1. Use curved arrows to show the movement of pairs of electrons in the following acid-base reaction and show the structures of the conjugate acid and conjugate base.

\[ \text{Structure A} \rightarrow \text{Structure B} \]

ANS:

\[
\text{Structure A} \quad \rightarrow \quad \text{Structure B}
\]

2. Complete the equation below for the protonation of cyclohexene with HCl. Show the movement of pairs of electrons with curved arrows and provide the structures of the conjugate acid and conjugate base.

\[
\text{Cyclohexene} + \text{HCl} \rightarrow \text{Product}
\]

ANS:

\[
\text{Cyclohexene} \quad \rightarrow \quad \text{Product}
\]
3. What is the IUPAC name of the following compound?

   ![Compound Image]

a. 1,3-dimethylhexene  
b. 2,4-dimethyl-2-hexene  
c. 2,4-dimethyl-1-hexene  
d. 3,5-dimethyl-4-hexene

ANS: B

4. Consider the following two structures. Which one is the most stable?

   ![Structures Image]

ANS: The structure on the right represents the more stable form of this compound.
5. What is the major organic product obtained from the following reaction?

\[
\text{HBr} \quad \text{Br}\quad \text{1} \quad \text{Br} \quad \text{2} \quad \text{Br} \quad \text{3} \quad \text{Br} \quad \text{4}
\]

a. 1 

b. 2 

c. 3 

d. 4 

ANS: B

6. Draw a mechanism for the reaction above

7. What is the major organic product obtained from the following reaction?

\[\text{(CH}_3\text{)}_2\text{CHCH}_2\text{MgBr} \quad \text{Et}_2\text{O} \quad 1. \quad \text{H}_3\text{O}^+ \quad 2. \quad \text{1} \quad \text{2} \quad \text{3} \quad \text{4}\]

ANS:
a. 2,3-dimethyl-3-heptanol
b. 2,4-dimethyl-4-heptanol
c. 3,5-dimethyl-4-heptanol
d. 3,5-dimethyl-3-heptanol

ANS: B

8. Which combination(s) of alkyl bromide and carbonyl compound can be used to prepare the following product by addition of the Grignard reagent derived from the alkyl bromide to the carbonyl compound?

\[ \text{OH} \quad \Rightarrow \]

\[
\begin{array}{cccc}
(CH_3)_2CHBr & (CH_3)_2CHCH_2Br & CH_3CH_2CH_2Br & CH_3CH_2Br \\
1 & 2 & 3 & 4
\end{array}
\]

a. Only 1
b. only 3
c. only 1 and 3
d. only 2 and 4

ANS: B
9. Which combination(s) of alkyl bromide and carbonyl compound can be used to prepare the following product by addition of the Grignard reagent derived from the alkyl bromide to the carbonyl compound?

\[ \text{OH} \quad \text{CH}_3\text{Br} \quad \text{CH}_3\text{CH}_2\text{CH}_2\text{Br} \quad \text{CH}_3\text{CH}_2\text{Br} \quad (\text{CH}_3)_2\text{CHBr} \]

a. only 1 and 2  
b. only 3 and 4  
c. only 2 and 3  
d. only 1, 2 and 3  

ANS: A

10. What is the major organic product obtained from the following sequence of reactions?

\[ \text{HCN} \quad \text{1} \quad \text{2} \quad \text{3} \quad \text{4} \]
11. Which ketone-diol undergoes cyclization to form the following acetal?

a. 1
b. 2
c. 3
d. 4

ANS: A
12. What is the major organic product obtained from the following reaction?

\[
\text{H}_2\text{SO}_4 \quad 1 \quad 2 \quad 3 \quad 4
\]

a. 1
b. 2
c. 3
d. 4

ANS: C

13. What is the major organic product obtained from the following reaction?

\[
\text{NaBH}_4 \quad 1. \text{NaBH}_4 \quad 2. \text{H}_2\text{O}
\]

a. 2-methypentane
b. 4-methyl-2-pentanol
c. 4-methyl-1-pentene
d. \((E)\) 4-methyl-2-pentene

ANS: B
14. What is the major organic product obtained from the following sequence of reactions?

\[ \text{Br} \quad \text{HCOCH}_2\text{CH}_2\text{OH} \quad 1. \text{Mg, Et}_2\text{O} \quad \text{H}_2\text{SO}_4 \quad 2. \text{PhCH}_2\text{CHO} \quad \text{HCl, H}_2\text{O} \]

a. 1  
b. 2  
c. 3  
d. 4  

ANS: C

15. What is the major organic product obtained from the following reaction?

\[ \text{Br} \quad \text{1. Mg} \quad \text{2. CO}_2 \quad \text{3. H}_2\text{O}^+ \]

\[ 1 \]

\[ 2 \]

\[ 3 \]

\[ 4 \]

ANS: C
16. What is the major organic product obtained from the following reaction?

ANS: A

17. The strongest acid of the following is indicated by the Roman numeral ______.

\[
\begin{array}{cccc}
\text{CH}_3\text{CH}_2\text{COOH} & \text{BrCH}_2\text{CH}_2\text{COOH} & \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3 & \text{CH}_3\text{CH}_2\text{COOH} \\
\text{I} & \text{II} & \text{III} & \text{IV}
\end{array}
\]

ANS: IV
18. What is the major organic product obtained from the following reaction?

![Reaction diagram]

a. 1  
b. 2  
c. 3  
d. 4  
ANS: D

19. What is the major organic product obtained from the following reaction?

![Reaction diagram]

a. 1  
b. 2  
c. 3  
d. 4  
ANS: D
21. What is the best choice of reagent(s) to achieve the following transformation?

\[
\begin{array}{c}
\text{OCH}_3 \\
\end{array} \xrightarrow{?} \begin{array}{c}
\text{OH} \\
\end{array}
\]

a. \( \text{H}_2\text{O} \)
b. \( \text{NaOH, H}_2\text{O} \)
c. 1. \( \text{LiAlH}_4 \); 2. \( \text{H}_3\text{O}^+ \)
d. \( \text{H}_2\text{SO}_4 \)

ANS: C