Chapter 2: Atoms, Molecules, and Ions

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 $CaCl_2$
   B) NO and NO_2
   C) H_2O and HI
   D) CH_4 and CO_2
   E) NH_3 and NBr_3

   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_2) reacts with 1.0 L of nitrogen gas (N_2), 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_4
   C) N_2H_3
   D) N_3H
   E) NH_3

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) $^{31}_{15}P$
   B) $^{20}_{10}Ne$
   C) $^{34}_{17}Cl$
   D) $^{39}_{19}K$
   E) $^{13}_{6}N$

   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}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) $^{7}_{8}\mathrm{N}$
B) $^{7}_{15}\mathrm{N}$
C) $^{8}_{7}\mathrm{N}$
D) $^{15}_{7}\mathrm{N}$

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) $^{15}_{7}\mathrm{N}$, $^{15}_{8}\mathrm{O}$
B) $^{12}_{6}\mathrm{C}$, $^{13}_{6}\mathrm{C}$
C) $^{18}_{8}\mathrm{O}$, $^{19}_{9}\mathrm{F}$
D) $^{32}_{16}\mathrm{S}$, $^{32}_{16}\mathrm{S}^{2-}$
E) O_2, 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 $^{31}\mathrm{P}^{3-}$ 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 $^{127}I^-$ 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 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) MgO, MgS, CaO
B) NaI, KBr, LiF
C) CaF_2, $MgBr_2$, SrI_2
D) Al_2O_3, In_2O_3, Ga_2S_3
E) PbI_2, $PbBr_2$, 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) $Ba(OH)_2$
B) LiO
C) NaBr
D) CsCl
E) $MgSO_3$

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_3SO_4 iron(III) sulfate
B) $BaBr_2$ barium bromide
C) Li_2O lithium oxide
D) HCl hydrogen chloride
E) Mg_3N_2 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_2O_3 chromium(III) oxide
C) NCl_3 nitrogen trichloride
D) CoO cobalt(II) oxide
E) $CaSO_4$ 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_2SO_4
C) ammonium sulfide NH_4S
D) zinc nitrate $Zn(NO_3)_2$
E) magnesium carbonate $MgCO_3$

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_2PO_4
B) $Ba_3(PO_4)_2$
C) $Ba_2(PO_4)_3$
D) Ba_3PO_4
E) $BaPO_4$

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_3PO_4 iron(III) phosphate
D) Li_2O lithium oxide
E) $BaCl_2$ 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) $Ba(NO_2)_2$
C) ZnBr
D) $NaC_2H_3O_2$
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) CrO_6
B) CrO_2
C) Cr_2O_3
D) Cr_6O
E) 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) PCl_5 phosphorus pentachoride
B) Fe_2O_3 iron(III) oxide
C) HClO hypochlorous acid
D) $BaSO_3$ barium sulfate
E) 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) $Al(OH)_2$ aluminum hydroxide
B) $Mg(C_2H_3O_2)_2$ magnesium acetate
C) ZnS zinc sulfide
D) Fe_2O_3 iron(III) oxide
E) 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) AuS
B) AuS_2
C) Au_2S_2
D) Au_2S
E) Au_2S_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
$^{206}_{82}Pb$				
	31	38		3+
	52	75	54	
$^{54}_{25}Mn^{2+}$		29		2+

ANS:

Symbol	Number of Protons	Number of Neutrons	Number of Electrons	Net Charge
$^{206}_{82}Pb$	82	124	82	0
$^{69}_{31}Ga^{3+}$	31	38	28	3+
$^{127}_{52}Te^{2-}$	52	75	54	2–
$^{54}_{25}Mn^{2+}$	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	**$^{56}Fe^{2+}$**	
Number of protons		35
Number of neutrons		45
Number of electrons		
Atomic number		
Mass number		
Net charge		1-

ANS:

Symbol	**$^{56}Fe^{2+}$**	**$^{80}Br^{-}$**
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. $Al_2(SO_4)_3$

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. NH_4NO_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. 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. $K_2Cr_2O_7$

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. 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. $CaSO_4$

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_3

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_2O_3

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_2

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:
$Na_2Cr_2O_7$

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:
Fe_2O_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:
N_2O_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:
$CoCl_2$

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:
$Al(OH)_3$

PTS: 1 DIF: easy TOP: 2.8
KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | ionic compound

51. hydrosulfuric acid

ANS:
H_2S

PTS: 1 DIF: easy TOP: 2.8
KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | acid

52. sulfurous acid

ANS:
H_2SO_3

PTS: 1 DIF: easy TOP: 2.8
KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | acid

53. nitric acid

ANS:
HNO_3

PTS: 1 DIF: easy TOP: 2.8
KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | acid

54. phosphoric acid

ANS:
H_3PO_4

PTS: 1 DIF: easy TOP: 2.8
KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | acid

55. acetic acid

ANS:
$HC_2H_3O_2$

PTS: 1 DIF: easy TOP: 2.8
KEY: general chemistry | early atomic theory | chemical substance | nomenclature of simple compound | acid

56. Write the chemical formulas for the following compounds or ions.

a) nitrate ion _____

b) aluminum oxide _____

c) ammonium ion _____

d) perchloric acid _____

e) copper(II) bromide _____

ANS:
a) NO_3^-
b) Al_2O_3
c) NH_4^+
d) $HClO_4$
e) $CuBr_2$

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) $FeSO_4$ _____

b) $NaC_2H_3O_2$ _____

c) KNO_2 _____

d) $Ca(OH)_2$ _____

e) $NiCO_3$ _____

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) $^{53}_{26}Fe$
B) $^{37}_{19}K$

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

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