

11. Evaluate each of the following as an acceptable name for water:
 - a. dihydrogen oxide
 - b. hydroxide hydride
 - c. hydrogen hydroxide
 - d. oxygen dihydride
12. Why do we call $\text{Ba}(\text{NO}_3)_2$ barium nitrate, but we call $\text{Fe}(\text{NO}_3)_2$ iron(II) nitrate?
13. Why is calcium dichloride not the correct systematic name for CaCl_2 ?
14. The common name for NH_3 is ammonia. What would be the systematic name for NH_3 ? Support your answer.

A blue question or exercise number indicates that the answer to that question or exercise appears at the back of this book and a solution appears in the *Solutions Guide*.

Questions

15. Use Dalton's atomic theory to account for each of the following.
 - a. the law of conservation of mass
 - b. the law of definite proportion
 - c. the law of multiple proportions
16. What refinements had to be made in Dalton's atomic theory to account for Gay-Lussac's results on the combining volumes of gases?
17. What evidence led to the conclusion that cathode rays had a negative charge?
18. What discoveries were made by J. J. Thomson, Henri Becquerel, and Lord Rutherford? How did Dalton's model of the atom have to be modified to account for these discoveries?
19. What is the distinction between atomic number and mass number? Between mass number and atomic mass?
20. Distinguish between the terms *family* and *period* in connection with the periodic table. For which of these terms is the term *group* also used?
21. When hydrogen is burned in oxygen to form water, the composition of water formed does not depend on the amount of oxygen. Interpret this in terms of the law of definite proportions.
22. The two most reactive families of elements are the halogens and the alkali metals. How do they differ in their reactivities?

Exercises

In this section similar exercises are paired.

Development of the Atomic Theory

23. When mixtures of gaseous H_2 and gaseous Cl_2 react, a product forms that has the same properties regardless of the relative amounts of H_2 and Cl_2 used.

- a. How is this result interpreted in terms of the law of definite proportion?
- b. When a volume of H_2 reacts with an equal volume of Cl_2 at the same temperature and pressure, what volume of product having the formula HCl is formed?
24. A reaction of 1 liter of chlorine gas (Cl_2) with 3 liters of fluorine gas (F_2) yields 2 liters of a gaseous product. All gas volumes are at the same temperature and pressure. What is the formula of the gaseous product?
25. Several compounds containing only sulfur (S) and fluorine (F) are known. Three of them have the following compositions:
 - i. 1.188 g of F for every 1.000 g of S
 - ii. 2.375 g of F for every 1.000 g of S
 - iii. 3.563 g of F for every 1.000 g of S
 How do these data illustrate the law of multiple proportions?
26. Hydrazine, ammonia, and hydrogen azide all contain only nitrogen and hydrogen. The mass of hydrogen that combines with 1.00 g of nitrogen for each compound is 1.44×10^{-1} g, 2.16×10^{-1} g, and 2.40×10^{-2} g, respectively. Show how these data illustrate the law of multiple proportions.

27. Early tables of atomic weights (masses) were generated by measuring the mass of a substance that reacts with 1.00 g of oxygen. Given the following data and taking the atomic mass of hydrogen as 1.00, generate a table of relative atomic masses for oxygen, sodium, and magnesium.

Element	Mass That Combines with 1.00 g Oxygen	Assumed Formula
Hydrogen	0.126 g	HO
Sodium	2.875 g	NaO
Magnesium	1.500 g	MgO

How do your values compare with those in the periodic table? How do you account for any differences?

28. The mass of beryllium that combines with 1.000 g of oxygen to form beryllium oxide is 0.5633 g. When atomic masses were first being measured, it was thought that the formula of beryllium oxide was Be_2O_3 . What would be the atomic mass of beryllium if this were the case? Assume that oxygen has an atomic mass of 16.00.

The Nature of the Atom

29. From the information in this chapter on the mass of the proton, the mass of the electron, and the sizes of the nucleus and the atom, calculate the densities of a hydrogen nucleus and a hydrogen atom.
30. If you wanted to make an accurate scale model of the hydrogen atom and decided that the nucleus would have a diameter of 1 mm, what would be the diameter of the entire model?

31. In an experiment it was found that the total charge on an oil drop was 5.93×10^{-18} C. How many negative charges does the drop contain?
32. A chemist in a galaxy far, far away performed the Millikan oil drop experiment and got the following results for the charges on various drops. Use these data to calculate the charge of the electron in zirkombs.
- | | |
|---------------------------------|---------------------------------|
| 2.56×10^{-12} zirkombs | 7.68×10^{-12} zirkombs |
| 3.84×10^{-12} zirkombs | 6.40×10^{-13} zirkombs |
33. What are the symbols of the following elements: gold, silver, mercury, potassium, iron, antimony, tungsten?
34. What are the symbols of the following metals: sodium, beryllium, manganese, chromium, uranium?
35. What are the symbols of the following nonmetals: fluorine, chlorine, bromine, sulfur, oxygen, phosphorus?
36. What are the symbols of the following elements: titanium, selenium, plutonium, nitrogen, and silicon?
37. Give the names of the metals that correspond to the following symbols: Sn, Pt, Co, Ni, Mg, Ba, K.
38. Give the names of the nonmetals that correspond to the following symbols: As, I, Xe, He, C, Si.
39. List the noble gas elements. Which of the noble gases has only radioactive isotopes? (This situation is indicated on most periodic tables by parentheses around the mass of the element. See inside front cover.)
40. Which lanthanide element and which transition element have only radioactive isotopes? (See Exercise 39.)
41. In the periodic table, how many elements are found in
- | | |
|-----------------------|-----------------------|
| a. the second period? | c. the fourth period? |
| b. the third period? | d. Group 5A? |
42. In the periodic table, how many elements are found in
- | | |
|-----------------------|----------------------|
| a. Group 2A? | c. the nickel group? |
| b. the oxygen family? | d. Group 8A? |
43. Give the number of protons and neutrons in the nucleus of each of the following atoms:
- | | |
|---------------------------|--------------------------|
| a. $^{238}_{94}\text{Pu}$ | d. ^4_2He |
| b. $^{65}_{29}\text{Cu}$ | e. $^{60}_{27}\text{Co}$ |
| c. $^{52}_{24}\text{Cr}$ | f. $^{54}_{24}\text{Cr}$ |
44. How many protons and neutrons are contained in the nucleus of each of the following atoms? In an atom of each element, how many electrons are present?
- | | | |
|--------------------------|--------------------------|--------------------------|
| a. $^{42}_{22}\text{Ti}$ | c. $^{76}_{32}\text{Ge}$ | e. $^{75}_{33}\text{As}$ |
| b. $^{64}_{30}\text{Zn}$ | d. $^{86}_{36}\text{Kr}$ | f. $^{41}_{19}\text{K}$ |
45. An atom has 9 protons and 10 neutrons in the nucleus. What is its symbol?
46. Write the atomic symbol (^A_ZX) for each of the isotopes described below.
- | | |
|-------------------------------------|--|
| a. $Z = 8$, number of neutrons = 9 | b. the isotope of chlorine in which $A = 37$ |
|-------------------------------------|--|

- c. $Z = 27$, $A = 60$
- d. number of protons = 26, number of neutrons = 31
- e. the isotope of I with a mass number of 131
- f. $Z = 3$, number of neutrons = 4

47. What is the symbol for an ion with 63 protons, 60 electrons, and 88 neutrons?
48. An ion contains 50 protons, 68 neutrons, and 48 electrons. What is its symbol?
49. What is the symbol of an ion with 16 protons, 18 neutrons, and 18 electrons?
50. What is the symbol for an ion that has 16 protons, 16 neutrons, and 18 electrons?
51. Complete the following table:

Symbol	Number of protons in nucleus	Number of neutrons in nucleus	Number of electrons	Net charge
	33	42		3+
$^{128}_{52}\text{Te}^{2-}$			54	
	16	16	16	
	81	123		1+
$^{195}_{78}\text{Pt}$				

52. Complete the following table:

Symbol	Number of protons in nucleus	Number of neutrons in nucleus	Number of electrons	Net charge
$^{238}_{92}\text{U}$				
	20	20		2+
	23	28	20	
$^{89}_{39}\text{Y}$				
	35	44	36	
	15	16		3-

53. Classify the following elements as metals or nonmetals:

Mg	Si	Rn
Ti	Ge	Eu
Au	B	Am
Bi	At	Br

54. The distinction between metals and nonmetals is really not a clear one. Some elements, called *metalloids*, are intermediate

in their properties. Which elements in Exercise 53 would you reclassify as metalloids? What other elements in the periodic table would you expect to be metalloids?

55. Which of the following sets of elements are all in the same group in the periodic table?

- a. Fe, Ru, Os c. Sn, As, S
b. Rh, Pd, Ag d. Se, Te, Po

56. Which of the following sets of elements are all in the same group in the periodic table?

- a. N, P, O c. Rb, Sn
b. C, Si, Ge d. Mg, Ca

57. Consider the elements of Group 4A (the "carbon family"): C, Si, Ge, Sn, and Pb. What is the trend in metallic character as one goes down this group?

58. What is the trend in metallic character going from left to right across a period in the periodic table?

59. Would you expect each of the following atoms to gain or lose electrons when forming ions? What ion is the most likely in each case?

- a. Na c. Ba e. Al
b. Sr d. I f. S

60. Would you expect each of the following atoms to gain or lose electrons when forming ions? What ion is the most likely in each case?

- a. Ra c. P e. Br
b. In d. Te f. Rb

Nomenclature

61. Name each of the following compounds:

- a. NaCl c. CaS
b. Rb₂O d. AlI₃

62. Name each of the following compounds:

- a. Hg₂O c. CoS
b. FeBr₃ d. TiCl₄

63. Name each of the following compounds:

- a. CrO₃ c. Al₂O₃ e. CaBr₂
b. Cr₂O₃ d. NaH f. ZnCl₂

64. Name each of the following compounds:

- a. CsF c. Ag₂S e. TiO₂
b. Li₃N d. MnO₂ f. Sr₃P₂

65. Name each of the following compounds:

- a. KClO₄ c. Al₂(SO₄)₃
b. Ca₃(PO₄)₂ d. Pb(NO₃)₂

66. Name each of the following compounds:

- a. BaSO₃ c. KMnO₄
b. NaNO₂ d. K₂Cr₂O₇

67. Name each of the following compounds:

- a. NI₃ c. SF₂
b. PCl₃ d. N₂F₄

68. Name each of the following compounds:

- a. SO₂ c. P₂S₅
b. ICl₃ d. N₂O₄

69. Name each of the following compounds:

- a. CuI f. S₄N₄
b. CuI₂ g. SF₆
c. CoI₂ h. NaOCl
d. Na₂CO₃ i. BaCrO₄
e. NaHCO₃ j. NH₄NO₃

70. Name each of the following compounds:

- a. HC₂H₃O₂ g. H₂SO₄
b. NH₄NO₂ h. Sr₃N₂
c. Co₂S₃ i. Al₂(SO₃)₃
d. ICl j. SnO₂
e. Pb₃(PO₄)₂ k. Na₂CrO₄
f. KIO₃ l. HClO

71. Write the formula for each of the following compounds:

- a. cesium bromide e. silicon tetrachloride
b. barium sulfate f. chlorine trifluoride
c. ammonium chloride g. beryllium oxide
d. chlorine monoxide h. magnesium fluoride

72. Write the formula for each of the following compounds:

- a. sulfur difluoride
b. sulfur hexafluoride
c. sodium dihydrogen phosphate
d. lithium nitride
e. chromium(III) carbonate
f. tin(II) fluoride
g. ammonium acetate
h. ammonium hydrogen sulfate
i. cobalt(III) nitrate
j. mercury(I) chloride
k. potassium chlorate
l. sodium hydride

73. Write the formula for each of the following compounds:

- a. sodium oxide g. lead(IV) sulfide
b. sodium peroxide h. copper(I) chloride
c. potassium cyanide i. gallium arsenide
d. copper(II) nitrate j. cadmium selenide
e. silicon tetrachloride k. zinc sulfide
f. lead(II) sulfide

74. Write the formula for each of the following compounds:

- a. ammonium hydrogen phosphate
b. mercury(I) sulfide
c. silicon dioxide
d. sodium sulfite
e. aluminum hydrogen sulfate
f. nitrogen trichloride
g. hydrobromic acid
h. bromous acid
i. perbromic acid
j. potassium hydrogen sulfide