

Standardized Test Prep

Select the choice that best answers each question or completes each statement.

- Which of the following is not a chemical change?
 (A) paper being shredded
 (B) steel rusting
 (C) charcoal burning
 (D) a newspaper yellowing in the sun
- Which phrase best describes an apple?
 (A) heterogeneous mixture
 (B) homogeneous compound
 (C) heterogeneous substance
 (D) homogeneous mixture
- Which element is paired with the wrong symbol?
 (A) sulfur, S
 (B) potassium, P
 (C) nitrogen, N
 (D) calcium, Ca
- Which of these properties could not be used to distinguish between table salt and table sugar?
 (A) boiling point
 (B) melting point
 (C) density
 (D) color
- The state of matter characterized by a definite volume and an indefinite shape is a
 (A) solid. (C) mixture.
 (B) liquid. (D) gas.

The lettered choices below refer to Questions 6–9. A lettered choice may be used once, more than once, or not at all.

- compound
- heterogeneous mixture
- element
- homogeneous mixture

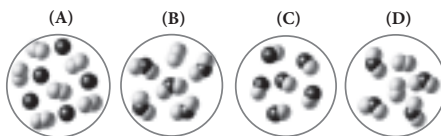
Which description correctly identifies each of the following materials?

- air
- carbon monoxide
- zinc
- mushroom pizza

Tips for Success

Using Models To answer some test questions, you will be asked to use visual models. At first the models may look very similar. Decide which information will help you answer the question. The number of particles, their colors, or their shapes may or may not be important.

Use the atomic windows to answer Question 10.



- The species in window A react. Use the law of conservation of mass to determine which window best represents the reaction products.

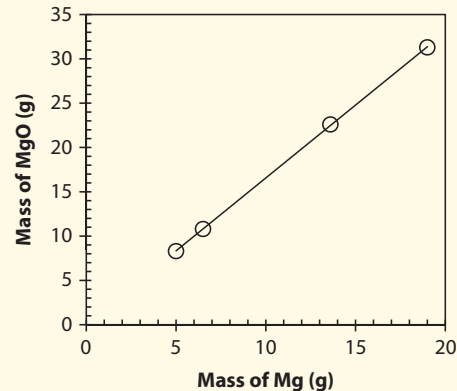
Use the data table to answer Questions 11–14.

Mass of magnesium (g)	Mass of oxygen (g)	Mass of magnesium oxide (g)
5.0	3.3	8.3
6.5	(a)	10.8
13.6	9.0	(b)
(c)	12.5	31.5

- Magnesium metal burns vigorously in oxygen to produce the compound magnesium oxide. Use the law of conservation of mass to identify the masses labeled (a), (b), and (c) in the table.
- Use the data in the completed table to construct a graph with mass of magnesium on the x -axis and mass of magnesium oxide on the y -axis.
- How many grams of magnesium oxide form when 8.0 g of magnesium are burned?
- How many grams of magnesium and oxygen react to form 20.0 g of magnesium oxide?

STP Answers

- a
- a
- b
- d
- b
- D
- A
- C
- B
- b
- (a) is 4.3 g; (b) is 22.6 g; (c) is 19.0 g
- 12.



- 13.3 g magnesium oxide
- 12.1 g magnesium and 7.9 g oxygen

If You Have Trouble With . . .

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14
See Lesson	2.4	2.2	2.3	2.1	2.1	2.3	2.3	2.3	2.3	2.4	2.4	2.4	2.4	2.4

Standardized Test Prep

Select the choice that best answers each question or completes each statement.

- The smallest particle of an element that retains its identity in a chemical reaction is a
 - proton.
 - neutron.
 - atom.
 - compound.
- Which of these descriptions is *incorrect*?
 - proton: positive charge, in nucleus, mass of ≈ 1 amu
 - electron: negative charge, mass of ≈ 0 amu, in nucleus
 - neutron: mass of ≈ 1 amu, no charge
- Thallium has two isotopes, thallium-203 and thallium-205. Thallium's atomic number is 81, and its atomic mass is 204.38 amu. Which statement about the thallium isotopes is true?
 - There is more thallium-203 in nature.
 - Atoms of both isotopes have 81 protons.
 - Thallium-205 atoms have fewer neutrons.
 - The most common atom of thallium has a mass of 204.38 amu.
- Which atom is composed of 16 protons, 16 electrons, and 16 neutrons?
 - ${}_{16}^{32}\text{S}$
 - ${}_{32}^{16}\text{Ge}$
 - ${}_{16}^{32}\text{S}$
 - ${}_{32}^{16}\text{S}$

Use the art to answer Question 5.

5. How many nitrogen-14 atoms (${}^{14}\text{N}$) would you need to place on the right pan to balance the three calcium-42 atoms (${}^{42}\text{Ca}$) on the left pan of the "atomic balance" below? Describe the method you used to determine your answer, including any calculations.



Tips for Success

Connectors Sometimes two phrases in a true/false question are connected by a word such as *because* or *therefore*. These words imply a relationship between one part of the sentence and another. Statements that include such words can be false even if both parts of the statement are true by themselves.

For each question below, there are two statements. Decide whether each statement is true or false. Then decide whether Statement II is a correct explanation for Statement I.

Statement I

- Every aluminum-27 atom has 27 protons and 27 electrons.
- Isotopes of an element have different atomic masses.
- An electron is repelled by a negatively charged particle.
- In an atom, the number of neutrons is generally equal to or greater than the number of protons.

Statement II

- BECAUSE The mass number of aluminum-27 is 27.
- BECAUSE The nuclei of an element's isotopes contain different numbers of protons.
- BECAUSE An electron has a negative charge.
- BECAUSE The mass number is generally equal to or greater than the atomic number.

If You Have Trouble With . . .

Question	1	2	3	4	5	6	7	8	9
See Lesson	4.1	4.2	4.3	4.3	4.3	4.3	4.3	4.2	4.2

STP Answers

- c
- b
- b
- c
- 9; three ${}^{42}\text{Ca}$ atoms have an approximate mass of $3 \times 42 = 126$ amu; one ${}^{14}\text{N}$ atom has an approximate mass of 14 amu; $126/14 = 9$ ${}^{14}\text{N}$ atoms with an approximate mass of 126 amu.
- false, true
- true, false
- true, true, correct explanation
- false, true

Evaluate

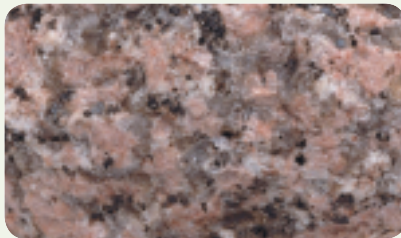
Answers

CUMULATIVE REVIEW

- 89.** **a** and **b** are heterogeneous; **c** is homogeneous
- 90.** Answers will vary but could include: water is lost as steam and burned meat gives off carbon dioxide.
- 91.** A compound has constant composition; the composition of a mixture can vary.
- 92.** a heterogeneous mixture
- 93.** $7.7 \times 10^{-5} \mu\text{m}$
- 94.** 18.9 cm^3
- 95.** the piece of lead
- 96.** **a.** $3.9 \times 10^{-5} \text{ kg}$
b. $7.84 \times 10^2 \text{ L}$
c. $8.30 \times 10^{-2} \text{ g}$
d. $9.7 \times 10^6 \text{ ng}$
- 97.** **a** and **b** are exact
- 98.** Mass remains the same; weight decreases because gravity on moon is less than gravity on earth.
- 99.** 8.92 g/cm^3
- 100.** 154 g , $1.54 \times 10^{-1} \text{ kg}$
- 101.** Helium gas is less dense than the nitrogen gas and oxygen gas in the air.
- 102.** Accuracy is a measure of how close the value is to the true value; precision is a measure of how close a series of measurements are to one another.
- 103.** **a.** 55 protons, 55 electrons
b. 47 protons, 47 electrons
c. 48 protons, 48 electrons
d. 34 protons, 34 electrons
- 104.** a
- 105.** Neon-20 has 10 neutrons; neon-21 has 11 neutrons.

Cumulative Review

- *89.** Classify each of the following as homogeneous or heterogeneous:
- a page of this textbook
 - a banana split
 - the water in bottled water
- 90.** Hamburger undergoes a chemical change when cooked on a grill. All chemical changes are subject to the law of conservation of mass. Yet, a cooked hamburger will weigh less than the uncooked meat patty. Explain.
- *91.** Homogeneous mixtures and compounds are both composed of two or more elements. How do you distinguish between a homogeneous mixture and a compound?
- 92.** The photo shows a magnified view of a piece of granite. Is granite a substance or a mixture?



- *93.** The diameter of a carbon atom is 77 pm . Express this measurement in μm .
- 94.** A silver bar has a mass of 368 g . What is the volume, in cm^3 , of the bar? The density of silver is 19.5 g/cm^3 .
- *95.** Which has more mass, a 28.0-cm^3 piece of lead or a 16.0-cm^3 piece of gold? The density of lead is 11.4 g/cm^3 ; the density of gold is 19.3 g/cm^3 .
- 96.** Express the following measurements in scientific notation.
- 0.000039 kg
 - 784 L
 - 0.0830 g
 - $9,700,000 \text{ ng}$

- 97.** Which of these quantities or relationships are exact?
- $10 \text{ cm} = 1 \text{ dm}$
 - There are 9 baseball players on the field.
 - A diamond has a mass of 12.4 g .
 - The temperature is 21°C .
- 98.** A one-kilogram steel bar is brought to the moon. How are its mass and its weight each affected by this change in location? Explain.
- *99.** When a piece of copper with a mass of 36.4 g is placed into a graduated cylinder containing 20.00 mL of water, the water level rises to 24.08 mL , completely covering the copper. What is the density of copper?
- 100.** The density of gold is 19.3 g/cm^3 . What is the mass, in grams, of a cube of gold that is 2.00 cm on each edge? In kilograms?
- *101.** A balloon filled with helium will rise upward when released. What does this result show about the relative densities of helium and air?
- *102.** Explain the difference between the accuracy of a measurement and the precision of a measurement.
- 103.** Give the number of protons and electrons in each of the following:
- Cs
 - Ag
 - Cd
 - Se
- 104.** Which of these was an essential part of Dalton's atomic model?
- indivisible atoms
 - electrons
 - atomic nuclei
 - neutrons
- *105.** How do neon-20 and neon-21 differ from each other?
- 106.** The mass of an atom should be very nearly the sum of the masses of its protons and neutrons. The mass of a proton and the mass of a neutron are each very close to 1 amu . Why is the atomic mass of chlorine, 35.453 amu , so far from a whole number?

If You Have Trouble With . . .

Question	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106
See Chapter	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4	4	4	4

Standardized Test Prep

Select the choice that best answers each question or completes each statement.

Tips for Success

Eliminate Wrong Answers If you don't know which response is correct, start by eliminating those you know are wrong. If you can rule out some choices, you'll have fewer left to consider and you'll increase your chances of choosing the correct answer.

- Select the correct electron configuration for silicon, atomic number 14.
(A) $1s^2 2s^2 2p^2 3s^2 3p^2 3d^2 4s^2$
(B) $1s^2 2s^2 2p^4 3s^2 3p^4$
(C) $1s^2 2s^6 2p^6$
(D) $1s^2 2s^2 2p^6 3s^2 3p^2$
- Which two orbitals have the same shape?
(A) $2s$ and $2p$
(B) $2s$ and $3s$
(C) $3p$ and $3d$
(D) More than one is correct.
- Which of these statements characterize the nucleus of every atom?
I. It has a positive charge.
II. It is very dense.
III. It is composed of protons, electrons, and neutrons.
(A) I and II only
(B) II and III only
(C) I and III only
(D) I, II, and III
- As the wavelength of light increases,
(A) the frequency increases.
(B) the speed of light increases.
(C) the energy decreases.
(D) the intensity increases.
- In the third energy level of an atom,
(A) there are two energy sublevels.
(B) the f sublevel has 7 orbitals.
(C) there are three s orbitals.
(D) a maximum of 18 electrons are allowed.

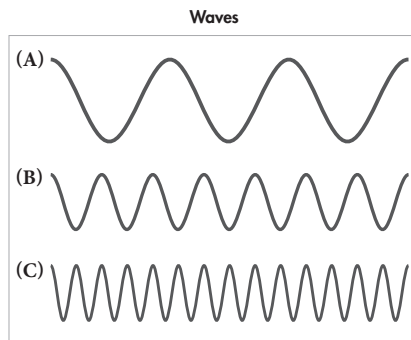
The lettered choices below refer to Questions 6–10. A lettered choice may be used once, more than once, or not at all.

(A) $s^2 p^6$ (B) $s^2 p^2$ (C) s^2 (D) $s^4 p^1$ (E) $s^2 p^4$

Which configuration is the configuration of the highest occupied energy level for each of these elements?

- sulfur
- germanium
- beryllium
- krypton
- strontium

Use the drawings to answer Questions 11–14. Each drawing represents an electromagnetic wave.



- Which wave has the longest wavelength?
- Which wave has the highest energy?
- Which wave has the lowest frequency?
- Which wave has the highest amplitude?

Write a short essay to answer Question 15.

- Explain the rules that determine how electrons are arranged around the nuclei of atoms.

STP Answers

- d
- b
- a
- c
- d
- E
- B
- C
- A
- C
- a
- c
- a
- a
15. According to the aufbau principle, electrons enter orbitals of lowest energy first. According to the Pauli exclusion principle, an orbital may contain at most two electrons. According to Hund's rule, one electron will enter each orbital of equal energy before electrons begin to pair up.

If You Have Trouble With . . .

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
See Lesson	5.2	5.1	5.1	5.3	5.1	5.2	5.2	5.2	5.2	5.2	5.3	5.3	5.3	5.3	5.2

81. From their positions in the periodic table, the three ions most likely have ionic sizes that increase going from Zn^{2+} to Cd^{2+} to Hg^{2+} . Since the increase in size from Zn^{2+} to Cd^{2+} adversely affects the process, it follows that a further increase in size could also adversely affect the process. The toxicity of mercury in biological systems is well known.

CUMULATIVE

82. 99: einsteinium (after Albert Einstein); 101: mendelevium (after Dimitri Mendeleev); 104: rutherfordium (after Ernest Rutherford); 107: bohrium (after Niels Bohr)
83. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 4f^{14} 5s^2 5p^6 5d^{10} 5f^6 6s^2 6p^6 7s^2$

Evaluate

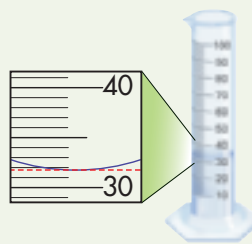
Answers

CUMULATIVE REVIEW

84. Answers will vary but are likely to mention the scientific method.
85. a. physical change
b. chemical change
c. physical change
d. chemical change
86. Use a magnet; iron beads are attracted to magnet, copper beads are not. Use tweezers and a magnifying glass; iron beads are silvery black, copper beads are dull red.
87. 4
88. a. 3
b. 8, the tenths place
89. The density of the cube is 0.984 g/cm^3 . The cube will float because its density is less than that of water.
90. a. $2.24 \times 10^{-9} \text{ m}$
b. $8.13 \times 10^{-2} \text{ m}$
c. $7.4 \times 10^{-12} \text{ m}$
d. $9.37 \times 10^{-3} \text{ m}$
91. 5.2%
92. $5.2 \times 10^3 \text{ g}$
93. The density of the olive is 1.05 g/cm^3 . The olive will sink because its density is greater than that of water.
94. 173
95. The density of sulfur does not vary with mass. The density is constant.
96. $2.57 \times 10^2 \text{ mL}$
97. 4.54 g/cm^3
98. a. 48
b. 44
c. 114
d. 110

Cumulative Review

84. Explain why science today depends less on chance discoveries than it did in the past.
- *85. Identify each process as a chemical change or a physical change.
- a. melting of iron c. grinding corn
b. lighting a match d. souring of milk
86. Describe at least two methods to separate a mixture of small copper and iron beads.
87. 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?
88. The volume of the liquid in the graduated cylinder is reported as 31.8 mL.
- a. How many significant figures are there in the measurement?
b. In which digit is there uncertainty?



89. A cube of plastic $1.20 \times 10^{-5} \text{ km}$ on a side has a mass of 1.70 g. Show by calculation whether this plastic cube will sink or float in pure water.
- *90. Convert the measurements to meters. Express your answers in scientific notation.
- a. 2.24 nm c. 7.4 pm
b. 8.13 cm d. 9.37 mm
91. 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?
92. 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 .

- *93. 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 water?
94. The distance from the sun to Earth is $1.50 \times 10^8 \text{ km}$. The speed of light is $3.00 \times 10^8 \text{ m/s}$. How many round trips between Earth and the sun could a beam of light make in one day?
95. The table shows how the volume of sulfur varies with mass. How does the density of sulfur vary with mass?

Mass of Sulfur vs. 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

96. 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 .
97. 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 and completely covers the rock. What is the density of the rock?
- *98. How many neutrons does an atom of each isotope contain?
- a. ${}^{84}_{36}\text{Kr}$ b. ${}^{79}_{35}\text{Br}$ c. ${}^{190}_{76}\text{Os}$ d. ${}^{185}_{75}\text{Re}$
99. Name the element and calculate the number of requested subatomic particles in each isotope.
- a. neutrons in ${}^{109}_{47}\text{Ag}$ c. electrons in ${}^{96}_{42}\text{Mo}$
b. protons in ${}^{118}_{50}\text{Sn}$ d. electrons in ${}^{45}_{21}\text{Sc}$
- *100. How many filled p orbitals do atoms of these elements contain?
- a. carbon c. oxygen
b. phosphorus d. nitrogen

If You Have Trouble With . . .

Question	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
See Chapter	1	2	2	3	3	3	3	3	3	3	3	3	3	3	4	4	5

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99. a. silver, 62 neutrons
b. tin, 50 protons
c. molybdenum, 42 electrons
d. scandium, 21 electrons

100. a. none
b. one, $2p$
c. none
d. none

Standardized Test Prep

Select the choice that best answers each question or completes each statement.

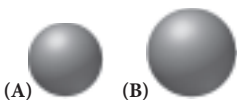
- Which of the following properties increases as you move across a period from left to right?
 - electronegativity
 - ionization energy
 - atomic radius

(A) I and II only (C) II and III only
(B) I and III only (D) I, II, and III
- List the symbols for sodium, sulfur, and cesium in order of increasing atomic radii.

(A) Na, S, Cs (C) S, Na, Cs
(B) Cs, Na, S (D) Cs, S, Na
- The electron configuration for an element in the halogen group should always end with

(A) ns^2np^6 . (C) ns^2np^4 .
(B) ns^2np^5 . (D) ns^2np^2 .

Use the spheres to answer Questions 4 and 5.



- If the spheres represent a potassium atom and a potassium ion, which best represents the ion?
- If the spheres represent an atom and an anion of the same element, which sphere represents the atom and which represents the anion?

Tips for Success

Interpreting Data Tables Tables can present a large amount of data in a small space. Before you try to answer questions based on a table, look at the table. Read the title, if there is one, and the column headings. Then read the questions. As you read each question, decide which data you will need to use to answer the question.

Use the data table to answer Questions 6–8.

Alkali metal	Atomic radius (pm)	First ionization energy (kJ/mol)	Electronegativity value
Li	152	520	1.0
Na	186	495.8	0.9
K	227	418.8	0.8
Rb	244	250	0.8
Cs	262	210	0.7

- If you plot atomic radius versus first ionization energy, would the graph reveal a direct or inverse relationship?
- If you plot atomic radius versus electronegativity, would the graph reveal a direct or inverse relationship?
- If you plot first ionization energy versus electronegativity, would the graph reveal a direct or inverse relationship?

STP Answers

- a
- c
- b
- The smaller sphere represents the potassium ion.
- The smaller sphere represents the atom; the larger sphere represents the anion.
- inverse
- inverse
- direct
- false, false
- true, false
- false, true
- false, false

For each question there are two statements. Decide whether each statement is true or false. Then decide whether Statement II is a correct explanation for Statement I.

Statement I

- Electronegativity values are higher for metals than for nonmetals.
- A calcium atom is larger than a calcium ion.
- The element hydrogen is a metal.
- Among all the elements in a period, the noble gas always has the smallest ionization energy.

Statement II

- BECAUSE** Atoms of nonmetals are among the largest atoms.
- BECAUSE** Ions are always larger than the atoms from which they are formed.
- BECAUSE** Hydrogen is on the left in the periodic table.
- BECAUSE** Within any period, atomic radii tend to decrease moving from right to left.

If You Have Trouble With . . .

Question	1	2	3	4	5	6	7	8	9	10	11	12
See Lesson	6.3	6.3	6.2	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.1	6.3

Standardized Test Prep

Select the choice that best answers each question or completes each statement.

Tips for Success

Review All the Answer Choices Even if you find an answer that looks correct, continue reading until you have looked at every answer. There may be more than one correct response, or one may be better than another. Also, “all of the above” may be a possible answer. If you stop reading as soon as you find an answer that is correct, you won’t notice this option.

- Which of these is not an ionic compound?
 (A) KF (C) Na_2SO_4
 (B) SiO_2 (D) Na_2O
- Which statements are correct when barium and oxygen react to form an ionic compound?
 - Each barium atom loses 2 electrons and forms a cation.
 - Oxygen atoms form oxide anions (O^{2-}).
 - The ions are present in a one-to-one ratio in the compound.
 (A) I and II only
 (B) II and III only
 (C) I and III only
 (D) I, II, and III

The lettered choices below refer to Questions 3–6. A lettered choice may be used once, more than once, or not at all.

- gains two electrons
- loses two electrons
- gains three electrons
- loses one electron
- gains one electron

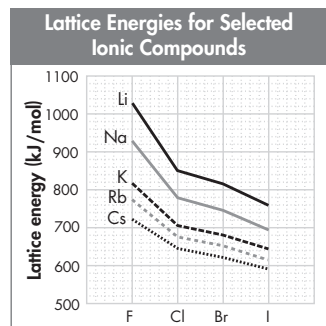
Which choice describes what likely happens as each of the following elements forms an ion?

- iodine
- magnesium
- cesium
- phosphorus

- How many valence electrons does arsenic have?
 (A) 5 (C) 3
 (B) 4 (D) 2
- Which electron configuration represents a nitride ion?
 (A) $1s^2 2s^2 3s^2 4s^2$ (C) $1s^2 2s^2 2p^3$
 (B) $1s^2 2s^2 2p^6$ (D) $1s^2$
- When a bromine atom gains an electron
 (A) a bromide ion is formed.
 (B) the ion formed has a 1– charge.
 (C) the ion formed is an anion.
 (D) all the above are correct.

Use the description and the graph to answer Questions 10–12.

Lattice energy is the energy required to change one mole (6.02×10^{23} formula units) of a crystalline, ionic solid to gaseous ions. The graph below shows the lattice energies for ionic compounds formed between selected alkali metals and halogens.



- For a given alkali metal, what is the trend in lattice energy as the atomic radius of the halogen increases?
- For a given halogen, what is the trend in lattice energy as the atomic radius of the alkali metal increases?
- Complete this sentence: “As the atomic radius of either the halogen or the alkali metal increases, the lattice energy _____.”

STP Answers

- c
- d
- (E)
- (B)
- (D)
- (C)
- a
- c
- d
- Because the atomic radius increases moving down the halogen group, the lattice energy decreases.
- Lattice energy decreases as the atomic radius of the alkali metal increases.
- decreases

If You Have Trouble With . . .

Question	1	2	3	4	5	6	7	8	9	10	11	12
See Lesson	7.2	7.2	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.2	7.2	7.2

Evaluate

Answers

CUMULATIVE REVIEW

96. formation of a gas, a change in color or odor, formation of a precipitate
97. a. 6.65×10^4 micrometers
b. 4 centigrams
c. 5.62×10^{-1} decigram per liter
d. 2.4×10^1 meters per second
98. a. 2 b. 2
c. 4 d. 4
99. a. 16 b. 12
c. 8 d. 26
100. Isotopes have the same number of protons and electrons, but different numbers of neutrons.
101. Protons and electrons must be equal.
102. a. 6 b. 2
c. 5 d. 0
103. The wavelength decreases as the frequency increases.
104. The d orbitals related to the third principal energy level contain 5 electrons.
105. a. $1s^2 2s^2 2p^6 3s^1$
b. $1s^2 2s^2 2p^6 3s^2 3p^4$
c. $1s^2 2s^2 2p^6 3s^2 3p^3$
d. $1s^2 2s^2 2p^3$
106. The anion is larger than the corresponding neutral atom.
107. Mendeleev arranged the elements by increasing atomic mass in vertical rows and by similarities in chemical and physical properties. Mosely arranged the elements by increasing atomic number in vertical rows and by similarities in chemical and physical properties.
108. a. K, $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$
b. Al, $1s^2 2s^2 2p^6 3s^2 3p^1$
c. S, $1s^2 2s^2 2p^6 3s^2 3p^4$
d. Ba, $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^6 6s^2$
109. a. barium
b. silicon
c. sodium
110. e. II and III only
111. All have the same number of electrons as a noble gas.
112. b. cesium
113. a. 8 b. 3
c. 6 d. 2
114. a. $1s^2 2s^2 2p^6$
b. $1s^2 2s^2 2p^6$
c. $1s^2 2s^2 2p^6$
d. $1s^2 2s^2 2p^6 3s^2 3p^6$
115. No, an alloy is a homogeneous mixture.

Cumulative Review

96. Name three indicators of chemical change.
- * 97. Make the following conversions:
a. 66.5 mm to micrometers
b. 4×10^{-2} g to centigrams
c. 5.62 mg/mL to decigrams per liter
d. 85 km/h to meters per second
98. How many significant figures are in each measurement?
a. 0.00052 m c. 5.050 mg
b. 9.8×10^4 g d. 8.700 mL
99. How many neutrons are in each atom?
a. silicon-30 c. nitrogen-15
b. magnesium-24 d. chromium-50
100. How do isotopes of an atom differ?
- *101. In a neutral atom, the number of which two subatomic particles must always be equal?
102. How many electrons are in the 2p sublevel of an atom of each element?
a. aluminum c. fluorine
b. carbon d. lithium
103. What happens to the wavelength of light as the frequency increases?
104. What does the 5 in $3d^5$ represent?
105. Write correct electron configurations for atoms of the following elements:
a. sodium c. phosphorus
b. sulfur d. nitrogen
106. How does the ionic radius of a typical anion compare with the radius for the corresponding neutral atom?
107. What criteria did Mendeleev and Moseley use to arrange the elements on the periodic table?
108. Give the electron configuration of the element found at each location in the periodic table.
a. Group 1A, period 4
b. Group 3A, period 3
c. Group 6A, period 3
d. Group 2A, period 6
- *109. Identify the larger atom of each pair.
a. calcium and barium
b. silicon and sulfur
c. sodium and nitrogen
110. Which of these statements about the periodic table is correct?
I. Elements are arranged in order of increasing atomic mass.
II. A period is a horizontal row.
III. Nonmetals are located on the right side of the table.
a. I only
b. I and II only
c. I, II, and III
d. I and III only
e. II and III only
- *111. Which of the following ions has the same number of electrons as a noble gas?
a. Al^{3+}
b. O^{2-}
c. Br^-
d. N^{3-}
112. Which element is likely to form an ionic compound with chlorine?
a. iodine
b. cesium
c. helium
113. How many valence electrons does each atom have?
a. argon
b. aluminum
c. selenium
d. beryllium
114. Write the electron configuration of each ion.
a. oxide ion
b. magnesium ion
c. nitride ion
d. potassium ion
115. An alloy is composed of two or more elements. Is an alloy a compound? Explain your answer.

If You Have Trouble With . . .

Question	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115
See Chapter	2	3	3	4	4	4	5	5	5	5	6	6	6	6	6	7	7	7	7	7

Standardized Test Prep

Select the choice that best answers each question or completes each statement.

- A bond in which two atoms share a pair of electrons is not
 - a coordinate covalent bond.
 - a polar covalent bond.
 - an ionic bond.
 - a nonpolar covalent bond.
- How many valence electrons are in a molecule of phosphoric acid, H_3PO_4 ?
 - 7
 - 16
 - 24
 - 32
- Which of these molecules can form a hydrogen bond with a water molecule?
 - N_2
 - NH_3
 - O_2
 - CH_4
- Which substance contains both covalent and ionic bonds?
 - NH_4NO_3
 - CH_3OCH_3
 - LiF
 - CaCl_2
- Which of these bonds is most polar?
 - $\text{H}-\text{Cl}$
 - $\text{H}-\text{Br}$
 - $\text{H}-\text{F}$
 - $\text{H}-\text{I}$

Use the description and data table below to answer Questions 6–9.

The table relates molecular shape to the number of bonding and nonbonding electron pairs in molecules.

Bonding pairs	Non-bonding pairs	Arrangement of electron pairs	Molecular shape	Example
4	0	tetrahedral	tetrahedral	CH_4
3	1	tetrahedral	pyramidal	NCl_3
2	2	tetrahedral	bent	H_2S
1	3	tetrahedral	linear	HF

- Draw the electron dot structure for each example molecule.

- Explain why the arrangement of electron pairs is tetrahedral in each molecule.
- H_2S has two hydrogen atoms bonded to a sulfur atom. Why isn't the molecule linear?
- What is the arrangement of electron pairs in PBr_3 ? Predict the molecular shape of a PBr_3 molecule.

For Questions 10–11, identify the type of intermolecular bonding represented by the dotted lines in the drawings.

10. H_2O



11. BrCl



Tips for Success

Connectors Sometimes two phrases in a true/false question are connected by a word such as *because*. The word implies that one thing caused another thing to happen. Statements that include such words can be false even if both parts of the statement are true by themselves.

In Questions 12–14, a statement is followed by an explanation. Decide if each statement is true, and then decide if the explanation given is correct.

- A carbon monoxide molecule has a triple covalent bond because carbon and oxygen atoms have an unequal number of valence electrons.
- Xenon has a lower boiling point than neon because dispersion forces between xenon atoms are stronger than those between neon atoms.
- The nitrate ion has three resonance structures because the nitrate ion has three single bonds.

STP Answers

MULTIPLE CHOICE

- c
- d
- b
- a
- c
- $$\begin{array}{c} \text{H} \\ | \\ \text{H}:\text{C}:\text{H} \\ | \\ \text{H} \end{array} \quad \begin{array}{c} \text{Cl} \\ | \\ \text{Cl}:\text{N}:\text{Cl} \\ | \\ \text{Cl} \end{array} \quad \begin{array}{c} \text{H} \\ | \\ \text{H}:\text{S}:\text{H} \\ | \\ \text{H} \end{array} \quad \begin{array}{c} \text{H} \\ | \\ \text{H}:\text{F}:\text{H} \\ | \\ \text{H} \end{array}$$
- Each central atom has four pairs of electrons that, according to VSEPR theory, assume a tetrahedral shape.
- The two nonbonding pairs repel the bonding pairs; there are still four pairs of electrons around the sulfur atom.
- The arrangement of electron pairs is tetrahedral. The electron dot structure shows three bonding electron pairs and one non-bonding electron pair; thus, the predicted molecular shape is pyramidal.
- hydrogen bonding
- primarily dispersion forces
- true, true
- false, true
- true, false

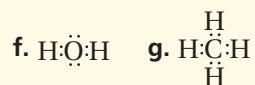
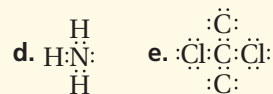
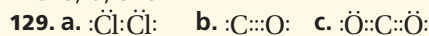
If You Have Trouble With . . .

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14
See Lesson	8.2	8.2	8.4	8.3	8.1	8.3	8.2	8.2	8.2	8.2	8.4	8.4	8.4	8.2

Answers

CUMULATIVE REVIEW

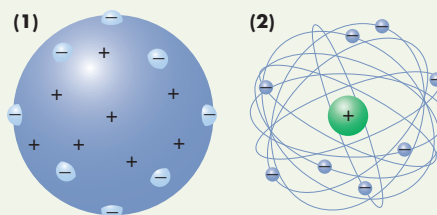
112. Answers may include: color (physical), solid (physical), magnetic (physical), conducts electricity (physical), burns (chemical).
113. a. 4 b. 2 c. 2 d. 4 e. 2 f. 1
114. 5.2 cm
115. a. $7.75 \times 10^5 \mu\text{L}$ b. 208 K c. 0.832 cg
116. 0.538 g/cm^3
117. Both are in the nucleus and have a mass of about 1 amu. A proton is positively charged; a neutron has no charge.
118. a. 2 b. protons c. electrons d. neutrons
119. a. neon b. carbon c. boron d. helium
120. The metalloids border a line separating the metals from the nonmetals. Their properties are intermediate between those of metals and nonmetals.
121. a. cesium, potassium, sodium, lithium b. lithium, boron, carbon, fluorine, neon
122. a. Li b. I c. S d. O e. N f. F
123. When metallic elements of Group 1A and 2A form ions, they lose all their outer shell electrons. This increases the attraction by the nucleus for the fewer remaining electrons and results in ions that are smaller than the neutral atoms. The electron that a Group 7A element gains in forming an ion enters the outer shell, resulting in a decrease in the effective nuclear attraction of the increased number of electrons. The anion is larger than the neutral atom.
124. a. 1 b. 6 c. 8 d. 2 e. 7 f. 5
125. $1s^2 2s^2 2p^6$; Possible answers are N^{3-} , O^{2-} , F^- , Na^+ , Mg^{2+} , and Al^{3+} .
126. a. 12 p^+ and 10 e^- b. 35 p^+ and 36 e^-
c. 38 p^+ and 36 e^- d. 16 p^+ and 18 e^-
127. b and c; molecular compounds formed by two nonmetals have covalent bonds.
128. b, d, and f



130. A hydrogen bond is an intermolecular force between a hydrogen atom covalently bonded to a very electronegative atom and an unshared pair of electrons on another electronegative atom.
131. ionic bond: electrons are transferred
 $\text{Na}\cdot + \cdot\ddot{\text{F}}\text{:} \rightarrow \text{Na}^+ \text{:}\ddot{\text{F}}\text{:}^-$
 covalent bond: electrons are shared
 $\text{H}\cdot + \cdot\text{H} \rightarrow \text{H}:\text{H}$

Cumulative Review

112. List five properties of the chair you are sitting on. Classify each as physical or chemical.
- *113. How many significant figures are in the following measurements?
 a. 15.05 g d. 300.0 cm^3
 b. 0.31 cm e. $3.0 \times 10^5 \text{ kg}$
 c. 890 mL f. 0.001 mm
114. Determine the sum of the following measurements to the correct number of significant figures.
 $1.55 \text{ cm} + 0.235 \text{ cm} + 3.4 \text{ cm}$
115. Make the following conversions:
 a. 775 mL to microliters (μL)
 b. 65°C to K
 c. 8.32 mg Ag to centigrams of silver (cg Ag)
116. A student finds that 6.62 g of a substance occupies a volume of 12.3 cm^3 . What is the density of the substance?
117. Compare neutrons and protons with respect to their charge, mass, and position in the atom.
- *118. The diagrams show two models of the atom.
 a. Which model is more accurate?
 b. What do the positively charged particles represent?
 c. What do the negatively charged particles represent?
 d. What major subatomic particle is missing in both of these models?



- *119. What elements have these electron configurations?
 a. $1s^2 2s^2 2p^6$ c. $1s^2 2s^2 2p^1$
 b. $1s^2 2s^2 2p^2$ d. $1s^2$

If You Have Trouble With . . .

Question	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131
See Chapter	2	3	3	3	3	4	5	5	6	6	6	6	7	7	7	8	8	8	8	8

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120. Where are the metalloids found on the periodic table? Compare the properties of the metalloids to metals and nonmetals.
121. Arrange the following groups of elements in order of increasing ionization energy.
 a. potassium, cesium, lithium, sodium
 b. fluorine, boron, lithium, carbon, neon
122. From the positions of the elements in the periodic table, choose the element in each pair with the higher electronegativity.
 a. Cs and Li c. S and Mg e. Te and N
 b. Sr and I d. O and Se f. C and F
123. The ions of the elements of Groups 1A and 2A have smaller radii than their neutral atoms, whereas the ions of Group 7A have larger radii than their neutral atoms. Explain.
- *124. How many valence electrons do atoms of the following elements have?
 a. lithium d. calcium
 b. sulfur e. bromine
 c. neon f. phosphorus
125. Write the electron configuration for the element neon, then identify three ions that have the same electron configuration.
126. How many protons and electrons are in each ion?
 a. magnesium ion c. strontium ion
 b. bromide ion d. sulfide ion
- *127. Which of these compounds would you expect to contain covalent bonds? Why?
 a. KCl b. PBr_3 c. ClBr d. NaI
128. Which of these substances would you expect to be polar?
 a. Cl_2 c. CO_2 e. CCl_4 g. CH_4
 b. CO d. NH_3 f. H_2O
129. Draw electron dot structures for the substances in Question 128.
130. Explain what a hydrogen bond is and under what conditions a hydrogen bond will form.
131. Explain the difference between an ionic bond and a covalent bond. Use electron dot structures to illustrate your explanation.

Standardized Test Prep

Select the choice that best answers each question or completes each statement.

- Identify the pair in which the formula does not match the name.
(A) sulfite, SO_3^{2-} (C) hydroxide, OH^-
(B) nitrite, NO_3^- (D) dichromate, $\text{Cr}_2\text{O}_7^{2-}$
- Which of these compounds are ionic?
I. CaSO_4 II. N_2O_4 III. NH_4NO_3 IV. CaS
(A) I and II only (C) III and IV only
(B) II and III only (D) I, III, and IV only
- What is the name of AlCl_3 ?
(A) aluminum trichloride
(B) aluminum(III) chloride
(C) aluminum chlorite
(D) aluminum chloride
- The Roman numeral in manganese(IV) sulfide indicates the
(A) group number on the periodic table.
(B) positive charge on the manganese ion.
(C) number of manganese ions in the formula.
(D) number of sulfide ions needed in the formula.

Tips for Success

Eliminate Wrong Answers If you don't know which choice is correct, start by eliminating those you know are wrong. If you can rule out some choices, you'll increase your chances of choosing the correct answer.

- Which of these statements does not describe every binary molecular compound?
(A) Molecules of binary molecular compounds are composed of two atoms.
(B) The names of binary molecular compounds contain prefixes.
(C) The names of binary molecular compounds end in the suffix *-ide*.
(D) Binary molecular compounds are composed of two nonmetals.
- What is the formula of ammonium carbonate?
(A) NH_4CO_3 (C) NH_3CO_4
(B) $(\text{NH}_4)_2\text{CO}_3$ (D) NH_4CO_2

The lettered choices below refer to Questions 7–10.

(A) QR (B) QR_2 (C) Q_2R (D) Q_2R_3

Which formula shows the correct ratio of ions in the compound formed by each pair of elements?

Element Q	Element R
7. aluminum	sulfur
8. potassium	oxygen
9. lithium	chlorine
10. strontium	bromine

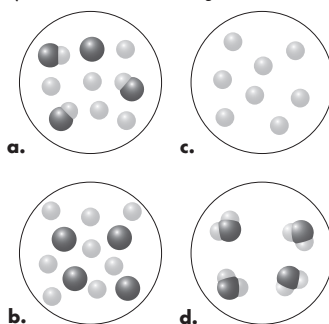
Use the data table to answer Questions 11–12. The table gives formulas for some of the ionic compounds formed when cations (M, N, P) combine with anions (A, B, C, D).

Cation	Anion			
	A	B	C	D
M	MA_2	(1)	(2)	MD
N	(3)	N_2B	(4)	(5)
P	PA_3	(6)	PC	$\text{P}_2(\text{D})_3$

- Use the given formulas to determine the ionic charge of each cation and anion.
- Write formulas for compounds (1) through (6).

Use the atomic windows to answer Question 13.

- Classify the contents as elements only, compounds only, or elements and compounds.



If You Have Trouble With . . .

Question	1	2	3	4	5	6	7	8	9	10	11	12	13
See Lesson	9.1	9.2	9.2	9.2	9.3	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2

STP Answers

- B
- D
- D
- B
- A
- B
- D
- C
- A
- B
- cations: M^{2+} , N^+ , P^{3+} ; anions: A^- , B^{2-} , C^{3-} , D^{2-}
- (1) MB, (2) M_3C_2 , (3) NA, (4) N_3C , (5) N_2D , (6) P_2B_3
- a contains elements and compounds, b and c contain only elements, and d contains only a compound.

Tips for Success

Wear a Watch Be aware of how many questions you have to answer and how much time you have to answer them. Look at your watch or a clock frequently to keep track of your progress.

1. Choose the term that best completes the second relationship.

a. dozen : eggs
mole : _____

- (A) atoms (C) size
(B) 6.02×10^{23} (D) grams

b. mole : Avogadro's number
molar volume : _____

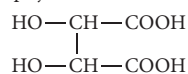
- (A) mole (C) STP
(B) water (D) 22.4 L

- Select the choice that best answers each question or completes each statement.

2. Calculate the molar mass of ammonium phosphate, $(\text{NH}_4)_3\text{PO}_4$.

- (A) 113.0 g/mol (C) 149.0 g/mol
(B) 121.0 g/mol (D) 242.0 g/mol

3. Based on the structural formula below, what is the empirical formula for tartaric acid, a compound found in grape juice?



- (A) $\text{C}_2\text{H}_3\text{O}_3$ (C) CHO
(B) $\text{C}_4\text{H}_6\text{O}_6$ (D) $\text{C}_1\text{H}_{1.5}\text{O}_{1.5}$

4. How many hydrogen atoms are in six molecules of ethylene glycol, $\text{C}_2\text{H}_6\text{O}_2$?

- (A) 6 (C) $6 \times (6.02 \times 10^{23})$
(B) 36 (D) $36 \times (6.02 \times 10^{23})$

5. Which of these compounds has the largest percent by mass of nitrogen?

- (A) N_2O (D) N_2O_3
(B) NO (E) N_2O_4
(C) NO_2

6. Which of these statements is true of a balloon filled with 1.00 mol $\text{N}_2(\text{g})$ at STP?

- I. The balloon has a volume of 22.4 L.
II. The contents of the balloon have a mass of 14.0 g.
III. The balloon contains 6.02×10^{23} molecules.

- (A) I only (C) I and III only
(B) I and II only (D) I, II, and III

7. Allicin, $\text{C}_6\text{H}_{10}\text{S}_2\text{O}$, is the compound that gives garlic its odor. A sample of allicin contains 3.0×10^{21} atoms of carbon. How many hydrogen atoms does this sample contain?

- (A) 10 (C) 1.8×10^{21}
(B) 1.0×10^{21} (D) 5.0×10^{21}

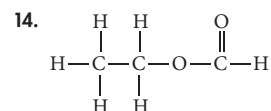
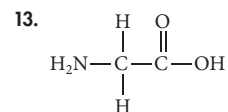
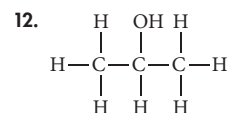
The lettered choices below refer to Questions 8–11. A lettered choice may be used once, more than once, or not at all.

- (A) CH (B) CH_2 (C) C_2H_5 (D) CH_3 (E) C_2H_3

Which of the formulas is the empirical formula for each of the following compounds?

8. C_8H_{12} 10. C_2H_6
9. C_6H_6 11. C_4H_{10}

For Questions 12–14, write the molecular formula for each compound whose structural formula is shown. Then calculate the compound's molar mass.



If You Have Trouble With . . .

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14
See Lesson	10.2	10.1	10.3	10.1	10.3	10.2	10.1	10.3	10.3	10.3	10.3	10.1	10.1	10.1

STP Answers

MULTIPLE CHOICE

1. a. A b. D
2. C
3. A
4. B
5. A
6. C
7. C
8. E
9. A
10. D
11. C
12. $\text{C}_3\text{H}_8\text{O}$, 60.0 g/mol
13. $\text{C}_2\text{H}_5\text{NO}_2$, 75.0 g/mol
14. $\text{C}_3\text{H}_6\text{O}_2$, 74.0 g/mol

- 76.** a. 2.97 mol b. 9.26×10^{-4} mol
c. 0.692 mol d. 29.5 mol
- 77.** a. 2.65×10^{24} molecules
b. 1.71×10^{23} formula units
c. 9.75×10^{23} molecules
d. 7.71×10^{24} formula units
- 78.** a. 0.121 mol b. 2.46 mol
c. 0.664 mol d. 15.0 mol
- 79.** a. 81.5 L b. 1.45 L
c. 189 L d. 28.2 L
- 80.** a. 2.52 mol b. 0.341 mol
c. 3.96×10^{-2} mol d. 5.63 mol
- 81.** a. 2.00×10^{23} molecules
b. 2.16×10^{23} atoms
c. 6.84×10^{21} formula units
d. 2.37×10^{23} formula units
- 82.** a. 1.86×10^{-12} g b. 6.43 g
c. 55 g d. 1.33×10^{-2} g
- 83.** a. 3.49 g b. 555 g
c. 279 g d. 5.7×10^{-3} g
- 84.** a. 0.148 L b. 33.5 L
c. 0.813 L d. 54.9 L
- 85.** a. 1.72×10^{24} molecules
b. 9.03×10^{22} molecules
c. 1.28×10^{27} molecules
d. 1.85×10^{21} atoms
- 86.** a. 0.136 L b. 2.27 L
c. 432 L d. 167 L
- 87.** a. 63 oxygen atoms
b. 3.61×10^{24} oxygen atoms
c. 1.08×10^{23} oxygen atoms
d. 1.82×10^{23} oxygen atoms
- 88.** a. 23 g b. 2.50 g
c. 222 g d. 7.72 g
- 89.** a. 86.6% Pb, 13.4% O
b. 62.1% C, 10.3% H, 27.6% O
c. 18.3% K, 59.3% I, 22.4% O
d. 29.1% Na, 40.6% S, 30.3% O
e. 57.2% I, 42.8% F
f. 0.69% H, 55.1% Br, 44.2% O
g. 56.4% P, 43.6% O
h. 54.5% C, 9.1% H, 36.4% C

- 76.** How many moles is each of the following?
a. 579 g Pt
b. 0.0426 g NO_2
c. 56.8 g H_2SO_3
d. 6.78×10^3 g CsH_2PO_4
- 77.** Find the number of representative particles in each of the following:
a. 4.40 mol Pd
b. 0.284 mol NaI
c. 1.62 mol NH_3
d. 12.8 mol $\text{Fe}(\text{C}_2\text{H}_3\text{O}_2)_2$
- 78.** How many moles is each of the following?
a. 7.26×10^{22} atoms Zr
b. 1.48×10^{24} molecules $\text{C}_2\text{H}_6\text{O}$
c. 4.00×10^{23} formula units KClO_3
d. 9.02×10^{24} molecules OF_2
- 79.** Calculate the volume, in liters, of each of these gases at STP.
a. 3.64 mol H_2
b. 0.0648 mol C_2H_6
c. 8.44 mol SO_3
d. 1.26 mol Xe
- 80.** How many moles is each of the following at STP?
a. 56.4 L He
b. 7.64 L N_2
c. 0.888 L CO
d. 126 L SO_2
- 81.** Calculate the number of representative particles in each mass.
a. 14.6 g CO_2
b. 68.3 g Os
c. 0.847 g KCl
d. 174 g Au_2O_3
- 82.** Calculate the mass of each of the following samples.
a. 7.00×10^9 molecules Br_2
b. 9.22×10^{22} formula units NaF
c. 4.8×10^{24} atoms Li
d. 2.66×10^{20} molecules H_2CO
- 83.** Find the mass of each of the gases at STP.
a. 2.44 L O_2 c. 78.0 L SO_3
b. 777 L CH_4 d. 0.0642 L H_2
- 84.** Calculate the volume of each of these gases at STP.
a. 0.469 g Cl_2
b. 44.8 g NO
c. 2.76 g N_2O_3
d. 93.2 g F_2
- 85.** Calculate the number of representative particles in each volume.
a. 64.0 L H_2S
b. 3.36 L C_3H_8
c. 4.78×10^4 L HF
d. 6.88×10^{-2} L Kr
- 86.** Find the volume at STP of the following:
a. 3.66×10^{21} molecules F_2
b. 6.11×10^{22} molecules PH_3
c. 1.16×10^{25} atoms Ne
d. 4.48×10^{24} molecules C_2H_2
- 87.** Calculate the number of oxygen atoms in each of the following:
a. 7 molecules of the explosive nitroglycerine, $\text{C}_3\text{H}_5(\text{NO}_3)_3$
b. 3.00 mol of the antiseptic hydrogen peroxide, H_2O_2
c. a balloon filled with 2.00 L O_2
d. 8.04 g of the fertilizer, NH_4NO_3
- 88.** Calculate the number of grams of hydrogen in each of the following.
a. a balloon filled with 7.06×10^{24} hydrogen molecules
b. a balloon filled with 14.0 L of methane, CH_4 , at STP
c. a 2.00-L bottle of water (density of $\text{H}_2\text{O} = 1.00$ g/mL)
d. a 69.5-g ice cube (density of ice = 0.917 g/cm³)
- 89.** Calculate the percent composition of each compound.
a. PbO_2
b. $(\text{CH}_3)_2\text{CO}$
c. KIO_3
d. $\text{Na}_2\text{S}_2\text{O}_3$
e. IF_5
f. HBrO_4
g. P_4O_6
h. $\text{C}_3\text{H}_7\text{COOH}$

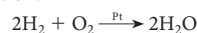
- 90.** Use the answers from Problem 89 to calculate the number of grams of the indicated element in the compound.
- lead in 63.8 g PbO_2
 - carbon in 1.664 g $(\text{CH}_3)_2\text{CO}$
 - oxygen in 36.8 g KIO_3
 - sulfur in 6.26 g $\text{Na}_2\text{S}_2\text{O}_3$
 - fluorine in 594 g IF_3
 - bromine in 82.7 g HBrO_4
 - phosphorus in 2.66 g P_4O_6
 - carbon in 55.0 g $\text{C}_3\text{H}_7\text{COOH}$
- 91.** Which of these are empirical formulas?
- $\text{Al}_2(\text{SO}_4)_3$
 - $\text{C}_6\text{H}_4\text{Cl}_2$
 - $\text{C}_2\text{H}_4(\text{OH})_2$
 - $\text{K}_2\text{Cr}_2\text{O}_7$
- 92.** What is the empirical formula of
- $\text{C}_6\text{H}_{16}\text{N}_2$, a compound used to make nylon?
 - $\text{C}_6\text{H}_8\text{N}_2$, a component of chocolate?
 - C_8H_8 , used to make polystyrene foam plastics?
 - $\text{C}_3\text{H}_7\text{OH}$, rubbing alcohol?
- 93.** Determine the empirical formula for each compound from the percent composition data.
- 85.71% C, 14.29% H
 - 60.94% Ba, 10.65% C, 28.41% O
 - 37.50% C, 12.50% H, 50.00% O
 - 27.87% P, 72.13% S
 - 67.61% U, 32.39% F
 - 74.19% Na, 25.79% O
 - 32.43% C, 5.41% H, 43.24% O, 18.92% N
 - 18.70% Li, 16.26% C, 65.04% O
- 94.** Find the molecular formula from the given empirical formula and molar mass.

Empirical formula	Molar mass (g/mol)	Molecular formula
C_2H_3	54.0	a. _____
$\text{C}_2\text{H}_2\text{Cl}$	123.0	b. _____
$\text{C}_3\text{H}_4\text{O}_3$	176.0	c. _____
$\text{C}_5\text{H}_7\text{N}$	162.0	d. _____

- 95.** A compound with a molar mass of 312.2 g/mol contains 69.23% C, 3.85% H, and 26.92% N. What is the molecular formula of this compound?
- 96.** The molar mass of caffeine, the stimulant found in coffee, is 194.0 g/mol. The percent composition of caffeine is 49.48% C, 5.19% H, 28.85% N, and 16.48% O. What is the molecular formula of caffeine?
- 97.** Linoleic acid, which has a molar mass of 280.0 g/mol, is found in many vegetable oils. The percent composition of this compound is 77.1% carbon, 11.4% hydrogen, and 11.4% oxygen. Find the empirical formula and molecular formula of this compound.
- 98.** A 2.716-g sample of a compound of C, H, N, and O was found to contain 0.7580 g C, 0.0633 g H, and 0.8843 g N. The molar mass of the compound is 129 g/mol. Calculate the compound's empirical and molecular formula.

Chapter 11

- 99.** What is the function of the element platinum in this reaction?



- 100.** Balance the following equations:

- $\text{Hg}(\text{NO}_3)_2 + \text{NH}_4\text{SCN} \longrightarrow \text{Hg}(\text{SCN})_2 + \text{NH}_4\text{NO}_3$
- $\text{CH}_4\text{O} + \text{O}_2 \longrightarrow \text{CO}_2 + \text{H}_2\text{O}$
- $\text{Ca} + \text{Cl}_2 \longrightarrow \text{CaCl}_2$
- $\text{Na}_3\text{PO}_4 + \text{CoCl}_2 \longrightarrow \text{Co}_3(\text{PO}_4)_2 + \text{NaCl}$
- $\text{Fe} + \text{AgNO}_3 \longrightarrow \text{Fe}(\text{NO}_3)_2 + \text{Ag}$
- $\text{N}_2\text{H}_4 \longrightarrow \text{NH}_3 + \text{N}_2$
- $\text{C}_{12}\text{H}_{26} + \text{O}_2 \longrightarrow \text{CO}_2 + \text{H}_2\text{O}$
- $\text{CuCl} + \text{Mg} \longrightarrow \text{Cu} + \text{MgCl}_2$

- 101.** Classify each of the equations in Problem 100 by type.

- 102.** Write balanced equations for each of these reactions. Indicate states of matter in your equations.

- Potassium metal reacts with water to form hydrogen gas and aqueous potassium hydroxide.
- Nitrogen monoxide gas reacts with gaseous carbon monoxide to form carbon dioxide gas and nitrogen gas.

- 55.3 g Pb
- 8.24 g O
- 254 g F
- 1.50 g P
- 1.03 g C
- 2.54 g S
- 45.6 g Br
- 30.0 g C

- yes
- no
- no
- yes

- $\text{C}_3\text{H}_8\text{N}$
- CH
- $\text{C}_3\text{H}_4\text{N}$
- $\text{C}_3\text{H}_7\text{OH}$

- CH_2
- CH_4O
- UF_6
- $\text{C}_2\text{H}_4\text{O}_2\text{N}$
- BaC_2O_4
- P_2S_5
- Na_2O
- Li_2CO_3

- C_4H_6
- $\text{C}_6\text{H}_8\text{O}_6$
- $\text{C}_4\text{H}_4\text{Cl}_2$
- $\text{C}_{10}\text{H}_{14}\text{N}_2$

- 95.** $\text{C}_{18}\text{H}_{12}\text{N}_6$

- 96.** $\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$

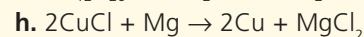
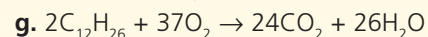
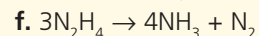
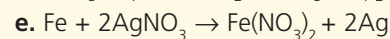
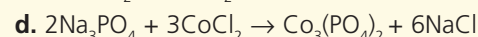
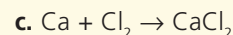
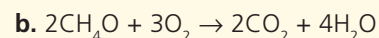
- 97.** empirical formula, $\text{C}_9\text{H}_{16}\text{O}$; molecular formula, $\text{C}_{18}\text{H}_{32}\text{O}_2$

- 98.** empirical formula, CHNO; molecular formula, $\text{C}_3\text{H}_3\text{N}_3\text{O}_3$

Chapter 11

- 99.** acting as a catalyst

- 100. a.** $\text{Hg}(\text{NO}_3)_2 + 2\text{NH}_4\text{SCN} \rightarrow \text{Hg}(\text{SCN})_2 + 2\text{NH}_4\text{NO}_3$



- 101. a.** double-replacement **b.** combustion
c. combination **d.** double-replacement
e. single-replacement **f.** decomposition
g. combustion **h.** single replacement

- 102. a.** $2\text{K}(s) + 2\text{H}_2\text{O}(l) \rightarrow \text{H}_2(g) + 2\text{KOH}(aq)$

