Ombudsperson

• We need to select at least one person from each section to represent the class in the ombuds meeting.

• The meeting will take place at noon sometime around week 5 or 6.
Organizational Lecture

- How to earn points
- Requirements to pass
- Questions
### Chemistry 3X Grading

#### Grading

To pass Ch 3:

- all assignments must be submitted,
- all reports must earn a minimum of 60%
- the final percentage grade must be a minimum of 65%.

The numerical grade will be assessed as follows:

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Beer’s Project</th>
<th>Project Ru(bpy)</th>
<th>Project Semiconductor</th>
<th>Points</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab Periods</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notebook</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-Lab</td>
<td>10</td>
<td>30</td>
<td>30</td>
<td>70</td>
<td>7%</td>
</tr>
<tr>
<td>In-Lab</td>
<td>25</td>
<td>75</td>
<td>75</td>
<td>175</td>
<td>18%</td>
</tr>
<tr>
<td>Technique</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assignments</td>
<td>20</td>
<td>60</td>
<td>60</td>
<td>140</td>
<td>14%</td>
</tr>
<tr>
<td>Quizzes</td>
<td>20</td>
<td>45</td>
<td>30</td>
<td>95</td>
<td>10%</td>
</tr>
<tr>
<td>Reports</td>
<td>50</td>
<td>225</td>
<td>105</td>
<td>380</td>
<td>38%</td>
</tr>
<tr>
<td>Total</td>
<td>145</td>
<td>495</td>
<td>360</td>
<td>1000</td>
<td>100%</td>
</tr>
</tbody>
</table>

A penalty of -10%/day (of total earned) will be imposed for lateness. You must e-mail Dr. Mendez if you turn in any assignment more than 15 minutes after its due date. If you earn less than 60% on any report, you may resubmit it for regrade within 10 days of its return.

#### Website

This lab manual, lecture notes, and TA contact information are on the Chem 3X website:

http://chemlabs.caltech.edu/wiki/ch3x:home

Also on this website is a link to report lab manual typos, you will receive 1 pt/typo.

The Mead Lab server can be found at smb://meadlab.caltech.edu (Mac) or \meadlab.caltech.edu\chem3 (Windows),

login: chem3

password is given in class, find it on the keyboards.
Notebooks

• A proper lab notebook will include:
  • Table of Contents
  • Prelab
    ‣ Questions
    ‣ Table
    ‣ Procedure (on separate page)
  • Lab notes & observations
    • Everything you do and every observation you make
    • An experienced scientist should be able to recreate experiment
Notebooks

- Get TA initials on prelab before you start the lab
- Get TA initials on in lab notes after you end the lab
- Only initialed pages are graded
- TAs stop initializing prelabs 8 minutes after class starts
  - 8:08 AM
  - 1:08 PM
- TAs stop initializing in labs 8 minutes after class ends
  - 11:08 AM
  - 4:08 PM
Technique

• The TA will give you a 0-20 grade after each lab section.

• Mainly focusing on preparedness and safety

• No one is prefect, don’t expect lots of 20’s
Weekly Lecture Quizzes

• There will be a 15 point quiz during the Friday lectures

• This will focus on the major point of the lab that week.

• Safety Quiz is 5 points
Weekly Assignments

• Page 18-19 (weekly assignment 1)

• Two parts
  • Experimental
  • Graphs, figures, and tables from the lab
Reports

- Scientific format
- Each report will have a different specific format

Different Values

- First report is 50 points (5%)
- Second report is 225 points 85%
- Third report is 105 points
- Must earn a minimum of 60% on all reports

- 10 days to resubmit report of <60%
Lateness

- Late to class: no initials, no prelab grade
- Assignments late: -10%/day including weekends
Submitting assignments

• http://meadlab.caltech.edu/file_upload.html
Demo
The Color Wheel
The Color Wheel

<table>
<thead>
<tr>
<th>Wavelength Range in nm</th>
<th>Absorption Region</th>
<th>Color Perceived</th>
</tr>
</thead>
<tbody>
<tr>
<td>380-435</td>
<td>Violet</td>
<td>Yellow-Green</td>
</tr>
<tr>
<td>435-480</td>
<td>Blue</td>
<td>Yellow</td>
</tr>
<tr>
<td>480-490</td>
<td>Greenish-Blue</td>
<td>Orange</td>
</tr>
<tr>
<td>490-500</td>
<td>Bluish-Green</td>
<td>Red</td>
</tr>
<tr>
<td>500-560</td>
<td>Green</td>
<td>Purple</td>
</tr>
<tr>
<td>560-580</td>
<td>Yellow-Green</td>
<td>Violet</td>
</tr>
<tr>
<td>580-595</td>
<td>Yellow</td>
<td>Blue</td>
</tr>
<tr>
<td>595-610</td>
<td>Orange</td>
<td>Green-Blue</td>
</tr>
<tr>
<td>610-750</td>
<td>Red</td>
<td>Blue-Green</td>
</tr>
</tbody>
</table>
Absorption corresponds to discrete electronic transitions
The Molecular Orbital Diagram for hydrogen is simple:
- Two hydrogen 1s atomic orbitals combine to form a molecular orbital (a chemical bond) that is delocalized between the two nuclei.
- Delocalization means that either of the electrons can reside on both atomic orbitals at any given time.
Electron Configuration: 

\[(\sigma_{2s})^2 \ (\sigma_{2s}^*)^2 \ (\sigma_{2p})^2 \ (\pi_{2p})^4 \ (\pi_{2p}^*)^2\]

Bond Order = \frac{1}{2} (2 - 2 + 2 + 4 - 2) = 2 \text{ Double Bond}
Fe

HOMO and LUMO (orbitals with d-character)

Cp₂Fe
staggered conformation
(D₅d symmetry)
Beer's Law

$T = \frac{I_T}{I_O} = 10^{-\varepsilon \ell [c]}$

where $\varepsilon$ is the extinction coefficient
$
\Rightarrow$ probability of absorbing light when contacted
Notice that the equation for $T$ is not linear

We will use this equation because it is linear in $[c]$ and $\ell$, 2 variables we control.

$$A = -\log T = \varepsilon \ell [c]$$

In the lab we will measure the light intensity of the source, $I_o$, this is called the reference. Then we are going to compare $I_o$ to the light after it passes through your sample. This ratio $I_o/I_T$ is referred to as the transmittance, $T$. We can plot $T$ or it’s negative logarithm, absorbance $A$. There are different absorbances for each wavelength, $\lambda$. A typical spectrum will look like this:
Three separate peaks, shows three separate electron excitations.

\[ A = \varepsilon [c] \ell \quad \text{← if } \ell \text{ is constant (1 cm)} \]
\[ y = mx \quad \text{where} \quad m = \varepsilon \]
\[ x = [c] \]

Plot \( A \) vs. \([c]\) and the slope is \( \varepsilon \)
Objectives for Laboratory

- Understand lab protocol and know the location and appropriate use of different items within the lab. This is the time to ask your TAs questions to make the rest of the term easier!
- Understand the absorbance spectra for trisbipyridineruthenium dichloride and other inorganic complexes
- Apply electronic excitations (atomic phenomenon) and absorbance/transmittance (macroscopic phenomena) to the interpretation of the spectra
To do this we need spectra at different concentrations. We will conduct a standard dilution.
Absorption vs Concentration

\[ m = \varepsilon_{\lambda_1} \]

\[ m = \varepsilon_{\lambda_2} \]