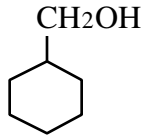
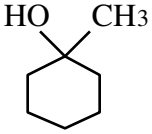
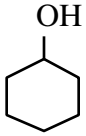
1. Which of the following compounds is a primary alcohol?

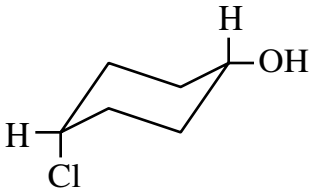
A. 

B. 

C. 

D. 

2. What is the name of the compound shown?



A. *trans*-4-chlorocyclohexanol
B. *cis*-4-chlorocyclohexanol
C. *trans*-1-chloro-4-cyclohexanol
D. *cis*-1-chloro-4-cyclohexanol

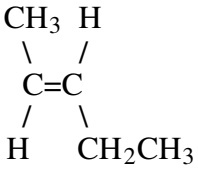
3. Which of the following statements about ethanol, CH_3CH_2OH, is true?

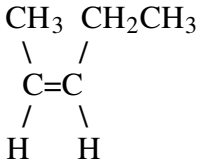
A. It contains one π bond.
B. It contains six σ bonds.
C. The C-O-H bond angle is approximately 120˚.
D. The H-C-H bond angles are approximately 109.5˚.

4. Which of the alkenes shown has the greatest heat of combustion?

A. $CH_2=CHCH_2CH_2CH_3$

B. $(CH_3)_2C=CHCH_3$

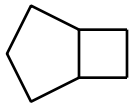
C. 

D. 

5. Which of the compounds shown is isobutyl chloride?

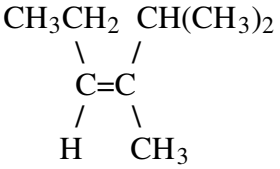
A. $(CH_3)_3CCl$
B. $CH_3CHClCH_2CH_3$
C. $(CH_3)_2CHCH_2Cl$
D. $CH_3CH_2CH_2CH_2Cl$

6. What is the name of the compound shown?



A. Bicyclo[4.1.0]heptane
B. Bicyclo[3.1.1]heptane
C. Bicyclo[3.2.0]heptane
D. Bicyclo[5.4.0]heptane

7. Which of the following designations describes the compound at right?

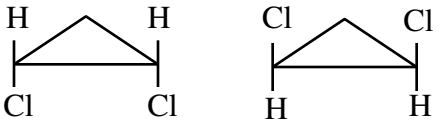


A. E
B. Z
C. cis
D. trans

8. What is the most important reason for the fact that cyclohexane is the most stable of the cycloalkanes of twelve carbons or less?

A. There is eclipsing along two of the carbon-carbon bonds in the boat conformation.
B. There is eclipsing along four of the carbon-carbon bonds in the chair conformation.
C. Both torsional and bond angle strain are minimized in the chair conformation.
D. Both torsional and bond angle strain are minimized in the boat conformation.

9. What is the relationship between the compounds shown?



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

10. Which of the following nucleophiles is the most reactive?

A. CH_3COOH B. CH_3COO^- C. CH_3OH D. CH_3O^-

11. Which of these is the best method for preparing 1-bromopropane, $CH_3CH_2CH_2Br$?

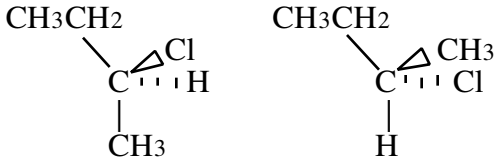
A. $CH_3CH_2CH_3 + Br_2 \xrightarrow{CCl_4}$

B. $CH_3CH_2CH_3 + Br_2 \xrightarrow{light}$

C. $CH_3CH{=}CH_2 + HBr \xrightarrow{peroxides}$

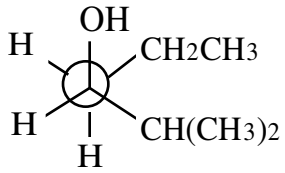
D. $CH_3CH{=}CH_2 + HBr \xrightarrow{no\ peroxides}$

12. What is the relationship between the compounds shown?



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

13. What is the name of the compound shown?



A. 4-heptanol
B. 2-methyl-3-hexanol
C. 1-isopropyl-1-butanol
D. 1-isopropyl-2-ethylethanol

14. Two structures are both superimposable on each other and the mirror images of one another. What is the relationship between them?

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

15. Which of the following reactions yields $(CH_3)_3CCl$?

A. $(CH_3)_3COH + HCl \longrightarrow$

B. $(CH_3)_2C{=}CH_2 + Cl_2 \xrightarrow{CCl_4}$

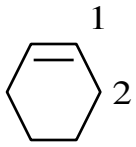
C. $(CH_3)_2CHCH_2OH + SOCl_2 \longrightarrow$

D. $(CH_3)_3CH + Cl_2 \xrightarrow{CCl_4}$

16. Which of the following acid-base reactions occurs as shown?

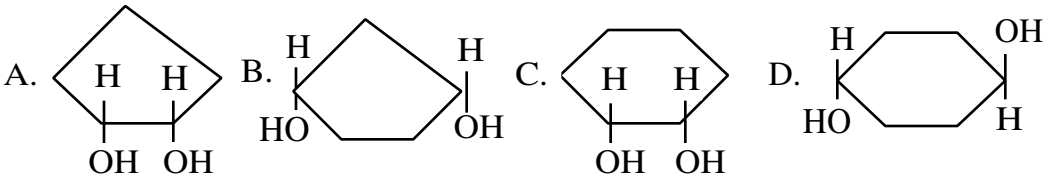
A. $CH_3COONa + HC{\equiv}CH \longrightarrow CH_3COOH + HC{\equiv}CNa$
B. $CH_3ONa + HC{\equiv}CH \longrightarrow CH_3OH + HC{\equiv}CNa$
C. $NaOH + HC{\equiv}CH \longrightarrow H_2O + HC{\equiv}CNa$
D. $CH_3NHNa + HC{\equiv}CH \longrightarrow CH_3NH_2 + HC{\equiv}CNa$

17. What are the hybridizations of the carbon atoms numbered 1 and 2 in the structure shown?

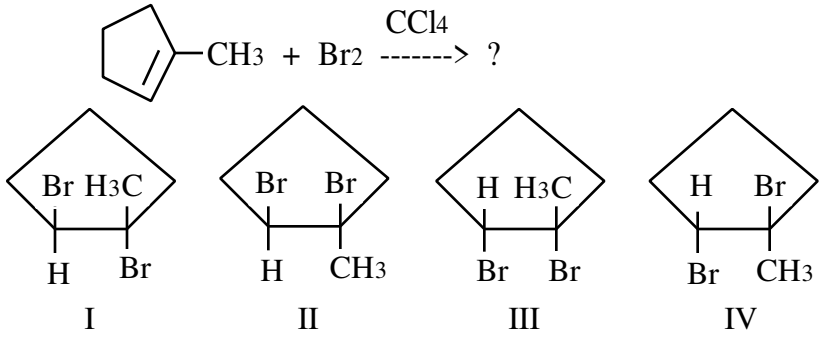


A. sp^2, sp^3 B. sp^2, sp^2 C. sp, sp^3 D. sp, sp^2

18. Which of the following is NOT a meso compound?

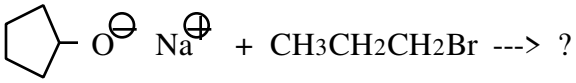


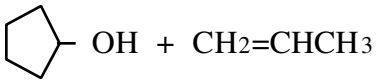
19. What are the major products of the reaction shown?



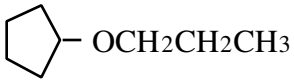
A. I and III B. I and IV C. II and III D. II and IV

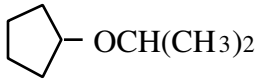
20. What is/are the major organic product(s) of the reaction shown?



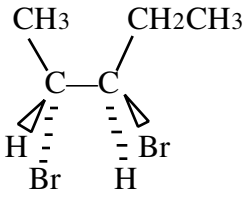
A. 

B. 

C. 

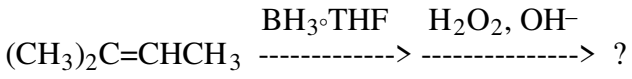
D. 

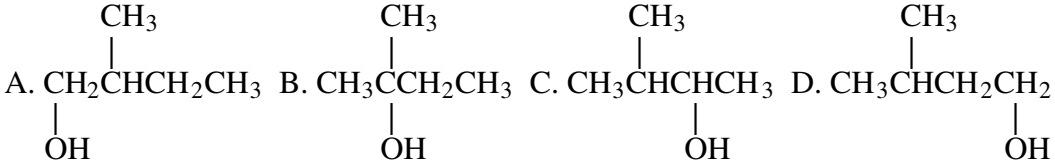
21. What is the configuration of the molecule shown?



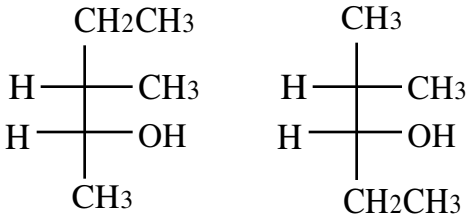
A. 2S, 3S B. 2S, 3R C. 2R, 3S D. 2R, 3R

22. What is the major organic product of the reaction shown?





23. What is the relationship between the compounds shown?



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

24. Which of the following solutions can be used in a test to distinguish between the compounds CH_2=$CHCH_2CH_3$ and CH_2=$CHCH_2CH_2Br$?

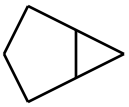
A. conc. H_2SO_4 B. Br_2/CCl_4 C. $AgNO_3$/ethanol D. $KMnO_4/H_2O$

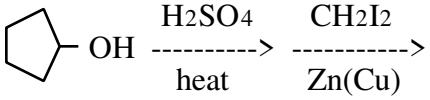
25. What is the best explanation for the relative stabilities of the gauche and anti forms of butane? The _____ form has more _____ strain.

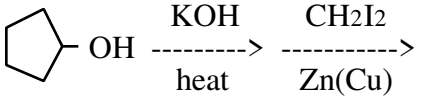
A. gauche . . . torsional
B. gauche . . . steric
C. anti . . . torsional
D. anti . . . steric

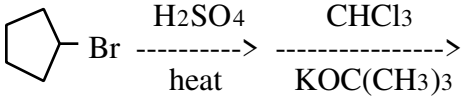
26. What are the predicted shape and bond angle of formaldehyde, H_2C=O?

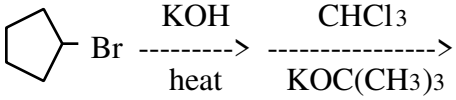
A. Trigonal pyramid, 109.5˚
B. Trigonal planar, 109.5˚
C. Trigonal pyramid, 120˚
D. Trigonal planar, 120˚

27. Which of the following sequences can be used to make  ?

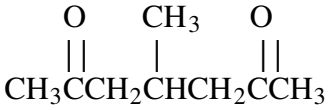
A. 

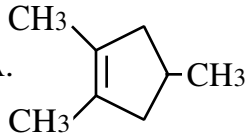
B. 

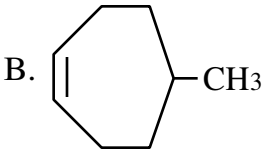
C. 

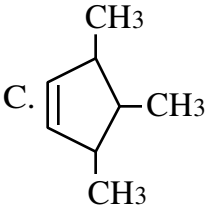
D. 

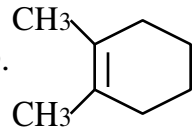
28. An unknown alkene was subjected to ozonolysis, and the product of the reaction was the compound shown. What is the structure of the unknown?



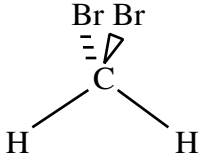
A. 

B. 

C. 

D. 

29. Which of the arrows gives the direction of the dipole moment of the molecule shown?



A.  B.  C.  D. 

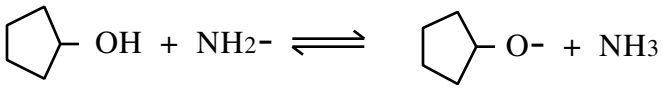
30. Which of the following sequences gives cyclohexane from cyclohexanol?

A. KOH, alcohol, heat; then Zn, HCl
B. Zn, HCl; then H_2, Pd
C. H_2, Ni; then H_2SO_4, heat
D. H_2SO_4, heat; then H_2, Pt

31. Which of the following compounds is the least soluble in water?

A.  B.  C.  D. 

32. What are the bases in the reaction shown?



I II III IV

A. I and III B. I and IV C. II and III D. II and IV

33. What is the value of ΔH in kJ mol^{-1} for the reaction below? Bond energies in kJ mol^{-1} are: CH_3CH_2-OH, 383; CH_3CH_2O-H, 431; HO-H, 498; CH_3CH_2-OCH_2CH_3, 335.

$$2\ CH_3CH_2OH \text{ ---> } H_2O + CH_3CH_2OCH_2CH_3$$

A. +29 B. -19 C. -67 D. -96

34. Which of the S_N2 reactions below is the FASTEST?

A. $CH_3Br + HC{\equiv}C^- \text{ ---> } CH_3C{\equiv}CH + Br^-$
B. $CH_3Br + HC{\equiv}CH \text{ ---> } CH_3C{\equiv}CH + HBr$
C. $CH_3CH_2Br + HC{\equiv}C^- \text{ ---> } CH_3CH_2C{\equiv}CH + Br^-$
D. $CH_3CH_2Br + HC{\equiv}CH \text{ ---> } CH_3CH_2C{\equiv}CH + HBr$

35. One of the two carbon-carbon bonding orbitals in ethylene, $H_2C{=}CH_2$, is formed from the overlap of ____ orbitals on the carbons, and the other is formed from the overlap of _____ orbitals.

A. sp, p B. sp^2, p C. sp^2, sp D. p, p

36. Rate data for the reaction shown is given in the table at right. What is the mechanism of this reaction?

Run no.	$[CH_3CH_2I]$	$[CH_3O^-]$	Rel. Rate
1	0.01	0.01	1
2	0.02	0.01	2
3	0.01	0.02	2

$$CH_3CH_2I + CH_3O^- \longrightarrow CH_3CH_2OCH_3 + I^-$$

A. S_N1 B. S_N2 C. E1 D. E2

37. Which of the carbocations shown do NOT rearrange?

I. $CH_3CH_2CH_2\overset{+}{C}H_2$ II. $CH_3\overset{+}{C}HCH_2CH_3$ III. $(CH_3)_2CH\overset{+}{C}H_2$ IV. $(CH_3)_3\overset{+}{C}$

A. I and III B. I and IV C. II and III D. II and IV

38. Which of the following compounds has the highest boiling point?

A. CH_3CH_2ONa B. $CH_3CH_2OCH_3$ C. $CH_3CH_2CH_2CH_3$ D. $CH_3CH_2CH_2OH$

39. Which of the following is the best synthesis of cyclohexene from cyclohexane?

A. KOH, alcohol
B. H_2SO_4, heat
C. Br_2, light; then KOH, alcohol
D. Br_2, CCl_4; then H_2SO_4, heat

40. Which of the following is a sigma (σ) bonding orbital? Nuclei are indicated by solid dots, and the signs of the wave functions are shown.