

**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.**

- 1) The  $\pi$  bond in ethylene,  $\text{H}_2\text{C}=\text{CH}_2$ , results from the interaction of \_\_\_\_\_. 1) \_\_\_\_\_  
A)  $\text{sp}^2$  hybrid orbitals  
B)  $\text{sp}^3$  hybrid orbitals  
C) sp hybrid orbitals  
D) p atomic orbitals  
E) s atomic orbitals
- 2) A valid Lewis structure of \_\_\_\_\_ cannot be drawn without violating the octet rule. 2) \_\_\_\_\_  
A)  $\text{CO}_2$       B)  $\text{ICl}_5$       C)  $\text{NI}_3$       D)  $\text{SO}_2$       E)  $\text{SiF}_4$
- 3) When NaCl dissolves in water, aqueous  $\text{Na}^+$  and  $\text{Cl}^-$  ions result. The force of attraction that exists between  $\text{Na}^+$  and  $\text{H}_2\text{O}$  is called a(n) \_\_\_\_\_ interaction. 3) \_\_\_\_\_  
A) London dispersion force  
B) dipole-dipole  
C) ion-ion  
D) hydrogen bonding  
E) ion-dipole
- 4) How many equivalent resonance forms can be drawn for  $\text{SO}_2$  without expanding octet on the sulfur atom? (Sulfur is the central atom.) 4) \_\_\_\_\_  
A) 0      B) 1      C) 2      D) 3      E) 4
- 5) In which of the molecules below is the carbon-carbon distance the shortest? 5) \_\_\_\_\_  
A)  $\text{H}_2\text{C}=\text{CH}_2$   
B)  $\text{H}_2\text{C}=\text{C}=\text{CH}_2$   
C)  $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_3$   
D)  $\text{H}_3\text{C}-\text{CH}_3$   
E)  $\text{H}-\text{C}\equiv\text{C}-\text{H}$
- 6) There are \_\_\_\_\_  $\sigma$  bonds and \_\_\_\_\_  $\pi$  bonds in  $\text{H}_3\text{C}-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-\text{C}\equiv\text{CH}$ . 6) \_\_\_\_\_  
A) 14, 2      B) 16, 3      C) 13, 2      D) 10, 3      E) 12, 2
- 7) The molecular geometry of the  $\text{BrO}_3^-$  ion is \_\_\_\_\_. 7) \_\_\_\_\_  
A) trigonal pyramidal  
B) trigonal planar  
C) tetrahedral  
D) T-shaped  
E) bent

8) The predominant intermolecular force in  $(\text{CH}_3)_2\text{NH}$  is \_\_\_\_\_. 8) \_\_\_\_\_  
A) ionic bonding  
B) dipole-dipole forces  
C) London dispersion forces  
D) ion-dipole forces  
E) hydrogen bonding

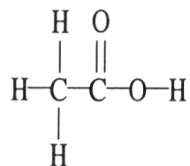
9) Based on molecular orbital theory, the bond orders of the H-H bonds in  $\text{H}_2$ ,  $\text{H}_2^+$ , and  $\text{H}_2^-$  are \_\_\_\_\_, respectively 9) \_\_\_\_\_  
A) 1, 0, and 0  
B) 1, 2, and 0  
C) 1, 1/2, and 0  
D) 1, 1/2, and 1/2  
E) 1, 0, and 1/2

10) Which one of the following should have the lowest boiling point? 10) \_\_\_\_\_  
A)  $\text{F}_2\text{O}$   
B)  $\text{CF}_4$   
C)  $\text{SnF}_3$   
D)  $\text{HCl}$   
E)  $\text{C}_4\text{H}_9\text{OH}$

11) The bond order of any molecule containing equal numbers of bonding and antibonding electrons is \_\_\_\_\_. 11) \_\_\_\_\_  
A) 0                      B) 1                      C) 2                      D) 3                      E) 1/2

12)  $\text{C}_{12}\text{H}_{26}$  molecules are held together by \_\_\_\_\_. 12) \_\_\_\_\_  
A) ion-ion interactions  
B) ion-dipole interactions  
C) dispersion forces  
D) dipole-dipole interactions  
E) hydrogen bonding

13) The molecular geometry of the right-most carbon in the molecule below is \_\_\_\_\_. 13) \_\_\_\_\_



- A) T-shaped
- B) tetrahedral
- C) octahedral
- D) trigonal bipyramidal
- E) trigonal planar

- 14) The electron-domain geometry of \_\_\_\_\_ is tetrahedral. 14) \_\_\_\_\_  
A)  $\text{CCl}_2\text{Br}_2$   
B)  $\text{CBr}_4$   
C)  $\text{XeF}_4$   
D)  $\text{PH}_3$   
E) all of the above except  $\text{XeF}_4$
- 15) The  $\text{sp}^3\text{d}^2$  atomic hybrid orbital set accommodates \_\_\_\_\_ electron domains. 15) \_\_\_\_\_  
A) 2                      B) 3                      C) 4                      D) 5                      E) 6
- 16) The molecular geometry of the  $\text{BCl}_3$  molecule is \_\_\_\_\_, and this molecule is \_\_\_\_\_. 16) \_\_\_\_\_  
A) trigonal planar, polar  
B) trigonal pyramidal, nonpolar  
C) trigonal pyramidal, polar  
D) trigonal bipyramidal, polar  
E) trigonal planar, nonpolar
- 17) Which one of the following has dipole-dipole attractions as one of its intermolecular forces? 17) \_\_\_\_\_  
A)  $\text{O}_2$                       B)  $\text{CF}_4$                       C)  $\text{C}_{10}\text{H}_{22}$                       D)  $\text{SF}_6$                       E)  $\text{NH}_3$
- 18) Three monosulfur fluorides are observed:  $\text{SF}_2$ ,  $\text{SF}_4$ , and  $\text{SF}_6$ . Of these, \_\_\_\_\_ is/are polar. 18) \_\_\_\_\_  
A)  $\text{SF}_6$  only  
B)  $\text{SF}_4$  only  
C)  $\text{SF}_2$ ,  $\text{SF}_4$ , and  $\text{SF}_6$   
D)  $\text{SF}_2$  and  $\text{SF}_4$  only  
E)  $\text{SF}_2$  only
- 19) Of the molecules below, the bond in \_\_\_\_\_ is the most polar. 19) \_\_\_\_\_  
A)  $\text{HBr}$                       B)  $\text{HI}$                       C)  $\text{HF}$                       D)  $\text{HCl}$                       E)  $\text{H}_2$
- 20) The predominant intermolecular force in  $\text{CaBr}_2$  is \_\_\_\_\_. 20) \_\_\_\_\_  
A) London-dispersion forces  
B) hydrogen bonding  
C) ion-dipole forces  
D) ionic bonding  
E) dipole-dipole forces
- 21) \_\_\_\_\_ are particularly polarizable (able to form instantaneous dipoles) 21) \_\_\_\_\_  
A) Small polar molecules  
B) Large polar molecules  
C) Large nonpolar molecules  
D) Small nonpolar molecules  
E) Large molecules, regardless of their polarity,

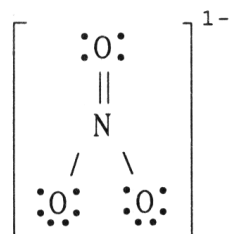
22) The Lewis structure of  $N_2H_2$  shows \_\_\_\_\_. 22) \_\_\_\_\_

A) each nitrogen has one nonbonding electron pair  
 B) a nitrogen–nitrogen single bond  
 C) a nitrogen–nitrogen triple bond  
 D) each nitrogen has two nonbonding electron pairs  
 E) each hydrogen has one nonbonding electron pair

23) The carbon–carbon  $\sigma$  bond in ethylene,  $H_2C=CH_2$ , results from the overlap of \_\_\_\_\_. 23) \_\_\_\_\_

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

24) The formal charge on nitrogen in  $NO_3^-$  is \_\_\_\_\_, where the Lewis structure of the ion is: 24) \_\_\_\_\_



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

25) Of the following substances, only \_\_\_\_\_ has London dispersion forces as the only intermolecular force. 25) \_\_\_\_\_

A)  $CH_3OH$               B)  $H_2S$                       C)  $HCl$                       D)  $Kr$                       E)  $NH_3$

Answer Key

Testname: 1AEXAM4SPRING2018VERSION2

- 1) D
- 2) B
- 3) E
- 4) C
- 5) E
- 6) B
- 7) A
- 8) E
- 9) D
- 10) B
- 11) A
- 12) C
- 13) E
- 14) E
- 15) E
- 16) E
- 17) E
- 18) D
- 19) C
- 20) D
- 21) E
- 22) A
- 23) C
- 24) A
- 25) D