1. (6) Draw the contributing resonance forms for the following carbocation:

\[
\begin{align*}
\text{Resonance Form 1} \\
\text{Resonance Form 2}
\end{align*}
\]

2. (6) Draw the major product, including stereochemistry if appropriate, for the following reaction:

\[
\text{Reaction with products}
\]

3. (6) Rank the following dienes from 1 to 4 in order of decreasing thermodynamic stability. Use "1" for the most stable...and "4" for the least.

\[
\begin{align*}
\text{Diene 1} & \quad \text{Diene 2} & \quad \text{Diene 3} & \quad \text{Diene 4}
\end{align*}
\]
4. (10) Draw the major product for each of the following reactions. Indicate any relevant stereochemistry in the product where needed.

\[ \text{1} \text{CH}_3 + \text{1 HBr} \rightarrow \]

\[ \text{1} \text{HCl} \rightarrow -80 ^\circ \text{C} \quad \text{(kinetic control)} \]

\[ \text{1} \text{HCl} \rightarrow +50 ^\circ \text{C} \quad \text{(thermo. control)} \]

5. (10) Predict the major product of the following Diels-Alder reactions. Account for all the regio- and stereochemistry where important.

\[ \text{CH}_3O\text{CH} \rightarrow \text{CH} + \text{CH}_2\text{CHCCH}_3 \]

\[ \text{H} \text{C}=\text{C} \rightarrow \text{H}_3 \text{C} \]+ \[ \text{H} \text{C} \rightarrow \text{C}=\text{N} \]
6. (10) (a) When 2-methylpropane is mono-chlorinated, two products form. Draw the isomer which forms in the greatest amount and predict the amount of it percentage-wise. The relative rates of alkyl radical formation by a chlorine radical are: $3^\circ$ C–H (5.0), $2^\circ$ C–H (3.8), and $1^\circ$ C–H (1.0).

(b) When 2-methylpropane is mono-brominated, two products form. Draw the isomer which forms in the greatest amount and predict the amount of it percentage-wise. The relative rates of alkyl radical formation by a bromine radical are: $3^\circ$ C–H (1600), $2^\circ$ C–H (82), and $1^\circ$ C–H (1.0).