

Preparation for the Exam 1

- Structural Theory (formal charges, valency, Lewis structures, octet rule, electron configuration)
- Hybridization
- Resonance
- Acid-base theory (Bronsted-Lowry, Lewis)
- Functional groups
- Nomenclature (naming of alkanes)
- Alkene conformations (Newman projection)

Formal charge

1. What is the formal charge of the nitrogen atom in the following structure?

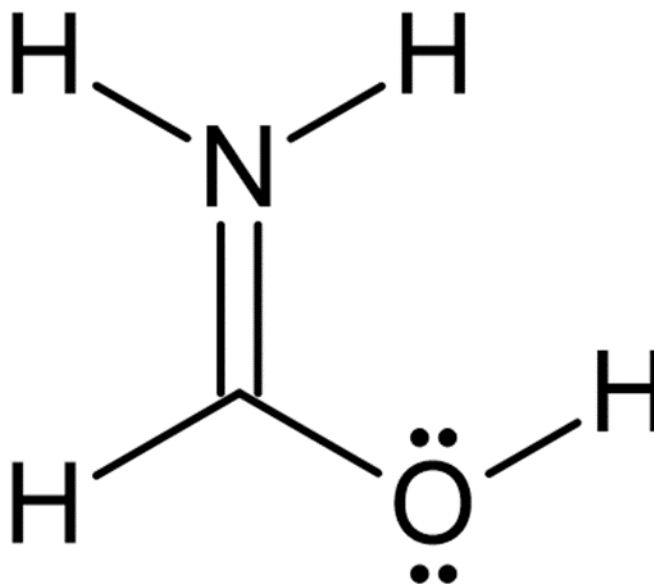
a. +2

b. +1

c. 0

d. -1

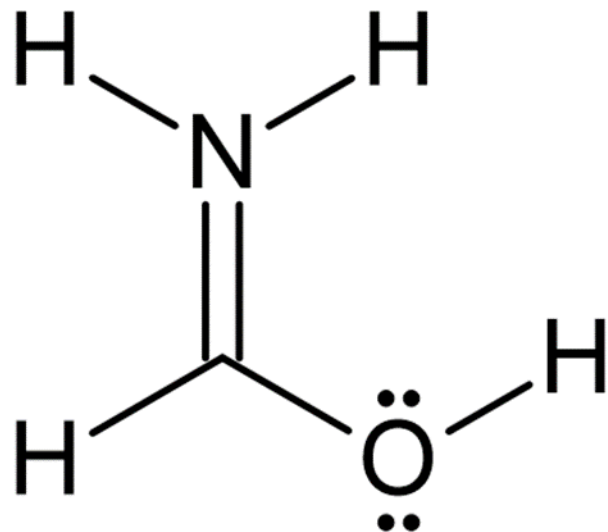
e. -2



Question 1 Answer

Answer: b. +1

For more examples of this type of problem, see SkillBuilder 1.3.



Electron configuration

2. What is the electron configuration of an oxygen ion with a single positive charge and what neutral atom shares the same electron configuration?

- A. $1s^2 2s^2 2p^3$, nitrogen
- B. $1s^2 2s^2 2p^3$, fluorine
- C. $1s^2 2s^1 2p^4$, nitrogen
- D. $1s^2 2s^1 2p^4$, fluorine

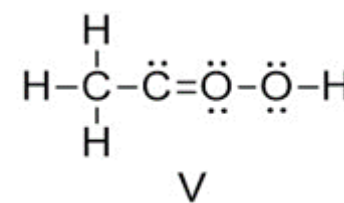
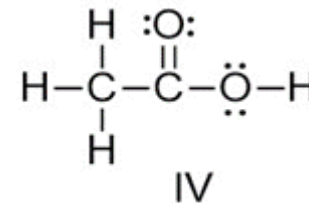
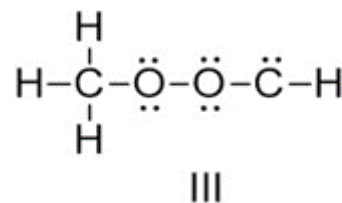
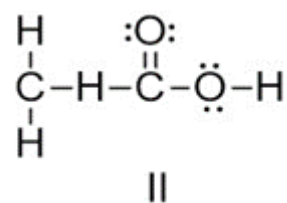
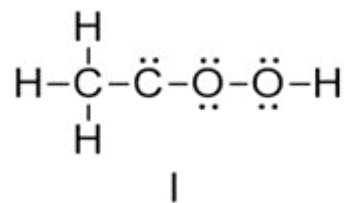
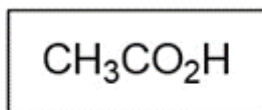
Question 2 Answer

Answer: a ($1s^2 2s^2 2p^3$, nitrogen)

A positive charge will subtract one electron from the electron configuration of an atom. Oxygen (atomic number 8) with a positive charge will have 7 electrons and have the same electron configuration as neutral nitrogen. For more examples of this type of problem, see SkillBuilder 1.6.

Lewis structure

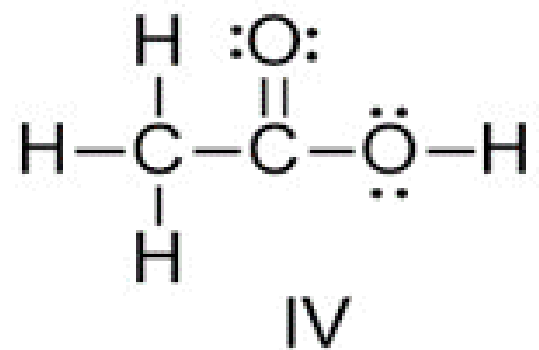
3. What is the correct Lewis structure for the molecule shown in the box below?



Question 3 Answer

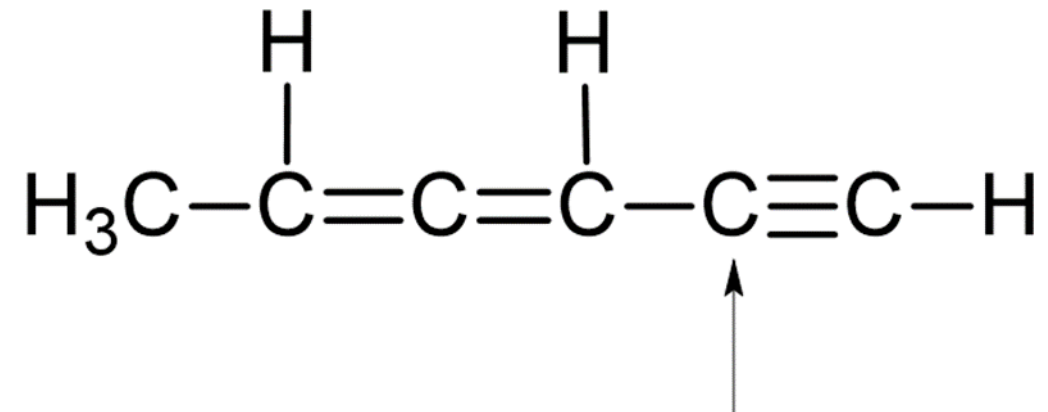
Answer: d (IV)

For more examples of this type of problem, see SkillBuilder 1.2 and 1.3.

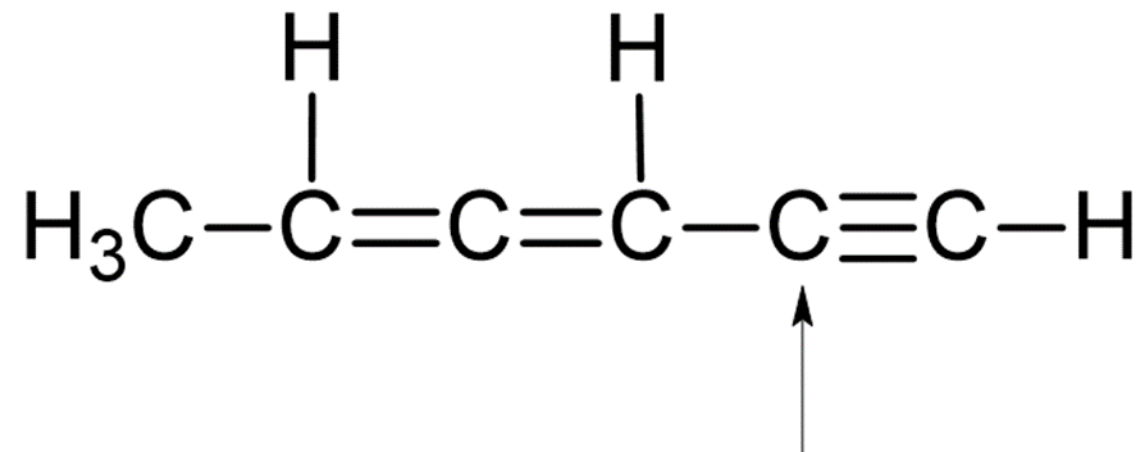


Hybridization

4. What is the hybridization of the indicated atom in the following structure?



Question 4 Answer

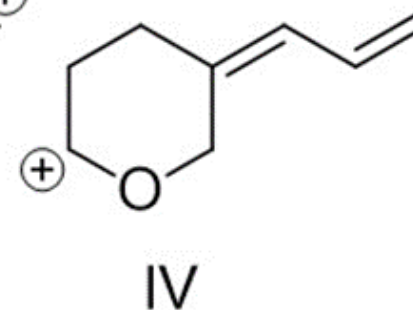
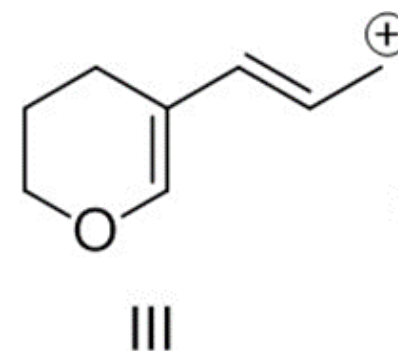
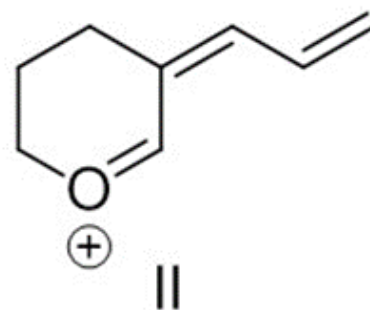
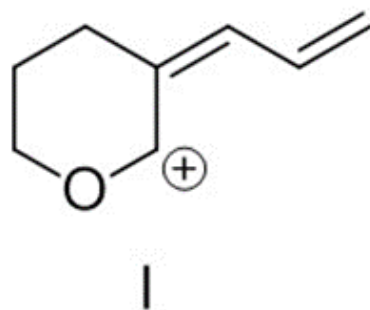
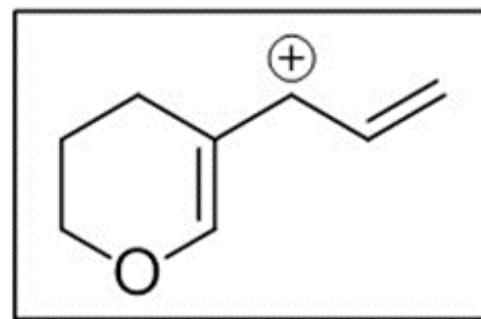


Answer: sp

For more examples of this type of problem, see SkillBuilder 1.7.

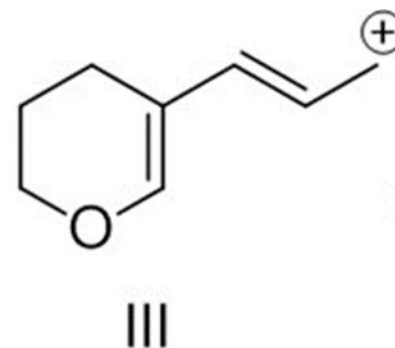
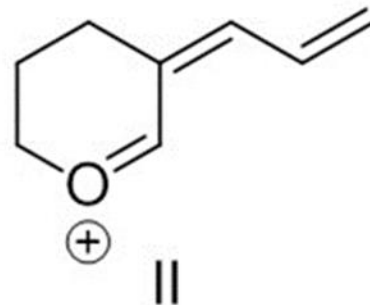
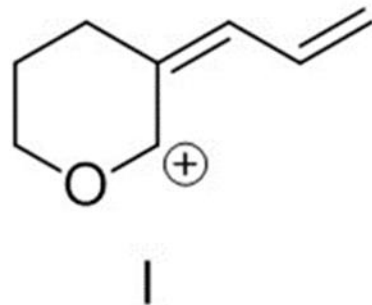
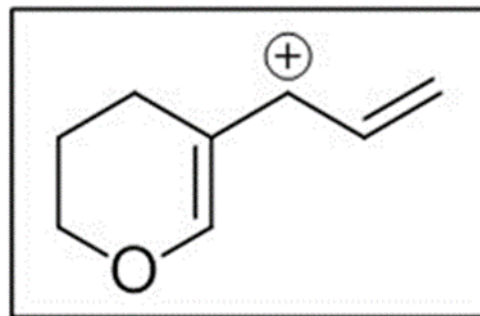
Resonance

5. For the structure shown in the box below identify corresponding correct resonance structures.



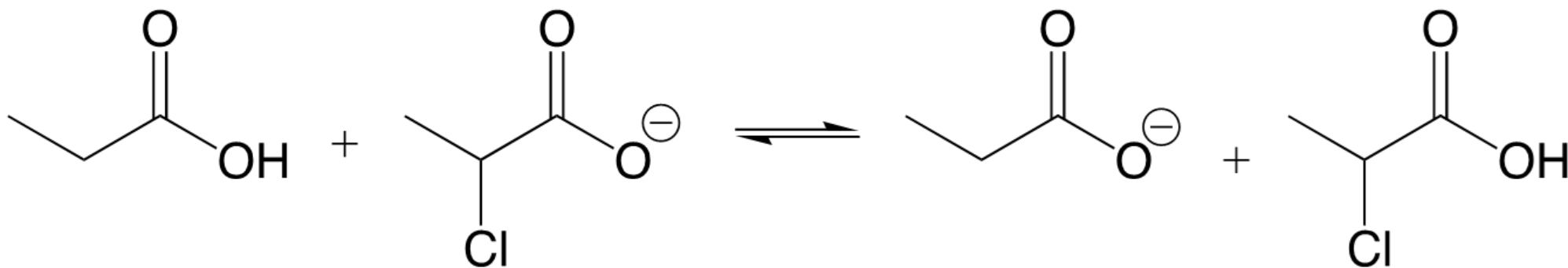
Question 5 Answer

Answer: I, II and III



Acid-base theory (Bronsted-Lowry, Lewis)

6. In which direction does the following equilibrium lie?



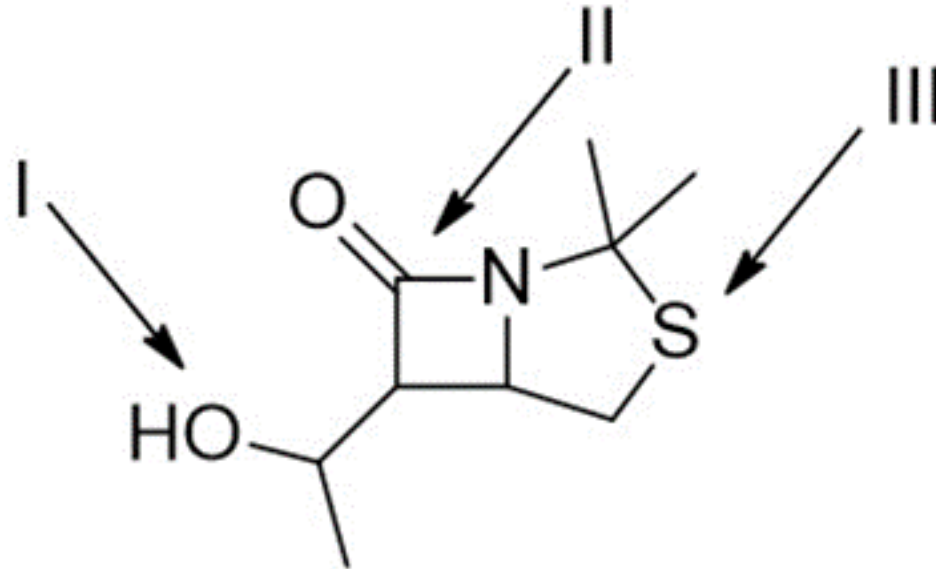
Question 6 Answer

Answer: a. Left, because the conjugate base on the left is more stable

Compare the conjugate bases on each side. The conjugate base on the left is more stable than the one on the right because the Cl inductively withdraws electrons towards it, which stabilizes the conjugate base. Acid/base equilibria lie towards the more stable conjugate base. For more examples of this type of problem, see SkillBuilder 3.10 – Assessing Relative Acidity.

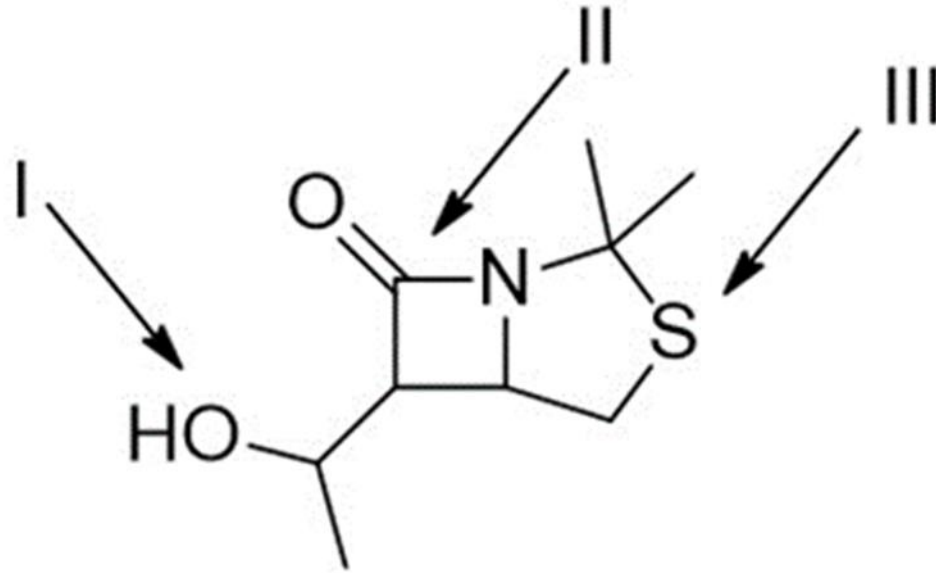
Functional groups

8. Identify the indicated functional groups in the following compound.



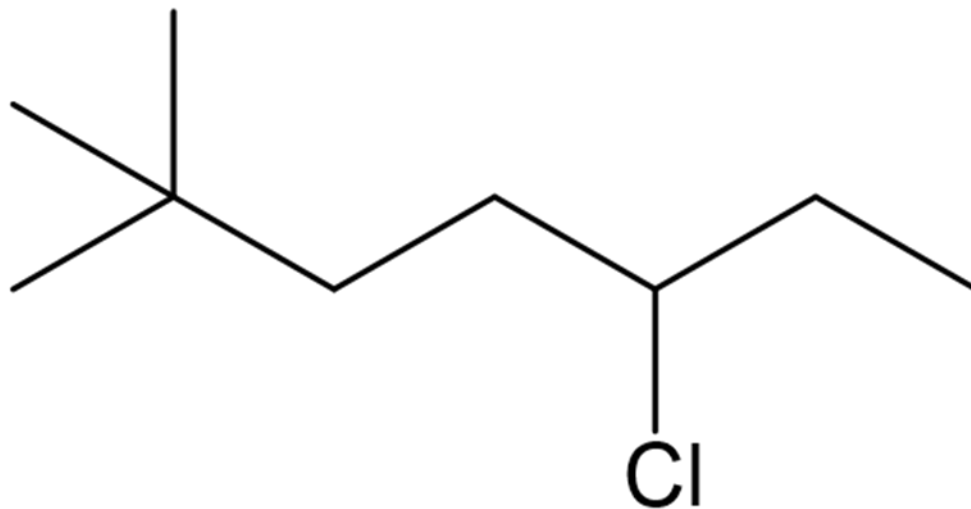
Question 8 Answer

Answer: I = alcohol; II = amide; III = sulfide



Nomenclature (alkanes)

9. What is the correct IUPAC name for the following structure?

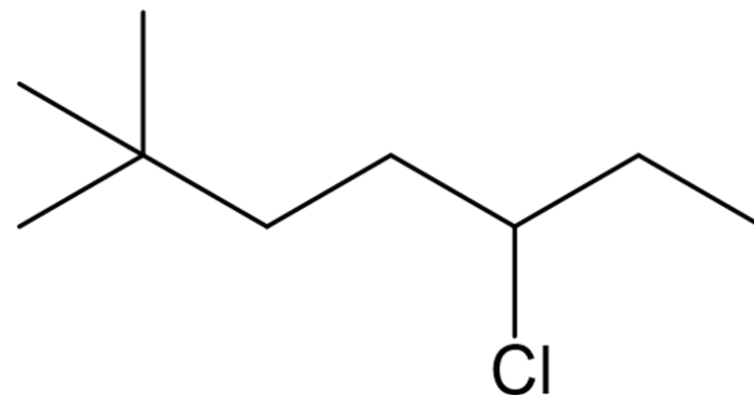


Question 9 Answer

Answer: d. 5-chloro-2,2-dimethylheptane

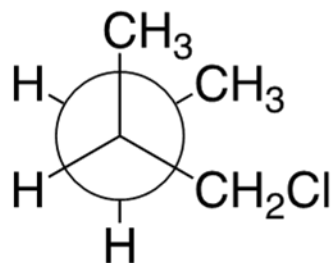
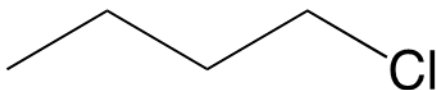
The parent chain is 7 carbons long, so it is a heptane. There are 2 methyl groups, and they must be indicated using the placement (2,2) as well as the number of groups (di-). The chlorine is named first as alphabetical takes precedence over location.

For more examples of this type of problem, see SkillBuilder 4.1, 4.2, 4.3 and 4.4.

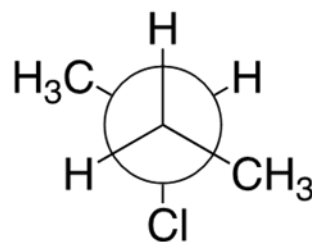


Alkene conformations (Newman projection)

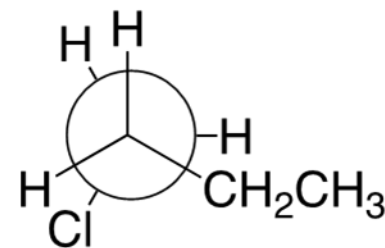
10. Which of the following is a Newman projection of the following structure?



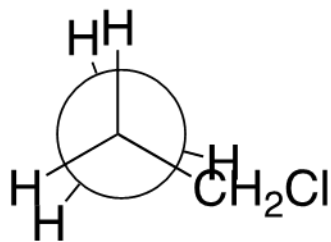
A



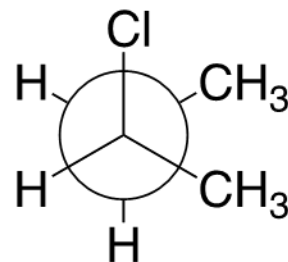
B



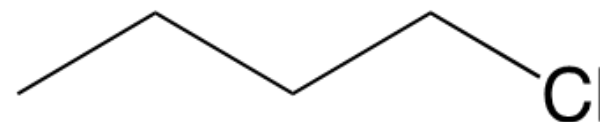
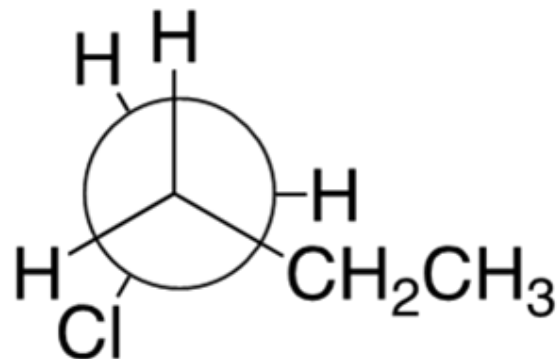
C



D



Question 10 Answer



Answer: c

For more examples of this type of problem, see SkillBuilder 4.7 – Drawing Newman Projections.