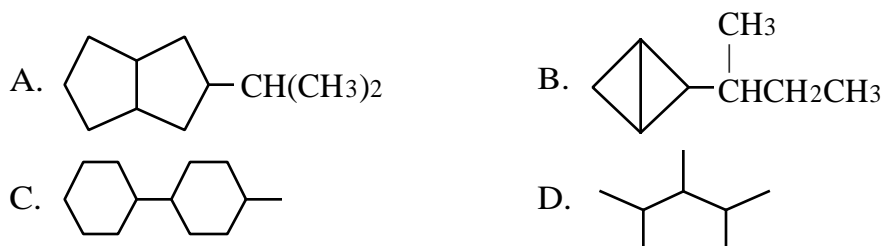
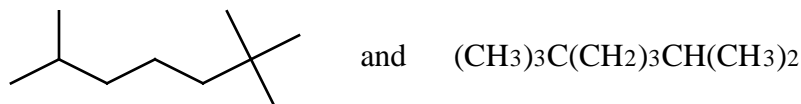


1. Which of the following bond angles is the LARGEST?
- A. H—O—H in H<sub>2</sub>O  
 B. H—C—O in CH<sub>3</sub>OH  
 C. C—C—O in CH<sub>2</sub>=CH-OH  
 D. C—O—C in CH<sub>3</sub>OCH<sub>3</sub>
2. A compound with the formula C<sub>4</sub>H<sub>8</sub>O can belong to any of the following families of organic compounds EXCEPT which one?
- A. ketone    B. carboxylic acid    C. ether    D. alcohol
3. Which of the following compounds contains the MOST secondary hydrogen atoms?

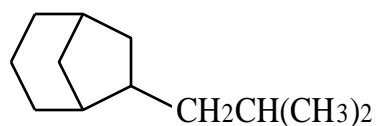


4. What is the relationship between the structures shown?

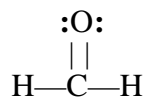


- A. Different compounds that are isomers  
 B. Different compounds that are not isomers  
 C. The same compound  
 D. Resonance structures
5. Which of the following compounds has the highest boiling point?
- A. CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>OCH<sub>3</sub>                      B. CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>  
 C.  $\begin{array}{c} \text{CH}_3-\text{N}-\text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$                                       D.  $\begin{array}{c} \text{CH}_3\text{CH}_2\text{CH}_2-\text{N}-\text{H} \\ | \\ \text{CH}_3 \end{array}$

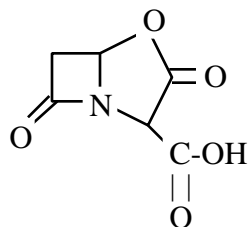
6. What is the name of the compound shown?



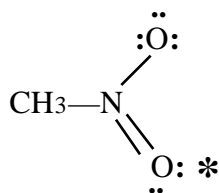
- A. 7-*tert*-butylbicyclo[3.2.1]octane  
B. 6-isobutylbicyclo[3.2.1]octane  
C. 3-isobutylbicyclo[3.2.1]octane  
D. 2-*tert*-butylbicyclo[3.2.1]octane
7. What type of orbital is occupied by the nonbonding electron pairs in the molecule shown?



- A.  $sp^2$     B.  $sp^3$     C. s    D. p
8. What functional groups are present in the molecule shown?

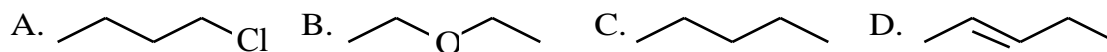


- A. Ester, amide, carboxylic acid  
B. Amine, ketone, ester, carboxylic acid  
C. Amide, ether, carboxylic acid, ketone  
D. Ether, amide, carboxylic acid
9. In the structure shown, what are the formal charges on the nitrogen atom and the starred oxygen atom, respectively?

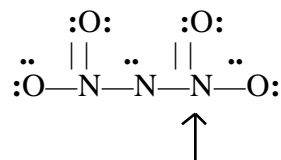


- A. +1, 0    B. +1, -1    C. 0, 0    D. 0, -1

10. Which of the compounds shown is the most soluble in water?

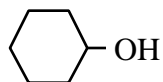


11. In the dinitramide ion (shown below without charges), what are the shape and approximate bond angles of the portion of the molecule around the indicated atom?



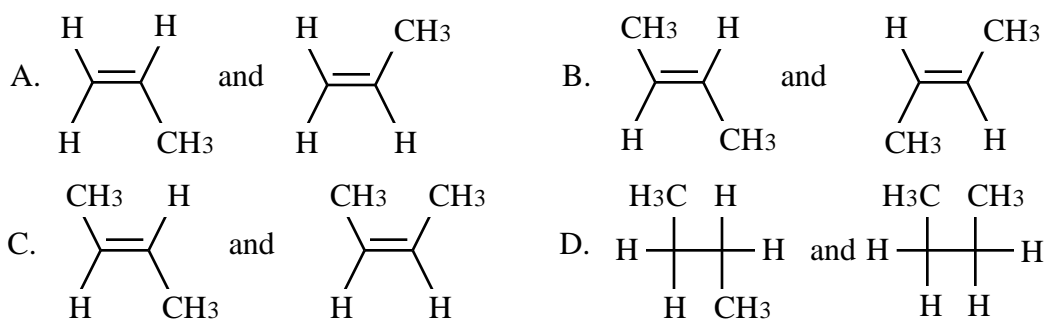
- A. Trigonal planar,  $120^\circ$   
B. Trigonal pyramid,  $120^\circ$   
C. Trigonal planar,  $109.5^\circ$   
D. Trigonal pyramid,  $109.5^\circ$

12. The IR spectrum of the compound shown contains a peak in which of the following regions?

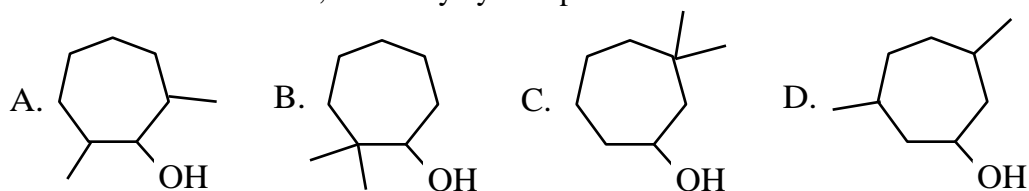


- A.  $1620\text{--}1680\text{ cm}^{-1}$   
B.  $2100\text{--}2260\text{ cm}^{-1}$   
C.  $3200\text{--}3550\text{ cm}^{-1}$   
D.  $2220\text{--}2260\text{ cm}^{-1}$

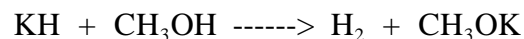
13. Which of these is a pair of isomers?



14. What is the structure of 2,2-dimethylcycloheptanol?

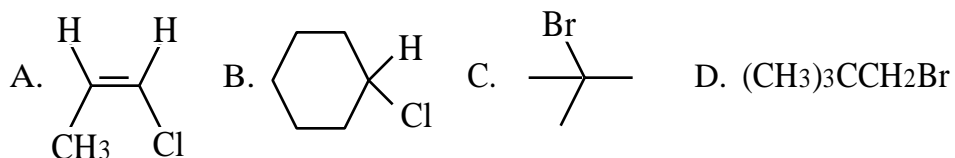


15. In the reaction shown, \_\_\_\_\_ is the conjugate \_\_\_\_\_ of  $\text{CH}_3\text{OH}$ .

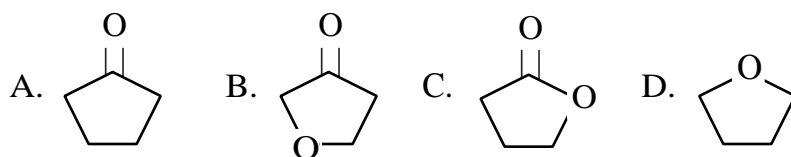


- A.  $\text{H}_2$  ... acid
- B.  $\text{H}_2$  ... base
- C.  $\text{CH}_3\text{OK}$  ... acid
- D.  $\text{CH}_3\text{OK}$  ... base

16. Which of the following compounds is a  $3^\circ$  alkyl halide?



17. Which of the following compounds is both an ether and a ketone?

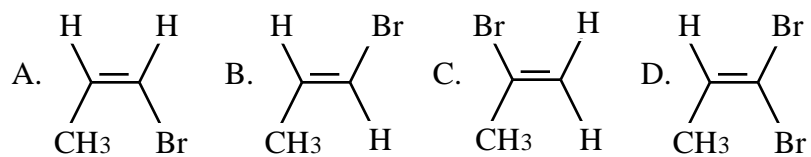


18. What is the IUPAC name of the compound shown?

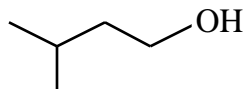


- A. 6-*tert*-butyl-2-methyl-3-hexanol
- B. 4-*tert*-butyl-1-isopropyl-1-butanol
- C. 2,2,7-trimethyl-6-octanol
- D. 2,7,7-trimethyl-3-octanol

19. Which of the following compounds is *cis*?

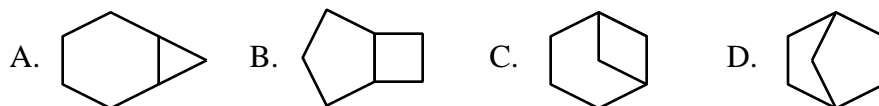


20. What is the IUPAC name of the compound shown?

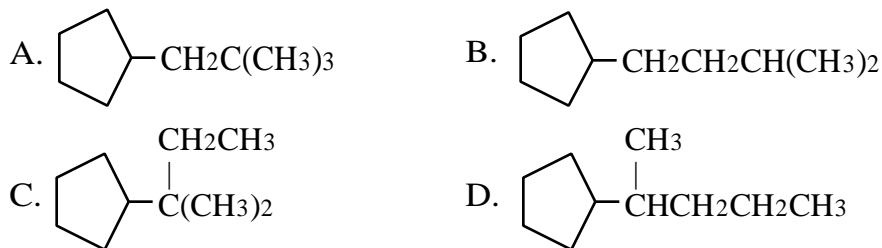


- A. 2-Methyl-4-butanol  
B. 2-methylbutanol  
C. 3-methyl-1-butanol  
D. 3-methylbutanol

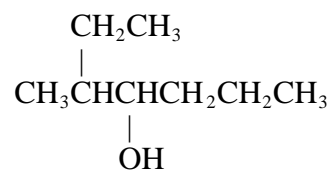
21. Which of the following compounds is bicyclo[3.2.0]heptane?



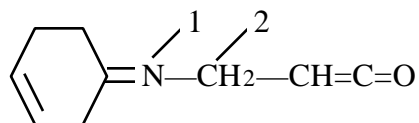
22. Which of the following compounds is neopentylcyclopentane?



23. What is the IUPAC name of the compound shown?



- A. 3-methyl-4-heptanol  
B. 2-ethyl-3-hexanol  
C. 5-ethyl-4-hexanol  
D. 5-methyl-4-heptanol
24. What are the hybridizations of atoms 1 and 2, respectively?



- A. sp, sp<sup>2</sup>    B. sp, sp<sup>3</sup>    C. sp<sup>2</sup>, sp<sup>2</sup>    D. sp<sup>2</sup>, sp<sup>3</sup>
25. What kind of orbital is the one illustrated? Nuclei are indicated by solid dots, and the signs of the wave functions are shown.



- A. sigma ( ) atomic    B. sigma ( ) molecular    C. hybrid atomic    D. hybrid molecular