**UCI DEPARTMENT OF ORGANIC CHEMISTRY PEER TUTORING REVIEW SESSION**

**FEEDBACK EVALUATION**

<table>
<thead>
<tr>
<th>Quarter: Fall 2017</th>
<th>Date: December 7, 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class: Professor Shea</td>
<td>Final Review</td>
</tr>
</tbody>
</table>

**Tutors’ Names:** Amelia Ooi, Kathy Vu, Phuc Nguyen

**COMMENTS/SUGGESTIONS**

(VERY IMPORTANT!)

<table>
<thead>
<tr>
<th>Amelia Ooi:</th>
<th>Kathy Vu:</th>
<th>Phuc Nguyen:</th>
</tr>
</thead>
<tbody>
<tr>
<td>What worked best?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What could be improved?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What would you like to see next time?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Agree or Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>This review was interactive and engaging.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Comments:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| The presentation volume was acceptable. | ☐ | ☐ | ☐ | ☐ | ☐ |
| Comments: | | | | | |

| The presentation was visually clear and logically organized. | ☐ | ☐ | ☐ | ☐ | ☐ |
| Comments: | | | | | |

| The review improved/reinforced your understanding of the material. | ☐ | ☐ | ☐ | ☐ | ☐ |
| Comments: | | | | | |

| The quality of the review packet was excellent. | ☐ | ☐ | ☐ | ☐ | ☐ |
| Comments: | | | | | |

Please fill out this evaluation, even if you plan to leave early. Thank you very much.
Final Review Packet

1) Important Trends

a. Rank the following in order of increasing leaving group ability: ___<___<___
   (a) Br-
   (b) NH$_2$-
   (c) F-

b. Rank the following in order of nucleophilicity in water: ___<___<___
   (a) F-
   (b) Br-
   (c) CH$_3$OH

c. Rank the following in order of increasing stability: ___<___<___
   (a) heterolysis of 1-chlorobutane
   (b) heterolysis of 2-bromopentane
   (c) heterolysis of 2-methyl-2-iodopropane

d. Rank the following in order of reactivity in an SN2 reaction: ___<___<___
   (a) 3-chloro-hexane
   (b) 2-chloro-2-methylpropane
   (c) 3-bromo-hexane

2) What would the rate law be for the following reaction?

\[
\text{[I]} + \text{NaOCH}_3 \; \text{DMF} \rightarrow \text{OCH}_3 + \text{NaI}
\]

Draw a reasonable approximation of the transition state for the reaction:
3) Draw the generic energy diagrams for SN2 and SN1 assuming that both reactions are exothermic. Provide all necessary labels:

4) Draw the correct product(s) and stepwise curved arrow mechanism for the following reaction:

\[
\begin{align*}
\text{Br} & \quad \text{CH}_3\text{OH} \\
& \quad \text{heat}
\end{align*}
\]
5) Provide the expected product(s) for the following substitution reactions. Note that it is possible to get "No Reaction." Show stereochemistry where necessary.

<table>
<thead>
<tr>
<th>Mech.</th>
<th>Alkyl Halide</th>
<th>Rate equation</th>
<th>Stereochem.</th>
<th>:Nu-</th>
<th>Solvent</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SN1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*If you are given experimental data of reaction rates for a specific substitution reaction, you can determine the mechanism if you notice different [:Nu-] affecting the rate (=SN2).
6. Draw the product(s) for the following reaction based on the provided mechanism.

[Diagram of reaction]

7. Use curved arrows to show the mechanism of the following reaction.

[Diagram of mechanism]

8. Classify each chemical reaction below as: addition, substitution, or elimination.
   a. [Diagram of reaction]
   b. [Diagram of reaction]
   c. [Diagram of reaction]
9. Draw the movement of electrons for the following reaction with curved arrows, then calculate the $\Delta H^\circ_{\text{rxn}}$.
*Note: The bond dissociation energy of a $\pi$ bond is 60 kcal/mol and a C-C bond is ~ 82 kcal/mol.

\[ \text{H}_2\text{C} = \text{C} - \text{H} + \text{H}-\text{Cl} \rightarrow \text{CH}_3\text{C} - \text{C} - \text{H} \]

\[ \Delta H^\circ_{\text{reaction}} = \boxed{\text{kcal/mol}} \]

10. Using the bond dissociation energies table below, calculate the enthalpy change ($\Delta H^\circ$) for the following reaction.

<table>
<thead>
<tr>
<th>Bond Dissociation Energies (kcal/mol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bond (A-B)</td>
</tr>
<tr>
<td>H-Cl</td>
</tr>
<tr>
<td>C=\pi bond</td>
</tr>
<tr>
<td>C-Cl</td>
</tr>
<tr>
<td>C-H (3°)</td>
</tr>
</tbody>
</table>

a. Indicate the bonds that are made and broken:

BM (bonds made)  

BB (bonds broken)  

b. Calculate the enthalpy of this reaction:  

\[ \Delta H^\circ_{\text{reaction}} = \boxed{\text{kcal/mol}} \]

c. Is this reaction exothermic or endothermic?
11. For the following examples, indicate whether equilibrium lies to the left or right.

a. \( K_{eq} = 0.027 \)

b. \( K_{eq} = 7 \)

c. \( \Delta G^\circ = -97 \)

d. \( \Delta G^\circ = 115 \)

12. Answer the questions below for the following SN\(_2\) reaction.

\[
\begin{array}{c}
\text{Cl} \\
\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 \\
\Theta \begin{array}{c}
\text{OH} \\
\text{DMSO}
\end{array}
\end{array}
\]

a. Draw the arrow pushing mechanism and product.

b. Determine the rate expression of the reaction.

c. Assuming the reaction is exothermic, sketch an energy diagram for the reaction.

On the diagram, draw the:

i. Starting material(s)

ii. Product(s)

iii. Transition state (Draw the actual TS)

iv. Activation Energy

v. \( \Delta G \) for the overall reaction

vi. Label the axes.
13a. Rank the following in order of increasing stability:
   _____ < _____ < _____
(a) the carbocation derived from the heterolysis of 1-bromo-1-methylcycopentane
(b) the carbocation derived from the heterolysis of 1-bromocyclohexane
(c) the carbocation derived from the heterolysis of 1-bromobutane

b. Rank the following in order of increasing basicity:
   _____ < _____ < _____
(a) lithium chloride (LiCl)
(b) n-pentyllithium (LiCH₂CH₂CH₂CH₂CH₃)
(c) lithium amide (LiNH₂)

c. Rank the underlined H in order of increasing acidity:
   _____ < _____ < _____
(a) propylamine (CH₃CH₂CH₂HNH)  
(b) ethanol (CH₃CH₂OH)
(c) 2,2,2-tribromoethanol (CBr₃CHHOH)

d. Rank the following in order of increasing boiling point:
   _____ < _____ < _____
(a)  
(b)  
(c)  

e. Rank the following in order of increasing solubility in water:
   _____ < _____ < _____
(a)  
(b)  
(c)  
14. Use curved arrows to draw the possible resonance structures for compound below. Then, draw the resonance hybrid.

![Resonance Structures Diagram]

15. Provide the arrow mechanism and products for the following Lewis acid/base reaction. Then, identify the Lewis acid/base in both. Indicate whether each reactant is a nucleophile/electrophile.

![Lewis Acid/Base Reaction Diagram]

16. Provide the arrow mechanism and products for the following Bronsted acid/base reaction. Then, identify the acid, base, conjugate acid, and conjugate base.

![Bronsted Acid/Base Reaction Diagram]
17) Label all the functional group groups in the following molecule:

![Molecule Diagram]

18) Label R/S configurations of the stereocenters of the given compound. Draw the chair conformation, do a ring flip, and circle the most stable chair conformation and state why.

![Stereochemistry Diagram]
19) the pairs of different compounds below are related by one and only one of the following terms:
(A) Resonance Structures  (B) Constitutional Isomers  (C) Diastereomers
(D) Enantiomers  (E) Conformational Isomers (different conformations of the SAME molecule)
Write the appropriate term in the boxes provided.

(a)

(b)

(c)

(d)

(e)
(A) Rank the following in order of increasing pKa: ___<___<___
   (a) Acetic Acid (C\text{CH}_3\text{CO}_2\text{H})
   (b) Ethanol (C\text{CH}_3\text{CH}_2\text{OH})
   (c) Trichloroacetic Acid (Cl\text{3}\text{CO}_2\text{H})

(B) Rank the following in order of increasing IR absorption frequency: ___<___<___
   (a) The O-H stretch in an alcohol, such as methanol
   (b) The C=O stretch in a ketone, such as acetone
   (c) The C-Cl stretch in an alkyl chloride, such as 2-chloropropane

(C) Rank the following in order of increasing basicity: ___<___<___
   (a) HO\text{^{-}}
   (b) H\text{2}N\text{^{-}}
   (c) HS\text{^{-}}

(D) Rank the following in order of increasing stability: ___<___<___
   (a) gauche butane
   (b) eclipsed butane
   (c) anti butane

(E) Rank the following in order of increasing C-C-C-C dihedral angle: ___<___<___
   (a) gauche butane
   (b) benzene
   (c) anti butane

(F) Rank the following in order of increasing nucleophilicity in H\text{2}O: ___<___<___
   (a) F\text{^{-}}
   (b) I\text{^{-}}
   (c) Br\text{^{-}}
21) Which of these molecules best corresponds to the IR spectrum below with the molecular formula C₆H₁₄O?

![IR Spectrum for C₆H₁₄O](image1)

22) Which of these molecules best corresponds to the IR spectrum below with the molecular formula C₄H₈O₂?

![IR Spectrum for C₄H₈O₂](image2)