A chemist attempted to prepare an amide using the following scheme. Unfortunately the reaction only yielded 50% of the desired amide. The remaining acid chloride was hydrolyzed to the acid.

\[
\text{Cyclohexyl} \quad \text{Cl} + \quad \text{Cyclohexyl} \quad \text{NH}_2 \quad \xrightarrow{\text{H}_2\text{O}} \quad \text{Cyclohexyl} \quad \text{CONH} \quad \text{Cyclohexyl} \quad \text{NH}_2 \Rightarrow \quad \text{Cyclohexyl} \quad \text{COOH} + \quad \text{Cyclohexyl} \quad \text{CONH} \quad \text{Cyclohexyl} \quad \text{NH}_2 \quad \text{50% yield} \quad \text{50% yield}
\]

The mixture of the two products and unreacted amine were subjected to the following separation scheme.

1. Which flask contains the acid?  
   - D

2. Which flask contains the amide?  
   - E

3. Which flask contains the amine?  
   - B

Which of the compounds above would be a major product of each of the following reaction schemes?

4. 

\[
\text{Cyclohexyl} \quad \text{CH} \quad \xrightarrow{\text{base}} \quad - \text{H}_2\text{O} \quad \xrightarrow{\text{LiAIH}_4} \quad \text{B}
\]

5. 

\[
\text{Cyclohexyl} \quad \text{CH} \quad \xrightarrow{\text{base}} \quad \xrightarrow{\text{NaBH}_4} \quad \text{E}
\]
6. Identity the major product of the following reaction sequence.

\[
\begin{align*}
&\text{C}_6\text{H}_5 \quad \text{Br}_2 \quad \text{FeBr}_3 \quad \text{HNO}_3 \quad \text{Cl}_2 \quad \text{FeCl}_3 \quad 1. \text{NaNO}_2, \text{H}^+ \quad 2. \text{CuCN} \quad \text{E} \\
\end{align*}
\]

A  B  C  D  E  F

7. Hydrangenol, Y, is a compound isolated from the flowering plant Hydrangea. Investigations of its biosynthetic path shows that it comes from a primer compound X and three malonate-Co-A thioesters. Identify the most likely structure for the primer compound X. D

\[
\begin{align*}
&\text{X} \quad \text{Primer} \quad + \quad 3 \quad \text{HO-} \quad \text{O} \quad \text{S-CoA} \quad \rightarrow \quad \text{OH} \quad \text{O} \\
&\text{OH} \quad \text{O} \quad \text{S-CoA} \quad \text{C}_{15}\text{H}_{12}\text{O}_4 \quad \text{OH} \\
&\text{A} \quad \text{B} \quad \text{C} \quad \text{D} \quad \text{E} \quad \text{F}
\end{align*}
\]
8. Identify the major product of the following reaction sequence. A

\[
\text{A} \xrightleftharpoons{1. \text{HC≡CLi} \atop 2. \text{H}_2\text{O}} \xrightarrow{\text{heat}} \text{?} \xrightarrow{\text{C=O}} \text{= A}
\]

A

B

C

D

E

F

9. Johnny proposed the following reaction sequence for one of the problems of the day. Predict his intended product. B

\[
\text{B} \xrightarrow{1. \text{Br}_2 / \text{FeBr}_3 \atop 2. \text{Li, Et}_2\text{O}} \xrightarrow{1. \text{HBr} \atop 2. \text{Li, Et}_2\text{O}} \xrightarrow{1. \text{CO}_2 \atop 2. \text{H}^+ / \text{H}_2\text{O} \atop 2. \text{NH}_3} \xrightarrow{\text{Br}_2 / \text{NaOH} \atop \text{H}_2\text{O}}
\]

A

B

C

D

E

F
10. Predict the product of the following reaction. **C**

\[
\begin{align*}
\text{C} & \xrightleftharpoons{\text{OH}} \text{CH}_3 \text{CO} \\
\text{A} & \qquad \text{B} & \qquad \text{C}
\end{align*}
\]

11. Predict the product of the following reaction. **F**

\[
\begin{align*}
\text{Ph} & \text{CO} \text{OMe} \quad + \quad \text{HO} \text{CO} \text{OMe} \quad \xrightleftharpoons{\text{KOH}} \\
\text{A} & \qquad \text{B} & \qquad \text{C} & \qquad \text{D} & \qquad \text{E} & \qquad \text{F}
\end{align*}
\]

12. Predict the product of the following reaction. **B**

\[
\begin{align*}
\text{H}_3C-NCH_3 & \quad , \quad \text{H} \quad \text{H} \\
\text{A} & \qquad \text{B} & \qquad \text{C} & \qquad \text{D} & \qquad \text{E} & \qquad \text{F}
\end{align*}
\]
13. Predict the product of the following transformations. 5 pts

14. The following reaction sequence gives a trail pheromone of the pharaoh ant. Give the structure. 5 pts
15. Azinomycin B, is a potent antibiotic produced by the bacterial strain *streptomyces sahachiroi*. The complex compound contains a polyketide derived bicyclic aromatic acid, X.

The precursor is shown below. It undergoes two intramolecular aldol condensations, three dehydrations and thioester hydrolysis to give the product, a bicyclic aromatic acid.

Draw the structure of the bicyclic aromatic acid, X.  . 10 pts

The *Arndt-Eistert Homologation* is a reaction sequence in which a carboxylic acid is converted to an ester of the carboxylic acid one carbon longer than the starting material.  . 10 pts

A. Draw a curved arrow mechanism for the second step of the transformation. Clearly draw all intermediate species.

**Friday Homework**

B. Draw a curved arrow mechanism for the third step of the transformation. Clearly draw all intermediate species.

**Friday Homework**
16. The Arndt-Eisert Homologation (see previous problem) was used in the synthesis of the boll weevil sex pheromone, grandisol. 10 pts

Identify the structure of intermediate compounds X and Y and of the final product, Z. **Clearly Show all stereochemistry.**
17. Methyl jasmonate is a component of jasmine oil. Propose a racemic synthesis from carbon compounds of four carbons or less. 10 pts

Hint: Consider a Michael addition as one of carbon–carbon bond forming steps.