Multiple Choice Questions: 50 points

1. Select the structure that is least likely to be an intermediate in the following Robinson annulation.

![Chemical structures](image)

2. Select the method(s) that produce(s) benzylamine as the major product.

![Chemical reactions](image)
3. Choose the best synthetic route for making the following amino alcohol from acetone.

\[
\begin{align*}
\text{CHO} & \rightarrow ? & \text{N}\text{-phenylethanol} \\
\text{NH}_2 & \rightarrow \text{1. } \text{PhMgBr} & \rightarrow \text{1. } \text{CH}_3\text{Li} \\
& \rightarrow \text{2. } \text{H}_2\text{O} & \rightarrow \text{2. } \text{H}_2\text{O}
\end{align*}
\]

\begin{align*}
i & \rightarrow \text{ii} & \rightarrow \text{iv} & \rightarrow \text{v} & \rightarrow \text{iii}
\end{align*}

A. \( iv \rightarrow v \rightarrow i \rightarrow ii \)
B. \( iii \rightarrow i \rightarrow ii \)
C. \( ii \rightarrow iv \rightarrow i \)
D. \( iii \rightarrow ii \rightarrow i \)
E. \( ii \rightarrow v \rightarrow iv \rightarrow i \)
F. \( iii \rightarrow iv \rightarrow ii \)

4. Select the compound that would not be one of the products formed from the following aldol condensation.

\[
\begin{align*}
\text{CH}_3\text{CHCH}_2\text{CHO} & + \text{PhCH}_2\text{CH}_2\text{CHO} & \rightarrow \text{OH}^- \rightarrow \\
\text{heat} & & \\
\text{A} & \rightarrow \text{B} & \rightarrow \text{C}
\end{align*}
\]

D. \( \text{PhCHCH}_2\text{CO} \)
E. \( \text{CH}_3\text{CHCH}_2\text{CH} = \text{CHPh} \)
F. \( \text{CH}_3\text{CHCH}_2\text{CH} = \text{CO} \)
5. The following flow chart summarizes a procedure for separating a mixture of phenacetin, ibuprofen and methamphetamine. Select the choice that gives the correct destinations on this flow chart at the end of the separation.

A. phenacetin = 1, ibuprofen = 2
B. phenacetin = 3, ibuprofen = 1
C. ibuprofen = 4, methamphetamine = 1
D. phenacetin = 5, methamphetamine = 1
E. ibuprofen = 3, methamphetamine = 4
F. phenacetin = 1, methamphetamine = 5

6. Choose the correct reactants for the following reaction.

A. i + iv  B. i + v  C. ii + iv  D. ii + v  E. iii + iv  F. iii + v
7. Choose the best method to synthesize the following $\alpha,\beta$-unsaturated ketone using two of the reactants shown below.

![Reaction Scheme]

A. Mix i with NaOH and then add ii dropwise.
B. Mix i with NaOH and then add iii dropwise.
C. Mix ii with NaOH and then add i dropwise.
D. Mix ii with NaOH and then add iii dropwise.
E. Mix iii with NaOH and then add i dropwise.
F. Mix i and ii with NaOH at the same time.

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

![Amine Structures]

A. 1 2 3 increasing basicity
B. 1 3 2 increasing basicity
C. 2 1 3 increasing basicity
D. 2 3 1 increasing basicity
E. 3 1 2 increasing basicity
F. 3 2 1 increasing basicity
9. Choose the major product of the following reaction.

\[
\text{\begin{align*}
\text{\text{CH}_2 \text{C(CH}_3)_2 \text{CH}_2 \text{OCH}_2 \text{CH}_2 \text{CH}_2 \text{CH}_2 \text{O}} & \xrightarrow{\text{OH}^- \ \text{heat}} ? \\
\text{H-C} & \text{O} \\
\text{H} & \text{O} \\
\text{A} & \text{B} & \text{C} \\
\text{D} & \text{E} & \text{F}
\end{align*}}
\]
12. Give the structure of the major product(s) of the following reaction sequence. 5 pts

\[
\begin{align*}
\text{N} & \quad \text{excess} \quad \text{CH}_3\text{I} \quad \text{Ag}_2\text{O} \quad \text{heat} \quad ? \\
\text{excess} & \quad \text{H}_2\text{O}
\end{align*}
\]

13. Give the structure of the major product(s) of the following reaction sequence. 7 pts

\[
\begin{align*}
\text{OCH}_3 & \quad \text{OCH}_3 \quad \text{NaOCH}_3 \quad \text{CH}_3\text{Br} \quad 1. \text{OH}^- \quad 2. \text{H}_3\text{O}^+ \quad 3. \text{heat} \quad ? \\
\text{OCH}_3 & \quad \text{OCH}_3
\end{align*}
\]

14. Give the structure of the major product(s) of the following reaction sequence. 7 pts

\[
\begin{align*}
\text{O} & \quad \text{HCN} \quad \text{KCN} \quad 1. \text{LiAlH}_4 \quad 2. \text{H}_2\text{O} \quad \text{PCC} \quad \text{H}_2 \quad \text{Ni} \quad ? \\
\text{C}_9\text{H}_{15}\text{N}
\end{align*}
\]

15. Propose a synthesis of meta-chlorofluorobenzene starting from benzene. You may use any reagents necessary. 8 pts

\[
\begin{align*}
\text{Cl} & \quad \text{F} \\
\text{F} & \quad \text{Cl}
\end{align*}
\]
16. Using the curved arrow formalism, show all the bond making and bond breaking steps of the following base-catalyzed retro-aldol reaction. 8 pts

\[
\begin{align*}
\text{H-O-C} & \quad \text{OH}^- \quad \text{heat} \\
\text{H-O-C} & \quad \rightarrow \quad \text{H-C=O} \quad \text{H-C=O}
\end{align*}
\]

17. Benzphetamine is an appetite suppressant drug sold under the brand name Didrex. Propose a synthesis of benzphetamine starting from benzene and any compound(s) containing three carbon atoms or less. 10 pts

\[
\text{benzphetamine}
\]