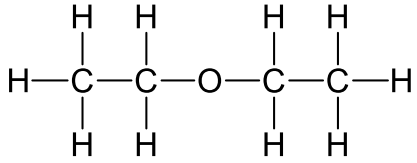
Klein, Organic Chemistry 3e
Chapter 2

1. What is the molecular formula for the following compound?



A. C_2H_6O
B. C_4H_6O
C. $C_4H_{10}O$
D. C_2H_4O
E. None of these

Answer: C
Learning Objective: 2.1 Convert molecular representations from one drawing style to another, including Lewis structures, partially condensed structures, condensed structures, and molecular formulas
Difficulty: Easy

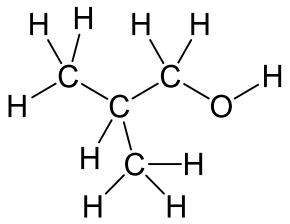
2. Which of the following compounds have a molecular formula of C_2H_6O?

CH_3OCH_3 (I) $CH_3CH_2OCH_3$ (II) CH_3CH_2OH (III) $CH_3CHOHCH_3$ (IV)

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

Answer: E
Learning Objective: 2.1 Convert molecular representations from one drawing style to another, including Lewis structures, partially condensed structures, condensed structures, and molecular formulas
Difficulty: Easy

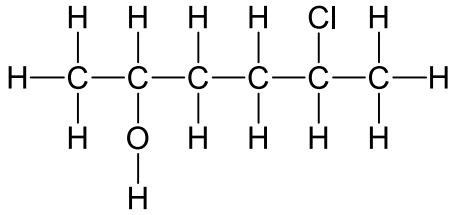
3. Which of the following is the correct condensed structure for the following compound?



A. $CH_3CHCH_3CH_2OH$
B. $CH_3CH_2CH_2OH$
C. $(CH_3)_2CHCH_2OH$
D. $CH_3CH_2CH_2OCH_3$
E. $CH_3CH_3CHCH_2OH$

Answer: C
Learning Objective: 2.1 Convert molecular representations from one drawing style to another, including Lewis structures, partially condensed structures, condensed structures, and molecular formulas
Difficulty: Easy

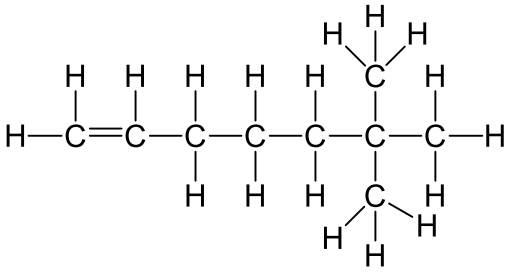
4. Which of the following is the correct condensed structure for the following compound?



A. $CH_3CHOHCH_2CHClCH_3$
B. $CH_3CHOH(CH_2)_2CHClCH_3$
C. $(CH_3)_2CHOHCH_2CH_2Cl$
D. $HOCH_3CHCH_2CH_2CH_3CHCl$
E. $CH_3C_2H_4CH_3OHCl$

Answer: B
Learning Objective: 2.1 Convert molecular representations from one drawing style to another, including Lewis structures, partially condensed structures, condensed structures, and molecular formulas
Difficulty: Easy

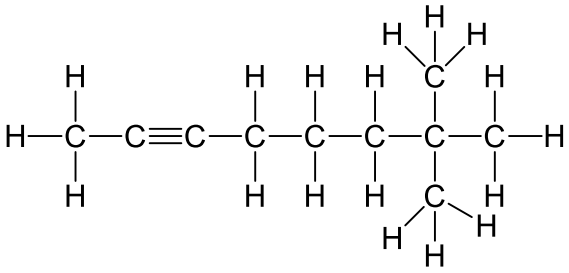
5. Which of the following is the correct condensed structure for the following compound?



A. $CH_2=CH(CH_2)_3C(CH_3)_3$
B. $CH(CH_2)_4C(CH_3)_3$
C. $(CH_3)_2CH(CH_2)_4CH_3$
D. $CH_2CH(CH_2)_3C(CH_3)_3$
E. $(CH)_3(CH_2)_3C(CH_3)_3$

Answer: A
Learning Objective: 2.1 Convert molecular representations from one drawing style to another, including Lewis structures, partially condensed structures, condensed structures, and molecular formulas
Difficulty: Medium

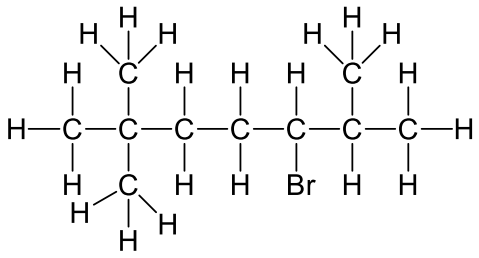
6. Which of the following is the correct condensed structure for the following compound?



A. $CH_3C_2(CH_2)_3C(CH_3)_3$
B. $CH_3CC(CH_2)_3C(CH_3)_2CH_3$
C. $(CH_3)_3C_2(CH_2)_3CH_3$
D. $CH_3C{\equiv}C(CH_2)_3C(CH_3)_3$
E. $CH_3CC(CH_2)_3C(CH_3)_3$

Answer: D
Learning Objective: 2.1 Convert molecular representations from one drawing style to another, including Lewis structures, partially condensed structures, condensed structures, and molecular formulas
Difficulty: Medium

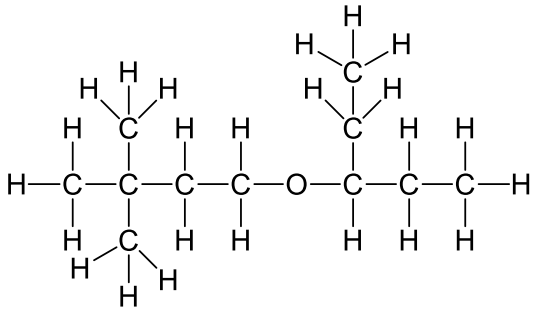
7. Which of the following is the correct condensed structure for the following compound?



A. $CH_3C(CH_3)_2(CH_2)_2(CH)BrC(CH_3)_2$
B. $CH_3CH_3CH_3C(CH_2)_2C(CH_3)_2CHBr$
C. $(CH_3)_3C(CH_2)_3BrCHCH_3CH_3$
D. $CH_3CH_3CH_3C(CH_2)_2CHBrCHCH_3CH_3$
E. $(CH_3)_3C(CH_2)_2CHBrCH(CH_3)_2$

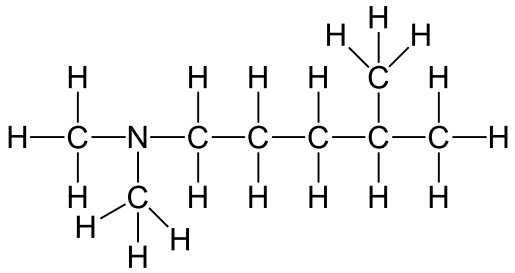
Answer: E
Learning Objective: 2.1 Convert molecular representations from one drawing style to another, including Lewis structures, partially condensed structures, condensed structures, and molecular formulas
Difficulty: Medium

8. Provide the correct condensed structure for the following compound.



Answer: $(CH_3)_3C(CH_2)_2OCH(CH_2CH_3)_2$
Learning Objective: 2.1 Convert molecular representations from one drawing style to another, including Lewis structures, partially condensed structures, condensed structures, and molecular formulas
Difficulty: Hard

9. Provide the correct condensed structure for the following compound.



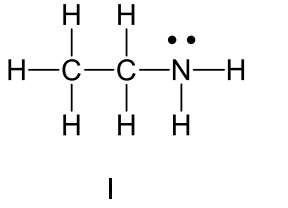
Answer: $(CH_3)_2N(CH_2)_3CH(CH_3)_2$
Learning Objective: 2.1 Convert molecular representations from one drawing style to another, including Lewis structures, partially condensed structures, condensed structures, and molecular formulas
Difficulty: Hard

10. Which of the following is the correct molecular formula for $(CH_3CH_2)_4C$?

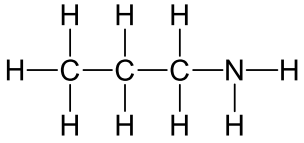
A. C_8H_{20}
B. C_5H_{20}
C. C_9H_{20}
D. C_6H_5
E. C_3H_{20}

Answer: C
Learning Objective: 2.1 Convert molecular representations from one drawing style to another, including Lewis structures, partially condensed structures, condensed structures, and molecular formulas
Difficulty: Easy

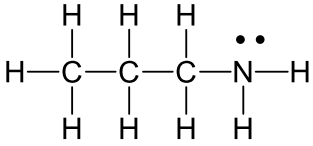
11. Which of the following is the correct Lewis structure for $CH_3(CH_2)_2NH_2$?



I



II



III

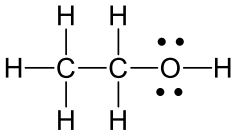
$CH_3CH_2CH_2NH_2$

IV

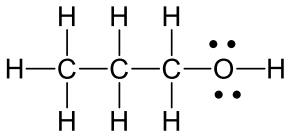
A. I
B. II
C. III
D. IV
E. Both II and III

Answer: C
Learning Objective: 2.1 Convert molecular representations from one drawing style to another, including Lewis structures, partially condensed structures, condensed structures, and molecular formulas
Difficulty: Easy

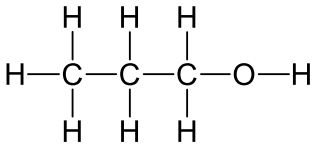
12. Which of the following is the correct Lewis structure for $CH_3(CH_2)_2OH$?



I



II



III

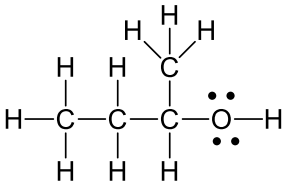
$CH_3CH_2CH_2OH$

IV

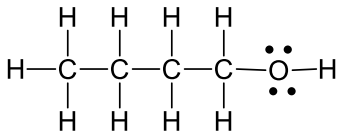
A. I
B. II
C. III
D. IV
E. Both II and III

Answer: B
Learning Objective: 2.1 Convert molecular representations from one drawing style to another, including Lewis structures, partially condensed structures, condensed structures, and molecular formulas
Difficulty: Easy

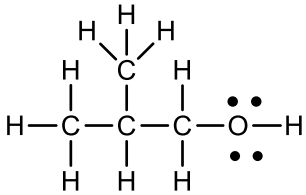
13. Which of the following is the correct Lewis structure for $(CH_3)_2CHCH_2OH$?



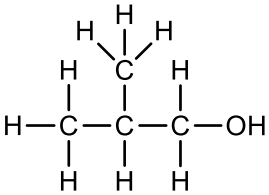
I



II



III

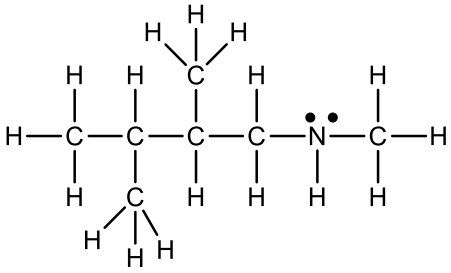


IV

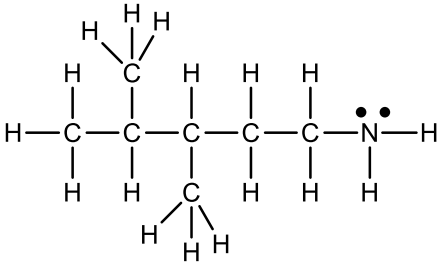
A. I
B. II
C. III
D. IV
E. Both III and IV

Answer: C
Learning Objective: 2.1 Convert molecular representations from one drawing style to another, including Lewis structures, partially condensed structures, condensed structures, and molecular formulas
Difficulty: Easy

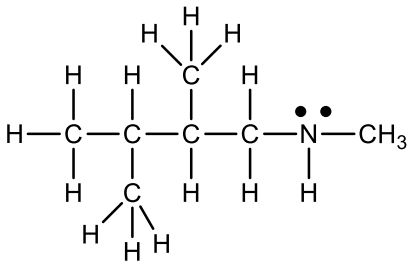
14. Which of the following is the correct Lewis structure for $(CH_3)_3C(CH_2)_2NHCH_3$?



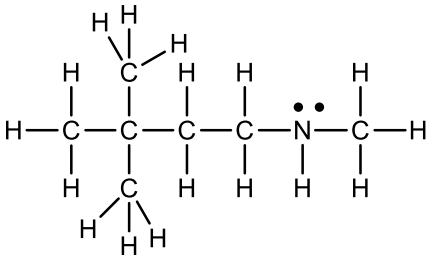
I



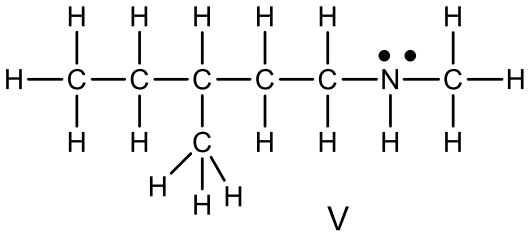
II



III



IV



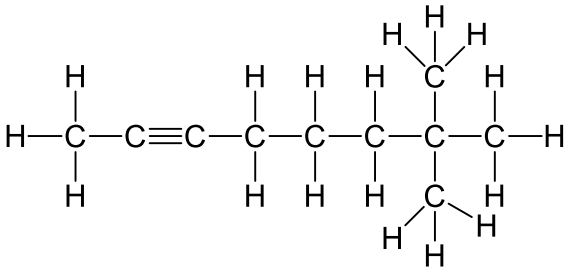
V

A. I
B. II
C. III
D. IV
E. V

Answer: D
Learning Objective: 2.1 Convert molecular representations from one drawing style to another, including Lewis structures, partially condensed structures, condensed structures, and molecular formulas
Difficulty: Medium

15. Draw the Lewis structure for $CH_3C{\equiv}C(CH_2)_3C(CH_3)_3$.

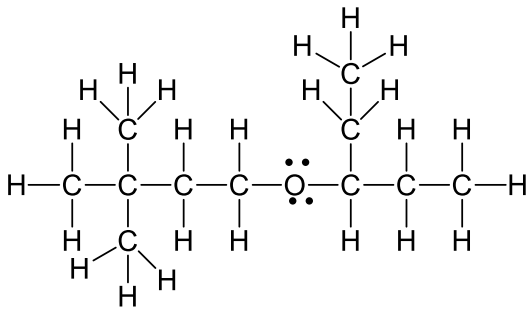
Answer:



Learning Objective: 2.1 Convert molecular representations from one drawing style to another, including Lewis structures, partially condensed structures, condensed structures, and molecular formulas
Difficulty: Medium

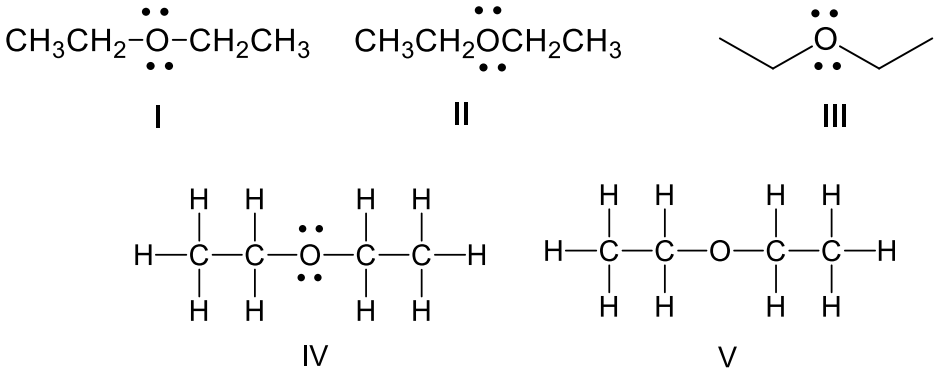
16. Draw the Lewis structure for $(CH_3)_3C(CH_2)_2OCH(CH_2CH_3)_2$.

Answer:



Learning Objective: 2.1 Convert molecular representations from one drawing style to another, including Lewis structures, partially condensed structures, condensed structures, and molecular formulas
Difficulty: Hard

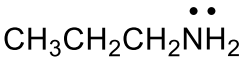
17. Identify the partially condensed structure for $CH_3CH_2OCH_2CH_3$.



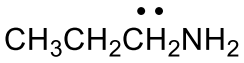
A. I
B. II
C. III
D. IV
E. V

Answer: A
Learning Objective: 2.1 Convert molecular representations from one drawing style to another, including Lewis structures, partially condensed structures, condensed structures, and molecular formulas
Difficulty: Easy

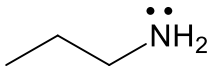
18. Identify the partially condensed structure for $CH_3CH_2CH_2NH_2$.



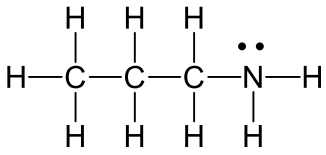
I



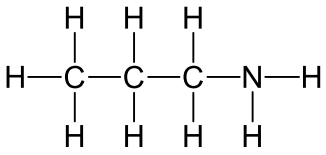
II



III



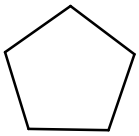
IV



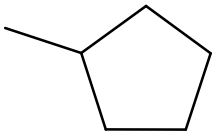
V

Answer: A
Learning Objective: 2.1 Convert molecular representations from one drawing style to another, including Lewis structures, partially condensed structures, condensed structures, and molecular formulas
Difficulty: Easy

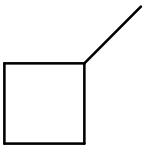
19. Which of the following bond-line structures are of the same compound?



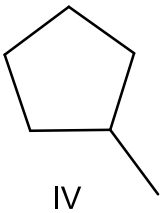
I



II



III

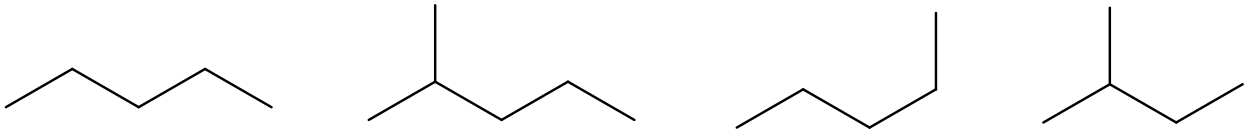


IV

A. I and II
B. II and III
C. III and IV
D. II and IV
E. None of these

Answer: D
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Easy

20. Which of the following bond-line structures are of the same compound?

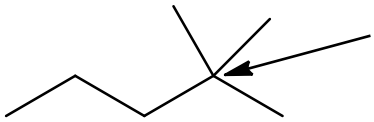


I II III IV

A. I and III
B. II and III
C. III and IV
D. II and IV
E. None of these

Answer: A
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Easy

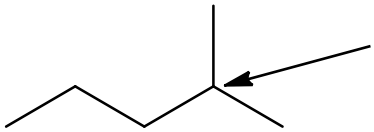
21. How many hydrogen atoms are connected to the indicated carbon atom?



A. one
B. two
C. three
D. four
E. none

Answer: E
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Easy

22. How many hydrogen atoms are connected to the indicated carbon atom?

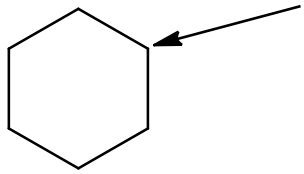


A. one
B. two

C. three
D. four
E. none

Answer: A
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Easy

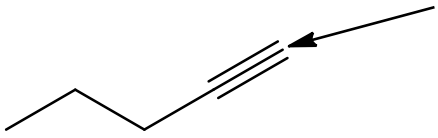
23. How many hydrogen atoms are connected to the indicated carbon atom?



A. one
B. two
C. three
D. four
E. none

Answer: B
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Easy

24. How many hydrogen atoms are connected to the indicated carbon atom?

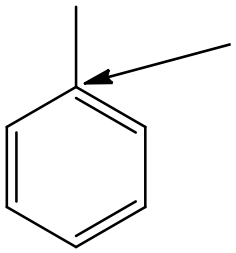


A. one
B. two
C. three
D. four
E. none

Answer: A

Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Easy

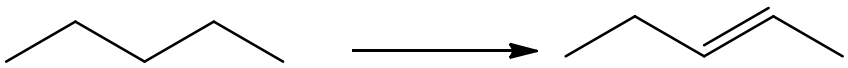
25. How many hydrogen atoms are connected to the indicated carbon atom?



A. one
B. two
C. three
D. four
E. none

Answer: E
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Easy

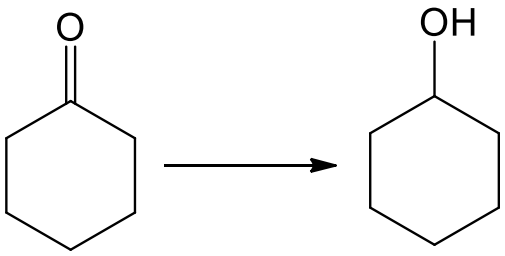
26. For the following equation, how many hydrogen atoms are added or lost?



A. added one
B. added two
C. lost one
D. lost two
E. no change

Answer: D
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Easy

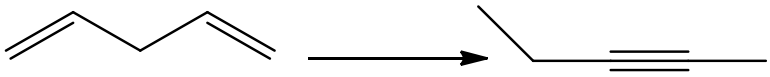
27. For the following equation, how many hydrogen atoms are added or lost?



A. added one
B. added two
C. lost one
D. lost two
E. no change

Answer: B
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Easy

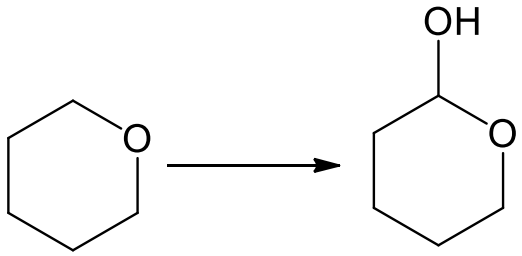
28. For the following equation, how many hydrogen atoms are added or lost?



A. added one
B. added two
C. lost one
D. lost two
E. no change

Answer: E
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Easy

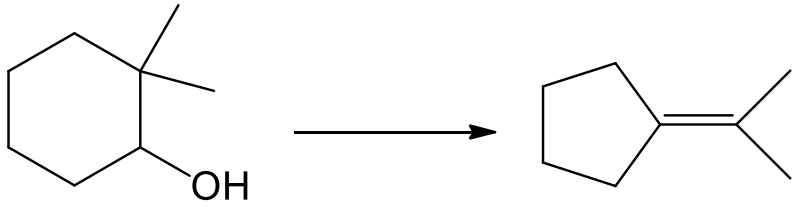
29. For the following equation, how many hydrogen atoms are added or lost?



A. added one
B. added two
C. lost one
D. lost two
E. no change

Answer: E
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Easy

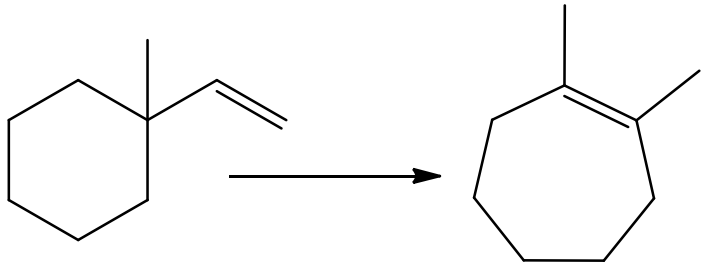
30. For the following equation, how many hydrogen atoms are added or lost?



A. added one
B. added two
C. lost one
D. lost two
E. no change

Answer: D
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Medium

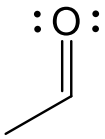
31. For the following equation, how many hydrogen atoms are added or lost?

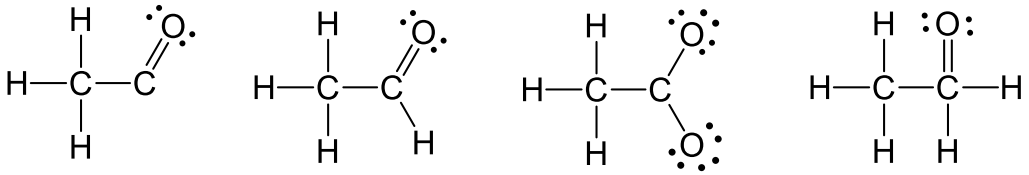


A. added one
B. added two
C. lost one
D. lost two
E. no change

Answer: E
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Medium

32. Which of the following is the correct Lewis structure for the following compound?

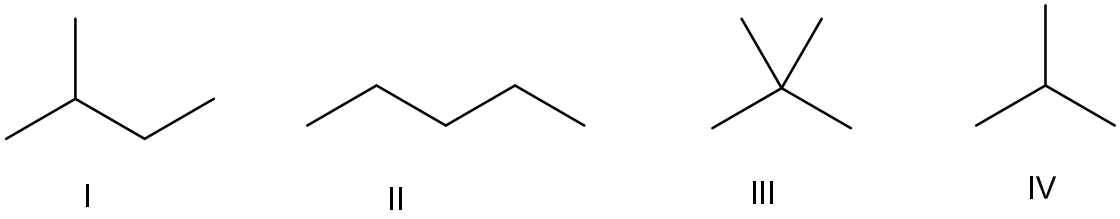




A. I
B. II
C. III
D. IV
E. none of these

Answer: B
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Easy

33. Which of the following is the correct bond-line structure for $(CH_3)_4C$?

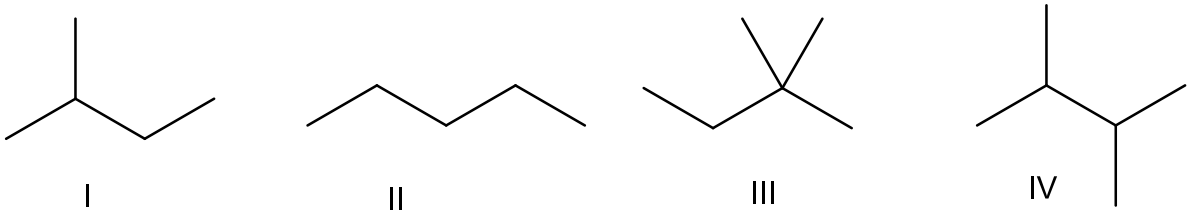


I II III IV

A. I
B. II
C. III
D. IV
E. None of these

Answer: C
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Easy

34. Which of the following is the correct bond-line structure for $(CH_3)_2CHCH_2CH_3$?

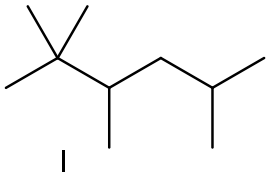


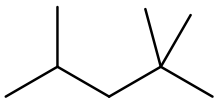
I II III IV

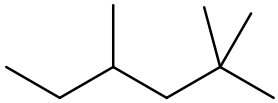
A. I
B. II
C. III
D. IV
E. None of these

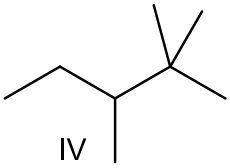
Answer: A
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Easy

35. Which of the following is the correct bond-line structure for $(CH_3)_2CHCH_2C(CH_3)_3$?


I


II

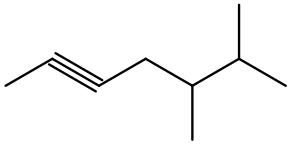

III

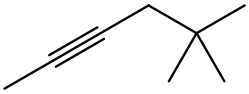

IV

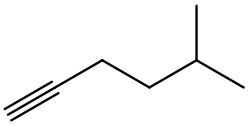
A. I
B. II
C. III
D. IV
E. None of these

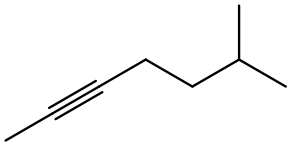
Answer: B
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Medium

36. Which of the following is the correct bond-line structure for $CH_3C{\equiv}C(CH_2)_2CH(CH_3)_2$?


I


II

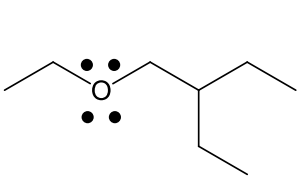

III


IV

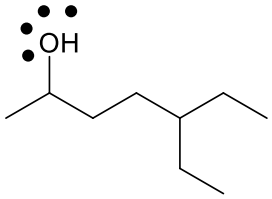
A. I
B. II
C. III
D. IV
E. None of these

Answer: D
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Medium

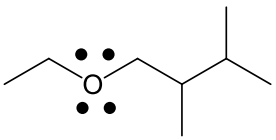
37. Which of the following is the correct bond-line structure for $CH_3CHOH(CH_2)_2CH(CH_2CH_3)_2$?



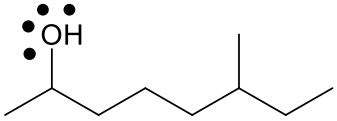
I



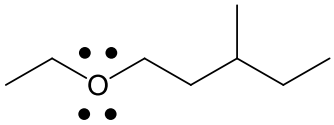
II



III



IV



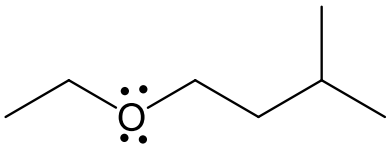
V

A. I
B. II
C. III
D. IV
E. V

Answer: B
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Medium

38. Draw a bond-line structure for $CH_3CH_2O(CH_2)_2CH(CH_3)_2$.

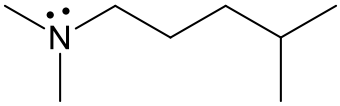
Answer:



Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Hard

39. Draw a bond-line structure for $(CH_3)_2N(CH_2)_3CH(CH_3)_2$.

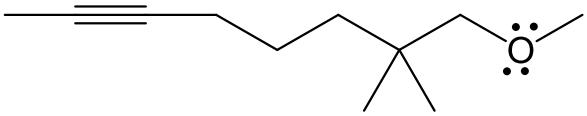
Answer:



Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Hard

40. Draw a bond-line structure for $CH_3C{\equiv}C(CH_2)_3C(CH_3)_2CH_2OCH_3$.

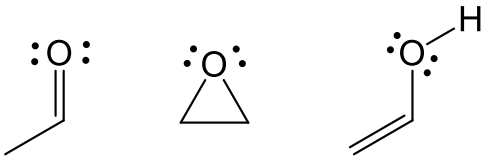
Answer:



Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Hard

41. Draw a bond-line structure for each constitutional isomer with a molecular formula of C_2H_4O.

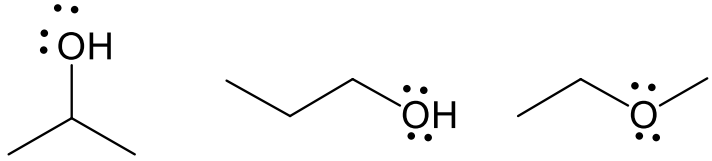
Answer:



Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Hard

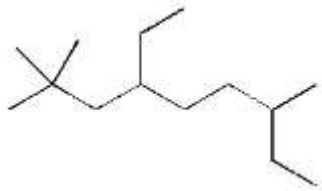
42. Draw a bond-line structure for each constitutional isomer with a molecular formula of C_3H_8O.

Answer:



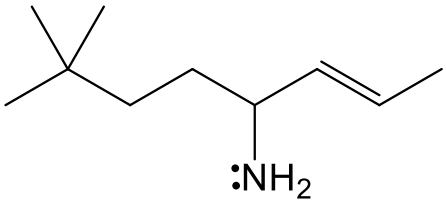
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Hard

43. Provide a condensed structure for the following compound.



Answer: $(CH_3)_3CCH_2CH(CH_2CH_3)(CH_2)_2CH(CH_3)CH_2CH_3$
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Hard

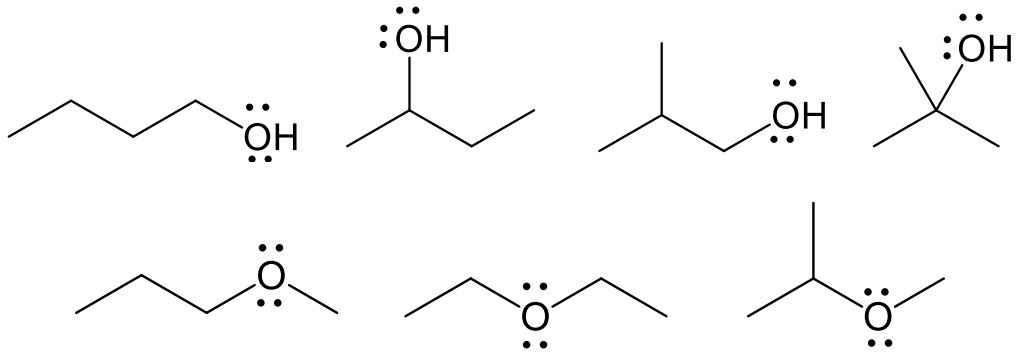
44. Provide a condensed structure for the following compound.



Answer: $(CH_3)_3C(CH_2)_2CH(NH_2)CH=CHCH_3$
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Hard

45. Draw a bond-line structure for each constitutional isomer with molecular formula $C_4H_{10}O$.

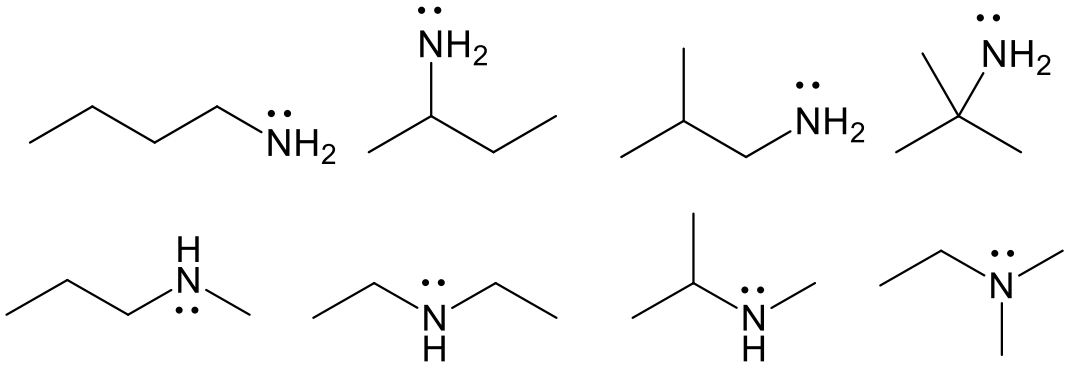
Answer:



Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Hard

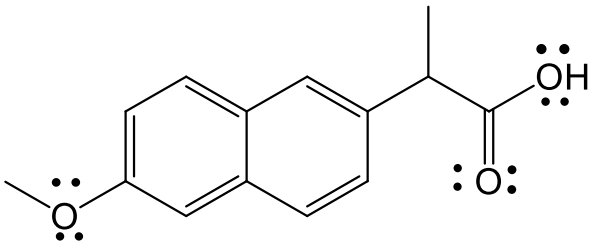
46. Draw a bond-line structure for each constitutional isomer with molecular formula $C_4H_{11}N$.

Answer:



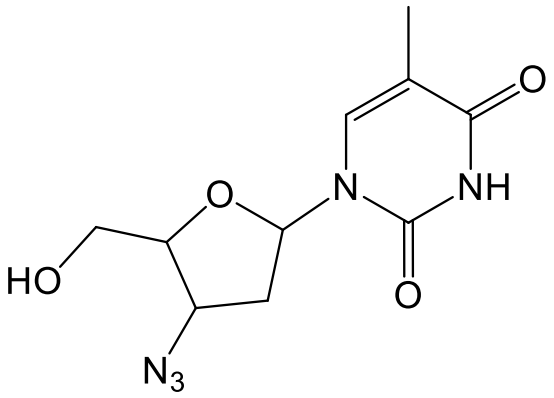
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Medium

47. Naproxen, sold under the trade name Aleve, has the following structure. What is the molecular formula for naproxen?



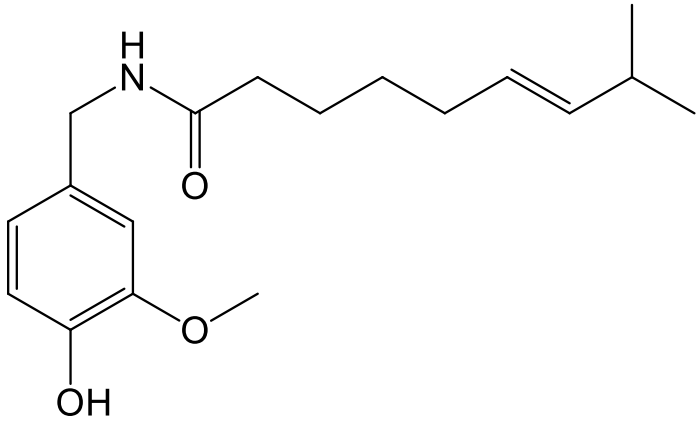
Answer: $C_{14}H_{14}O_3$
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Hard

48. AZT, used in the treatment of AIDS, has the following structure. What is the molecular formula for AZT?



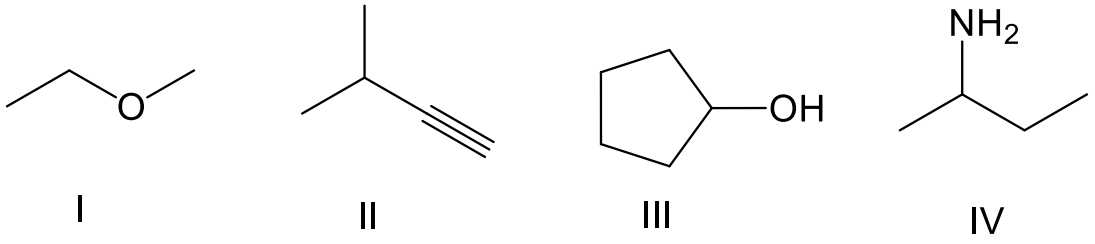
Answer: $C_{10}H_{13}N_5O_4$
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Hard

49. Capsaicin, found in peppers, has the following structure. What is the molecular formula for capsaicin?



Answer: $C_{18}H_{27}NO_3$
Learning Objective: 2.2 Demonstrate how to read and draw bond-line structures through converting other styles of molecular representation into bond-line structures and vice versa
Difficulty: Hard

50. Which of the following compounds contain an alcohol functional group?

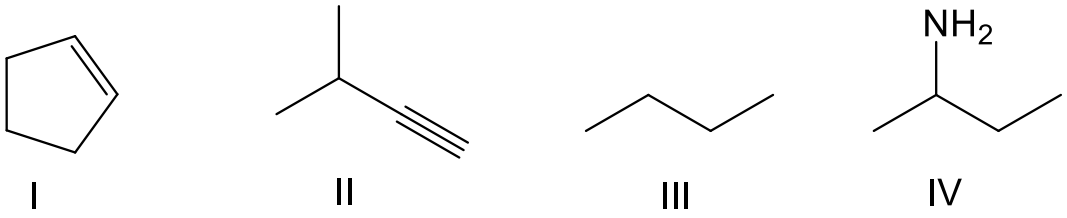


I II III IV

A. I
B. II
C. III
D. IV
E. None of these

Answer: C
Learning Objective: 2.3 Identify and draw the functional groups
Difficulty: Easy

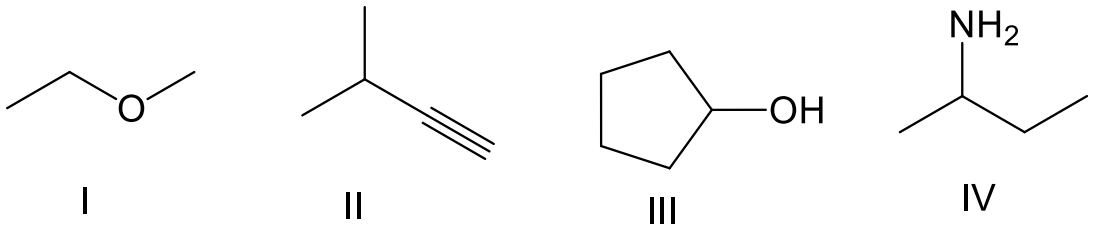
51. Which of the following compounds contain an alkene functional group?



A. I
B. II
C. III
D. IV
E. None of these

Answer: A
Learning Objective: 2.3 Identify and draw the functional groups
Difficulty: Easy

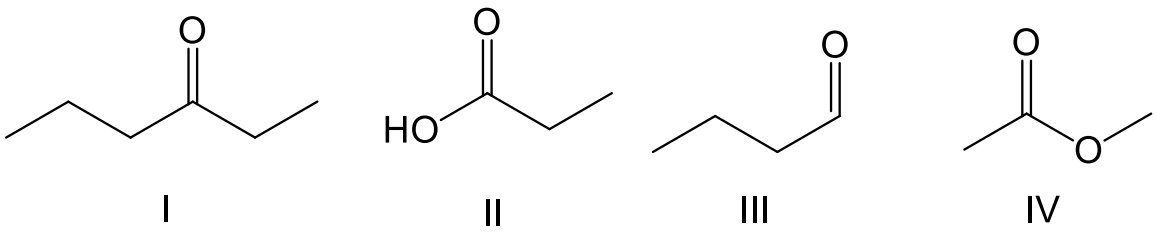
52. Which of the following compounds contain an amine functional group?



A. I
B. II
C. III
D. IV
E. None of these

Answer: D
Learning Objective: 2.3 Identify and draw the functional groups
Difficulty: Easy

53. Which of the following compounds contain a ketone functional group?

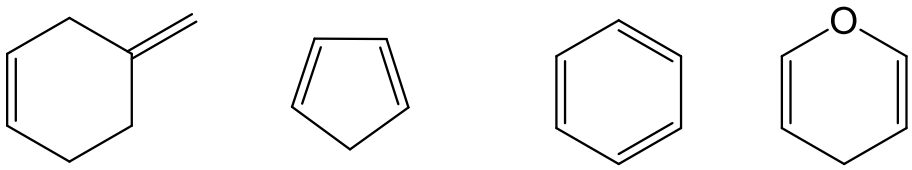


I II III IV

A. I
B. II
C. III
D. IV
E. All of these

Answer: A
Learning Objective: 2.3 Identify and draw the functional groups
Difficulty: Easy

54. Which of the following compounds contain an aromatic ring?

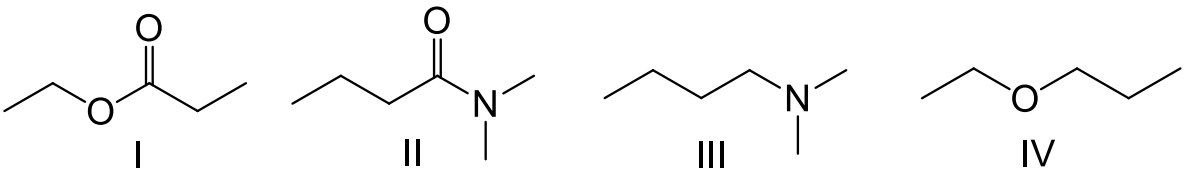


I II III IV

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

Answer: C
Learning Objective: 2.3 Identify and draw the functional groups
Difficulty: Easy

55. Which of the following compounds contain an ester functional group?

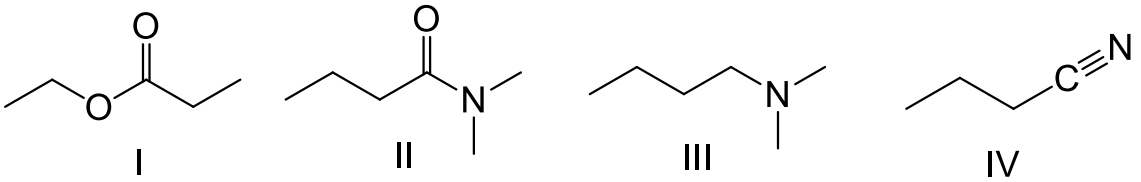


I II III IV

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

Answer: A
Learning Objective: 2.3 Identify and draw the functional groups
Difficulty: Easy

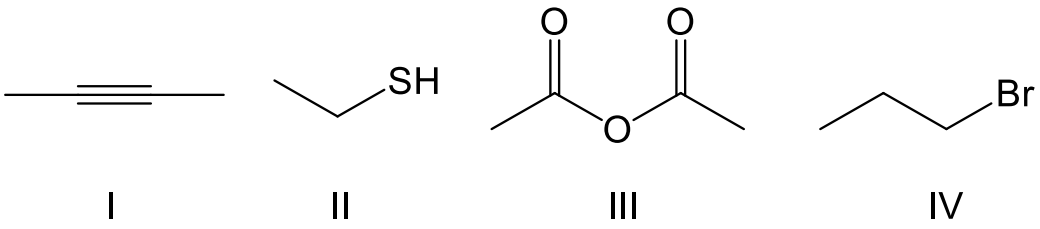
56. Which of the following compounds contain an amide functional group?



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

Answer: B
Learning Objective: 2.3 Identify and draw the functional groups
Difficulty: Easy

57. Which of the following compounds contain an anhydride functional group?

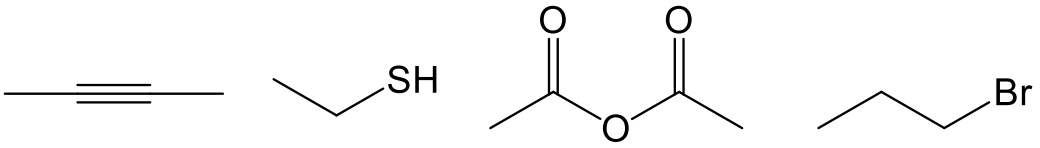


A. I
B. II
C. III
D. IV
E. none of the above

Answer: C
Learning Objective: 2.3 Identify and draw the functional groups

Difficulty: Easy

58. Which of the following compounds contain an alkyne functional group?

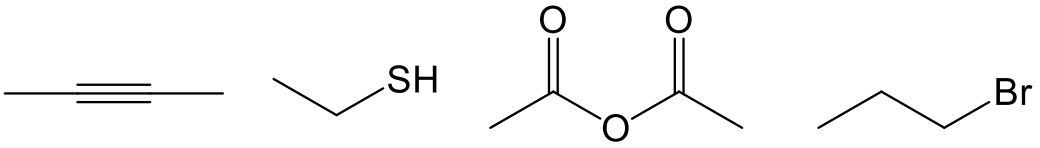


I II III IV

A. I
B. II
C. III
D. IV
E. none of the above

Answer: A
Learning Objective: 2.3 Identify and draw the functional groups
Difficulty: Easy

59. Which of the following compounds contain a thiol functional group?

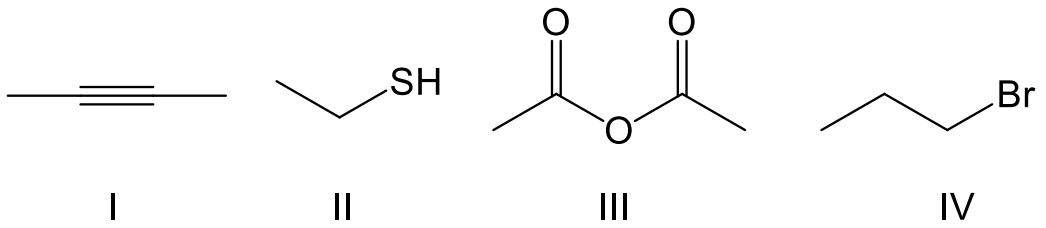


I II III IV

A. I
B. II
C. III
D. IV
E. none of the above

Answer: B
Learning Objective: 2.3 Identify and draw the functional groups
Difficulty: Easy

60. Which of the following compounds contain an alkyl halide functional group?

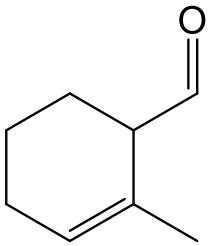


I II III IV

A. I
B. II
C. III
D. IV
E. none of the above

Answer: D
Learning Objective: 2.3 Identify and draw the functional groups
Difficulty: Easy

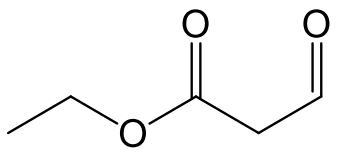
61. What functional group(s) is (are) present in the following compound?



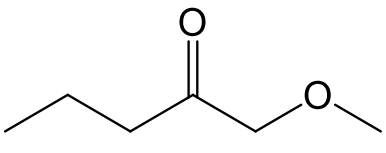
A. ketone and alkene
B. ketone and alkyne
C. aldehyde and alkene
D. aldehyde and alkyne
E. ester and alkene

Answer: C
Learning Objective: 2.3 Identify and draw the functional groups
Difficulty: Medium

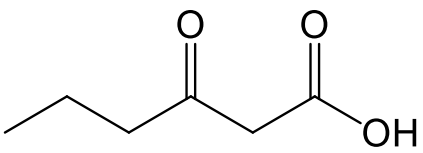
62. Which of the following compounds have both a ketone and an ester functional group?



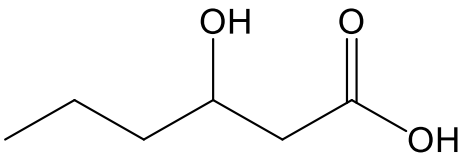
I



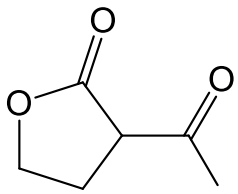
II



III



IV

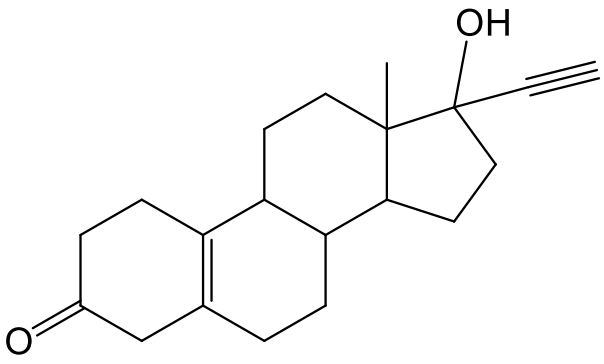


V

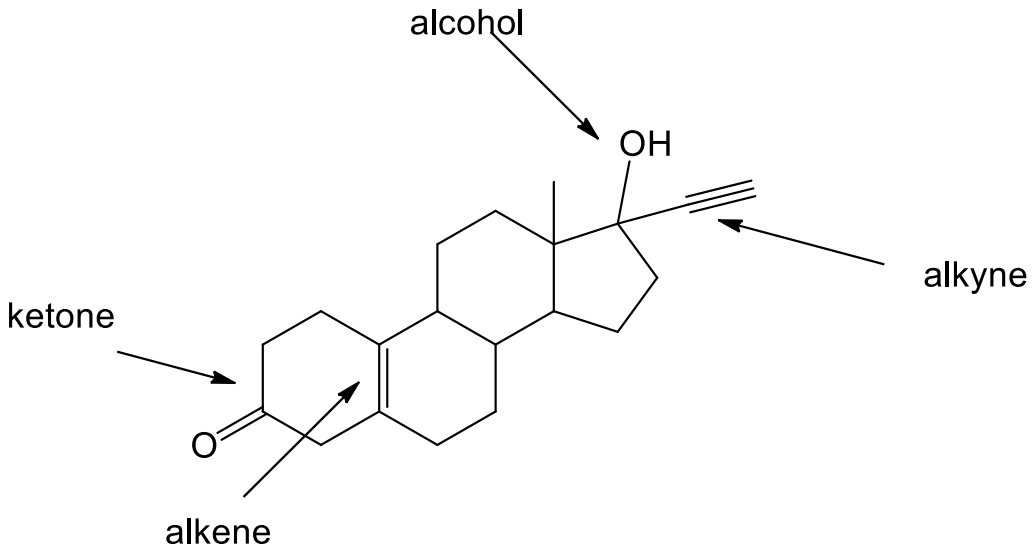
A. I
B. II
C. III
D. IV
E. V

Answer: E
Learning Objective: 2.3 Identify and draw the functional groups
Difficulty: Medium

63. Norethynodrel, a component of the first combined oral contraceptive, has the following structure. Identify the functional groups in Norethynodrel.

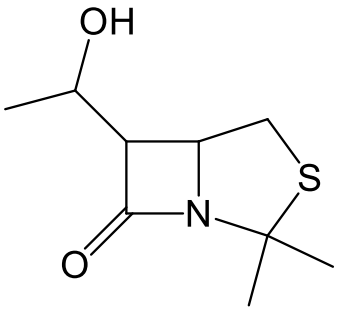


Answer:

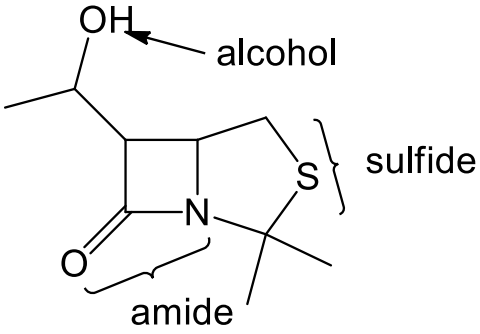


Learning Objective: 2.3 Identify and draw the functional groups
Difficulty: Medium

64. Identify the functional groups in the following compound.



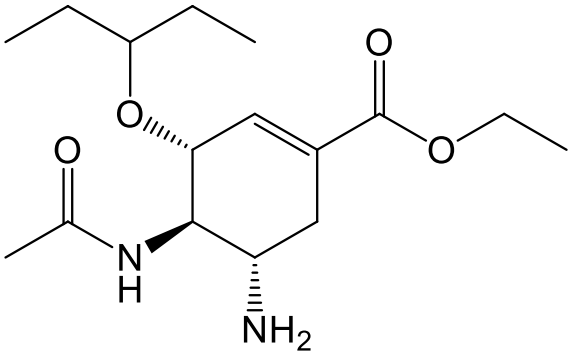
Answer:



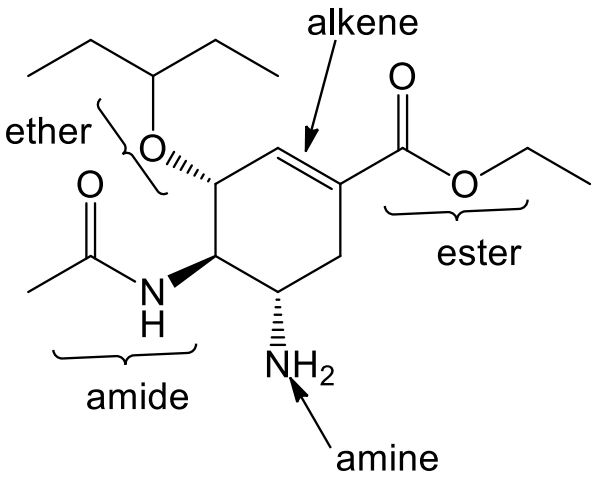
Learning Objective: 2.3 Identify and draw the functional groups

Difficulty: Medium

65. Tamiflu®, the most effective antiviral drug used to treat avian influenza, has the following structure. Identify the functional groups in Tamiflu®.

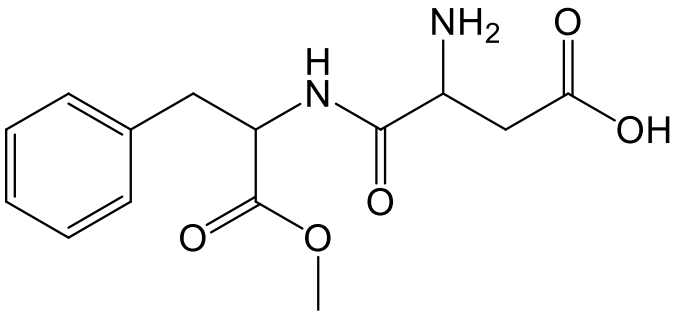


Answer:

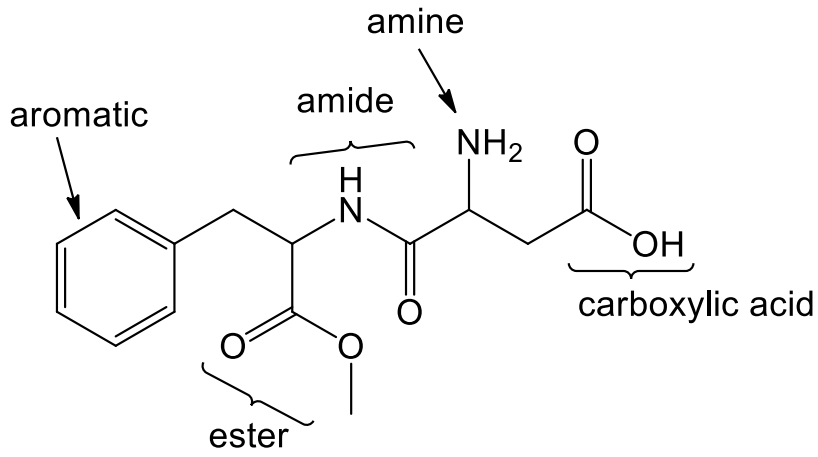


Learning Objective: 2.3 Identify and draw the functional groups
Difficulty: Hard

66. Aspartame, an artificial sweetener used in Equal® and diet beverages, has the following structure. Identify the functional groups in Aspartame.



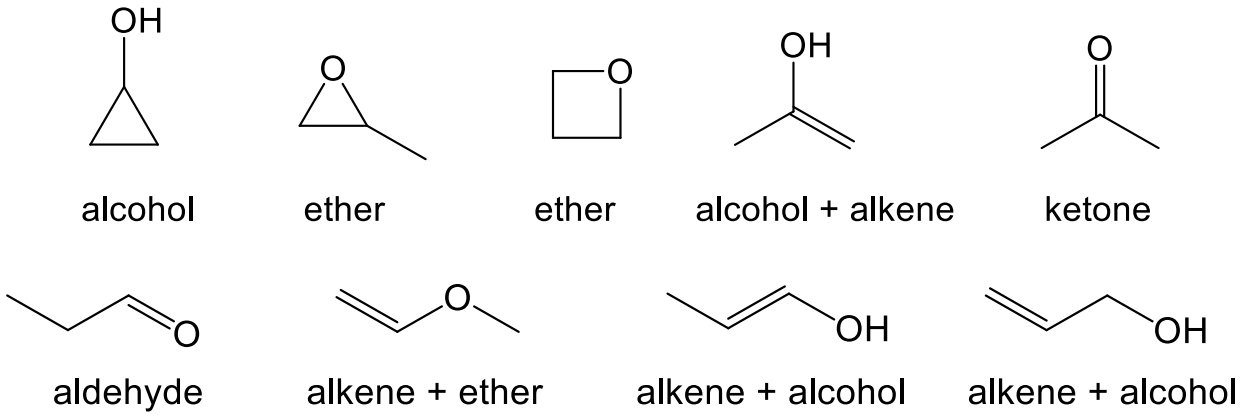
Answer:



Learning Objective: 2.3 Identify and draw the functional groups
Difficulty: Hard

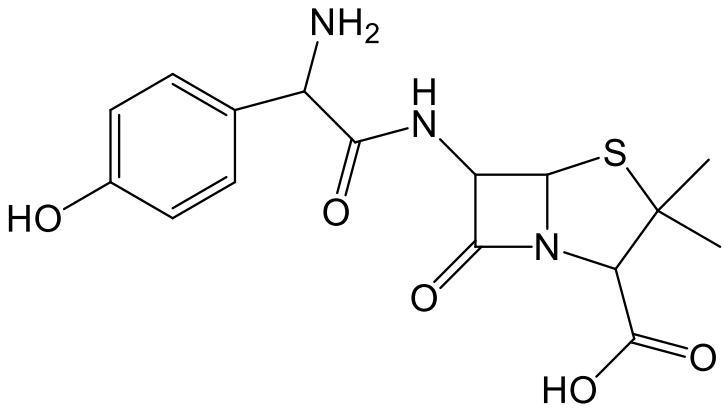
67. Draw all the constitutional isomers with a molecular formula of C_3H_6O and label the functional groups in each isomer.

Answer:

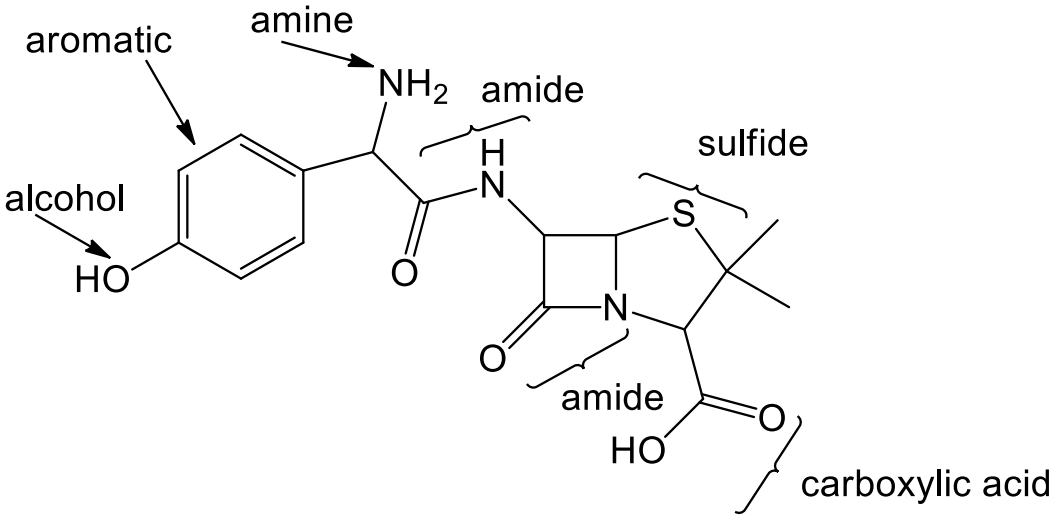


Learning Objective: 2.3 Identify and draw the functional groups
Difficulty: Hard

68. Amoxicillin, an antibiotic, has the following structure. Identify the functional groups in amoxicillin.

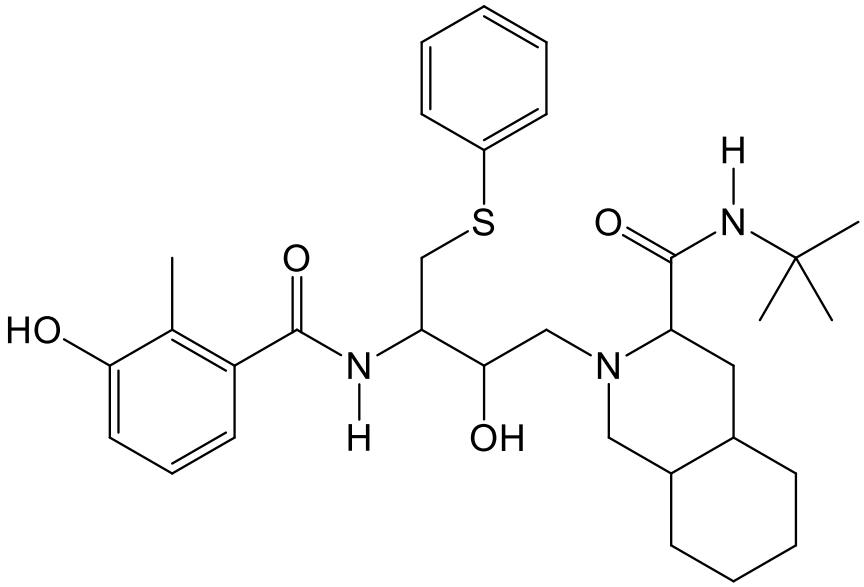


Answer:

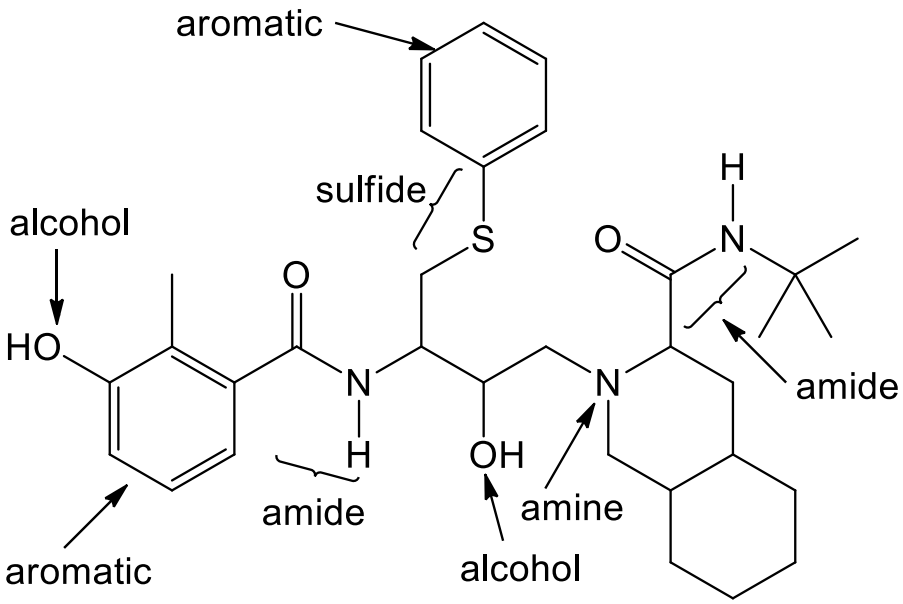


Learning Objective: 2.3 Identify and draw the functional groups
Difficulty: Hard

69. Viracept, used in the treatment of HIV, has the following structure. Identify the functional groups in Viracept.

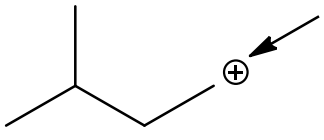


Answer:



Learning Objective: 2.3 Identify and draw the functional groups
Difficulty: Hard

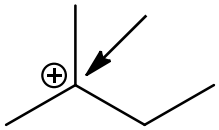
70. How many hydrogen atoms are connected to the indicated carbon atom?



A. one
B. two
C. three
D. four
E. none

Answer: B
Learning Objective: 2.4 Identify formal charges on carbon
Difficulty: Easy

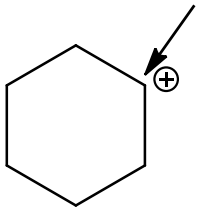
71. How many hydrogen atoms are connected to the indicated carbon atom?



A. one
B. two
C. three
D. four
E. none

Answer: E
Learning Objective: 2.4 Identify formal charges on carbon
Difficulty: Easy

72. How many hydrogen atoms are connected to the indicated carbon atom?

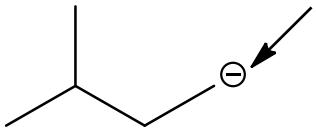


A. one
B. two
C. three
D. four
E. none

Answer: A
Learning Objective: 2.4 Identify formal charges on carbon

Difficulty: Easy

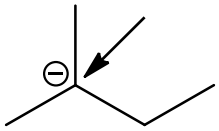
73. How many hydrogen atoms are connected to the indicated carbon atom?



A. one
B. two
C. three
D. four
E. none

Answer: B
Learning Objective: 2.4 Identify formal charges on carbon
Difficulty: Easy

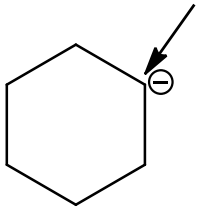
74. How many hydrogen atoms are connected to the indicated carbon atom?



A. one
B. two
C. three
D. four
E. none

Answer: E
Learning Objective: 2.4 Identify formal charges on carbon
Difficulty: Easy

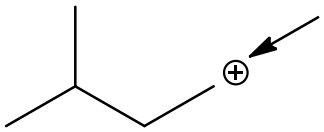
75. How many hydrogen atoms are connected to the indicated carbon atom?



A. one
B. two
C. three
D. four
E. none

Answer: A
Learning Objective: 2.4 Identify formal charges on carbon
Difficulty: Easy

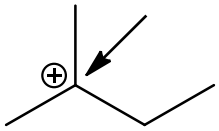
76. What is the formal charge on the indicated carbon atom?



A. -2
B. -1
C. 0
D. +1
E. +2

Answer: D
Learning Objective: 2.4 Identify formal charges on carbon
Difficulty: Easy

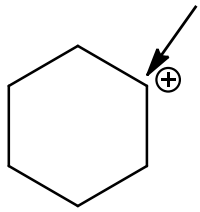
77. What is the formal charge on the indicated carbon atom?



A. -2
B. -1
C. 0
D. +1
E. +2

Answer: D
Learning Objective: 2.4 Identify formal charges on carbon
Difficulty: Easy

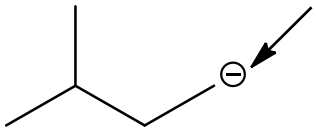
78. What is the formal charge on the indicated carbon atom?



A. -2
B. -1
C. 0
D. +1
E. +2

Answer: D
Learning Objective: 2.4 Identify formal charges on carbon
Difficulty: Easy

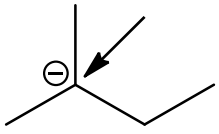
79. What is the formal charge on the indicated carbon atom?



A. -2
B. -1
C. 0
D. +1
E. +2

Answer: B
Learning Objective: 2.4 Identify formal charges on carbon
Difficulty: Easy

80. What is the formal charge on the indicated carbon atom?

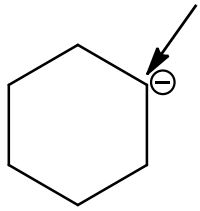


A. -2

B. -1
C. 0
D. +1
E. +2

Answer: B
Learning Objective: 2.4 Identify formal charges on carbon
Difficulty: Easy

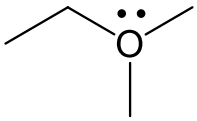
81. What is the formal charge on the indicated carbon atom?



A. -2
B. -1
C. 0
D. +1
E. +2

Answer: B
Learning Objective: 2.4 Identify formal charges on carbon
Difficulty: Easy

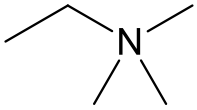
82. What is the formal charge on the oxygen atom in the following compound?



A. +1
B. +2
C. -1
D. -2
E. 0

Answer: A
Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Easy

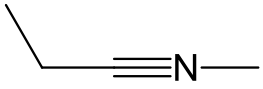
83. What is the formal charge on the nitrogen atom in the following compound?



A. -1
B. -2
C. +1
D. +2
E. 0

Answer: C
Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Easy

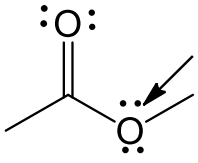
84. What is the formal charge on the nitrogen atom in the following compound?



A. +1
B. +2
C. -1
D. -2
E. 0

Answer: A
Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Easy

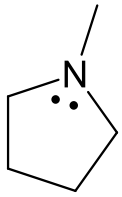
85. What is the formal charge on the indicated oxygen atom in the following compound?



A. +1
B. +2
C. -1
D. -2
E. 0

Answer: E
Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Easy

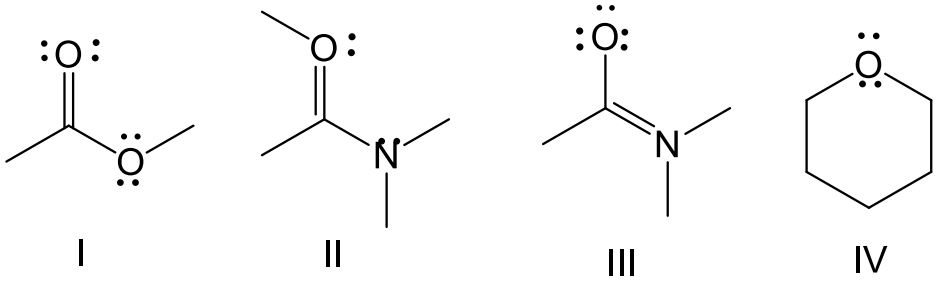
86. What is the formal charge on the nitrogen atom in the following compound?



A. +1
B. +2
C. -1
D. -2
E. 0

Answer: E
Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Easy

87. Which of the following compounds have +1 as a formal charge on an oxygen atom?

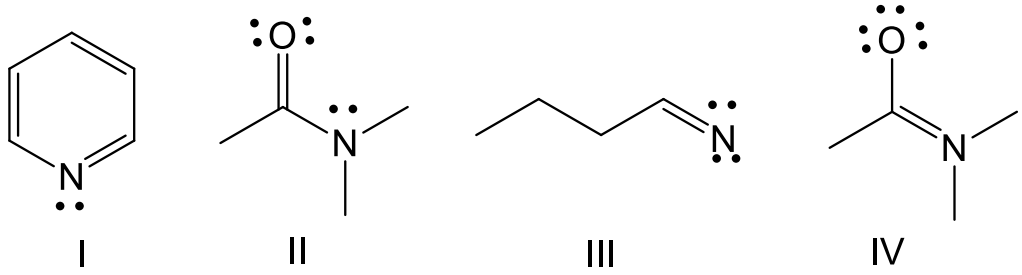


A. I
B. II

C. III
D. IV
E. Both I and IV

Answer: B
Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Medium

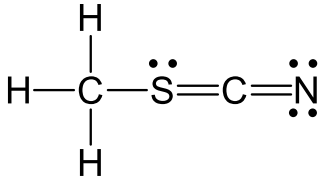
88. Which of the following compounds have +1 as a formal charge on the nitrogen atom?



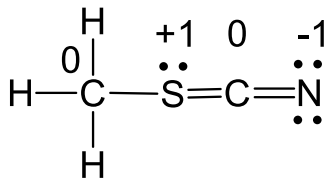
A. I
B. II
C. III
D. IV
E. Both I and II

Answer: D
Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Medium

89. Determine the formal charges on each atom except hydrogen.



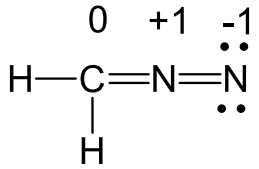
Answer:



Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Medium

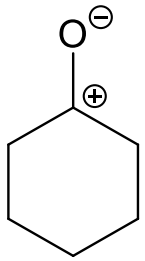
90. Diazomethane has the molecular formula CH_2N_2. Draw the preferred Lewis structure for diazomethane and assign formal charges to all atoms except hydrogen.

Answer:

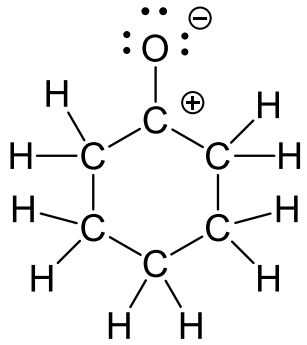


Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Hard

91. Draw Lewis structure for the following compound.

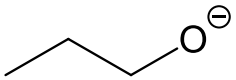


Answer:



Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Medium

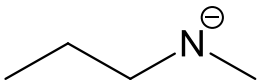
92. How many lone pairs of electrons are on the oxygen atom?



A. one
B. two
C. three
D. four
E. none

Answer: C
Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Easy

93. How many lone pairs of electrons are on the nitrogen atom?

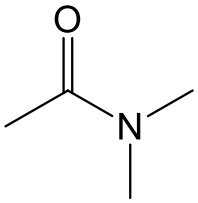


A. one
B. two
C. three
D. four
E. none

Answer: B

Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Easy

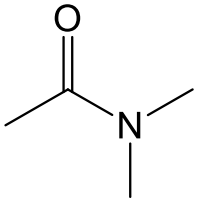
94. How many lone pairs of electrons are on the oxygen atom?



A. one
B. two
C. three
D. four
E. none

Answer: B
Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Easy

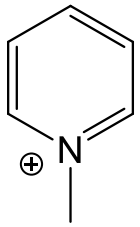
95. How many lone pairs of electrons are on the nitrogen atom?



A. one
B. two
C. three
D. four
E. none

Answer: A
Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Easy

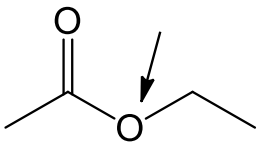
96. How many lone pairs of electrons are on the nitrogen atom?



A. one
B. two
C. three
D. four
E. none

Answer: E
Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Easy

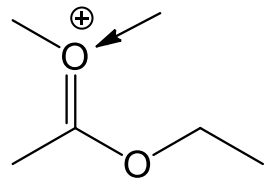
97. How many lone pairs of electrons are on the indicated oxygen atom?



A. one
B. two
C. three
D. four
E. none

Answer: B
Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Easy

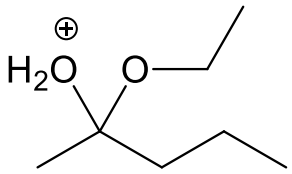
98. How many lone pairs of electrons are on the indicated oxygen atom?



A. one
B. two
C. three
D. four
E. none

Answer: A
Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Medium

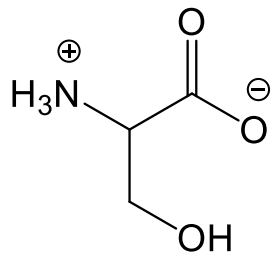
99. How many total lone pairs of electrons are in the following compound?



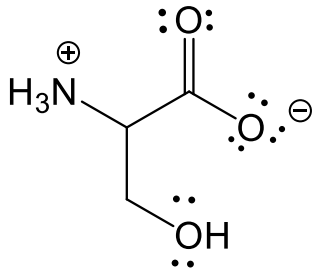
A. one
B. two
C. three
D. four
E. none

Answer: C
Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Easy

100. Draw all lone pairs of electrons for the following compound.

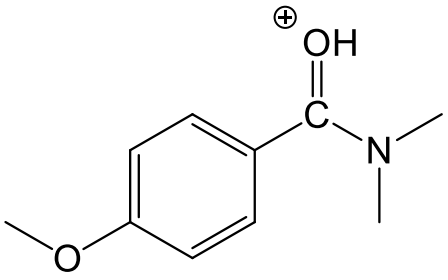


Answer:

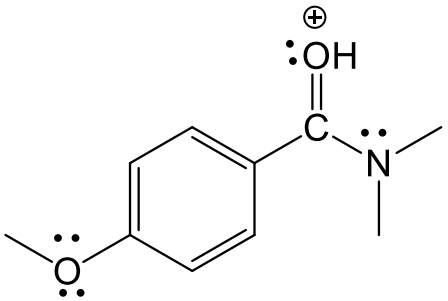


Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Medium

101. Draw all lone pairs of electrons for the following compound.

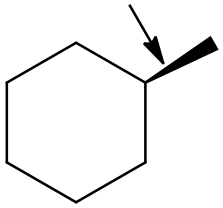


Answer:



Learning Objective: 2.5 Describe the relationship between the number of bonds, the number of lone pairs, and formal charge for oxygen and nitrogen atoms
Difficulty: Medium

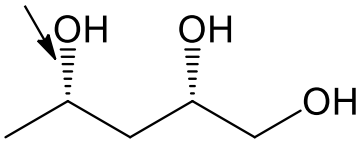
102. The indicated bond in the following compound is_____ of the paper.



A. in the plane
B. out of the plane
C. behind the plane
D. None of these

Answer: B
Learning Objective: 2.6 Describe how wedges and dashes are used to indicate three-dimensional molecular structure
Difficulty: Easy

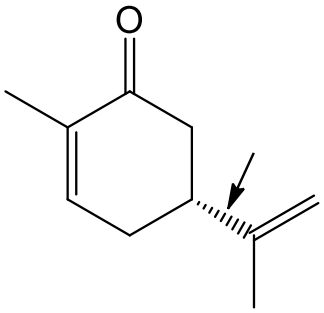
103. The indicated bond in the following compound is_____ of the paper.



A. in the plane
B. out of the plane
C. behind the plane
D. None of these

Answer: C
Learning Objective: 2.6 Describe how wedges and dashes are used to indicate three-dimensional molecular structure
Difficulty: Easy

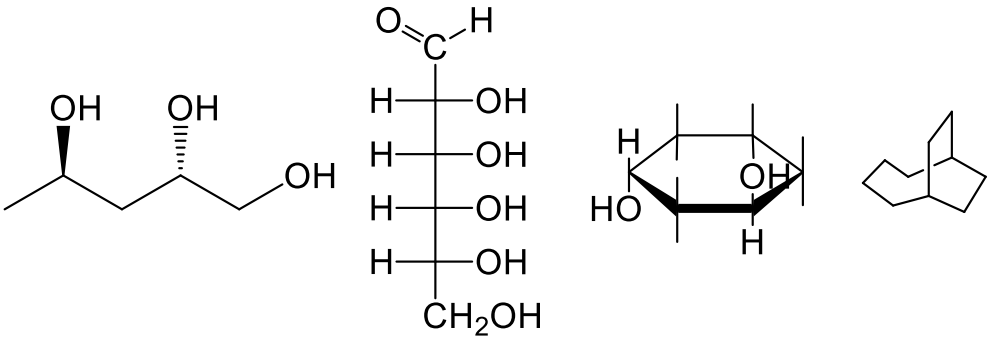
104. The indicated bond in the following compound is_____ of the paper.



A. in the plane
B. out of the plane
C. behind the plane
D. None of these

Answer: C
Learning Objective: 2.6 Describe how wedges and dashes are used to indicate three-dimensional molecular structure
Difficulty: Easy

105. Which of the following is a Fischer projection?

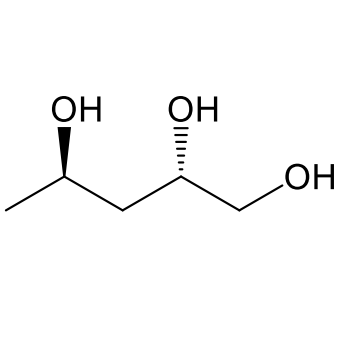


I II III IV

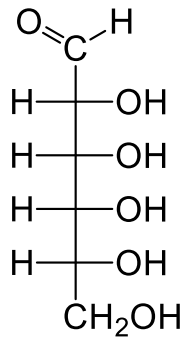
A. I
B. II
C. III
D. IV
E. Both III and IV

Answer: B
Learning Objective: 2.6 Describe how wedges and dashes are used to indicate three-dimensional molecular structure
Difficulty: Easy

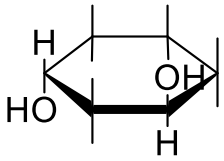
106. Which of the following is a Haworth projection?



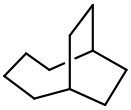
I



II



III

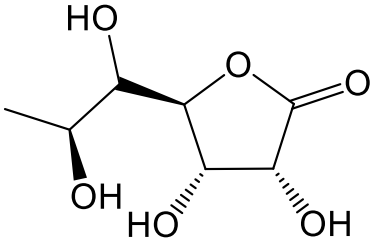


IV

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

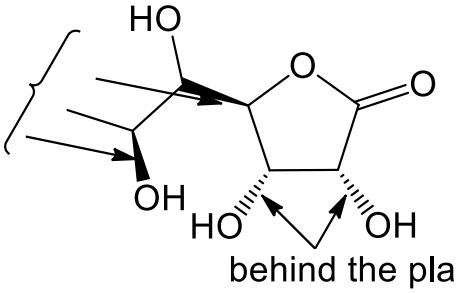
Answer: C
Learning Objective: 2.6 Describe how wedges and dashes are used to indicate three-dimensional molecular structure
Difficulty: Easy

107. Label the bonds that are out of the plane and behind the plane of the paper.



Answer:

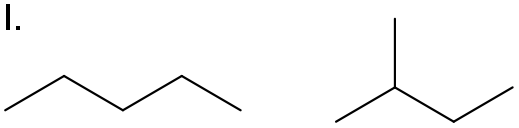
out of the plane

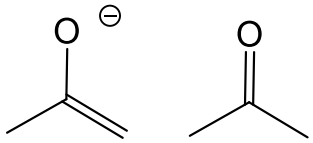


behind the plane

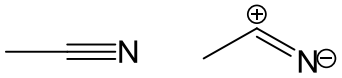
Learning Objective: 2.6 Describe how wedges and dashes are used to indicate three-dimensional molecular structure
Difficulty: Medium

108. Which of the following pairs are resonance structures of each other?

I. 

II. 

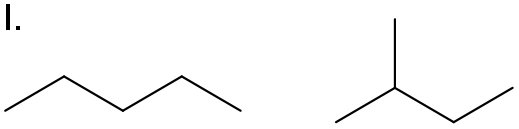
III. 

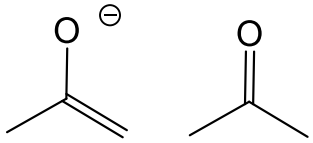
IV. 

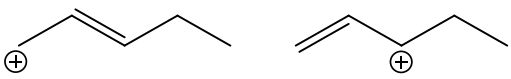
A. I
B. II
C. III
D. IV
E. None of these

Answer: D
Learning Objective: 2.7 Define "resonance," describing the relationship between resonance and molecular orbital theory
Difficulty: Easy

109. Which of the following pairs are resonance structures of each other?

I. 

II. 

III. 

IV. 

A. I
B. II
C. III
D. IV
E. None of these

Answer: C

Learning Objective: 2.7 Define "resonance," describing the relationship between resonance and molecular orbital theory
Difficulty: Easy

110. The spreading of positive or negative charge over two or more atoms in a compound is called_____.

A. isomerism
B. delocalization
C. stereoisomerism
D. localization
E. None of these

Answer: B
Learning Objective: 2.7 Define "resonance," describing the relationship between resonance and molecular orbital theory
Difficulty: Easy

111. Delocalization of charge over two or more atoms _____ a molecule.

A. destabilizes
B. delocalizes
C. localizes
D. stabilizes
E. None of these

Answer: D
Learning Objective: 2.7 Define "resonance," describing the relationship between resonance and molecular orbital theory
Difficulty: Easy

112. Resonance structures have _____ connectivity of atoms and _____ distribution of electrons.

A. different, same
B. same, same
C. different, different
D. same, different
E. None of these

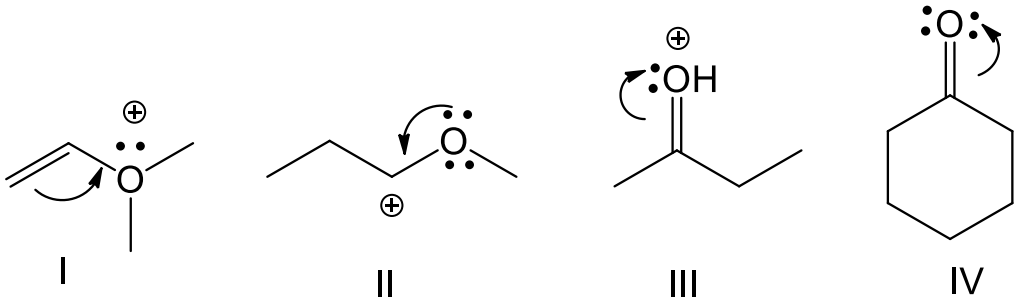
Answer: D
Learning Objective: 2.7 Define "resonance," describing the relationship between resonance and molecular orbital theory

Difficulty: Medium

113. What is a resonance hybrid?

Answer: A molecule that can be represented by drawing two or more resonance structures is viewed as a resonance hybrid.
Learning Objective: 2.7 Define "resonance," describing the relationship between resonance and molecular orbital theory
Difficulty: Medium

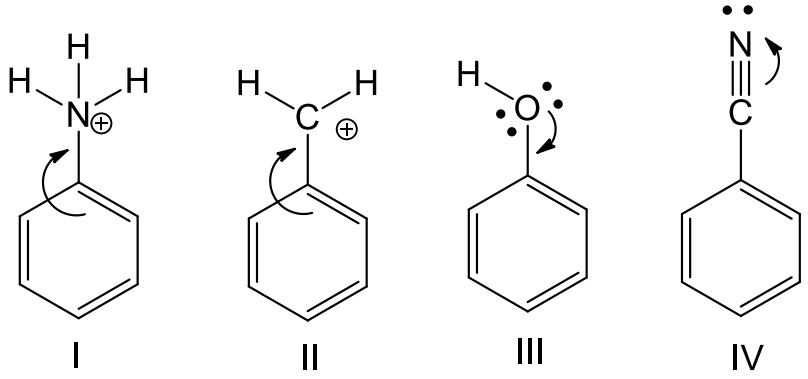
114. Which of the following violates the rules for curved arrows?



A. I
B. II
C. III
D. IV
E. none of these

Answer: A
Learning Objective: 2.8 Demonstrate the used of curved arrows in drawing resonance structures, stating the two rules to be applied when drawing curved arrows
Difficulty: Easy

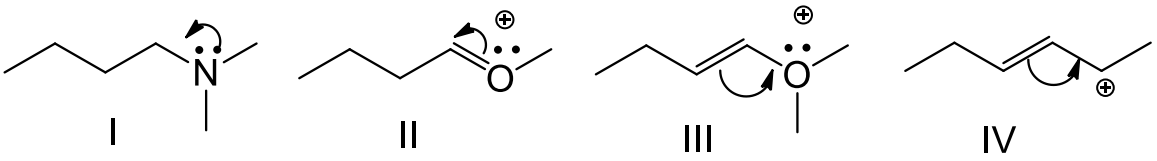
115. Which of the following violates the rules for curved arrows?



A. I
B. II and IV
C. I and III
D. III and IV
E. None of these

Answer: C
Learning Objective: 2.8 Demonstrate the used of curved arrows in drawing resonance structures, stating the two rules to be applied when drawing curved arrows
Difficulty: Easy

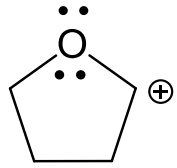
116. Which of the following violates the rules for curved arrows?



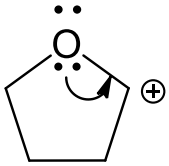
A. I and II
B. III and IV
C. I, and III
D. II, III and IV
E. all of these

Answer: C
Learning Objective: 2.8 Demonstrate the used of curved arrows in drawing resonance structures, stating the two rules to be applied when drawing curved arrows
Difficulty: Easy

117. Provide the curved arrow(s) to draw a resonance structure for the following compound.

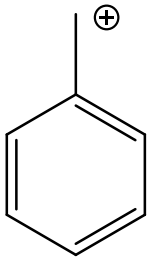


Answer:

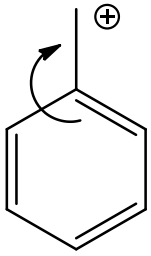


Learning Objective: 2.8 Demonstrate the used of curved arrows in drawing resonance structures, stating the two rules to be applied when drawing curved arrows
Difficulty: Medium

118. Provide the curved arrow(s) to draw a resonance structure for the following compound.

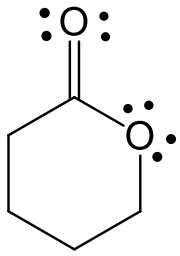


Answer:

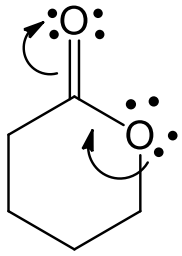


Learning Objective: 2.8 Demonstrate the used of curved arrows in drawing resonance structures, stating the two rules to be applied when drawing curved arrows
Difficulty: Medium

119. Provide the curved arrow(s) to draw a resonance structure for the following compound.

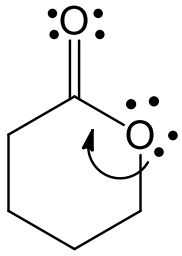


Answer:

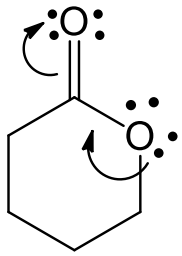


Learning Objective: 2.8 Demonstrate the used of curved arrows in drawing resonance structures, stating the two rules to be applied when drawing curved arrows
Difficulty: Hard

120. Explain using words as well as structural drawings, if the single curved arrow shown is sufficient to draw the resonance structure.

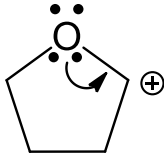


Answer: The single arrow shown will violate the octet rule. Drawing another curved arrow will remove the violation.

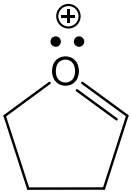


Learning Objective: 2.8 Demonstrate the used of curved arrows in drawing resonance structures, stating the two rules to be applied when drawing curved arrows
Difficulty: Hard

121. Draw the resonance structure indicated by the curved arrows.

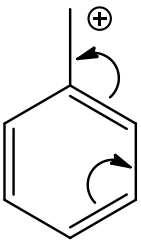


Answer:

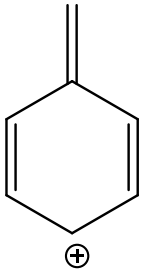


Learning Objective: 2.9 Describe the use of arrow pushing and formal charges in resonance structures
Difficulty: Medium

122. Draw the resonance structure indicated by the curved arrows.

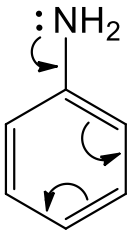


Answer:

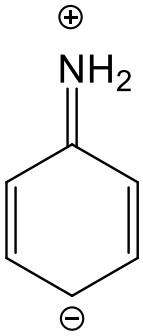


Learning Objective: 2.9 Describe the use of arrow pushing and formal charges in resonance structures
Difficulty: Medium

123. Draw the resonance structure indicated by the curved arrows.

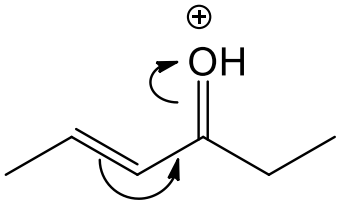


Answer:

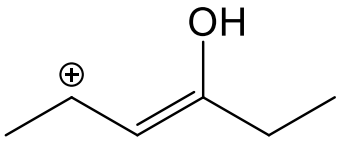


Learning Objective: 2.9 Describe the use of arrow pushing and formal charges in resonance structures
Difficulty: Medium

124. Draw the resonance structure indicated by the curved arrows.

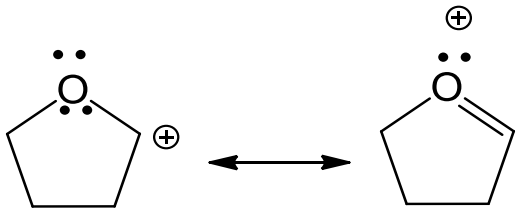


Answer:

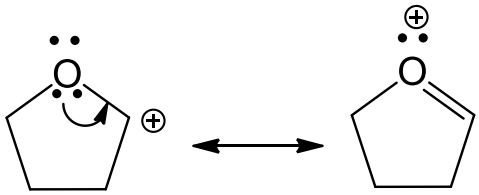


Learning Objective: 2.9 Describe the use of arrow pushing and formal charges in resonance structures
Difficulty: Medium

125. Draw the curved arrow(s) for converting the first resonance structure into the second resonance structure.

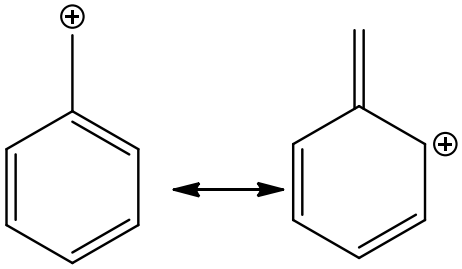


Answer:

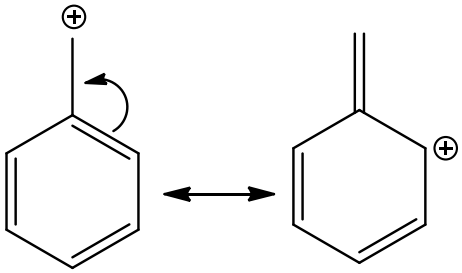


Learning Objective: 2.9 Describe the use of arrow pushing and formal charges in resonance structures
Difficulty: Medium

126. Draw the curved arrow(s) for converting the first resonance structure into the second resonance structure.

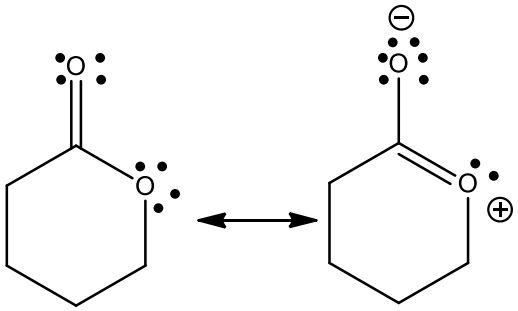


Answer:

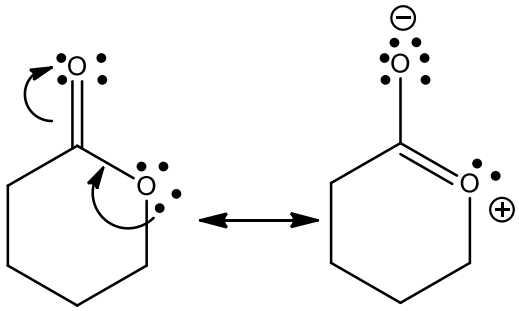


Learning Objective: 2.9 Describe the use of arrow pushing and formal charges in resonance structures
Difficulty: Hard

127. Draw the curved arrow(s) for converting the first resonance structure into the second resonance structure.

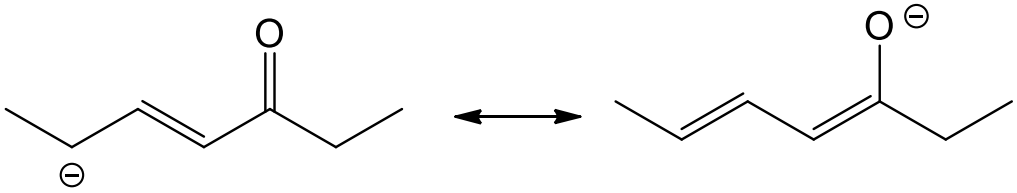


Answer:

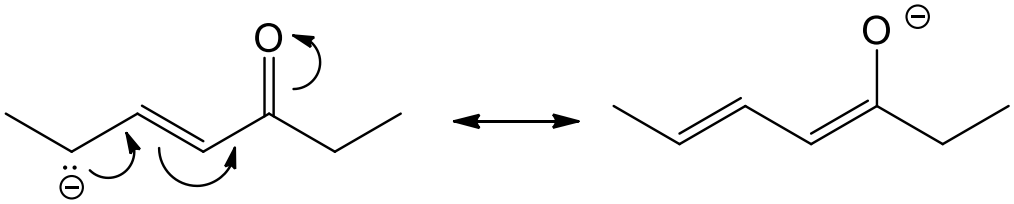


Learning Objective: 2.9 Describe the use of arrow pushing and formal charges in resonance structures
Difficulty: Hard

128. Draw the curved arrow(s) for converting the first resonance structure into the second resonance structure.

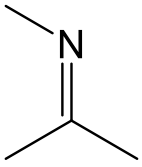


Answer:

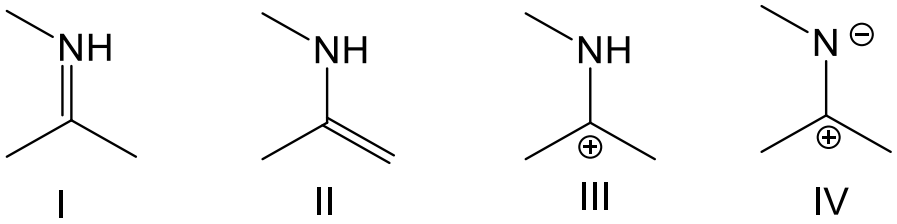


Learning Objective: 2.9 Describe the use of arrow pushing and formal charges in resonance structures
Difficulty: Hard

129. Which of the following is a correct resonance structure for compound A?



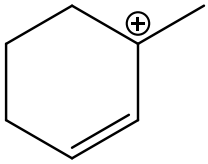
A



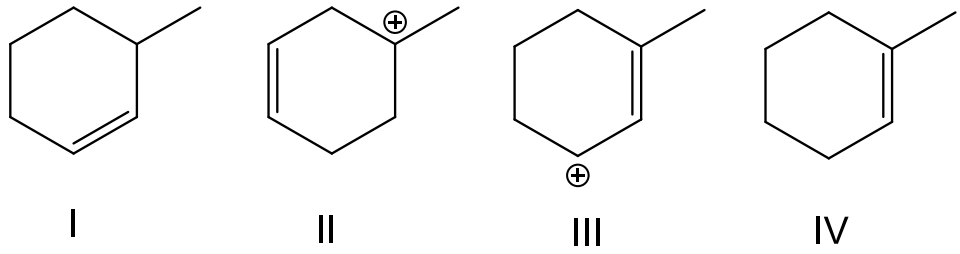
A. I
B. II
C. III
D. IV
E. none of these

Answer: D
Learning Objective: 2.10 Identify resonance structures by naming the five different structural patterns in molecules
Difficulty: Easy

130. Which of the following is a correct resonance structure for compound A?



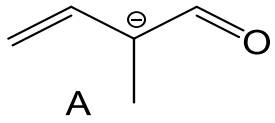
A



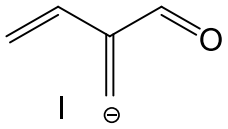
A. I
B. II
C. III
D. IV
E. None of these

Answer: C
Learning Objective: 2.10 Identify resonance structures by naming the five different structural patterns in molecules
Difficulty: Medium

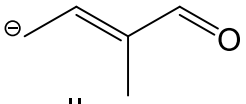
131. Which of the following is/are correct resonance structure(s) for compound A?



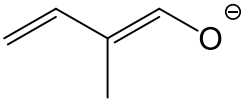
A



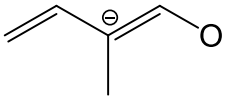
I



II



III

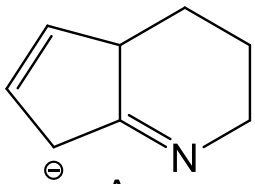


IV

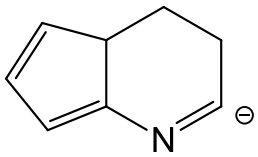
A. I
B. II and III
C. III and IV
D. I and III
E. I and IV

Answer: B
Learning Objective: 2.10 Identify resonance structures by naming the five different structural patterns in molecules
Difficulty: Easy

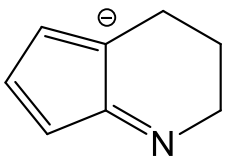
132. Which of the following is/are correct resonance structure(s) for compound A?



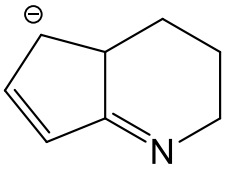
A



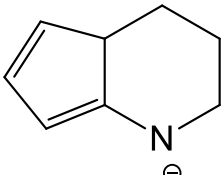
I



II



III



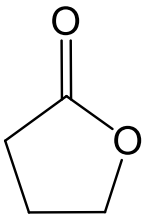
IV

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

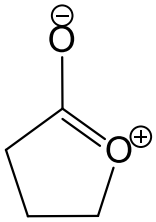
E. I and IV

Answer: C
Learning Objective: 2.10 Identify resonance structures by naming the five different structural patterns in molecules
Difficulty: Medium

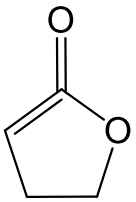
133. Which of the following is a correct resonance structure for compound A?



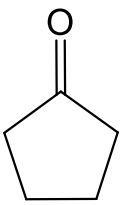
A



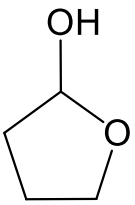
I



II



III

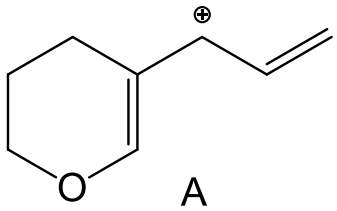


IV

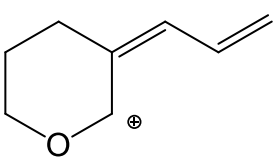
A. I
B. II
C. III
D. IV
E. none of these

Answer: A
Learning Objective: 2.10 Identify resonance structures by naming the five different structural patterns in molecules
Difficulty: Easy

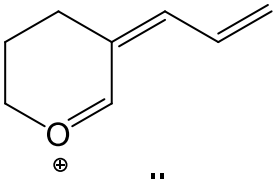
134. Which of the following is/are correct resonance structure(s) for compound A?



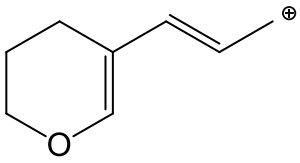
A



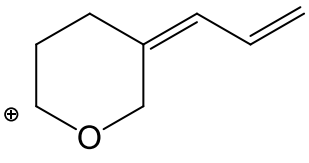
I



II



III

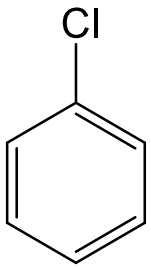


IV

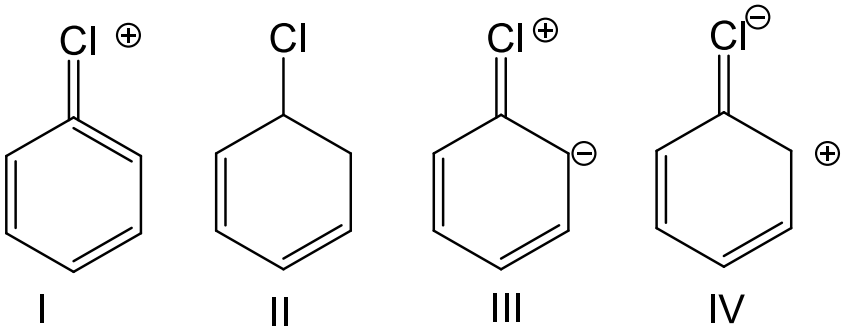
A. I and II
B. II and III
C. III and IV
D. I, II and III
E. I and IV

Answer: D
Learning Objective: 2.10 Identify resonance structures by naming the five different structural patterns in molecules
Difficulty: Medium

135. Which of the following is a correct resonance structure for compound A?



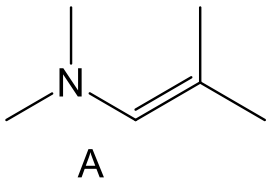
A

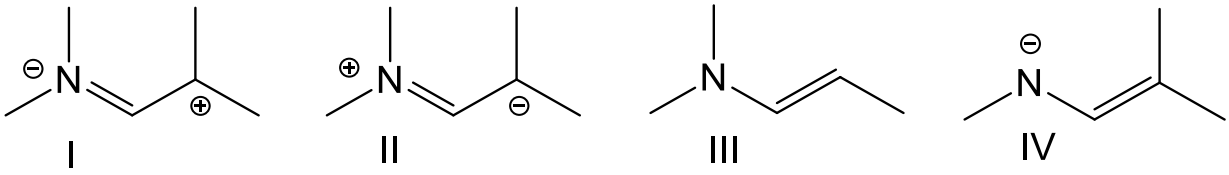


A. I
B. II
C. III
D. IV
E. None of these

Answer: C
Learning Objective: 2.10 Identify resonance structures by naming the five different structural patterns in molecules
Difficulty: Easy

136. Which of the following is a correct resonance structure for compound A?



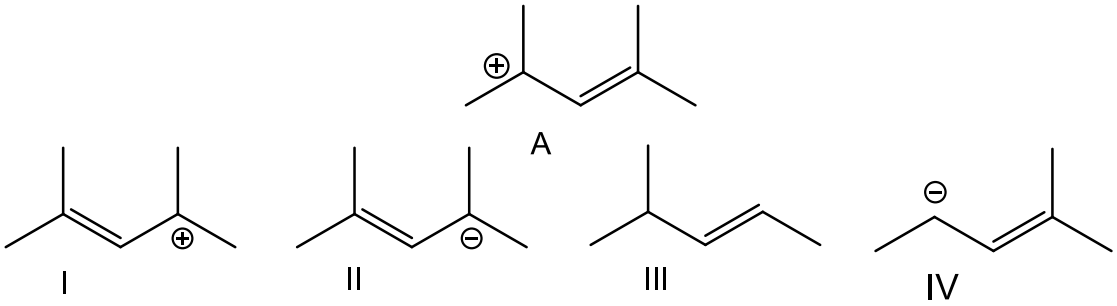


A. I
B. II
C. III
D. IV
E. None of these

Answer: B
Learning Objective: 2.10 Identify resonance structures by naming the five different structural patterns in molecules

Difficulty: Easy

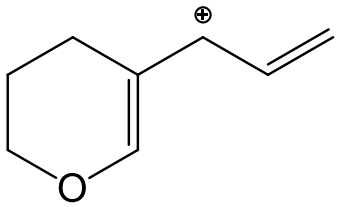
137. Which of the following is a correct resonance structure for compound A?



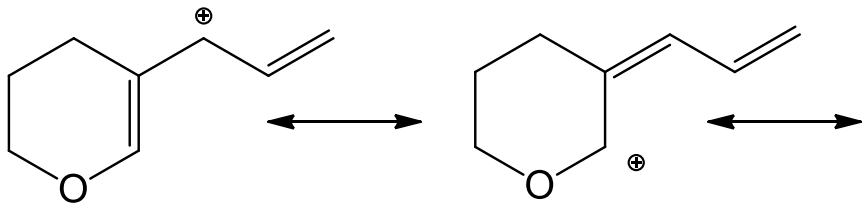
A. I
B. II
C. III
D. IV
E. none of these

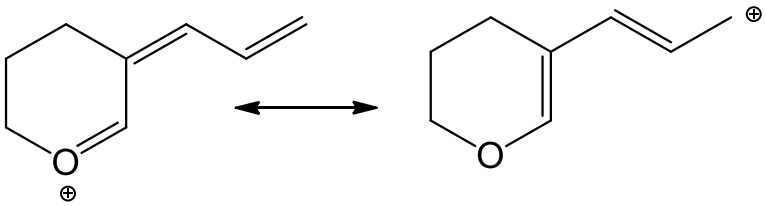
Answer: A
Learning Objective: 2.10 Identify resonance structures by naming the five different structural patterns in molecules
Difficulty: Medium

138. Draw resonance structures for the following compound.



Answer:

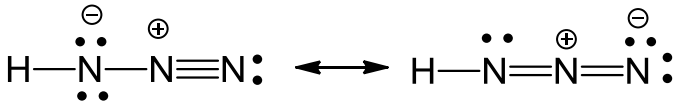




Learning Objective: 2.10 Identify resonance structures by naming the five different structural patterns in molecules
Difficulty: Medium

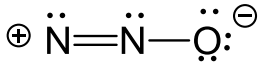
139. Draw two resonance structures for HN_3.

Answer:

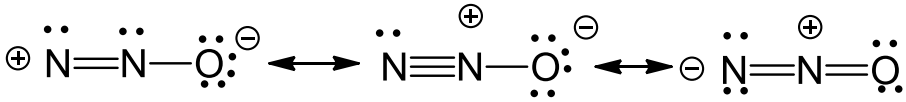


Learning Objective: 2.10 Identify resonance structures by naming the five different structural patterns in molecules
Difficulty: Hard

140. Draw two additional resonance structures for the following compound.

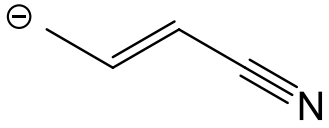


Answer:

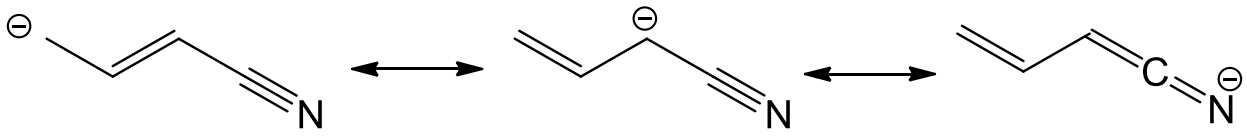


Learning Objective: 2.10 Identify resonance structures by naming the five different structural patterns in molecules
Difficulty: Hard

141. Draw two additional resonance structures for the following compound.

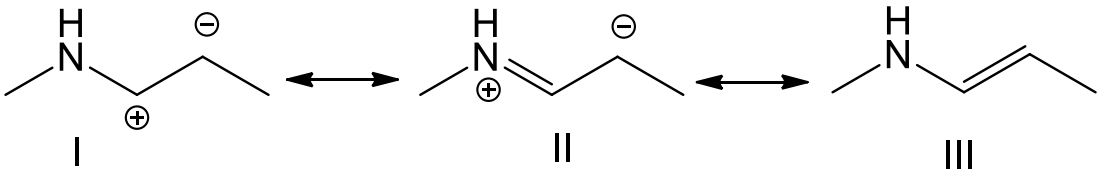


Answer:



Learning Objective: 2.10 Identify resonance structures by naming the five different structural patterns in molecules
Difficulty: Hard

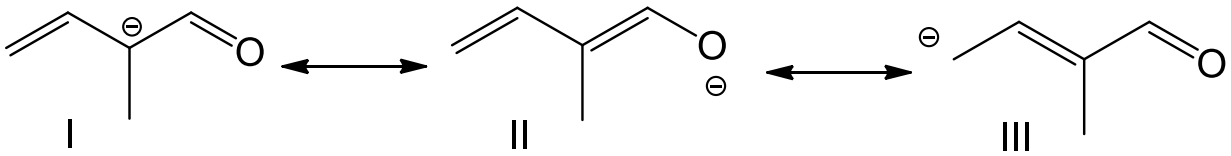
142. Which of the following is/are the most significant resonance structure(s)?



A. I
B. II
C. III
D. II and III
E. all of these

Answer: C
Learning Objective: 2.11 Distinguish between significant and insignificant resonance structures, describing how the significance of resonance is determined
Difficulty: Easy

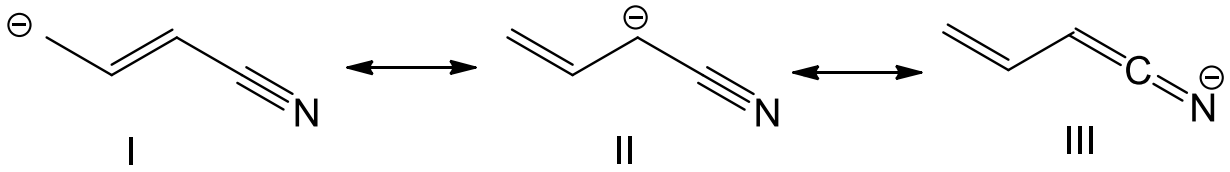
143. Which of the following is/are the most significant resonance structure(s)?



A. I
B. II
C. III
D. I and II
E. all of these

Answer: B
Learning Objective: 2.11 Distinguish between significant and insignificant resonance structures, describing how the significance of resonance is determined Difficulty: Easy

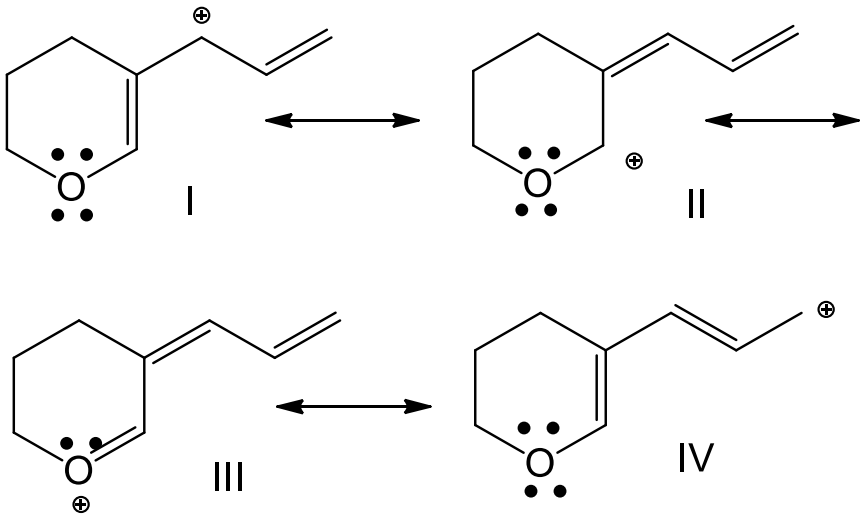
144. Which of the following is/are the most significant resonance structure(s)?



A. I
B. II
C. III
D. I and II
E. all of these

Answer: C
Learning Objective: 2.11 Distinguish between significant and insignificant resonance structures, describing how the significance of resonance is determined Difficulty: Medium

145. Which of the following is/are the most significant resonance structure(s)?

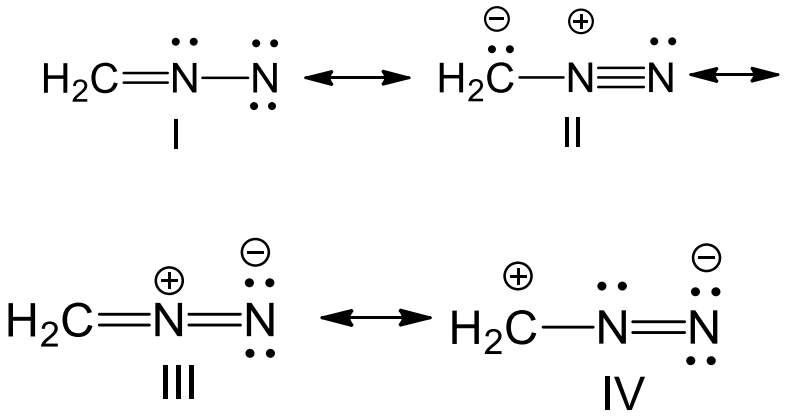


A. I
B. II
C. III
D. I and II

E. I and IV

Answer: C
Learning Objective: 2.11 Distinguish between significant and insignificant resonance structures, describing how the significance of resonance is determined
Difficulty: Medium

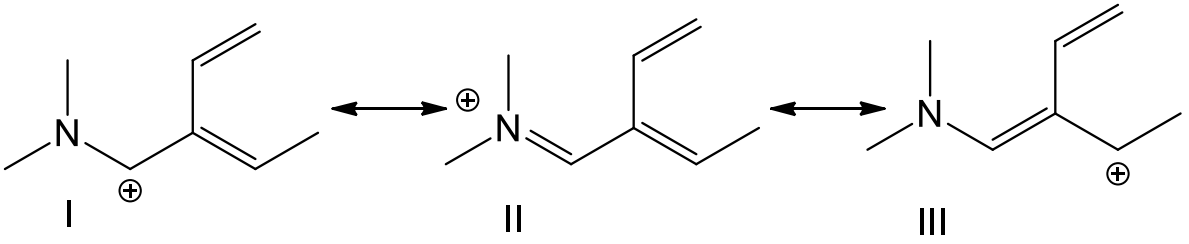
146. Which of the following is the most significant resonance structure?



A. I
B. II
C. III
D. IV
E. None of these

Answer: C
Learning Objective: 2.11 Distinguish between significant and insignificant resonance structures, describing how the significance of resonance is determined
Difficulty: Medium

147. Which of the following is/are the most significant resonance structure(s)?



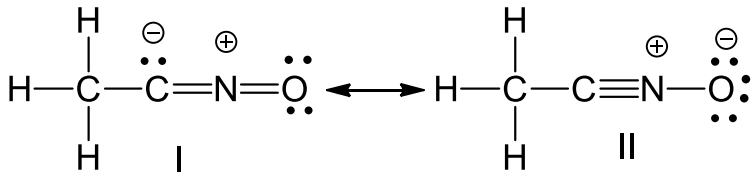
A. I
B. II

C. III
D. I and III
E. all of these

Answer: B
Learning Objective: 2.11 Distinguish between significant and insignificant resonance structures, describing how the significance of resonance is determined
Difficulty: Medium

148. Draw significant resonance structures for the following compound, CH_3CNO. Which of these is/are the most significant resonance structure(s)? Explain why.

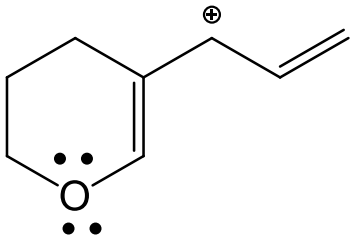
Answer:



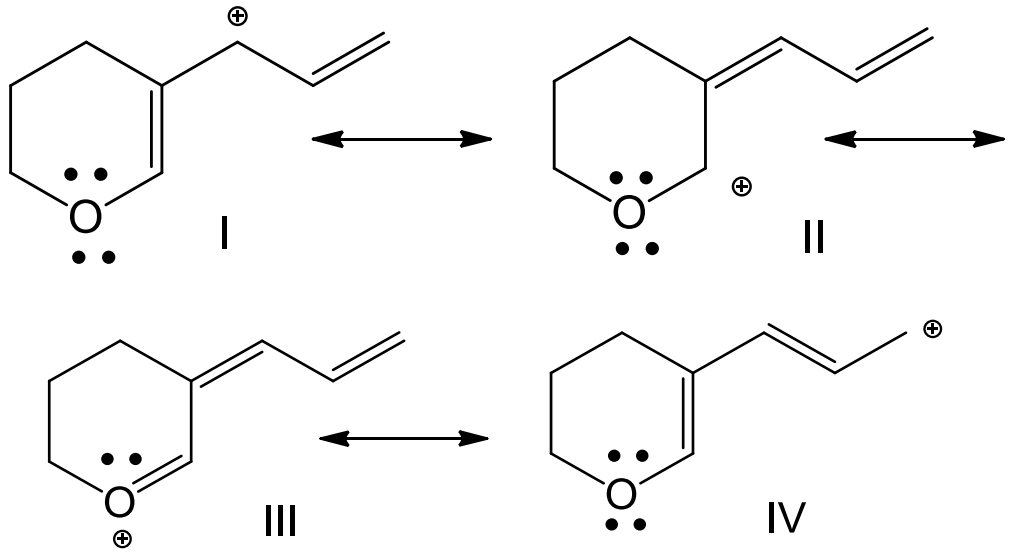
Resonance structure II is most significant, because the more electronegative oxygen atom carries a negative formal charge.

Learning Objective: 2.11 Distinguish between significant and insignificant resonance structures, describing how the significance of resonance is determined
Difficulty: Hard

149. Draw significant resonance structures for the following compound. Which of these is/are the most significant resonance structure(s)? Explain why.



Answer:

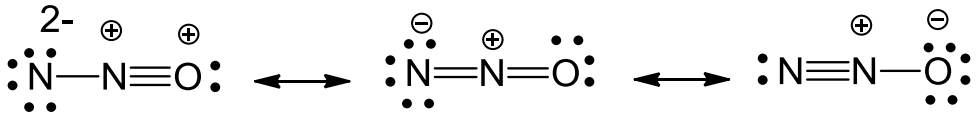


Resonance structure III is most significant, because all atoms have octet of electrons.

Learning Objective: 2.11 Distinguish between significant and insignificant resonance structures, describing how the significance of resonance is determined
Difficulty: Hard

150. Draw significant resonance structures for N_2O. Which of these is/are the most significant resonance structure(s)? Explain why.

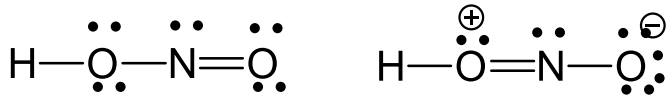
Answer:



Resonance structure III is most significant, because the more electronegative oxygen atom carries a negative formal charge.

Learning Objective: 2.11 Distinguish between significant and insignificant resonance structures, describing how the significance of resonance is determined
Difficulty: Hard

151. What is the relationship between the following compounds?



A. constitutional isomers
B. resonance structures
C. conformers
D. identical compounds

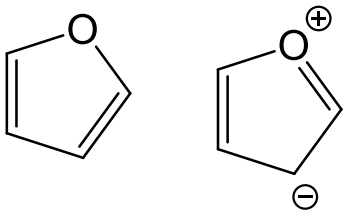
Answer: B
Learning Objective: 2.11 Distinguish between significant and insignificant resonance structures, describing how the significance of resonance is determined
Difficulty: Easy

152. What is the relationship between the following compounds?

A. constitutional isomers
B. resonance structures
C. conformers
D. identical compounds

Answer: A
Learning Objective: 2.11 Distinguish between significant and insignificant resonance structures, describing how the significance of resonance is determined
Difficulty: Easy

153. What is the relationship between the following compounds?



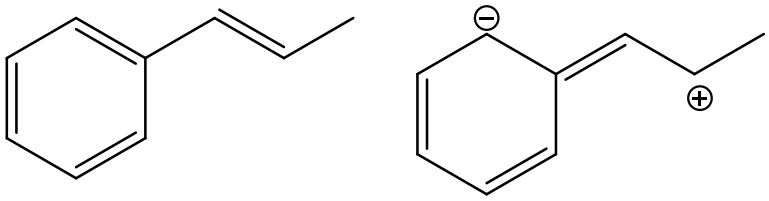
A. constitutional isomers
B. resonance structures
C. conformers
D. identical compounds
E. different compounds

Answer: B

Learning Objective: Assessing Importance
Section: 2.11

Difficulty: Easy

154. What is the relationship between the following compounds?

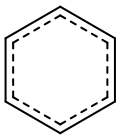


A. constitutional isomers
B. resonance structures
C. conformers
D. identical compounds
E. different compounds

Answer: B
Learning Objective: 2.11 Distinguish between significant and insignificant resonance structures, describing how the significance of resonance is determined
Difficulty: Easy

155. Draw the resonance hybrid of C_6H_6.

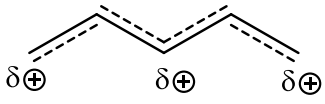
Answer:



Learning Objective: 2.12 Draw a resonance hybrid using partial bonds and partial charges, reflecting the combination of individual resonance structures
Difficulty: Medium

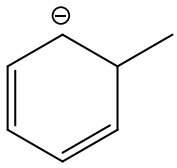
156. Draw the resonance hybrid of $CH_2CHCHCHCH_2^+$.

Answer:

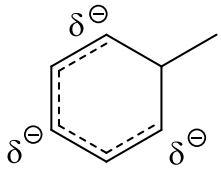


Learning Objective: 2.12 Draw a resonance hybrid using partial bonds and partial charges, reflecting the combination of individual resonance structures
Difficulty: Medium

157. Draw the resonance hybrid for the following structure.

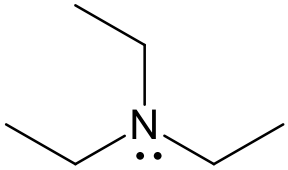


Answer:



Learning Objective: 2.12 Draw a resonance hybrid using partial bonds and partial charges, reflecting the combination of individual resonance structures
Difficulty: Medium

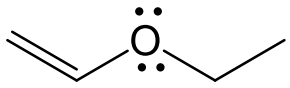
158. The lone pair on nitrogen in the following compound is _____.



A. localized
B. delocalized

Answer: A
Learning Objective: 2.13 Distinguish between delocalized and localized lone pairs and describe how delocalized lone pairs participate in resonance and why localized lone pairs do not participate in resonance
Difficulty: Easy

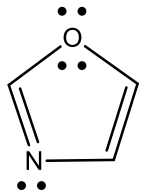
159. The lone pair on oxygen in the following compound is _____.



A. both localized
B. both delocalized
C. one localized and one delocalized

Answer: C
Learning Objective: 2.13 Distinguish between delocalized and localized lone pairs and describe how delocalized lone pairs participate in resonance and why localized lone pairs do not participate in resonance
Difficulty: Easy

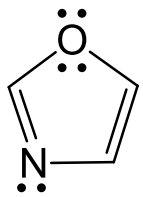
160. The lone pair on nitrogen in the following compound is _____.



A. localized
B. delocalized

Answer: A
Learning Objective: 2.12 Distinguish between delocalized and localized lone pairs and describe how delocalized lone pairs participate in resonance and why localized lone pairs do not participate in resonance
Difficulty: Easy

161. The lone pairs on oxygen in the following compound are _____.

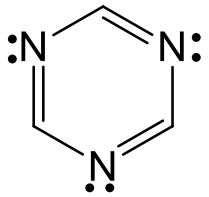


A. both localized
B. both delocalized

C. one localized and one delocalized

Answer: C
Learning Objective: 2.13 Distinguish between delocalized and localized lone pairs and describe how delocalized lone pairs participate in resonance and why localized lone pairs do not participate in resonance
Difficulty: Easy

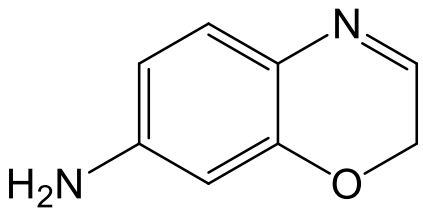
162. The lone pairs on nitrogen in the following compound are _____.



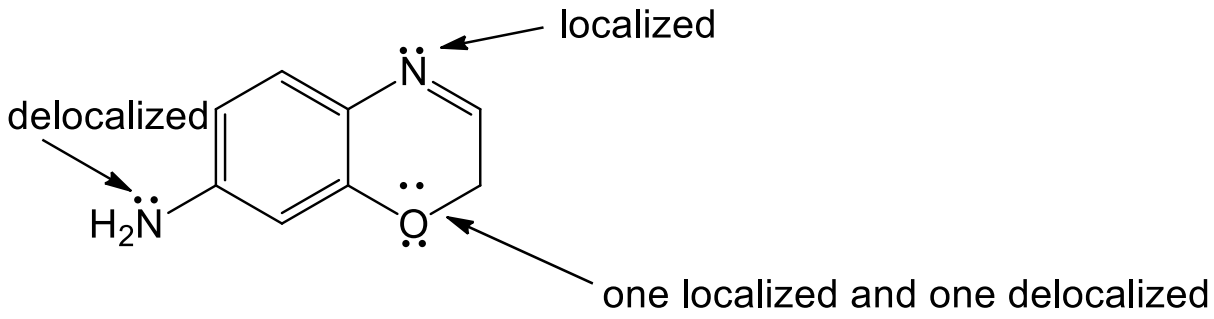
A. three localized
B. three delocalized
C. two localized and one delocalized
D. one localized and two delocalized

Answer: A
Learning Objective: 2.13 Distinguish between delocalized and localized lone pairs and describe how delocalized lone pairs participate in resonance and why localized lone pairs do not participate in resonance
Difficulty: Easy

163. For the following compound identify the lone pairs and indicate if each lone pair is localized or delocalized.

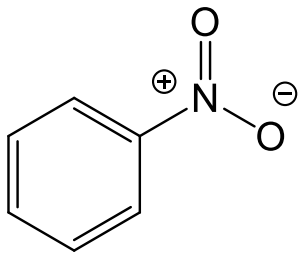


Answer:

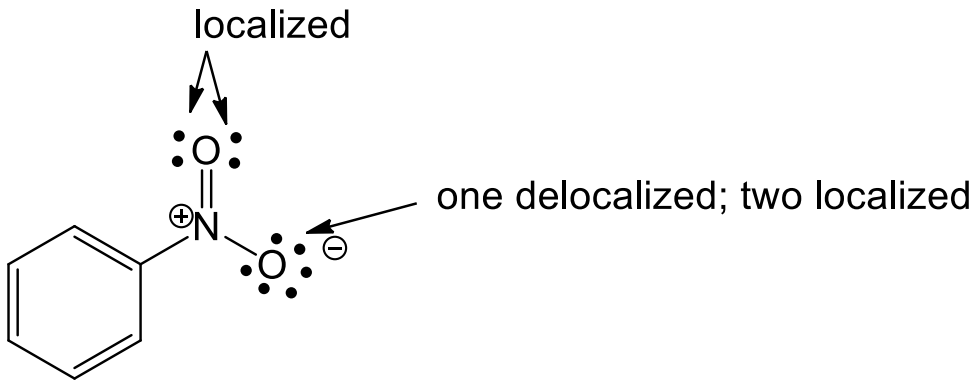


Learning Objective: 2.13 Distinguish between delocalized and localized lone pairs and describe how delocalized lone pairs participate in resonance and why localized lone pairs do not participate in resonance
Difficulty: Medium

164. For the following compound identify the lone pairs and indicate if each lone pair is localized or delocalized.

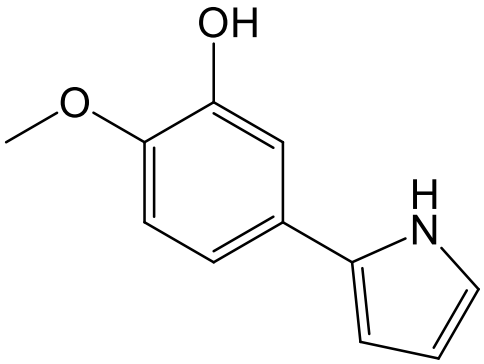


Answer:

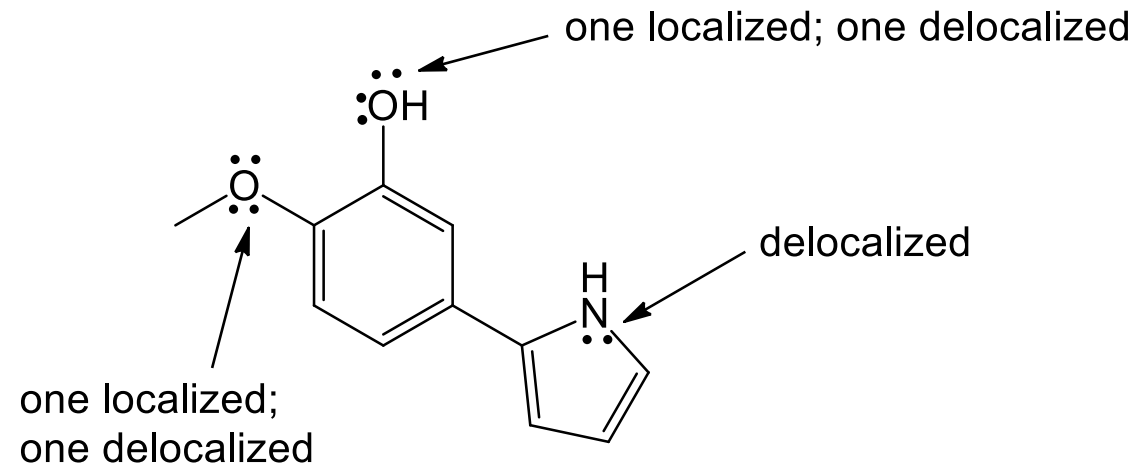


Learning Objective: 2.13 Distinguish between delocalized and localized lone pairs and describe how delocalized lone pairs participate in resonance and why localized lone pairs do not participate in resonance
Difficulty: Medium

165. For the following compound identify the lone pairs and indicate if each lone pair is localized or delocalized.

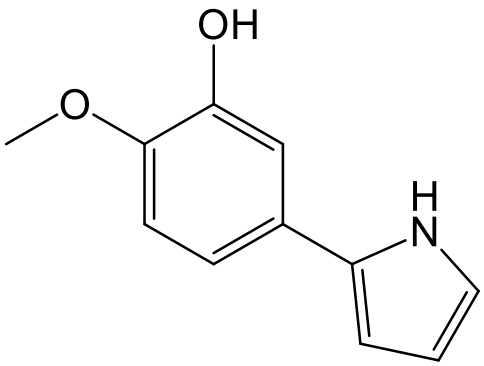


Answer:

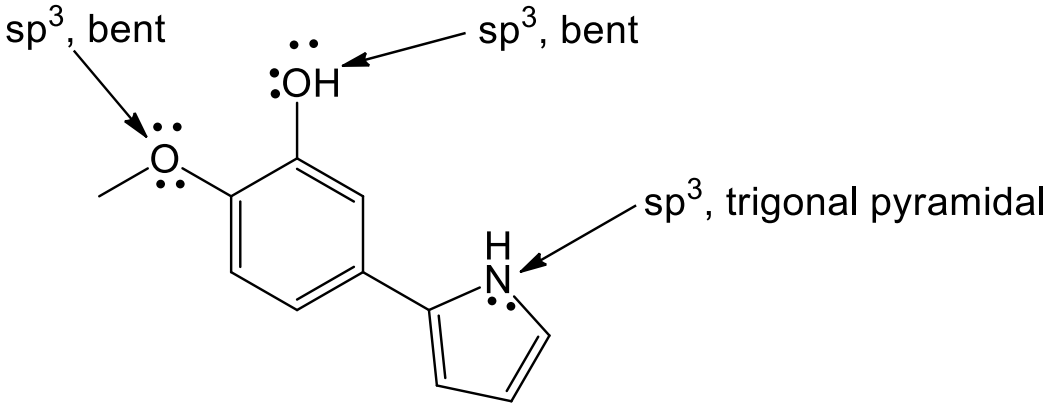


Learning Objective: 2.13 Distinguish between delocalized and localized lone pairs and describe how delocalized lone pairs participate in resonance and why localized lone pairs do not participate in resonance
Difficulty: Medium

166. For the following compound what is the hybridization state and molecular geometry at each oxygen and nitrogen atom.

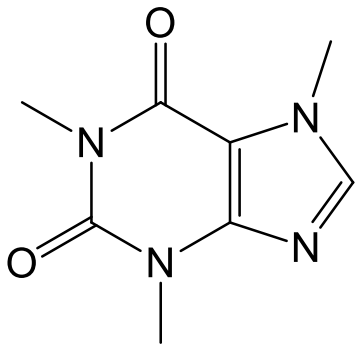


Answer:

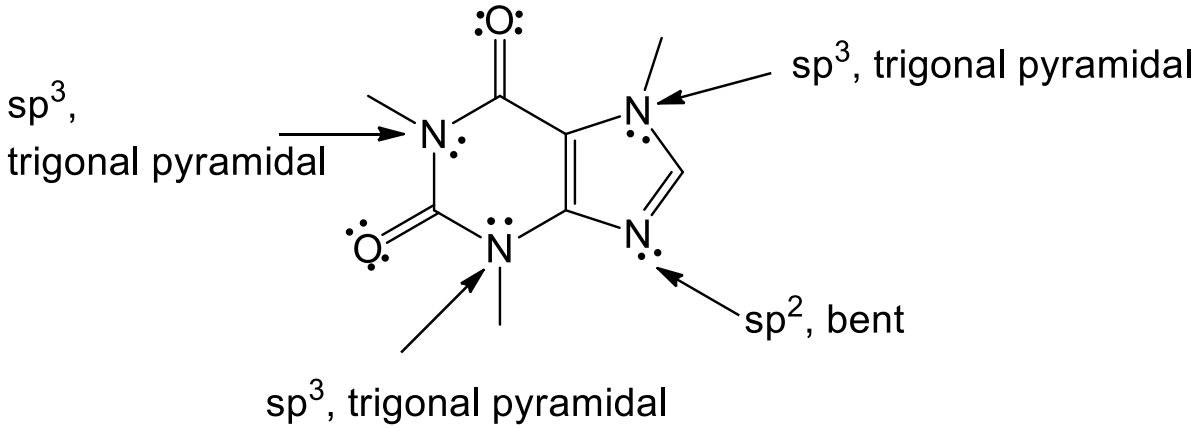


Learning Objective: 2.13 Distinguish between delocalized and localized lone pairs and describe how delocalized lone pairs participate in resonance and why localized lone pairs do not participate in resonance
Difficulty: Hard

167. Caffeine has the following structure. What is the hybridization state and molecular geometry at each nitrogen atom in caffeine?

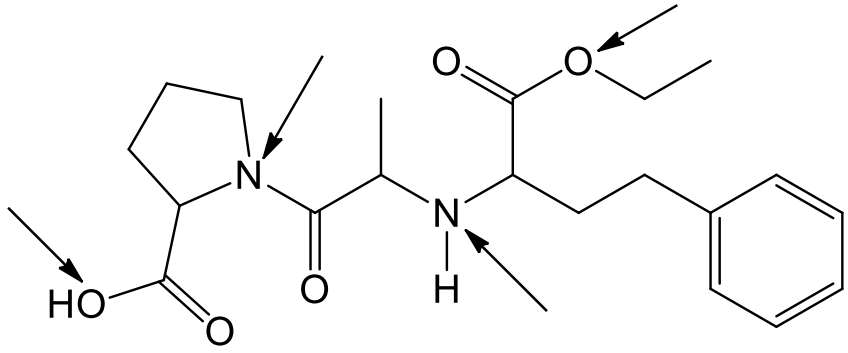


Answer:

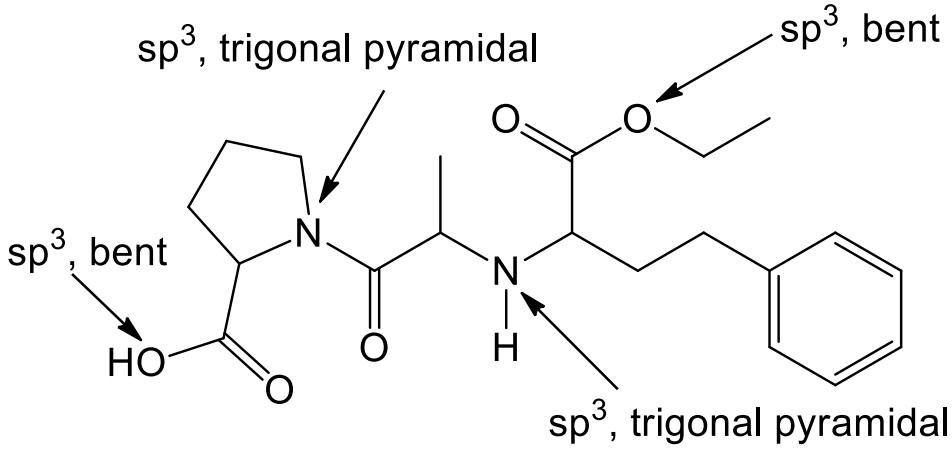


Learning Objective: 2.13 Distinguish between delocalized and localized lone pairs and describe how delocalized lone pairs participate in resonance and why localized lone pairs do not participate in resonance
Difficulty: Hard

168. Enalapril, is a drug used in the treatment of heart disease. What is the hybridization state and molecular geometry at the indicated atoms in Enalapril?



Answer:



Learning Objective: 2.13 Distinguish between delocalized and localized lone pairs and describe how delocalized lone pairs participate in resonance and why localized lone pairs do not participate in resonance
Difficulty: Hard