1. Which statement is **false**? A sigma molecular orbital

**(a) may result from overlap of p atomic orbitals perpendicular to the molecular axis (side-on).**

(b) may result from overlap of p atomic orbitals along the molecular axis (head-on).

(c) may result from overlap of two s atomic orbitals.

(d) may result from overlap of one s and one p atomic orbitals.

(e) may be either bonding or antibonding.

1. Carbon monoxide has ten bonding electrons and four antibonding electrons. Therefore it has a bond order of

**(a) 3**

(b) 7

(c) 1

(d) 5/2

(e) 2

1. Which of the following is the correct electron configuration for C2?

(a) http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif1s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif2s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/pi.gif2py2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif\*1s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif\*2s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/pi.gif\*2py2

(b) http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif1s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif\*1s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif2s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif\*2s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/pi.gif2py2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/pi.gif\*2pz1http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif2p1

**(c) http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif1s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif\*1s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif2s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif\*2s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/pi.gif2py2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/pi.gif2pz2**

(d) http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif1s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif\*1s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif2s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif\*2s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/pi.gif2py1http://www.chem.tamu.edu/class/fyp/mcquest/Pics/pi.gif2pz1

(e) http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif1s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif\*1s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif2s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif\*2s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/pi.gif2py1http://www.chem.tamu.edu/class/fyp/mcquest/Pics/pi.gif\*2py1http://www.chem.tamu.edu/class/fyp/mcquest/Pics/pi.gif2pz1http://www.chem.tamu.edu/class/fyp/mcquest/Pics/pi.gif\*2pz1

1. What is the correct electron configuration for the molecular ion, B2+?

(a) http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif1s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif\*1s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif2s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif\*2s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif2p2

(b) http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif1s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif\*1s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif2s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif\*2s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/pi.gif2py2

(c) http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif1s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif\*1s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif2s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif\*2s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/pi.gif2py2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/pi.gif2pz1

(d) http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif1s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif\*1s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif2s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif\*2s2http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif2p1http://www.chem.tamu.edu/class/fyp/mcquest/Pics/pi.gif2py1

**(e) none of the above.**

1. Draw the molecular orbital diagram for the molecular ion, N2+. The number of electrons in the http://www.chem.tamu.edu/class/fyp/mcquest/Pics/sigma.gif2p molecular orbital is:

(a) 0

**(b) 1**

(c) 2

(d) 3

(e) 4

1. What is the bond order in O2+?

(a) 3.5

(b) 2.0

(c) 1.5

**(d) 2.5**

(e) 0

1. Draw the molecular orbital diagram for B2. The number of unpaired electrons in the B2 molecule is

(a) zero

(b) 1

**(c) 2**

(d) 3

(e) 4

1. Which one of the following statements is false?

(a) Valence bond theory and molecular orbital theory can be described as two different views of the same thing.

(b) When one considers the molecular orbitals resulting from the overlap of any two specific atomic orbitals, the bonding orbitals are always lower in energy than the antibonding orbitals.

(c) Molecular orbitals are generally described as being more delocalized than hybridized atomic orbitals.

**(d) One of the shortcomings of molecular orbital theory is its inability to account for a triple bond in the nitrogen molecule, N2.**

(e) One of the shortcomings of valence bond theory is its inability to account for the paramagnetism of the oxygen molecule, O2.

1. Antibonding molecular orbitals are produced by

(a) constructive interaction of atomic orbitals.

**(b) destructive interaction of atomic orbitals.**

(c) the overlap of the atomic orbitals of two negative ions

(d) all of these

(e) none of these

1. Which statement regarding stable heteronuclear diatomic molecules is false?

(a) All have bond orders greater than zero.

(b) The antibonding molecular orbitals have more of the character of the more electropositive element than of the more electronegative element.

**(c) Their molecular orbital diagrams are more symmetrical than those of homonuclear diatomic molecules.**

(d) The bonding molecular orbitals have more of the character of the more electronegative element than of the less electronegative element.

(e) The greater is the difference in energy between two overlapping atomic orbitals, the more polar the resulting bond is, due to electrons occupying the resulting bonding molecular orbital.

1. A http://www.chem.tamu.edu/class/fyp/mcquest/Pics/pi.gif(pi) bond is the result of the

(a) overlap of two s orbitals.

(b) overlap of an s and a p orbital.

(c) overlap of two p orbitals along their axes.

**(d) sidewise overlap of two parallel p orbitals.**

(e) sidewise overlap of two s orbitals.

1. A triple bond contains \_\_\_ sigma bond(s) and \_\_\_ pi bond(s).

(a) 0, 3

(b) 3, 0

(c) 2, 1

**(d) 1, 2**

(e) 3, 2

1. With regard to the species 16O2-, 19F- and 20Ne, which of the following statements is correct?

**(a) All three species contain 10 electrons.**

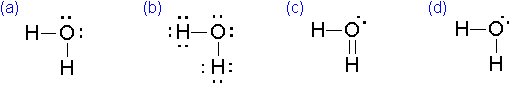
(b)The sum of the neutrons in all three species is 27.

(c) The sum of the protons in all three species is 28.

(d) Both 19F- and 20Ne contain 20 neutrons.

(e) none of the above

1. Which of the following is the correct electron-dot formula for water?



1. Which of the following is the correct electron-dot formula for carbon dioxide?

https://chemistry.boisestate.edu/richardbanks/inorganic/mc111/vol3/v3_111mc2.gif

1. The molecule N2 is isoelectronic with...

(a) O2 (b) O2 (c) NO **(d) CN-**

1. In which of the following compounds does ionic bonding predominate?

(a) NH4Cl(b) CO2 (c) CH4 (d) LiBr

1. Which of the following gases would be most soluble in water?

(a)N2 (b)NH3 (c)CH4 (d) CO2

1. Which of the following compounds should have the highest boiling point?

(a)NH3 (b)CH4 (c)H2O (d) HF

1. Additive combinations of atomic orbitals give:

(a) antibonding molecular orbitals

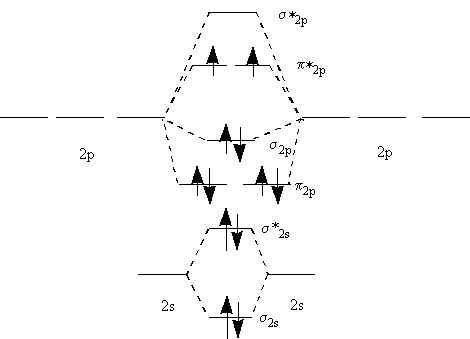
(b)hybrid orbitals

(c) other atomic orbitals

(d) bonding molecular orbitals

(e) resonant structures

1. The C2 molecule has 6 bonding and 2 antibonding electrons. The bond order of this species is:
2. -2 (b) -1 (c) 0 (d) 1 (e) 2



1. A molecular orbital diagram for the O2 molecule is shown below. The bond order for this species is:

(a) 0 (b) 0.5 (c) 1.0 (d) 1.5 (e) 2.0

1. Referring to the diagram in question 4, which of the following statements is true?
   1. The O2- ion is not paramagnetic
   2. The O2+ ion is not paramagnetic
   3. The O2 molecule is not paramagnetic
   4. The O2-2 ion is not paramagnetic
   5. The O2+2 ion is paramagnetic
2. Referring to the diagram in question 4, what would happen to the O2 molecule upon ionization to O2+?
3. The bond length will increase and the bond energy will increase
4. The bond length will increase and the bond energy will decrease
5. The bond length will decrease and the bond energy will decrease
6. The bond length will decrease and the bond energy will increase
7. Nothing will happen
8. A molecular orbital diagram for the N2 molecule is shown below. What would happen to the molecule upon ionization to N2+?
9. The bond length will increase and the bond energy will increase
10. The bond length will increase and the bond energy will decrease
11. The bond length will decrease and the bond energy will decrease
12. The bond length will decrease and the bond energy will increase
13. Nothing will happen
14. Referring to the diagram in question 7, what kind of bond is present in the N2 molecule?
15. A single bond
16. A double bond
17. A triple bond
18. A "one and a half" bond
19. A hydrogen bond
20. Referring to the diagram in question 7, the N2 molecule is:
21. Paramagnetic
22. Diamagnetic
23. Supermagnetic
24. Ferromagnetic
25. Not magnetic
26. What is the hybridization of the oxygen atom in water?
27. https://chemistry.boisestate.edu/richardbanks/inorganic/mc111/vol10/v10_111mc1.gifSp (b) sp2 (c) sp3 (d) It is not hybridized.
28. Use molecular orbital theory to determine the bond order for the O2+ ion.
29. 3
30. 1½
31. 2½
32. 2
33. Which of the following describes a hydrogen bond?
34. the bond between hydrogen in one water molecule and oxygen in a different water molecule
35. the bond between hydrogen and oxygen within a molecule of water
36. the bond between hydrogen in one water molecule and another hydrogen in a different water molecule
37. the bond between two hydrogen atoms within a molecule of water
38. The strong bonds that usually form between carbon and hydrogen are called \_\_\_\_\_\_\_\_ bonds.
39. hydrogen
40. covalent
41. elemental
42. ionic
43. Metals lose electrons from their lattice to become
44. positive ions
45. negative ions
46. alkalis
47. non-metals
48. Neither ions nor electrons are free to move in
49. liquids
50. metals
51. ionic solids
52. All of Above
53. Attractive forces between metal ions and delocalized electrons can be weaken or overcome by
54. hammer
55. high temperature
56. water
57. All of Above
58. Metals are good conductors due to
59. ionic lattices
60. crystalline lumps
61. mostly solids
62. localized electrons
63. Conduction of electricity in metallic bonding is due to presence of
64. protons
65. lattice
66. delocalized electrons
67. nucleus
68. Which one of the following is not a form of chemical bonding?
69. covalent bonding
70. hydrogen bonding
71. ionic bonding
72. metallic bonding
73. Which one of the following statements about positive ions is incorrect?
74. they are also known as cations
75. they are formed when electrons are removed from atoms
76. they are larger than the atom from which they were formed
77. they are smaller than the atom from which they were formed
78. Which one of the following statements about negative ions is incorrect?
79. they are also known as anions
80. they are formed when atoms gain electrons
81. they are larger than the atom from which they were formed
82. they are smaller than the atom from which they were formed
83. Instantaneous dipole-induced dipole forces are also known as...
84. dipole-dipole interactions
85. hydrogen bonds
86. covalent bonds
87. van der Waals forces
88. Which of the following statements is incorrect?
89. the greater the number of electrons in a molecule, the greater the van der Waals forces
90. the layers in graphite are held together by van der Waals forces
91. the boiling point of noble gases increases down the group
92. water has a higher than expected boiling point because of intermolecular van der Waals forces
93. The correct order of increasing attractive strength for weak intermolecular forces is...
94. dipole-dipole interaction, hydrogen bonding, van der Waals forces
95. van der Waals forces, dipole-dipole interaction, hydrogen bonding
96. hydrogen bonding, dipole-dipole interaction, van der Waals forces
97. hydrogen bonding, van der Waals forces, dipole-dipole interaction
98. Which one of the following exhibits intermolecular hydrogen bonding?
99. HF
100. HCl
101. HBr
102. HI
103. Which one of the following is not true of water?
104. in ice each water molecule is bonded to four others
105. water molecules have a high boiling point due to intermolecular hydrogen bonding
106. ice has a structure similar to that of diamond
107. water has a maximum density at 1ºC
108. Which one of the following is not true of metallic bonding?
109. it gives rise to excellent electrical conductivity
110. electrons are free to move throughout the structure
111. the strength of metallic bonds increases down a group
112. the strength of metallic bonding affects the boiling point of metals
113. Which one of the following statements about the melting point of metals is true?
114. sodium has a lower melting point than potassium
115. sodium has a higher melting point than magnesium
116. potassium has a higher melting point than rubidium
117. lithium has a lower melting point than sodium
118. Chemical bonding occurs when the \_\_\_\_\_\_\_\_\_\_ are transferred or shared between atoms.
     1. outer protons
     2. largest neutrons
     3. outermost electrons
     4. innermost electrons
     5. outermost protons
119. When two hydrogen atoms each share an electron with an oxygen atom (H2O),
120. polar covalent bonding occurs.
121. nonpolar covalent bonding occurs.
122. ionic bonding occurs.
123. metallic bonding occurs.
124. it is called a james bond.
125. When a positively charged hydrogen atom of one water molecule is attracted to a negatively charged oxygen atom of another water molecule,
126. covalent bonding occurs.
127. hydrogen bonding occurs.
128. ionic bonding occurs.
129. metallic bonding occurs.
130. When the 1s orbitals of two hydrogen atoms combine to form a hydrogen molecule,how many molecular orbitals are formed?
131. 1
132. 2
133. 3
134. 4
135. 5
136. When the ls orbitals of two hydrogen atoms combine to form a hydrogen molecule,which molecular orbitals are formed?
137. One bonding molecular orbital only
138. Two bonding molecular orbitals
139. One bonding molecular orbital and one antibonding molecular orbital
140. Two antibonding molecular orbitals
141. Three bonding molecular orbitals
142. A solute is most likely to be highly soluble in a solvent if the solute is \_\_\_\_\_ and the solvent is \_\_\_\_\_\_.
143. ionic or polar, non-polar
144. non-polar, polar
145. ionic or polar, polar
146. non-polar, ionic
147. The boiling point of CH4 is much lower than that of HF. This is because:
148. of hydrogen bonding in HF.
149. of dipole-dipole interactions in CH4.
150. CH4 is polar.
151. HF is more polarizable.
152. of ion-dipole interactions in CH4.
153. The boiling point of water is about 200°C higher than one would predict from the boiling points of hydrogen sulfide and hydrogen selenide. One may explain this apparent anomaly by which of the following?
154. The H-O covalent bond is much stronger than the H-S and H-Se bonds.
155. Water is less polar than hydrogen sulfide and hydrogen selenide.
156. The water molecule is lighter than the other two molecules.
157. Water has the lowest molecular weight.
158. The intermolecular attractive forces are much greater in water than in hydrogen sulfide and hydrogen selenide.
159. Which of the below is described by: high melting point, can conduct, soluble in water.
160. Al(s) Can conduct but is insoluble.
161. carbon (graphite) Identified it has a high mp and can conduct, it is not soluble.
162. CH4(g) Is incorrect on all properties.
163. NaCl (aq) Correct answer, can conduct as it is aqueous.
164. Which of the following causes the boiling point of HF to be much higher than that of HCl or HBr?
165. coordinate covalent bonds
166. hydrogen bonds
167. covalent bonds
168. van der Waals forces
169. Which type of solid has the highest melting point?
170. nonmetallic solid
171. network solid
172. ionic solid
173. metal
174. Which of the forces of molecular attraction is the weakest?
175. hydrogen bond
176. dipole interaction
177. dispersion
178. polar bond
179. Which of the forces of molecular attraction is the strongest?
180. hydrogen bonds
181. dipole interaction
182. dispersion forces
183. polar bond
184. If a material can be shaped or extended by physical pressure, such as hammering, which property does the material have?
185. conductivity
186. ductility
187. malleability
188. luster
189. Metals are malleable because the metallic bonding
190. holds the layers of ions in rigid positions.
191. maximizes the repulsive forces within the metal.
192. c.allows one plane of ions to slide past another.
193. d.is easily broken.
194. The shiny appearance of a metal is most closely related to the metal's
195. highly mobile valence electrons.
196. c.brittle crystalline structure.
197. covalent bonds.
198. positive ions.
199. As light strikes the surface of a metal, the electrons in the electron sea
200. allow the light to pass through.
201. become attached to particular positive ions.
202. fall to lower energy levels.
203. absorb and re emit the light
204. Which of the following type of bonds will have the highest electrical and thermal conductivity?
205. ionic bond
206. polar covalent bond
207. metallic bond
208. nonpolar covalent bond
209. Why can metals be hammered without breaking?
210. They are ductile.
211. They are not brittle.
212. They are malleable.
213. Its particles are strong.

66. How many hydrogen bonds can a water molecule potentially take in liquid form?

1. a. one
2. b. two
3. c. three
4. d. **four**
5. e. none of the above

67. Which one among the following does not have the hydrogen bond?  
a. phenol  
b. liquid NH3  
c. water  
d. **liquid HCl**

68.The molecule having one unpaired electron is:  
**a. NO**  
b. CO  
c. CN-  
d. O2

69.The hydrogen bond is strongest in:  
a. O-H…S  
b. S-H…O  
**c. F-H…S**  
d. F-H...O

**Answer Key Chemical Bonding**

1. A
2. A
3. C
4. E
5. B
6. C
7. C
8. D
9. B
10. C
11. D
12. D
13. E
14. A
15. C
16. D
17. D
18. B
19. C
20. B
21. E
22. E
23. D
24. A
25. C
26. C
27. B
28. C
29. B
30. A
31. B
32. A
33. B
34. B
35. D
36. E
37. B
38. D
39. C
40. A
41. A
42. B
43. A
44. A
45. D
46. D
47. A
48. A
49. B
50. B
51. C
52. C
53. A
54. E
55. D
56. B
57. C
58. A
59. A
60. A
61. B
62. A
63. A
64. A
65. C
66. D
67. D
68. A
69. C