Chapter 7

Exercise 7.7 Explain why each of the following sets of quantum numbers is not permissible for an orbital.

a. $n = 0, l = 1, m_l = 0, m_s = +\frac{1}{2}$ $n > 0$

b. $n = 2, l = 3, m_l = 0, m_s = -\frac{1}{2}$ $l (0 \to n-1)$ $(0, 1)$

c. $n = 3, l = 2, m_l = +3, m_s = +\frac{1}{2}$ $m_l (-l, l)$

d. $n = 3, l = 2, m_l = +2, m_s = 0$ $m_s < \frac{1}{2}$

7.63 If the n quantum number of an atomic orbital is 4, what are the possible values of l? If the l quantum number is 3, what are the possible values of m_l?

$n = 4$

l 0 → 3 : 0, 1, 2, 3 $m_l = (-3, -2, -1, 0, 1, 2, 3)$

7.65 How many subshells are there in the M shell? How many orbitals are there in the d subshell?

$M = n = 3 \longrightarrow$ 3 subshells

d subshell → 5 orbitals

7.67 Give the notation (using letter designations for l) for the subshells denoted by the following quantum numbers.

a. $n = 6, l = 2$ 6d

b. $n = 5, l = 4$ 5g

c. $n = 4, l = 3$ 4f

d. $n = 6, l = 1$ 6p

7.69 Explain why each of the following sets of quantum numbers would not be permissible for an electron, according to the rules for quantum numbers.

a. $n = 1, l = 0, m_l = 0, m_s = +1$ $m_s < -\frac{1}{2}$

b. $n = 1, l = 3, m_l = +3, m_s = +\frac{1}{2}$ $l < n$

c. $n = 3, l = 2, m_l = +3, m_s = -\frac{1}{2}$ $l: -2 \to 2$

d. $n = 0, l = 1, m_l = 0, m_s = +\frac{1}{2}$ $n > 0 / n \neq 0$

e. $n = 2, l = 1, m_l = -1, m_s = +\frac{3}{2}$ $m_s < -\frac{1}{2}$

Chapter 8

Exercise 8.1 Look at the following orbital diagrams and electron configurations. Which are possible and which are not, according to the Pauli exclusion principle? Explain.

a. ✓ 1s ↑↓ 2s ↑↓ 2p ◯◯◯

b. ✓ 1s ↑↓ 2s ↑↓ 2p ↑↑↑↑↑

c. ✗ 1s ↑↓ 2s ↑↓ 2p ↑↑↓↑↓

d. $1s^2 2s^2 2p^4$

e. ✗ $1s^2 2s^4 2p^2$

f. ✗ $1s^2 2s^2 2p^6 3s^2 3p^{10} 3d^{10}$

Exercise 8.2 Use the building-up principle to obtain the electron configuration for the ground state of the manganese atom ($Z = 25$). $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^5$

Exercise 8.3 Using the periodic table on the inside front cover, write the valence-shell configuration of arsenic (As). $4s^2 4p^3$

$^{33}As: [Ar] 4s^2 3d^{10} 4p^3 = [Ar] 3d^{10} 4s^2 4p^3$

Exercise 8.4 The lead atom has the ground-state configuration $[Xe]4f^{14}5d^{10}6s^26p^2$. Find the period and group for this element. From its position in the periodic table, would you classify lead as a main-group element, a transition element, or an inner transition element? $n = 6$ group = 4

Exercise 8.5 Write an orbital diagram for the ground state of the phosphorus atom ($Z = 15$). Write all orbitals.

$1s^2 2s^2 2p^6 3s^2 3p^3$

↑↓ $1s^2$ ↑↓ $2s^2$ ↑↓ ↑ ↑ $2p^6$ ↑↓ $3s^2$ ↑ ↑ ↑ $3p^3$

Exercise 8.6 Using a periodic table, arrange the following in order of increasing atomic radius: Na, Be, Mg.

Be Mg Na

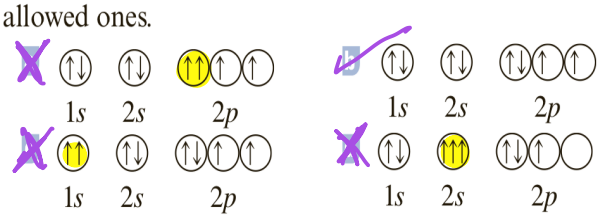
Exercise 8.7 The first ionization energy of the chlorine atom is 1251 kJ/mol. Without looking at Figure 8.18, state which of the following values would be the more likely ionization energy for the iodine atom. Explain.

a. 1000 kJ/mol. b. 1400 kJ/mol.

Exercise 8.8 Without looking at Table 8.4 but using the general comments in this section, decide which has the larger electron affinity, C or F.

Pauli Exclusion Principle

8.41 Which of the following orbital diagrams are allowed by the Pauli exclusion principle? Explain how you arrived at this decision. Give the electron configuration for the allowed ones.



8.43 Which of the following electron configurations are possible? Explain why the others are not.

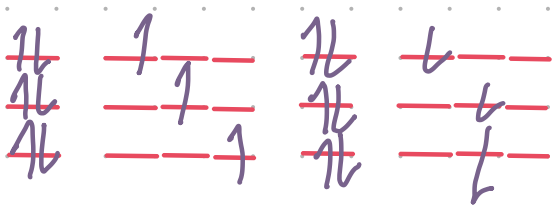
a $1s^1 2s^2 2p^7$

b $1s^2 2s^2 2p^5$

c $1s^2 2s^2 2p^6 3s^3 3d^7$

d $1s^2 2s^2 2p^6 3s^2 3d^8$

8.45 Write all of the possible orbital diagrams for the electron configuration $1s^2 2p^1$. (There are six different diagrams.)



8.47 Give the electron configuration of the ground state of tellurium, using the building-up principle.

52 Te: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^4$

8.49 Use the building-up principle to obtain the electron configuration of the ground state of manganese.

25 Mn: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^5$

8.51 Barium is a Group 2A element in Period 6. Deduce the valence-shell configuration of barium.

56 Ba: [Xe] $6s^2$

8.53 Tungsten is a Group 6B element in Period 6. What would you expect for the valence-shell configuration of tungsten? $6s^2\ 4d^4$

8.55 Thallium has the ground-state configuration $[Xe]4f^{14}5d^{10}6s^26p^1$. Give the group and period for this element. Classify it as a main-group, a *d*-transition, or an *f*-transition element. 3A period 6

Periodic Trends

8.61 Order the following elements by increasing atomic radius according to what you expect from periodic trends: Se, S, As.

S < As < Se

8.63 Using periodic trends, arrange the following elements by increasing ionization energy: Ar, Na, Cl, Al.

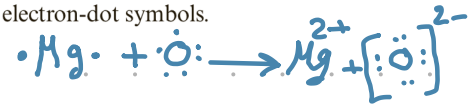
Na Al Cl Ar

increasing

8.65 From what you know in a general way about electron affinities, state which member of each of the following pairs has the greater value: a As, Br b F, Li.

Chapter "9"

Exercise 9.1 Represent the transfer of electrons from magnesium to oxygen atoms to assume noble-gas configurations. Use Lewis electron-dot symbols.



Exercise 9.2 Write the electron configuration and the Lewis symbol for Ca^{2+} and for S^{2-}.

Exercise 9.3 Write the electron configurations of Pb and Pb^{2+}.

Pb: [Xe] $4f^{14} 5d^{10} 6s^2 6p^2$

Pb^{2+}: [Xe] $4f^{14} 5d^{10} 6s^2$

Exercise 9.4 Write the electron configuration of Mn^{2+}.

Mn: [Ar] $4s^2 3d^5$

Mn^{2+}: [Ar] $3d^5$

Exercise 9.5 Which has the larger radius, S or S^{2-}? Explain.

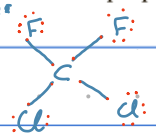
Exercise 9.6 Without looking at Table 9.3, arrange the following ions in order of increasing ionic radius: Sr^{2+}, Mg^{2+}, Ca^{2+}. (You may use a periodic table.) Mg Ca Sr

Exercise 9.7 Without looking at Table 9.3, arrange the following ions in order of increasing ionic radius: Cl^-, Ca^{2+}, P^{3-}. (You may use a periodic table.)

Ca^{2+} Cl^- P^{3-}

Exercise 9.8 Using electronegativities, decide which of the following bonds is most polar: C—O, C—S, H—Br.

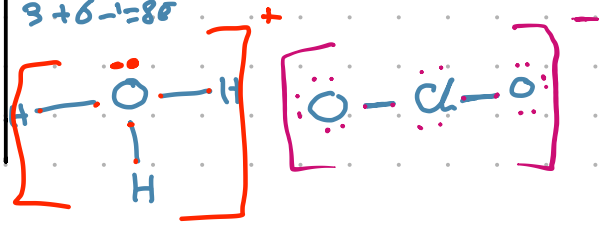
Exercise 9.9 Dichlorodifluoromethane, CCl_2F_2, is a gas used as a refrigerant and aerosol propellant. Write the Lewis formula for CCl_2F_2.



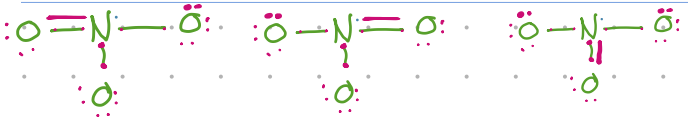
Exercise 9.10 Write the electron-dot formula of carbon dioxide, CO_2. 4 + 2×6 = 16

Exercise 9.11 Write the electron-dot formula of a. the hydronium ion, H_3O^+; b. the chlorite ion, ClO_2^-. = 20e

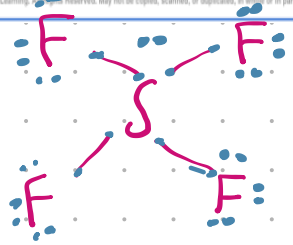
3 + 6 − 1 = 8e



Exercise 9.12 Describe the bonding in NO_3^- using resonance formulas. VE = 24 e⁻

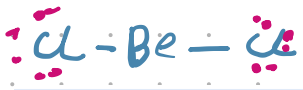


Exercise 9.13 Sulfur tetrafluoride, SF_4, is a colorless gas. Write the electron-dot formula of the SF_4 molecule. 34e

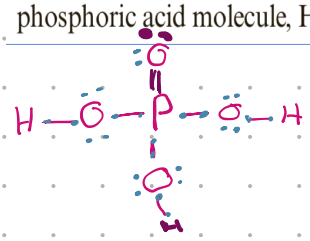


However, if the solid is heated, it forms a vapor of $BeCl_2$ molecules. Write the electron-dot formula of the $BeCl_2$ molecule.

BeCl₂ = 16e⁻

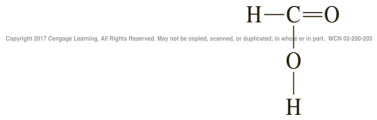


Exercise 9.15 Write the Lewis formula that best describes the phosphoric acid molecule, H_3PO_4. 32 e⁻



Exercise 9.16 Estimate the O—H bond length in H_2O from the covalent radii listed in Table 9.4. 66 + 31 = 97

Exercise 9.17 Formic acid, isolated in 1670, is the irritant in ant bites. The structure of formic acid is

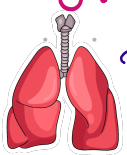


One of the carbon–oxygen bonds has a length of 136 pm; the other is 123 pm long. What is the length of the C=O bond in formic acid?

Exercise 9.18 Use bond enthalpies to estimate the enthalpy change for the combustion of ethylene, C_2H_4, according to the equation

$$C_2H_4(g) + 3O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(g)$$

6(14) + 4(413) + 3(498) − 2(2 × 804) − 2(463) = −1308 kJ



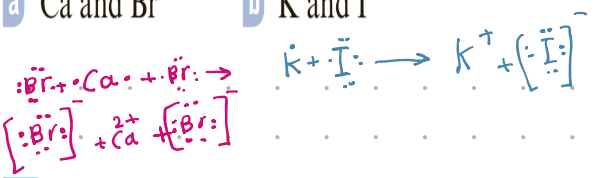
Ionic Bonding

9.35 Write Lewis symbols for the following:

a Br b Br^- c Ga d Ga^{3+}

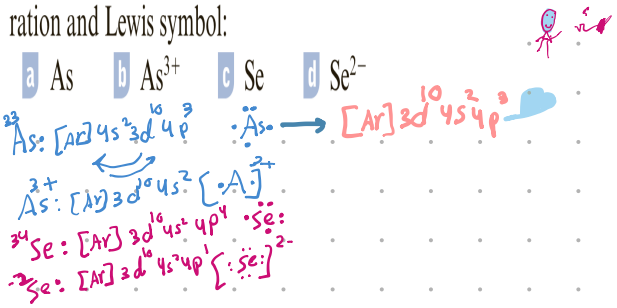
9.37 Use Lewis symbols to represent the transfer of electrons between the following atoms to form ions with noble-gas configurations:

a Ca and Br b K and I



9.39 For each of the following, write the electron configuration and Lewis symbol:

a As b As^{3+} c Se d Se^{2-}



9.41 Write the electron configurations of Bi and Bi^{3+}.

Bi: [Xe] 4f¹⁴ 5d¹⁰ 6s² 6p³ → Bi³⁺: [Xe] 4f¹⁴ 5d¹⁰ 6s²

9.43 Give the electron configurations of Ni^{2+} and Ni^{3+}.

Ionic Radii

9.45 Arrange the members of each of the following pairs in order of increasing radius and explain the order:

a Ca, Ca^{2+} b P, P^{3-}

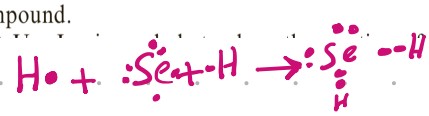
9.47 Without looking at Table 9.3, arrange the following in order of increasing ionic radius: As^{3-}, Se^{2-}, Br^-. Explain how you arrived at this order. (You may use a periodic table.)

9.49 Arrange the following in order of increasing ionic radius: F^-, Na^+, and N^{3-}. Explain this order. (You may use a periodic table.)

N³⁻ > F⁻ > Na⁺

Covalent Bonding

9.51 Use Lewis symbols to show the reaction of atoms to form hydrogen selenide, H_2Se. Indicate bonding pairs and lone pairs in the electron-dot formula of this compound.



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

Polar Covalent Bonds; Electronegativity

9.55 Using a periodic table (not Figure 9.15), arrange the following in order of increasing electronegativity:

a P, O, N **b** Na, Al, Mg **c** C, Al, Si

9.57 Arrange the following bonds in order of increasing polarity using electronegativities of atoms: P—O, C—Cl, As—Br.

9.59 Indicate the partial charges for the bonds given in Problem 9.57, using the symbols δ^+ and δ^-.

Writing Lewis Formulas

9.61 Write Lewis formulas for the following molecules:

a Br_2 **b** H_2S **c** NF_3

9.63 Write Lewis formulas for the following molecules:

a P_2 **b** $COBr_2$ **c** HNO_2

9.65 Write Lewis formulas for the following ions:

a ClO^- **b** $SnCl_3^-$ **c** S_2^{2-}

Resonance

9.67 Write resonance descriptions for the following:

a HNO_3 **b** SO_3

9.69 Use resonance to describe the electron structure of nitromethane, CH_3NO_2. The skeleton structure is

Exceptions to the Octet Rule

9.71 Write Lewis formulas for the following:

a XeF_2 **b** SeF_4 **c** TeF_6 **d** XeF_4

9.73 Write Lewis formulas for the following:

a BCl_3 **b** $TlCl_2^+$ **c** $BeBr_2$

Formal Charge and Lewis Formulas

9.75 Write a Lewis formula for each of the following, assuming that the octet rule holds for the atoms. Then obtain the formal charges of the atoms.

a O_3 **b** CO **c** HNO_3

9.77 For each of the following, use formal charges to choose the Lewis formula that gives the best description of the electron distribution:

a SOF_2
b H_2SO_3
c $HClO_2$

9.83 One of the following compounds has a carbon–nitrogen bond length of 116 pm; the other has a carbon–nitrogen bond length of 147 pm. Match a bond length with each compound.

Methylamine Acetonitrile

Done By Noor Marzoog