1. (5 minutes) Use as specific an example as you can to argue that induced dipole moments can be more important than permanent dipole moments in causing non-bonded attraction between organic halides.

2. (6 min) How did Boltzmann explain that it should be more likely for a “degree of freedom” of a particular individual molecule to have the lowest possible energy than to have the average energy, even when the temperature is very high?
3. (5 min) What are the assumptions of Eyring’s transition state theory, and why is it often a more practical theory for understanding rates than a theory involving trajectories on the potential energy surface?

4. (9 min) Draw four lines to connect each radical in the second column with the corresponding dissociation energy (kcal/mole) in the first column for its bond to the CH₃ group.

Then explain the size of the other three values relative to that for the CH₃-CH₃ bond.

<table>
<thead>
<tr>
<th>BDE CH₃-R</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>76.5</td>
<td>CH₃</td>
</tr>
<tr>
<td>87.5</td>
<td>C(CH₃)₃</td>
</tr>
<tr>
<td>90.1</td>
<td>CH=CH₂</td>
</tr>
<tr>
<td>101.4</td>
<td>CH₂-CH=CH₂</td>
</tr>
</tbody>
</table>
5. (5 min) Propose an example and a plausible mechanistic interpretation of ONE ONLY of these three reaction orders:

0 or 1/6 or pseudo 1st order

6. The secondary C-H bonds of propane are 2.5 kcal/mole weaker (i.e. lower in BDE) than its primary C-H bonds.

   A) (4 min) Use this value to estimate the ratio of secondary to primary propyl radicals in equilibrium at room temperature. Explain your thinking.

   B) (8 min) Explain why it is curious that free radical bromination of propane at about twice room temperature gives a secondary-to-primary product ratio of about 10:1. Also say what lesson is to be learned from this fact.
7. (4 min) The first step in the Kenyon & Philips experiment that proved the stereochemistry of $S_N2$ substitution involved preparing a starting material by reacting a chiral alcohol, ROH with Cl-SO$_2$-$R'$. **Draw the product** of this first reaction and **explain why** it was prepared.

8. a) (2 min) In light of Question 7, suggest why, in making S-Adenosylmethionine, Nature chooses to use ATP rather than Adenosine itself.

![Structures](image)

Adenosine  ATP  S-Adenosylmethionine

b) (2 min) Explain why S-Adenosylmethionine is chemically suited for the purpose to which Nature puts it.