1. The final product, D, in the following reaction sequence,

\[
\begin{align*}
 &\text{CH}_3\text{CHOH} \quad \xrightarrow{\text{PBr}_3} \quad A \quad \xrightarrow{\text{ether}} \quad B \quad \xrightarrow{\text{Mg}} \quad C \quad \xrightarrow{\text{H}_2\text{O}^+} \quad D \\
 &\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \quad \text{CH}_3\text{CH}_2\text{CH}_2\text{Br} \quad \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \quad \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 \quad \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3
\end{align*}
\]

, would be?

A. 
B. 
C. 
D. 
E. 

2. What is the product, A, that would be obtained from the following reaction sequence?

\[
\begin{align*}
 &\text{C} \equiv \text{CH} \quad \xrightarrow{\text{CH}_3\text{CH}_2\text{MgBr}} \quad \text{CH}_3\text{CH} \quad \xrightarrow{\text{H}_2\text{O}^+} \quad A \\
 &\text{C} \equiv \text{C} \equiv \text{CH}_2 \text{CH}_3 \quad \text{C} \equiv \text{C} \equiv \text{CH} \quad \text{CHOCH}_2\text{CH}_3 \quad \text{CH}_3\text{CH}_2 \quad \text{C} \equiv \text{C} \equiv \text{CH} \quad \text{CHOH} \\
 &\text{C} \equiv \text{C} \equiv \text{CH} \quad \text{CHOH} \quad \text{C} \equiv \text{C} \equiv \text{O} \quad \text{CHCH}_2\text{CH}_3
\end{align*}
\]

A. I  B. II  C. III  D. IV  E. V

3. What would be the product, C, of the following reaction sequence?

\[
\begin{align*}
 &\text{CH}_3\text{CCH}_2\text{Br} \quad \xrightarrow{\text{Li}} \quad A \quad \xrightarrow{\text{CuI}} \quad B \quad \xrightarrow{\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}} \quad C \\
 &\text{CH}_3\text{CH}_2\text{CHCH}_3 \quad \text{CH}_3\text{CH}_2\text{CHCH}_3 \quad \text{CH}_3\text{CH}_2\text{CHCH}_3
\end{align*}
\]

A. 2,6-Dimethylheptane  B. 2,2-Dimethylpropane
C. 2-Methylpentane  D. 2,2,5-Trimethylhexane
E. 2,2,6-Trimethylheptane

4. What would be the product, O, of the following reaction sequence?

\[
\begin{align*}
 &\text{CH}_3\text{CH}_2\text{CH}_3 \quad \xrightarrow{\text{Mg}} \quad N \quad \xrightarrow{\text{D}_2\text{O}} \quad O \\
 &\text{CH}_3\text{CH}_2\text{CHCH}_3 \quad \text{CH}_3\text{CH}_2\text{CHCH}_3 \quad \text{CH}_3\text{CH}_2\text{CHCH}_3
\end{align*}
\]

A. CH₃CH₂CH₂CH₃  B. 
C. OD
5. What is the product, A, that would be obtained from the following reaction sequence?

A. I
B. II
C. III
D. IV
E. V

6. What would be the final product, A, in the following reaction sequence?

A. I
B. II
C. III
D. IV
E. V

7. What would be the major product of the following reaction?

A. (R)-3-ethyl-5-methylheptane
B. (R,S)-3-ethyl-5-methylheptane
C. (S)-3-ethyl-5-methylheptane
D. (3R,5S)-5-ethyl-3-methylheptane
E. (3S,5R)-5-ethyl-3-methylheptane

8. What is the principal product(s) formed when 1 mol of methylmagnesium iodide reacts with 1 mol of p-hydroxyacetophenone?

A. I
B. II
C. III
D. IV
E. V
9. What product(s) is/are produced in the 1:1 reaction of sec-butylmagnesium bromide with
\[ \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{C}==\text{O} \]

A. 

\[ \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{C}==\text{O} \quad \text{OMgBr} \]

B. 

\[ \text{CH}_3\text{CH}_2\text{CH}_2\text{C}==\text{O} \quad \text{OMgBr} \]

C. 

\[ \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{C}==\text{O} \quad \text{OH} \]

D. 

\[ \text{CH}_3\text{CH}_2\text{CH}_2\text{C}==\text{O} \quad \text{OMgBr} \]

E. 

CH3

10. What is the principal product of the following reaction:

\[ \text{CH}_3\text{CH}==\text{CH}_2 + \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{MgBr/ether; then H}_2\text{O} \]

A. 

\[ \text{CH}_3\text{CH}==\text{CH}_2 \quad \text{OH} \]

B. 

\[ \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3 \quad \text{OH} \]

C. 

\[ \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3 \quad \text{CH}_2\text{OH} \]

D. 

\[ \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3 \quad \text{CH}_2\text{OH} \]

E. 

CH3

11. The reaction of lithium diethylcuprate with 1-bromo-4,4-dimethylhexane yields:

A. 3,3-Dimethylheptane
B. 3,3-Dimethyloctane
C. 1-Ethyl-4,4-dimethylhexane
D. Di-4,4-dimethylhexylcuprate
E. None of the above

12. Which of the following synthetic procedures would be employed most effectively to transform ethanol into ethyl propyl ether?

A. Ethanol + HBr, then Mg/ether, then H₂O⁺, then NaH, then CH₂CH₂Br
B. Ethanol + HBr, then Mg/ether, then HCHO, then H₂O⁺, then NaH, then CH₂CH₂Br
C. Ethanol + CH₂CH₂CH₂OH + H₂SO₄/140°C
D. Ethanol + NaH, then HCHO, then H₂O⁺, then HBr, then Mg/ether, then CH₂CH₂CH₂Br
E. Ethanol + H₂SO₄/180°C, then CH₂CH₂CH₂Br
13. What compound(s) result(s) from the reaction of \( \text{CH}_3\text{CH}_2\text{CH}_2\text{MgBr} \) with \( \text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H} \) (1:1 mole ratio)?

A. \( \text{CH}_3\text{CH}_2\text{CH}_2\text{MgBr} + \text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H} \)
B. \( \text{CH}_3\text{CH}_2\text{CCH}_2\text{CH}_2\text{CH}_2\text{CH}_3 \)
C. \( \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COCH}_2\text{CH}_2\text{CH}_3 \)
D. \( \text{CH}_3\text{CH}_2\text{CH}_3 + \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CO}_2\text{MgBr} \)
E. \( \text{CH}_3\text{CH}_2\text{COCCCH}_2\text{CH}_2\text{CH}_2\text{CH}_3 \)

14. Your task is to synthesize \( \text{CH}_3\text{CH}_2\text{CH}_2\text{Br} \) through a Grignard synthesis. Which pairs of compounds listed below would you choose as starting materials?

A. \( \text{CH}_3\text{CH}_2\text{CH}_2\text{Br} \) and \( \text{CH}_3\text{CC}_6\text{H}_5 \)
B. \( \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 \) and \( \text{C}_6\text{H}_5\text{Br} \)
C. \( \text{C}_6\text{H}_5\text{CH} \) and \( \text{Br} \)
D. More than one of these. Which ones?
E. None of these

15. Your task is to synthesize 2-phenyl-2-hexanol through a Grignard synthesis. Which pair(s) of compounds listed below would you choose as starting materials?

A. \( \text{CH}_3\text{CH}_2\text{CH}_2\text{Br} \) and \( \text{CH}_3\text{CC}_6\text{H}_5 \)
B. \( \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 \) and \( \text{C}_6\text{H}_5\text{Br} \)
C. \( \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3 \) and \( \text{C}_6\text{H}_5\text{Br} \)
D. Answers A or B
E. Answers A or C

16. Which combination of reagents is to be preferred for the synthesis of 2,4-dimethylhexane by the Corey-Posner, Whitesides-House procedure?

A. Lithium diisobutylcuprate + sec-butyl bromide
B. Lithium dimethylcuprate + 2-bromo-4-methylhexane
C. Lithium dimethylcuprate + 4-bromo-2-methylhexane
D. Lithium diisopropylcuprate + 1-bromo-2-methylbutane
E. Lithium di(2-methylbutyl)cuprate + isopropyl bromide
17. Which of the following would serve as a synthesis of racemic 2-methyl-1-phenyl-2-butanol?

A. I
B. II
C. III
D. All of the above
E. None of the above

18. Which Grignard synthesis will produce an optically active product or product mixture?

A. \[ \text{MgBr} + \text{CH}_3\text{C}H_2\text{C}H_3 \rightarrow \text{Et}_2\text{O} \rightarrow \text{NH}_4^+ \]
B. \[ \text{MgCl} + \text{CH}_3\text{C}H_2\text{C}H_3 \rightarrow \text{Et}_2\text{O} \rightarrow \text{NH}_4^+ \]
C. \[ \text{CH}_3\text{C}H_2\text{I} + \text{CH}_3\text{C}H_2\text{C}H_3 \rightarrow \text{Et}_2\text{O} \rightarrow \text{NH}_4^+ \]
D. \[ \text{H}_3\text{C} + \text{MgBr} \rightarrow \text{Et}_2\text{O} \rightarrow \text{NH}_4^+ \]
E. None of the above

19. Which of the following is the strongest acid?

A. RMgX  B. Mg(OH)X  C. RH  D. H_2O

20. Which of the following is the strongest base?

A. RMgX  B. Mg(OH)X  C. RH  D. H_2O

21. Grignard reagents react with oxirane (ethylene oxide) to form 1° alcohols but can be prepared in tetrahydrofuran solvent. Why is this difference in behavior observed?

A. Steric hindrance in the case of tetrahydrofuran precludes reaction with the Grignard.
B. There is a better leaving group in the oxirane molecule.
C. The oxirane ring is the more highly strained.
D. It is easier to obtain tetrahydrofuran in anhydrous condition.
E. Oxirane is a cyclic ether, while tetrahydrofuran is a hydrocarbon.

22. Which of these compounds can be used to prepare the corresponding Grignard reagent?

A. CH_3CHOHCH_2CH_2CH_2Br
B. (CH_3)_2CHCHBrCH_2CH_2CO_2H
C. BrCH=CHCH_2CH_2CH_3
D. CH_3NHCHCH_2Br
E. None of the above can be used to prepare the corresponding Grignard reagent
23. Which of these compounds cannot be used to prepare the corresponding Grignard reagent?
   A. CH₃OCH₂CH₂CH₂Br  
   B. (CH₃)₃CCl  
   C. CH₂=CHCH₂Br  
   D. (CH₃)₂NCH₂CH₂Br  
   E. O=C(CH₂)₂

24. Which of these is the least reactive type of organometallic compound?
   A. RK  
   B. R₂Hg  
   C. RLi  
   D. R₂Zn  
   E. R₃Al

25. If the role of the solvent is to assist in the preparation and stabilization of the Grignard reagent by coordination with the magnesium, which of these solvents should be least effective?
   A. I  
   B. II  
   C. III  
   D. IV  
   E. V

26. Which of these is most likely to be a successful synthesis of an organometallic compound?
   A. CH₃CH₂CH₂MgBr + LiCl → CH₃CH₂CH₂Li + MgBrCl  
   B. 2 CH₃CH₂CH₂Li + ZnCl₂ → (CH₃CH₂CH₂)_2Zn + 2 LiCl  
   C. 3 (CH₃CH₂)₂Hg + 2 AlCl₃ → 2 (CH₃CH₂)_3Al + 3 HgCl₂  
   D. (CH₃CH₂)_3Al + 3 NaCl → 3 CH₃CH₂Na + AlCl₃  
   E. (CH₃)₂Cu + MgBr₂ → (CH₃)₂Mg + CuBr₂

27. What is the product of the following reaction?
   1) HO  
   2) OH  
   3) OH  
   4) OH

28. 1-Phenynaphthalene, shown below, can be prepared in over 80% yield by one of the reactions below. Which one?
   1) C₆H₆, AlCl₃  
   2) (C₆H₅)₂CuLi, diethyl ether  
   3) C₆H₅MgBr, diethyl ether  
   4) C₆H₅Br, AlCl₃
29. How many stereoisomers are formed in this reaction?
   A. just one      B. two      C. three      D. four

30. What is being made in this reaction?

31. What would be the final product, A, in the following reaction sequence?
   A. I      B. II      C. III      D. IV      E. V
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