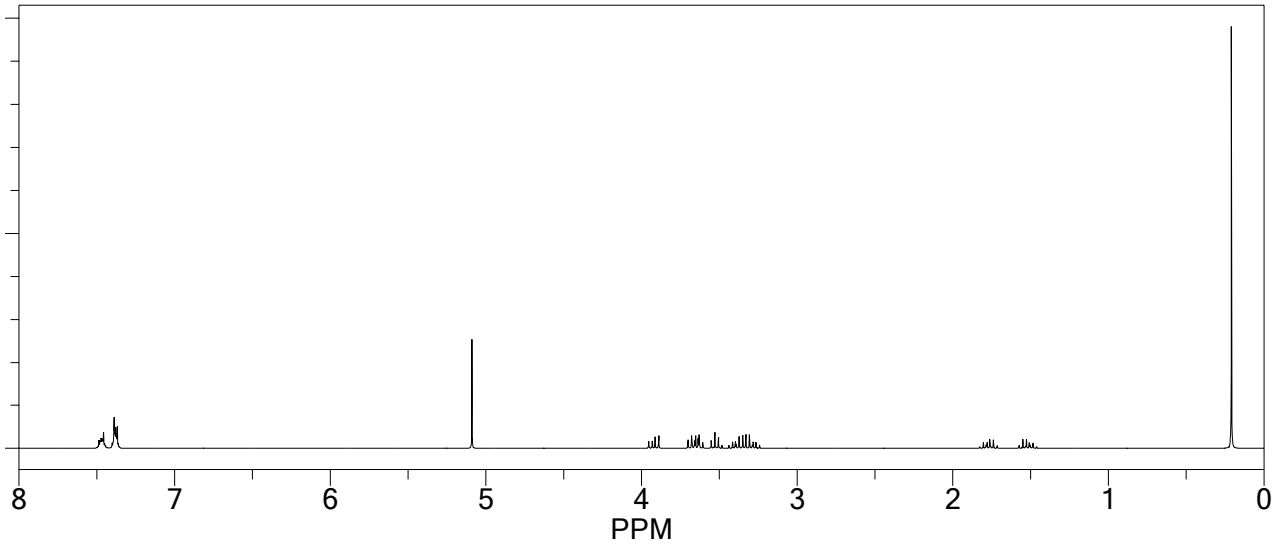


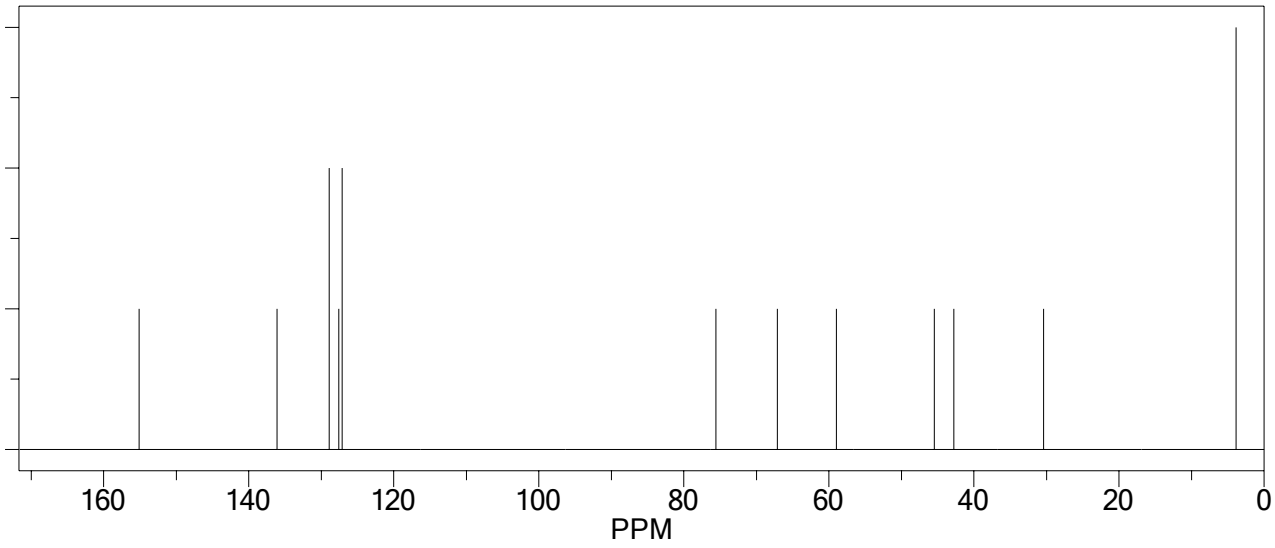

O–SiMe3
Br
N
H


4
3
2
1
0
PPM

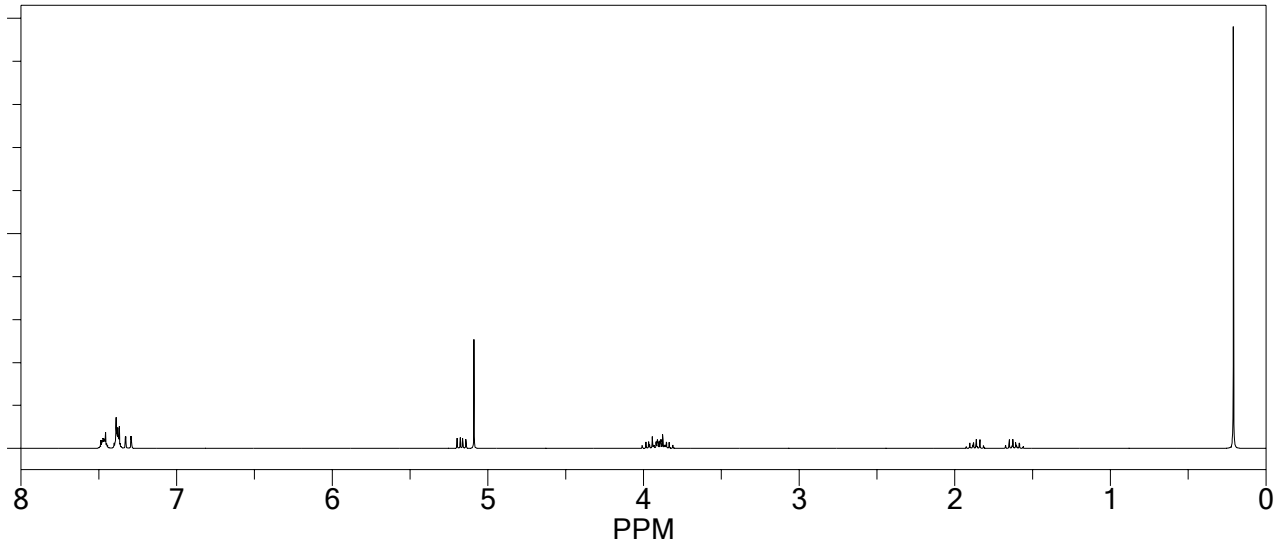

80
70
60
50
40
30
20
10
0
PPM

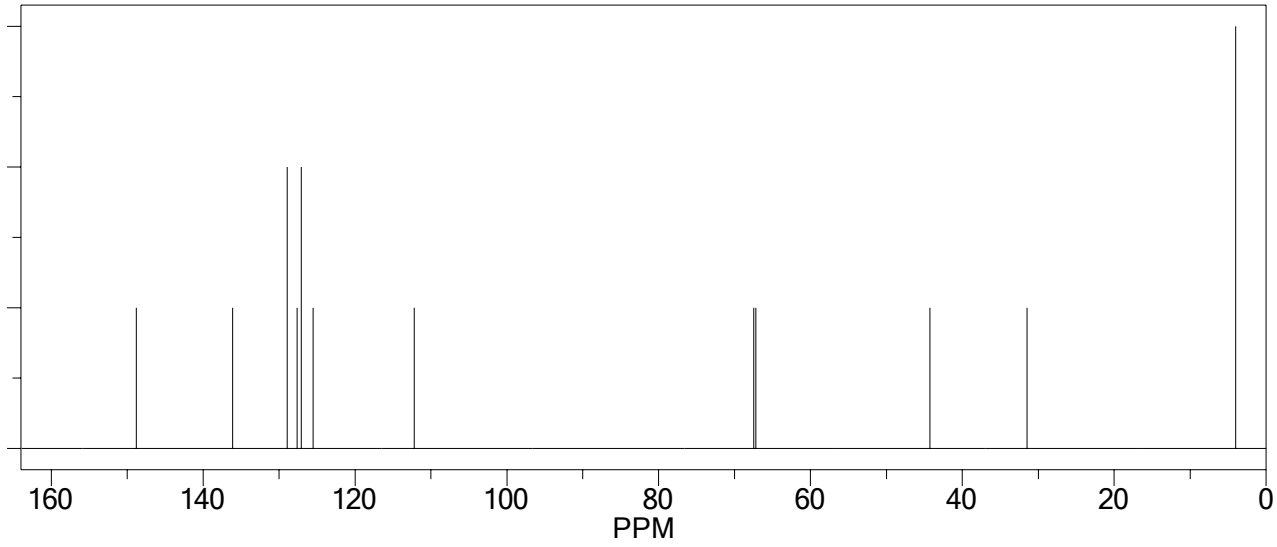
X_1



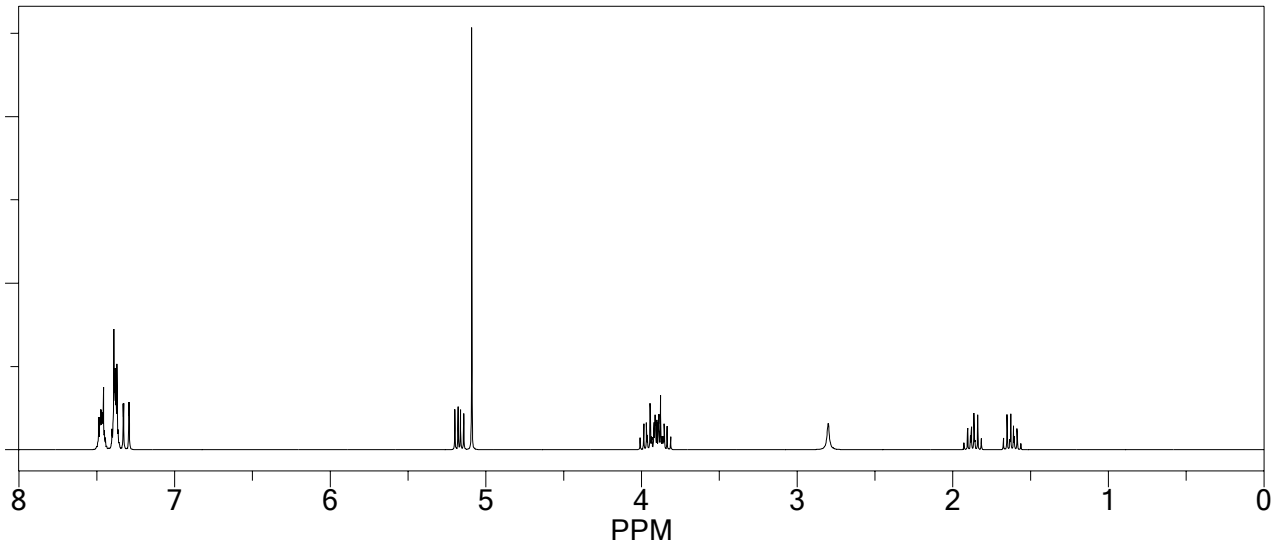


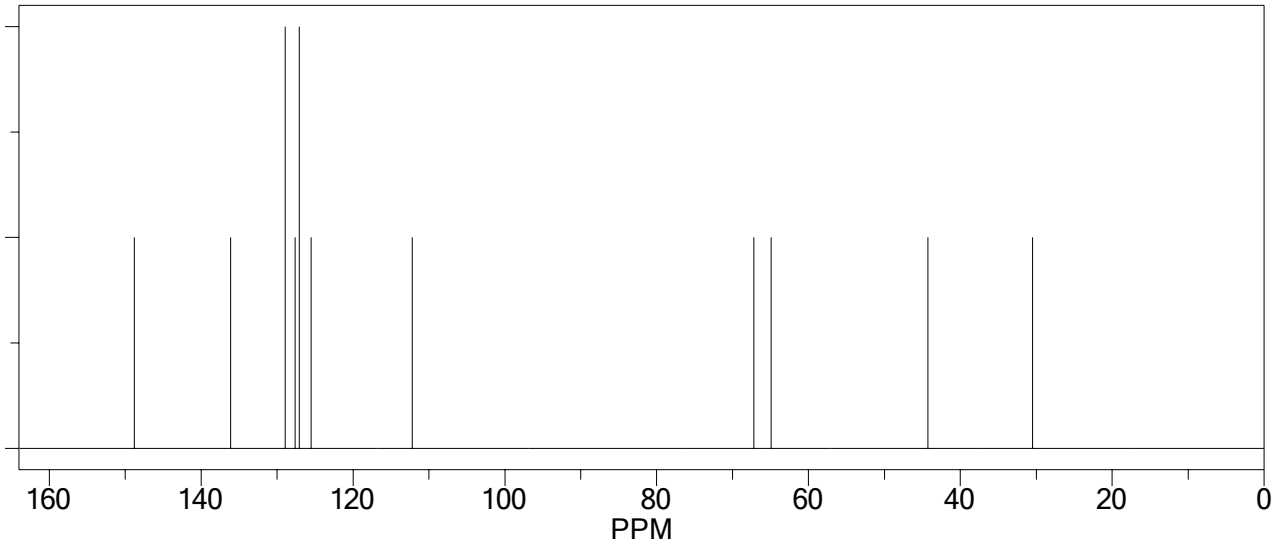
X_2



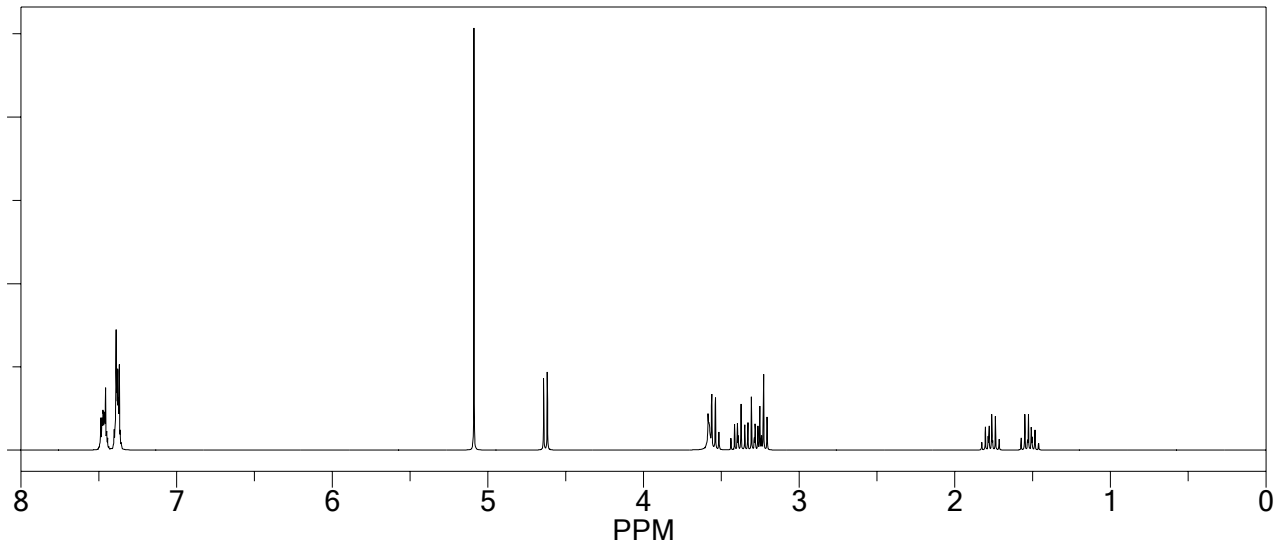


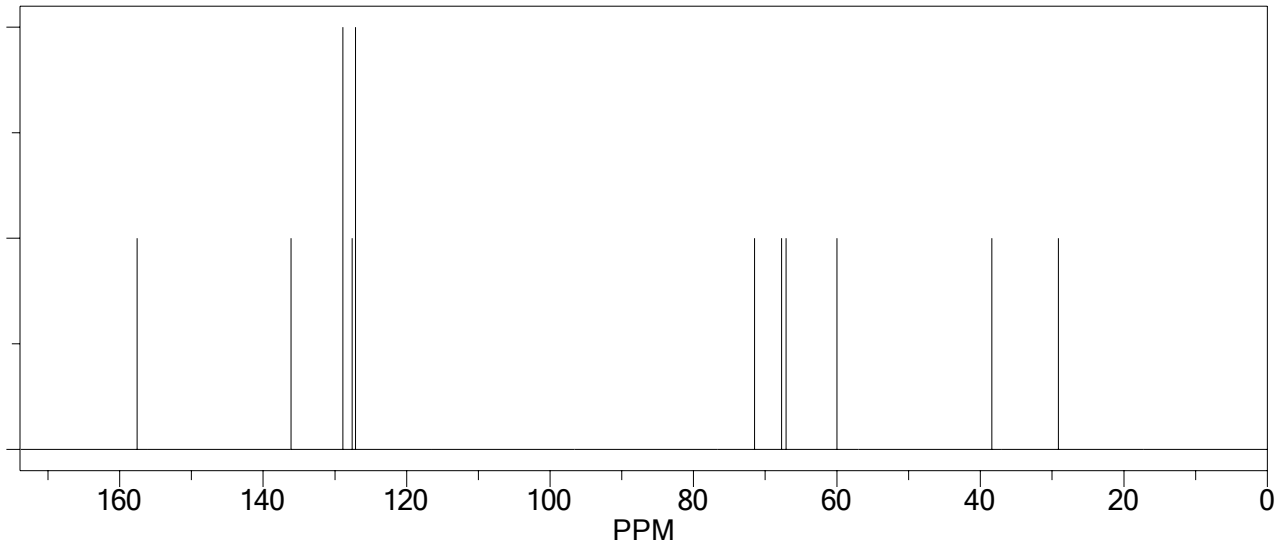
X_3



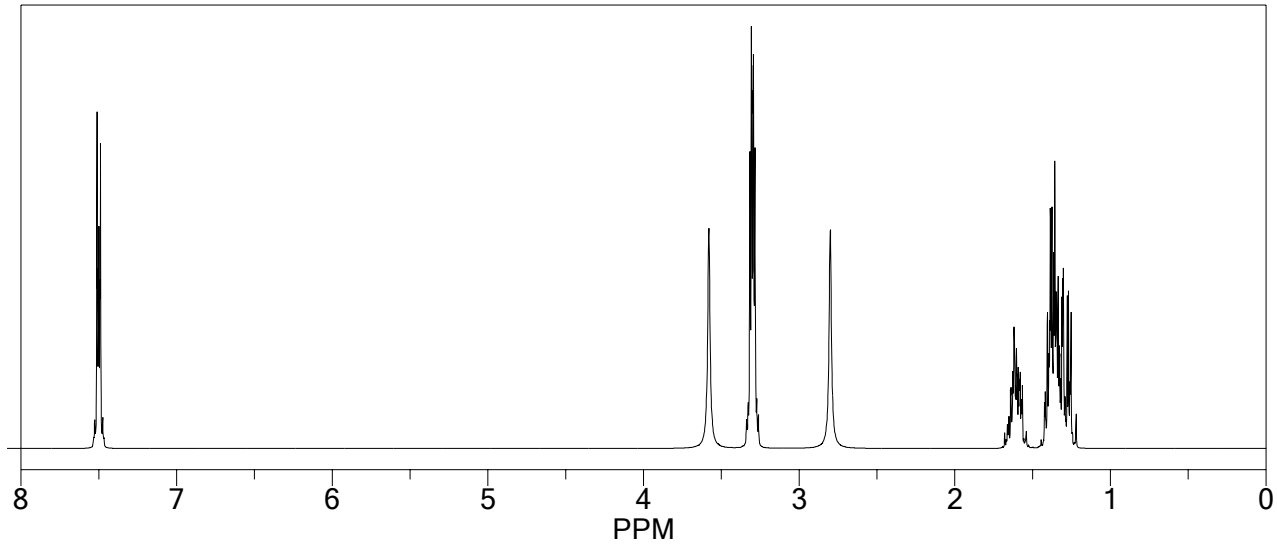


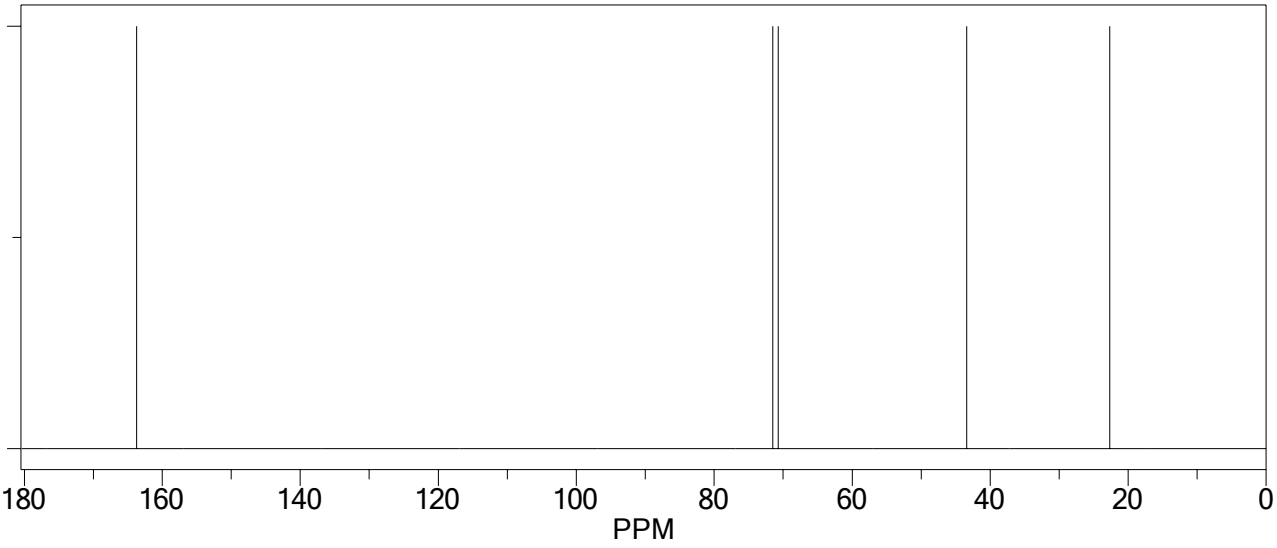
X_4





X_5





X_6