

Package title: Solomons Test Bank
Course Title: Solomons 12e
Chapter Number: 1

Question type: Multiple choice

1) Which of the following best describes the origin of carbon atoms?

- a) The Big Bang
- b) amino acids found on meteorites
- c) byproduct of chemical fusion in stars
- d) gradual decay of radioactive isotopes of nitrogen
- e) All of these choices.

Answer: C

Topic: General
Section: 1.1
Difficulty Level: Easy

2) Credit for the first synthesis of an organic compound from an inorganic precursor is usually given to ____.

- a) Berzelius
- b) Arrhenius
- c) Kekule
- d) Wöhler
- e) Lewis

Answer: D

Topic: General
Section: 1.1
Difficulty Level: Easy

3) The greatest degree of ionic character is anticipated for the bond between

- a) H and C.
- b) H and Cl.
- c) C and Cl.
- d) H and Br.
- e) Br and Cl.

Answer: B

Topic: Atomic Orbitals, Periodic Trends, Electronegativity

Section: 1.3

Difficulty Level: Easy

4) Select the least electronegative element from the list below.

- a) P
- b) N
- c) Mg
- d) Si
- e) K

Answer: E

Topic: Periodic Trends, Electronegativity

Section: 1.3

Difficulty Level: Easy

5) Select the most electronegative element from the list below.

- a) H
- b) O
- c) N
- d) B
- e) C

Answer: B

Topic: Periodic Properties, Electronegativity

Section: 1.3

Difficulty Level: Easy

6) Which of these substances contain both covalent and ionic bonds?

- a) NH_4Cl
- b) H_2O_2
- c) CH_4
- d) HCN
- e) H_2S

Answer: A

Topic: Bonding

Section: 1.3

Difficulty Level: Medium

7) Which type of bonding is present in the compound CH_3Li ?

- a) Ionic bonding
- b) Covalent bonding
- c) Hydrogen bonding
- d) Ionic and covalent bonding
- e) Ionic, covalent, and hydrogen bonding

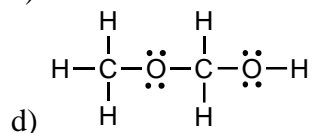
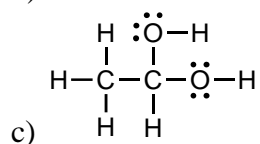
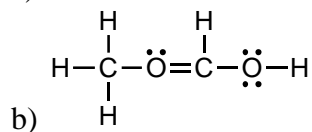
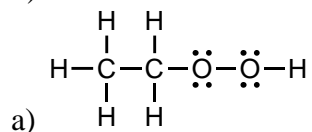
Answer: D

Topic: Bonding

Section 1.3

Difficulty Level: Medium

8) Which of the following is the Lewis structure for $\text{CH}_3\text{CH}_2\text{O}_2\text{H}$?



e) None of these choices.

Answer: A

Topic: Lewis Structures

Section: 1.4

Difficulty Level: Medium

9) In which of the following does the central atom have 2 pairs of non-bonding electrons?

a) O_3

b) CO_2

c) CO_3^{2-}

d) NH_4^+

e) H_2S

Answer: E

Topic: Lewis Structures

Section: 1.4

Difficulty Level: Medium

10) Which is NOT a correct Lewis structure?

- a) $\begin{array}{c} \text{H}-\ddot{\text{N}}=\ddot{\text{F}}: \\ | \\ \text{H} \end{array}$
- b) $\begin{array}{c} \text{H} \\ | \\ \text{H}-\text{C}-\ddot{\text{F}}: \\ | \\ \text{H} \end{array}$
- c) $\begin{array}{c} \text{H}-\ddot{\text{O}}-\ddot{\text{O}}-\text{H} \\ \vdots \quad \vdots \end{array}$
- d) $\begin{array}{c} \text{H}-\ddot{\text{O}}-\text{B} \begin{array}{l} \nearrow \ddot{\text{O}}-\text{H} \\ \searrow \ddot{\text{O}}-\text{H} \end{array} \\ \vdots \end{array}$
- e) None of these choices.

Answer: A

Topic: Lewis Structures, Formal Charges

Section: 1.4

Difficulty Level: Medium

11) Which of these is a correct electron-dot representation of the nitrite ion, NO_2^- ?

- I $\left[\begin{array}{c} \ddot{\text{O}}:\ddot{\text{N}}::\ddot{\text{O}} \\ \vdots \quad \vdots \end{array} \right]^-$
- II $\left[\begin{array}{c} \ddot{\text{O}}::\text{N}:\ddot{\text{O}}: \\ \vdots \quad \vdots \end{array} \right]^-$
- III $\left[\begin{array}{c} \ddot{\text{O}}::\text{N}::\ddot{\text{O}} \\ \vdots \quad \vdots \end{array} \right]^-$
- IV $\left[\begin{array}{c} \ddot{\text{O}}:\ddot{\text{N}}:\ddot{\text{O}}: \\ \vdots \quad \vdots \end{array} \right]^-$
- V $\left[\begin{array}{c} \ddot{\text{O}}::\ddot{\text{N}}:\ddot{\text{O}} \\ \vdots \quad \vdots \end{array} \right]^-$

- a) I
b) II
c) III
d) IV
e) V

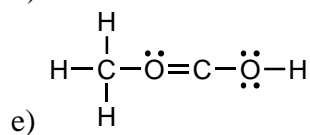
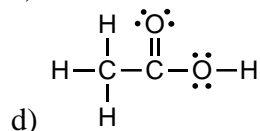
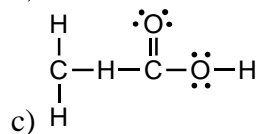
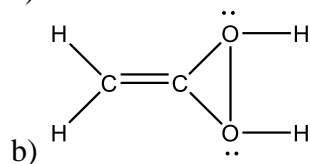
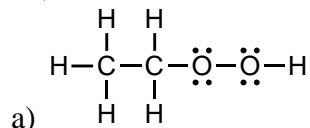
Answer: A

Topic: Lewis Structures, Formal Charges

Section: 1.4

Difficulty Level: Medium

12) Which of the following is the Lewis structure for $\text{CH}_3\text{CO}_2\text{H}$?



Answer: D

Topic: Lewis Structures

Section: 1.4

Difficulty Level: Hard

13) Considering Lewis structures, which of these compounds possesses a single unpaired electron?

- a) N_2
- b) N_2O
- c) NO
- d) N_2O_4
- e) O_2

Answer: C

Topic: Lewis Structures

Section: 1.4

Difficulty Level: Hard

14) $\text{Y} \begin{array}{c} \ddot{\text{Z}} \\ \diagup \quad \diagdown \\ \text{Y} \end{array}$ is a generalized structural representation which can be used for all of the following, except:

- a) H_2O
- b) H_2Se
- c) H_2S
- d) BeH_2
- e) There is no exception.

Answer: D

Topic: Lewis Structures

Section: 1.4

Difficulty Level: Hard

15) Expansion of the valence shell to accommodate more than eight electrons is possible with ____.

- a) fluorine
- b) nitrogen
- c) carbon
- d) sulfur
- e) beryllium

Answer: D

Topic: Lewis Structures, Formal Charges

Section: 1.2, 1.4

Difficulty Level: Easy

16) What is the formal charge on oxygen in the following structure?
 $\text{H}_3\text{CC}\equiv\text{O}:$

- a) +2
- b) +1
- c) 0
- d) -1
- e) -2

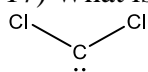
Answer: B

Topic: Lewis Structures, Formal Charges

Section: 1.5

Difficulty Level: Easy

17) What is the formal charge on carbon in the following structure?



- a) +2
- b) +1
- c) 0
- d) -1
- e) -2

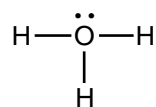
Answer: C

Topic: Lewis Structures, Formal Charges

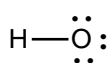
Section: 1.5

Difficulty Level: Easy

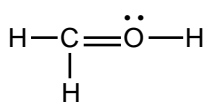
18) In which structure(s) below does the oxygen have a formal charge of +1?



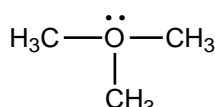
I



II



III



IV

- a) I only
- b) II only
- c) I and III
- d) I and IV
- e) I, III, and IV

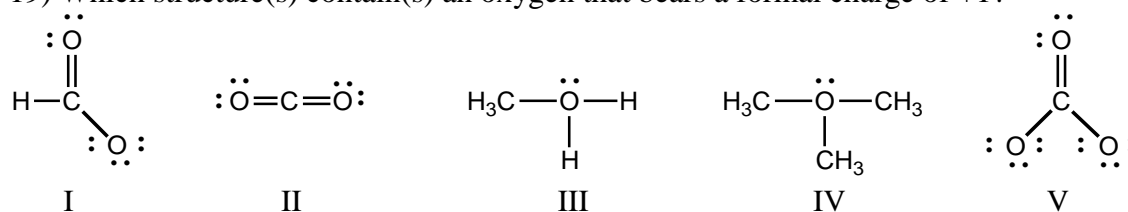
Answer: E

Topic: Lewis Structures, Formal Charges

Section: 1.5

Difficulty Level: Easy

19) Which structure(s) contain(s) an oxygen that bears a formal charge of +1?



- a) I and II
- b) III and IV
- c) V
- d) II
- e) I and V

Answer: B

Topic: Lewis Structures, Formal Charges

Section: 1.5

Difficulty Level: Easy

20) Which of the following compounds contain a sulfur atom that bears a +1 formal charge?

- a) H₂S
- b) SO₂
- c) SF₆
- d) MgSO₄
- e) H₂SO₄

Answer: B

Topic: Lewis Structures, Formal Charges

Section: 1.5

Difficulty Level: Medium

21) Which of the following molecules or ions has a nitrogen with a formal charge of -1?

- a) $\begin{array}{c} \text{:}\ddot{\text{N}}\text{---H} \\ | \\ \text{H} \end{array}$
- b) $\begin{array}{c} \text{H---}\ddot{\text{N}}\text{---H} \\ | \\ \text{H} \end{array}$
- c) $\begin{array}{c} \text{H---}\ddot{\text{N}}\text{---CH}_3 \\ | \\ \text{H} \end{array}$
- d) $\begin{array}{c} \text{H}_3\text{C---}\ddot{\text{N}}\text{---CH}_3 \\ | \\ \text{H} \end{array}$
- e) $\text{H}_3\text{C---C}\equiv\text{N:}$

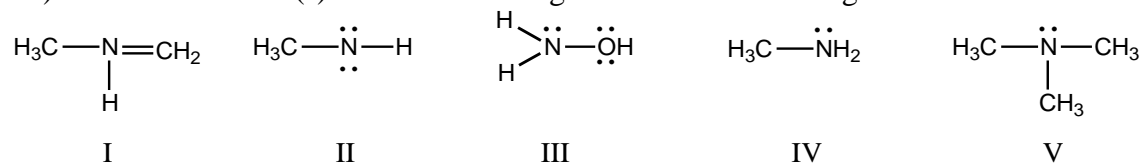
Answer: A

Topic: Lewis Structures, Formal Charges

Section: 1.5

Difficulty Level: Easy

22) In which structure(s) below does nitrogen have a formal charge of +1?



- a) I
 b) II and IV
 c) III and V
 d) I and V
 e) V

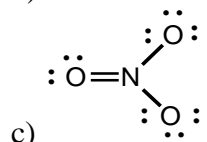
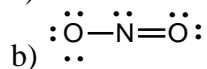
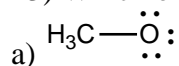
Answer: A

Topic: Lewis Structures, Formal Charges

Section: 1.5

Difficulty Level: Easy

23) Which of the following is an ion with a negative one charge?



- d) All of these choices.
e) None of these choices.

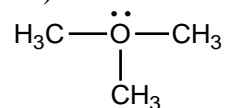
Answer: D

Topic: Lewis Structures, Formal Charges

Section: 1.5

Difficulty Level: Easy

24) What is the formal charge on oxygen in the following structure?



- a) +2
b) +1
c) 0
d) -1
e) -2

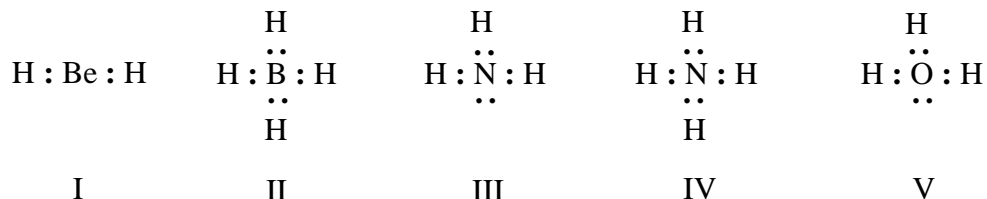
Answer: B

Topic: Lewis Structures, Formal Charges

Section: 1.5

Difficulty Level: Easy

25) Listed below are electron dot formulas for several simple molecules and ions. All valence electrons are shown; however, electrical charges have been omitted deliberately.



Which of the structures actually bear(s) a positive charge?

- a) I
- b) II
- c) III
- d) III and V
- e) IV and V

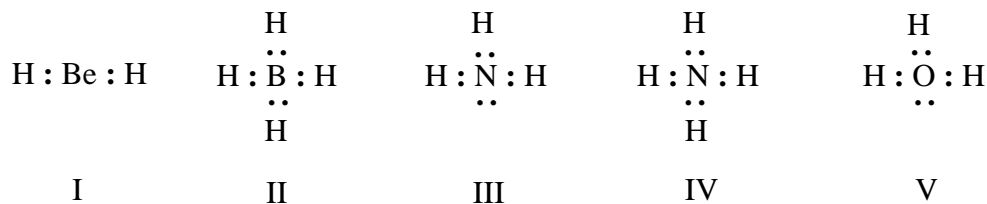
Answer: E

Topic: Lewis Structures, Formal Charges

Section: 1.5

Difficulty Level: Easy

26) Listed below are electron dot formulas for several simple molecules and ions. All valence electrons are shown; however, electrical charges have been omitted deliberately.



Which of the structures is negatively charged?

- a) I
- b) II
- c) III
- d) IV
- e) V

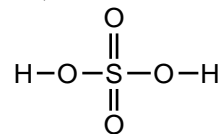
Answer: B

Topic: Lewis Structures, Formal Charges

Section: 1.5

Difficulty Level: Easy

27) The formal charge on sulfur in sulfuric acid is:



- a) 0
- b) -1
- c) +1
- d) -2
- e) +2

Answer: A

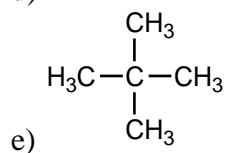
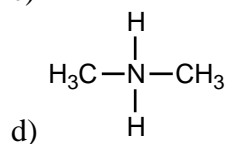
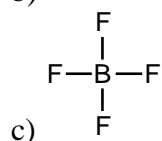
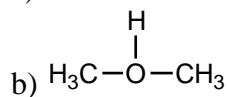
Topic: Lewis Structures, Formal Charges

Section: 1.5

Difficulty Level: Easy

28) In which of these cases does the central atom have a zero formal charge?

a) HFH



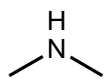
Answer: E

Topic: Lewis Structures, Formal Charges

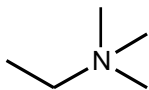
Section: 1.5

Difficulty Level: Medium

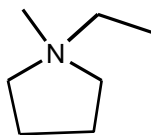
29) Which compound contains a nitrogen atom with a formal positive charge?



I



II



III

- a) I
- b) II
- c) III
- d) More than one of these choices.
- e) None of these choices.

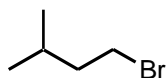
Answer: D

Topic: Lewis Structures, Formal Charges

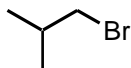
Section: 1.5

Difficulty Level: Medium

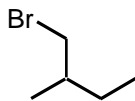
30) Which of the following is a set of constitutional isomers?



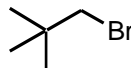
I



II



III



IV

- a) I and II
- b) II and III
- c) I, II, and III
- d) II, III, and IV
- e) I, III, and IV

Answer: E

Topic: Isomerism

Section: 1.6

Difficulty Level: Easy

31) $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ are examples of what are now termed:

- a) Conformational isomers
- b) Resonance structures
- c) Functional isomers
- d) Empirical isomers
- e) Constitutional isomers

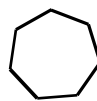
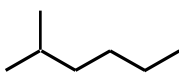
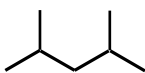
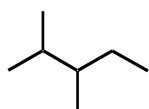
Answer: E

Topic: Isomerism

Section: 1.6

Difficulty Level: Easy

32) Which of the following structures represent compounds that are constitutional isomers of each other?



- a) I and II
- b) I and III
- c) I, II, and III
- d) I, II, III, and IV
- e) II and III

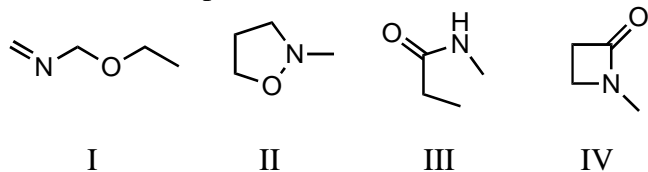
Answer: C

Topic: Isomerism

Section: 1.6

Difficulty Level: Easy

33) Which compound is not a constitutional isomer of the others?



- a) I
- b) II
- c) III
- d) IV
- e) All of these choices are isomers of each other.

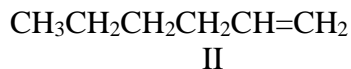
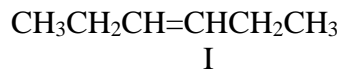
Answer: D

Topic: Isomerism

Section: 1.6

Difficulty Level: Easy

34) Consider the following:



Which two structures represent the same compound?

- a) I and II
- b) II and III
- c) I and III
- d) II and IV
- e) None of these choices.



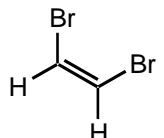
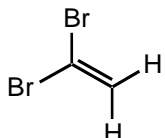
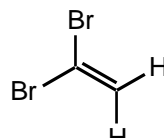
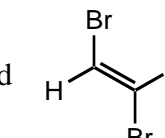
Answer: D

Topic: Isomerism

Section: 1.6

Difficulty Level: Easy

35) Which of the following represent a pair of constitutional isomers?

- a)  and 
- b) $\text{CH}_3\text{CH}=\text{CH}_2$ and $\text{CH}_2=\text{CHCH}_3$
- c)  and 
- d)  and 
- e) More than one of these choices.

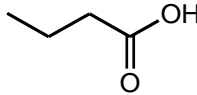
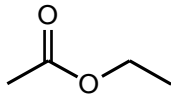
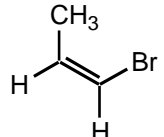
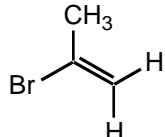
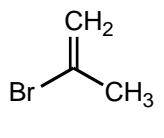
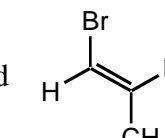
Answer: E

Topic: Isomerism

Section: 1.6

Difficulty Level: Easy

36) Which of the following represent pairs of constitutional isomers?

- a)  and 
- b)  and 
- c)  and 
- d) None of these pairs.
- e) All of these pairs.

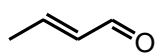
Answer: E

Topic: Isomerism

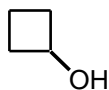
Section: 1.6

Difficulty Level: Easy

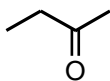
37) Which compound is not a constitutional isomer of the others?



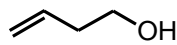
I



II



III



IV

- a) I
- b) II
- c) III
- d) IV
- e) All of these choices are isomers of each other.

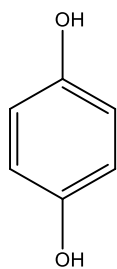
Answer: A

Topic: Isomerism

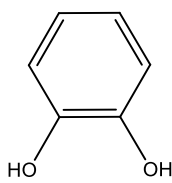
Section: 1.6

Difficulty Level: Medium

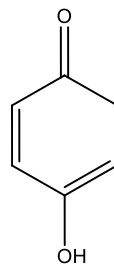
38) Which of the following compounds is not a constitutional isomer of the others?



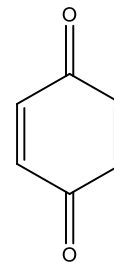
I



II



III



IV

- a) I
- b) II
- c) III
- d) IV
- e) All of these choices are constitutional isomers.

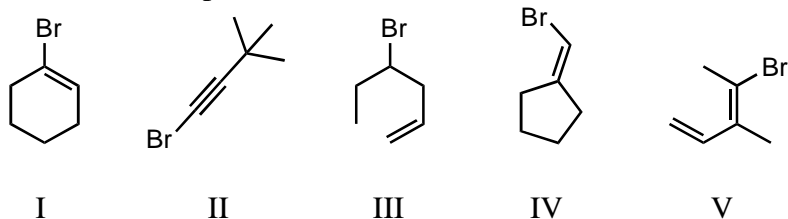
Answer: D

Topic: Isomerism

Section: 1.6

Difficulty Level: Medium

39) Which compound is not a constitutional isomer of the others?



- a) I and II
- b) II
- c) III
- d) IV and V
- e) All of these choices are isomers of each other.

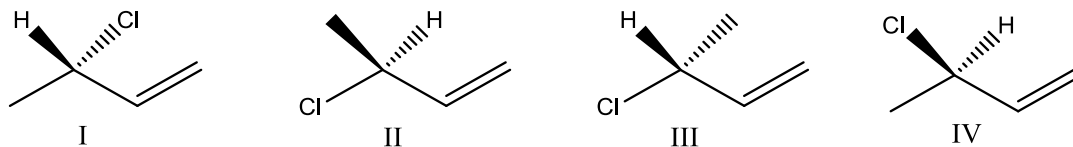
Answer: C

Topic: Isomerism

Section: 1.6

Difficulty Level: Medium

40) Which of the following structure is an acceptable bond line formula for $\text{CH}_3\text{CHClCHCH}_2$?



- a) I
- b) I and IV
- c) II and III
- d) I, II, and III
- e) All of these choices.

Answer: E

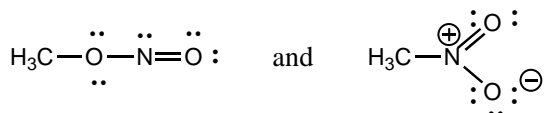
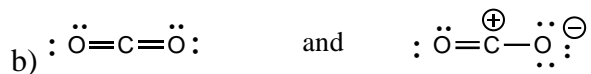
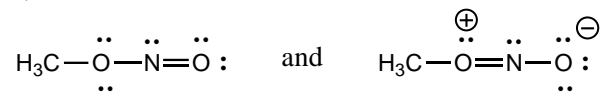
Topic: Three Dimensional Formulas

Section 1.7

Difficulty Level: Hard

41) Which of the following pairs are NOT resonance structures?

a)



c)

d) Each of these pairs represents resonance structures.

e) None of these pairs represents resonance structures.

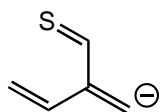
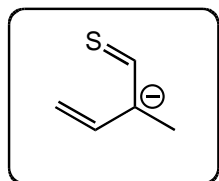
Answer: C

Topic: Atomic Orbitals, Lewis Structures, Resonance

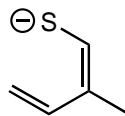
Section: 1.8

Difficulty Level: Easy

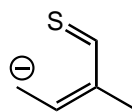
42) Which of the following species is/are *not* a resonance form(s) of the anionic species in the box?



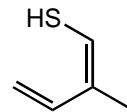
I



II



III



IV

a) I

b) II and III

c) III and IV

d) I and IV

e) I and III

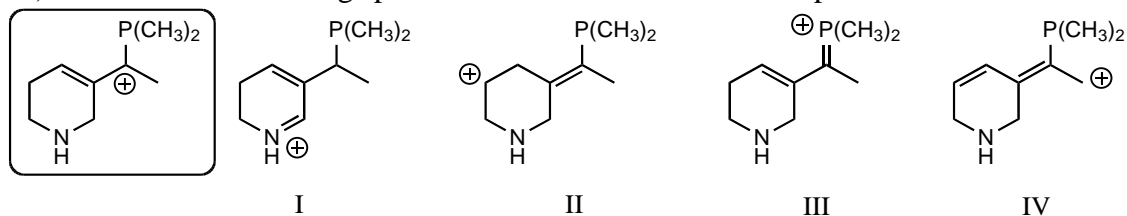
Answer: D

Topic: Resonance

Section: 1.8

Difficulty Level: Medium

43) Which of the following species is a resonance form of the species in the box?



- a) I
- b) II
- c) III
- d) IV
- e) None of these choices are correct resonance forms.

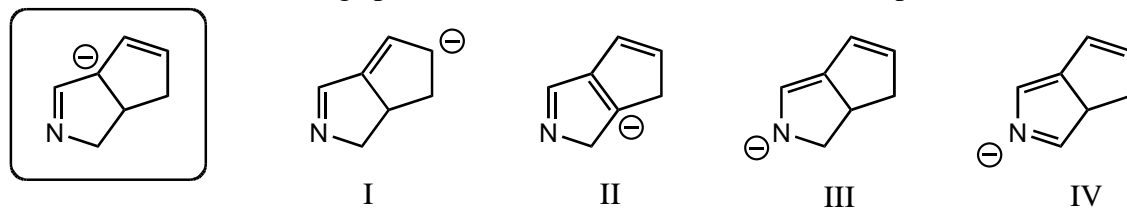
Answer: C

Topic: Resonance

Section: 1.8

Difficulty Level: Medium

44) Which of the following species is/are a resonance form(s) of the species in the box?



- a) I and II
- b) I and III
- c) III and IV
- d) III
- e) More than two of these choices are correct resonance forms.

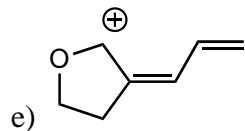
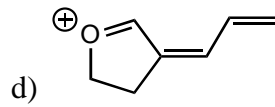
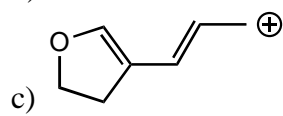
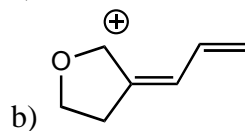
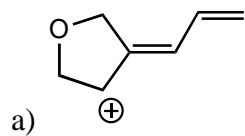
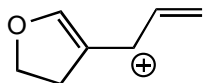
Answer: B

Topic: Resonance

Section: 1.8

Difficulty Level: Medium

45) Which of the following species is *not* a resonance form of the following species?



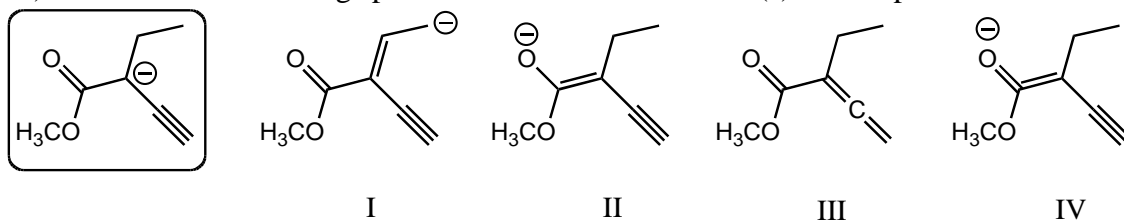
Answer: A

Topic: Resonance

Section: 1.8

Difficulty Level: Medium

46) Which of the following species is/are a resonance form(s) of the species in the box?



- a) I and II
- b) II and III
- c) III
- d) II
- e) More than two of these choices are correct resonance forms.

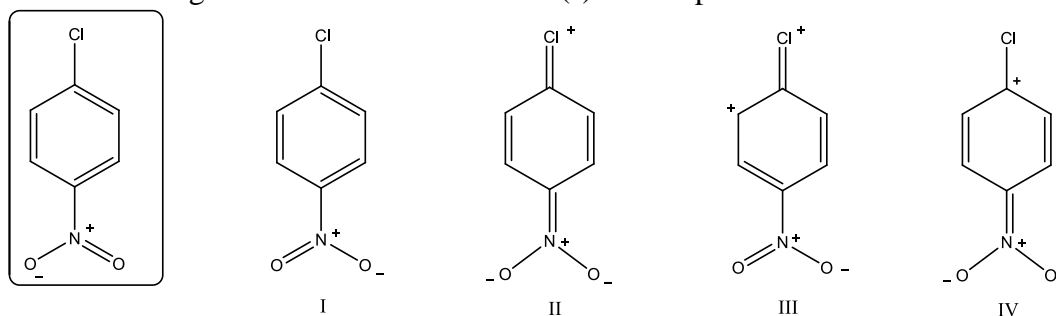
Answer: D

Topic: Resonance

Section: 1.8

Difficulty Level: Medium

47) Which of the following is/are not a resonance form(s) of the species in the box?



- a) I
- b) II
- c) III
- d) IV
- e) More than two of these choices are incorrect resonance forms.

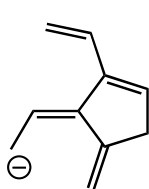
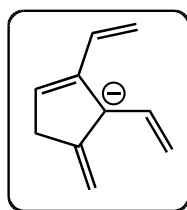
Answer: C

Topic: Resonance

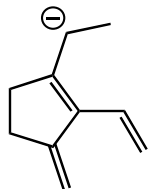
Section: 1.8

Difficulty Level: Medium

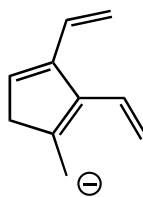
48) Which of the following species is/are **not** a resonance form(s) of the species in the box?



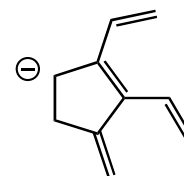
I



II



III



IV

- a) I
- b) II
- c) III
- d) IV
- e) More than two of these choices are incorrect resonance forms.

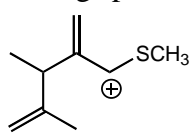
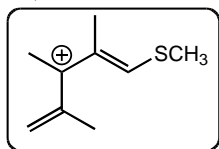
Answer: B

Topic: Resonance

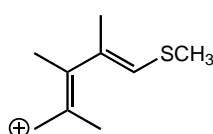
Section: 1.8

Difficulty Level: Medium

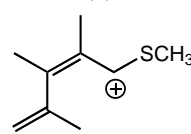
49) Which of the following species is/are **not** a resonance form(s) of the species in the box?



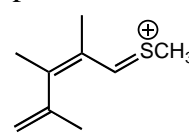
I



II



III



IV

- a) I
- b) II
- c) III
- d) IV
- e) More than two of these choices are incorrect resonance forms.

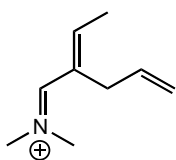
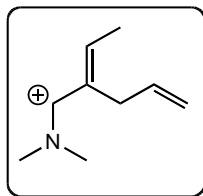
Answer: A

Topic: Resonance

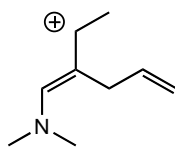
Section: 1.8

Difficulty Level: Medium

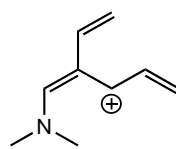
50) Which of the following species is/are **not** a resonance form(s) of the species in the box?



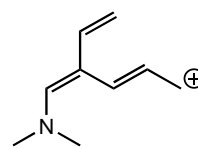
I



II



III



IV

- a) I and II
- b) II and III
- c) III and IV
- d) I and IV
- e) II and IV

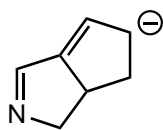
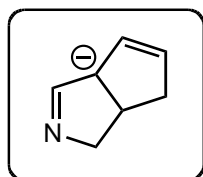
Answer: C

Topic: Resonance

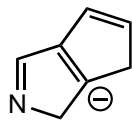
Section: 1.8

Difficulty Level: Medium

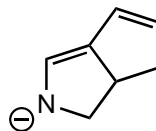
51) Which of the following species contributes more to the overall hybrid for the species in the box?



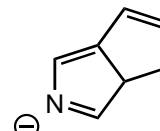
I



II



III



IV

- a) I
- b) II
- c) III
- d) IV
- e) The one in the box.

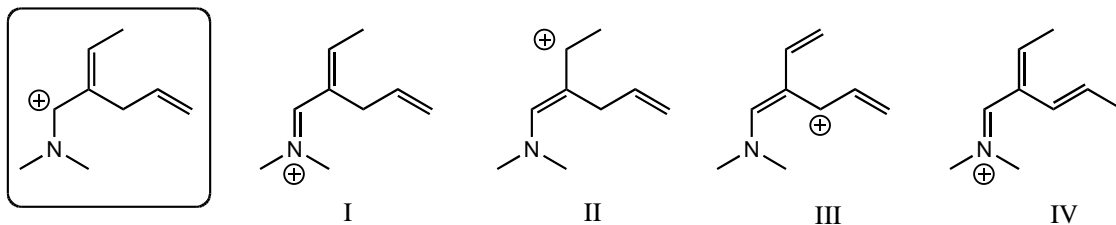
Answer: C

Topic: Resonance

Section: 1.8

Difficulty Level: Medium

52) Which of the following species contributes more to the overall hybrid for the species in the box?



- a) I
- b) II
- c) III
- d) IV
- e) The one in the box.

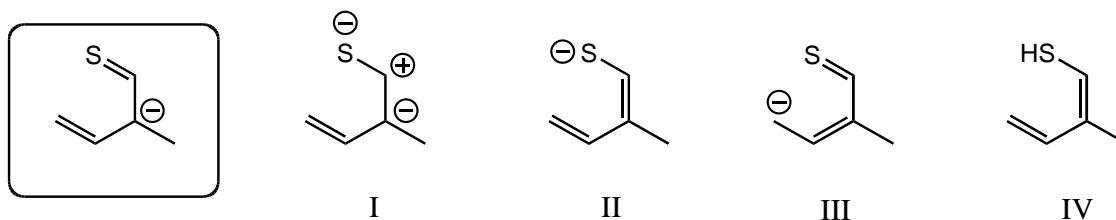
Answer: A

Topic: Resonance

Section: 1.8

Difficulty Level: Medium

53) Which of the following species contributes more to the overall hybrid for the species in the box?



- a) I
- b) II
- c) III
- d) IV
- e) The one in the box.

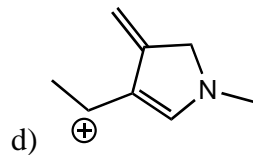
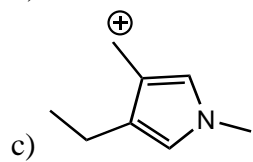
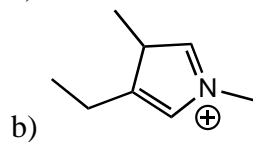
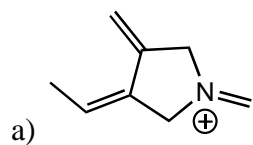
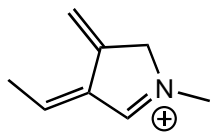
Answer: B

Topic: Resonance

Section: 1.8

Difficulty Level: Medium

54) Which of the following species is a resonance form of the following species?



e) All of these choices are correct resonance forms.

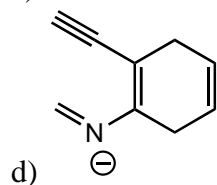
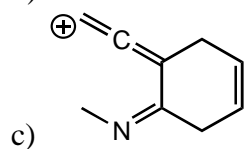
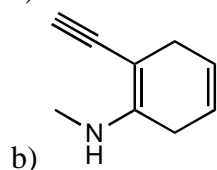
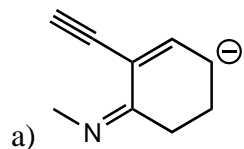
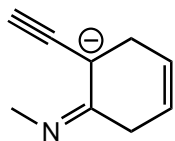
Answer: D

Topic: Resonance

Section: 1.8

Difficulty Level: Hard

55) Which of the following structures is/are *not* a resonance form of the following species?



e) None of these choices are correct resonance forms.

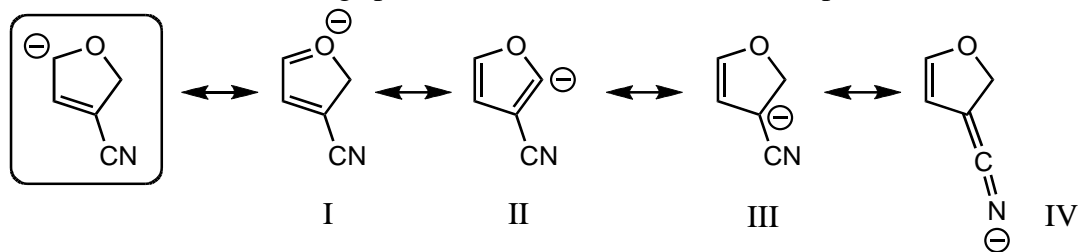
Answer: E

Topic: Resonance

Section: 1.8

Difficulty Level: Hard

56) Which of the following species are resonance forms of the species in the box?



- a) I and III
- b) I and II
- c) III and IV
- d) II and IV
- e) All of these choices are correct resonance forms.

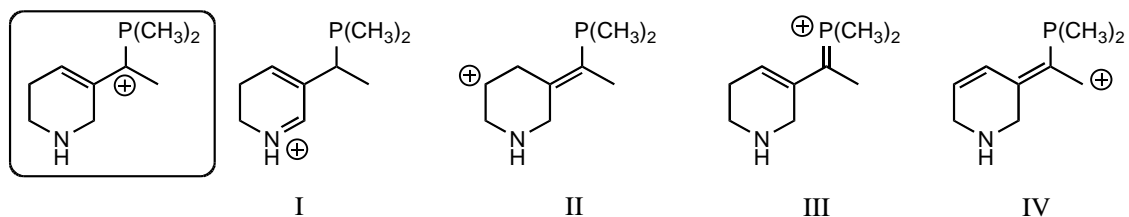
Answer: C

Topic: Resonance

Section: 1.8

Difficulty Level: Hard

57) Which of the following species contributes more to the overall hybrid for the species in the box?



- a) I
- b) II
- c) III
- d) IV
- e) The one in the box.

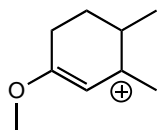
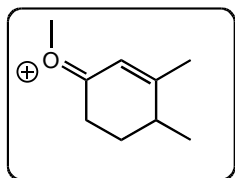
Answer: C

Topic: Resonance

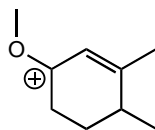
Section: 1.8

Difficulty Level: Hard

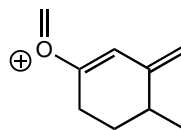
58) Which of the following species contributes more to the overall hybrid for the species in the box?



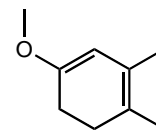
I



II



III



IV

- a) I
- b) II
- c) III
- d) IV
- e) The one in the box.

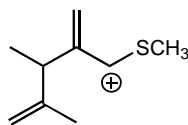
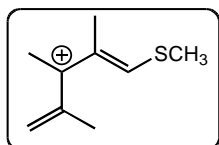
Answer: E

Topic: Resonance

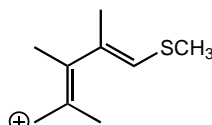
Section: 1.8

Difficulty Level: Hard

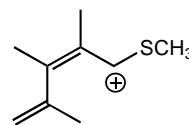
59) Which of the following species contributes more to the overall hybrid for the species in the box?



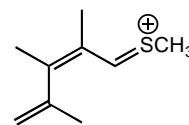
I



II



III



IV

- a) I
- b) II
- c) III
- d) IV
- e) The one in the box.

Answer: D

Topic: Resonance

Section: 1.8

Difficulty Level: Hard

60) Which of the structures below is not expected to contribute to the CO₂ resonance hybrid?

- a) $\text{O}=\overset{+}{\text{C}}-\overset{-}{\text{O}}$
- b) $\overset{-}{\text{O}}-\overset{+}{\text{C}}=\text{O}$
- c) $\text{O}=\text{C}=\text{O}$
- d) $\overset{-}{\text{O}}-\overset{+}{\text{C}}\overset{+}{\text{C}}-\overset{-}{\text{O}}$
- e) $\overset{-}{\text{O}}-\text{C}\equiv\overset{+}{\text{O}}$

Answer: D

Topic: Atomic Orbitals, Lewis structures, Resonance

Section: 1.4 and 1.8

Difficulty Level: Medium

61) Which of the following could not be a resonance structure of CH₃NO₂?

- a)
- b)
- c)
- d)

e) More than one of these choices.

Answer: D

Topic: Atomic orbitals, Lewis structures, resonance

Section: 1.4 and 1.8

Difficulty Level: Medium

62) How many resonance structures can be written for the NO_3^- ion in which the nitrogen atom bears a formal charge of +1?

- a) 1
- b) 2
- c) 3
- d) 4
- e) 5

Answer: C

Topic: Atomic Orbitals, Lewis Structures, Resonance

Section: 1.5 and 1.8

Difficulty Level: Medium

63) Which of the following species exhibits resonance stabilization?

- a) H_2SO_4
- b) O_3
- c) CO_2
- d) CCl_4
- e) None of the species exhibit resonance.

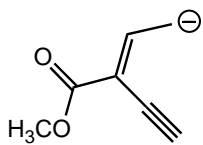
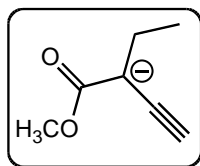
Answer: B

Topic: Resonance

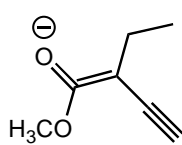
Section: 1.5 and 1.8

Difficulty Level: Medium

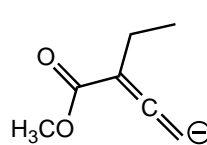
64) Which of the following species contributes more to the overall hybrid for the species in the box?



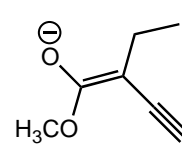
I



II



III



IV

- a) I
- b) II
- c) III
- d) IV
- e) The one in the box.

Answer: D

Topic: Resonance

Section: 1.8

Difficulty Level: Medium

65) The relative probability of finding an electron a certain distance from the nucleus can be calculated using ____.

- a) electron configuration
- b) the wave function
- c) statistical probability
- d) atomic orbitals
- e) all of these choices

Answer: B

Topic: Quantum Mechanics

Section: 1.9

Difficulty Level: Easy

66) When two waves with equal amplitude and the opposite phase sign interact this results in generating

- a) a wave that has half the amplitude of the original wave.
- b) a wave that has double the amplitude of the original wave.
- c) no wave as it has an amplitude of zero.
- d) two new waves that have opposite phase signs of each other.
- e) none of these choices.

Answer: C

Topic: Quantum Mechanics

Section: 1.9

Difficulty Level: Easy

67) In quantum mechanics a node (nodal surface or plane) is

- a) a place where Ψ is negative.
- b) a place where Ψ is positive.
- c) a place where $\Psi = 0$.
- d) a place where Ψ^2 is large.
- e) a place where Ψ^2 is negative.

Answer: C

Topic: Atomic Orbitals

Section: 1.9

Difficulty Level: Easy

68) Which principle(s) or rule(s) must be used to determine the correct electronic configuration for carbon in its ground state?

- a) Aufbau principle
- b) Hund's Rule
- c) Pauli exclusion principle
- d) Aufbau principle and Hund's rule only
- e) Aufbau principle, Hund's rule, and Pauli exclusion principle

Answer: E

Topic: Atomic Orbitals

Section: 1.10

Difficulty Level: Easy

69) When the $1s$ orbitals of two hydrogen atoms combine to form a hydrogen molecule, how many molecular orbitals are formed?

- a) 1
- b) 2
- c) 3
- d) 4
- e) 5

Answer: B

Topic: Atomic Orbitals, Molecular Orbitals

Section: 1.11

Difficulty Level: Easy

70) When the $1s$ orbitals of two hydrogen atoms combine to form a hydrogen molecule, which molecular orbitals are formed?

- a) One bonding molecular orbital only.
- b) Two bonding molecular orbitals.
- c) One bonding molecular orbital and one antibonding molecular orbital.
- d) Two antibonding molecular orbitals.
- e) Three bonding molecular orbitals.

Answer: C

Topic: Atomic Orbitals, Molecular Orbitals

Section: 1.11

Difficulty Level: Easy

71) When the $1s$ orbitals of two hydrogen atoms combine to form a hydrogen molecule, how are the electrons distributed in the resulting molecular orbitals?

- a) Two electrons in the bonding molecular orbital.
- b) One electron in the bonding molecular orbital, one electron in the non-bonding molecular orbital.
- c) One electron in the bonding molecular orbital, one electron in the antibonding molecular orbital.
- d) Two electrons in the non-bonding molecular orbital.
- e) Two electrons in the antibonding molecular orbital.

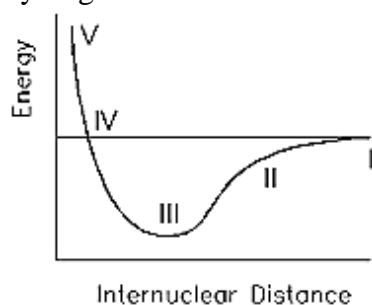
Answer: A

Topic: Atomic orbitals, molecular orbitals

Section: 1.11

Difficulty Level: Easy

72) What point on the potential energy diagram below represents the most stable state for the hydrogen molecule?



- a) I
- b) II
- c) III
- d) IV
- e) V

Answer: C

Topic: Atomic Orbitals, Bonding

Section: 1.11

Difficulty Level: Easy

73) According to molecular orbital theory, which molecule could not exist?

- a) H_2
- b) He_2
- c) Li_2
- d) F_2
- e) N_2

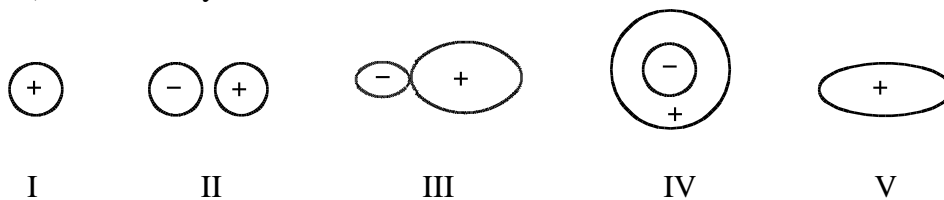
Answer: B

Topic: Atomic Orbitals, Molecular Orbitals

Section: 1.11

Difficulty Level: Medium

74) Select the hybridized atomic orbital.



- a) I
- b) II
- c) III
- d) IV
- e) V

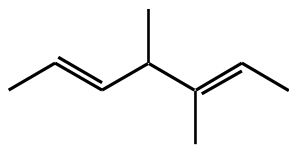
Answer: C

Topic: Atomic Orbitals, Hybridization

Section: 1.12

Difficulty Level: Easy

75) How many $s-sp^3$ bonds are there in the following substance?



- a) 3
- b) 8
- c) 12
- d) 13
- e) 16

Answer: D

Topic: Atomic Orbitals, Hybridization

Section: 1.13

Difficulty Level: Easy

76) How many sigma $1s-2sp^3$ bonds are there in ethane?

- a) 7
- b) 6
- c) 5
- d) 3
- e) 1

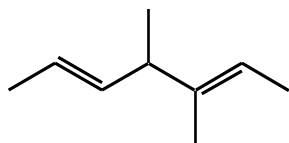
Answer: B

Topic: Atomic Orbitals, Hybridization

Section: 1.13

Difficulty Level: Easy

77) How many $s-sp^2$ bonds are there in the following substance?



- a) 2
- b) 3
- c) 4
- d) 5
- e) 12

Answer: B

Topic: Atomic Orbitals, Hybridization

Section: 1.13

Difficulty Level: Easy

78) According to molecular orbital theory, in the case of a carbon-carbon double bond, the carbon-carbon bonding electrons of higher energy occupy this molecular orbital:

- a) σ bonding MO
- b) π bonding MO
- c) σ^* antibonding MO
- d) π^* antibonding MO
- e) π^* bonding MO

Answer: B

Topic: Atomic Orbitals, Molecular Orbitals

Section: 1.13

Difficulty Level: Medium

79) Cis-trans isomerism is possible only in the case of:

- a) $\text{CH}_2=\text{CBr}_2$
- b) $\text{CH}_2=\text{CHBr}$
- c) $\text{BrCH}=\text{CHBr}$
- d) $\text{Br}_2\text{C}=\text{CHBr}$
- e) $\text{Br}_2\text{C}=\text{CBr}_2$

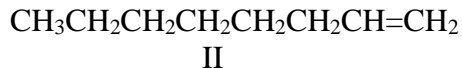
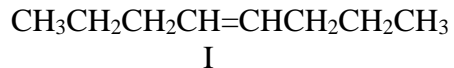
Answer: C

Topic: Isomerism

Section: 1.13

Difficulty Level: Easy

80) Consider the following:



Which structures can exist as cis-trans isomers?

- a) I and II
- b) I and III
- c) I and IV
- d) II and III
- e) I alone

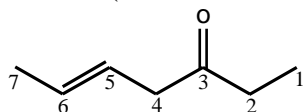
Answer: B

Topic: Isomerism

Section: 1.13

Difficulty Level: Easy

81) The C4-C5 carbon-carbon bond in the following molecule results from the overlap of which orbitals (in the order C4-C5)?



- a) $sp-sp^2$
- b) $sp-sp^3$
- c) sp^2-sp^2
- d) sp^2-sp^3
- e) sp^3-sp^2

Answer: E

Topic: General, Bonding

Section: 1.13

Difficulty Level: Easy

82) Identify the atomic orbitals in the C-C sigma bond in acetylene (ethyne).

- a) ($2sp^2$, $2sp^2$)
- b) ($2sp^3$, $2sp^3$)
- c) ($2sp$, $2sp$)
- d) ($2p$, $2p$)
- e) ($2sp$, $1s$)

Answer: C

Topic: Atomic Orbitals, Hybridization

Section: 1.14

Difficulty Level: Easy

83) Identify the atomic orbitals in the C-H sigma bond in acetylene (ethyne).

- a) ($2sp^2$, $1s$)
- b) ($2sp^3$, $2sp^3$)
- c) ($2sp$, $2sp$)
- d) ($2p$, $2p$)
- e) ($2sp$, $1s$)

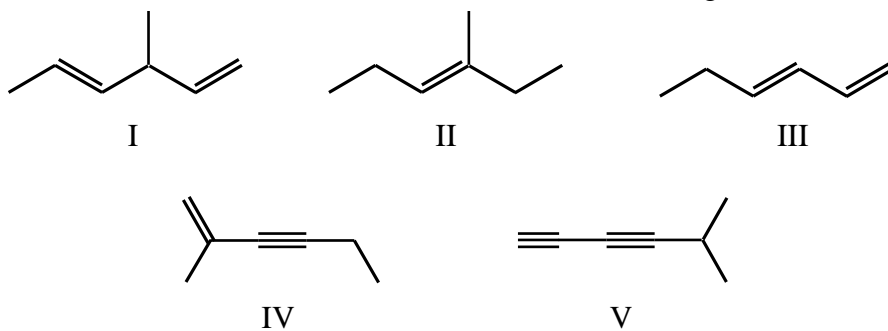
Answer: E

Topic: Atomic Orbitals, Hybridization

Section: 1.14

Difficulty Level: Easy

84) Which molecule has the shortest carbon-carbon single bond?



- a) I
- b) II
- c) III
- d) IV
- e) V

Answer: E

Topic: Bond lengths

Section: 1.14

Difficulty Level: Easy

85) Which compound has the shortest carbon-carbon bond(s)?

- a) CH_3CH_3
- b) $\text{CH}_2=\text{CH}_2$
- c) $\text{HC}\equiv\text{CH}$
- d) $\text{CH}_3\text{CH}_2\text{CH}_3$
- e) All carbon-carbon bonds are the same length.

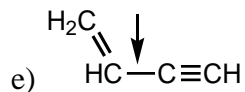
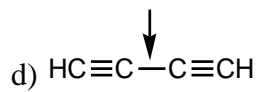
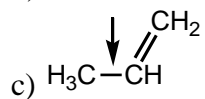
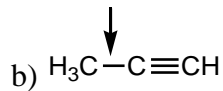
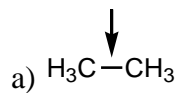
Answer: C

Topic: Bond lengths

Section: 1.14

Difficulty Level: Easy

86) Which is the shortest of the carbon-carbon single bonds indicated by arrows in the following compounds?



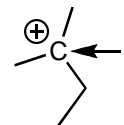
Answer: D

Topic: Bond lengths

Section: 1.14

Difficulty Level: Medium

87) What is the hybridization of the C indicated with the arrow?



- a) sp^3
- b) sp^2
- c) sp
- d) s
- e) p

Answer: B

Topic: Atomic Orbitals, Hybridization

Section: 1.16

Difficulty Level: Easy

88) Which of the following contains an sp^2 -hybridized carbon?

- a) CH_4
- b) CH_3^-
- c) CH_3CH_3
- d) CH_3^+
- e) $\text{HC}\equiv\text{CH}$

Answer: D

Topic: Atomic Orbitals, Hybridization

Section: 1.16

Difficulty Level: Easy

89) How many $2p$ atomic orbitals from boron must be mixed with a $2s$ atomic orbital to yield the bonding hybrid atomic orbitals in BF_3 ?

- a) 1
- b) 2
- c) 3
- d) 4
- e) 5

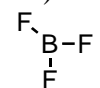
Answer: B

Topic: Atomic Orbitals, Hybridization

Section: 1.16

Difficulty Level: Easy

90) Identify the atomic orbital the lone pair electrons on the B atom are contained in:



- a) $2sp^2$
- b) $2sp^3$
- c) $2p$
- d) $2s$
- e) There are no lone pair electrons on B.

Answer: E

Topic: Atomic Orbitals, Hybridization

Section: 1.16

Difficulty Level: Easy

91) What is the approximate hybridization state of the oxygen molecule in ethanol, C₂H₅OH?

- a) sp
- b) sp^2
- c) sp^3
- d) p^3
- e) d^2sp^3

Answer: C

Topic: Hybridization

Section: 1.16

Difficulty Level: Easy

92) What is the approximate hybridization state of the nitrogen atom in trimethylamine, (CH₃)₃N?

- a) sp
- b) sp^2
- c) sp^3
- d) p^3
- e) d^2sp^3

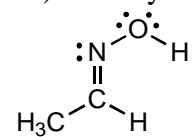
Answer: C

Topic: Hybridization

Section: 1.16

Difficulty Level: Easy

93) Identify the atomic orbitals in the C-N sigma bond in the following oxime:



- a) ($2sp^2$, $2sp^2$)
- b) ($2sp^3$, $2sp^3$)
- c) ($2sp$, $2sp$)
- d) ($2sp^2$, $2sp^3$)
- e) ($2sp$, $1s$)

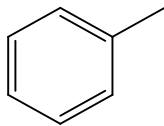
Answer: A

Topic: Atomic Orbitals, Hybridization

Section: 1.16

Difficulty Level: Medium

94) How many total sigma bonds are present in the following compound?



- a) 3
- b) 7
- c) 10
- d) 15
- e) None of these choices.

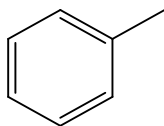
Answer: D

Topic: Atomic Orbitals, Hybridization

Section: 1.16

Difficulty Level: Medium

95) How many electrons contribute to pi bonds in the following compound?



- a) 0
- b) 3
- c) 6
- d) 7
- e) None of these choices.

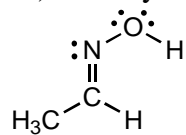
Answer: C

Topic: Atomic Orbitals, Hybridization

Section: 1.16

Difficulty Level: Medium

96) Identify the atomic orbital the lone pair electrons on the O atom are contained in:



- a) $2sp^2$
- b) $2sp^3$
- c) $2sp$
- d) $2s$
- e) $2p$

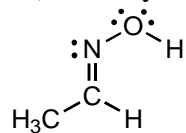
Answer: B

Topic: Atomic Orbitals, Hybridization

Section: 1.16

Difficulty Level: Medium

97) Identify the atomic orbital the lone pair electrons on the N atom are contained in:



- a) $2sp^2$
- b) $2sp^3$
- c) $2sp$
- d) $2s$
- e) $2p$

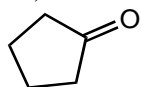
Answer: A

Topic: Atomic Orbitals, Hybridization

Section: 1.16

Difficulty Level: Medium

98) What is the hybridization of the O atom in the following molecule?



- a) sp^3
- b) sp^2
- c) sp
- d) s
- e) p

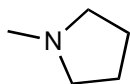
Answer: B

Topic: Atomic Orbitals, Hybridization

Section: 1.16

Difficulty Level: Medium

99) What is the hybridization of the N atom in the following molecule?



- a) sp^3
- b) sp^2
- c) sp
- d) s
- e) sp^4

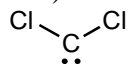
Answer: A

Topic: Atomic Orbitals, Hybridization

Section: 1.16

Difficulty Level: Medium

100) What is the hybridization of the C atom in the following molecule?



- a) s
- b) p
- c) sp
- d) sp^2
- e) sp^3

Answer: D

Topic: Atomic Orbitals, Hybridization

Section: 1.16

Difficulty Level: Medium

101) In which molecule is the central atom sp^3 hybridized?

- a) CH_4
- b) NH_3
- c) H_2O
- d) All of these choices.
- e) None of these choices.

Answer: D

Topic: Atomic Orbitals, Hybridization

Section: 1.16

Difficulty Level: Medium

102) In which of the following would you expect the central atom to be sp^3 hybridized (or approximately sp^3 hybridized)?

- a) BH_4^-
- b) NH_4^+
- c) CCl_4
- d) CH_3^-
- e) All of these choices.

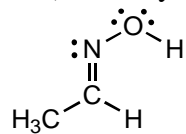
Answer: E

Topic: Atomic Orbitals, Hybridization

Section: 1.16

Difficulty Level: Medium

103) Identify the atomic orbitals in the N-O sigma bond in the following oxime:



- a) ($2sp^2, 2sp^2$)
- b) ($2sp^3, 2sp^3$)
- c) ($2sp, 2sp$)
- d) ($2sp^2, 2sp^3$)
- e) ($2sp, 1s$)

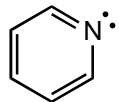
Answer: D

Topic: Atomic Orbitals, Hybridization

Section: 1.16

Difficulty Level: Hard

104) What is the hybridization of the N atom in the following molecule?



- a) s
- b) p
- c) sp
- d) sp^2
- e) sp^3

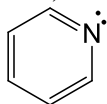
Answer: D

Topic: Atomic Orbitals, Hybridization

Section: 1.16

Difficulty Level: Hard

105) Identify the atomic orbital the lone pair electrons on the N atom are contained in:



- a) $2sp^2$
- b) $2sp^3$
- c) $2p$
- d) $2s$
- e) $2sp$

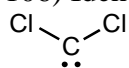
Answer: A

Topic: Atomic Orbitals, Hybridization

Section: 1.16

Difficulty Level: Hard

106) Identify the atomic orbital the lone pair electrons on the C atom are contained in:



- a) $2sp^3$
- b) $2sp^2$
- c) $2sp$
- d) $2s$
- e) $2p$

Answer: B

Topic: Atomic Orbitals, Hybridization

Section: 1.16

Difficulty Level: Hard

107) In which molecule(s) can the molecular geometry be attributed to an sp^2 hybridized central atom?

- a) PBr_3
- b) CH_4
- c) $CHCl_3$
- d) HNO_2
- e) None of these choices has an sp^2 hybridized central atom.


Answer: D

Topic: Atomic Orbitals, Hybridization

Section: 1.4 and 1.16

Difficulty Level: Hard

108) Which molecule contains an *sp*-hybridized carbon?

- a) HCN
- b) CH₂=CH₂
- c) CH₃Cl
- d) 
- e) CH₃CH₃

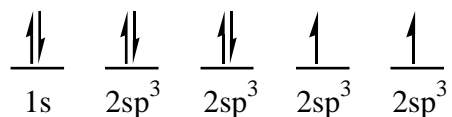
Answer: A

Topic: Atomic Orbitals, Hybridization

Section: 1.5, 1.14, and 1.16

Difficulty Level: Medium

109) The following electron configuration represents:



- a) the ground state of nitrogen
- b) the ground state of oxygen
- c) the *sp*³ hybridized state of carbon
- d) the excited state of oxygen
- e) None of these choices correctly identifies the given electron configuration.

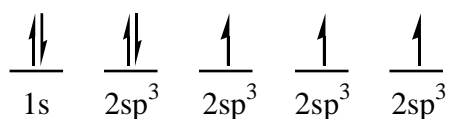
Answer: E

Topic: Atomic Orbitals, Electron Configuration, Hybridization

Section: 1.12 and 1.16

Difficulty Level: Easy

110) The following electron configuration represents:



- a) the ground state of boron
- b) the sp^3 hybridized state of carbon
- c) the sp^3 hybridized state of nitrogen
- d) the ground state of carbon
- e) an excited state of carbon

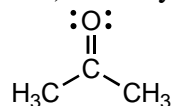
Answer: C

Topic: Atomic Orbitals, Hybridization

Section: 1.12 and 1.16

Difficulty Level: Medium

111) Identify the atomic and/or hybridized orbitals in the C-O sigma bond in acetone.



- a) ($2sp^2$, $2sp^2$)
- b) ($2sp^3$, $2sp^3$)
- c) ($2sp$, $2sp$)
- d) ($2p$, $2p$)
- e) ($2sp$, $1s$)

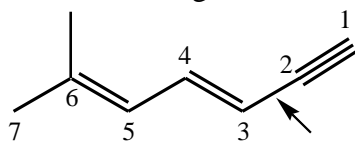
Answer: A

Topic: Atomic Orbitals, Hybridization

Section: 1.13 and 1.16

Difficulty Level: Medium

112) Identify the hybridized orbitals involved in the C-2–C-3 sigma bond (indicated by an arrow) in the following molecule:



- a) sp^2, sp^2
- b) sp^2, sp
- c) sp^2, sp^3
- d) sp^3, sp^2
- e) sp, sp^2

Answer: E

Topic: Atomic Orbitals, Hybridization, Bonding

Section: 1.13, 1.14, and 1.16

Difficulty Level: Easy

113) Which molecule has a non-linear shape (i.e., for which molecule are the nuclei *not* in a straight line)?

- a) $O=C=O$
- b) $H-O-H$
- c) $H-Cl$
- d) $H-C\equiv N$
- e) $H-C\equiv C-H$

Answer: B

Topic: Molecular Geometry

Section: 1.17

Difficulty Level: Easy

114) What would be the spatial arrangement (shape) of the atoms of the methyl anion $:\text{CH}_3^-$?

- a) octahedral
- b) tetrahedral
- c) trigonal planar
- d) linear
- e) trigonal pyramidal

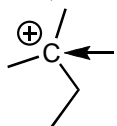
Answer: E

Topic: Molecular Geometry

Section: 1.17

Difficulty Level: Medium

115) What is the geometry of the C indicated with the arrow?



- a) tetrahedral
- b) trigonal pyramidal
- c) linear
- d) bent
- e) trigonal planar

Answer: E

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Easy

116) What geometry does the methyl cation, CH_3^+ , have?

- a) octahedral
- b) tetrahedral
- c) trigonal planar
- d) linear
- e) trigonal pyramidal

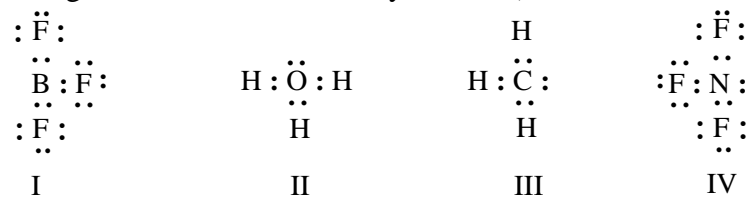
Answer: C

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Easy

117) Which of the structures below would be trigonal planar (a planar triangle)? (Electrical charges have been deliberately omitted.)



- a) I
- b) II
- c) III
- d) IV
- e) I and IV

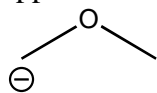
Answer: A

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Easy

118) The bond angle for the C-O-C bonds in the following molecule would be expected to be approximately:



- a) 90°
- b) 109°
- c) 120°
- d) 145°
- e) 180°

Answer: B

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Easy

119) The bond angles for the **bold-faced C** in $\text{CH}_3\text{CH}_2\text{C}^+\text{H}_2$ would be expected to be approximately:

- a) 60°
- b) 90°
- c) 105°
- d) 109°
- e) 120°

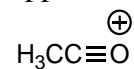
Answer: E

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Easy

120) The bond angle for the C-C-O bonds in the following molecule would be expected to be approximately:



- a) 90°
- b) 109°
- c) 120°
- d) 145°
- e) 180°

Answer: E

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Easy

121) What bond angle is associated with a tetrahedral molecule?

- a) 120°
- b) 109.5°
- c) 180°
- d) 90°
- e) 45°

Answer: B

Topic: Molecular Geometry

Section: 1.17

Difficulty Level: Easy

122) Based on VSEPR theory, which of the following would have a trigonal planar shape?

- a) $(\text{CH}_3)_3\text{N}$
- b) HCN
- c) NH_4^+
- d) CH_3^-
- e) CH_3^+

Answer: E

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Medium

123) VSEPR theory predicts an identical shape for all of the following, except:

- a) NH_3
- b) H_3O^+
- c) BH_3
- d) CH_3^-
- e) All of these choices have the same geometry.

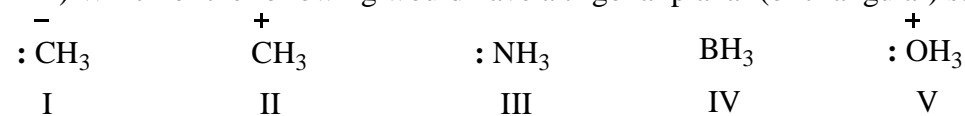
Answer: C

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Medium

124) Which of the following would have a trigonal planar (or triangular) structure?



- a) I, II, and IV
- b) II and IV
- c) IV
- d) II, IV, and V
- e) All of these choices.

Answer: B

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Medium

125) Which of these structures would be a perfectly regular tetrahedron?

- a) CH_3Br
- b) CH_2Br_2
- c) CHBr_3
- d) CBr_4
- e) More than one of these choices.

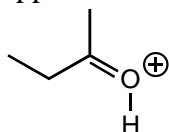
Answer: D

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Medium

126) The bond angle for the C-C-O bonds in the following compound would be expected to be approximately:



- a) 60°
- b) 90°
- c) 105°
- d) 109°
- e) 120°

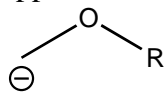
Answer: E

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Medium

127) The bond angle for the H-C-O bonds in the following molecule would be expected to be approximately:



- a) 90°
- b) 109°
- c) 120°
- d) 145°
- e) 180°

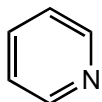
Answer: B

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Medium

128) What is the geometry of the N in the following molecule?



- a) tetrahedral
- b) trigonal pyramidal
- c) linear
- d) bent
- e) trigonal planar

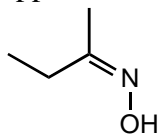
Answer: E

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Medium

129) The bond angle for the C-N-O bonds in the following molecule would be expected to be approximately:



- a) 90°
- b) 109°
- c) 120°
- d) 145°
- e) 180°

Answer: C

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Hard

130) The bond angle for the C-C-H bonds in CH_3CN would be expected to be approximately:

- a) 90°
- b) 109°
- c) 120°
- d) 145°
- e) 180°

Answer: B

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Easy

131) The bond angle for the C-C-N bonds in CH_3CN would be expected to be approximately:

- a) 90°
- b) 109°
- c) 120°
- d) 145°
- e) 180°

Answer: E

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Medium

132) The bond angle for the C-P-C bonds in $(\text{C}_6\text{H}_5)_3\text{P}$ would be expected to be approximately:

- a) 60°
- b) 90°
- c) 109°
- d) 120°
- e) 180°

Answer: C

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Medium

133) Based on the VSEPR theory, which of the following would have a tetrahedral arrangement of electrons around the central atom?

- a) BH_3
- b) NO_2^-
- c) SiH_4
- d) CO_3^{2-}
- e) SO_3

Answer: C

Topic: Molecular Geometry

Section: 1.17

Difficulty Level: Hard

134) What would be the spatial arrangement of the atoms of the ozone molecule (O_3)?

- a) linear
- b) angular
- c) trigonal planar
- d) trigonal pyramidal
- e) tetrahedral

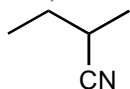
Answer: B

Topic: Molecular Geometry

Section: 1.17

Difficulty Level: Hard

135) What is the geometry around the N in the following molecule?



- a) tetrahedral
- b) trigonal pyramidal
- c) linear
- d) bent
- e) trigonal planar

Answer: C

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Hard

136) Which molecule would be linear? (In each case you should write a Lewis structure before deciding.)

- a) SO_2
- b) HCN
- c) H_2O_2
- d) H_2S
- e) OF_2

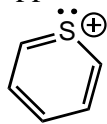
Answer: B

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Medium

137) The bond angle for the C-S-C bonds in the following molecule would be expected to be approximately:



- a) 90°
- b) 109°
- c) 120°
- d) 145°
- e) 180°

Answer: C

Topic: Lewis Structures, Molecular Geometry

Section: 1.17

Difficulty Level: Hard

Question type: True/false

138) All organic compounds have their origins from living organisms.

Answer: False

Topic: General

Section: 1.1

Difficulty Level: Easy

139) Carbon and other elements in the second period cannot have expanded octets.

Answer: True

Topic: Octet Rule

Section: 1.3 and 1.4

Difficulty Level: Easy

140) Contributing resonance structures cannot have contributors whose sigma bonds have been broken.

Answer: True

Topic: Resonance

Section: 1.8

Difficulty Level: Medium

141) The major resonance contributor to the resonance hybrid will have the greatest separation of formal charges.

Answer: False

Topic: Resonance

Section: 1.8

Difficulty Level: Medium

142) Nonbonding lone electron pairs exist in the unhybridized orbitals of an atom.

Answer: False

Topic: Hybridization

Section: 1.16

Difficulty Level: Medium

143) If a tetrahedral carbon atom were to lose its electrons from a single covalent bond its hybridization would change from sp^3 hybridized to sp^2 hybridized.

Answer: True

Topic: Hybridization

Section: 1.16

Difficulty Level: Hard

Question Type: fill-in-the-blank

144) The modern definition of organic chemistry is ____.

Answer: the study of carbon compounds

Topic: General

Section: Introduction

Difficulty Level: Easy

145) Organic compounds were originally defined as compounds obtained from ____.

Answer: living sources/organisms

Topic: General

Section: 1.1

Difficulty Level: Easy

146) The bond that results when two atoms share a pair of electrons is called a ____.

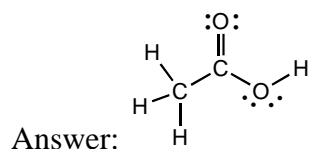
Answer: covalent bond

Topic: General

Section: 1.3

Difficulty Level: Easy

147) Draw the Lewis structure of acetic acid, $\text{CH}_3\text{CO}_2\text{H}$, clearly indicating all non-bonding pairs of electrons.



Topic: Lewis Structures

Section: 1.4

Difficulty Level: Medium

Question type: essay

148) Even though nitrogen and phosphorus have the same number of valence electrons, nitrogen can only bond to chlorine four times forming NCl_4^+ but phosphorus can bond with chlorine five times forming PCl_5 . Explain.

Answer:

Topic: Lewis Structures

Section: 1.4

Difficulty Level: Medium

Solution: Phosphorus can have an expanded octet with five bonds (10 electrons) using its $3d$ electrons whereas nitrogen, which is a row 2 element like carbon, can only form up to four bonds (8 electrons) since it does not have any d orbitals.

Question type: fill-in-the-blank

149) Constitutional isomers differ in the ____.

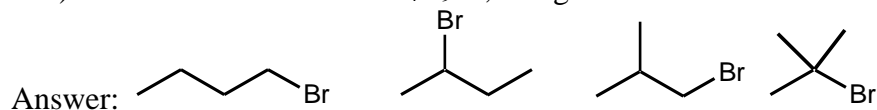
Answer: connectivity of their atoms

Topic: Isomers

Section: 1.6

Difficulty Level: Easy

150) Draw all the isomers of $\text{C}_4\text{H}_9\text{Br}$, using bond-line formulas.

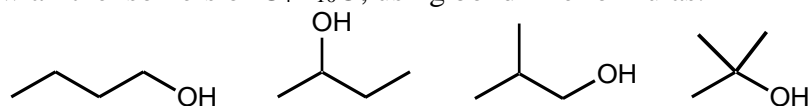


Topic: Isomers, Bond-Line Formulas

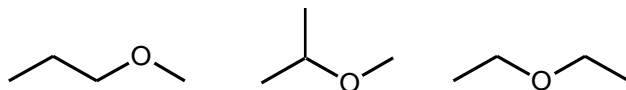
Section: 1.6

Difficulty Level: Easy

151) Draw all the isomers of $C_4H_{10}O$, using bond-line formulas.



Answer:

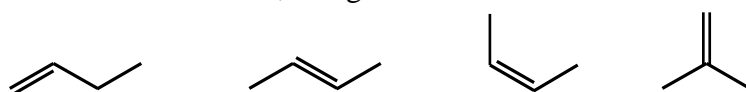


Topic: Isomers, Bond-Line Formulas

Section: 1.6

Difficulty Level: Medium

152) Draw all isomers of C_4H_8 , using bond-line formulas.



Answer:

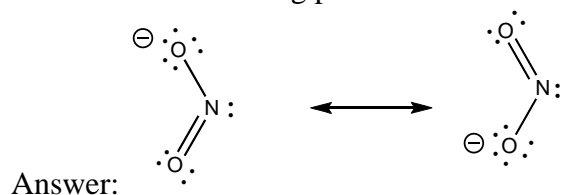


Topic: Isomers, Bond-Line Formulas

Section: 1.6

Difficulty Level: Medium

153) Draw the Lewis structure of the nitrite ion, NO_2^- , clearly indicating resonance contributors as well as non-bonding pairs of electrons and formal charges, as relevant.



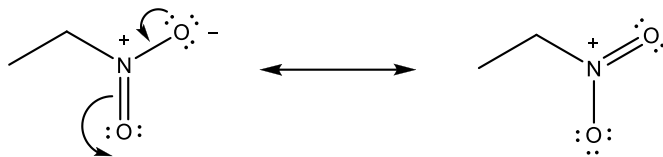
Topic: Lewis Structures, Resonance

Section: 1.4 and 1.8

Difficulty Level: Medium

154) Draw the Lewis structure of nitroethane $\text{CH}_3\text{CH}_2\text{NO}_2$, clearly indicating resonance contributors as well as non-bonding pairs of electrons and formal charges, as relevant.

Answer:



Topic: Lewis Structure, Resonance

Sections: 1.4 and 1.8

Difficulty Level: Medium

155) An orbital is defined as a region of space where the probability of ___ is high.

Answer: finding an electron

Topic: Atomic orbitals

Section: 1.10

Difficulty Level: Easy

156) Define an orbital.

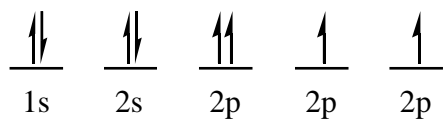
Answer: A region of space where the probability of finding an electron is high.

Topic: Atomic orbitals

Section: 1.11

Difficulty Level: Medium

157) There are three fundamental rules that we use in writing electronic configurations for atoms and molecules. The configuration shown below (for oxygen) violates one of these rules. Which one?



Answer: Pauli exclusion principle

Topic: Atomic orbitals, Electron configuration

Section: 1.10

Difficulty Level: Easy

158) When atomic orbitals of opposite phase overlap a(n) ___ molecular orbital is formed.

Answer: antibonding

Topic: Molecular orbitals

Section: 1.11

Difficulty Level: Easy

159) When atomic orbitals of the same phase overlap a(n) ___ molecular orbital is formed.

Answer: bonding

Topic: Molecular orbitals

Section: 1.11

Difficulty Level: Easy

160) An overlapping of unhybridized *s* orbitals is called a ___ bond, and an overlapping of unhybridized *p* orbitals is called a ___ bond.

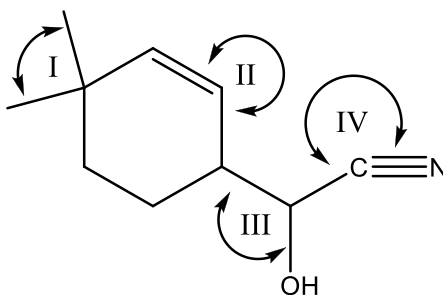
Answer: sigma, pi

Topic: Hybridization

Section 1.12

Difficulty Level: Easy

161) Determine the bond angles (I – IV) on the following structure based according to the VSEPR theory.



Answer: I = 109.5°, II = 120°, III = 109.5°, IV = 180°

Topic: VSEPR theory

Section: 1.17

Difficulty Level: Hard