Chapter10 Tro

1. All of the geometries listed below are examples of the five basic geometries for molecules with more than 3 atoms except
   A) planar triangular
   B) octahedral
   C) tetrahedral
   D) trihedral
   E) trigonal bipyramidal

2. The basic geometry for molecules in the set below which possesses the smallest bond angles is
   A) linear
   B) planar triangular
   C) tetrahedral
   D) trihedral
   E) octahedral

3. Which one of the following arrangements would best accommodate three electron domains in the valence shell of a covalently bonded atom?
   A) planar triangular
   B) octahedral
   C) tetrahedral
   D) trihedral
   E) trigonal bipyramidal

4. Based on the Lewis structure, the number of electron domains in the valence shell of the CO molecule is
   A) 1
   B) 2
   C) 3
   D) 4
   E) 5

5. Based on the Lewis structure, the number of electron domains in the valence shell of the arsenic atom in the $AsCl_3$ molecule is
   A) 1
   B) 2
   C) 3
   D) 4
   E) 5

6. Based on the Lewis structure, the number of electron domains in the valence shell of the carbon atom in the CO_3^{2-} ion is
   A) 1
   B) 2
   C) 3
   D) 4
   E) 5

7. Based on the Lewis structure, the number of nonbonding domains in the O_3 molecule is
   A) 3
   B) 4
   C) 5
   D) 6
   E) 7

8. Application of the concepts of VSEPR theory leads to the prediction that the shape of the PCl_3 molecule is
   A) bent
   B) linear
   C) regular tetrahedral
   D) triangular planar
   E) trigonal pyramidal

9. The geometry of the ClF_3 molecule is best described as
   A) distorted tetrahedral
   B) regular tetrahedral
   C) T−shaped
   D) trigonal pyramidal
   E) triangular planar

10. Based on conclusions from application of the VSEPR theory, which one of the following molecules is trigonal bipyramidal?
   A) AsF_5
   B) NF_3
   C) SF_4
   D) SF_6
   E) IF_5^-

11. Based on conclusions from application of the VSEPR theory, which one of the following molecules or ions is bent (nonlinear)?
    A) Cl_2O
    B) CO_2
    C) HCN
    D) CO
    E) NO_2^+

12. The smallest F—S—F bond angle in SF_6, in degrees, is
    A) 90 degrees
    B) 109.5 degrees
    C) 120 degrees
    D) 145 degrees
    E) 180 degrees

13. The Se=C=Se molecule is a non-polar molecule because
    A) the bonds in the molecule are all non-polar
    B) the bonds in the molecule are polar but their effect on the overall polarity is canceled by the effect of lone pairs in the valence shell of the carbon atom
    C) the bonds in the molecule are polar but their effect on the overall polarity is canceled by the fact that they are equal in magnitude and oppositely directed
    D) the bonds in the molecule are polar but the polar effect is canceled by the resonance hybrids which distribute the charge evenly
    E) the bonds in the molecule are polar but only slightly so and this is not enough to affect the polarity of the molecule as a whole

14. Which one of the molecules below is not polar, due to symmetric arrangement of electron domains?
    A) SO_3
    B) SO_2
    C) CO
    D) NH_3
    E) CH_2Cl_2

15. Determine the expected molecular geometry and polarity of the SO_2 molecule by applying VSEPR theory.
    A) linear, nonpolar
    B) linear, polar
    C) bent, 109.5° angle, polar
    D) bent, 120° angle, polar
    E) bent, 109.5° angle, nonpolar

16. Bonding in the chlorine molecule can be explained by the valence bond theory in terms of an overlap between
    A) the 1s orbital of a chlorine atom and the 1s orbital of the other chlorine atom
    B) the 2s orbital of a chlorine atom and the 2s orbital of the other chlorine atom
    C) the 2p orbital of a chlorine atom and the 2p orbital of the other chlorine atom
    D) the 3s orbital of a chlorine atom and the 3s orbital of the other chlorine atom
    E) the 3p orbital of a chlorine atom and the 3p orbital of the other chlorine atom

17. Draw a Lewis structure for the NH_3 molecule. What is the hybrid orbital set used by the nitrogen atom for bonding?
    A) sp^3d^2
    B) sp
    C) sp^3d
    D) sp^3
    E) sp^2

18. Which one of the following hybrid orbital sets is used by the central atom for σ–bonding in the PCl_4^- ion?
    A) sp
    B) sp^2
    C) sp^3
    D) sp^3d
    E) sp^3d^2

19. Which one of the following hybrid orbital sets is used by the central atom for σ–bonding in the AsF_5 molecule?
    A) sp
    B) sp^2
    C) sp^3
    D) sp^3d
    E) sp^3d^2

20. Which one of the following hybrid orbital sets is used by the As atom for σ–bonding in the AsF_4^- ion?
    A) sp
    B) sp^2
    C) sp^3
    D) sp^3d
    E) sp^3d^2

21. The skeleton for the Lewis structure of thionyl chloride, $SOCl_2$, is shown below. Complete the Lewis structure by filling in the bonds and the remaining valence electrons which are not involved in bonds.

After adjusting for formal charges, what types of orbitals are predicted to lie around the sulfur atom by the valence bond theory?

A) 5 sp^3d hybrid orbitals and no π-orbitals
B) 4 sp^3 hybrid orbitals and one localized π-orbital
C) 4 sp^3 hybrid orbitals and one delocalized π-orbital
D) 3 sp^3d hybrid orbitals and one localized π-orbital
E) 3 sp^3d hybrid orbitals and one delocalized π-orbital

22. How many σ-bonds and π-bonds, respectively, are there in a CO_2 molecule?

A) 1 σ-bonds and 2 π-bonds
B) 2 σ-bonds and 0 π-bonds
C) 2 σ-bonds and 2 π-bonds
D) 2 σ-bonds and 4 π-bonds
E) 4 σ-bonds and 0 π-bonds

23. Draw a Lewis structure for $H_3C—NO_2$. Both oxygen atoms are directly attached to the nitrogen atom. If you take formal charge considerations into account, how many π-bonds are there in the molecule?

A) 0
B) 1
C) 2
D) 3
E) 4

24. When we compare the carbon monoxide molecule with the carbon dioxide molecule, from VSEPR theory we find

A) CO_2 is polar and CO is non-polar
B) the bond in CO is weaker than the ones in CO_2
C) CO_2 has shorter bonds than CO
D) the bond order in CO is higher than the bond order in CO_2
E) both CO and CO_2 are non-polar

25. An energy level scheme for the valence orbitals of 2nd period homonuclear diatomic molecules lists the valence molecular orbitals in the following order of increasing energy

$\sigma_{2s} < \sigma^*_{2s} < \sigma_{2p(x)} < \pi_{2p(y)}, \pi_{2p(z)} < \pi^*_{2p(y)}, \pi^*_{2p(z)} < \sigma^*_{2p(x)}$

Based on this energy level scheme, the bond order for the bond in the N_2^+ ion is

A) 1.0
B) 1.5
C) 2.0
D) 2.5
E) 3.0

26. An energy level scheme for the valence orbitals of 2nd period homonuclear diatomic molecules lists the valence molecular orbitals in the following order of increasing energy

$\sigma_{2s} < \sigma^*_{2s} < \sigma_{2p(x)} < \pi_{2p(y)}, \pi_{2p(z)} < \pi^*_{2p(y)}, \pi^*_{2p(z)} < \sigma^*_{2p(x)}$

Based on this energy level scheme, how many electrons are there in all of the antibonding molecular orbitals of the F_2^+ ion in its ground state?

A) 1
B) 2
C) 3
D) 4
E) 5

27. An energy level scheme for the valence orbitals of 2nd period homonuclear diatomic molecules lists the valence molecular orbitals in the following order of increasing energy

$\sigma_{2s} < \sigma^*_{2s} < \sigma_{2p(x)} < \pi_{2p(y)}, \pi_{2p(z)} < \pi^*_{2p(y)}, \pi^*_{2p(z)} < \sigma^*_{2p(x)}$

Based on this energy level scheme, which statement below is true about the bonds in the set, O_2, O_2^+, O_2^-, O_2^{2-}?

A) O_2^- has the highest bond order.
B) O_2^{2-} has the highest bond order.
C) O_2 has the highest bond order.
D) O_2^+ has the highest bond order.
E) Actually, the bond order in all these species is the same.

28. The SO_2 molecule is polar because the polar S—O bonds are geometrically balanced. ___

A) True
B) False

29. The hexagonal pyramid is one of the basic arrangements upon which molecular geometries are based. ___

A) True
B) False

30. The NH_3 molecule is polar because the polar N—H bonds are not geometrically balanced. ___
    A) True
    B) False

Answer Key

1. D
2. E
3. A
4. C
5. D
6. C
7. D
8. E
9. C
10. A
11. A
12. A
13. C
14. A
15. D
16. E
17. D
18. D
19. D
20. D
21. B
22. C
23. B
24. D
25. D
26. E
27. D
28. B
29. B
30. A