Chapter 15 Practice Problems

1. What is the product of the following reaction?

![Reaction Diagram]

A. cyclohexanol
B. cyclohexane
C. cyclohexene
D. 1,2-cyclohexanediol

2. What is the product of the following reactions?

![Reaction Diagram]

A. CH₃CH₂CH₂CH₂CH₂CH₂CO₂H
B. CH₃CH₂CH₂CH₂CH₂CH₂OH
C. CH₃CH₂CH₂CH₃CH=CH₂
D. CH₃CH₂CH₂CH₂CH₂CH₃

3. Which of the following cannot be made by the reduction of a ketone or aldehyde with NaBH₄ in methanol?

A. 1-butanol
B. 2-butanol
C. 2-methyl-1-propanol
D. 2-methyl-2-propanol
4. An alcohol has the same oxidation state as a(n)
   A. ketone.
   B. alkene.
   C. organolithium compound.
   D. alkyl halide.

5. In general, the reduction of a ketone to an alcohol can be accomplished by all of the following except one. Which one will not reduce a ketone?
   A. $\text{H}_2/\text{Pt}$
   B. $\text{HIO}_4$
   C. $\text{LiAlH}_4$
   D. $\text{NaBH}_4$

6. What is the product of the following reaction?

   ![Diagram of a reaction](image)

   A. A
   B. B
   C. C
   D. D

7. Which one of the following is not readily oxidized by $\text{K}_2\text{Cr}_2\text{O}_7$ in $\text{H}_2\text{SO}_4/\text{H}_2\text{O}$?
   A. n-butyl alcohol
   B. sec-butyl alcohol
   C. isobutyl alcohol
   D. tert-butyl alcohol

8. In general, which one of the functional groups below does not react with $\text{LiAlH}_4$?
   A. esters
   B. ketones
   C. ethers
   D. carboxylic acids
9. Give the product of the following reaction.

\[
\text{\begin{align*}
\text{O} & \quad \text{(1) LiAlD}_4 \\
\text{\begin{array}{c}
\text{\_} \\
\text{\_} \\
\text{\_} \\
\text{\_} \\
\text{\_} \\
\text{\_} \\
\end{array}} & \quad \text{(2) H}_2\text{O} \\
\end{align*}}
\]

A) \( \text{CH}_3\text{CH}_2\text{CCH}_3 \)

B) \( \text{CH}_3\text{CH}_2\text{CCH}_3 \)

C) \( \text{CH}_3\text{CH}_2\text{CCH}_3 \)

D) \( \text{CH}_3\text{CH}_2\text{CCH}_3 \)

A. A  
B. B  
C. C  
D. D

10. Which of the following reagents would be used to carry out the transformation shown below?

\[
\text{\begin{align*}
\text{\begin{array}{c}
\text{\_} \\
\text{\_} \\
\text{\_} \\
\end{array}} & \quad \text{\begin{array}{c}
\text{\_} \\
\text{\_} \\
\text{\_} \\
\text{\_} \\
\text{\_} \\
\end{array}} & \quad ? \\
\end{align*}}
\]

A. \( \text{NaBH}_4 \)  
B. \( \text{LiAlH}_4 \)  
C. \( \text{H}_2/\text{Pt} \)  
D. \( \text{PCC/CH}_2\text{Cl}_2 \)
11. The reaction of a Grignard reagent with ethylene oxide followed by dilute acid gives

A. a primary alcohol.  
B. a secondary alcohol.  
C. a tertiary alcohol.  
D. methanol.

12. What is the product of the following reaction?

\[
\begin{array}{c}
\text{H}_3\text{C} \\
\text{C} = \text{C} \\
\text{H} \\
\text{CH}_3 \\
\text{OsO}_4, (\text{CH}_3)_3\text{COOH} \\
(\text{CH}_3)_3\text{COH}, \text{OH}
\end{array}
\]

A. \( \text{CH}_3\text{CH}=\text{O} \)  
B. \textit{meso}-2,3-butanediol  
C. racemic \( (2R,3R) \) and \( (2S,3S) \)-2,3-butanediol  
D. \textit{cis}-2,3-epoxybutane

13. Consider the conversion of 1-butanol to each of the compounds shown below. In which conversion is an oxidizing agent needed?

A. \( \text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2 \)  
B. \( \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br} \)  
C. \( \text{(CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{)}_2\text{O} \)  
D. \( \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}=\text{O} \)
14. Which of the following syntheses gives 3-methyl-1-hexanol?

A) 2-bromopentane \[ \xrightarrow{\text{Mg}} \text{diethyl ether} \] \[ \xrightarrow{\Delta} \text{O} \] \[ \xrightarrow{2} \text{H}^+ \]

B) 2-bromohexane \[ \xrightarrow{\text{Mg}} \text{diethyl ether} \] \[ \xrightarrow{1} \text{H}2\text{C}=\text{O} \] \[ \xrightarrow{2} \text{H}^+ \]

C) 3-bromopentane \[ \xrightarrow{\text{Mg}} \text{diethyl ether} \] \[ \xrightarrow{1} \text{CH}3\text{CH}=\text{O} \] \[ \xrightarrow{2} \text{H}^+ \]

D) 1-bromobutane \[ \xrightarrow{\text{Mg}} \text{diethyl ether} \] \[ \xrightarrow{1} \text{CH}3\text{CCH}3 \] \[ \xrightarrow{2} \text{H}^+ \]

A. A  
B. B  
C. C  
D. D

15. Identify the reagent needed to carry out the following conversion.

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

A. \( \text{K}_2\text{Cr}_2\text{O}_7, \text{H}_2\text{SO}_4/\text{H}_2\text{O} \)  
B. \( \text{PCC}/\text{CH}_2\text{Cl}_2 \)  
C. \( \text{HIO}_4 \)  
D. \( \text{OsO}_4, (\text{CH}_3)_3\text{COOH}, (\text{CH}_3)_3\text{COH}, \text{OH}^- \)

16. Which one of the following diols would cleave into two fragments with \( \text{HIO}_4 \)?

A. 1,3-hexanediol  
B. 2,4-hexanediol  
C. 3,4-hexanediol  
D. 1,6-hexanediol
17. Consider the structure of the \( \text{AlH}_4^- \) ion. The formal charge of Al is

A. –1.
B. 0.
C. +1.
D. +3.

18. As a reducing agent, \( \text{NaBH}_4 \) donates a __________ to a ketone or aldehyde.

A. proton
B. hydrogen atom
C. hydride ion
D. hydrogen molecule

19. Which of the following best describes the role of the coenzyme \( \text{NAD}^+ \) (nicotinamide adenine dinucleotide) in biological chemistry?

A. It reduces other species.
B. It oxidizes other species.
C. It catalyzes oxidation-reduction reactions.
D. It inhibits oxidation-reduction reactions.

20. What is the product of the synthetic sequence below?

A. A
B. B
C. C
D. D

A) \( \text{CH}_3\text{CO}_2\text{H} \)
B) \( \text{CHO} \)
C) \( \text{CHO} \)
D) \( \text{CH}_3\text{OH} \)