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Fourier Transform Infrared Spectrometry Prelab

Last modified: June 17, 2014

Recommended reading:

AirUCI Lab Manual:	FTIR Lab	
Environmental Chemistry Text:	Pages: 6, 7, 13–16 on Light Absorption	
	Pages: 175–177, 184, 185 on Molecular Vibrations	
	Pages: 247–249 and 319 – 320 on Fuel & MTBE	
	Pages: 295–302: Ethanol	
Online: www.whfreeman.com/envchem5e	Organic Review on Alcohols and Ethers (Pages: Ap7 and AP8)	

Prelab Questions:

1) What is the overall goal of this lab?

2) Draw the molecular structures for Ethanol and MTBE (see the Appendix in your Text for help). Circle the IR active functional groups that distinguish these molecules.

3) What is the ethanol volume percentage of 80 proof vodka?

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4) Define wavelength, frequency and wavenumber, and how they are related. Convert wavenumber value of 2000 cm^{-1} into wavelength in nm and in frequency in s^{-1}.

5) List as many different types of molecular vibrations as possible. Which types of vibrations can an ethanol molecule have?

6) Write the Beer–Lambert Law. A form of the equation that is useful for experimental plots is: "y = mx + b". Identify each parameter (y, m, x, and b) for Beer's Law plots.

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Gas Chromatography – Mass Spectrometry Prelab

Last modified: June 17, 2014

Recommended reading:

AirUCI Manual: GC–MS Lab (8 pages)

Environmental Chemistry Text:

Pages: 155–156 and 236–249 on benzene and Aromatics
Pages: 247–249 on gasoline and additives
Pages: 247–249 and 319 – 320 on Fuel & MTBE
Pages: 295–302: Ethanol

Online: www.whfreeman.com/envchem5e Organic Review on Ethers and Benzene (Pages: AP8, AP11 and AP12)

Prelab Questions:

1) What are the overall goals of this Lab?

2) What is chromatography mainly used for?

3) In Mass Spectrometry, the m/z ratio of each species is measured. Explain what m/z means:

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4) Molecules undergo electron impact in our Mass Spectrometer. What two major things occur during this process?

5) Draw the molecular structures for benzene, toluene, *o* – xylene and ethanol (see Appendix for help if needed). List their molecular weights, density and boiling points.

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High Performance Liquid Chromatography Prelab

Last modified: June 17, 2014

Recommended reading:

AirUCI Manual: HPLC Lab (13 pages)
Environmental Chemistry Text: Pages: 157–160, 382, 553, 558 and 559 on tobacco smoke
Pages: 664–672 on PAH compounds

Prelab Questions:

1) What is the overall goal of this Lab?

2) What is the main difference between Gas Chromatography and Liquid Chromatography?

3) Define: eluent, retention time, resolution, and selectivity factor in chromatography:

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4) Briefly explain what reversed–phase partition chromatography is:

5) List several ways to increase the resolution and efficiency of a chromatographic column:

6) What is gradient elution (as used in this HPLC experiment):

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Laser Induced Breakdown Spectroscopy Prelab

Last modified: June 17, 2014

Recommended reading:

AirUCI Manual: Laser Induced Breakdown Spectroscopy

Prelab Questions:

1) What are the overall goals of this lab?

2) What safety factors are critically important to be aware of for this lab?

3) Briefly attempt to explain how a Nd:YAG laser operates in a few sentences.

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4) What does the plasma consist of? Which of these species may undergo excitation and emission of radiation?

5) Plasma is perfectly visible by naked eye. Why do we need a spectrometer to look at the plasma? In other words, what additional information does the spectrometer provide?

6) What does the acronym “LASER” stand for?

7) How are the energy and power of a laser related? If two lasers had the same energy, but one had a 5 nanosecond pulse and the other a 5 picosecond pulse, which would have the higher power?

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Catalytic Converter (NOx) Prelab

Last modified: June 17, 2014

Recommended reading:

AirUCI Lab Manual:	Catalytic Converter Lab
Environmental Chemistry Text:	Pages: 6, 7, 13–16 on Light Absorption
	Pages: 91–94 and 96–98 on Catalytic Converters
	Pages: 94–96 on Air Quality Standards

Prelab Questions:

1) What are the goals of this experiment?

2) What gases are expected to be present in "raw" untreated car exhaust? What gases should be present in car exhaust that has passed through an efficient 3-way catalytic converter?

3) What is meant by the term "3-way catalyst?"

4) Vehicles are a major source of CO_2 to the atmosphere. Why do we have to be concerned with CO_2 emissions and what steps can be taken to reduce CO_2 emissions from automobiles? Do catalytic converters help here?

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5) Write the Beer–Lambert Law that relates absorbance, pathlength, and concentration. Imagine that you plot absorbance as a function of concentration. A form of the equation that is useful for fitting this experimental plot is: "y = mx + b". Relate the variables and linear fit parameter (y, m, x, and b) to the constants used in Beer's Law.

6) Dilution of solutions is very common in "wet" labs. In this lab, a nitrite (NO_2^-) solution of approximately 5 μg/mL will be used to make 4 standard solutions of varying concentrations. If 500.0 μL of the 5 μg/mL solution is diluted to 25.00 mL in a volumetric flask, what is the resulting concentration of the diluted standard solution in μg/mL. (Remember the dilution equation: $C_1V_1 = C_2V_2$ where C = concentration; V = volume).

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Basics of Atmospheric Modeling Prelab

Last modified: June 17, 2014

Required reading:

AirUCI Manual: Air PSE Lab
Environmental Chemistry Text: Pages: 76–90, 136, 149, 150 and 764–771 on Photochemical Smog

(1) What environmental factors affect air quality modeling?

(2) How do people affect the air quality? Is the effect of people on air quality in major cities more significant than that of natural processes?

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(3) What are the main molecular precursors to photochemical smog formation?

(4) If you had the authority to regulate atmospheric emissions of one chosen air pollutant, which air pollutant would you pick in order to have the largest impact on the air quality?

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Computational Chemistry Prelab

Last modified: June 17, 2014

Recommended reading:

AirUCI Manual: Computational Chemistry Lab (Spartan)
Environmental Chemistry Text: Pages: 175–179, 184–187 and 193–196 on Molecular Vibrations

Prelab Questions:

1) What is the overall goal of this lab?

2) What computer program will be used for the computations?

3) What region of the electromagnetic spectrum can induce molecular vibrations:

4) Convert the wavenumber (similar to a "frequency") 1000 cm^{-1} to a wavelength in μm.

5) What is a dipole?

6) What is the model chemistry (i.e., theoretical model and basis set) that will be used for the calculations in this lab:

7) What do the terms HOMO and LUMO stand for?