

## Chapter 2: Atoms, Molecules, and Ions

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1. According to the law of definite proportions,
- A) the ratio of the masses of the elements in a compound is always the same.
  - B) it is not possible for the same two elements to form more than one compound.
  - C) if the same two elements form two different compounds, they do so in the same ratio.
  - D) the total mass after a chemical change is the same as before the change.

ANS: A                    PTS: 1                    DIF: easy                    TOP: 2.2  
KEY: general chemistry | general concepts | matter | compound

2. Which of the following pairs of compounds can be used to illustrate the law of multiple proportions?
- A) CaO and CaCl<sub>2</sub>
  - B) NO and NO<sub>2</sub>
  - C) H<sub>2</sub>O and HI
  - D) CH<sub>4</sub> and CO<sub>2</sub>
  - E) NH<sub>3</sub> and NBr<sub>3</sub>

ANS: B                    PTS: 1                    DIF: easy                    TOP: 2.2  
KEY: general chemistry | general concepts | matter | compound

3. How many of the following did Dalton *not* discuss in his atomic theory?
- I. isotopes
  - II. ions
  - III. protons
  - IV. neutrons
  - V. electrons

- A) 2
- B) 5
- C) 4
- D) 1
- E) 3

ANS: B                    PTS: 1                    DIF: easy                    TOP: 2.3  
KEY: general chemistry | early atomic theory | atomic theory of matter | Dalton's atomic theory

4. When 3.0 L of hydrogen gas (H<sub>2</sub>) reacts with 1.0 L of nitrogen gas (N<sub>2</sub>), 2.0 L of gaseous product is formed. All volumes of gases are measured at the same temperature and pressure. What is the formula of the product?
- A) NH
  - B) NH<sub>4</sub>
  - C) N<sub>2</sub>H<sub>3</sub>
  - D) N<sub>3</sub>H
  - E) NH<sub>3</sub>

ANS: E                   PTS: 1                   DIF: easy                   TOP: 2.4  
KEY: general chemistry | early atomic theory | chemical substance | chemical formula | molecular substance

5. Which one of the following statements about atomic structure is false?
- A) Almost all of the mass of the atom is concentrated in the nucleus.
  - B) The protons and neutrons in the nucleus are very tightly packed.
  - C) The number of protons and the number of neutrons are always the same in the neutral atom.
  - D) The electrons occupy a very large volume compared to the nucleus.

ANS: C                   PTS: 1                   DIF: easy                   TOP: 2.4 | 2.5  
KEY: general chemistry | early atomic theory | atomic theory of matter | nuclear structure

6. Which of the experiments listed below did *not* provide the information stated about the nature of the atom?
- A) The Rutherford experiment proved that the Thomson "plum pudding" model of the atom was essentially correct.
  - B) The Rutherford experiment determined the charge on the nucleus.
  - C) The cathode-ray tube proved that electrons have a negative charge.
  - D) Millikan's oil-drop experiment showed that the charge on any particle was a simple multiple of the charge on the electron.

ANS: A                   PTS: 1                   DIF: easy                   TOP: 2.5  
KEY: general chemistry | early atomic theory | atomic theory of matter | structure of the atom

7. Which of the following atomic symbols is incorrect?
- A)  $^{31}_{15}\text{P}$
  - B)  $^{20}_{10}\text{Ne}$
  - C)  $^{34}_{17}\text{Cl}$
  - D)  $^{39}_{19}\text{K}$
  - E)  $^{13}_6\text{N}$

ANS: E                   PTS: 1                   DIF: easy                   TOP: 2.5  
KEY: general chemistry | early atomic theory | atomic theory of matter | isotope

8. The element rhenium (Re) exists as two stable isotopes and 18 unstable isotopes. Rhenium-185 has in its nucleus
- A) 75 protons, 110 neutrons.
  - B) 75 protons, 75 neutrons.
  - C) 75 protons, 130 neutrons.
  - D) 130 protons, 75 neutrons.
  - E) not enough information is given.

ANS: A                   PTS: 1                   DIF: easy                   TOP: 2.5  
KEY: general chemistry | early atomic theory | atomic theory of matter | isotope

9. Which of the following statements is(are) true?
- I. O and F have the same number of neutrons.
  - II. C and N are isotopes of each other because their mass numbers are the same.
  - III.  $O^{2-}$  has the same number of electrons as Ne.

- A) I only
- B) II only
- C) III only
- D) I and II only
- E) I and III only

ANS: C                    PTS: 1                    DIF: moderate            TOP: 2.5  
KEY: general chemistry | early atomic theory | atomic theory of matter | isotope

10. Which among the following represent a set of isotopes? Atomic nuclei containing
- I. 20 protons and 20 neutrons.
  - II. 21 protons and 19 neutrons.
  - III. 22 neutrons and 18 protons.
  - IV. 20 protons and 22 neutrons.
  - V. 21 protons and 20 neutrons.

- A) I, V
- B) III, IV
- C) I, II, III
- D) I, IV and II, V
- E) No isotopes are indicated.

ANS: D                    PTS: 1                    DIF: moderate            TOP: 2.5  
KEY: general chemistry | early atomic theory | atomic theory of matter | isotope

11. How many protons, neutrons, and electrons does the atom  $^{31}\text{P}$  have?
- A) 16 protons, 15 neutrons, 16 electrons
  - B) 15 protons, 15 neutrons, 31 electrons
  - C) 16 protons, 16 neutrons, 15 electrons
  - D) 15 protons, 15 neutrons, 15 electrons
  - E) 15 protons, 16 neutrons, 15 electrons

ANS: E                    PTS: 1                    DIF: easy                    TOP: 2.6  
KEY: general chemistry | early atomic theory | atomic theory of matter | isotope

12. An ion is formed
- I. by either adding protons to or subtracting protons from the atom.
  - II. by either adding electrons to or subtracting electrons from the atom.
  - III. by either adding neutrons to or subtracting neutrons from the atom.

- A) Only I is true.
- B) Only II is true.

- C) Only III is true.
- D) All of the statements are true.
- E) Two of the statements are true.

ANS: B                      PTS: 1                      DIF: easy                      TOP: 2.6  
KEY: general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance

13. Which is the symbol for the isotope of nitrogen that has 7 protons and 8 neutrons?

- A)  ${}^7_8\text{N}$
- B)  ${}^7_{15}\text{N}$
- C)  ${}^8_7\text{N}$
- D)  ${}^{15}_7\text{N}$

ANS: D                      PTS: 1                      DIF: easy                      TOP: 2.6  
KEY: general chemistry | early atomic theory | atomic theory of matter | isotope

14. Which of the following represents a pair of isotopes?

- A)  ${}^{15}_7\text{N}$ ,  ${}^{15}_8\text{O}$
- B)  ${}^{12}_6\text{C}$ ,  ${}^{13}_6\text{C}$
- C)  ${}^{18}_8\text{O}$ ,  ${}^{19}_9\text{F}$
- D)  ${}^{32}_{16}\text{S}$ ,  ${}^{32}_{16}\text{S}^{2-}$
- E)  $\text{O}_2$ ,  $\text{O}_3$

ANS: B                      PTS: 1                      DIF: easy                      TOP: 2.6 | 2.7  
KEY: general chemistry | early atomic theory | atomic theory of matter | isotope

15. Which of the following statements is(are) true?

- I. The number of protons is the same for all neutral atoms of an element.
- II. The number of electrons is the same for all neutral atoms of an element.
- III. The number of neutrons is the same for all neutral atoms of an element.

- A) I, II, and III are all true.
- B) I, II, and III are all false.
- C) Only I and II are true.
- D) Only I and III are true.
- E) Only II and III are true.

ANS: C                      PTS: 1                      DIF: easy                      TOP: 2.6 | 2.7  
KEY: general chemistry | early atomic theory | atomic theory of matter | isotope

16. The ion  ${}^{31}\text{P}^{3-}$  has

- A) 15 protons, 15 neutrons, 12 electrons
- B) 15 protons, 15 neutrons, 3 electrons
- C) 15 protons, 31 neutrons, 15 electrons
- D) 15 protons, 16 neutrons, 18 electrons
- E) 15 protons, 15 neutrons, 15 electrons

ANS: D                   PTS: 1                   DIF: easy                   TOP: 2.6 | 2.9  
KEY: general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance

17. The ion  $^{127}\text{I}^-$  has
- A) 53 protons, 74 neutrons, 52 electrons
  - B) 53 protons, 74 neutrons, 54 electrons
  - C) 53 protons, 53 neutrons, 53 electrons
  - D) 53 protons, 74 neutrons, 53 electrons
  - E) 53 protons, 127 neutrons, 54 electrons

ANS: B                   PTS: 1                   DIF: easy                   TOP: 2.6 | 2.9  
KEY: general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance

18. An element's most stable ion forms an ionic compound with chlorine having the formula  $\text{XCl}_2$ . If the mass number of the ion is 24 and it has 10 electrons, what is the element and how many neutrons does it have?
- A) Mg, 12 neutrons
  - B) Ne, 16 neutrons
  - C) O, 16 neutrons
  - D) Ne, 14 neutrons
  - E) Na, 11 neutrons

ANS: A                   PTS: 1                   DIF: moderate                   TOP: 2.6 | 2.9  
KEY: general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance

19. Which element does *not* belong to the family or classification indicated?
- A) I, halogen
  - B) K, alkali metal
  - C) Sn, lanthanides
  - D) Ar, noble gas
  - E) Fe, transition metal

ANS: C                   PTS: 1                   DIF: easy                   TOP: 2.7 | 2.8  
KEY: general chemistry | early atomic theory | periodic table

20. Which are alkaline earth halides?
- A)  $\text{MgO}$ ,  $\text{MgS}$ ,  $\text{CaO}$
  - B)  $\text{NaI}$ ,  $\text{KBr}$ ,  $\text{LiF}$
  - C)  $\text{CaF}_2$ ,  $\text{MgBr}_2$ ,  $\text{SrI}_2$
  - D)  $\text{Al}_2\text{O}_3$ ,  $\text{In}_2\text{O}_3$ ,  $\text{Ga}_2\text{S}_3$
  - E)  $\text{PbI}_2$ ,  $\text{PbBr}_2$ ,  $\text{CdF}_2$

ANS: C                   PTS: 1                   DIF: easy                   TOP: 2.8 | 2.9  
KEY: general chemistry | early atomic theory | periodic table

21. Select the group of symbols that would correctly complete the following statements, respectively.

\_\_\_ is the heaviest noble gas.

\_\_\_ is the transition metal that has 24 electrons as a 3+ ion.

\_\_\_ is the halogen in the third period.

\_\_\_ is the alkaline earth metal that has 18 electrons as a stable ion.

A) Rn, Cr, Br, Ca

B) Ra, Sc, Br, K

C) Ra, Co, Cl, K

D) Rn, Co, Cl, Ca

ANS: D                      PTS: 1                      DIF: moderate                      TOP: 2.8 | 2.9

KEY: general chemistry | early atomic theory | periodic table

22. \_\_\_\_\_ form ions with a 2+ charge when they react with nonmetals.

A) Halogens

B) Noble gases

C) Alkaline earth metals

D) Alkali metals

E) None of these choices

ANS: C                      PTS: 1                      DIF: easy                      TOP: 2.8

KEY: general chemistry | early atomic theory | periodic table | group

23. Which of the following formulas is *not* correct?

A) Ba(OH)<sub>2</sub>

B) LiO

C) NaBr

D) CsCl

E) MgSO<sub>3</sub>

ANS: B                      PTS: 1                      DIF: easy                      TOP: 2.8

KEY: general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance

24. Which of the following is *not* the correct chemical formula for the compound named?

A) Fe<sub>3</sub>SO<sub>4</sub>                      iron(III) sulfate

B) BaBr<sub>2</sub>                      barium bromide

C) Li<sub>2</sub>O                      lithium oxide

D) HCl                      hydrogen chloride

E) Mg<sub>3</sub>N<sub>2</sub>                      magnesium nitride

ANS: A                      PTS: 1                      DIF: easy                      TOP: 2.9

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

25. Which of the following is *not* the correct name for the formula given?

- A) HClO                    hypochlorous acid
- B) Cr<sub>2</sub>O<sub>3</sub>                chromium(III) oxide
- C) NCl<sub>3</sub>                   nitrogen trichloride
- D) CoO                     cobalt(II) oxide
- E) CaSO<sub>4</sub>                 calcium sulfite

ANS: E                    PTS: 1                    DIF: easy                TOP: 2.9

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound

26. Which is *not* the correct chemical formula for the compound named?

- A) iron(II) oxide                    FeO
- B) potassium sulfate                K<sub>2</sub>SO<sub>4</sub>
- C) ammonium sulfide                NH<sub>4</sub>S
- D) zinc nitrate                        Zn(NO<sub>3</sub>)<sub>2</sub>
- E) magnesium carbonate            MgCO<sub>3</sub>

ANS: C                    PTS: 1                    DIF: easy                TOP: 2.9

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

27. What is the correct formula for barium phosphate?

- A) Ba<sub>2</sub>PO<sub>4</sub>
- B) Ba<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>
- C) Ba<sub>2</sub>(PO<sub>4</sub>)<sub>3</sub>
- D) Ba<sub>3</sub>PO<sub>4</sub>
- E) BaPO<sub>4</sub>

ANS: B                    PTS: 1                    DIF: easy                TOP: 2.9

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

28. Which of the following is *not* the correct chemical formula for the compound named?

- A) HF                        hydrogen fluoride
- B) MgO                     magnesium oxide
- C) Fe<sub>3</sub>PO<sub>4</sub>                iron(III) phosphate
- D) Li<sub>2</sub>O                    lithium oxide
- E) BaCl<sub>2</sub>                 barium chloride

ANS: C                    PTS: 1                    DIF: easy                TOP: 2.9

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound

29. Which formula is *not* correct?

- A) LiF
- B) Ba(NO<sub>2</sub>)<sub>2</sub>
- C) ZnBr
- D) NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>
- E) CaO

ANS: C                      PTS: 1                      DIF: easy                      TOP: 2.9  
KEY: general chemistry | early atomic theory | chemical substance | chemical formula | ionic substance

30. What is the correct formula for chromium(VI) oxide?

- A)  $\text{CrO}_6$
- B)  $\text{CrO}_2$
- C)  $\text{Cr}_2\text{O}_3$
- D)  $\text{Cr}_6\text{O}$
- E)  $\text{CrO}_3$

ANS: E                      PTS: 1                      DIF: moderate                      TOP: 2.9  
KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

31. Which of the following is *not* the correct name for the formula given?

- A)  $\text{PCl}_5$                       phosphorus pentachloride
- B)  $\text{Fe}_2\text{O}_3$                       iron(III) oxide
- C)  $\text{HClO}$                       hypochlorous acid
- D)  $\text{BaSO}_3$                       barium sulfate
- E)  $\text{CoO}$                       cobalt(II) oxide

ANS: D                      PTS: 1                      DIF: easy                      TOP: 2.9  
KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

32. Which of the following is *not* the correct chemical formula for the compound named?

- A)  $\text{Al}(\text{OH})_2$                       aluminum hydroxide
- B)  $\text{Mg}(\text{C}_2\text{H}_3\text{O}_2)_2$                       magnesium acetate
- C)  $\text{ZnS}$                       zinc sulfide
- D)  $\text{Fe}_2\text{O}_3$                       iron(III) oxide
- E)  $\text{LiCN}$                       lithium cyanide

ANS: A                      PTS: 1                      DIF: moderate                      TOP: 2.9  
KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

33. Which is the correct formula for gold(I) sulfide?

- A)  $\text{AuS}$
- B)  $\text{AuS}_2$
- C)  $\text{Au}_2\text{S}_2$
- D)  $\text{Au}_2\text{S}$
- E)  $\text{Au}_2\text{S}_3$

ANS: D                      PTS: 1                      DIF: moderate                      TOP: 2.9  
KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound



34. Complete the following table.

Symbol	Number of Protons	Number of Neutrons	Number of Electrons	Net Charge
$^{206}_{82}\text{Pb}$				
	31	38		3+
	52	75	54	
$^{54}_{25}\text{Mn}^{2+}$		29		2+

ANS:

Symbol	Number of Protons	Number of Neutrons	Number of Electrons	Net Charge
$^{206}_{82}\text{Pb}$	82	124	82	0
$^{69}_{31}\text{Ga}^{3+}$	31	38	28	3+
$^{127}_{52}\text{Te}^{2-}$	52	75	54	2-
$^{54}_{25}\text{Mn}^{2+}$	25	29	23	2+

PTS: 1 DIF: difficult TOP: 2.6 | 2.7

KEY: general chemistry | early atomic theory | atomic theory of matter | isotope

35. Complete the following table.

Symbol	$^{56}\text{Fe}^{2+}$	
Number of protons		35
Number of neutrons		45
Number of electrons		
Atomic number		
Mass number		
Net charge		1-

ANS:

Symbol	$^{56}\text{Fe}^{2+}$	$^{80}\text{Br}^-$
Number of protons	26	35
Number of neutrons	30	45
Number of electrons	24	36
Atomic number	26	35
Mass number	56	80
Net charge	2+	1-

PTS: 1 DIF: difficult TOP: 2.6 | 2.7

KEY: general chemistry | early atomic theory | atomic theory of matter | isotope

Name the following compounds:

36.  $\text{Al}_2(\text{SO}_4)_3$

ANS:

aluminum sulfate

PTS: 1

DIF: easy

TOP: 2.8

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

37.  $\text{NH}_4\text{NO}_3$

ANS:

ammonium nitrate

PTS: 1

DIF: easy

TOP: 2.8

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

38.  $\text{NaH}$

ANS:

sodium hydride

PTS: 1

DIF: easy

TOP: 2.8

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

39.  $\text{K}_2\text{Cr}_2\text{O}_7$

ANS:

potassium dichromate

PTS: 1

DIF: easy

TOP: 2.8

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

40.  $\text{CCl}_4$

ANS:

carbon tetrachloride

PTS: 1

DIF: easy

TOP: 2.8

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | binary molecular compound

41. AgCl

ANS:  
silver chloride

PTS: 1                    DIF: easy                    TOP: 2.8

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

42. CaSO<sub>4</sub>

ANS:  
calcium sulfate

PTS: 1                    DIF: easy                    TOP: 2.8

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

43. HNO<sub>3</sub>

ANS:  
nitric acid

PTS: 1                    DIF: easy                    TOP: 2.8

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | acid

44. N<sub>2</sub>O<sub>3</sub>

ANS:  
dinitrogen trioxide

PTS: 1                    DIF: easy                    TOP: 2.8

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | binary molecular compound

45. SnI<sub>2</sub>

ANS:  
tin(II) iodide

PTS: 1                    DIF: easy                    TOP: 2.8

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

Write the formula for:

46. sodium dichromate

ANS:  
 $\text{Na}_2\text{Cr}_2\text{O}_7$

PTS: 1                    DIF: easy                    TOP: 2.8

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

47. iron(III) oxide

ANS:  
 $\text{Fe}_2\text{O}_3$

PTS: 1                    DIF: easy                    TOP: 2.8

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

48. dinitrogen trioxide

ANS:  
 $\text{N}_2\text{O}_3$

PTS: 1                    DIF: easy                    TOP: 2.8

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | binary molecular compound

49. cobalt(II) chloride

ANS:  
 $\text{CoCl}_2$

PTS: 1                    DIF: easy                    TOP: 2.8

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

50. aluminum hydroxide

ANS:  
 $\text{Al}(\text{OH})_3$

PTS: 1                    DIF: easy                    TOP: 2.8

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

51. hydrosulfuric acid



- b) aluminum oxide \_\_\_\_\_
- c) ammonium ion \_\_\_\_\_
- d) perchloric acid \_\_\_\_\_
- e) copper(II) bromide \_\_\_\_\_

ANS:

- a)  $\text{NO}_3^-$   
b)  $\text{Al}_2\text{O}_3$   
c)  $\text{NH}_4^+$   
d)  $\text{HClO}_4$   
e)  $\text{CuBr}_2$

PTS: 1                      DIF: moderate              TOP: 2.9

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound

57. Write the names of the following compounds:

- a)  $\text{FeSO}_4$  \_\_\_\_\_
- b)  $\text{NaC}_2\text{H}_3\text{O}_2$  \_\_\_\_\_
- c)  $\text{KNO}_2$  \_\_\_\_\_
- d)  $\text{Ca}(\text{OH})_2$  \_\_\_\_\_
- e)  $\text{NiCO}_3$  \_\_\_\_\_

ANS:

- a) iron(II) sulfate  
b) sodium acetate  
c) potassium nitrite  
d) calcium hydroxide  
e) nickel(II) carbonate

PTS: 1                      DIF: moderate              TOP: 2.9

KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

58. Which nuclide has more protons than neutrons?

- A)  $^{53}_{26}\text{Fe}$   
B)  $^{37}_{19}\text{K}$

- C)  $^{60}_{27}\text{Co}$   
D)  $^{57}_{28}\text{Ni}$

ANS: A                   PTS: 1

59. An isotope of an element is formed

- I. by adding protons to, or removing protons from, the atom.
- II. by adding neutrons to, or removing neutrons from, the atom.
- III. by adding electrons to, or removing electrons from, the atom.

- A) Only I is true
- B) Only II is true
- C) Only III is true
- D) All of the statements are true
- E) Two of the statements are true

ANS: B                   PTS: 1

60. Which statement or statements regarding Antoine Lavoisier and his discovery of the conservation of mass in chemical reactions must be false.

- A) Lavoisier conducted his experiment in an apparatus that trapped all reaction products.
- B) Lavoisier was able to make accurate mass measurements.
- C) Lavoisier was able to make precise mass measurements.
- D) Lavoisier did not trap gases in his experiments because their mass was negligible.
- E) A and D

ANS: D                   PTS: 1

61. The experiments of what two scientists were instrumental in determining the mass and charge of the electron?

- A) Lavoisier and Dalton
- B) Rutherford and Curie
- C) Thompson and Rutherford
- D) Millikan and Cannizzaro
- E) Thompson and Millikan

ANS: E                   PTS: 1