

End of Chapter Questions

Section B

1. Name the three primary components to a tree. Which is the most abundant?
2. Knowing the molecular weight of one of the building blocks of a polysaccharide, $C_6H_{10}O_5$, what do you determine the molecular weight of a typical 10,000 unit polysaccharide to be?
3. What's the purpose of the lignin in the tree?

Section C

4. Write the expected electron configurations for each of the following atoms:
 - a. Sc
 - b. Fe
 - c. S
 - d. P
 - e. Cs
 - f. Eu
 - g. Pt
 - h. Xe
 - i. Br
 - j. Se
5. Write the expected electron configurations for each of the following atoms:
 - a. K
 - b. Rb
 - c. Fr
 - d. Pu
 - e. Sb
 - f. Os
 - g. Pd
 - h. Cd
 - i. Pb
 - j. I
6. How many unpaired electrons are present in the ground state electron configurations of:
 - a. Sc
 - b. Ti
 - c. Al
 - d. Sn
 - e. Te
 - f. Br

7. How many unpaired electrons are present in the ground state electron configurations of:
- O
 - Fe
 - Mn
 - S
 - F
 - Ar

8. Which of the following electron configurations correspond to an excited state? Identify the atoms and write the ground state electron configurations where appropriate.

- $1s^2 2s^2 3p^1$
- $1s^2 2s^2 2p^6$
- $1s^2 2s^2 2p^4 3s^1$
- $[\text{Ar}] 4s^2 3d^5 4p^1$

How many unpaired electrons are present in each of these species?

9. Write electron configurations for

- Mg^{2+}
- Sn^{2+}
- K^+
- Al^{3+}
- Tl^+
- As^{3+}

10. Write electron configurations for

- Sn^{4+}
- Cs^+
- Ga^{3+}
- Tl^{3+}
- As^{5+}

11. Write electron configurations for

- N^{3-}
- O^{2-}
- F^-
- Te^{2-}

12. Write electron configurations for

- P^{3-}
- S^{2-}
- Br^-

13. Brightly colored fireworks that are observed during many celebrations are the result of several exothermic reactions. Based on your knowledge of electronic structure, propose how different colors are generated.

Section D

14. For each of the following write the electron configuration and the Lewis symbol:

- a. Mg
- b. Mg^{2+}
- c. Se^{2-}
- d. Br^-
- e. Sn
- f. Sn^{2+}

15. For each of the following write the electron configuration and the Lewis symbol:

- a. Rb
- b. Rb^+
- c. I^-
- d. Te^{2-}
- e. Bi
- f. Bi^{3+}

16. Write Lewis symbols for the following:

- a. Ba
- b. Ba^{2+}
- c. I
- d. I^-

17. Write Lewis symbols for the following:

- a. In
- b. In^{3+}
- c. P
- d. P^{3-}

18. Write Lewis formulas for the following molecules:

- a. Br_2
- b. H_2Se
- c. COF_2
- d. P_2
- e. COBr_2
- f. HNO_2

19. Write Lewis formulas for the following molecules:

- a. BrF
- b. PBr₃
- c. NOF
- d. BrCN
- e. N₂F₂

20. Write Lewis formulas for the following ions:

- a. ClO⁻
- b. SnCl₃⁻
- c. S₂²⁻

21. Write Lewis formulas for the following ions:

- a. IBr⁺
- b. ClF₂⁺
- c. CN⁻

22. Write Lewis structures that obey the octet rule for each of the following:

- a. HCN
- b. PH₃
- c. CHCl₃
- d. NH₄⁺
- e. BF₄⁻
- f. SeF₂

23. Write Lewis structures that obey the octet rule for each of the following:

- a. POCl₃
- b. SO₄²⁻
- c. PO₄³⁻
- d. ClO₄⁻

24. Write Lewis structures that obey the octet rule for each of the following:

- a. NF₃
- b. SO₃²⁻
- c. PO₃³⁻
- d. ClO₃⁻

25. Write Lewis structures that obey the octet rule for each of the following:

- a. ClO₂⁻
- b. SCl₂
- c. PCl₂⁻

26. Some of the important pollutants in the atmosphere are ozone, O₃, sulfur dioxide, SO₂, and sulfur trioxide, SO₃. Write Lewis structures for these molecules. Show the different resonance structures where appropriate.

27. Write resonance structures for the following:

- a. FNO_2
- b. SeO_3
- c. NO_2^-
- d. HNO_3

Section E

28. Without using Table 1, predict the order of increasing electronegativity in each of the following groups of elements:

- a. C, N, O
- b. S, Se, Cl
- c. Si, Ge, Sn
- d. Tl, S, Ge

29. Without using Table 1, predict which bond in each of the following groups will be the most polar:

- a. C-F, Si-F, Ge-F
- b. Si-Cl, P-Cl, S-Cl
- c. S-F, S-Cl, S-Br
- d. Ti-Cl, Si-Cl, Ge-Cl

30. Without using Table 1, predict which bond in each of the following groups will be the most polar:

- a. C-H, Si-H, Sn-H
- b. Al-Br, Ga-Br
- c. O-F, O-Cl, S-Br
- g. C-O, Si-O
- h. In-Br, Tl-Br

31. Decide which of the following bonds is least polar on the basis of electronegativities of atoms:

- a. H-Se, P-Cl, N-Cl
- b. Si-O, C-Br, As-Br

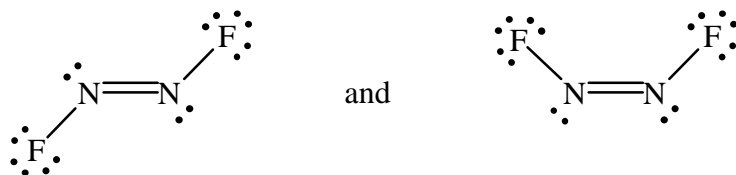
Indicate the partial charges for the bonds above using the symbols δ^+ and δ^- .

Section F

32. Assuming that the atoms form the normal number of covalent bonds, give the molecular formula of the simplest compound of silicon and chlorine atoms.

33. Assuming that the atoms form the normal number of covalent bonds, give the molecular formula of the simplest compound of arsenic and hydrogen atoms.

34. Predict the molecular structure and bond angles for each molecule or ion.
- HCN
 - PH₃
 - CHCl₃
 - NH₄⁺
 - BF₄⁻
 - SeF₂
35. Predict the molecular structure and bond angles for each molecule or ion.
- BF₃
 - BH₂⁻
 - COCl₂
 - I₃⁻
36. Which of the following molecules or ions has a dipole moment?
- OCl₂
 - Br₃⁻
 - BeH₂
 - BH₂⁻
37. Which of the following molecules has a dipole moment?
- BCl₃
 - NF₃
 - IF
 - CF₄
38. Write Lewis structures and predict whether each of the following is polar or nonpolar.
- HCN
 - BeF₂
 - CF₂Cl₂
 - H₂NNH₂
 - H₂CO
39. The molecules BF₃, CF₄, and CO₂ are all nonpolar, even though they all contain polar bonds. Why?
40. Two molecules exist with the formula N₂F₂. The Lewis structures are:



- What are the N-N-F bond angles in the two molecules?
- Are these molecules polar or nonpolar?

Section G

41. What kinds of intermolecular forces (London, dipole-dipole, hydrogen bonding) are expected in the following substances?
- BF_3
 - $\text{CH}_3\text{CHOHCH}_3$
 - HI
 - Kr
42. What kinds of intermolecular forces (London, dipole-dipole, hydrogen bonding) are expected in the following substances?
- CH_4
 - CHCl_3
 - $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
43. What kinds of intermolecular forces (London, dipole-dipole, hydrogen bonding) are expected in the following substances?
- $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
 - CO_2
 - SO_2
44. Which of the following compounds would you expect to exhibit *only* London forces?
- CCl_4
 - CH_3Cl
 - PCl_3
45. Arrange the following substances in order of increasing magnitude of London forces.
- SiCl_4 , CCl_4 , GeCl_4
 - Ar , He , Kr
46. Explain on the basis that “like dissolves like” why glycerol, $\text{CH}_2\text{OHCHOHCH}_2\text{OH}$, is miscible in water but benzene, C_6H_6 , has very limited solubility in water.
47. Which of the following is more likely to be soluble in water: $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ or $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{SH}$. Explain.
48. Would Boric acid, $\text{B}(\text{OH})_3$, be more soluble in Ethanol, $\text{CH}_3\text{CH}_2\text{OH}$, or in benzene, C_6H_6 ?
49. For each of the following pairs, predict which substance would be more soluble in water.
- $\text{CH}_3\text{CH}_2\text{OH}$ or CH_3CH_3
 - CHCl_3 or CCl_4
 - CH_3COOH or $\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$
 - Na_2S or CuS

50. For each of the following pairs, predict which substance would be more soluble in water.

- CH_3CN or CH_3CH_3
- NH_3 or CO_2
- CH_3COOH or $\text{CH}_3\text{COOCH}_3$

51. Which solvent, water or carbon tetrachloride (CCl_4), would you choose to dissolve each of the following?

- $\text{Cu}(\text{NO}_3)_2$
- CS_2
- CH_3COOH
- $\text{CH}_3(\text{CH}_2)_{16}\text{CH}_2\text{OH}$
- HCl
- C_6H_6

52. Which solvent, water or hexane (C_6H_{14}), would you choose to dissolve each of the following?

- NaCl
- HF
- C_8H_{18}
- $(\text{NH}_4)_2\text{SO}_4$

53. Rationalize the trend in water solubility for the following simple alcohols.

<u>Alcohol</u>	<u>Solubility (g/100g water at 20°C)</u>
CH_3OH	soluble in all proportions (miscible)
$\text{CH}_3\text{CH}_2\text{OH}$	soluble in all proportions (miscible)
$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	soluble in all proportions (miscible)
$\text{CH}_3(\text{CH}_2)_3\text{OH}$	8.14
$\text{CH}_3(\text{CH}_2)_4\text{OH}$	2.64
$\text{CH}_3(\text{CH}_2)_5\text{OH}$	0.59
$\text{CH}_3(\text{CH}_2)_6\text{OH}$	0.09

54. Arrange the following substances in order of increasing solubility in hexane, C_6H_{14} :

- $\text{CH}_2\text{OHCH}_2\text{OH}$
- $\text{C}_{10}\text{H}_{22}$
- H_2O

55. Arrange the following substances in order of increasing solubility in ethanol,

$\text{CH}_3\text{CH}_2\text{OH}$:

- Acetic acid, CH_3COOH
- Stearic acid, $\text{C}_{17}\text{H}_{35}\text{COOH}$

56. A typical detergent is sodium dodecylsulfate, or SDS, $\text{CH}_3(\text{CH}_2)_{10}\text{CH}_2\text{SO}_4^-\text{Na}^+$. In aqueous solution, small aggregates of detergent anions called *micelles* form. Propose a structure for the micelles.

Section H

57. Each of the formulas below belongs to one of the following classes of substances: alkane, alkene, alkyne, alcohol, ether, or aromatic. Match each formula with the term that is most specific.
- $\text{CH}_3(\text{CH}_2)_6\text{CH}_3$
 - $\text{CH}_3\text{CH}_2\text{CHOHCH}_3$
 - C_6H_6
 - $\text{CH}_3\text{COOCH}_3$
 - $\text{CH}_2=\text{C}=\text{CH}_2$
 - $\text{HC}\equiv\text{CH}$
58. Can a substance whose molecular formula is C_3H_4 be an alkane?
59. Identify the functional group in each of the following:
- $\text{CH}_3\text{OCH}_2\text{CH}_3$
 - $\text{CH}_3\text{CH}=\text{CH}_2$
 - $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
 - $\text{C}_6\text{H}_5\text{CH}_3$

Section I

60. Name the functional groups in the molecule pinosylvin (Figure 28).
61. How many carbon, hydrogen, and oxygen atoms are in a molecule of pinosylvin?
62. Explain why proteins and pectic substances (Figure 28) are soluble in water.
63. Organic acids have the functional group. $\begin{array}{c} \text{O} \\ || \\ -\text{C}-\text{OH} \end{array}$ Butyric acid or stomach acid has the formula $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$. Obviously this is water soluble. Can you suggest why this is water soluble?
64. Compare the building blocks to cellulose and lignin, namely glucose and coniferyl alcohol for instance (see Figures 7 and 9). Which would you expect to be more water soluble? Why?