Data Sheet for Experiment 1B (also posted on CH 461 Web Site).

Name ___________________________________ Date ___________ Station # ________

IV. Sample Compartment-Colors! (bottom p. 7)

Shortest detectable wavelength:________ nm; Color: _______________
Longest detectable wavelength:_________nm; Color: _______________

VB. Using the Silicon Photodiode (the PD). (p. 10)

PD drift (V/min):___________ (Attach Excel Chart (graph only))

Dark current voltage (E_d):_________________

Total output voltage (E_t):_________________

Photocurrent voltage (E_p):_________________

Show the calculation of

1) the photocurrent (i_p) from the photocurrent voltage from eq. 4 (p. 9)

2) the incident radiant power (Φ) with eq. 2 (p. 8)

VIB: Using the PMT as the Photodetector. (p. 11)
Check that the PMT optical alignment position is optimized for this experiment to get good results.

What is the wavelength monochromator set to? ___________nm

Was the PMT zero knob adjusted to output 0 V at the start of this experiment? _________

Table I. PMT Gain

PMT Bias Voltage Settings (V)	E_t Total Voltage (measured) (mV)	E_d Dark Current Voltage (measured) (mV)	E_p Photocurrent Voltage (mV)	i_{cp} Photocathodic Current (nA)	i_{ap} Photoanodic Current (nA)	**m** Gain
-390						
-420						
-480						

Fill in the rest of table I as follows on the next page for each PMT bias voltage:

1) determine E_p and i_{ap} from eq. 3 (p. 9) and 8 (p.11), respectively,

2) calculate the photocathodic current from eq. 5 (p. 11) , the value of R(λ) for the PMT at the wavelength used (note the units in fig. 5 are mA/W), and the incident radiant power measured with the PD in section V (Φ is the same because the source, the slit width, and wavelength are not altered), and

3) calculate the gain m from eq. 7 (p. 11).

Illustrate your approach by showing the calculation of E_p, $i_{ap,}$ i_{cp}, and m for the -390 V setting of the PMT. (Use actual data in sample calculations with units and proper Sig. Figs.)

4) attach a plot from the ECR program showing the steps in gain for the output for this part.

VIIB: Wavelength Scanning using the tungsten/halide source. (p. 15)

PMT dark current voltage: ___________

PMT voltage at 0.85 V: ____________

ECR recorder program settings:____

At 600 nm, approximate voltage observed: __________ and corresponding time: ________

Calculated time to scan from 300 to 750 nm at 200 nm/min: ___________________

Time measured to scan from 300 to 750 nm at 200 nm/min: ___________________

Open the scan file in Excel and plot signal vs. wavelength (you will have to convert time to wavelength). Attach a hardcopy of this labeled plot.

1. At what wavelength does the system begin to respond? ________________ nm

2. At what wavelength is the response of the system at a maximum? ________________ nm

VIIIB. CCD spectrometer (p. 16)

From the copy of the spectrum from 375-400 nm, measure and report the half-width of the triangle which represents the spectral bandpass of the combined PTR monochromator and OOI spectrometer. Indicate how you obtained this value directly on the hardcopy.

Calculate the expected half-width of the triangle. Show your calculation based on the bandpass for the PTR mono and the CCD coupled together.

IXB: Noise, Frequency Response and Signal Averaging (p. 20)

Table II. Effect of Signal Averaging

number of integrations per data point (Hz)	mean signal (counts)	standard deviation (counts)
1		
10		

Does the magnitude of the noise depend upon the number of integrations averaged as expected? See lab manual for discussion (p.20). Explain your reasoning in a sentence or two with evidence. Attach a copy of the raw data in this case.

XB: Optical Filters (p. 22)

The transmittance, T, is the ratio of the radiation passed by the filter to the radiation passed when the filter is removed (first spectrum).

1. a. Transmittance of the red Kodak filter at 650 nm. T at 650 nm = ___________

   b. Wavelength where transmittance crosses below 1% = ______ nm (also label on hardcopy). This is the “cutoff wavelength”.

2. a. For the green filter plastic filter, maximum T value = _____________

   b. Wavelength of maximum T = ___________ nm

   c. Half-width of transmittance band = __________ nm (also show this calculation on the hardcopy)

XIB: Wavelength Calibration and Wavelength Resolution with the Hybrid OOI - CCD Spectrometer using the Mercury Source

Table III. Wavelength Calibration for the OOI- CCD Spectrometer. Add three other lines of your choice for Hg spectrum to the list below. (p. 26)

Wavelength of mercury line (nm)	Wavelength of peak maximum displayed on monitor or in file (nm)	Correction for displayed reading (nm)
253.7		
546.1		

Table IV. Resolution for the Hybrid OOI- CCD Spectrometer for two different Hg doublets (p 26)

Doublets (nm)	True separation of lines (nm)	Spectrometer Wavelength resolution* (nm)	Nearly Baseline Resolved? (Yes or No)
404 & 407			
577 & 579			

* See spectrometer specifications in Section VIIIA

XIC: Wavelength Calibration with PTR Monochromator System

3.b. Plot the spectrum of the 546.1 nm Hg line in Excel and calculate the half-width in nm and compare to the expected half-width. Show your work on the hardcopy of this peak. As mentioned in Section III, the reciprocal linear dispersion of the grating is 6 nm/mm.

3.c. Report value for MiniChrom readout at the peak for the 546. 1 nm Hg line in Table V.

3.e. Complete Table V. on the next page using the plot of complete Hg spectrum using the Hybrid spectrometer. (p. 29)

Table V. Calibration of Readout Display and Monochromator Program. Add three other lines for Hg to the list here. Report only 546.1 for the MiniChrom Readout.

	MiniChrom PTR Wavelength Readout Display		Monchromator Program File for PTR		
True wavelength of mercury line (nm)	Wavelength reading at the peak maximum intensity (nm)	Wavelength correction in display reading (nm)	Wavelength used in program at the peak maximum intensity (nm)	Wavelength correction in program (nm)	PMT bias voltage (V)
253.7	NA	NA			
546.1					
	NA	NA			
	NA	NA			
	NA	NA			

Answer this question in your report: Look at the scan of the Hg spectrum taken with the PTR monochromator system. A fairly intense signal is observed at 507.4 nm. This indicates that some source radiation is entering the monochromator and passing through the exit slit to the PMT detector. However, according to the reference list for true wavelengths for the Hg line spectrum, the mercury lamp does not emit at this wavelength! What is happening here and what emission line from Hg is really being observed in this case? Succinctly explain your reasoning.

XID: Wavelength Resolution with PTR Monochromator System for Mercury doublet.

From your saved data for the two scans with differing slit widths for the Hg doublet at 577nm & 579 nm, import the data into a spreadsheet and produce a proper graph **of both scans on the same chart** of signal versus wavelength (identify which graph is for the 150 slit and which is for the 300 μm slit).

a. Make a statement about your success in baseline separating these Hg lines.

b. Calculate what slit width value is really necessary to produce baseline resolution of these two lines.

c. Do your results support the calculated slit value? Explain briefly.