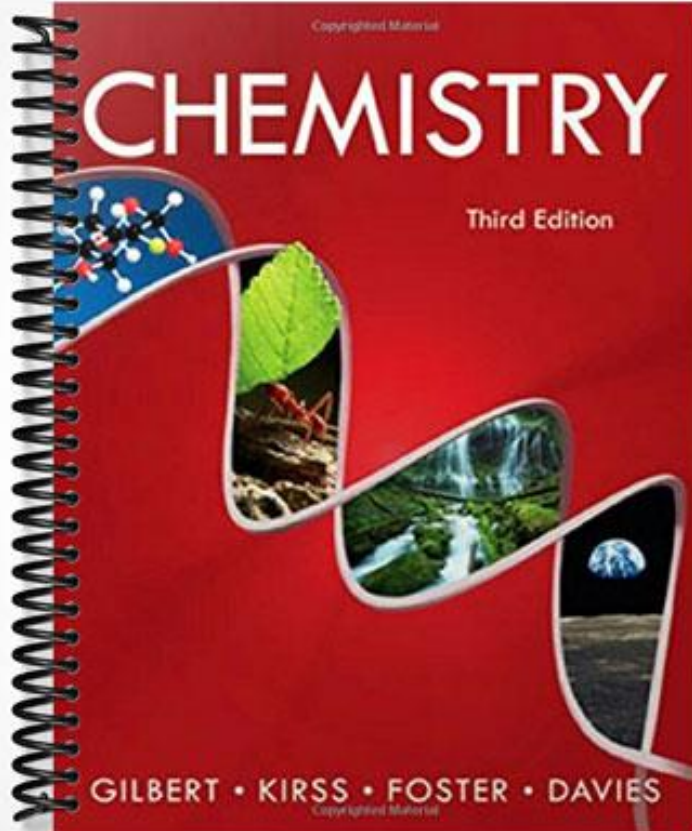


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# CHEMISTRY

Third Edition



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## Chapter 2: Atoms, Ions, and Compounds

### MULTIPLE CHOICE

1. Who discovered electrons?

- a. Robert Boyle
- b. Robert Millikan
- c. Joseph John Thomson
- d. John Dalton
- e. Albert Einstein

ANS: C                      DIF: Easy                      REF: 2.1

OBJ: Identify the scientists who contributed to the development of modern atomic theory.

MSC: Factual

2. Who was the first scientist to determine the charge of an electron?

- a. Robert Boyle
- b. Robert Millikan
- c. Joseph John Thomson
- d. John Dalton
- e. Albert Einstein

ANS: B                      DIF: Easy                      REF: 2.1

OBJ: Identify the scientists who contributed to the development of modern atomic theory.

MSC: Factual

3. What is the correct symbol for an electron?

- a.  ${}^0_{-1}e$
- b.  ${}^1_{-0}e$
- c.  ${}^0_1e$
- d.  ${}^1_{-1}e$
- e.  ${}^0_0e$

ANS: A                      DIF: Easy                      REF: 2.1

OBJ: Write the complete symbols used for subatomic particles.                      MSC: Applied

4. What is the correct symbol for a proton?

- a.  ${}^0_{-1}p$
- b.  ${}^0_1p$
- c.  ${}^1_1p$
- d.  ${}^1_0p$
- e.  ${}^0_0p$

ANS: C                      DIF: Easy                      REF: 2.1

OBJ: Write the complete symbols used for subatomic particles.                      MSC: Applied

5. What is the correct symbol for a neutron?

- a.  ${}^1_0n$
- b.  ${}^1_1n$
- c.  ${}^0_1n$
- d.  ${}^1_{-1}n$
- e.  ${}^0_0n$

ANS: A                      DIF: Easy                      REF: 2.1

OBJ: Write the complete symbols used for subatomic particles.                      MSC: Applied

6. What is the correct symbol for an  $\alpha$  particle?

- a.  ${}^4_1\alpha$
- b.  ${}^2_2\alpha$
- c.  ${}^4_2\alpha$
- d.  ${}^4_2\alpha$
- e.  ${}^0_0\alpha$

c.  $\frac{2}{4}\alpha$

ANS: D                      DIF: Medium                      REF: 2.1  
OBJ: Write the complete symbols used for subatomic particles.                      MSC: Applied

7. In the Rutherford–Geiger–Marsden experiment,  $\alpha$  particles were projected at a thin film of \_\_\_\_\_
- a. gold.
  - b. silver.
  - c. platinum.
  - d. sodium.
  - e. aluminum.

ANS: A                      DIF: Easy                      REF: 2.1  
OBJ: Identify and describe experiments that provided evidence to support modern atomic theory.  
MSC: Factual

8. In the atoms in the Rutherford–Geiger–Marsden experiment, the  $\alpha$  particles were repelled by \_\_\_\_\_
- a. electrons.
  - b. protons.
  - c. neutrons.
  - d. nuclei.
  - e. gravity.

ANS: D                      DIF: Easy                      REF: 2.1  
OBJ: Identify and describe experiments that provided evidence to support modern atomic theory.  
MSC: Factual

9. Which one of the following experiments provided evidence that atoms contained small massive nuclei with positive charges?
- a. Bunsen and Kirchoff’s flame test
  - b. Fraunhofer lines
  - c. the Rutherford–Geiger–Marsden experiment
  - d. Thomson’s experiments with cathode ray tubes
  - e. Millikan’s oil-drop experiment

ANS: C                      DIF: Easy                      REF: 2.1  
OBJ: Identify and describe experiments that provided evidence to support modern atomic theory.  
MSC: Factual

10. Rutherford, Geiger, and Marsden’s experiment demonstrated that the volume of the nucleus is roughly what fraction of the volume occupied by the electrons?
- a. 1/10
  - b. 1/100
  - c. 1/1,000
  - d. 1/10,000
  - e. 1/100,000

ANS: D                      DIF: Easy                      REF: 2.1  
OBJ: Compare the size of the nucleus with the size of the atom.                      MSC: Factual

11. If an atom had a radius of 100 m, it would be approximately the size of a football stadium. On this scale, what would be the radius of the atomic nucleus since the radius of the nucleus is approximately 10,000 times smaller than the radius of an atom?
- a. 1 mm, like a very dull pencil point
  - b. 1 cm, like a dime
  - c. 10 cm, like your longest finger
  - d. 10  $\mu$  m, like a red blood cell
  - e. 100 pm, like a real atom

ANS: B                      DIF: Difficult                      REF: 2.1  
OBJ: Compare the size of the nucleus with the size of the atom.                      MSC: Applied

12. Protons and neutrons are examples of \_\_\_\_\_
- a. nuclei.
  - b. nuclides.
  - c. isotopes.
  - d. isotopes.
  - e. charged particles.

c. nucleons.

ANS: C  
MSC: Factual

DIF: Easy

REF: 2.2

OBJ: Identify the subatomic particles.

13. The  ${}^4\text{He}$  nucleus is an example of \_\_\_\_\_

- a. a nuclide.
- b. an element.
- c. a proton.
- d. a neutron.
- e. a nucleon.

ANS: A  
MSC: Factual

DIF: Easy

REF: 2.2

OBJ: Identify the subatomic particles.

14. A  ${}^{35}_{17}\text{Cl}$  atom has \_\_\_\_\_ protons, \_\_\_\_\_ neutrons, and \_\_\_\_\_ electrons.

- a. 17, 18, 19
- b. 17, 20, 17
- c. 17, 17, 20
- d. 17, 18, 17
- e. 18, 17, 18

ANS: D

DIF: Easy

REF: 2.2

OBJ: Decompose an atomic symbol to determine the number of protons, neutrons, and electrons.

MSC: Applied

15. A  ${}^{16}_8\text{O}^{2-}$  ion has \_\_\_\_\_ protons, \_\_\_\_\_ neutrons, and \_\_\_\_\_ electrons.

- a. 8, 10, 8
- b. 8, 10, 10
- c. 8, 8, 10
- d. 8, 8, 8
- e. 8, 16, 8

ANS: C

DIF: Easy

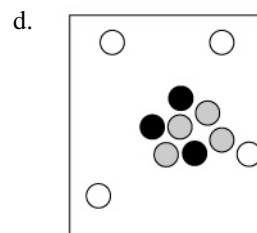
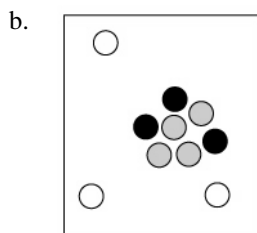
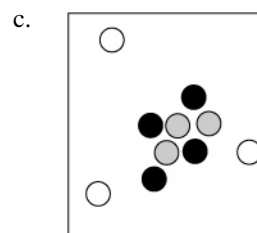
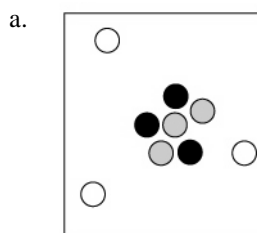
REF: 2.2

OBJ: Decompose an atomic symbol to determine the number of protons, neutrons, and electrons.

MSC: Applied

16. Which particle diagram is the best representation for a  ${}^7_3\text{Li}$  atom?

● = Proton  
● = Neutron  
○ = Electron



ANS: B

DIF: Easy

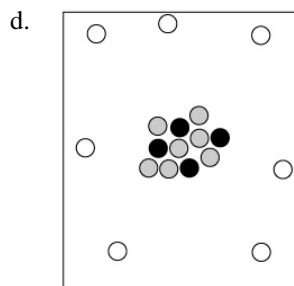
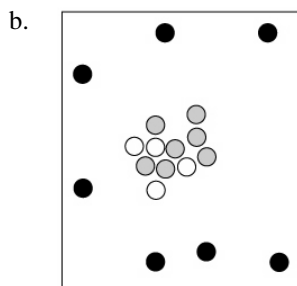
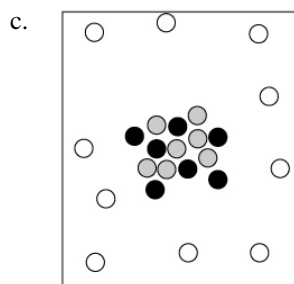
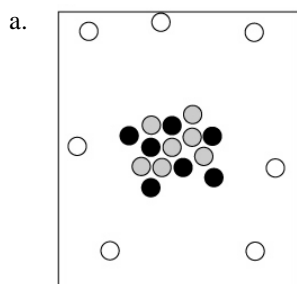
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OBJ: Identify how particles are distributed in an atom given its atomic symbol.

MSC: Conceptual

17. Which particle-level diagram is the best representation of a  ${}^{14}_7\text{N}^{3-}$  ion?

- = Proton
- = Neutron
- = Electron



ANS: C

DIF: Easy

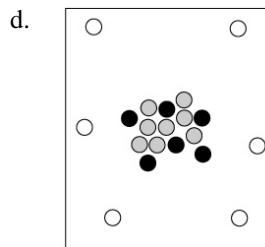
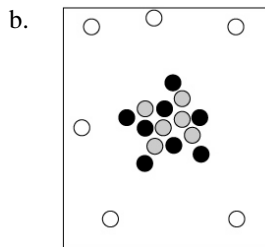
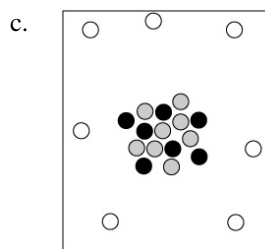
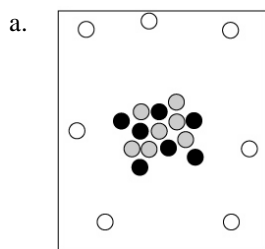
REF: 2.2

OBJ: Identify how particles are distributed in an atom given its atomic symbol.

MSC: Conceptual

18. When cosmic rays strike atoms in the upper atmosphere, energetic neutrons are produced. These neutrons collide with nitrogen-14 atoms, producing carbon-14 atoms and hydrogen atoms. Which diagram represents the carbon-14 product?

- = Proton
- = Neutron
- = Electron



ANS: D

DIF: Medium

REF: 2.2

OBJ: Identify how particles are distributed in an atom given its name.

MSC: Conceptual

19. Which statement best describes isotopes?

- a. They have the same atomic mass.



- b. Cl  
c. Ar
- e. Ca

ANS: D DIF: Difficult REF: 2.3

OBJ: Determine the average atomic mass of an atom from data on the masses and natural abundances of its isotopes.  
MSC: Applied

25. A hypothetical element has two stable isotopes: one isotope has a mass of 106.9051 amu with an abundance of 48.183%, the other isotope has a mass of 108.9048 amu with an abundance of 51.825%. What is the average atomic mass of this element?

- a. 107.980 amu  
b. 107.970 amu  
c. 107.960 amu
- d. 107.950 amu  
e. 107.940 amu

ANS: D DIF: Difficult REF: 2.3

OBJ: Determine the average atomic mass of an atom from data on the masses and natural abundances of its isotopes.  
MSC: Applied

26. The average atomic mass of lithium is 6.941 amu. Lithium has two naturally occurring isotopes,  ${}^6\text{Li}$  (7.52%) and  ${}^7\text{Li}$  (92.48%). The mass of  ${}^6\text{Li}$  is 6.0151 amu. What is the mass of  ${}^7\text{Li}$ ?

- a. 7.016 amu  
b. 0.926 amu  
c. 6.001 amu
- d. 7.000 amu  
e. 6.941 amu

ANS: A DIF: Difficult REF: 2.3

OBJ: Determine the mass of an isotope from the average mass and natural abundances of other isotopes.  
MSC: Applied

27. Zinc has five naturally occurring isotopes with an average mass of 65.39 amu. Three isotopes, in roughly equal amounts, account for 95% of zinc. Which isotope is most abundant?

- a.  ${}^{64}\text{Zn}$ , 63.9291 amu  
b.  ${}^{66}\text{Zn}$ , 65.9260 amu  
c.  ${}^{67}\text{Zn}$ , 66.9271 amu
- d.  ${}^{68}\text{Zn}$ , 67.9249 amu  
e.  ${}^{70}\text{Zn}$ , 69.9253 amu

ANS: A DIF: Difficult REF: 2.3

OBJ: Given an average atomic mass, identify the isotope that is likely to be the most abundant.  
MSC: Conceptual

28. Enriched weapons-grade uranium consists of 80% uranium-235 (235.044 amu) and 20% uranium-238 (238.051 amu). What is the average atomic mass of weapons grade uranium assuming the percentages are exact?

- a. 235.044 amu  
b. 236.547 amu  
c. 238.051 amu
- d. 235.645 amu  
e. 235.754 amu

ANS: D DIF: Difficult REF: 2.3

OBJ: Determine the average atomic mass of an atom from data on the masses and natural abundances of its isotopes.  
MSC: Applied

29. What is the symbol for sulfur?

- a. Si  
b. Sc  
c. Su
- d. S  
e. Sf

ANS: D DIF: Easy REF: 2.4

OBJ: Convert between the name and symbol of an element. MSC: Factual

30. What is the symbol for magnesium?

- a. M  
d. Mo





ANS: A                    DIF: Easy                    REF: 2.4  
OBJ: Classify/identify an element as a metal, metalloid, or nonmetal.    MSC: Factual

38. Sodium is best described as a \_\_\_\_\_

- a. metalloid.
- b. metal.
- c. transition metal.
- d. noble gas.
- e. nonmetal.

ANS: B                    DIF: Easy                    REF: 2.4  
OBJ: Classify/identify an element as a metal, metalloid, or nonmetal.    MSC: Factual

39. Cobalt is best described as a \_\_\_\_\_

- a. metalloid.
- b. transition metal.
- c. chalcogen.
- d. noble gas.
- e. nonmetal.

ANS: B                    DIF: Easy                    REF: 2.4  
OBJ: Identify the transition metals in the periodic table.                    MSC: Factual

40. Oxygen is best described as a \_\_\_\_\_

- a. metalloid.
- b. metal.
- c. transition metal.
- d. noble gas.
- e. nonmetal.

ANS: E                    DIF: Easy                    REF: 2.4  
OBJ: Classify/identify an element as a metal, metalloid, or nonmetal.    MSC: Factual

41. Based on its position in the periodic table, which atom would you predict to form a compound with two bromine atoms?

- a. sodium
- b. aluminum
- c. lithium
- d. calcium
- e. carbon

ANS: D                    DIF: Easy                    REF: 2.4  
OBJ: Identify combining ratios of atoms based on their positions in the periodic table.  
MSC: Applied

42. Based on its position in the periodic table, which atom would you predict to form a compound with one chlorine atom?

- a. boron
- b. aluminum
- c. lithium
- d. calcium
- e. carbon

ANS: C                    DIF: Easy                    REF: 2.4  
OBJ: Identify combining ratios of atoms based on their positions in the periodic table.  
MSC: Applied

43. What is the correct formula for the compound formed between sodium and iodine based on their positions in the periodic table?

- a. Na<sub>2</sub>I
- b. NaI<sub>2</sub>
- c. NaI
- d. Na<sub>2</sub>I<sub>2</sub>
- e. Na<sub>3</sub>I

ANS: C                    DIF: Easy                    REF: 2.4  
OBJ: Identify combining ratios of atoms based on their positions in the periodic table.  
MSC: Applied

44. The sixth period of the periodic table contains \_\_\_\_\_ elements.

- a. 18  
b. 32  
c. 24
- d. 16  
e. 8

ANS: B                      DIF: Difficult                      REF: 2.4  
OBJ: Identify periods in the periodic table.                      MSC: Applied

45. Dalton's law of multiple proportions deals with \_\_\_\_\_
- a. the proportions of reacting chemicals that maximize the reaction rate.  
b. the total number of different compounds that can be made from two elements.  
c. the volumes of two elements that can combine to form two or more compounds.  
d. the masses of two elements that can combine to form two or more compounds.  
e. reactions that involve multiple steps.

ANS: D                      DIF: Medium                      REF: 2.5  
OBJ: Identify the meaning of Dalton's law of multiple proportions.                      MSC: Conceptual

46. Dalton's law of multiple proportions can be applied to \_\_\_\_\_
- a. H<sub>2</sub>O and CO<sub>2</sub>.  
b. CO and NO.  
c. PF<sub>3</sub> and PF<sub>5</sub>.
- d. SO<sub>2</sub> and CO.  
e. O<sub>2</sub> and O<sub>3</sub>.

ANS: C                      DIF: Easy                      REF: 2.5  
OBJ: Identify the meaning of Dalton's law of multiple proportions.                      MSC: Conceptual

47. Iron can form two sulfides: FeS and Fe<sub>2</sub>S<sub>3</sub>. Use Dalton's law of multiple proportions to predict the ratio of the two masses of sulfur that combine with 100 g of iron in each case to form these compounds.
- a. 1:1  
b. 1:3  
c. 1:2
- d. 2:3  
e. 3:4

ANS: D                      DIF: Easy                      REF: 2.5  
OBJ: Use Dalton's law of multiple proportions to determine the combining ratio of elements in forming compounds.                      MSC: Applied

48. When 10.0 g of sulfur is combined with 10.0 g of oxygen, 20.0 g of sulfur dioxide is formed. What mass of oxygen would be required to convert 10.0 g of sulfur into sulfur trioxide?
- a. 5.0 g  
b. 10 g  
c. 15 g
- d. 30 g  
e. 20 g

ANS: C                      DIF: Difficult                      REF: 2.5  
OBJ: Use Dalton's law of multiple proportions to determine the combining ratio of elements in forming compounds.                      MSC: Applied

49. Nitrogen and oxygen combine to form several different nitrogen oxides. In one case, 8.4 g of nitrogen reacted completely with 4.8 g of oxygen. In another case, 4.2 g of nitrogen reacted with 9.6 g of oxygen. Which pair of nitrogen oxides is consistent with these data?
- a. NO and N<sub>2</sub>O  
b. NO and NO<sub>2</sub>  
c. N<sub>2</sub>O and N<sub>2</sub>O<sub>5</sub>
- d. NO and N<sub>2</sub>O<sub>4</sub>  
e. N<sub>2</sub>O and N<sub>2</sub>O<sub>4</sub>

ANS: E                      DIF: Difficult                      REF: 2.5  
OBJ: Use Dalton's law of multiple proportions to determine the combining ratio of elements in forming compounds.                      MSC: Applied

50. Which one of the following statements is *not* consistent with Dalton's atomic theory of matter?
- a. Atoms of one element can be converted into atoms of another element.

- b. Each element is composed of atoms that are identical in size, mass, and chemical properties.
- c. Compounds are formed from different atoms in simple whole number ratios.
- d. Atoms of different elements can combine in several different proportions to make different compounds.
- e. Matter is discrete, as proposed by Democritus.

ANS: A                    DIF: Easy                    REF: 2.5  
OBJ: Identify the components of the modern atomic theory.                    MSC: Factual

51. Which has more mass: a lump of coal (assumed to be 100% carbon) or the carbon dioxide gas formed from burning the lump of coal?
- a. The lump of coal because it is a solid.
  - b. The lump of coal because gases have little mass.
  - c. The carbon dioxide gas because it occupies a much larger volume.
  - d. The carbon dioxide gas because it includes oxygen that was added from the air.
  - e. Both weigh the same because mass is conserved.

ANS: D                    DIF: Easy                    REF: 2.5  
OBJ: Apply conservation of mass to chemical reactions.                    MSC: Conceptual

52. Which contains more carbon by mass, 1 g of CO<sub>2</sub> or 1 g of CO?
- a. CO<sub>2</sub>
  - b. CO
  - c. Both contain the same mass of carbon.
  - d. Both contain the same mass of carbon, but different masses of oxygen.

ANS: B                    DIF: Medium                    REF: 2.5  
OBJ: Apply conservation of mass to chemical reactions.                    MSC: Conceptual

53. Which has more mass, 1 g of CO<sub>2</sub> gas or 1 g of CO gas?
- a. CO
  - b. CO<sub>2</sub>
  - c. Both have the same mass.
  - d. It depends on the density of these gases.
  - e. It depends on the volume of these gases.

ANS: C                    DIF: Easy                    REF: 2.5  
OBJ: Apply the concepts of mass, volume, and density correctly.                    MSC: Conceptual

54. Which would produce the larger mass of carbon dioxide, CO<sub>2</sub>, when combined with oxygen: 1 g of pure carbon or 1 g of pure octane (C<sub>8</sub>H<sub>14</sub>)? Assume that all the carbon is converted to carbon dioxide in both cases.
- a. C
  - b. C<sub>8</sub>H<sub>14</sub>
  - c. They would produce the same mass of CO<sub>2</sub>.
  - d. It depends on the densities of the carbon and octane.

ANS: A                    DIF: Difficult                    REF: 2.5  
OBJ: Apply conservation of mass to chemical reactions.                    MSC: Conceptual

55. Which one of the following is an ionic compound?
- a. SO<sub>2</sub>
  - b. ClO<sub>2</sub>
  - c. H<sub>2</sub>O
  - d. TiO<sub>2</sub>
  - e. CO<sub>2</sub>

ANS: D                    DIF: Easy                    REF: 2.5  
OBJ: Classify a compound as molecular or ionic.                    MSC: Conceptual

56. Which one of the following is a molecular compound? Molecular compounds also are known as covalent compounds.



- b. NaBr  
c. Na<sub>2</sub>Br
- e. NaBr<sub>2</sub>

ANS: B                      DIF: Easy                      REF: 2.6  
OBJ: Convert between the name and formula of a binary ionic compound.  
MSC: Applied

64. What is the correct name for FeCl<sub>3</sub>?

- a. iron(III) chloride  
b. iron trichloride  
c. ferrum trichloride
- d. ferric trichloride  
e. iron chloride

ANS: A                      DIF: Medium                      REF: 2.6  
OBJ: Convert between the name and formula of a binary ionic compound.  
MSC: Applied

65. Manganese(IV) oxide is a brown insoluble solid often found as a product of reactions of potassium permanganate. What is the formula of manganese(IV) oxide?

- a. Mn<sub>4</sub>O  
b. MnO<sub>4</sub>  
c. Mn(IV)O
- d. MnO<sub>2</sub>  
e. Mn<sub>2</sub>O<sub>2</sub>

ANS: D                      DIF: Medium                      REF: 2.6  
OBJ: Convert between the name and formula of a binary ionic compound.  
MSC: Applied

66. TiO<sub>2</sub> is a white oxide used in paints. What is the proper name for TiO<sub>2</sub>?

- a. titanium oxide  
b. titanium(IV) oxide  
c. titanic acid
- d. titanium oxoate  
e. titanium dioxide

ANS: B                      DIF: Medium                      REF: 2.6  
OBJ: Convert between the name and formula of a binary ionic compound.  
MSC: Applied

67. Zinc oxide is found in ointments for the skin. What formula best describes this compound, which has Zn as a doubly charged cation?

- a. ZnO  
b. Zn<sub>2</sub>O  
c. ZnO<sub>2</sub>
- d. Zn<sub>2</sub>O<sub>2</sub>  
e. Zn<sub>2</sub>O<sub>3</sub>

ANS: A                      DIF: Medium                      REF: 2.6  
OBJ: Convert between the name and formula of a binary ionic compound.  
MSC: Applied

68. Name the following oxides of nitrogen in this sequence: NO, N<sub>2</sub>O, NO<sub>2</sub>, N<sub>2</sub>O<sub>4</sub>.

- a. nitrogen monoxide, dinitrogen oxide, nitrogen dioxide, dinitrogen tetroxide  
b. nitrox, dinitrox, nitridiox, dinitritriox  
c. mononitrogen monoxide, dinitrogen monoxide, mononitrogen dioxide, dinitrogen tetraoxide  
d. nitrogen oxide, nitrogen(II) oxide, nitrogen oxide(II), nitrogen(II) oxide(IV)  
e. nitric oxide, nitrous oxide, nitrogen dioxide, nitrogen tetraoxide

ANS: A                      DIF: Medium                      REF: 2.6  
OBJ: Convert between names and formulas of molecular compounds.  
MSC: Applied

69. Which one of the formula-name combinations is *not* correct?

- a. sulfur monoxide: SO  
d. disulfur oxide: S<sub>2</sub>O



- a. SNO  
 b. NaNO<sub>2</sub>  
 c. NaNO<sub>3</sub>
- d. Na<sub>2</sub>NO<sub>4</sub>  
 e. Na<sub>2</sub>NO<sub>2</sub>

ANS: B                    DIF: Medium                    REF: 2.6  
 OBJ: Convert between the name and the chemical formula of compounds with a polyatomic ion.  
 MSC: Applied

76. According to the Big Bang theory, which statement about the origin of the elements is *not* correct?
- a. Initially, energy was transformed into electrons and other elementary particles.  
 b. As the universe cooled, neutrons and protons were formed.  
 c. Collisions of neutrons and protons produced deuterons, which then led to the formation of alpha particles.  
 d. The nuclides of the elements then were formed by nuclear reactions in the interior of stars.  
 e. These nuclear reactions all require the addition of energy to form the elements.

ANS: E                    DIF: Medium                    REF: 2.7  
 OBJ: Describe the sequence of events that are part of the Big Bang theory.  
 MSC: Factual

77. A high-energy particle with a negative charge is called a \_\_\_\_\_ particle?

- a.  $\alpha$   
 b.  $\beta$   
 c.  $\gamma$
- d. neutron  
 e. positron

ANS: B                    DIF: Easy                    REF: 2.7  
 OBJ: Identify the particles associated with nuclear reactions.                    MSC: Factual

78. The emission of a  $\beta$  particle is associated with the \_\_\_\_\_

- a. conversion of a neutron to a proton.  
 b. conversion of a proton to a neutron.  
 c. increase in mass number.  
 d. decrease in mass number.  
 e. the formation of an isotope.

ANS: A                    DIF: Medium                    REF: 2.7  
 OBJ: Identify the products in a nuclear reaction.                    MSC: Factual

79. Two neutrons were walking down the street. One said, "Wait a minute...I think I lost a \_\_\_\_\_!" The other one asked, "Are you sure?" The first replied, "Yes, I'm *positive!*"

- a. positron  
 b.  $\beta$  particle  
 c.  $\gamma$  ray  
 d. neutrino

ANS: B                    DIF: Medium                    REF: 2.7  
 OBJ: Identify the products in a nuclear reaction.                    MSC: Factual

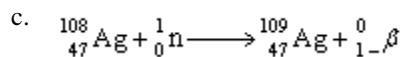
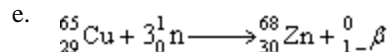
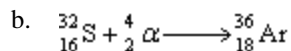
80. A supernova event is the explosion caused by the collapse of a dying star that has run out of its nuclear fuel. These stars and events are responsible for \_\_\_\_\_

- a. the production of elements heavier than iron-56.  
 b. nuclear fission of heavy elements.  
 c. the distribution of heavy elements throughout the universe.  
 d. both a and c.  
 e. both b and c.

ANS: D                    DIF: Medium                    REF: 2.7  
 OBJ: Identify the source of elements heavier the iron-56.                    MSC: Factual

81. Which stellar nuclear reaction is *not* correctly written?

- a.  ${}^{12}_6\text{C} + {}^4_2\alpha \longrightarrow {}^{16}_8\text{O}$
- d.  ${}^{68}_{30}\text{Zn} + {}^1_0\text{n} \longrightarrow {}^{70}_{31}\text{Ga} + {}^0_{-1}\beta$



ANS: C                      DIF: Difficult                      REF: 2.7

OBJ: Identify the source of elements heavier than iron-56.

MSC: Applied

## SHORT ANSWER

1. In one sentence, describe the picture of the atom that emerged from the Rutherford-Geiger-Marsden experiment with alpha particles.

ANS:

The atom was pictured as consisting of a tiny, positively charged nucleus surrounded by a diffuse cloud of negatively charged electrons.

DIF: Easy                      REF: 2.1

OBJ: Describe the picture of the atom that emerged from the Rutherford-Geiger-Marsden experiment with alpha particles.                      MSC: Factual

2. The average atomic mass of carbon is 12.01 amu. What is the average atomic mass of carbon in grams? (1 amu =  $1.6605402 \times 10^{-27}$  kg)

ANS:

$$1.994 \times 10^{-23} \text{ g}$$

DIF: Medium                      REF: 2.1

OBJ: Convert between atomic mass units, amu, and grams, g, given the equivalence statement.

MSC: Applied

3. Write the complete atomic symbol with both a superscript and a subscript for a sodium ion that contains 11 protons, 10 electrons, and 12 neutrons.

ANS:



DIF: Easy                      REF: 2.2

OBJ: Write the complete atomic symbol for a given element or ion.                      MSC: Applied

4.  ${}^1\text{H}$ ,  ${}^2\text{H}$ , and  ${}^3\text{H}$  are examples of \_\_\_\_\_ because they have different numbers of \_\_\_\_\_.

ANS:

isotopes / neutrons

DIF: Easy                      REF: 2.2

OBJ: Identify the feature that distinguishes one isotope from another.                      MSC: Applied

5. What distinguishes one isotope from another?

ANS:

Isotopes have the same number of protons but different numbers of neutrons.

DIF: Easy                      REF: 2.2

OBJ: Identify the feature that distinguishes one isotope from another.                      MSC: Applied



6. Nuclear reactors used for power generation require uranium enriched in uranium-235. What is the average atomic mass of enriched uranium consisting of exactly 3.0% uranium-235 (235.04 amu) and 97.0% uranium-238 (238.05 amu)?

ANS:  
237.96 amu

DIF: Difficult      REF: 2.3

OBJ: Calculate the average atomic mass of an element given the masses of the isotopes and their abundances.

MSC: Applied

7. Boron, which has an average atomic mass of 10.81 amu, has two stable isotopes: boron-10 (19.78%) and boron-11 (80.22%). Boron-10 has an atomic mass of 10.0129 amu; what is the atomic mass of boron-11?

ANS:  
11.01 amu

DIF: Difficult      REF: 2.3

OBJ: Determine the mass of an isotope from the average mass and natural abundances of other isotopes.

MSC: Applied

8. Give an example of an alkali metal.

ANS:  
Sodium; answers will vary.

DIF: Easy      REF: 2.4

OBJ: Associate elements with the group to which they belong.

MSC: Applied

9. Give an example of an alkaline earth metal.

ANS:  
Calcium; answers will vary.

DIF: Easy      REF: 2.4

OBJ: Associate elements with the group to which they belong.

MSC: Applied

10. Give an example of a halogen.

ANS:  
Bromine; answers will vary.

DIF: Easy      REF: 2.4

OBJ: Associate elements with the group to which they belong.

MSC: Applied

11. Give an example of a transition metal.

ANS:  
Iron; answers will vary.

DIF: Easy      REF: 2.4

OBJ: Associate elements with the group to which they belong.

MSC: Applied

12. Give an example of a nonmetal.

ANS:  
Sulfur; answers will vary.

DIF: Easy      REF: 2.4

OBJ: Classify/identify elements as metals, metalloids, or nonmetals. MSC: Applied

13. Give an example of a metalloid (aka semimetal).

ANS:

Silicon; answers will vary.

DIF: Easy REF: 2.4

OBJ: Classify/identify elements as metals, metalloids, or nonmetals. MSC: Applied

14. Give an example of an ionic compound.

ANS:

Sodium chloride, NaCl; answers will vary.

DIF: Easy

REF: 2.5

OBJ: Distinguish between ionic and covalent compounds.

MSC: Applied

15. Give an example of a molecular compound (aka a covalent compound).

ANS:

Carbon dioxide, CO<sub>2</sub>; answers will vary.

DIF: Easy

REF: 2.5

OBJ: Distinguish between ionic and covalent compounds.

MSC: Applied

16. A cation has a \_\_\_\_\_ charge, and an anion has a \_\_\_\_\_ charge.

ANS:

positive / negative

DIF: Easy

REF: 2.5

OBJ: Distinguish between anions and cations.

MSC: Factual

17. Nitrogen and oxygen combine to form several different nitrogen oxides. Chemical analysis found that the N:O mass ratio in NO is 0.875. Two other nitrogen oxides were produced by reacting 8.4 g of nitrogen completely with 4.8 g of oxygen in one case and in another case by reacting 4.2 g of nitrogen with 9.6 g of oxygen. What are the empirical formulas of these two nitrogen oxides?

ANS:

N<sub>2</sub>O and NO<sub>2</sub>

DIF: Difficult REF: 2.5

OBJ: Use Dalton's law of multiple proportions to determine combining ratios of elements in forming compounds. MSC: Applied

18. What is the chemical formula for manganese(IV) oxide?

ANS:

MnO<sub>2</sub>

DIF: Easy REF: 2.6

OBJ: Convert between the name and formula of a binary ionic compound.

MSC: Applied

19. What is the correct name for CuCl<sub>2</sub>?

ANS:

Copper(II) chloride

DIF: Easy                    REF: 2.6  
OBJ: Convert between the name and formula of a binary ionic compound.  
MSC: Applied

20. What is the chemical formula for hexasulfur monoxide?

ANS:  
S<sub>6</sub>O

DIF: Easy                    REF: 2.6  
OBJ: Convert between the name and the molecular formula of a binary molecular compound.  
MSC: Applied

21. What is the correct name for SO<sub>3</sub>?

ANS:  
Sulfur trioxide

DIF: Easy                    REF: 2.6  
OBJ: Convert between the name and the molecular formula of a binary molecular compound.  
MSC: Applied

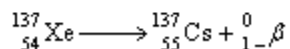
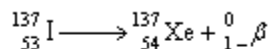
22. The evaporation of seawater gives a mixture of ionic compounds containing sodium combined with chloride, sulfate, carbonate, and hydrogen carbonate. Write the chemical formulas of these compounds.

ANS:  
NaCl, Na<sub>2</sub>SO<sub>4</sub>, Na<sub>2</sub>CO<sub>3</sub>, NaHCO<sub>3</sub>

DIF: Difficult                REF: 2.6  
OBJ: Convert between the name and the chemical formula of compounds with a polyatomic ion.  
MSC: Applied

23. Iodine-137 decays to xenon by beta emission, which then decays to cesium-137. Write the nuclear reaction equations for these two decay processes.

ANS:



DIF: Difficult                REF: 2.7                    OBJ: Write nuclear reaction equations.  
MSC: Applied