Covalent Bonds Study Guide

Matching

Match each item with the correct statement below.

a. coordinate covalent bond  
   1. a depiction of the arrangement of atoms in molecules and polyatomic ions
b. double covalent bond  
   2. a covalent bond in which only one pair of electrons is shared
c. structural formula  
   3. a covalent bond in which two pairs of electrons are shared
d. single covalent bond  
   4. a covalent bond in which the shared electron pair comes from only one of the atoms
e. polar bond  
   5. a covalent bond between two atoms of significantly different electronegativities
f. hydrogen bond  
   6. a type of bond that is very important in determining the properties of water and of important biological
       molecules such as proteins and DNA

Match each item with the correct statement below.

a. network solid  
   7. energy needed to break a single bond between two covalently bonded atoms
b. bonding orbital  
   8. attraction between polar molecules
c. dipole interaction  
   9. crystal in which all the atoms are covalently bonded to each other
d. bond dissociation energy  

Multiple Choice

Identify the choice that best completes the statement or answers the question.

10. What information does a molecular formula provide?
    a. the number and kind of atoms that are bonded by the transfer of electrons
    b. the simplest whole-number ratio of atoms that are bonded by the transfer of electrons
    c. information about a molecule’s structure
    d. the number and kind of atoms present in a molecule

11. What is shown by the structural formula of a molecule or polyatomic ion?
    a. the arrangement of bonded atoms
    b. the number of ionic bonds
    c. the number of metallic bonds
    d. the shapes of molecular orbitals

12. How do atoms achieve noble-gas electron configurations in single covalent bonds?
    a. One atom completely loses two electrons to the other atom in the bond.
    b. Two atoms share two pairs of electrons.
    c. Two atoms share two electrons.
    d. Two atoms share one electron.
13. Why do atoms share electrons in covalent bonds?
   a. to become ions and attract each other
   b. to attain a noble-gas electron configuration
   c. to become more polar
   d. to increase their atomic numbers

14. Which noble gas has the same electron configuration as the oxygen in a water molecule?
   a. helium
   b. neon
   c. argon
   d. xenon

15. Which elements can form diatomic molecules joined by a single covalent bond?
   a. hydrogen only
   b. halogens only
   c. halogens and members of the oxygen group only
   d. hydrogen and the halogens only

16. Which of the following diatomic molecules is joined by a double covalent bond?
   a. O₂
   b. Cl₂
   c. N₂
   d. He₂

17. Which molecule has a single covalent bond?
   a. CO₂
   b. Cl₂
   c. CO
   d. N₂

18. The chemical formula of an ionic compound shows
   a. how many atoms of each element a molecule contains.
   b. the lowest whole-number ratio between ions in the ionic compound.
   c. which molecules the ionic compound contains.
   d. how the atoms bond.

19. When H⁺ forms a bond with H₂O to form the hydronium ion H₃O⁺, this bond is called a coordinate covalent bond because
   a. both bonding electrons come from the oxygen atom.
   b. it forms an especially strong bond.
   c. the electrons are equally shared.
   d. the oxygen no longer has eight valence electrons.

20. Which of the following bonds is the least reactive?
   a. C—C
   b. H—H
   c. O—H
   d. H—Cl
21. How many valid electron dot formulas—having the same number of electron pairs for a molecule or ion—can be written when a resonance structure occurs?
   a. 0
   b. 1 only
   c. 2 only
   d. 2 or more

22. In which of the following compounds is the octet expanded to include 12 electrons?
   a. \( \text{H}_2\text{S} \)
   b. \( \text{PCl}_3 \)
   c. \( \text{PCl}_5 \)
   d. \( \text{SF}_6 \)

23. Which of the following atoms acquires the most negative charge in a covalent bond with hydrogen?
   a. \( \text{C} \)
   b. \( \text{Na} \)
   c. \( \text{O} \)
   d. \( \text{S} \)

24. A bond formed between a silicon atom and an oxygen atom is likely to be ____.
   a. ionic
   b. coordinate covalent
   c. polar covalent
   d. nonpolar covalent

25. Which of the following covalent bonds is the most polar?
   a. \( \text{H—F} \)
   b. \( \text{H—C} \)
   c. \( \text{H—H} \)
   d. \( \text{H—N} \)

26. When placed between oppositely charged metal plates, the region of a water molecule attracted to the negative plate is the ____.
   a. hydrogen region of the molecule
   b. geometric center of the molecule
   c. \( \text{H—O—H} \) plane of the molecule
   d. oxygen region of the molecule

27. What is thought to cause the dispersion forces?
   a. attraction between ions
   b. motion of electrons
   c. sharing of electron pairs
   d. differences in electronegativity

28. Which of the forces of molecular attraction is the weakest?
   a. dipole interaction
   b. dispersion
   c. hydrogen bond
   d. single covalent bond
29. What causes dipole interactions?
   a. sharing of electron pairs
   b. attraction between polar molecules
   c. bonding of a covalently bonded hydrogen to an unshared electron pair
   d. attraction between ions

Numeric Response

30. How many valence electrons does an iodine atom have?
31. What is the total number of covalent bonds normally associated with a single carbon atom in a compound?
32. How many electrons are shared in a single covalent bond?
33. How many electrons does carbon need to gain in order to obtain a noble-gas electron configuration?
34. How many covalent bonds are in a covalently bonded molecule containing 1 phosphorus atom and 3 chlorine atoms?

Essay

35. What is bond dissociation energy, and how does it affect carbon compounds?
36. What determines the degree of polarity in a bond? Distinguish between nonpolar covalent, polar covalent, and ionic bonds in terms of relative polarity.
Covalent Bonds Study Guide
Answer Section

MATCHING

1. ANS: C  PTS: 1
2. ANS: D  PTS: 1
3. ANS: B  PTS: 1
4. ANS: A  PTS: 1
5. ANS: E  PTS: 1
6. ANS: F  PTS: 1
7. ANS: D  PTS: 1
8. ANS: C  PTS: 1
9. ANS: A  PTS: 1

MULTIPLE CHOICE

10. ANS: D  PTS: 1
11. ANS: A  PTS: 1
12. ANS: C  PTS: 1
13. ANS: B  PTS: 1
14. ANS: B  PTS: 1
15. ANS: D  PTS: 1
16. ANS: A  PTS: 1
17. ANS: B  PTS: 1
18. ANS: B  PTS: 1
19. ANS: A  PTS: 1
20. ANS: B  PTS: 1
21. ANS: A  PTS: 1
22. ANS: D  PTS: 1
23. ANS: C  PTS: 1
24. ANS: C  PTS: 1
25. ANS: A  PTS: 1
26. ANS: A  PTS: 1
27. ANS: B  PTS: 1
28. ANS: B  PTS: 1
29. ANS: B  PTS: 1

NUMERIC RESPONSE

30. ANS: 7
    PTS: 1
31. ANS: 4  
PTS: 1  
32. ANS: 2  
PTS: 1  
33. ANS: 4  
PTS: 1  
34. ANS: 3  
PTS: 1  

ESSAY  
35. ANS:  
Bond dissociation energy is the energy required to break a single bond. The greater the bond dissociation energy, the more stable the compound. Due in part to the high bond dissociation energy of carbon-carbon bonds, carbon compounds are not very reactive chemically.  
PTS: 1  
36. ANS:  
The relative electronegativity of the two bonded atoms determines the polarity of a bond. If the difference in electronegativities between the two atoms is less than 0.4, the bond is nonpolar covalent. If the difference in electronegativities between the two atoms is 0.4 to 1.0, the bond is moderately polar covalent. If the difference in electronegativities between the two atoms is 1.0 to 2.0, the bond is highly polar covalent. If the difference in electronegativities between the two atoms is more than 2.0, the bond is ionic.  
PTS: 1