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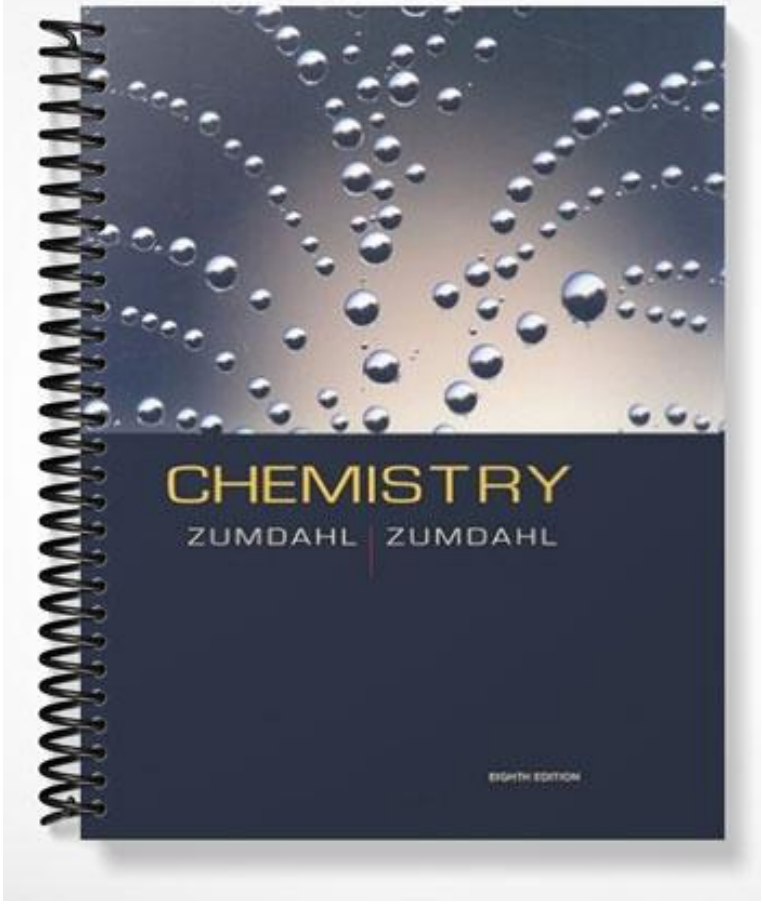

Chapter 2: Atoms, Molecules, and Ions

Student: _____

1. The first people to attempt to explain why chemical changes occur were

   A. alchemists
   B. metallurgists
   C. physicians
   D. physicists
   E. the Greeks

2. The Greeks proposed that matter consisted of four fundamental substances:

   A. fire, earth, water, air
   B. fire, metal, water, air
   C. earth, metal, water, air
   D. atoms, fire, water, air
   E. atoms, metal, fire, air

3. The first chemist to perform truly quantitative experiments was

   A. Paracelsus
   B. Boyle
   C. Priestly
   D. Bauer
   E. Lavoisier

4. The scientist who discovered the law of conservation of mass and is also called the father of modern chemistry is

   A. Proust
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5. Which of the following pairs of compounds can be used to illustrate the law of multiple proportions?

   A. NH_4 and NH_4Cl
   B. ZnO_2 and $ZnCl_2$
   C. H_2O and HCl
   D. NO and NO_2
   E. CH_4 and CO_2

6. Which of the following pairs can be used to illustrate the law of multiple proportions?

   A. SO and SO_2
   B. CO and $CaCO_3$
   C. H_2O and $C_{12}H_{22}O_{11}$
   D. H_2SO_4 and H_2S
   E. KCl and $KClO_2$

7. According to the law of multiple proportions:

   A. If the same two elements form two different compounds, they do so in the same ratio.
   B. It is not possible for the same two elements to form more than one compound.
   C. The ratio of the masses of the elements in a compound is always the same.
   D. The total mass after a chemical change is the same as before the change.
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8. A sample of chemical X is found to contain 5.0 grams of oxygen, 10.0 grams of carbon, and 20.0 grams of nitrogen. The law of definite proportion would predict that a 70 gram sample of chemical X should contain how many grams of carbon?

   A. 5.0 grams
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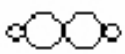
9. Consider the following two compounds: H_2O  and H_2O_2  . According to the law of multiple proportions, the ratio of hydrogen atoms per gram of oxygen in H_2O to hydrogen atoms per gram of oxygen in H_2O_2 is

   A. 1:1
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   C. 1:2
   D. 2:2
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10. Which of the following statements from Dalton's atomic theory is no longer true, according to modern atomic theory?

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    A. Boyle
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    A. Each atom of oxygen is 16 times more massive than an atom of hydrogen.
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    A. pass directly through without changing direction
    B. be slightly diverted by attraction to electrons
    C. be reflected by direct contact with nuclei
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18. Which one of the following statements about atomic structure is false?

    A. An atom is mostly empty space.
    B. Almost all of the mass of the atom is concentrated in the nucleus.
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19. If the Thomson model of the atom had been correct, Rutherford would have observed:

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    B. Alpha particles greatly deflected by the metal foil.
    C. Alpha particles bouncing off the foil.
    D. Positive particles formed in the foil.
    E. None of the above observations is consistent with the Thomson model of the atom.

20. Which statement is *not* correct?

A. The mass of an alpha particle is 7300 times that of the electron.
B. An alpha particle has a 2+ charge.
C. Three types of radioactive emission are gamma rays, beta rays, and alpha particles.
D. A gamma ray is high-energy light.
E. There are only three types of radioactivity known to scientists today.

21. Rutherford's experiment was important because it showed that:

A. Radioactive elements give off alpha particles.
B. Gold foil can be made to be only a few atoms thick.
C. A zinc sulfide screen scintillates when struck by a charged particle.
D. The mass of the atom is uniformly distributed throughout the atom.
E. An atom is mostly empty space.

22. Bromine exists naturally as a mixture of bromine-79 and bromine-81 isotopes. An atom of bromine-79 contains

A. 35 protons, 44 neutrons, 35 electrons
B. 34 protons and 35 electrons, only
C. 44 protons, 44 electrons, and 35 neutrons
D. 35 protons, 79 neutrons, and 35 electrons
E. 79 protons, 79 electrons, and 35 neutrons

23. Which of the following atomic symbols is incorrect?

A. $^{14}_{6}C$
B. $^{37}_{17}Cl$
C. $^{32}_{15}P$
D. $^{39}_{19}K$
E. $^{14}_{8}N$

24. The element rhenium (Re) exists as two stable isotopes and 18 unstable isotopes. Rhenium-185 has in its nucleus

A. 75 protons, 75 neutrons
B. 75 protons, 130 neutrons
C. 130 protons, 75 neutrons
D. 75 protons, 110 neutrons
E. not enough information

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

26. By knowing the number of protons a neutral atom has, you should be able to determine

A. the number of neutrons in the neutral atom
B. the number of electrons in the neutral atom
C. the name of the atom
D. two of the above
E. none of the above

27. Which of the following statements are *true* of uranium-238?

I. Its chemical properties will be exactly like those of uranium-235.
II. Its mass will be slightly different from that of an atom of uranium-235.
III. It will contain a different number of protons than an atom of uranium-235.
IV. It is more plentiful in nature than uranium-235.

A. III, IV
B. I, II, III
C. I, II, IV
D. II, III, IV
E. all of these

28. An isotope, *X*, of a particular element has an atomic number of 15 and a mass number of 31. Therefore:

A. *X* is an isotope of phosphorus.
B. *X* has 16 neutrons per atom.
C. *X* has an atomic mass of 30.973.
D. A and B.
E. A, B, and C.

29. Which of the following statements is true?

A. Ions are formed by adding or removing protons or electrons.
B. Scientists believe that solids are mostly open space.
C. Heating water with a Bunsen burner results in a 2:1 mixture of hydrogen and oxygen gases.
D. At least two of the above statements (A-C) are true.
E. All of the statements (A-C) are false.

30. The number of neutrons in an atom is the same for all neutral atoms of that element.

True False

31. The number of electrons in an atom is the same for all neutral atoms of that element.

True False

32. $^{40}_{20}Ca^{2+}$ has

A. 20 protons, 20 neutrons, and 18 electrons
B. 22 protons, 20 neutrons, and 20 electrons
C. 20 protons, 22 neutrons, and 18 electrons
D. 22 protons, 18 neutrons, and 18 electrons
E. 20 protons, 20 neutrons, and 22 electrons

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

A. $^{18}_{8}O$ and $^{19}_{9}F$ have the same number of neutrons.
B. $^{14}_{6}C$ and $^{14}_{7}N$ are isotopes of each other because their mass numbers are the same.
C. $^{18}_{8}O^{2-}$ has the same number of electrons as $^{20}_{10}Ne$.
D. A and B
E. A and C

34. A species with 12 protons and 10 electrons is

A. Ne^{2+}
B. Ti^{2+}
C. Mg^{2+}
D. Mg^{2-}
E. Ne^{2-}

35. The numbers of protons, neutrons, and electrons in $^{39}_{19}K^{+}$ are:

A. 20 p, 19 n, 19 e
B. 20 p, 19 n, 20 e
C. 19 p, 20 n, 20 e
D. 19 p, 20 n, 19 e
E. 19 p, 20 n, 18 e

36. An ion is formed

A. By either adding or subtracting protons from the atom.
B. By either adding or subtracting electrons from the atom
C. By either adding or subtracting neutrons from the atom.
D. All of the above are true.
E. Two of the above are true.

37. The formula of water, H_2O, suggests:

A. There is twice as much mass of hydrogen as oxygen in each molecule.
B. There are two hydrogen atoms and one oxygen atom per water molecule.
C. There is twice as much mass of oxygen as hydrogen in each molecule.
D. There are two oxygen atoms and one hydrogen atom per water molecule.
E. None of these.

38. All of the following are true *except*:

A. Ions are formed by adding electrons to a neutral atom.
B. Ions are formed by changing the number of protons in an atom's nucleus.
C. Ions are formed by removing electrons from a neutral atom.
D. An ion has a positive or negative charge.
E. Metals tend to form positive ions.

39. Which of the following are incorrectly paired?

A. K, alkali metal
B. Ba, alkaline earth metal
C. O, halogen
D. Ne, noble gas
E. Ni, transition metal

40. Which of the following are *incorrectly* paired?

A. Sr, alkaline earth metal
B. Ir, transition metal
C. F, halogen
D. Ra, noble gas
E. Ti, transition metal

41. Which of the following are *incorrectly* paired?

A. Phosphorus, Pr
B. Palladium, Pd
C. Platinum, Pt
D. Lead, Pb
E. Potassium, K

42. Which of the following are *incorrectly* paired?

A. Copper, Cu
B. Carbon, C
C. Cobalt, Co
D. Calcium, Ca
E. Cesium, Ce

43. Which of the following are *incorrectly* paired?

A. Antimony, Sb
B. Silicon, Si
C. Silver, Ag
D. Argon, Ar
E. Astatine, As

44. All of the following are characteristics of metals *except*:

A. good conductors of heat
B. malleable
C. ductile
D. often lustrous
E. tend to gain electrons in chemical reactions

45. All of the following are characteristics of nonmetals *except*:

A. poor conductors of electricity
B. often bond to each other by forming covalent bonds
C. tend to form negative ions in chemical reactions with metals
D. appear in the upper left-hand corner of the periodic table
E. do not have a shiny (lustrous) appearance

46. Which of the following has 61 neutrons, 47 protons, and 46 electrons?

A. $^{80}_{61}\text{Pm}$

B. $^{108}_{47}\text{Ag}^{+}$

C. $^{108}_{46}\text{Pd}^{-}$

D. $^{108}_{47}\text{Cd}^{+}$

E. $^{108}_{47}\text{Ag}$

47. How many protons and electrons does the most stable ion for oxygen have?

	# protons	# electrons
A.	10 p	8 e
B.	8 p	6 e
C.	6 p	8 e
D.	8 p	8 e
E.	8 p	10 e

48. You are given a compound with the formula MCl_2, in which M is a metal. You are told that the metal ion has 25 electrons. What is the identity of the metal?

A. Mn
B. Mg
C. Cu
D. Fe
E. Co

49. Which of the following names is incorrect?

A. cobalt(II) chloride
B. magnesium oxide
C. aluminum(III) oxide
D. diphosphorus pentoxide
E. All of the above names are correct.

50. Which of the following pairs is incorrect?

A. iodine trichloride, ICl_3
B. phosphorus pentoxide, P_2O_5
C. ammonia, NH_3
D. sulfur hexafluoride, SF_6
E. All of the above pairs are correct.

51. The correct name for LiCl is

A. lithium monochloride
B. lithium(I) chloride
C. monolithium chloride
D. lithium chloride
E. monolithium monochloride

52. How many oxygen atoms are there in one formula unit of $Ca_3(PO_4)_2$?

A. 2
B. 4
C. 6
D. 8
E. none of these

53. How many oxygen atoms are there in 3 formula units of $Al(NO_2)_3$?

A. 6
B. 15
C. 18
D. 9
E. 21

54. The correct name for FeO is

A. iron oxide
B. iron(II) oxide
C. iron(III) oxide
D. iron monoxide
E. iron(I) oxide

55. The correct name for Ca^{2+} is

A. calcium
B. calcium(II) ion
C. calcium ion
D. calcium(I) ion
E. monocalcium ion

56. The correct name for V^{3+} is

A. vanadide
B. vanadite ion
C. vanadium(III) ion
D. vanadium(V) ion
E. trivanadium ion

57. The correct name for N^{3-} is

A. nitride ion
B. nitrogen ion
C. nitrogen(III) ion
D. nitro(III) ion
E. nitrite

58. What is the subscript of rubidium in the formula of rubidium phosphate?

A. 3
B. 4
C. 1
D. 0
E. 2

59. The formula for calcium bisulfate is

A. $Ca(SO_4)_2$
B. CaS_2
C. $Ca(HSO_4)_2$
D. Ca_2HSO_4
E. Ca_2S

60. The formula for lithium dihydrogen phosphate is

A. LiH_2PO_4
B. $Li(HPO_4)_2$
C. $LiHPO_4$
D. Li_2HPO_4
E. $Li_2H_2PO_4$

61. Which of the following is *incorrectly* named?

A. $Pb(NO_3)_2$, lead(II) nitrate
B. NH_4ClO_4, ammonium perchlorate
C. PO_4^{3-}, phosphate ion
D. $Mg(OH)_2$, magnesium hydroxide
E. NO_2^-, nitrite ion

62. Which of the following is *incorrectly* named?

A. SO_3^{2-}, sulfite ion
B. $S_2O_3^{2-}$, thiosulfate ion
C. PO_4^{3-}, phosphate ion
D. ClO^-, chlorite ion
E. CN^-, cyanide ion

63. All of the following are in aqueous solution. Which is *incorrectly* named?

A. H_2SO_4, sulfuric acid
B. H_2CO_3, carbonic acid
C. H_3PO_4, phosphoric acid
D. HCN, cyanic acid
E. HCl, hydrochloric acid

64. All of the following are in aqueous solution. Which is *incorrectly* named?

A. $HC_2H_3O_2$, acetic acid
B. HBr, bromic acid
C. H_2SO_3, sulfurous acid
D. HNO_2, nitrous acid
E. $HClO_3$, chloric acid

65. Which of the following pairs is *incorrect?*

A. NH_4Br, ammonium bromide
B. K_2CO_3, potassium carbonate
C. $BaPO_4$, barium phosphate
D. CuCl, copper(I) chloride
E. MnO_2, manganese(IV) oxide

66. Which of the following name(s) is(are) correct?

1. sulfide, S^{2-}
2. ammonium chloride, NH_4Cl
3. acetic acid, $HC_2H_3O_2$
4. barium oxide, BaO

A. all
B. none
C. 1, 2
D. 3, 4
E. 1, 3, 4

67. Which metals form cations with varying positive charges?

A. transition metals
B. Group 1 metals
C. Group 2 metals
D. Group 3 metals
E. metalloids

68. Three samples of a solid substance composed of elements A and Z were prepared. The first contained 4.31 g A and 7.70 g Z. The second sample was 35.9% A and 64.1% Z. It was observed that 0.718 g A reacted with Z to form 2.00 g of the third sample. Show that these data illustrate the law of definite composition.

69. Explain how Dalton's atomic theory accounts for:
    a) the law of conservation of mass
    b) the law of definite composition
    c) the law of multiple proportion

70. Complete the following table.

Symbol	**# Protons**	**# Neutrons**	**# Electrons**	**Net Charge**
^{206}Pb				
	31	38		3^{+}
	52	75	54	
Mn^{2+}		30		2^{+}

71. Complete the following table.

Symbol	**$^{69}Ga^{3+}$**	
Number of protons		34
Number of neutrons		46
Number of electrons		
Atomic number		
Mass number		
Net charge		2–

72. Arsenopyrite is a mineral containing As, Fe, and S. Classify each element as metal, nonmetal, or metalloid.

73. Write the symbol for each of the following elements.

a) silver _____

b) calcium _____

c) iodine _____

d) copper _____

e) phosphorus _____

74. Write the names of the following compounds:

a) $FeSO_4$ _____

b) $NaC_2H_3O_2$ _____

c) KNO_2 _____

d) $Ca(OH)_2$ _____

e) $NiCO_3$ _____

75. 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 _____

76. How many atoms (total) are there in one formula unit of $Ca_3(PO_4)_2$?

77. Name the following compounds: Reference: Ref 2-1

$Al_2(SO_4)_3$

78. Name the following compounds: Reference: Ref 2-1
NH_4NO_3

79. Name the following compounds: Reference: Ref 2-1
NaH

80. Name the following compounds: Reference: Ref 2-1
$K_2Cr_2O_7$

81. Name the following compounds: Reference: Ref 2-1
CCl_4

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AgCl

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$CaSO_4$

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HNO_2

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N_2O_3

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SnI_2

87. Write the formula for: Reference: Ref 2-2
sodium thiosulfate

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iron(III) oxide

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dichlorine heptoxide

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Reference: Ref 2-2

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phosphoric acid

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acetic acid

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Chapter 2: Atoms, Molecules, and Ions Key

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   A. alchemists
   B. metallurgists
   C. physicians
   D. physicists
   E. the Greeks

2. The Greeks proposed that matter consisted of four fundamental substances:

   A. fire, earth, water, air
   B. fire, metal, water, air
   C. earth, metal, water, air
   D. atoms, fire, water, air
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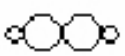
9. Consider the following two compounds: H_2O  and H_2O_2  . According to the law of multiple proportions, the ratio of hydrogen atoms per gram of oxygen in H_2O to hydrogen atoms per gram of oxygen in H_2O_2 is

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A. The mass of an alpha particle is 7300 times that of the electron.
B. An alpha particle has a 2+ charge.
C. Three types of radioactive emission are gamma rays, beta rays, and alpha particles.
D. A gamma ray is high-energy light.
E. There are only three types of radioactivity known to scientists today.

21. Rutherford's experiment was important because it showed that:

A. Radioactive elements give off alpha particles.
B. Gold foil can be made to be only a few atoms thick.
C. A zinc sulfide screen scintillates when struck by a charged particle.
D. The mass of the atom is uniformly distributed throughout the atom.
E. An atom is mostly empty space.

22. Bromine exists naturally as a mixture of bromine-79 and bromine-81 isotopes. An atom of bromine-79 contains

A. 35 protons, 44 neutrons, 35 electrons
B. 34 protons and 35 electrons, only
C. 44 protons, 44 electrons, and 35 neutrons
D. 35 protons, 79 neutrons, and 35 electrons
E. 79 protons, 79 electrons, and 35 neutrons

23. Which of the following atomic symbols is incorrect?

A. $^{14}_{6}C$
B. $^{37}_{17}Cl$
C. $^{32}_{15}P$
D. $^{39}_{19}K$
E. $^{14}_{8}N$

24. The element rhenium (Re) exists as two stable isotopes and 18 unstable isotopes. Rhenium-185 has in its nucleus

A. 75 protons, 75 neutrons
B. 75 protons, 130 neutrons
C. 130 protons, 75 neutrons
D. 75 protons, 110 neutrons
E. not enough information

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

26. By knowing the number of protons a neutral atom has, you should be able to determine

A. the number of neutrons in the neutral atom
B. the number of electrons in the neutral atom
C. the name of the atom
D. two of the above
E. none of the above

27. Which of the following statements are *true* of uranium-238?

I. Its chemical properties will be exactly like those of uranium-235.
II. Its mass will be slightly different from that of an atom of uranium-235.
III. It will contain a different number of protons than an atom of uranium-235.
IV. It is more plentiful in nature than uranium-235.

A. III, IV
B. I, II, III
C. I, II, IV
D. II, III, IV
E. all of these

28. An isotope, *X*, of a particular element has an atomic number of 15 and a mass number of 31. Therefore:

A. *X* is an isotope of phosphorus.
B. *X* has 16 neutrons per atom.
C. *X* has an atomic mass of 30.973.
D. A and B.
E. A, B, and C.

29. Which of the following statements is true?

A. Ions are formed by adding or removing protons or electrons.
B. Scientists believe that solids are mostly open space.
C. Heating water with a Bunsen burner results in a 2:1 mixture of hydrogen and oxygen gases.
D. At least two of the above statements (A-C) are true.
E. All of the statements (A-C) are false.

30. The number of neutrons in an atom is the same for all neutral atoms of that element.

FALSE

31. The number of electrons in an atom is the same for all neutral atoms of that element.

TRUE

32. $^{40}_{20}Ca^{2+}$ has

A. 20 protons, 20 neutrons, and 18 electrons
B. 22 protons, 20 neutrons, and 20 electrons
C. 20 protons, 22 neutrons, and 18 electrons
D. 22 protons, 18 neutrons, and 18 electrons
E. 20 protons, 20 neutrons, and 22 electrons

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

A. $^{18}_{8}O$ and $^{19}_{9}F$ have the same number of neutrons.
B. $^{14}_{6}C$ and $^{14}_{7}N$ are isotopes of each other because their mass numbers are the same.
C. $^{18}_{8}O^{2-}$ has the same number of electrons as $^{20}_{10}Ne$.
D. A and B
E. A and C

34. A species with 12 protons and 10 electrons is

A. Ne^{2+}
B. Ti^{2+}
C. Mg^{2+}
D. Mg^{2-}
E. Ne^{2-}

35. The numbers of protons, neutrons, and electrons in $^{39}_{19}K^{+}$ are:

A. 20 p, 19 n, 19 e
B. 20 p, 19 n, 20 e
C. 19 p, 20 n, 20 e
D. 19 p, 20 n, 19 e
E. 19 p, 20 n, 18 e

36. An ion is formed

A. By either adding or subtracting protons from the atom.
B. By either adding or subtracting electrons from the atom
C. By either adding or subtracting neutrons from the atom.
D. All of the above are true.
E. Two of the above are true.

37. The formula of water, H_2O, suggests:

A. There is twice as much mass of hydrogen as oxygen in each molecule.
B. There are two hydrogen atoms and one oxygen atom per water molecule.
C. There is twice as much mass of oxygen as hydrogen in each molecule.
D. There are two oxygen atoms and one hydrogen atom per water molecule.
E. None of these.

38. All of the following are true *except*:

A. Ions are formed by adding electrons to a neutral atom.
B. Ions are formed by changing the number of protons in an atom's nucleus.
C. Ions are formed by removing electrons from a neutral atom.
D. An ion has a positive or negative charge.
E. Metals tend to form positive ions.

39. Which of the following are incorrectly paired?

A. K, alkali metal
B. Ba, alkaline earth metal
C. O, halogen
D. Ne, noble gas
E. Ni, transition metal

40. Which of the following are *incorrectly* paired?

A. Sr, alkaline earth metal
B. Ir, transition metal
C. F, halogen
D. Ra, noble gas
E. Ti, transition metal

41. Which of the following are *incorrectly* paired?

A. Phosphorus, Pr
B. Palladium, Pd
C. Platinum, Pt
D. Lead, Pb
E. Potassium, K

42. Which of the following are *incorrectly* paired?

A. Copper, Cu
B. Carbon, C
C. Cobalt, Co
D. Calcium, Ca
E. Cesium, Ce

43. Which of the following are *incorrectly* paired?

A. Antimony, Sb
B. Silicon, Si
C. Silver, Ag
D. Argon, Ar
E. Astatine, As

44. All of the following are characteristics of metals *except*:

A. good conductors of heat
B. malleable
C. ductile
D. often lustrous
E. tend to gain electrons in chemical reactions

45. All of the following are characteristics of nonmetals *except*:

A. poor conductors of electricity
B. often bond to each other by forming covalent bonds
C. tend to form negative ions in chemical reactions with metals
D. appear in the upper left-hand corner of the periodic table
E. do not have a shiny (lustrous) appearance

46. Which of the following has 61 neutrons, 47 protons, and 46 electrons?

A. $^{80}_{61}Pm$

B. $^{108}_{47}Ag^{+}$

C. $^{108}_{46}Pd^{-}$

D. $^{108}_{47}Cd^{+}$

E. $^{108}_{47}Ag$

47. How many protons and electrons does the most stable ion for oxygen have?

	# protons	# electrons
A.	10 p	8 e
B.	8 p	6 e
C.	6 p	8 e
D.	8 p	8 e
E.	8 p	10 e

48. You are given a compound with the formula MCl_2, in which M is a metal. You are told that the metal ion has 25 electrons. What is the identity of the metal?

A. Mn
B. Mg
C. Cu
D. Fe
E. Co

49. Which of the following names is incorrect?

A. cobalt(II) chloride
B. magnesium oxide
C. aluminum(III) oxide
D. diphosphorus pentoxide
E. All of the above names are correct.

50. Which of the following pairs is incorrect?

A. iodine trichloride, ICl_3
B. phosphorus pentoxide, P_2O_5
C. ammonia, NH_3
D. sulfur hexafluoride, SF_6
E. All of the above pairs are correct.

51. The correct name for LiCl is

A. lithium monochloride
B. lithium(I) chloride
C. monolithium chloride
D. lithium chloride
E. monolithium monochloride

52. How many oxygen atoms are there in one formula unit of $Ca_3(PO_4)_2$?

A. 2
B. 4
C. 6
D. 8
E. none of these

53. How many oxygen atoms are there in 3 formula units of $Al(NO_2)_3$?

A. 6
B. 15
C. 18
D. 9
E. 21

54. The correct name for FeO is

A. iron oxide
B. iron(II) oxide
C. iron(III) oxide
D. iron monoxide
E. iron(I) oxide

55. The correct name for Ca^{2+} is

A. calcium
B. calcium(II) ion
C. calcium ion
D. calcium(I) ion
E. monocalcium ion

56. The correct name for V^{3+} is

A. vanadide
B. vanadite ion
C. vanadium(III) ion
D. vanadium(V) ion
E. trivanadium ion

57. The correct name for N^{3-} is

A. nitride ion
B. nitrogen ion
C. nitrogen(III) ion
D. nitro(III) ion
E. nitrite

58. What is the subscript of rubidium in the formula of rubidium phosphate?

A. 3
B. 4
C. 1
D. 0
E. 2

59. The formula for calcium bisulfate is

A. $Ca(SO_4)_2$
B. CaS_2
C. $Ca(HSO_4)_2$
D. Ca_2HSO_4
E. Ca_2S

60. The formula for lithium dihydrogen phosphate is

A. LiH_2PO_4
B. $Li(HPO_4)_2$
C. $LiHPO_4$
D. Li_2HPO_4
E. $Li_2H_2PO_4$

61. Which of the following is *incorrectly* named?

A. $Pb(NO_3)_2$, lead(II) nitrate
B. NH_4ClO_4, ammonium perchlorate
C. PO_4^{3-}, phosphate ion
D. $Mg(OH)_2$, magnesium hydroxide
E. NO_2^{3-}, nitrite ion

62. Which of the following is *incorrectly* named?

A. SO_3^{2-}, sulfite ion
B. $S_2O_3^{2-}$, thiosulfate ion
C. PO_4^{3-}, phosphate ion
D. ClO^{4-}, chlorite ion
E. CN^-, cyanide ion

63. All of the following are in aqueous solution. Which is *incorrectly* named?

A. H_2SO_4, sulfuric acid
B. H_2CO_4, carbonic acid
C. H_3PO_4, phosphoric acid
D. HCN, cyanic acid
E. HCl, hydrochloric acid

64. All of the following are in aqueous solution. Which is *incorrectly* named?

A. $HC_2H_3O_2$, acetic acid
B. HBr, bromic acid
C. H_2SO_3, sulfurous acid
D. HNO_2, nitrous acid
E. $HClO_3$, chloric acid

65. Which of the following pairs is *incorrect?*

A. NH_4Br, ammonium bromide
B. K_2CO_3, potassium carbonate
C. $BaPO_4$, barium phosphate
D. CuCl, copper(I) chloride
E. MnO_2, manganese(IV) oxide

66. Which of the following name(s) is(are) correct?

1. sulfide, S^{2-}
2. ammonium chloride, NH_4Cl
3. acetic acid, $HC_2H_3O_2$
4. barium oxide, BaO

A. all
B. none
C. 1, 2
D. 3, 4
E. 1, 3, 4

67. Which metals form cations with varying positive charges?

A. transition metals
B. Group 1 metals
C. Group 2 metals
D. Group 3 metals
E. metalloids

68. Three samples of a solid substance composed of elements A and Z were prepared. The first contained 4.31 g A and 7.70 g Z. The second sample was 35.9% A and 64.1% Z. It was observed that 0.718 g A reacted with Z to form 2.00 g of the third sample. Show that these data illustrate the law of definite composition.

Sample (1): ratio of masses (Z/A) = 7.70/4.13 = 1.785
Sample (2): ratio of masses (Z/A) = 64.1/35.9 = 1.785
Sample (3): ratio of masses (Z/A) = (2.00-0.718)/0.718 = 1.785
These three samples thus illustrate that a given compound always contains the same proportion of elements by mass.
See Sec. 2.2 of Zumdahl, *Chemistry*.

69. Explain how Dalton's atomic theory accounts for:
a) the law of conservation of mass
b) the law of definite composition
c) the law of multiple proportion

(a) Chemical reactions involve only reorganization of the atoms.
(b) A given compound always has the same relative numbers and types of atoms.
(c) Since, according to Dalton, atoms of a given element are identical and a given compound always has the same relative numbers and types of atoms, the observation of different mass ratio combinations of the same elements to give different compounds supports the law of multiple proportion.
See Sec. 2.3 of Zumdahl, *Chemistry*.

70. Complete the following table.

Symbol	**# Protons**	**# Neutrons**	**# Electrons**	**Net Charge**
^{206}Pb				
	31	38		3^{+}
	52	75	54	
Mn^{2+}		30		2^{+}

Symbol	**# Protons**	**# Neutrons**	**# Electrons**	**Net Charge**
^{206}Pb	82	124	82	0
Ga^{3+}	31	38	28	3+
Te^{2-}	52	75	54	2-
Mn^{2+}	25	29	23	2+

71. Complete the following table.

Symbol	**$^{69}Ga^{3+}$**	
Number of protons		34
Number of neutrons		46
Number of electrons		
Atomic number		
Mass number		
Net charge		2–

Symbol	**$^{69}Ga^{3+}$**	$^{80}Se^{2-}$
Number of protons	31	34
Number of neutrons	38	46
Number of electrons	28	36
Atomic number	31	34
Mass number	69	80
Net charge	+3	2–

72. Arsenopyrite is a mineral containing As, Fe, and S. Classify each element as metal, nonmetal, or metalloid.

As = metalloid, Fe = metal, S = nonmetal

73. Write the symbol for each of the following elements.

a) silver _____
b) calcium _____
c) iodine _____
d) copper _____
e) phosphorus _____

a) Ag, b) Ca, c) I, d) Cu, e) P

74. Write the names of the following compounds:

a) $FeSO_4$ _____
b) $NaC_2H_3O_2$ _____
c) KNO_2 _____
d) $Ca(OH)_2$ _____
e) $NiCO_3$ _____

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

75. 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 _____

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

76. How many atoms (total) are there in one formula unit of $Ca_3(PO_4)_2$?

13

77. Name the following compounds: Reference: Ref 2-1
$Al_2(SO_4)_3$

aluminum sulfate

78. Name the following compounds: Reference: Ref 2-1
NH_4NO_3

ammonium nitrate

79. Name the following compounds: Reference: Ref 2-1
NaH

sodium hydride

80. Name the following compounds: Reference: Ref 2-1
$K_2Cr_2O_7$

potassium dichromate

81. Name the following compounds: Reference: Ref 2-1
CCl_4

carbon tetrachloride

82. Name the following compounds: Reference: Ref 2-1
AgCl

silver chloride

83. Name the following compounds: Reference: Ref 2-1
$CaSO_4$

calcium sulfate

84. Name the following compounds: Reference: Ref 2-1
HNO_2

nitrous acid

85. Name the following compounds: Reference: Ref 2-1
N_2O_3

dinitrogen trioxide

86. Name the following compounds: Reference: Ref 2-1
SnI_2

tin(II) iodide

87. Write the formula for: Reference: Ref 2-2
sodium thiosulfate

$Na_2S_2O_3$

88. Write the formula for: Reference: Ref 2-2
iron(III) oxide

Fe_2O_3

89. Write the formula for: Reference: Ref 2-2
dichlorine heptoxide

Cl_2O_7

90. Write the formula for: Reference: Ref 2-2
cobalt(II) chloride

$CoCl_2$

91. Write the formula for: Reference: Ref 2-2
aluminum hydroxide

$Al(OH)_3$

92. Write the formula for: Reference: Ref 2-2
sulfurous acid

H_2SO_3

93. Write the formula for: Reference: Ref 2-2
nitric acid

HNO_3

94. Write the formula for: Reference: Ref 2-2
phosphoric acid

H_3PO_4

95. Write the formula for: Reference: Ref 2-2
acetic acid

CH_3COOH

96. Write the formula for: Reference: Ref 2-2
phosphorus trichloride

PCl3