CHAPTER 6

Assessment

Reviewing Content

6.1 Organizing the Elements

24. Why did Mendeleev leave spaces in his periodic table?

25. What effect did the discovery of gallium have on the acceptance of Mendeleev's table?

26. What pattern is revealed when the elements are arranged in a periodic table in order of increasing atomic number?

27. Based on their locations in the periodic table, would you expect carbon and silicon to have similar properties? Explain your answer.

28. Identify each property below as more characteristic of a metal or a nonmetal.
- **a.** a gas at room temperature
- **b.** brittle
- **c.** malleable
- **d.** poor conductor of electric current
- **e.** shiny

29. In general, how are metalloids different from metals and nonmetals?

6.2 Classifying the Elements

30. Where are the alkali metals, the alkaline earth metals, the halogens, and the noble gases located in the periodic table?

31. Which of the following are symbols for representative elements: Na, Mg, Fe, Ni, Cl?

32. Which noble gas does not have eight electrons in its highest occupied energy level?

33. Which of these metals isn't a transition metal?
- **a.** aluminum
- **b.** silver
- **c.** iron
- **d.** zirconium

34. Use Figure 6.12 to write the electron configurations of these elements.
- **a.** boron
- **b.** arsenic
- **c.** fluorine
- **d.** zinc
- **e.** aluminum

35. Write the electron configuration of these elements.
- **a.** the noble gas in period 3
- **b.** the metalloid in period 3
- **c.** the alkali earth metal in period 3

6.3 Periodic Trends

36. Which element in each pair has atoms with a larger atomic radius?
- **a.** sodium, lithium
- **b.** strontium, magnesium
- **c.** carbon, germanium
- **d.** selenium, oxygen

37. Explain the difference between the first and second ionization energy of an element.

38. Which element in each pair has a greater first ionization energy?
- **a.** lithium, boron
- **b.** magnesium, strontium
- **c.** cesium, aluminum

39. Arrange the following groups of elements in order of increasing ionization energy.
- **a.** Be, Mg, Sr
- **b.** Bi, Cs, Ba
- **c.** Na, Al, S

40. Why is there a large increase between the first and second ionization energies of the alkali metals?

41. How does the ionic radius of a typical metal compare with its atomic radius?

42. Which particle has the larger radius in each atom/ion pair?
- **a.** Na, Na^+
- **b.** S, S^{2-}
- **c.** I, I^-
- **d.** Al, Al^{3+}

43. Which element in each pair has a higher electronegativity value?
- **a.** Cl, F
- **b.** C, N
- **c.** Mg, Ne
- **d.** As, Ca

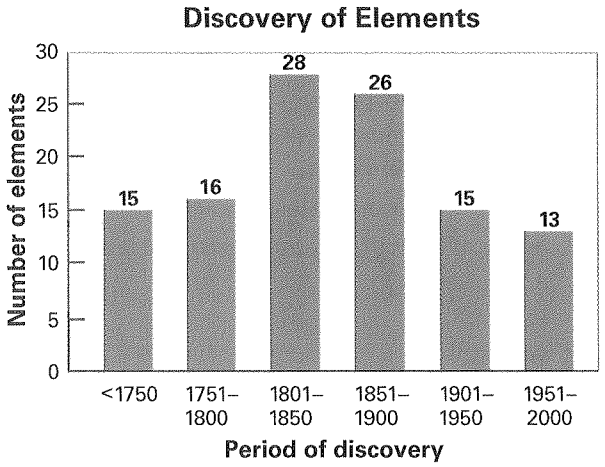
44. Why are noble gases not included in Table 6.2?

45. When the elements in each pair are chemically combined, which element in each pair has a greater attraction for electrons?
- **a.** Ca or O
- **b.** O or F
- **c.** H or O
- **d.** K or S

46. For which of these properties does lithium have a larger value than potassium?
- **a.** first ionization energy
- **b.** atomic radius
- **c.** electronegativity
- **d.** ionic radius

Understanding Concepts

47. The bar graph shows how many elements were discovered before 1750 and in each 50-year period between 1750 and 2000.
- **a.** In which 50-year period were the most elements discovered?
- **b.** How did Mendeleev's work contribute to the discovery of elements?
- **c.** What percent of the elements were discovered by 1900?



48. Write the symbol of the element or elements that fit each description.
- **a.** a nonmetal in Group 4A
- **b.** the inner transition metal with the lowest atomic number
- **c.** all of the nonmetals for which the atomic number is a multiple of five
- **d.** a metal in Group 5A.

49. In which pair of elements are the chemical properties of the elements most similar? Explain your reasoning.
- **a.** sodium and chlorine
- **b.** nitrogen and phosphorus
- **c.** boron and oxygen

50. Explain why fluorine has a smaller atomic radius than both oxygen and chlorine.

51. Would you expect metals or nonmetals in the same period to have higher ionization energies? Give a reason for your answer.

52. In each pair, which ion is larger?
- **a.** Ca^{2+}, Mg^{2+} **b.** Cl^-, P^{3-} **c.** Cu^+, Cu^{2+}

53. List the symbols for all the elements with electron configurations that end as follows. Each n represents an energy level.
- **a.** ns^1 **b.** ns^2np^4 **c.** ns^2nd^{10}

54. Explain why there should be a connection between an element's electron configuration and its location on the periodic table?

55. Which equation represents the first ionization of an alkali metal atom?
- **a.** $Cl \longrightarrow Cl^+ + e^-$
- **b.** $Ca \longrightarrow Ca^+ + e^-$
- **c.** $K \longrightarrow K^+ + e^-$
- **d.** $H \longrightarrow H^+ + e^-$

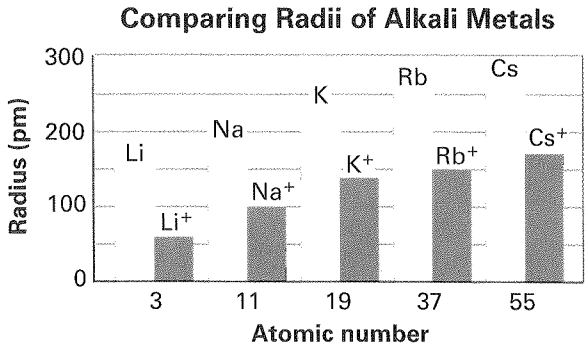
56. Use the graph in Figure 6.14 to estimate the atomic radius of the indium atom.

57. What trend is demonstrated by the following series of equations?

$Li + 520\ kJ/mol \longrightarrow Li^+ + e^-$
$O + 1314\ kJ/mol \longrightarrow O^+ + e^-$
$F + 1681\ kJ/mol \longrightarrow F^+ + e^-$
$Ne + 2080\ kJ/mol \longrightarrow Ne^+ + e^-$

58. There is a large jump between the second and third ionization energies of magnesium. There is a large jump between the third and fourth ionization energies of aluminum. Explain these observations.

59. The bar graph shows the relationship between atomic and ionic radii for Group 1A elements.
- **a.** Describe and explain the trend in atomic radius within the group.
- **b.** Explain the difference between the size of the atoms and the size of the ions.



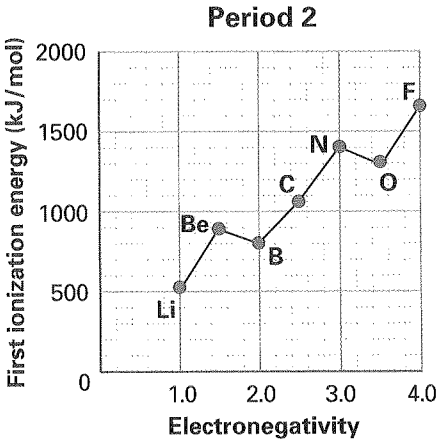
Critical Thinking

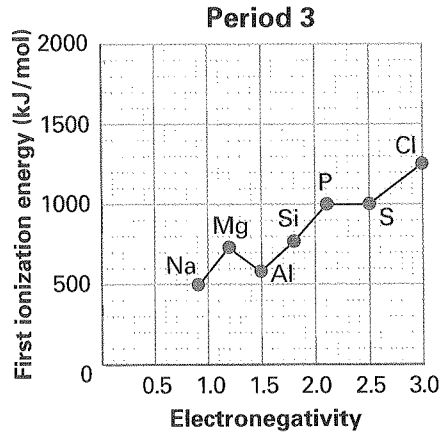
60. Do you think there are more elements left to discover? If so, what is the lowest atomic number a new element could have? Explain your answers.

61. The graphs show the relationship between the electronegativities and first ionization energies for period 2 and period 3 elements.

a. Based on data for these two periods, what is the general trend between these two values?

b. Use nuclear charge and shielding effect to explain this trend.





62. Explain why it takes more energy to remove a 4*s* electron from zinc than from calcium.

63. Explain each of the following comparisons.

a. Calcium has a smaller second ionization energy than does potassium.

b. Lithium has a larger first ionization energy than does cesium.

c. Magnesium has a larger third ionization energy than does aluminum.

Concept Challenge

64. The Mg^{2+} and Na^{+} ions each have ten electrons. Which ion would you expect to have the smaller radius? Explain your choice.

65. The ions S^{2-}, Cl^{-}, K^{+}, Ca^{2+}, and Sc^{3+} have the same total number of electrons as the noble gas argon. How would you expect the radii of these ions to vary? Would you expect to see the same variation in the series O^{2-}, F^{-}, Na^{+}, Mg^{2+}, and Al^{3+}, in which each ion has the same total number of electrons as the noble gas neon? Explain your answer.

66. Make a graph of average atomic mass versus atomic number. Choose 11 points (atomic numbers 1, 10, 20, and so forth up to atomic number 100) to make your graph. Use the graph to describe the relationship between average atomic mass and atomic number. Is there a 1:1 correspondence between average atomic mass and atomic number? Explain how you reached your conclusion.

67. The ionization energies for the removal of the first six electrons in carbon are, starting with the first electron, 1086 kJ/mol, 2352 kJ/mol, 4619 kJ/mol, 6220 kJ/mol, 37,820 kJ/mol, and 47,260 kJ/mol.

a. Make a graph of ionization energy versus ionization number. The ionization number indicates which electron is lost.

b. Between which two ionization numbers does the ionization energy have the largest increase? Explain why this behavior is predictable.

68. Atoms and ions with the same number of electrons are called isoelectronic.

a. Write the symbol for a cation and an anion that are isoelectronic with krypton.

b. Is it possible for a cation to be isoelectronic with an anion from the same period? Explain.

69. Electron affinity is a measure of an atom's ability to gain electrons. Predict the trend for electron affinity across a period. Explain your answer.

Cumulative Review

70. Explain why science today depends less on chance discoveries than it did in the past. *(Chapter 1)*

71. Identify each process as a chemical or physical change. *(Chapter 2)*

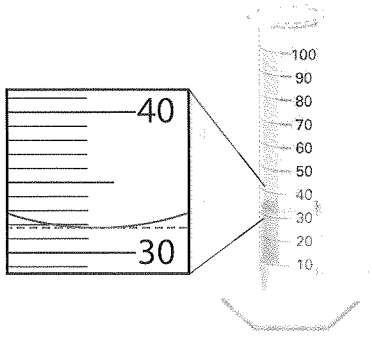
a. melting of iron **b.** lighting a match
c. grinding corn **d.** souring of milk

72. Describe at least two methods to separate a mixture of small copper and iron beads. *(Chapter 2)*

73. In the United States a typical can of "cola" holds 355 mL. How many 2.00-L bottles could be filled from a 24-can case of cola? *(Chapter 3)*

74. The volume of the liquid in the graduated cylinder is reported as 31.8 mL. *(Chapter 3)*

a. How many significant figures are there in the measurement?
b. In which digit is there uncertainty?



75. A cube of plastic 1.20×10^{-5} km on a side has a mass of 1.70 g. Show by calculation whether this plastic cube will sink or float in pure water. *(Chapter 3)*

76. Convert the measurements to meters. Express your answers in scientific notation. *(Chapter 3)*

a. 2.24 nm **b.** 8.13 cm
c. 7.4 pm **d.** 9.37 mm

77. An apprentice jeweler determines the density of a sample of pure gold to be 20.3 g/cm^3. The accepted value is 19.3 g/cm^3. What is the percent error of the jeweler's density measurement? *(Chapter 3)*

78. What is the mass of 7.7 L of gasoline at 20°C? Assume the density of gasoline to be 0.68 g/cm^3. *(Chapter 3)*

79. A black olive containing its seed has a mass of 4.5 g and a volume of 4.3 cm^3. Will the olive sink or float on the water? *(Chapter 3)*

80. The distance is 1.50×10^8 km from the sun to Earth. The speed of light is 3.00×10^8 m/s. How many round trips between Earth and the sun could a beam of light make in one day? *(Chapter 3)*

81. The table shows how the volume of sulfur varies with mass. How does the density of sulfur vary with mass? *(Chapter 3)*

Mass of Sulfur Versus Volume of Sulfur

Mass of sulfur (g)	Volume of sulfur (cm^3)
23.5	11.4
60.8	29.2
115	55.5
168	81.1

82. Calculate the volume of acetone with the same mass as 15.0 mL of mercury. The density of mercury is 13.59 g/mL. The density of acetone is 0.792 g/mL. *(Chapter 3)*

83. A rectangular container has inside dimensions of 15.2 cm by 22.9 cm and is about 1 meter tall. Water is poured into the container to a height of 55.0 cm. When a jagged rock with a mass of 5.21 kg is placed in the container, it sinks to the bottom. The water level rises to 58.3 cm. What is the density of the rock? *(Chapter 3)*

84. How many neutrons does an atom of each isotope contain? *(Chapter 4)*

a. $^{84}_{36}$Kr **b.** $^{79}_{35}$Br **c.** $^{190}_{76}$Os **d.** $^{185}_{75}$Re

85. Name the element and calculate the number of requested subatomic particles in each isotope. *(Chapter 4)*

a. neutrons in $^{109}_{47}$Ag **b.** protons in $^{118}_{50}$Sn
c. electrons in $^{96}_{42}$Mo **d.** electrons in $^{45}_{21}$Sc

86. How many filled *p* orbitals do atoms of these elements contain? *(Chapter 5)*

a. carbon **b.** phosphorus
c. oxygen **d.** nitrogen