The exam budgets 50 minutes, but you may have 60 minutes to finish it. Good answers can fit in the space provided.

1. Over the past three and a half years the American Chemical Society has honored 181 different compounds as “Molecule of the Week.” This week (November 10, 2008) it belatedly honored L-(+)-Tartaric acid (shown in the figures to the right).

A) (1.5 min) Give common names for three other forms (or configurational isomers) of tartaric acid with sharp melting points.

B) (2 min) Write CIP priority numbers (1 is high) on the substituents of one of the stereogenic carbons in the ball-and-stick formula and label it as R or S.

C) (1.5 min) Explain whether L-(+)-Tartaric should be denoted $d-$, or $l-$, or whether the designation is uncertain?

D) (2 min) In the left margin draw the Fischer Projection of L-(+)-Tartaric acid.

2. (5 min) Briefly describe two different ways to separate 50:50 mixtures of enantiomers. Try to be specific. The methods must NOT involve the type of conglomerate used by Pasteur in his 1848 preparation of “unnatural” tartaric acid.
3. Joseph Louis Gay-Lussac was involved in a number of important chemical developments at the beginning of the 19th Century that are more often associated with others.

A) (2 min) Draw clear lines to match each of Gay-Lussac’s activities in the left column with one of the important contributors in the right column. One line already drawn to help you get started.

<table>
<thead>
<tr>
<th>Work by Gay-Lussac</th>
<th>Contributions by Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making a balloon ascent with J. B. Biot</td>
<td>Amodeo Avogadro’s Law</td>
</tr>
<tr>
<td>Analyzing water and ammonia</td>
<td>Friedrich Wöhler’s “Isomerism”</td>
</tr>
<tr>
<td>Advising research on Cyanate salts</td>
<td>Humphry Davy’s discovery of New Elements</td>
</tr>
<tr>
<td>Working with NaClO₃</td>
<td>John Dalton’s Atomic Theory</td>
</tr>
<tr>
<td>Working on “Big Science”</td>
<td>Organic Analysis by J.-J. Berzelius</td>
</tr>
</tbody>
</table>

B) (5 min) Choose two of the lines drawn in part A and write a few explanatory sentences about the connection between Gay-Lussac’s contribution and the related contribution by someone else.
4. (3 min) Explain very briefly why the device shown on this woodcarving in the SCL Library was revolutionary for 19th Century organic chemistry.

5. The dualistic radical theory of Wöhler, Liebig, and Berzelius was founded in part on the reaction between benzaldehyde (C₆H₅CH₃) and elemental chlorine (Cl₂).

A) (3 min) Write a balanced equation showing the composition of starting materials and products for this reaction, and explain how it might cast doubt on the theory of dualism.

B) (6 min) Draw a series of steps with curved arrows to show how the transformation actually did involve free radicals.
6. (8 min) Suppose a friend of yours who took organic chemistry somewhere else ridiculed this structural formula for glucose. What would you say to explain that his criticism is naïve and that in fact this formula is not only in its own terms correct but represents one of the most important advances ever in organic chemistry?

7. (4 min) Draw “3-isopropyl-5,5-dimethyloctane” and give its proper systematic (IUPAC) name.
8. Below are shown two of Dewar’s 2-dimensional models for possible constitutions for benzene, and a 3-dimensional structural formula for the first one.

![Dewar models and 3D structural formula](image)

A) (2 min) In the open space above draw an analogous 3-dimensional structural formula for the second Dewar model. Use wedges and/or dashed bonds as necessary to show the configuration unambiguously. (Do not worry about conformation.)

B) (5 min) Explain how counting stereoisomers of monosubstituted versions of these molecules might allow discriminating between the 3-dimensional isomers in Question A.