## **Organic Chemistry 3rd Edition Gorzynski Test Bank**

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1. Which is the most electronegative atom in the compound below?



A) Carbon C) Oxygen

B) Nitrogen D) Bromine

- 2. Which of the following correctly describes the electrons of a carbon atom in its ground state?
- A) 3 *s* electrons; 3 *p* electrons
- B) 2 1s electrons; 4 2p electrons
- C) 2 1s electrons; 2 2s electrons; 2 2p electrons
- D) 2 1s electrons; 2 2s electrons; 4 2p electrons
- E) None of these choices is correct.
- 3. Which of the following statements correctly describes the typical bonding of carbon, nitrogen, and oxygen in organic molecules?
- A) Carbon participates in 4 covalent bonds, oxygen participates in 2 covalent bonds and nitrogen participates in 5 covalent bonds.
- B) Carbon participates in 3 covalent bonds, oxygen participates in 2 covalent bonds and nitrogen participates in 5 covalent bonds.
- C) Carbon participates in 4 covalent bonds, oxygen participates in 3 covalent bonds and nitrogen participates in 3 covalent bonds.
- D) Carbon participates in 3 covalent bonds, oxygen participates in 3 covalent bonds and nitrogen participates in 5 covalent bonds.
- E) Carbon participates in 4 covalent bonds, oxygen participates in 2 covalent bonds and nitrogen participates in 3 covalent bonds.

4. Which is not an acceptable Lewis structure for the anion (CH<sub>2</sub>NCO)<sup>-</sup>?



5. Which of the following is (are) valid Lewis structure(s) for the anion (HCONCH<sub>3</sub>)<sup>-</sup>?



A) a B) b C) c D) d E) e

6. Which of the following is (are) valid Lewis structure(s) for the anion  $(CH_2NO_2)^{-2}$ ? Assume the atoms are arranged as drawn.



A) a B) b C) c D) d E) e

7. Which is the appropriate conversion of CH<sub>3</sub>CHClCH<sub>2</sub>CH(CH<sub>3</sub>)<sub>2</sub> to a skeletal formula?



- A) a B) b C) c D) d E) e
- 8. Convert the following compound from a condensed formula to a skeletal formula: CH<sub>3</sub>CH<sub>2</sub>C(CH<sub>3</sub>)<sub>2</sub>CH<sub>2</sub>CH(CH<sub>2</sub>CH<sub>3</sub>)CH<sub>2</sub>CH(CH<sub>3</sub>)<sub>2</sub>.









e. None of the choices is correct.

9. What is the condensed formula of the compound below?



a. CH<sub>3</sub>CH<sub>2</sub>CH(CH<sub>3</sub>)CH<sub>2</sub>CH(CH<sub>3</sub>)CHBr<sub>2</sub>

b. CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>(CH<sub>3</sub>)CH<sub>2</sub>CH(CH<sub>3</sub>)CHBr<sub>2</sub>

c. CH<sub>3</sub>CH<sub>2</sub>CH(CH<sub>3</sub>)CH(CH<sub>3</sub>)CH<sub>2</sub>CHBr<sub>2</sub> A) a B) b C) c

10. Convert the following skeletal formula to a condensed formula.



a. CH<sub>3</sub>CH<sub>2</sub>CH(CH<sub>3</sub>)<sub>2</sub>CH(CH<sub>2</sub>CH<sub>3</sub>)CH(CH<sub>3</sub>)<sub>2</sub>

**b.**  $CH_3CH_2CH(CH_3)CH(CH_2CH_3)CH(CH_3)_2$ 

c. CH<sub>3</sub>CH(CH<sub>3</sub>)CH(CH<sub>2</sub>CH<sub>3</sub>)CH(CH<sub>3</sub>)<sub>2</sub> A) a B) b C) c

11. Which of the following is *not* a valid Lewis structure of CH<sub>3</sub>NO<sub>2</sub>?



A) a B) b C) c D) d

12. Which is *not* a valid resonance structure for the anion below?



13. How are the molecules in the following pair related?

 $H_3C^{O^+}CH_2$  and  $H_3C^{O^+}CH_2$ 

- A) They are constitutional isomers.
- B) They are resonance structures.
- C) They represent the same structure.

14. How are the molecules in the following pair related?

 $begin{tabular}{|c|c|c|c|} \hline & \text{and} & H_3C-C\equiv CH \\ A) \text{ They are constitutional isomers.} \end{aligned}$ 

- B) They are resonance structures.
- C) Neither of the choices is correct.

15. How are the molecules in the following pair related?

- A) They are constitutional isomers.
- B) They are resonance structures.
- C) Neither of the choices is correct.

16. How are the molecules in the following pair related?



- A) They are constitutional isomers.
- B) They are resonance structures.
- C) They are unrelated molecules.
- 17. How are the molecules in the following pair related?

- A) They are constitutional isomers.
- B) They are resonance structures.
- C) Neither of the choices is correct.

18. How are the molecules in the following pair related?



- A) They are constitutional isomers.
- B) They are resonance structures.
- C) Neither of the choices is correct.

19. How are the molecules in the following pair related?



- A) They are constitutional isomers.
- B) They are resonance structures.
- C) Neither of the choices is correct.

20. How are the molecules in the following pair related?



- A) They are constitutional isomers.
- B) They are resonance structures.
- C) They are unrelated molecules.
- 21. How are the molecules in the following pair related?



- A) They are constitutional isomers.
- B) They are resonance structures.
- C) Neither of the choices is correct.
- 22. Which is the most accurate representation of the resonance hybrid for the resonance structures shown below?



e. None of the choices is correct. A) a B) b C) c D) d E) e

23. Which of the following pairs of compounds are resonance structures?



24. Which of the following structures are resonance structures of each other?



A) a and b

B) b and cC) a and cD) All are resonance structures.E) None of these are resonance structures.

25. What is the hybridization for each of the indicated atoms in the following compound?

H<sub>2</sub>C<sup>$$\stackrel{,}{\rightarrow}$$</sup>CH<sub>3</sub>  
 $a c$   
A)  $a - sp^2$ ;  $b - sp^2$ ;  $c - sp^2$   
B)  $a - sp^2$ ;  $b - sp^3$ ;  $c - sp^3$   
C)  $a - sp$ ;  $b - sp^2$ ;  $c - sp^3$   
D)  $a - sp^2$ ;  $b - sp^2$ ;  $c - sp^3$ 

26. Indicate the hybridization of the carbon ion in each compound below.



27. Consider the organic molecule drawn below. Describe which orbitals are used to form the C=O bond. Since there are two bonds, you must identify two different sets of orbitals.

$$O = H$$
A)  $C_{sp}^2 - O_{sp}^2$  and  $C_s - O_p$ 
B)  $C_{sp} - O_{sp}$  and  $C_p - O_p$ 
C)  $C_{sp}^2 - O_{sp}^2$  and  $C_s - O_s$ 
D)  $C_{sp}^3 - O_{sp}^2$  and  $C_p - O_p$ 
E)  $C_{sp}^2 - O_{sp}^2$  and  $C_{2p} - O_{2p}$ 

28. Which of the following compounds has a labeled carbon atom that is  $sp^2$  hybridized?

**a.** 
$$H_2C=C=CH_2$$
 **b.**  $H_3C 
ightarrow CH_3$  **c.**  $H_3C 
ightarrow CH_3$ 

**d.** Compounds **b** and **c e. a**, **b** and **c** all have  $sp^3$  hybridized carbon.

A) a B) b C) c D) d E) e

29. Which of the following compounds contains a labeled atom that is *sp* hybridized? (All nonbonded electron pairs have been drawn in.)



A) a B) b C) c D) d E) e

30. Which of the compounds drawn below contains an  $sp^2$  hybridized carbon atom? Select any and all structures that apply.

a.  $CO_2$ b.  $H_2C=O$ c.  $CH_3^+$ d.  $CH_3OH$ A) a only D) a and bB) b only E) b and cC) d only

31. Which of the labeled carbon atoms is (are)  $sp^2$  hybridized?

a. (A) a B b C c D d E eb.  $CH_3^+$  c.  $H_2C=C=CH_2$  d. a and b e. a, b and c

32. Which statement best describes the orbital hybridization used to form bonds in the cation below?

H<sub>2</sub>C−C≡N∶

- A) The  $\sigma$  bond between the two carbon atoms is formed between two  $sp^2$  hybridized atoms.
- B) The  $\sigma$  bond between the C and N is formed between an  $sp^2$  hybridized C and an *sp* hybridized N.
- C) The  $\sigma$  bond between the two carbons is formed between one  $sp^3$  hybridized C and one *sp* hybridized C.
- D) The lone pair of electrons on N is in an *sp* hybridized orbital.

E) None of the statements is correct.

33. Indicate the formal charge on the B, O, and F atoms in the following compound.

B) B: -1; O: -1; F: 0 C) B: +1; O: -1; F: 0 D) B: -1; O: +1; F: 0 E) None of the choices is correct.

34. In the following compound, indicate the formal charge on all atoms except hydrogen.

D) Carbon +1; Oxygen -1; Nitrogen -1

- E) None of the choices is correct.
- 35. In the following compound, indicate the formal charge on all atoms except hydrogen, from left to right.

A) Carbon 0; Nitrogen –1; Carbon +1; Oxygen 0

- B) Carbon -0; Nitrogen -1; Carbon 0; Oxygen -1
- C) Carbon 0; Nitrogen -1; Carbon 0; Oxygen -1
- D) Carbon 0; Nitrogen +1; Carbon 0; Oxygen -1
- E) None of the choices is correct.
- 36. Which of the following compounds has a labeled atom with a +1 formal charge? (All nonbonded electron pairs have been drawn in.)



- A) a B) b C) c D) d E) e
- 37. Which of the following species has a labeled atom with a +1 formal charge? (All nonbonded electron pairs have been drawn in.)



38. Which of the following species contains a carbon atom with a +1 formal charge? (All nonbonded electron pairs have been drawn in.)

**a.** 
$$H \xrightarrow{C} C \xrightarrow{H} D$$
  
H H H  $H \xrightarrow{C} C \xrightarrow{H} C$  H C. H-CEC: **d.**  $C = N$   
H H  $H \xrightarrow{C} C \xrightarrow{C} H$   
H H H H H H

- A) a B) b C) c D) d E) e
- 39. Which of the following species contains a carbon atom with a −1 formal charge? (All nonbonded electron pairs have been drawn in.)

**a.** H-C=C-H **b.** 
$$H^{C} \xrightarrow{C} H$$
 **c.** H-C-H **d.**  $H^{C} \xrightarrow{C} H$  **e.**  $H_2C=C=CH_2$ 

- A) a B) b C) c D) d E) e
- 40. Which of the following species contains an O atom with a +1 formal charge? (All nonbonded electron pairs have been drawn in.)



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A) a B) b C) c D) d E) e
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41. Which of the following species contains a carbon atom with a +1 formal charge? (All nonbonded electrons and electron pairs have been drawn in.)



A) a B) b C) c D) d E) e

42. Which of the following species has (have) a trigonal planar structure with 120° bond angles around the labeled carbon atom?

a. 
$$H_2C=C=CH_2$$
 b.  $H_3C$   $CH_3$  c.  $H_3C$   $+$   $CH_3$  d. b and c e. a, b and c f  
A) a B) b C) c D) d E) e

43. Which of the following molecules has (have) a trigonal planar geometry?

a.  $\downarrow$  b.  $\bigcirc$  c.  $\nearrow$  d. a and c e. None of the choices are correct.

A) a B) b C) c D) d E) e

44. Which of the following compounds possess(es) a nitrogen with tetrahedral geometry? A)  $CH_3C \equiv N$ : B)  $NH_2^-$ C)  $NH_4^+$ D)  $CH_3C$   $\equiv$  N: and  $NH_2^-$  are both tetrahedral. E)  $NH_2^-$  and  $NH_4^+$  are both tetrahedral.

45. Which of the following molecules is (are) polar?

**b.**  $CH_2CI_2$  **c.**  $CCI_4$ a. CH<sub>3</sub>CI A) a D) a and b B) b E) b and c C) c

46. Which of the following statements is (are) correct?

- A) Ethane has  $sp^3$  carbon atoms and the geometry around each carbon is trigonal planar.
- B) Ethane has  $sp^3$  carbon atoms and the geometry around each carbon is tetrahedral.
- C) Ethane has  $sp^2$  carbon atoms and the geometry around each carbon is tetrahedral.
- D) Ethane has  $sp^2$  carbon atoms and the geometry around each carbon is trigonal planar.

E) None of the statements are correct.

47. Which of the following statements is (are) correct?

- A) The carbon–carbon distance in acetylene is longer than in ethylene.
- B) The carbon-hydrogen bond in acetylene is weaker than the carbon-hydrogen bond in ethane.
- C) The carbon–carbon distance in acetylene is shorter than in ethane.
- D) The statements (The carbon–carbon distance in acetylene is longer than in ethylene) and (The carbon hydrogen bond in acetylene is weaker than the carbon hydrogen bond in ethane) are correct.
- E) The statements (The carbon hydrogen bond in acetylene is weaker than the carbon hydrogen bond in ethane) and (The carbon-carbon distance in acetylene is shorter than in ethane) are correct.

48. How many hydrogens are directly bonded to each of the indicated carbon atoms?



A) C<sub>a</sub> 1; C<sub>b</sub> 3; C<sub>c</sub> 2 B) C<sub>a</sub> 2; C<sub>b</sub> 3; C<sub>c</sub> 2 C) C<sub>a</sub> 1; C<sub>b</sub> 2; C<sub>c</sub> 2 D) C<sub>a</sub> 1; C<sub>b</sub> 3; C<sub>c</sub> 3 E) None of the choices is correct.

49. Of the molecules listed, which does *not* have a dipole moment?

A) HCl

B) NCl<sub>3</sub>

C) CO

D) BF<sub>3</sub>

E) All molecules have a dipole moment.

50. For the elements Rb, F, and O, the order of increasing electronegativity is: A) Rb < F < O B) Rb < O < F C) O < F < Rb D) F < Rb < O

E) The order cannot be determined.

51. Which of the following Lewis dot structure(s) below bear(s) a positive charge?

a.  $\overset{H}{\overset{Be}{\overset{}}_{H}}$  b.  $\overset{H}{\overset{}_{H}-\overset{}{B}-\overset{}_{H}-\overset{}{H}}$  c.  $\overset{H}{\overset{}_{N},\overset{}{\overset{}_{N},\overset{}_{H}-\overset{}}{\overset{}_{H}-$ 

52. Which of the following species has (have) a trigonal planar structure?

**a.**  $\overset{-}{C}H_3$  **b.**  $\overset{+}{C}H_3$  **c.**  $\overset{-}{N}H_3$  **d.**  $BF_3$  **e.**  $\overset{+}{O}H_3$ A) a, b, and c B) b and d C) d D) b, d, and e E) All of the choices are correct.

53. What is the molecular shape of methyl anion?

<sup>-</sup> CH<sub>3</sub> A) Octahedral B) Tetrahedral C) Trigonal planar D) Trigonal pyramidal E) Linear

## **Challenge Questions**

54. **Enalapril** is currently in clinical trials for congestive heart failure, and its structure is given below. What is the correct molecular formula for this interesting antihypertensive agent?



**Enalapril** A) a B) b C) c D) d E) e

55. The following compound is a synthetic intermediate in the production of **lactacystin**. Identify the orbital hybridization and geometry of the atoms next to the three arrows.



56. The following scheme represents an  $S_N1$  mechanism for the conversion of alkyl halide "**a**" to ether "**b**." Determine the correct structure for intermediate "**X**" based on the curved arrow formulism shown.



57. With reference to compound **X** drawn below, label each compound as an isomer, a resonance structure or neither.



- A) a. resonance structure; b. isomer; c. neither; d. isomer
- B) **a.** isomer; **b.** resonance structure; **c.** isomer; **d.** neither
- C) a. isomer; b. neither; c. isomer; d. resonance structure
- D) a. resonance structure; b. isomer; c. resonance structure; d. isomer
- E) None of the choices are correct.

Use the following to answer questions 58-60.

Answer the following questions about lidocaine, a commonly used dental anesthetic.



58. What orbitals are used to form the bond indicated by a?
A) Csp<sup>2-</sup>Csp<sup>2</sup> D) Csp<sup>-</sup>Csp<sup>2</sup>
B) Csp<sup>3-</sup>Csp<sup>2</sup> E) Csp<sup>3-</sup>Csp
C) Csp<sup>2-</sup>Csp

59. How many carbon atoms have sp<sup>2</sup> hybridization?
A) 7 D) 10
B) 5 E) 8

C) 6

60. Predict the geometry around the oxygen atom indicated by arrow **c**.

A) Linear

B) Tetrahedral

C) Trigonal bipyrimidal

D) Trigonal planar

E) Square planar

## Answer Key - Chapter 1: Structure and Bonding

1. C

2. C

- 3. E
- 4. C

5. D 6. E

0. E 7. B

7. D 8. D

- 9. A
- 10. B
- 11. B

12. C

- 13. B 14. A
- 15. A
- 16. C
- 17. B
- 18. A 19. B
- 20. C

21. A

22. B

23. B 24. A

25. D

26. D

- 27. E
- 28. D
- 29. D

30. E 31. D

31. D 32. D

33. D

34. C

35. D

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- 36. C
- 37. A
- 38. A
- 39. B
- 40. B
- 41. D
- 42. D
- 43. A
- 44. E
- 45. D
- 46. B 47. C
- 48. A
- 49. D
- 50. B
- 51. E
- 52. B
- 53. D 54. A
- 55. D
- 56. C
- 57. D
- 58. B
- 59. A
- 60. D