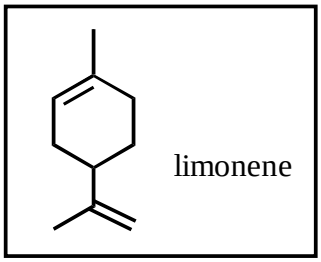
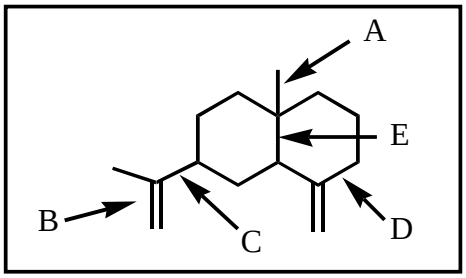
Name: _____ Date: _____

1. What is the molecular formula of limonene, the major volatile compound in orange peel oil?



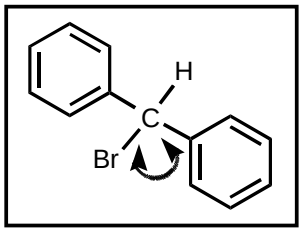
A) $C_{10}H_{18}$
B) $C_{10}H_{20}$
C) $C_{10}H_{16}$
D) $C_{11}H_{14}$
E) $C_{11}H_{18}$

2. Of those indicated, which would be the shortest carbon-carbon bond in α-selinene?



A) A
B) B
C) C
D) D
E) E

3. What would be the ideal value for the indicated bond angle?

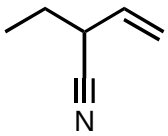


A) 120°
B) 90°
C) 104°
D) 180°
E) 109°

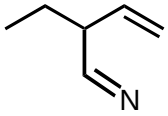
4. Which structure matches the following condensed structure?

$CH_3CH_2CH(CN)CH=CH_2$

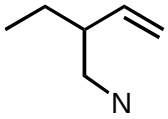
A)



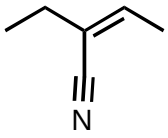
B)



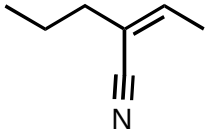
C)



D)

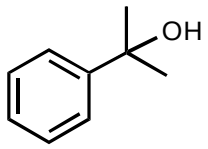


E)

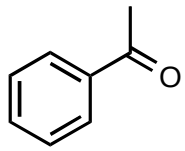


5. Which one of the following structures must be incorrect?

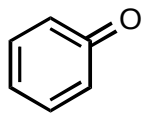
A)



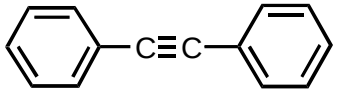
B)



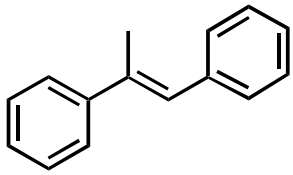
C)



D)

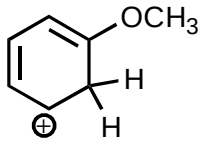


E)



6. Which of the following is **not** a resonance structure of the others?

A)



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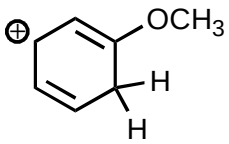
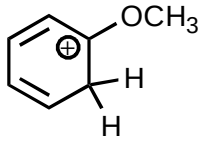
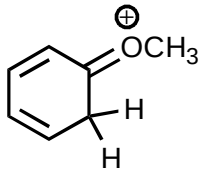


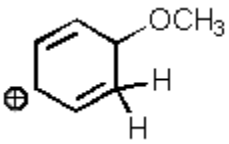
C)



D)

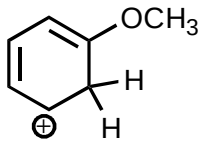


E)

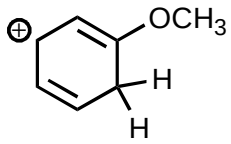


7. Which one of the resonance structures below would be the most important (i.e., most stable)?

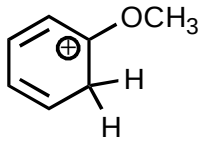
A)



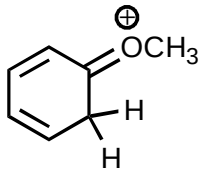
B)



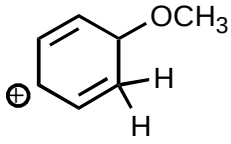
C)



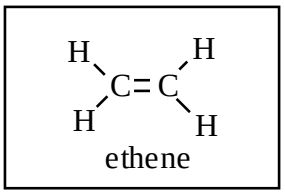
D)



E)



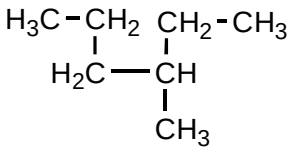
8. How many atoms in ethene are required by sp^2 bonding to lie in the same plane?



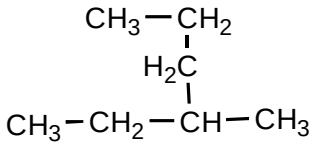
A) 2
B) 3
C) 4
D) 5
E) 6

9. Which one of the following structures is not chemically identical to the others?

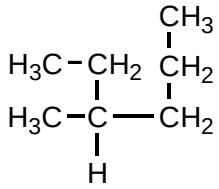
A)



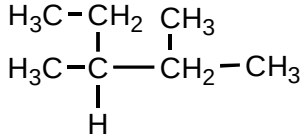
B)



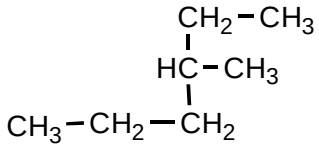
C)



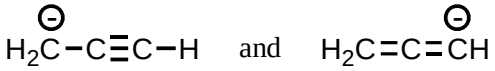
D)

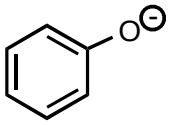
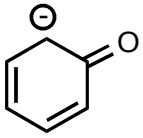


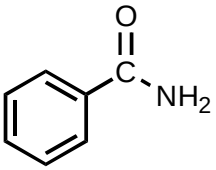
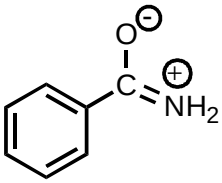
E)

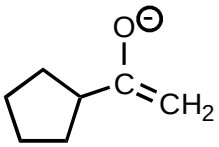
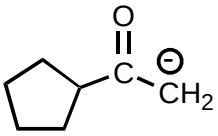


10. Which of the following pairs are **not** resonance structures of each other?

A)  and

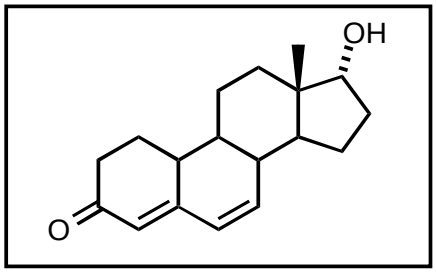
B)  and 

C)  and 

D)  and 

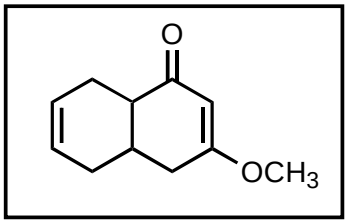
E) All are pairs of resonance structures.

11. How many hydrogen atoms are part of the following steroid?



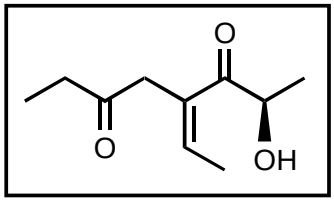
A) 18
B) 20
C) 21
D) 22
E) 24

12. In the following molecule, how many carbon atoms are in the sp^3 hybridization state?



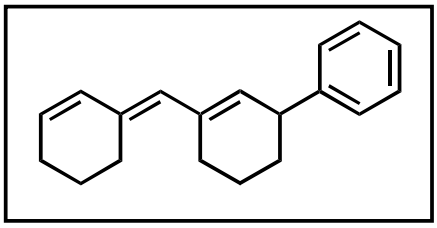
A) 2
B) 4
C) 5
D) 6
E) 11

13. In the following molecule, how many carbon atoms are in the sp^2 hybridization state?



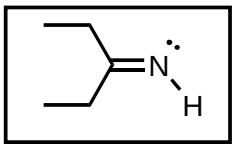
A) 0
B) 1
C) 2
D) 4
E) 6

14. In the following molecule, how many carbon atoms are in the *sp* hybridization state?



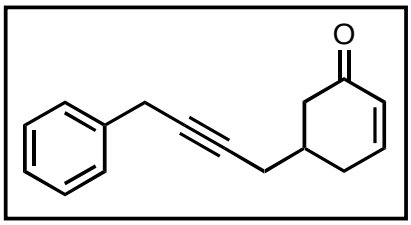
A) 2
B) 4
C) 6
D) 12
E) None of the above.

15. The lone-pair of electrons on nitrogen in the following molecule reside in what type of orbital?



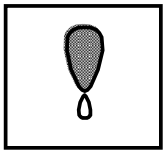
A) sp^3
B) sp^2
C) sp
D) $2p$
E) $2s$

16. In the following molecule, how many carbon atoms are in the sp^2 hybridization state?



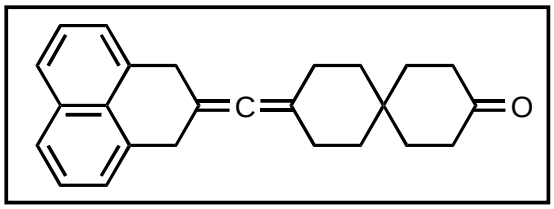
A) 1
B) 3
C) 7
D) 8
E) 9

17. The boxed item most likely represents what?



A) *s* orbital
B) sp^3 orbital
C) *p* orbital
D) could be any of A–C
E) None of the above.

18. The following molecule contains how many carbon atoms in the *sp* hybridization state?



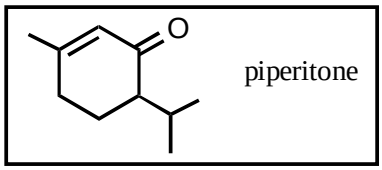
A) 1
B) 3
C) 8
D) 13
E) 16

19. The nitrogen of trimethylamine [$(CH_3)_3N$] contains how many lone pairs of electrons?
A) none
B) one
C) two
D) three
E) there is no nitrogen in this molecule

20. A positive charge on oxygen generally occurs when:
A) oxygen has too many electrons.
B) oxygen has too few electrons.
C) oxygen is sharing one of its non-bonding electron pairs.
D) oxygen has too many non-bonding electron pairs.
E) oxygen is borrowing electrons from another atom.

21. The carbon atom in CH_2Cl_2 has what hybridization?
A) *sp*
B) sp^2
C) sp^3
D) sp^4
E) they are not hybridized

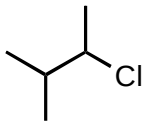
22. The molecular formula for piperitone is



A) $C_9H_{16}O$
B) $C_{10}H_{18}O$
C) $C_9H_{18}O$
D) $C_{10}H_{14}O$
E) $C_{10}H_{16}O$

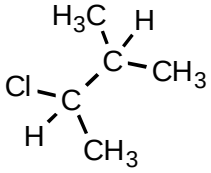
23. Which structure is different from the others?

A)

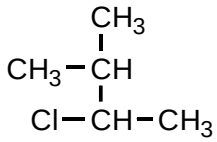


B) $CH_3CHClCH(CH_3)_2$

C)

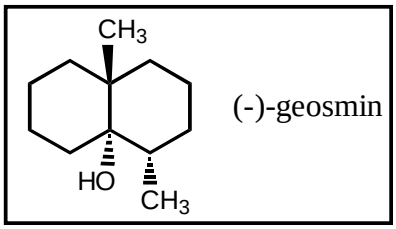


D)



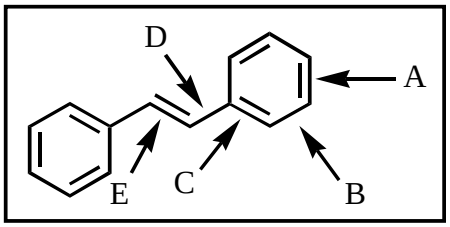
E) All are identical.

24. A fairly common algal metabolite is the compound (-)-geosmin, which imparts a musty odor to water even at concentrations in the ppb range. What is the molecular formula of geosmin?



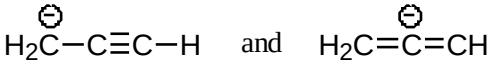
A) $C_{11}H_{20}O$
B) $C_{12}H_{22}O$
C) $C_{11}H_{21}O$
D) $C_{12}H_{20}O$
E) $C_{12}H_{21}O$

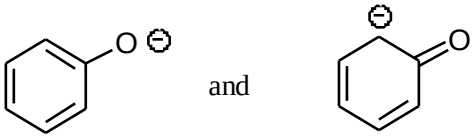
25. Which of the carbon-carbon bonds indicated would you expect to be the **longest** in stilbene?

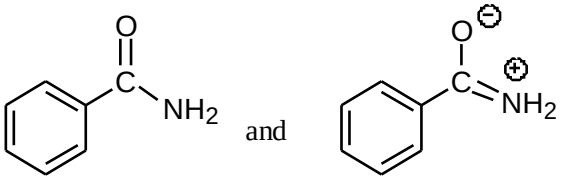


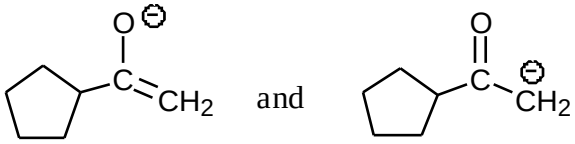
A) A
B) B
C) C
D) D
E) E

26. Which of the following pairs are **not** resonance structures of each other?

A) 

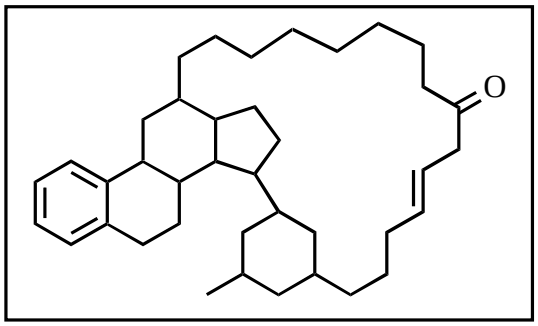
B) 

C) 

D) 

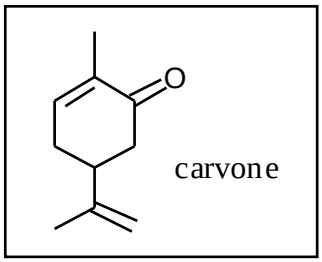
E) All are pairs of resonance structures.

27. The following molecule has what molecular formula?



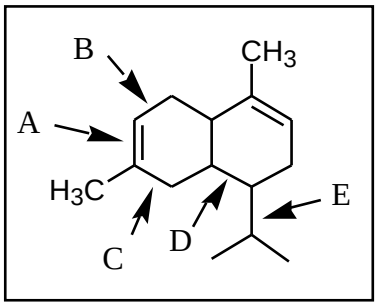
A) $C_{39}H_{58}O$
B) $C_{40}H_{58}O$
C) $C_{39}H_{60}O$
D) $C_{44}H_{44}O$
E) None of the above.

28. What is the molecular formula of carvone, the major volatile compound in caraway oil?



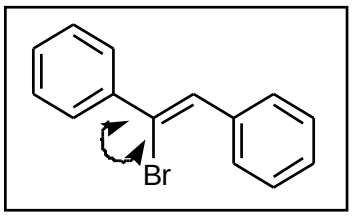
A) $C_{10}H_{18}O$
B) $C_{10}H_{17}O$
C) $C_{10}H_{16}O$
D) $C_{10}H_{14}O$
E) $C_{10}H_{15}O$

29. Of those indicated, which would be the shortest carbon-carbon bond in β-cadinene?



A) A
B) B
C) C
D) D
E) E

30. What would be the ideal value for the indicated bond angle?

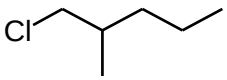


A) 120°
B) 90°
C) 104°
D) 180°
E) 109°

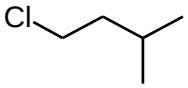
31. Which structure matches the following condensed structure?

$ClCH_2CH(CH_3)CH_2CH_3$

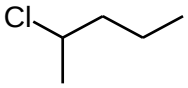
A)



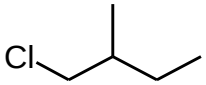
B)



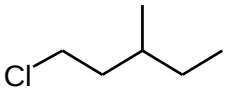
C)



D)

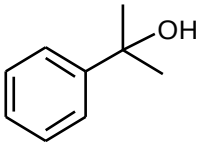


E)

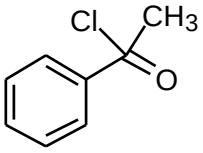


32. Which one of the following structures must be incorrect?

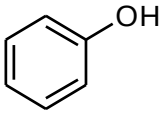
A)



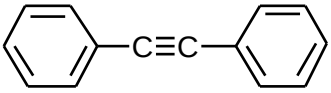
B)



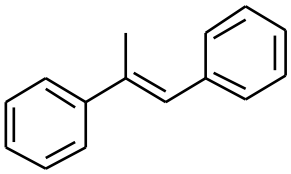
C)



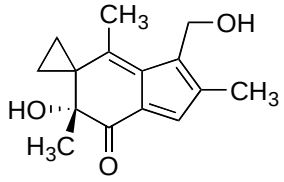
D)



E)



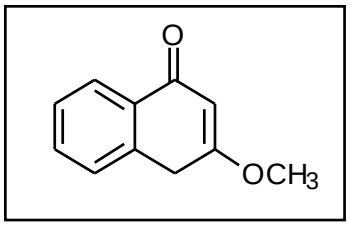
33. How many sp^2 hybridized carbon atoms are in the potent anticancer compound hydroxymethylacylfulvene?



hydroxymethylacylfulvene

A) 2
B) 4
C) 6
D) 8
E) None of the above.

34. In the following molecule, how many carbon atoms are in the sp^3 hybridization state?

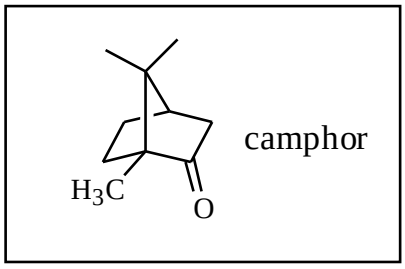


A) 2
B) 4
C) 5
D) 6
E) 9

35. Which of the following statements are true of sp orbitals?
A) Orbitals of the *sp* type are 50% *s* and 50% *p* character.
B) They are hybrid orbitals.
C) They are linear.
D) They result when one *s* orbital and one *p* orbital are mixed.
E) All are correct.

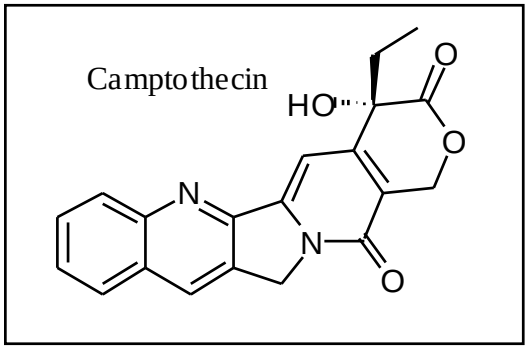
36. Which of the following molecules are most likely to be held together by a purely covalent bond?
A) NaCl
B) H_2
C) HF
D) BH_3
E) KI

37. What is the molecular formula of camphor?



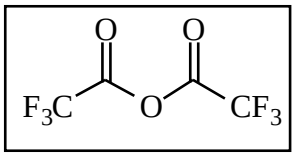
A) $C_{10}H_{15}O$
B) $C_{10}H_{16}O$
C) $C_{10}H_{17}O$
D) $C_{11}H_{18}O$
E) $C_{11}H_{16}O$

38. Camptothecin is an important anticancer compound; how many carbons are in the *sp* hybridization state?



A) 0
B) 1
C) 2
D) 3
E) 4

39. How many sp^3 carbons are in the following molecule?

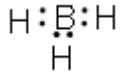


A) 0
B) 1
C) 2
D) 3
E) 4

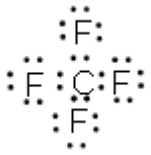
40. The process of adding electrons one by one to atomic orbitals beginning with the lowest energy is described by:
A) the Aufbau Principle.
B) Hund's Rule.
C) the de Broglie Relation.
D) the Pauli Exclusion Principle.
E) Coulomb's Law.

41. Which of the following cannot be a correct Lewis structure?

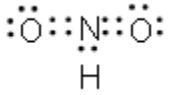
A)



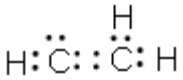
B)



C)

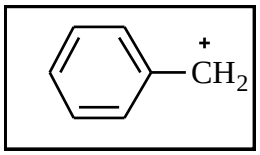


D)



E) All are correct.

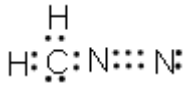
42. How many different resonance structures can be drawn for the benzyl cation (shown below) which place the plus charge on a carbon atom in the ring?



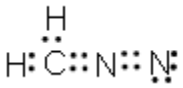
A) 1
B) 2
C) 3
D) 5
E) 6

43. Which of the following represent resonance contributing Lewis structures for CH_2N_2?

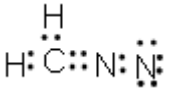
A)



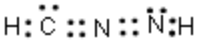
B)



C)

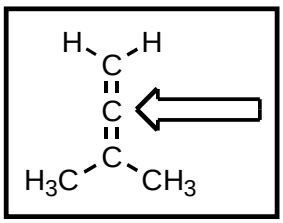


D)



E) both A and B are correct

44. The following molecule belongs to a class of compounds known as allenes. Based on your knowledge of bonding, predict the hybridization of the carbon atom indicated by the arrow.



A) *sp*
B) sp^2
C) sp^3
D) *p-p* pi
E) a hypervalent carbon

45. How many isomers of C_4H_9Br are possible?

A) two
B) three
C) four
D) five
E) six

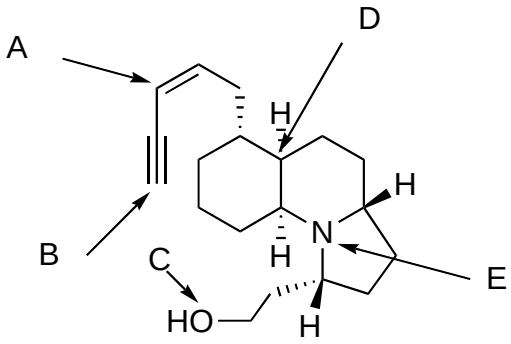
46. How many isomers of C_5H_{12} are possible?
    A) two
    B) three
    C) four
    D) five
    E) six

47. Which of the following most correctly defines "structural isomers"?
    A) molecules with different molecular formulas but the same connectivity
    B) compounds that are not constitutional isomers
    C) molecules with the same molecular formula but different connectivity
    D) *Anti* and *gauche* conformers
    E) both B and C

48. How many structural isomers exist for the formula C_6H_{14}?
    A) 3
    B) 4
    C) 5
    D) 6
    E) 7

49. A hydrocarbon with a double bond and a ring will have the general formula?
    A) C_nH_{2n+2}
    B) C_nH_{2n}
    C) C_nH_{2n-2}
    D) C_nH_{2n-4}
    E) $C_{2n}H_{2n}$

50. What is the hybridization of the each of the labeled atoms for the potent neurotoxin (-)-gephyrotoxin?



(-)-gephyrotoxin
source: poison frog
acitivty: neurotoxin

A) A = sp^2, B = sp, C = sp^2, D = sp^3, E = sp^3
B) A = sp^2, B = sp, C = sp^3, D = sp^3, E = sp^2
C) A = sp^2, B = sp, C = sp^2, D = sp^3, E = sp^2
D) A = sp^2, B = sp, C = sp^3, D = sp^3, E = sp^3
E) A = sp, B = sp, C = sp^3, D = sp^3, E = sp^3

Answer Key

1. C
2. B
3. E
4. A
5. C
6. E
7. D
8. E
9. D
10. E
11. E
12. D
13. D
14. E
15. B
16. E
17. B
18. A
19. B
20. C
21. C
22. E
23. E
24. B
25. D
26. A
27. A
28. D
29. A
30. A
31. D
32. B
33. E
34. A
35. E
36. B
37. B
38. A
39. C
40. A
41. C
42. C
43. E
44. A

45. C
46. B
47. C
48. C
49. C
50. D