

14. What are the properties of metals? Where are metals found on the periodic table?
16. Where on the periodic table are metalloids found?
17. What is a family or group of elements?
18. Locate each group of elements on the periodic table and list its group number.
- alkali metals
  - alkaline earth metals
  - halogens
  - noble gases
19. What is an ion?
20. What is an anion? What is a cation?
21. Locate each group on the periodic table and list the charge of the ions it tends to form.
- Group 1A
  - Group 2A
  - Group 3A
  - Group 6A
  - Group 7A
22. What are isotopes?
23. What is the percent natural abundance of isotopes?
24. What is the mass number of an isotope?
25. What notations are commonly used to specify isotopes? What do each of the numbers in these symbols mean?
26. What is the atomic mass of an element?
27. Which statements are *inconsistent* with Dalton's atomic theory as it was originally stated? Explain your answers.
- All carbon atoms are identical.
  - Helium atoms can be split into two hydrogen atoms.
  - An oxygen atom combines with 1.5 hydrogen atoms to form water molecules.
  - Two oxygen atoms combine with a carbon atom to form carbon dioxide molecules.
31. If atoms are mostly empty space and atoms compose all ordinary matter, why does solid matter seem to have no space within it?
33. Which statements about electrons are true?
- Electrons repel each other.
  - Electrons are attracted to protons.
  - Some electrons have a charge of  $1-$  and some have no charge.
  - Electrons are much lighter than neutrons.
34. Which statements about electrons are false?
- Most atoms have more electrons than protons.
  - Electrons have a charge of  $1-$ .
  - If an atom has an equal number of protons and electrons, it will be charge-neutral.
  - Electrons experience an attraction to protons.
35. Which statements about protons are true?
- Protons have twice the mass of neutrons.
  - Protons have the same magnitude of charge as electrons but are opposite in sign.
  - Most atoms have more protons than electrons.
  - Protons have a charge of  $1+$ .
36. Which statements about protons are false?
- Protons have about the same mass as neutrons.
  - Protons have about the same mass as electrons.
  - Some atoms don't have any protons.
  - Protons have the same magnitude of charge as neutrons but are opposite in sign.
41. Find the atomic number ( $Z$ ) for each element.
- Fr
  - Kr
  - Pa
  - Ge
  - Al
43. How many protons are in the nucleus of an atom of each element?
- Ar
  - Sn
  - Xe
  - O
  - Tl
45. List the symbol and atomic number of each element.
- carbon
  - nitrogen
  - sodium
  - potassium
  - copper
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47. List the name and the atomic number of each element.
- Mn
  - Ag
  - Au
  - Pb
  - S
51. Classify each element as a metal, nonmetal, or metalloid.
- Sr
  - Mg
  - F
  - N
  - As
53. Which elements would you expect to lose electrons in chemical changes?
- potassium
  - sulfur
  - fluorine
  - barium
  - copper
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55. Which elements are main-group elements?
- Te
  - K
  - V
  - Re
  - Ag
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57. Which elements are alkaline earth metals?
- sodium
  - aluminum
  - calcium
  - barium
  - lithium
59. Which elements are alkali metals?
- barium
  - sodium
  - gold
  - tin
  - rubidium
61. Classify each element as a halogen, a noble gas, or neither.
- Cl
  - Kr
  - F
  - Ga
  - He
63. To what group number does each element belong?
- oxygen
  - aluminum
  - silicon
  - tin
  - phosphorus

66. Which element do you expect to be most like magnesium? Why?

- (a) potassium
- (b) silver
- (c) bromine
- (d) calcium
- (e) lead

67. Which pair of elements do you expect to be most similar? Why?

- (a) Si and P
- (b) Cl and F
- (c) Na and Mg
- (d) Mo and Sn
- (e) N and Ni

68. Which pair of elements do you expect to be most similar? Why?

- (a) Ti and Ga
- (b) N and O
- (c) Li and Na
- (d) Ar and Br
- (e) Ge and Ga

69. Which element is a main-group nonmetal?

- (a) K
- (b) Fe
- (c) Sn
- (d) S

70. Which element is a row 5 transition element?

- (a) Sr
- (b) Pd
- (c) P
- (d) V

71. Fill in the blanks to complete the table.

Chemical Symbol	Group Number	Group Name	Metal or Nonmetal
K	_____	_____	metal
Br	_____	halogens	_____
Sr	_____	_____	_____
He	8A	_____	_____
Ar	_____	_____	_____

73. Complete each ionization equation.

- (a)  $\text{Na} \longrightarrow \text{Na}^+ + \text{_____}$
- (b)  $\text{O} + 2\text{e}^- \longrightarrow \text{_____}$
- (c)  $\text{Ca} \longrightarrow \text{Ca}^{2+} + \text{_____}$
- (d)  $\text{Cl} + \text{e}^- \longrightarrow \text{_____}$

75. Determine the charge of each ion.

- (a) oxygen ion with 10 electrons
- (b) aluminum ion with 10 electrons
- (c) titanium ion with 18 electrons
- (d) iodine ion with 54 electrons

77. Determine the number of protons and electrons in each ion.

- (a)  $\text{Na}^+$
- (b)  $\text{Ba}^{2+}$
- (c)  $\text{O}^{2-}$
- (d)  $\text{Co}^{3+}$

79. Determine whether each statement is true or false. If false, correct it.

- (a) The  $\text{Ti}^{2+}$  ion contains 22 protons and 24 electrons.
- (b) The  $\text{I}^-$  ion contains 53 protons and 54 electrons.
- (c) The  $\text{Mg}^{2+}$  ion contains 14 protons and 12 electrons.
- (d) The  $\text{O}^{2-}$  ion contains 8 protons and 10 electrons.

81. Predict the ion formed by each element.

- (a) Rb
- (b) K
- (c) Al
- (d) O

83. Predict how many electrons each element will most likely gain or lose.

- (a) Ga
- (b) Li
- (c) Br
- (d) S

87. Determine the atomic number and mass number for each isotope.

- (a) the hydrogen isotope with 2 neutrons
- (b) the chromium isotope with 28 neutrons
- (c) the calcium isotope with 22 neutrons
- (d) the tantalum isotope with 109 neutrons

89. Write isotopic symbols in the form  ${}^A_Z\text{X}$  for each isotope.

- (a) the oxygen isotope with 8 neutrons
- (b) the fluorine isotope with 10 neutrons
- (c) the sodium isotope with 12 neutrons
- (d) the aluminum isotope with 14 neutrons

91. Write the symbol for each isotope in the form  ${}^A_Z\text{X}$ .

- (a) cobalt-60
- (b) neon-22
- (c) iodine-131
- (d) plutonium-244

93. Determine the number of protons and neutrons in each isotope.

- (a)  ${}^{23}_{11}\text{Na}$
- (b)  ${}^{266}_{88}\text{Ra}$
- (c)  ${}^{208}_{82}\text{Pb}$
- (d)  ${}^{14}_7\text{N}$

97. Rubidium has two naturally occurring isotopes: Rb-85 with mass 84.9118 amu and a natural abundance of 72.17%, and Rb-87 with mass 86.9092 amu and a natural abundance of 27.83%. Calculate the atomic mass of rubidium.

99. Bromine has two naturally occurring isotopes (Br-79 and Br-81) and an atomic mass of 79.904 amu.

- (a) If the natural abundance of Br-79 is 50.69%, what is the natural abundance of Br-81?
- (b) If the mass of Br-81 is 80.9163 amu, what is the mass of Br-79?

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101. An element has two naturally occurring isotopes. Isotope 1 has a mass of 120.9038 amu and a relative abundance of 57.4%, and isotope 2 has a mass of 122.9042 amu and a relative abundance of 42.6%. Find the atomic mass of this element and, referring to the periodic table, identify it.

103. Electrical charge is sometimes reported in coulombs (C). On this scale, 1 electron has a charge of  $-1.6 \times 10^{-19}$  C. Suppose your body acquires  $-125$  mC (millicoulombs) of charge on a dry day. How many excess electrons has it acquired? (*Hint:* Use the charge of an electron in coulombs as a conversion factor between charge and electrons.)

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105. The hydrogen atom contains 1 proton and 1 electron. The radius of the proton is approximately 1.0 fm (femtometer), and the radius of the hydrogen atom is approximately 53 pm (picometers). Calculate the volume of the nucleus and the volume of the atom for hydrogen. What percentage of the hydrogen atom's volume does the nucleus occupy?