CHEM 322 **Name**__________________________________
Exam 3 **Spring 2010**

Due by 4:00 PM Monday, April 12
NO LATE PAPERS ACCEPTED!

Complete these problems on separate paper and staple it to these sheets when you are finished. Please put your name or initials on each sheet as well. Clearly mark your answers. YOU MUST SHOW YOUR WORK TO RECEIVE CREDIT.

Instructions

- *This is **NOT** an open-book, open-note exam. You MAY NOT consult any human or nonhuman resource besides Dr. Lamp as you complete the exam. This exam MUST be completed INDIVIDUALLY and in your own words.* Group work or plagiarism will result in a zero for the exam.
- You will be allowed to ask Dr. Lamp a maximum of one (1) question regarding the exam. Additional questions may be asked at a 3-point penalty per question. If you are working on the exam on the weekend or in the evening, you may try to reach Dr. Lamp on his cell phone at 660-341-0067 before 10:00 PM.
- Before opening the exam, prepare for it like you would for a traditional, in-class exam. Review concepts and examples from the text, as well as those discussed in class. This preparation will help to maximize your effort on the exam and allow you to complete it more efficiently.

Time Restriction

You may spend no more than forty-five (45) minutes working on this exam. This <u>must</u> be in one continuous block of time. You are on your honor to adhere to this restriction and record the time spent in the chart below.

Date	Time Began	Time Finished	Total Time
Total Time Spent on the Exam			

Pledge

I pledge on my honor that I have completed the exam in accordance with the above instructions and that I have not provided or received unethical assistance. I realize that failure to comply with these instructions will result in a score of zero on the exam.

____ ________________
Signature Date

CHEM 322 **Name**____________________________________

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Complete these problems in the space provided. If you run out of space, continue on the back of the page and direct me where to find the rest of your work. Clearly mark your answers. YOU MUST SHOW YOUR WORK TO RECEIVE CREDIT. 14 points each.

1. Describe the principles of operation and advantages and disadvantages of **one** of the following. Feel free to use clearly labeled drawings in your description.
   a. Time of flight mass spectrometer with a reflectron.
   b. Ion cyclotron resonance mass spectrometer.

2. As a newly hired mass spectrometry expert, you have been assigned the task of designing solutions to the MS problems below. For **two** of the issues, use a block diagram to identify the ionization source(s), mass analyzer, and detector you would select to accomplish each task. Provide justification for your choices.

   a. The determination of trace levels of arsenic in municipal drinking water.
   b. The accurate determination of the molar mass of a protein from the stuff growing in Dr. McCormick's iced tea glass.
   c. Both molar mass and structural information of a suspected pheromone of the eastern grey squirrel. (note: this pheromone is a small organic compound)

3. You have been instructed to build a UV-Vis instrument using a linear CCD array detector that has 1024 pixels aligned on a 2.00 cm chip.

   a. If you want the first order diffraction of light from 200-800 nm to completely fill the array, how many grooves per millimeter should his grating have? Assume the focal length of the monochromator is 0.20 m.

   b. If you were building a scanning spectrometer using the grating from part a, what slit width would be required to produce the same bandwidth as in the CCD instrument? Could the two emission lines of sodium (589.0 and 589.6 nm) be resolved using under these conditions?

Possibly Useful Information

$\lambda = \frac{RT}{\sqrt{2}\pi d^2 N_A P} \approx \frac{5\,cm}{mtorr}$	$\frac{m}{z} = \frac{B^2 r^2 e}{2V} = F_c$
$F_M = Bzev = \frac{mv^2}{r} = F_c$	$\frac{N}{N_0} = \frac{g}{g_0} e^{-E/kT}$
$A = \log(P_0/P) = \varepsilon bc$	$T = P/P_0$
$E = \frac{hc}{\lambda} = h\nu$	$c = 3.00 \times 10^8\ ms^{-1}$
$k = 1.38 \times 10^{-23}\ JK^{-1}$	$\eta_1 \sin\theta_1 = \eta_2 \sin\theta_2$
Planck's Constant = 6.63×10^{-34} Js	$n\lambda = d(\sin i + \sin r)$
$\Delta\lambda = wD^{-1}$	$R = \frac{\lambda}{\Delta\lambda} = nN$
$D = \frac{dy}{d\lambda} = F\frac{dr}{d\lambda}$	$\frac{dr}{d\lambda} = \frac{n}{d\cos r}$
$D^{-1} = \frac{d\lambda}{dy} = \frac{d}{nF}$	Nothing useful in this cell…sorry!