Exam II
7 November 2012

Key

- This exam contains 5 pages of questions – confirm this once you begin.
- You will have 55 minutes
- An abbreviated Periodic Table can be found on the last page.
- No calculators or models are permitted.
- Read all questions carefully – answer the question that is asked!
- Illegible or indecipherable answers may not receive potential partial credit.
- Good luck!

1. (5 pts) Identify, using an asterisk (*), all stereocenters in the following compounds.

![Chemical structures](image)

2. (8 pts) From the group of compounds shown below, identify a pair of enantiomers, a pair of diastereomers, a meso compound, and two identical compounds. Be sure your answers are on the provided lines.

Identical compounds: \[A = B\]
Enantiomers: \[A \neq B\] & \(F\)
Diastereomers: \[A \neq B\] & \(E \neq F\) or \(E + F\)
Meso: \[\text{not related}\]

![Chemical structures](image)
3. (7 pts) Provide the structure of the **major** organic product or products expected from each of the following reactions. Indicate stereochemistry where applicable.

![Chemical structures](image1)

4. (4 pts) Provide mechanism arrows for the following reaction. Sketch the reaction coordinate diagram that describes the energetic changes for this reaction. Label the following: $E_a$, $\Delta$, RDS, Reactant, Product, and any Intermediate(s). *Tip:* You may find it helpful to redraw the nucleophile for clarity.

![Chemical structures](image2)
5. (3 pts) Provide the complete structure of the tosylate group (\(-\text{OTs}\)) and, using only the space provided, offer a very brief comment as to why it is a great leaving group.

\[
\begin{align*}
\text{partial structure} \\
\text{It leaves as a weak base.}
\end{align*}
\]

6. (8 pts) Assign absolute configuration (\(R\) or \(S\)) to the following stereocenters.

"Hmmmm...could be \(S\), but not sure."

7. (6 pts) Provide a complete and detailed mechanism for the following transformation. Be certain to include all arrows, lone pairs, and formal charges.
8. (20 pts) Clearly circle the correct answer for the following questions. There is only one correct answer for each; no credit will be given if more than one answer is circled for each question.

a) Identify the substrate that is equipped with the best leaving group.

\[ \text{Br} \] \[ \text{F} \] \[ \text{Cl} \]

b) Identify which of the following would be the best solvent for an S<sub>N</sub>2 reaction.

\[ \text{H}_2\text{O} \] \[ \text{CH}_3\text{NCH}_3 \] \[ \text{O} \] \[ \text{OH} \]

c) A compound with 4 stereocenters can have a maximum of \( \boxed{16} \) possible stereoisomers.

d) Which of the following compounds will not exhibit optical activity?

\[ \text{OH} \] \[ \text{meso} \] \[ \text{H}_2\text{C}=\text{C}=\text{C}=\text{Br} \] \[ \text{OH} \]

e) Radical iodination is not synthetically useful because:

- the reaction is endothermic
- alkyl iodides are highly reactive
- it is commonly explosive

f) The hybridization of methyl radical (\( \text{CH}_3^* \)) is \( \boxed{sp^3} \).

\[ \text{sp}^3 \] \[ \text{sp}^2 \] \[ \text{sp} \]

g) What is the percent composition of a mixture of (\( R \))- and (\( S \))-2-butanol that has an ee of 38% and is dextrorotatory?

\[ 38\% \text{ R, } 62\% \text{ S} \] \[ 62\% \text{ R, } 28\% \text{ S} \] \[ 69\% \text{ R, } 31\% \text{ S} \] \[ 31\% \text{ R, } 69\% \text{ S} \]

\[ \alpha = -13.5^\circ \]

h) An endothermic reaction will display a(n) \( \boxed{late} \) transition state.

early symmetric late

i) Identify the most stable carbocation.

\[ \text{C}_7\text{H}_5^+ \] \[ \text{C}_7\text{H}_5^+ \] \[ \text{C}_7\text{H}_5^+ \] \[ \text{C}_7\text{H}_5^+ \]

j) Identify the most stable carbocation.

\[ \text{C}_7\text{H}_5^+ \] \[ \text{C}_7\text{H}_5^+ \] \[ \text{C}_7\text{H}_5^+ \] \[ \text{C}_7\text{H}_5^+ \]
9. (6 pts) Provide the two propagation steps for free radical bromination of 2-methylpropane. Do not show the mechanism arrows. Sketch the reaction coordinate diagram that describes the energetic changes for these two steps. (Do not label $E_a$, etc.)

Propagation step 1:

Propagation step 2:

10. (3 pts) Provide the name for the following compound, adhering to IUPAC rules.

11. (2 pts) According to the Hammond postulate, which of the following transition states best represents the exothermic hydrogen abstraction by chlorine in radical chlorination?

$$\begin{array}{c}
\text{[early]} \\
\text{E} \\
\text{R.C.} \\
\end{array}$$
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