a. Find the atomic mass of this element. Show all your work.

Mass contribution = (mass)(percent abundance)

Isotope 1: (23.985 amu)(78.70%) = 18.88 amu

Isotope 2: (24.946 amu)(10.13%) = 2.531 amu

Isotope 3: (25.983 amu)(11.17%) = 2.902 amu

Atomic mass of element = 18.88 amu + 2.527 amu + 2.902 amu = 24.31 amu

b. Identify the element, using the periodic table.

The element is magnesium.

c. Write each isotope in symbolic notation.

$^{24}_{12}Mg$, $^{25}_{12}Mg$, $^{26}_{12}Mg$

16. The isotope carbon-14 can be used to determine the ages of objects that were once living, such as wood, bones, and fossils. While alive, living things take in all the isotopes of carbon, including carbon-14. Carbon-14 undergoes radioactive decay continuously. After an organism dies, the carbon-14 in its body continues to decay. However, its body no longer takes in new carbon-14. Thus, by measuring how much carbon-14 a once-living object contains and comparing it with the amount of carbon-14 in a currently living thing, you can determine the age of the object.

a. In terms of subatomic structure, how does carbon-14 differ from carbon-12 and carbon-13?

Carbon-14 has 8 neutrons, carbon-12 has 6 neutrons, and carbon-13 has 7 neutrons. Carbon-14 has a larger atomic mass than the other two isotopes have.

b. How is carbon-14 like carbon-12 and carbon-13?

All three isotopes have 6 protons and 6 electrons. They all show the same physical and chemical properties of the element carbon.

c. Carbon-14 emits a beta particle as it decays. What atom does carbon-14 decay to?

If carbon-14 emits a beta particle, then it must become nitrogen-14 ($-1 + x = 6$; thus, $x = 7$, which is the atomic number of nitrogen).

d. Write an equation to represent the decay of carbon-14.

The equation that shows this change is $^{14}_{6}C \longrightarrow ^{14}_{7}N + ^{0}_{-1}\beta$.

Chapter 5

1. Orange light has a frequency of 4.8×10^{14} s^{-1}. What is the energy of one quantum of orange light?

$E_{photon} = h\nu = (6.626 \times 10^{-34}\ J\cdot\cancel{s})(4.8 \times 10^{14}\ \cancel{s^{-1}})$
$= 3.18048 \times 10^{-19}\ J = 3.2 \times 10^{-19}\ J$

2. Which is greater, the energy of one photon of orange light or the energy of one quantum of radiation having a wavelength of 3.36×10^{-9}m?

Calculate the frequency: $c = \lambda\nu$,

therefore, $\nu = \dfrac{c}{\lambda}$

$\nu = (3.00 \times 10^{8}\ m/s)/(3.36 \times 10^{-9}\ \cancel{m})$
$= 8.93 \times 10^{16}\ s^{-1}$

Calculate the energy of one quantum:
$E_{photon} = h\nu$

$E_{photon} = (6.626 \times 10^{-34}\ J\cdot\cancel{s})(8.93 \times 10^{16}\ \cancel{s^{-1}})$
$= 5.92 \times 10^{-17}\ J$

From problem 1, orange light has an energy of 3.2×10^{-19} J. Therefore, a quantum of radiation with a wavelength of 3.36×10^{-9} m has more energy than orange light does.

3. Use the relationships $E = h\nu$ and $c = \lambda\nu$ to write E in terms of h, c, and λ.

From $c = \lambda\nu$, $\nu = \dfrac{c}{\lambda}$.

$E = h\nu = \dfrac{hc}{\lambda}$

4. A radio station emits radiation at a wavelength of 2.90 m. What is the station's frequency in megahertz?

$c = \lambda\nu$, therefore, $\nu = \dfrac{c}{\lambda}$

$$\nu = \frac{3.00 \times 10^8\ \cancel{m}/s}{2.90\ \cancel{m}} = 1.034 \times 10^8\ s^{-1}$$

$1.034 \times 10^{-8}\ s^{-1} = 103.4 \times 10^{-6}\ s^{-1}$
$= 103.4$ megahertz

You can tune in at 103.4 FM.

5. Record the frequency of your favorite radio station. What is the wavelength of the radiation emitted from the station?

Answers will vary. Students should use $c = \lambda\nu$, where $c = 3.00 \times 10^8$ m/s, to calculate the wavelength of their favorite radio station.

6. List the sequence in which the following orbitals fill up: 1s, 2s, 3s, 4s, 5s, 6s, 7s, 2p, 3p, 4p, 5p, 6p, 7p, 3d, 4d, 5d, 6d, 4f, 5f.

The correct order is as follows:
1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s, 4f, 5d, 6p, 7s, 5f, 6d, 7p

7. Which element has the ground-state electron configuration $[Kr]5s^24d^{10}5p^4$?

tellurium

8. Which element has the ground-state electron configuration $[Ar]4s^23d^{10}$?

zinc

9. Write electron-dot structures for the following atoms.

a. $[Ne]3s^23p^3$

 ••
•P•
 •

b. $[Ar]4s^23d^3$

•V•

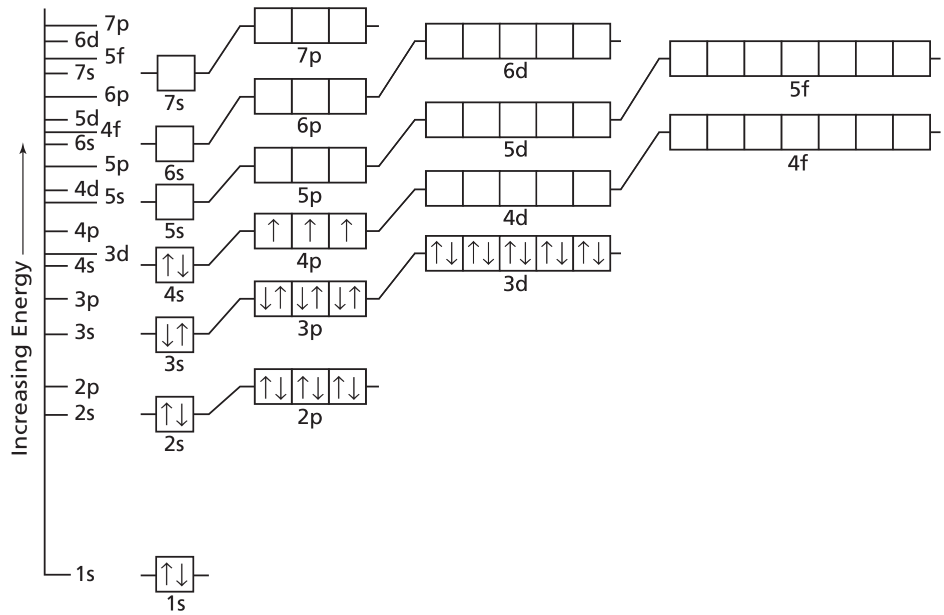
c. potassium

K•

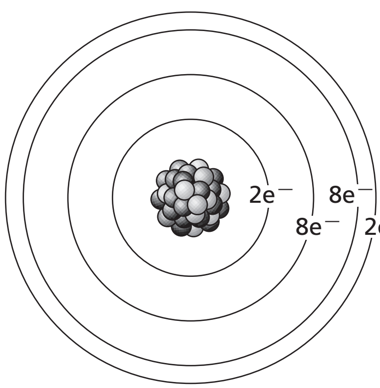
10. Complete the following table.

Element	Symbol	Orbitals					Electron Configuration
		1s	2s	$2p_x$	$2p_y$	$2p_z$	
a. Nitrogen	N	↑↓	↑↓	↑	↑	↑	$1s^22s^22p^3$
b. Fluorine	F	↑↓	↑↓	↑↓	↑↓	↑	$1s^22s^22p^5$
c. Carbon	C	↑↓	↑↓	↑	↑		$1s^22s^22p^2$
d. Lithium	Li	↑↓	↑				$1s^22s^1$

11. Complete the orbital diagram for arsenic.



12. Use the figure below to answer the following questions.



a. How many valence electrons does an atom of this element have?

2

b. What is the atom's electron-dot structure?

•Ca•

c. If enough energy was added to remove an electron, from which energy level would the electron be removed? Explain your answer.

The first electron to leave the atom would be one in the highest energy level, which is the fourth energy level. Electrons in the highest energy level are the least attracted to the nucleus because they are the most distant.

13. What is the ground-state electron configuration of each of the following atoms? Use noble-gas notation.

a. selenium

$[Ar]4s^2 3d^{10} 4p^4$

b. krypton

[Kr] or $[Ar]4s^2 3d^{10} 4p^6$

c. chlorine

$[Ne]3s^2 3p^5$

14. What is the highest energy level (n) that is occupied in the following elements?

a. He

$n = 1$

b. Ca

$n = 4$

c. Sn

$n = 5$

15. Write the electron configuration for each element described below and identify the element.

a. an element that contains 8 electrons

$1s^2 2s^2 2p^4$

b. an element that contains 14 electrons

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

The element is silicon.

Chapter 6

For questions 1–5, do not use the periodic table.

1. Write the electron configurations for the elements in periods 2–4 of group 2A.

period 2, group 2A: $1s^2 2s^2$

period 3, group 2A: $1s^2 2s^2 2p^6 3s^2$

period 4, group 2A: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

2. Determine the group, period, and block of the elements with the following electron configurations.

a. $[He]2s^2 2p^4$

group 6A, period 2, p-block

b. $[Xe]6s^1$

group 1A, period 6, s-block

c. $[Ar]4s^2 3d^{10} 4p^2$

group 4A, period 4, p-block

3. Categorize each of the elements in problem 2 as a representative element or a transition element.

All of the elements are representative elements.

4. Write the electron configuration of the element fitting each of the following descriptions. Use noble-gas notations.

a. Group 8A element in the third period

$[Ne]3s^2 3p^6$

b. Group 4A element in the fourth period

$[Ar]4s^2 3d^{10} 4p^2$

c. Halogen in the second period

$[He]2s^2 2p^5$

d. Group 1A element in the fourth period

$[Ar]4s^1$

5. What are the noble-gas notations of all the elements with the following valence electron configurations?

a. s^2

$1s^2$, $[He]2s^2$, $[Ne]3s^2$, $[Ar]4s^2$, $[Kr]5s^2$, $[Xe]6s^2$, $[Rn]7s^2$

b. s^2p^1

$[He]2s^2 2p^1$, $[Ne]3s^2 3p^1$, $[Ar]4s^2 3d^{10} 4p^1$, $[Kr]5s^2 4d^{10} 5p^1$, $[Xe]6s^2 4f^{14} 5d^{10} 6p^1$

For questions 6–9, do not use Figure 6-12, 6-15, or 6-20.

6. Rank the following atoms in order of decreasing radii.

a. Al, Na, P, S

Na, Al, P, S