Multiple Choice Questions: 50 points

1. Choose the product that forms when 1,6-cyclodecadione is treated with a warm sodium hydroxide solution.

\[
\text{1,6-cyclodecadione} + \text{NaOH} \xrightarrow{\text{heat}} ?
\]

A  
B  
C  
D  
E  
F

2. Choose the correct reactants for the following reaction.

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

A  
B  
C  
D  
E  
F

3. Choose the order that has the following amines correctly arranged with respect to increasing basicity.

\[
i \quad \text{NH}_2 \quad \text{H}
\]

A  
B  
C  
D  
E  
F
4. Select the reactant(s) that would give the following compound by an aldol condensation reaction.

\[
? \xrightarrow{\Theta \text{OH}} \text{heat} \rightarrow \overset{\text{H}}{\overset{\text{O}}{\text{\text{CH}_{2}}} \text{CHCH=CH}}
\]

A
\[\overset{\text{CH}_3}{\text{CHCH=CH}}\]

B
\[\overset{\text{CH}_3}{\text{CHCH=CH}}\]

C
\[\overset{\text{CH}_3}{\text{CHCH=CH}}\]

D
\[\overset{\text{CH}_3}{\text{CHCH=CH}}\]

E
\[\overset{\text{CH}_3}{\text{CHCH=CH}}\]

F

5. Select the amine(s), that upon Hofmann elimination, would produce 4,4-dimethyl-2-pentene as the major product.

\[
? \xrightarrow{\text{CH}_3\text{I, excess}} \xrightarrow{\text{Ag}_2\text{O, }\text{H}_2\text{O, heat}} \text{4,4-dimethyl-2-pentene}
\]

i
[structure]

ii
[structure]

iii
[structure]

A i
B ii
C iii
D i + ii
E i + iii
F ii + iii

6. Select the intermediate that is least likely formed during the course of the acid-catalyzed aldol reaction of acetone.

\[
\text{acetone} \xrightarrow{\text{H}_3\text{O}^+, \text{heat}} \overset{\text{H}_3\text{O}^+}{\overset{\text{H}_2\text{O}}{\text{\text{CH}}} \text{CHCH=CH}}
\]

A
\[\overset{\text{CH}_3}{\text{CHCH=CH}}\]

B
\[\overset{\text{CH}_3}{\text{CHCH=CH}}\]

C
\[\overset{\text{CH}_3}{\text{CHCH=CH}}\]

D
\[\overset{\text{CH}_3}{\text{CHCH=CH}}\]

E
\[\overset{\text{CH}_3}{\text{CHCH=CH}}\]

F
7. Select the correct reactant(s) that would produce the product of the following reaction sequence.

\[
\begin{align*}
\text{?} & \xrightarrow{\text{1. } \text{OEt}} \text{Et} & \xrightarrow{\text{1. } \text{OH}} \text{heat} & \text{EtC} \\
\text{i} & \xrightarrow{\text{2. } \text{H}^+} \text{ii} & \xrightarrow{\text{2. } \text{H}^+} \text{iii} & \text{iv}
\end{align*}
\]

A i  B ii  C i + iv  D iii  E ii + iii  F iii + iv

8. Choose the reaction(s), that beginning with benzyl bromide, would produce benzylamine as the major product.

\[
\begin{align*}
\text{PhCH}_2\text{Br} & \xrightarrow{\text{?}} \text{PhCH}_2\text{NH}_2 \\
\text{i} & \xrightarrow{\text{NH}_3 \text{ 1 eq.}} \text{ii} & \xrightarrow{\text{NaN}_3 \text{ 1. LiAlH}_4 \text{ 2. H}_2\text{O}} \text{iii}
\end{align*}
\]

A i  B ii  C iii  D i + ii  E i + iii  F ii + iii

9. Select the major product of the following reaction.

\[
\text{EtO}_2\text{C} = \text{C} = \text{OEt} + \text{C}_6\text{H}_8 \xrightarrow{\text{EtO}} \text{?}
\]

A  B  C  D  E
10. Tobacco smoke contains the following chemicals. From the following extraction procedure on a sample of condensed tobacco smoke, select where the nicotine would be found.

Short Answer Questions: 50 points

11. Give the structure of the major product of the following reaction sequence. 5 pts

12. Give the structure of the major product of the following reaction. 5 pts
13. Give the structure of the major product of the following reaction sequence. 5 pts

\[
\begin{align*}
\text{LDA} & \quad \text{LDA} \\
-78^\circ \text{C} & \quad -78^\circ \text{C} \\
\text{1. H}^+ \text{, heat} & \quad \text{1. H}^+ \text{, heat} \\
\text{C}_9\text{H}_{19}\text{NO} & \quad \text{C}_9\text{H}_{19}\text{NO}
\end{align*}
\]

14. Propose a synthesis of 3-bromophenol starting from benzene. You may use any reagents necessary. 7 pts

\[
\text{3-bromophenol}
\]

15. Based on the following reactions, clearly draw the structures of compounds A (C\text{\textsubscript{16}H\textsubscript{22}O\textsubscript{4}}) and B. 8 pts

\[
\begin{align*}
\text{A} \quad \text{C}_{16}\text{H}_{22}\text{O}_4 & \quad \text{C}_{16}\text{H}_{22}\text{O}_4 \\
\text{1. NaOEt} & \quad \text{1. NaOEt} \\
\text{2. H}^+ & \quad \text{2. H}^+ \\
\text{B} & \quad \text{B} \\
\text{1. OH}^- & \quad \text{1. OH}^- \\
\text{2. H}^+ & \quad \text{2. H}^+ \\
\text{3. heat} & \quad \text{3. heat}
\end{align*}
\]
16. Below is a variation of the Curtius rearrangement. Using the curved arrow formalism, show all the bond making and bond breaking steps. HINT: the first step will proceed with the same three-arrow rearrangement step as during the Curtius rearrangement. 10 pts

17. Propose a synthesis of the following secondary amine starting from benzene and any compound(s) containing three carbon atoms or less. 10 pts