1. Choose the major thermodynamic product of the following reaction.

\[ \text{products} \]

\[ \text{products} \]

A.  
B.  
C.  
D.  
E.  

2. Choose the order that has the following cations correctly arranged with respect to increasing stability.

\[ i \]

\[ ii \]

\[ iii \]

A.  
B.  
C.  
D.  
E.  

increasing stability

increasing stability

increasing stability

increasing stability

increasing stability

3. Choose the order that has the following C-H bonds of the omega-6 fatty acid linoleic acid correctly arranged with respect to the free radical reaction reactivity of the hydroxyl radical (HO⁻).

\[ \text{linoleic acid} \]

\[ \text{H}_\text{ii} \]

\[ \text{H}_\text{ii} \]

\[ \text{H}_\text{iii} \]

A.  
B.  
C.  
D.  
E.  

increasing reactivity

increasing reactivity

increasing reactivity

increasing reactivity

increasing reactivity
4. Choose the answer that has the correct reactants to complete the following Diels-Alder reaction.

\[
\begin{align*}
A &= 1 + 4 & B &= 2 + 5 & C &= 3 + 6 \\
D &= 1 + 5 & E &= 2 + 4
\end{align*}
\]

5. Choose the nitrogen atom(s) that donate two electrons to the aromatic π-system of the nucleoside adenosine.

6. Choose the order that has the following compounds arranged correctly with respect to increasing wavelength of their ultraviolet-visible light absorption.

\[
\begin{align*}
A &= i < ii < iii & B &= i < iii < ii & C &= ii < iii < i & D &= ii < i < iii & E &= iii < i < ii
\end{align*}
\]

7. Choose those compounds that are predicted to be aromatic according to Hückel’s rule.

\[
\begin{align*}
A &= 1 & B &= 2 & C &= 3 & D &= 1 + 3 & E &= 1 + 2
\end{align*}
\]
8. Choose the major product of the following reaction.

\[ \text{Reagent} \]

9. Choose the correct product of the following Diels-Alder reaction

\[ \text{Reagent} \]

10. Choose the major product of the following reaction.

\[ \text{Reagent} \]
Short Answer

11. Give the reactant that would produce the following Diels-Alder product. 5 pts

\[ ? \xrightarrow{\text{heat}} \]

12. Give the complete structure (all resonance forms) of the intermediate in the following reaction. 5 pts

\[ \text{HBr} \xrightarrow{?} \text{Br} + \text{Br} \]

13. Give reactants and reagents for performing the following transformation. 5 pts

\[ \text{?} \xrightarrow{?} \text{?} \]

14. Give the product of the following reaction. 5 pts

\[ \text{F} \xrightarrow{\text{HNO}_3, \text{H}_2\text{SO}_4} \]

15. Propose a synthesis of the following diene from benzene and compounds containing 4 carbon atoms or less. 10 pts

\[ ? \xrightarrow{?} \text{?} \]
16. Propose structures for compounds A and B. 10 pts

\[
\text{\begin{array}{c}
\text{\( \text{HNO}_3 \)} \\
\text{\( \text{H}_2\text{SO}_4 \)}
\end{array}} \xrightarrow{} \text{A} \xrightarrow{\text{Br}_2/\text{FeBr}_3} \text{B}
\]

17. Using the curved arrow formalism, show the bond making and bond breaking in the following transformation. 10 pts

\[
\text{\begin{array}{c}
\text{\( \text{\(C_6H_6\)} \)} \\
\text{\( \text{\(\text{CHO}^+\)} \)} \xrightarrow{\text{HCl}} \text{\( \text{\(C_6H_5\text{Cl}\)} \)}
\end{array}}
\]