1. For the molecule shown, which column gives the best answers to the questions given?

```
  CH3  CH3
 /    /    \\
\|   \|   \|   \\
H    H    H

Is the molecule chiral?  No     No      Yes        Yes
How many stereocenters does it contain?   0      2        1            2
Is it superposable on its mirror image? Yes    Yes       No         No
Does it have a plane of symmetry? Yes    Yes       No         No
Is it optically active?  No     No       Yes        Yes
Is it a meso compound? No    Yes        No        No
```

2. Which of the following compounds undergoes E1 reactions most readily?
   A. 1-chloropentane
   B. 2-chloropentane
   C. 2-chloro-2-methylbutane
   D. 2,2-dimethyl-1-chloropropane

3. The reaction shown yields:

```
CH3CH2
 /    /    \\
\|   \|   \\
\H    H
CH3

\( \text{C} \)CH2CH2CH2Br + Zn + HBr -----> ?
```

A. a pair of enantiomers
B. a single chiral compound without its enantiomer
C. a meso compound
D. only achiral compounds having no stereocenters
4. What is the name of the compound shown?

\[
\begin{align*}
\text{Cl} & \\
\text{CH}_2\text{CH}_3 & \\
\text{CH}_3\text{CH} & \\
\text{H} & \\
\text{H} & \\
\text{H} & \\
\end{align*}
\]

A. 4-chloroheptane  
B. 3-chloro-2-methylhexane  
C. 1-chloro-1-isopropylbutane  
D. 1-chloro-1-isopropyl-2-ethylethane

5. Which of the following statements about the relative stabilities of the structures shown is TRUE?

\[
\begin{align*}
\text{I} & \\
\text{II} & \\
\end{align*}
\]

A. I has more steric strain.  
B. I has more bond angle strain.  
C. II has more steric strain.  
D. II has more bond angle strain.

6. Which of the following structures of cyclohexane has the most bond angle strain?

\[
\begin{align*}
\text{A.} & \\
\text{B.} & \\
\text{C.} & \\
\text{D.} & \\
\end{align*}
\]

7. What is the relationship between the structures shown?

\[
\begin{align*}
\text{CH}_3\text{CH}_2 & \\
\text{CH}_3\text{CH}_2 & \\
\text{C} & \\
\text{Br} & \\
\text{Br} & \\
\text{C} & \\
\text{H} & \\
\text{H} & \\
\text{CH}_3 & \\
\end{align*}
\]

A. Structural isomers  
B. Diastereomers  
C. Enantiomers  
D. Same compound
8. What is the major organic product of the reaction sequence shown?

\[
\text{CH}_3\text{Br} \quad \text{H}_2, \text{Pt} \quad \text{Br}_2, \text{light} \\
\text{CH}_3\text{C≡CNa} \quad \rightarrow \quad \rightarrow \quad \rightarrow \quad \text{?}
\]
A. CH\text{C≡CH} \\
B. CH\text{C≡CCH}_3 \\
C. CH_3\text{CH}_2\text{CH}_3\text{Br} \\
D. CH_3\text{CH}_2\text{CHBrCH}_3

9. How many tetrahedral stereocenters are there in the compound shown?

\[
\text{H}_3\text{C} \quad \text{CO}_2\text{H}
\]
A. 1  B. 2  C. 3  D. 4

10. What is the relationship between the pair of compounds shown?

\[
\begin{array}{c|c}
\text{CHO} & \text{CHO} \\
\text{H} & \text{HO} \\
\text{HO} & \text{H} \\
\text{H} & \text{OH} \\
\text{CH}_2\text{OH} & \text{CH}_2\text{OH}
\end{array}
\]
A. Same compound  B. Enantiomers  C. Diastereomers  D. Constitutional isomers

11. What is the configuration of the compound shown?

\[
\begin{array}{c}
\text{CH}_3 \\
\text{H} \\
\text{Br} \\
\text{Br} \\
\text{H} \\
\text{CH}_2\text{CH}_3
\end{array}
\]
A. (2R,3R)  B. (2S,3S)  C. (2R,3S)  D. (2S,3R)
12. S\textsubscript{n}1 reactions occur most rapidly in which of the following substrates?

A. \( \text{C}_6\text{H}_5\text{Br} \)  B. \( \text{C}_6\text{H}_5\text{I} \)  C. \( \text{CH}_3\text{Br} \)  D. \( \text{CH}_3\text{I} \)

13. What is the major organic product of the S\textsubscript{n}2 reaction shown?

\[ \text{CH}_3\text{CH}_3\text{I} + \text{Br}^- \rightarrow ? \]

A. 1-butene  B. 2-butene  C. R-2-bromobutane  D. S-2-bromobutane

14. Which of the following molecules has a plane of symmetry?

A. \( \text{CH}_3\text{Br} \)  B. \( \text{Br} \)  C. \( \text{C}_6\text{H}_5\text{CO}_2\text{H} \)  D. \( \text{CH}_3\text{NH}_2 \)

15. Which of the following compounds is the best starting material for the reaction shown?

\[ ? \xrightarrow{\text{CH}_3\text{O}^-} \text{CH}_3\text{CH}_2\text{OH} \rightarrow \text{C}_6\text{H}_5\text{CH}_3 \]

A. \( \text{C}_6\text{H}_5\text{CH}_2\text{Br} \)  B. \( \text{CH}_3\text{O}^- \)  C. \( \text{BrCH}_3\text{CH}_3 \)  D. \( \text{CH}_3\text{Br} \)
16. Hydrogenation of a pure sample of the alkene shown gives a product that is ______.

\[ \text{CH}_3\text{CH} = \text{CH}_2 \quad \text{H}_2, \text{Ni} \quad \begin{array}{c} \text{CH}_2\text{CH}_3 \\ \text{CH}_3 \end{array} \quad \text{?} \]

A. a linear alkyne
B. a racemic mixture
C. a pure enantiomer
D. an achiral compound

17. Which of the following changes *increases* the rate of an S_{N}1 reaction?

A. Increasing the temperature
B. Using a less polar solvent
C. Decreasing the concentration of substrate
D. Increasing the concentration of nucleophile

18. Which of these compounds is a major organic product of the sequence of reactions shown?

\[ \text{H}_2, \text{Pt} \quad \text{Cl}_2, \text{light} \quad \begin{array}{c} \text{S}^\ominus \\ \text{CH}_3\text{CH} = \text{CH}_2 \end{array} \quad \text{?} \]

A. \( \text{CH}_3\text{CH}_2\text{CH}_2\text{Cl} \)
B. \( \text{ClCH}_2\text{CH}_2\text{CH}_2\text{S} \)
C. \( \text{CH}_3\text{CH}_2\text{CH}_2\text{S} \)
D. \( \text{CH}_2 = \text{CHCH}_2\text{S} \)

19. Which of the following reaction sequences gives \((\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CH}_3\) as the major organic product?

A. \( (\text{CH}_3)_2\text{CHCH}_2\text{C} = \text{CH} \quad \text{NaNH}_2 \quad \text{CH}_3\text{Br} \quad \text{H}_2, \text{Ni} \quad \text{?} \)
B. \( (\text{CH}_3)_2\text{CHC} = \text{CH} \quad \text{NaNH}_2 \quad \text{CH}_3\text{Br} \quad \text{H}_2, \text{Ni} \quad \text{?} \)
C. \( (\text{CH}_3)_2\text{CHCH}_2\text{C} = \text{CH} \quad \text{NaNH}_2 \quad \text{Zn, HCl} \quad \text{?} \)
D. \( (\text{CH}_3)_2\text{CHC} = \text{CH} \quad \text{NaNH}_2 \quad \text{Zn, HCl} \quad \text{?} \)
20. Which of these is the gauche conformation of 1-bromobutane?

A.  
\[
\begin{array}{c}
\text{Br} \\
\text{H} \\
\text{H} \\
\text{C} \quad \text{CH}_2\text{CH}_3
\end{array}
\]

B.  
\[
\begin{array}{c}
\text{Br} \\
\text{H} \\
\text{H} \\
\text{C} \quad \text{CH}_2\text{CH}_3
\end{array}
\]

C.  
\[
\begin{array}{c}
\text{Br} \\
\text{H} \\
\text{H} \\
\text{C} \quad \text{CH}_2\text{CH}_3
\end{array}
\]

D.  
\[
\begin{array}{c}
\text{Br} \\
\text{H} \\
\text{H} \\
\text{C} \quad \text{CH}_2\text{CH}_3
\end{array}
\]

21. A sample of R-2-chloropentane has an optical purity (enantiomeric excess) of 36%. What percentage of this sample is S-2-chloropentane?

A. 68%  B. 64%  C. 36%  D. 32%

22. Which of these represents the most stable conformation of cis-4-isopropylcyclohexanol?

A.  
\[
\begin{array}{c}
\text{H} \\
\text{H} \\
\text{HO} \\
\text{CH(CH}_3)_2
\end{array}
\]

B.  
\[
\begin{array}{c}
\text{H} \\
\text{H} \\
\text{HO} \\
\text{CH(CH}_3)_2
\end{array}
\]

C.  
\[
\begin{array}{c}
\text{H} \\
\text{H} \\
\text{HO} \\
\text{CH(CH}_3)_2
\end{array}
\]

D.  
\[
\begin{array}{c}
\text{H} \\
\text{H} \\
\text{HO} \\
\text{CH(CH}_3)_2
\end{array}
\]

23. The reaction of methanol with tert-butyl bromide gives methyl tert-butyl ether, \((\text{CH}_3)_3\text{COCH}_3\), as the major product. If the concentration of methanol is tripled, what happens to the rate of the reaction?

A. It triples.  
B. It remains the same.  
C. It decreases to 1/3 of the original rate  
D. It doubles.
24. What is the relationship between the structures shown?

\[
\begin{array}{cc}
\text{CH}_3 & \text{Br} \\
/ & / \\
C=C & C=C \\
/ & / \\
H & H & \text{Br} & \text{CH}_3 & H
\end{array}
\]

A. Same compound
B. Enantiomers
C. Diastereomers
D. Constitutional isomers

25. The two compounds whose structures are shown have _____ melting points. Their rotation of plane-polarized light would be _____.

\[
\begin{array}{cc}
\text{H} & \text{H} \\
\text{CH}_3 & \text{CH}_3 \\
\text{CH}_3 & \text{CH}_3
\end{array}
\]

A. equal . . . equal in magnitude but in opposite directions
B. equal . . . identical
C. different . . . both equal to zero
D. different . . . different