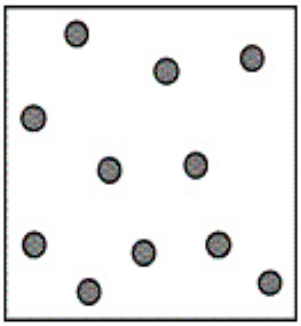
Chapter 2 - Atoms, Molecules, and Ions

Student: _____

1. Which of the following is/are postulates of Dalton's atomic theory?
    1. Atoms combine in fixed ratios of whole numbers.
    2. Atoms of each element have different properties.
    3. Elements occur as solids, liquids, or gases.

    A. 1 only
    B. 2 only
    C. 3 only
    D. 1 and 2
    E. 1, 2, and 3

2. Which of the following statements best describes the particulate representation depicted by the picture?



    A. The figure is a representation of a gas made up of a single element.
    B. The figure is a representation of a liquid mixture of two elements.
    C. The figure is a representation of a molecular solid.
    D. The figure is a representation of a liquid mixture of two compounds.
    E. The figure is a representation of a gas of a compound.

3. Which of the following is <u>not</u> a correct name–symbol combination?

    A. cobalt, Co
    B. vanadium, V
    C. neon, Ne
    D. scandium, Sc
    E. titanium, Mg

4. The symbol for tin is

   A. T.
   B. Tn.
   C. Si.
   D. Ti.
   E. Sn.

5. What is the symbol for the element phosphorus?

   A. Po
   B. P
   C. Pt
   D. K
   E. Pr

6. Which one of the following lists gives the correct symbols for the elements phosphorus, potassium, silver, chlorine, and sulfur?

   A. P, Po, Ag, Cl, S
   B. K, Ag, Po, Cl, S
   C. P, K, Ag, Cl, S
   D. Ph, K, Ag, S, Cl
   E. Ph, Po, Ag, Cl, S

7. Which of the following lists gives the atomic symbols for potassium, magnesium, beryllium, and sodium?

   A. Po, Mn, Br, Na
   B. P, Mn, Be, Se
   C. K, Mg, Be, Na
   D. Pt, Mg, Be, Sc
   E. K, Mn, Br, Na

8. The names of the elements whose symbols are Si, P, Mn, and S are, respectively,

   A. silicon, phosphorus, manganese, and sulfur.
   B. silicon, potassium, magnesium, and sulfur.
   C. silver, phosphorus, magnesium, and sodium.
   D. silver, potassium, manganese, and sodium.
   E. silicon, potassium, manganese, and sulfur.

9. Which of the following is the atomic symbol for the element cobalt?

   A. CO
   B. Co
   C. C
   D. co
   E. All of the above

10. A series of silicon–hydrogen compounds with the general formula Si_nH_{2n+2} can be represented by the known compounds SiH_4, Si_2H_6, and Si_3H_8. This best illustrates the law of

A. multiple proportions.
B. conservation of charge.
C. definite composition.
D. conservation of mass.
E. conservation of atoms.

11. According to the law of multiple proportions:

A. the total mass is the same after a chemical change as before the change.
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. if the same two elements form two different compounds, they do so in the same ratio.
E. none of these

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

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

13. Cathode rays are

A. anions.
B. protons.
C. cations.
D. positrons.
E. electrons.

14. A subatomic particle is

A. a piece of an atom.
B. only found in the nucleus of an atom.
C. always positively charged.
D. larger than the nucleus of an atom.
E. always negatively charged.

15. Experiments were carried out in which a beam of cathode rays was first bent by a magnetic field and then bent back by an electrostatic field until the beam hit the screen exactly where it had been hitting before the fields were applied. This experiment permitted the direct measurement of

    A. the ratio of mass to charge of an electron.
    B. the charge on the nucleus of an atom.
    C. the charge on the electron.
    D. the mass of the atom.
    E. the mass of the electron.

16. Who discovered the electron?

    A. Bohr
    B. de Broglie
    C. Rutherford
    D. Heisenberg
    E. Thomson

17. Which of the following conclusions regarding Rutherford's gold foil experiment is not consistent with the observations?

    A. The nucleus occupies only a small portion of the space of an atom.
    B. Most alpha particles travel straight through the gold foil.
    C. The nucleus occupies a large amount of the atom space.
    D. The nucleus, like the alpha particles used to bombard the gold foil, is positively charged.
    E. Wide angle deflections result from a collision of an alpha particle and a gold atom nucleus.

18. Who discovered the nucleus of an atom?

    A. Thomson
    B. de Broglie
    C. Rutherford
    D. Bohr
    E. Heisenberg

19. If the Thomson model of the atom had been correct, Rutherford would have observed

    A. alpha particles bouncing off the foil.
    B. alpha particles going through the foil with little or no deflection.
    C. alpha particles greatly deflected by the metal foil.
    D. positive particles formed in the foil.
    E. None of the above observations is consistent with the Thomson model of the atom.

20. The nucleus of a ^{208}Pb nuclide contains

A. 208 neutrons and 290 electrons.
B. 82 protons and 208 neutrons.
C. 208 protons and 126 electrons.
D. 208 protons, 82 neutrons, and 208 electrons.
E. 82 protons and 126 neutrons.

21. If two different nuclides have the same atomic number, it must mean that

A. they have the same atomic mass.
B. they have the same mass number.
C. they have the same number of protons.
D. they have the same number of electrons.
E. they have the same number of neutrons.

22. If two different nuclides have the same mass number, it must mean that

A. the combined number of protons and neutrons are the same.
B. both have the same number of neutrons.
C. both have the same number of electrons.
D. both have the same number of protons.
E. they are isotopes.

23. The number of protons in a given nucleus determines the

A. mass number.
B. atomic number.
C. number of electrons.
D. number of protons.
E. number of isotopes.

24. Which nuclide has the same number of protons as $^{14}_{7}N$?

A. $^{19}_{9}F$

B. $^{15}_{8}O$

C. $^{12}_{6}C$

D. $^{31}_{15}P$

E. $^{15}_{7}N$

25. How many electrons does the ion $^{35}_{17}Cl^-$ have?

A. 18
B. 36
C. 16
D. 34
E. 19

26. How many protons are there in the chromium-52 nuclide?

A. 29
B. 76
C. 23
D. 24
E. 28

27. How many neutrons are there in the cobalt-59 nuclide?

A. 27
B. 2
C. 86
D. 59
E. 32

28. An atom that has the same number of neutrons as ^{59}Ni is

A. ^{58}Zn.
B. ^{57}Fe.
C. ^{57}Cr.
D. ^{58}Mn.
E. ^{59}Co.

29. Which combination of protons, neutrons, and electrons correctly represents a ^{56}Fe nuclide?

A. 26 protons, 30 neutrons, 56 electrons
B. 26 protons, 30 neutrons, 30 electrons
C. 26 protons, 30 neutrons, 26 electrons
D. 56 protons, 26 neutrons, 56 electrons
E. 56 protons, 26 neutrons, 26 electrons

30. The species that has the same number of neutrons as $^{37}_{17}Cl$ is

A. $^{36}_{16}S$.

B. $^{35}_{17}Cl$.

C. $^{40}_{18}Ar$.

D. $^{32}_{16}S$.

E. $^{31}_{15}P$.

31. Which of the following nuclides contains more protons than neutrons?

A. $^{1}_{1}H$

B. $^{19}_{9}F$

C. $^{34}_{16}S$

D. $^{24}_{12}Mg$

E. $^{4}_{2}He$

32. How many neutrons are there in 6 molecules of $^{33}_{16}S_2$?

A. 204
B. 102
C. 6
D. 396
E. 192

33. Suppose atom 1 has the same number of protons as atom 2, and atom 2 has the same number of neutrons as atom 3. Atom 1 does not have the same number of neutrons as atom 3. Which of the following statements is true?

A. Atom 3 must have the same number of protons as atom 2.
B. Atoms 1 and 2 must be isotopes.
C. Atoms 1 and 3 must be isotopes.
D. Atom 2 must have the same number of neutrons as atom 1.
E. Atom 3 must have the same number of protons as atom 1.

34. Which of the following statements is true concerning the two nuclides ^{3}He and ^{4}He?

A. They have the same number of neutrons.
B. They are isotopes.
C. They have the same relative atomic mass.
D. They have the same mass number.
E. They have different chemical properties.

35. Which of the following atomic symbols represents an isotope of ^{99}Ru?

A. ^{98}Tc
B. ^{100}Rh
C. ^{99}Rh
D. ^{100}Ru
E. ^{99}Tc

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

		Atomic Number	Mass Number
A.	I	17	36
	II	18	36
B.	I	7	15
	II	8	15
C.	I	17	35
	II	17	37
D.	I	17	37
	II	18	38
E.	I	7	16
	II	8	17

37. There are three isotopes of carbon differing with respect to

A. electron configuration.
B. nuclear charge.
C. number of neutrons.
D. number of protons.
E. atomic number.

38. Which of the following about the isotopes of a particular element is not true?

A. Each unique isotope has a different atomic mass.
B. Each unique isotope has a different atomic number.
C. Each unique isotope has a different number of neutrons.
D. Each unique isotope has the same number of protons.
E. In neutral atoms of each unique isotope, the number of electrons equals the number of protons.

39. The neutral atoms of all the isotopes of the same element have

A. different numbers of protons.
B. the same number of neutrons.
C. the same number of electrons.
D. the same mass.
E. the same mass number.

40. What is the symbol of the nuclide having 15 protons and 16 neutrons?

A. $^{31}_{15}\mathrm{S}$

B. $^{16}_{15}\mathrm{S}$

C. $^{31}_{15}\mathrm{P}$

D. $^{15}_{16}\mathrm{S}$

E. $^{16}_{15}\mathrm{P}$

41. Which of the following has 62 neutrons, 46 protons, and 46 electrons?

A. $^{108}_{48}Cd^{2+}$

B. $^{108}_{46}Pd$

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

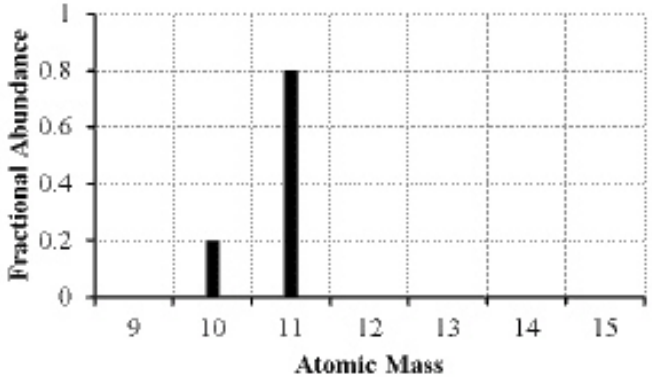
D. $^{110}_{48}Cd^{2+}$

E. $^{103}_{45}Rh^{3+}$

42. Which of the following elements has the largest atomic mass?

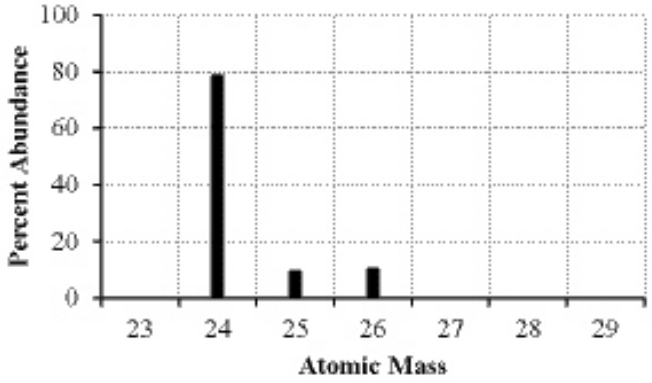
A. rhenium
B. manganese
C. thallium
D. argon
E. fluorine

43. The mass spectrum of an element with two naturally occurring isotopes is shown below. What is the best estimate of the element's atomic mass?



A. 10 amu
B. 11 amu
C. 10.8 amu
D. 10.2 amu
E. 10.5 amu

44. The mass spectrum of an element with two naturally occurring isotopes is shown below. Its average atomic mass would be best estimated as



A. less than 26 amu but greater than 25 amu.
B. less than 25 amu but greater than 24 amu.
C. equal to 24 amu.
D. equal to 25 amu.
E. greater than 26 amu.

45. Lithium has two naturally occurring isotopes, ^{6}Li and ^{7}Li . The average atomic mass of lithium is 6.941. Which of the following statements concerning the relative abundance of each isotope is correct?

A. The abundance of ^{7}Li is greater than ^{6}Li.
B. The abundance of ^{7}Li is less than ^{6}Li.
C. The abundance of ^{6}Li is equal to the abundance of ^{7}Li.
D. Not enough data is provided to determine the correct answer.
E. Based on the atomic mass, only ^{7}Li occurs naturally.

46. A certain element is listed as having an atomic mass of 63.5 amu. It is probably true that this element contains

A. a mixture of isotopes.
B. a mixture of neutrons.
C. a mixture of isomers.
D. a mixture of allotropes.
E. a mixture of ions.

47. The average atomic mass of Eu is 151.96 amu. There are only two naturally occurring isotopes of europium, ^{151}Eu with a mass of 151.0 amu and ^{153}Eu with a mass of 153.0 amu. The natural abundance of the ^{131}Eu isotope must be approximately

A. 60%.
B. 20%.
C. 50%.
D. 80%.
E. 40%.

48. Naturally occurring element X exists in three isotopic forms: X-28 (27.977 amu, 92.21% abundance), X-29 (28.976 amu, 4.70% abundance), and X-30 (29.974 amu, 3.09% abundance). Calculate the atomic weight of X.

A. 29.09 amu
B. 28.09 amu
C. 35.29 amu
D. 86.93 amu
E. 25.80 amu

49. Neon has three naturally occuring isotopes. The abundance of ^{20}Ne is 90.48% and ^{22}Ne is 9.25%. What is the percent abundance of ^{21}Ne?

A. 9.25%
B. 0.27%
C. 49.9%
D. 33.2%
E. 81.2%

50. An element, X, has the following isotopic composition: X-200, 90%; X-199, 8.0%; and X-202, 2.0%. Its average atomic mass is closest to

A. 200 amu.
B. 203 amu.
C. 199 amu.
D. 202 amu.
E. 201 amu.

51. Which of the following concerning atomic mass is/are correct?

1. The atomic mass listed on a modern periodic table for each element is the mass of the most abundant isotope.
2. The atomic mass listed on a modern periodic table is a relative atomic mass, based on the definition that ^{12}C equals 12 amu.
3. Relative atomic masses can only be determined with a mass spectrometer.

A. 1 only
B. 2 only
C. 1 and 2
D. 2 and 3
E. 1, 2, and 3

52. A periodic law based on atomic masses would necessitate Te and I changing places in the periodic table. This was not done in the early periodic table because

A. a periodic law based on atomic masses is not valid.
B. it was thought that the atomic masses might be in error.
C. iodine behaves chemically like chlorine and bromine.
D. the tellurium samples could contain a heavy impurity.
E. iodine contains one naturally occurring isotope, whereas tellurium consists of several isotopes.

53. The elements in a row of the periodic table are known as

A. metals.
B. a period.
C. metalloids.
D. a family.
E. a group.

54. Which of the following statements about different elements is incorrect?

A. Potassium is an alkali metal.
B. Fluorine is a halogen.
C. Aluminum is a transition element.
D. Barium is an alkaline earth metal.
E. Helium is a noble gas.

55. Which of the following statements is <u>not</u> true about the element calcium?

A. It is a metal.
B. It is an alkaline earth metal.
C. It is in period 4.
D. It has chemical and physical properties most similar to silver.
E. It is in group IIA (group 2).

56. The elements in groups 1A-8A or 1-2 and 15-18 are known as the

A. main group.
B. alkaline earth metals.
C. metalloids or semimetals.
D. halogens.
E. transition metals.

57. Choose the group containing the most reactive nonmetals.

A. Group 5A
B. Group 3A
C. Group 7A
D. Group 8A
E. Group 1A

58. Which element belongs to the transition metals?

A. palladium
B. sodium
C. calcium
D. iodine
E. helium

59. Which of the following statements about different elements is/are true?

1. As is a metalloid and Se is a nonmetal.
2. Cu is a transition element and Ge is a metalloid.
3. Both F and I are halogens.

A. 1 only
B. 2 only
C. 3 only
D. 1 and 2
E. 1, 2, and 3

60. Which of the following is a metalloid?

A. oxygen
B. hydrogen
C. silicon
D. carbon
E. copper

61. All of the following elements are best classified as metalloids except

A. Si.
B. Te.
C. As.
D. B.
E. Ga.

62. Which formula is best described as a (condensed) structural formula?

A. $C_2B_{10}H_{12}$
B. $C_6H_{11}Cl$
C. $CH_3CH_2CH_2CH_2Cl$
D. $C_{12}H_{22}O_{11}$
E. C_2H_6O

63. Which of the following is/are information that is unique to a space-filling molecular model?

1. The model shows the relative sizes of each element.
2. The model shows the charge distribution.
3. The model shows the types of bonds (single or multiple) connecting the atoms.

A. 1 only
B. 2 only
C. 3 only
D. 1 and 2
E. 1, 2, and 3

64. In a particular mass of $KAu(CN)_2$, there are 8.87×10^{20} atoms of gold. What is the total number of atoms in this sample?

A. 1.77×10^{21}
B. 2.66×10^{21}
C. 5.32×10^{21}
D. 4.44×10^{21}
E. 3.55×10^{21}

65. A sample of TNT, $C_7H_5N_3O_6$, has 7.68×10^{21} nitrogen atoms. How many hydrogen atoms are there in this sample of TNT?

A. 1.54×10^{22}
B. 10.24×10^{21}
C. 1.28×10^{22}
D. 7.68×10^{21}
E. 1.79×10^{22}

66. A 1.4-g sample of washing soda, $Na_2CO_3 \cdot 10H_2O$, has 2.9×10^{21} carbon atoms. How many oxygen atoms are present in 1.4 g of washing soda?

A. 2.9×10^{22}
B. 2.9×10^{21}
C. 4.1×10^{21}
D. 3.8×10^{22}
E. 8.8×10^{21}

67. A sample of the mineral troegerite, $(UO_2)_3(AsO_4)_2 \cdot 12H_2O$, has 1.33×10^{21} U atoms. How many arsenic atoms are present in this sample of troegerite?

A. 2.00×10^{22}
B. 1.60×10^{22}
C. 2.66×10^{21}
D. 6.65×10^{22}
E. 8.87×10^{20}

68. An ion is formed

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

69. The species Au^{+}, Mg^{2+}, and V^{3+} are all

A. anions.
B. isotopes.
C. isoelectronic.
D. allotropes.
E. cations.

70. The species that is formed when a molecule gains or loses an electron is called

A. an ion.
B. a metalloid.
C. an isotope.
D. an atom.
E. a metal.

71. Which of the following statements is true about one formula unit of $SrBr_2$?

A. It is composed of one Sr atom and one Br_2 molecule.
B. It is composed of one Sr atom and two Br atoms.
C. It is composed of one Sr^{2+} ion and one Br_2^{2-} ion.
D. It is composed of one $SrBr_2$ molecule.
E. It is composed of one Sr^{2+} ion and two Br^{-} ions.

72. Aluminum(III) sulfite is an ionic compound formed from Al^{3+} and SO_3^{2-}. What is the correct way to represent the formula?

A. $AlSO_3^{+}$
B. $Al(SO_3)_2^{-}$
C. $Al^{3+}SO_3^{2-}$
D. $Al_2(SO_3)_3$
E. $Al_{7}^{2}(SO_{3}^{3})_{10.5}^{3}$

73. Chemical reactions between nonmetals and nonmetals primarily involve

A. sharing of electrons.
B. interactions between protons.
C. transfer of electrons.
D. interactions among protons, electrons, and neutrons.
E. interactions between protons and electrons.

74. Which of the following is an ionic compound?

A. HOClO
B. NH_3
C. CH_3OH
D. N_2O_3
E. NH_4CN

75. 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 oxygen atoms and one hydrogen atom per water molecule.
C. there is twice as much mass of oxygen as of hydrogen in each molecule.
D. there are two hydrogen atoms and one oxygen atom per water molecule.
E. none of these

76. How many oxygen atoms are there in a formula unit of $UO_2(C_2H_3O_2)_2 \cdot NH_4C_2H_3O_2 \cdot 4H_2O$?

A. 4
B. 12
C. 21
D. 8
E. 10

77. What is the ratio of oxygen atoms to hydrogen atoms in the compound $Fe_4(PO_4)_3(OH)_3 \cdot 12H_2O$?

A. 15:3
B. 27:15
C. 27:27
D. 18:27
E. 25:17

78. What is the ratio of oxygen atoms to hydrogen atoms in the mineral carnotite, $K_2(UO_2)_3(VO_4)_2 \cdot 3H_2O$?

A. 8:6
B. 8:3
C. 17:3
D. 9:6
E. 17:6

79. Which statement is <u>incorrect</u> concerning the formation of ionic compounds?

A. Halogens tend to form anions with a charge of –1.
B. Alkali metals tend to form cations with a charge of +1.
C. Metals tend to form cations, while nonmetals tend to form anions.
D. Transition metals tend to form cations with a charge of +3.
E. Noble gases tend not to form ionic compounds.

80. The empirical formula of a salt consisting of Sr^{2+} and NO_2^- ions is

A. $Sr^{2+}NO_2^-$.
B. $SrNO_2$.
C. Sr_2NO_2.
D. $Sr_2(NO_2)_3$.
E. $Sr(NO_2)_2$.

81. Which of the following molecules is a hydrocarbon?

A. H_2O
B. $CH_3CH_2CH_3$
C. $C_6H_{12}O_6$
D. CH_3CH_2OH
E. CH_3OCH_3

82. Which of the following molecules contains the ether functional group?

A. $CH_3CH_2NH_2$
B. $CH_3CH_2OCH_2CH_3$
C. CH_3CH_2OH
D. CH_3CH_2COOH
E. H_2O_3

83. Which of the following molecules contains the carboxylic acid functional group?

A. $CH_3CH_2CH_2OH$
B. $CH_3CH_2COCH_2CH_3$
C. CH_3NHCH_3
D. $CH_3OCH_2CH_3$
E. $CH_3CH_2CH_2COOH$

84. Which of the following molecules contains the alcohol functional group?

A. C_6H_6
B. CH_3OH
C. CH_3
D. CH_4OCH_3
E. C_2H_2

85. How many electrons does a barium ion have?

A. 56
B. 8
C. 54
D. 38
E. 2

86. Which of the following statements is <u>false</u>?

A. A crystal of calcium fluoride has equal numbers of calcium ions and fluoride ions.
B. A sodium atom is most likely to ionize to form a cation of charge +1.
C. A sulfide ion has a total of 18 e^-.
D. A potassium ion has a total of 18 e^-.
E. The charge on a neutral chlorine atom is zero.

87. As an ion, sodium has _____ electrons?

A. 24
B. 14
C. 11
D. 28
E. 10

88. How many electrons does a chloride ion have?

A. 17
B. 22
C. 15
D. 18
E. 2

89. Which metals form cations with varying positive charges?

A. many transition metals
B. Zn and Al
C. Group 1 metals
D. Group 1 and Group 2 metals
E. Group 2 metals

90. Which of the following represents a known ion?

A. S^{2+}
B. Sc^{4+}
C. Sn^{2+}
D. P^{4-}
E. Na^{-}

91. The formula for the sulfide ion is

A. SO^{2-}.
B. SO_4^{2-}.
C. $S_2O_3^{2-}$.
D. S^{2-}.
E. HSO_4^{-}.

92. The correct name for Sn^{2+} is

A. monotin ion.
B. tin(II) ion.
C. tin ion.
D. tin(I) ion.
E. tin.

93. The formula of the perchlorate ion is

A. $Cl_2O_3^-$.
B. ClO_3^{-2}.
C. CN^-.
D. ClO_4^-.
E. ClO^{-4}.

94. The name of the SO_4^{2-} ion is

A. persulfate.
B. thiosulfite.
C. sulfite.
D. sulfate.
E. sulfide.

95. The formulas of the nitrite, phosphate, and nitrate ions are represented, respectively, as

A. N^{3-}, PO_3^{3-}, NO_3^-.
B. NO^-, P^{3-}, NO_3^-.
C. NO_2^-, P^{3-}, NO_3^-.
D. NO^{2-}, PO_2^-, N^{3-}.
E. NO_2^{3-}, PO_4^{2-}, NO_3^-.

96. The formulas of the hydroxide ion, the nitrate ion, and the phosphate ion are represented, respectively, as

A. OH^-, NO_2^-, PO_3^{3-}.
B. OH^-, NO^{2-}, PO^{3-}.
C. H^-, NO_2^-, P^{3-}.
D. H^-, NO^{2-}, P^{3-}.
E. OH^-, NO_3^-, PO_4^{3-}.

97. All the following ions have the same charge except

A. sulfate.
B. dichromate.
C. chlorate.
D. sulfide.
E. sulfite.

98. All the following ions have the same charge except

A. oxide.
B. monohydrogen phosphate.
C. peroxide.
D. permanganate.
E. oxalate.

99. The formulas of the carbonate ion, the ammonium ion, and the chlorate ion are represented, respectively, as

A. CO_3^{2-}, NH_2^-, ClO_3^-.
B. CO_3^{2-}, NH_4^+, ClO_3^-.
C. CO_3^{3-}, NH_4^+, ClO_3^-.
D. P^{3-}, NH_3^+, ClO_2^-.
E. CO_3^{2-}, NH_3^+, ClO_2^-.

100. The systematic name for BaH_2 is

A. barium(II) hydrate.
B. barium hydride.
C. barium dihydrate.
D. barium dihydrogen.
E. barium dihydride.

101. What is the name of the compound whose formula is $Al_2(SO_4)_3$?

A. aluminum sulfate
B. dialuminum tri(sulfur tetraoxygen)
C. aluminum sulfide
D. aluminum persulfate
E. aluminum sulfite

102. The correct name for FeO is

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

103. What is the formula for the chloride of praseodymium(III)?

A. $Pr_2(ClO_2)_3$
B. $Pr(ClO_4)_2$
C. Pr_3Cl
D. $PrCl_3$
E. $Pr(ClO_3)_3$

104. What is the correct formula for bismuth(III) sulfite?

A. $BiSO_3$
B. Bi_2SO_3
C. $Bi_2(SO_3)_2$
D. $Bi_3(SO_3)_2$
E. $Bi_2(SO_3)_3$

105. What is the correct name for Sc_2O_3?

A. manganese(III) oxide
B. manganese oxide
C. dimanganese trioxide
D. manganese trioxide
E. dimanganese(II) oxide

106. What is the formula for calcium nitride?

A. $CaNO_2$
B. $Ca(NO_2)_2$
C. $Ca(NO_3)_2$
D. Ca_3N_2
E. Ca_2N_3

107. The formula of magnesium sulfide is

A. MgS.
B. $MgSO_2$.
C. $MgSO_4$.
D. $MgSO_3$.
E. $Mg(SO_4)_2$.

108. What is the formula of magnesium nitrite?

A. $Mg(NO_2)_2$
B. Mg_3N_2
C. $Mg_2(NO_2)_2$
D. Mg_2N_3
E. $Mg(NO_2)_3$

109. The formula for aluminum bromide is

A. AlB.
B. AlBr.
C. Al_2Br_3.
D. $AlBr_2$.
E. $AlBr_3$.

110. The chemical formula for iron(III) sulfide is

A. $Fe_3(SO_4)_2$.
B. Fe_2S_3.
C. $Fe_2(SO_3)_2$.
D. $Fe_3(SO_3)_2$.
E. $Fe_2(SO_4)_3$.

111. The formula for aluminum sulfate is

A. $Al_2(SO_3)_3$.
B. Al_2S_3.
C. $Al_2(SO_4)_3$.
D. Al_2S_3.
E. $Al_3(SO_4)_2$.

112. The formula for copper(II) phosphate is

A. $Co_3(PO_4)_2$.
B. $CuPO_4$.
C. $Co_2(PO_4)_3$.
D. $Cu_2(PO_4)_3$.
E. $Cu_3(PO_4)_2$.

113. Choose the name–formula pair that does not match.

A. calcium fluoride, CaF_2
B. iron(III) oxide, Fe_2O_3
C. aluminum oxide, Al_2O_3
D. potassium permanganate, K_2MnO_4
E. sodium sulfite, Na_2SO_3

114. Choose the name–formula pair that does not match.

A. calcium hydride, CaH_2
B. ammonium hydrogen carbonate, NH_4CO_3
C. sodium chlorite, $NaClO_2$
D. calcium hydroxide, $Ca(OH)_2$
E. nitric acid, HNO_3

115. The formula for aluminum fluoride is

A. AlF_3.
B. AlF.
C. Al_2F.
D. AlF_4.
E. AlF_2.

116. The formula for potassium carbonate is

A. P_2C.
B. K_2CO_3.
C. Po_2CO_3.
D. P_2CO_3.
E. K_2C.

117. The formula for magnesium nitride is

A. Mg_2N_3.
B. Mg_3N_2.
C. $MgNO_2$.
D. $Mg(NO_2)_2$.
E. MgN.

118. What is the subscript of potassium in the formula for potassium sulfate?

A. 2
B. 5
C. 3
D. 4
E. 1

119. What is the formula for sodium peroxide?

A. Na_3O_2
B. NaO_2
C. Na_2O
D. NaO_2
E. Na_2O_2

120. What is the formula for the chlorate of gadolinium(III)?

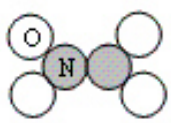
A. $Gd(ClO_4)_2$
B. $GdCl_2$
C. $Gd_2(ClO_3)_3$
D. $GdCl_3$
E. $Gd(ClO_3)_3$

121. What is the formula for the nitride of samarium(III)?

A. SmN
B. Sm_2N_3
C. $Sm(NO_3)_2$
D. $Sm(NO_3)_3$
E. $Sm(NO_2)_3$

122. The correct name for LiCl is

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

123. The chemical name for the model  is

A. dinitrogen tetroxide.
B. nitrogen tetroxide.
C. nitrogen oxide.
D. nitric oxide.
E. nitrogen trioxide

124. The chemical name for the binary, non-ionic molecule with the formula PBr_5 is

A. phosphorus pentabromide.
B. monophosphorus bromide.
C. phosphide pentabromide.
D. phosphorus pentabromine.
E. monophosphorus pentabromine.

125. The formula for chloric acid is

A. $HClO_2$.
B. $HClO$.
C. HCl.
D. $HClO_4$.
E. $HClO_3$.

126. Which name–formula pair is <u>incorrect</u>?

A. HI, hydroiodic acid
B. H_2SO_3, sulfurous acid
C. H_2SO_4, sulfuric acid
D. $HClO_4$, perchloric acid
E. HNO_3, carbonic acid

127. Which name–formula pair is <u>incorrect</u>?

A. hypochlorous acid, $HClO_2$
B. titanium(IV) carbide, TiC_2
C. strontium nitride, Sr_3N_2
D. magnesium sulfate heptahydrate, $MgSO_4 \cdot 7H_2O$
E. dinitrogen tetroxide, N_2O_4

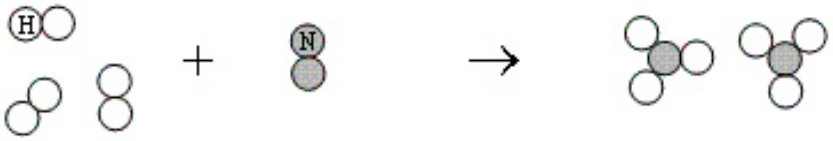
128. The oxoanion that comes from nitrous acid is

A. $N_2O_3^-$.
B. NO_2^-.
C. HNO_3^-.
D. NO_3^-.
E. NO_3^-.

129. For the following balanced chemical equation, which substance represents the catalyst?
$2CO(g) + 2NO(g) \xrightarrow{Rh(s)} 2CO_2(g) + N_2(g)$

A. $NO(g)$
B. $CO(g)$
C. $CO_2(g)$
D. $N_2(g)$
E. $Rh(s)$

130. What is the balanced chemical equation that represents the following reaction?



A. $6H + 2N \rightarrow 2NH_3$
B. $6H + 2N \rightarrow 2HN_3$
C. $2N + 2H_3 \rightarrow 2H_3N$
D. $6H + 2N_3 \rightarrow 2N_3H$
E. $3H_2 + N_2 \rightarrow 2NH_3$

131. In the following chemical equation, what is the reactant?
$CuSO_4 \cdot 5H_2O(s) \rightarrow CuO(s) + SO_3(g) + 5H_2O(l)$

A. $CuSO_4 \cdot 5H_2O(s)$
B. $H_2O(l)$
C. $CuO(s)$
D. $SO_3(g)$
E. $CuSO_4(s)$

132. Which is a correct balanced chemical equation corresponding to the following description of a chemical reaction?
Hydrochloric acid reacts with magnesium metal to produce aqueous magnesium chloride and hydrogen gas.

A. $2HCl(aq) + Mg(s) \rightarrow MgCl_2(aq) + 2H(g)$
B. $2HCl(aq) + Mg(s) \rightarrow MgCl_2(aq) + H_2(g)$
C. $2HCl(aq) + Mg(s) \rightarrow MgCl(aq) + H_2(g)$
D. $2HCl(aq) + Mg(aq) \rightarrow MgCl_2(s) + H_2(g)$
E. $HCl(aq) + Mg(s) \rightarrow MgCl(aq) + H(g)$

133. Sulfuric acid reacts with aqueous sodium hydroxide to produce aqueous sodium sulfate and liquid water. Which is the correct balanced chemical equation for this reaction description?

A. $H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2S(aq) + 2H_2O(l) + 2O_2(g)$
B. $H_2S(aq) + 2NaOH(aq) \rightarrow Na_2S(aq) + 2H_2O(l)$
C. $H_2SO_4(aq) + NaOH(aq) \rightarrow NaSO_4(aq) + H_2O(g)$
D. $H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$
E. $H_2SO_4(aq) + (NaOH)_2(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$

134. How many of the following statements are true concerning chemical equations?
I. Coefficients can be fractions.
II. Subscripts can be fractions.
III. Coefficients represent the relative masses of the reactants and/or products.
IV. Changing the subscripts to balance an equation can be done only once.
V. Atoms are conserved when balancing chemical equations.

A. 3
B. 4
C. 2
D. 5
E. 1

135. When the following equation is balanced with lowest whole-number coefficients, what is the coefficient for $NO(g)$?
$\_\_\_NH_3(g) + \_\_\_O_2(g) \rightarrow \_\_\_NO(g) + \_\_\_H_2O(g)$

A. 3
B. 2
C. 5
D. 4
E. 1

136. The complete combustion of propane, C_3H_8, yields carbon dioxide and water:

$$\_\_C_3H_8 + \_\_O_2 \rightarrow \_\_CO_2 + \_\_H_2O$$

The smallest whole-number coefficient of oxygen in the balanced equation is

A. 6.
B. 3.
C. 7.
D. 4.
E. 5.

137. The complete combustion of butane, C_4H_{10}, yields carbon dioxide and water:

$$\_\_C_4H_{10} + \_\_O_2 \rightarrow \_\_CO_2 + \_\_H_2O$$

The smallest whole-number coefficient of oxygen in the balanced equation is

A. 12.
B. 14.
C. 10.
D. 11.
E. 13.

138. The products of the combustion of acetaldehyde with oxygen are shown in the following equation:

__ CH_3CHO + __ O_2 ® __ CO_2 + __ H_2O

When properly balanced, the equation indicates that ____ molecules of O_2 are required to burn 2 molecules of CH_3CHO.

A. 2
B. 6
C. 4
D. 3
E. 5

139. Energy from the following reaction provided the lift for the moon lander:

__ $(CH_3)_2N_2H_2$ + __ N_2O_4 ® __ N_2 + __ H_2O + __ CO_2

When the equation is balanced, the smallest whole-number coefficient of nitrogen is

A. 5.
B. 4.
C. 1.
D. 3.
E. 2.

140. Treatment of sodium borohydride with sulfuric acid is a convenient method for the preparation of diborane:
__ $NaBH_4$ + __ H_2SO_4 ® __ B_2H_6 + __ H_2 + __Na_2SO_4
When the equation is balanced, the lowest whole number coefficient for hydrogen is

A. 5.
B. 2.
C. 4.
D. 1.
E. 3.

141. All the following may change during a chemical reaction except

A. the total volume of the system.
B. the density of the system.
C. the temperature of the system.
D. the total number of atoms in the system.
E. the total number of molecules in the system.

142. The complete combustion of phenylhydrazine, $C_6H_5NHNH_2$, with the oxidizer dinitrogen tetraoxide is shown in the following equation:
__ $C_6H_5NHNH_2$ + __ N_2O_4 ® __ CO_2 + __ H_2O + __ N_2
When this equation is balanced, the sum of all the coefficients (using smallest whole numbers) is

A. 30.
B. 20.
C. 25.
D. 10.
E. 15.

143. The complete combustion of pentane yields carbon dioxide and water. When the equation
__ $C_5H_{12}(l)$ + __ $O_2(g)$ ® __ $CO_2(g)$ + __ $H_2O(l)$
is balanced, the ratio of the coefficient of CO_2 to the coefficient of O_2 is

A. 8:5.
B. 8:6.
C. 6:5.
D. 5:6.
E. 5:8.

144. A reaction occurs between sodium carbonate and hydrochloric acid, producing sodium chloride, carbon dioxide, and water. Which is the correct set of coefficients, respectively, for the balanced reaction?

A. 3 6 6 3 4
B. 8 6 5 10 5
C. 5 10 10 5 5
D. 1 2 2 1 1
E. none of these

145. When the equation
__ $(CH_3)_2NNH_2$ + __ N_2O_4 ® __ N_2 + __ H_2O + __ CO_2
is balanced, the sum of all the coefficients (simplest whole number) is

A. 13.
B. 12.
C. 9.
D. 10.
E. 11.

146. When the equation
__ $C_5H_6N_2OS(s)$ + __ $O_2(g)$ ® __ $CO_2(g)$ + __ $H_2O(l)$ + __ $N_2(g)$ + __ $SO_2(g)$
is balanced, the sum of all the coefficients (simplest whole number) is

A. 19.
B. 20.
C. 24.
D. 18.
E. 21.

147. Ammonia can be made by reaction of water with magnesium nitride:
__ $Mg_3N_2(s)$ + __ $H_2O(l)$ ® __ $Mg(OH)_2(s)$ + __ $NH_3(g)$
When the equation is properly balanced, the sum of the coefficients is

A. 6.
B. 14.
C. 12.
D. 9.
E. 8.

148. Which one of the following equations is properly balanced?

A. $Sn + 4HNO_3 \rightarrow SnO_2 + 4NO_2 + 2H_2O$
B. $2Na_2SO_4 + 3Bi(NO_3)_3 \rightarrow Bi_2(SO_4)_3 + 9NaNO_3$
C. $CH_3CHO + 3O_2 \rightarrow 2CO_2 + 2H_2O$
D. $NH_4NO_3 \rightarrow 2H_2O + N_2$
E. $Na_2CO_3 + 2H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O + CO_2$

149. Which of the following chemical equations is <u>not</u> balanced?

A. $NH_4NO_3 \rightarrow N_2O + 2H_2O$
B. $C_{12}H_{22}O_{11} \rightarrow 12C + 11H_2O$
C. $2NH_4SCN + Ba(OH)_2 \cdot 8H_2O \rightarrow 2NH_3 + 10H_2O + Ba(SCN)_2$
D. $(NH_4)_2Cr_2O_7 \rightarrow N_2O + Cr_2O_3 + 4H_2O$
E. $2Mg + CO_2 \rightarrow 2MgO + C$

150. Which of the following equations is <u>not</u> balanced?

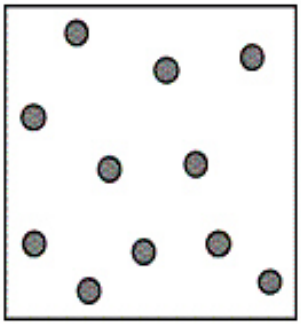
A. $2Sb_2OS_2 + 10O_2 \rightarrow 2Sb_2O_5 + 4SO_3$
B. $(NH_4)_2Cr_2O_7 \rightarrow N_2 + 4H_2O + Cr_2O_3$
C. $C_{12}H_{22}O_{11} + 12O_2 \rightarrow 12CO_2 + 11H_2O$
D. $2NaCl + Pb(NO_3)_2 \rightarrow PbCl_2 + 2NaNO_3$
E. $Fe_3O_4 + 3CO \rightarrow 3Fe + 3CO_2$

Chapter 2 - Atoms, Molecules, and Ions Key

1. Which of the following is/are postulates of Dalton's atomic theory?
    1. Atoms combine in fixed ratios of whole numbers.
    2. Atoms of each element have different properties.
    3. Elements occur as solids, liquids, or gases.

A. 1 only
B. 2 only
C. 3 only
D. 1 and 2
E. 1, 2, and 3

2. Which of the following statements best describes the particulate representation depicted by the picture?



A. The figure is a representation of a gas made up of a single element.
B. The figure is a representation of a liquid mixture of two elements.
C. The figure is a representation of a molecular solid.
D. The figure is a representation of a liquid mixture of two compounds.
E. The figure is a representation of a gas of a compound.

3. Which of the following is not a correct name–symbol combination?

A. cobalt, Co
B. vanadium, V
C. neon, Ne
D. scandium, Sc
E. titanium, Mg

4. The symbol for tin is

A. T.
B. Tn.
C. Si.
D. Ti.
E. Sn.

5. What is the symbol for the element phosphorus?

A. Po
B. P
C. Pt
D. K
E. Pr

6. Which one of the following lists gives the correct symbols for the elements phosphorus, potassium, silver, chlorine, and sulfur?

A. P, Po, Ag, Cl, S
B. K, Ag, Po, Cl, S
C. P, K, Ag, Cl, S
D. Ph, K, Ag, S, Cl
E. Ph, Po, Ag, Cl, S

7. Which of the following lists gives the atomic symbols for potassium, magnesium, beryllium, and sodium?

A. Po, Mn, Br, Na
B. P, Mn, Be, Se
C. K, Mg, Be, Na
D. Pt, Mg, Be, Sc
E. K, Mn, Br, Na

8. The names of the elements whose symbols are Si, P, Mn, and S are, respectively,

A. silicon, phosphorus, manganese, and sulfur.
B. silicon, potassium, magnesium, and sulfur.
C. silver, phosphorus, magnesium, and sodium.
D. silver, potassium, manganese, and sodium.
E. silicon, potassium, manganese, and sulfur.

9. Which of the following is the atomic symbol for the element cobalt?

A. CO
B. Co
C. C
D. co
E. All of the above

10. A series of silicon–hydrogen compounds with the general formula Si_nH_{2n+2} can be represented by the known compounds SiH_4, Si_2H_6, and Si_3H_8. This best illustrates the law of

A. multiple proportions.
B. conservation of charge.
C. definite composition.
D. conservation of mass.
E. conservation of atoms.

11. According to the law of multiple proportions:

A. the total mass is the same after a chemical change as before the change.
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. if the same two elements form two different compounds, they do so in the same ratio.
E. none of these

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

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

13. Cathode rays are

A. anions.
B. protons.
C. cations.
D. positrons.
E. electrons.

14. A subatomic particle is

A. a piece of an atom.
B. only found in the nucleus of an atom.
C. always positively charged.
D. larger than the nucleus of an atom.
E. always negatively charged.

15. Experiments were carried out in which a beam of cathode rays was first bent by a magnetic field and then bent back by an electrostatic field until the beam hit the screen exactly where it had been hitting before the fields were applied. This experiment permitted the direct measurement of

A. the ratio of mass to charge of an electron.
B. the charge on the nucleus of an atom.
C. the charge on the electron.
D. the mass of the atom.
E. the mass of the electron.

16. Who discovered the electron?

A. Bohr
B. de Broglie
C. Rutherford
D. Heisenberg
E. Thomson

17. Which of the following conclusions regarding Rutherford's gold foil experiment is not consistent with the observations?

A. The nucleus occupies only a small portion of the space of an atom.
B. Most alpha particles travel straight through the gold foil.
C. The nucleus occupies a large amount of the atom space.
D. The nucleus, like the alpha particles used to bombard the gold foil, is positively charged.
E. Wide angle deflections result from a collision of an alpha particle and a gold atom nucleus.

18. Who discovered the nucleus of an atom?

A. Thomson
B. de Broglie
C. Rutherford
D. Bohr
E. Heisenberg

19. If the Thomson model of the atom had been correct, Rutherford would have observed

A. alpha particles bouncing off the foil.
B. alpha particles going through the foil with little or no deflection.
C. alpha particles greatly deflected by the metal foil.
D. positive particles formed in the foil.
E. None of the above observations is consistent with the Thomson model of the atom.

20. The nucleus of a ^{208}Pb nuclide contains

A. 208 neutrons and 290 electrons.
B. 82 protons and 208 neutrons.
C. 208 protons and 126 electrons.
D. 208 protons, 82 neutrons, and 208 electrons.
E. 82 protons and 126 neutrons.

21. If two different nuclides have the same atomic number, it must mean that

A. they have the same atomic mass.
B. they have the same mass number.
C. they have the same number of protons.
D. they have the same number of electrons.
E. they have the same number of neutrons.

22. If two different nuclides have the same mass number, it must mean that

A. the combined number of protons and neutrons are the same.
B. both have the same number of neutrons.
C. both have the same number of electrons.
D. both have the same number of protons.
E. they are isotopes.

23. The number of protons in a given nucleus determines the

A. mass number.
B. atomic number.
C. number of electrons.
D. number of protons.
E. number of isotopes.

24. Which nuclide has the same number of protons as $^{14}_{7}N$?

A. $^{19}_{9}F$

B. $^{15}_{8}O$

C. $^{12}_{6}C$

D. $^{31}_{15}P$

E. $^{15}_{7}N$

25. How many electrons does the ion $^{35}_{17}Cl^-$ have?

A. 18
B. 36
C. 16
D. 34
E. 19

26. How many protons are there in the chromium-52 nuclide?

A. 29
B. 76
C. 23
D. 24
E. 28

27. How many neutrons are there in the cobalt-59 nuclide?

A. 27
B. 2
C. 86
D. 59
E. 32

28. An atom that has the same number of neutrons as ^{59}Ni is

A. ^{58}Zn.
B. ^{57}Fe.
C. ^{57}Cr.
D. ^{58}Mn.
E. ^{59}Co.

29. Which combination of protons, neutrons, and electrons correctly represents a ^{56}Fe nuclide?

A. 26 protons, 30 neutrons, 56 electrons
B. 26 protons, 30 neutrons, 30 electrons
C. 26 protons, 30 neutrons, 26 electrons
D. 56 protons, 26 neutrons, 56 electrons
E. 56 protons, 26 neutrons, 26 electrons

30. The species that has the same number of neutrons as $^{37}_{17}Cl$ is

A. $^{36}_{16}S$.

B. $^{35}_{17}Cl$.

C. $^{40}_{18}Ar$.

D. $^{32}_{16}S$.

E. $^{31}_{15}P$.

31. Which of the following nuclides contains more protons than neutrons?

A. $^{1}_{1}H$

B. $^{19}_{9}F$

C. $^{34}_{16}S$

D. $^{24}_{12}Mg$

E. $^{4}_{2}He$

32. How many neutrons are there in 6 molecules of $^{33}_{16}S_2$?

A. 204
B. 102
C. 6
D. 396
E. 192

33. Suppose atom 1 has the same number of protons as atom 2, and atom 2 has the same number of neutrons as atom 3. Atom 1 does not have the same number of neutrons as atom 3. Which of the following statements is true?

A. Atom 3 must have the same number of protons as atom 2.
B. Atoms 1 and 2 must be isotopes.
C. Atoms 1 and 3 must be isotopes.
D. Atom 2 must have the same number of neutrons as atom 1.
E. Atom 3 must have the same number of protons as atom 1.

34. Which of the following statements is true concerning the two nuclides ^{3}He and ^{4}He?

A. They have the same number of neutrons.
B. They are isotopes.
C. They have the same relative atomic mass.
D. They have the same mass number.
E. They have different chemical properties.

35. Which of the following atomic symbols represents an isotope of ^{99}Ru?

A. ^{98}Tc
B. ^{100}Rh
C. ^{99}Rh
D. ^{100}Ru
E. ^{99}Tc

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

		Atomic Number	Mass Number
A.	I	17	36
	II	18	36
B.	I	7	15
	II	8	15
C.	I	17	35
	II	17	37
D.	I	17	37
	II	18	38
E.	I	7	16
	II	8	17

37. There are three isotopes of carbon differing with respect to

A. electron configuration.
B. nuclear charge.
C. number of neutrons.
D. number of protons.
E. atomic number.

38. Which of the following about the isotopes of a particular element is not true?

A. Each unique isotope has a different atomic mass.
B. Each unique isotope has a different atomic number.
C. Each unique isotope has a different number of neutrons.
D. Each unique isotope has the same number of protons.
E. In neutral atoms of each unique isotope, the number of electrons equals the number of protons.

39. The neutral atoms of all the isotopes of the same element have

A. different numbers of protons.
B. the same number of neutrons.
C. the same number of electrons.
D. the same mass.
E. the same mass number.

40. What is the symbol of the nuclide having 15 protons and 16 neutrons?

A. $^{31}_{15}S$

B. $^{16}_{15}S$

C. $^{31}_{15}P$

D. $^{15}_{16}S$

E. $^{16}_{15}P$

41. Which of the following has 62 neutrons, 46 protons, and 46 electrons?

A. $^{108}_{48}Cd^{2+}$

B. $^{108}_{46}Pd$

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

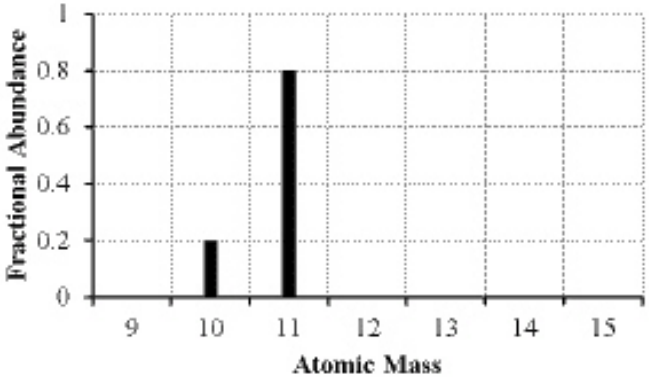
D. $^{110}_{48}Cd^{2+}$

E. $^{103}_{45}Rh^{3+}$

42. Which of the following elements has the largest atomic mass?

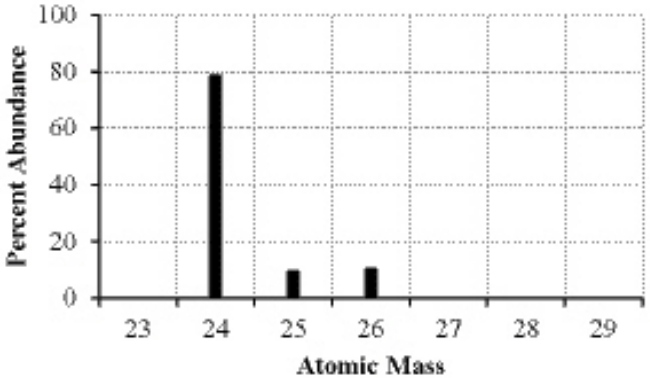
A. rhenium
B. manganese
C. thallium
D. argon
E. fluorine

43. The mass spectrum of an element with two naturally occurring isotopes is shown below. What is the best estimate of the element's atomic mass?



A. 10 amu
B. 11 amu
C. 10.8 amu
D. 10.2 amu
E. 10.5 amu

44. The mass spectrum of an element with two naturally occurring isotopes is shown below. Its average atomic mass would be best estimated as



A. less than 26 amu but greater than 25 amu.
B. less than 25 amu but greater than 24 amu.
C. equal to 24 amu.
D. equal to 25 amu.
E. greater than 26 amu.

45. Lithium has two naturally occurring isotopes, ^{6}Li and ^{7}Li . The average atomic mass of lithium is 6.941. Which of the following statements concerning the relative abundance of each isotope is correct?

A. The abundance of ^{7}Li is greater than ^{6}Li.
B. The abundance of ^{7}Li is less than ^{6}Li.
C. The abundance of ^{6}Li is equal to the abundance of ^{7}Li.
D. Not enough data is provided to determine the correct answer.
E. Based on the atomic mass, only ^{7}Li occurs naturally.

46. A certain element is listed as having an atomic mass of 63.5 amu. It is probably true that this element contains

A. a mixture of isotopes.
B. a mixture of neutrons.
C. a mixture of isomers.
D. a mixture of allotropes.
E. a mixture of ions.

47. The average atomic mass of Eu is 151.96 amu. There are only two naturally occurring isotopes of europium, ^{151}Eu with a mass of 151.0 amu and ^{153}Eu with a mass of 153.0 amu. The natural abundance of the ^{131}Eu isotope must be approximately

A. 60%.
B. 20%.
C. 50%.
D. 80%.
E. 40%.

48. Naturally occurring element X exists in three isotopic forms: X-28 (27.977 amu, 92.21% abundance), X-29 (28.976 amu, 4.70% abundance), and X-30 (29.974 amu, 3.09% abundance). Calculate the atomic weight of X.

A. 29.09 amu
B. 28.09 amu
C. 35.29 amu
D. 86.93 amu
E. 25.80 amu

49. Neon has three naturally occuring isotopes. The abundance of ^{20}Ne is 90.48% and ^{22}Ne is 9.25%. What is the percent abundance of ^{21}Ne?

A. 9.25%
B. 0.27%
C. 49.9%
D. 33.2%
E. 81.2%

50. An element, X, has the following isotopic composition: X-200, 90%; X-199, 8.0%; and X-202, 2.0%. Its average atomic mass is closest to

A. 200 amu.
B. 203 amu.
C. 199 amu.
D. 202 amu.
E. 201 amu.

51. Which of the following concerning atomic mass is/are correct?

1. The atomic mass listed on a modern periodic table for each element is the mass of the most abundant isotope.
2. The atomic mass listed on a modern periodic table is a relative atomic mass, based on the definition that ^{12}C equals 12 amu.
3. Relative atomic masses can only be determined with a mass spectrometer.

A. 1 only
B. 2 only
C. 1 and 2
D. 2 and 3
E. 1, 2, and 3

52. A periodic law based on atomic masses would necessitate Te and I changing places in the periodic table. This was not done in the early periodic table because

A. a periodic law based on atomic masses is not valid.
B. it was thought that the atomic masses might be in error.
C. iodine behaves chemically like chlorine and bromine.
D. the tellurium samples could contain a heavy impurity.
E. iodine contains one naturally occurring isotope, whereas tellurium consists of several isotopes.

53. The elements in a row of the periodic table are known as

A. metals.
B. a period.
C. metalloids.
D. a family.
E. a group.

54. Which of the following statements about different elements is incorrect?

A. Potassium is an alkali metal.
B. Fluorine is a halogen.
C. Aluminum is a transition element.
D. Barium is an alkaline earth metal.
E. Helium is a noble gas.

55. Which of the following statements is not true about the element calcium?

A. It is a metal.
B. It is an alkaline earth metal.
C. It is in period 4.
D. It has chemical and physical properties most similar to silver.
E. It is in group IIA (group 2).

56. The elements in groups 1A-8A or 1-2 and 15-18 are known as the

A. main group.
B. alkaline earth metals.
C. metalloids or semimetals.
D. halogens.
E. transition metals.

57. Choose the group containing the most reactive nonmetals.

A. Group 5A
B. Group 3A
C. Group 7A
D. Group 8A
E. Group 1A

58. Which element belongs to the transition metals?

A. palladium
B. sodium
C. calcium
D. iodine
E. helium

59. Which of the following statements about different elements is/are true?

1. As is a metalloid and Se is a nonmetal.
2. Cu is a transition element and Ge is a metalloid.
3. Both F and I are halogens.

A. 1 only
B. 2 only
C. 3 only
D. 1 and 2
E. 1, 2, and 3

60. Which of the following is a metalloid?

A. oxygen
B. hydrogen
C. silicon
D. carbon
E. copper

61. All of the following elements are best classified as metalloids except

A. Si.
B. Te.
C. As.
D. B.
E. Ga.

62. Which formula is best described as a (condensed) structural formula?

A. $C_2B_{10}H_{12}$
B. $C_6H_{11}Cl$
C. $CH_3CH_2CH_2CH_2Cl$
D. $C_{12}H_{22}O_{11}$
E. C_2H_6O

63. Which of the following is/are information that is unique to a space-filling molecular model?

1. The model shows the relative sizes of each element.
2. The model shows the charge distribution.
3. The model shows the types of bonds (single or multiple) connecting the atoms.

A. 1 only
B. 2 only
C. 3 only
D. 1 and 2
E. 1, 2, and 3

64. In a particular mass of $KAu(CN)_2$, there are 8.87×10^{20} atoms of gold. What is the total number of atoms in this sample?

A. 1.77×10^{21}
B. 2.66×10^{21}
C. 5.32×10^{21}
D. 4.44×10^{21}
E. 3.55×10^{21}

65. A sample of TNT, $C_7H_5N_3O_6$, has 7.68×10^{21} nitrogen atoms. How many hydrogen atoms are there in this sample of TNT?

A. 1.54×10^{22}
B. 10.24×10^{21}
C. 1.28×10^{22}
D. 7.68×10^{21}
E. 1.79×10^{22}

66. A 1.4-g sample of washing soda, $Na_2CO_3 \cdot 10H_2O$, has 2.9×10^{21} carbon atoms. How many oxygen atoms are present in 1.4 g of washing soda?

A. 2.9×10^{22}
B. 2.9×10^{21}
C. 4.1×10^{21}
D. 3.8×10^{22}
E. 8.8×10^{21}

67. A sample of the mineral troegerite, $(UO_2)_3(AsO_4)_2 \cdot 12H_2O$, has 1.33×10^{21} U atoms. How many arsenic atoms are present in this sample of troegerite?

A. 2.00×10^{22}
B. 1.60×10^{22}
C. 2.66×10^{21}
D. 6.65×10^{22}
E. 8.87×10^{20}

68. An ion is formed

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

69. The species Au^+, Mg^{2+}, and V^{3+} are all

A. anions.
B. isotopes.
C. isoelectronic.
D. allotropes.
E. cations.

70. The species that is formed when a molecule gains or loses an electron is called

A. an ion.
B. a metalloid.
C. an isotope.
D. an atom.
E. a metal.

71. Which of the following statements is true about one formula unit of $SrBr_2$?

A. It is composed of one Sr atom and one Br_2 molecule.
B. It is composed of one Sr atom and two Br atoms.
C. It is composed of one Sr^{2+} ion and one Br_2^{2-} ion.
D. It is composed of one $SrBr_2$ molecule.
E. It is composed of one Sr^{2+} ion and two Br^- ions.

72. Aluminum(III) sulfite is an ionic compound formed from Al^{3+} and SO_3^{2-}. What is the correct way to represent the formula?

A. $AlSO_3^+$
B. $Al(SO_3)^-$
C. $Al^{3+}SO_3^{2-}$
D. $Al_2(SO_3)_3$
E. $Al_7(SO_3)_{10.5}$

73. Chemical reactions between nonmetals and nonmetals primarily involve

A. sharing of electrons.
B. interactions between protons.
C. transfer of electrons.
D. interactions among protons, electrons, and neutrons.
E. interactions between protons and electrons.

74. Which of the following is an ionic compound?

A. HOClO
B. NH_3
C. CH_3OH
D. N_2O_3
E. NH_4CN

75. 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 oxygen atoms and one hydrogen atom per water molecule.
C. there is twice as much mass of oxygen as of hydrogen in each molecule.
D. there are two hydrogen atoms and one oxygen atom per water molecule.
E. none of these

76. How many oxygen atoms are there in a formula unit of $UO_2(C_2H_3O_2)_2 \cdot NH_4C_2H_3O_2 \cdot 4H_2O$?

A. 4
B. 12
C. 21
D. 8
E. 10

77. What is the ratio of oxygen atoms to hydrogen atoms in the compound $Fe_4(PO_4)_3(OH)_3 \cdot 12H_2O$?

A. 15:3
B. 27:15
C. 27:27
D. 18:27
E. 25:17

78. What is the ratio of oxygen atoms to hydrogen atoms in the mineral carnotite, $K_2(UO_2)_3(VO_4)_2 \cdot 3H_2O$?

A. 8:6
B. 8:3
C. 17:3
D. 9:6
E. 17:6

79. Which statement is incorrect concerning the formation of ionic compounds?

A. Halogens tend to form anions with a charge of –1.
B. Alkali metals tend to form cations with a charge of +1.
C. Metals tend to form cations, while nonmetals tend to form anions.
D. Transition metals tend to form cations with a charge of +3.
E. Noble gases tend not to form ionic compounds.

80. The empirical formula of a salt consisting of Sr^{2+} and NO_2^- ions is

A. $Sr^{2+}NO_2^-$.
B. $SrNO_2$.
C. Sr_2NO_2.
D. $Sr_2(NO_2)_3$.
E. $Sr(NO_2)_2$.

81. Which of the following molecules is a hydrocarbon?

A. H_2O
B. $CH_3CH_2CH_3$
C. $C_6H_{12}O_6$
D. CH_3CH_2OH
E. CH_3OCH_3

82. Which of the following molecules contains the ether functional group?

A. $CH_3CH_2NH_2$
B. $CH_3CH_2OCH_2CH_3$
C. CH_3CH_2OH
D. CH_3CH_2COOH
E. H_2O_2

83. Which of the following molecules contains the carboxylic acid functional group?

A. $CH_3CH_2CH_2OH$
B. $CH_3CH_2COCH_2CH_3$
C. CH_3NHCH_3
D. $CH_3OCH_2CH_3$
E. $CH_3CH_2CH_2COOH$

84. Which of the following molecules contains the alcohol functional group?

A. C_6H_6
B. CH_3OH
C. CH_4
D. CH_3OCH_3
E. C_2H_2

85. How many electrons does a barium ion have?

A. 56
B. 8
C. 54
D. 38
E. 2

86. Which of the following statements is false?

A. A crystal of calcium fluoride has equal numbers of calcium ions and fluoride ions.
B. A sodium atom is most likely to ionize to form a cation of charge +1.
C. A sulfide ion has a total of 18 e^-.
D. A potassium ion has a total of 18 e^-.
E. The charge on a neutral chlorine atom is zero.

87. As an ion, sodium has _____ electrons?

A. 24
B. 14
C. 11
D. 28
E. 10

88. How many electrons does a chloride ion have?

A. 17
B. 22
C. 15
D. 18
E. 2

89. Which metals form cations with varying positive charges?

A. many transition metals
B. Zn and Al
C. Group 1 metals
D. Group 1 and Group 2 metals
E. Group 2 metals

90. Which of the following represents a known ion?

A. S^{2+}
B. Sc^{4+}
C. Sn^{2+}
D. P^{4-}
E. Na^-

91. The formula for the sulfide ion is

A. SO^{2-}.
B. SO_4^{2-}.
C. $S_2O_3^{2-}$.
D. S^{2-}.
E. HSO_4^-.

92. The correct name for Sn^{2+} is

A. monotin ion.
B. tin(II) ion.
C. tin ion.
D. tin(I) ion.
E. tin.

93. The formula of the perchlorate ion is

A. $Cl_2O_3^-$.
B. ClO_3^-.
C. CN^-.
D. ClO_4^-.
E. ClO^-.

94. The name of the SO_4^{2-} ion is

A. persulfate.
B. thiosulfite.
C. sulfite.
D. sulfate.
E. sulfide.

95. The formulas of the nitrite, phosphate, and nitrate ions are represented, respectively, as

A. N^{3-}, PO_3^{3-}, NO_3^-.
B. NO^-, P^{5-}, NO_3^-.
C. NO_2^-, P^{3-}, NO_3^-.
D. NO^{2-}, PO^-, N^{3-}.
E. NO_2^{3-}, PO_4^{3-}, NO_3^-.

96. The formulas of the hydroxide ion, the nitrate ion, and the phosphate ion are represented, respectively, as

A. OH^-, NO^-, PO^{3-}.
B. OH^-, NO^{2-}, PO^{3-}.
C. H^-, NO^-, P^{3-}.
D. H^-, NO^{2-}, P^{3-}.
E. OH^-, NO_3^-, PO_4^{3-}.

97. All the following ions have the same charge except

A. sulfate.
B. dichromate.
C. chlorate.
D. sulfide.
E. sulfite.

98. All the following ions have the same charge except

A. oxide.
B. monohydrogen phosphate.
C. peroxide.
D. permanganate.
E. oxalate.

99. The formulas of the carbonate ion, the ammonium ion, and the chlorate ion are represented, respectively, as

A. CO^{2-}, NH^{-}, ClO^{-}.
B. CO_3^{2-}, NH_4^{+}, ClO_3^{-}.
C. CO^{3-}, NH^{+4}, ClO^{-3}.
D. P^{3-}, NH_3^{+4}, ClO_2^{-}.
E. CO_3^{2-}, NH_3^{+}, ClO_2^{-}.

100. The systematic name for BaH_2 is

A. barium(II) hydrate.
B. barium hydride.
C. barium dihydrate.
D. barium dihydrogen.
E. barium dihydride.

101. What is the name of the compound whose formula is $Al_2(SO_4)_3$?

A. aluminum sulfate
B. dialuminum tri(sulfur tetraoxygen)
C. aluminum sulfide
D. aluminum persulfate
E. aluminum sulfite

102. The correct name for FeO is

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

103. What is the formula for the chloride of praseodymium(III)?

A. $Pr_2(ClO_2)_3$
B. $Pr(ClO_4)_2$
C. Pr_3Cl
D. $PrCl_3$
E. $Pr(ClO_3)_3$

104. What is the correct formula for bismuth(III) sulfite?

A. $BiSO_3$
B. Bi_2SO_3
C. $Bi_3(SO_3)_2$
D. $Bi_2(SO_3)_3$
E. $Bi(SO_3)_2$

105. What is the correct name for Sc_2O_3?

A. manganese(III) oxide
B. manganese oxide
C. dimanganese trioxide
D. manganese trioxide
E. dimanganese(II) oxide

106. What is the formula for calcium nitride?

A. $CaNO_2$
B. $Ca(NO_3)_2$
C. $Ca(NO_3)_2$
D. Ca_3N_2
E. Ca_2N_3

107. The formula of magnesium sulfide is

A. MgS.
B. $MgSO_2$.
C. $MgSO_4$.
D. $MgSO_3$.
E. $Mg(SO_4)_2$.

108. What is the formula of magnesium nitrite?

A. $Mg(NO_2)_2$
B. Mg_3N_2
C. $Mg_2(NO_2)_2$
D. Mg_2N_3
E. $Mg(NO_2)_3$

109. The formula for aluminum bromide is

A. AlB.
B. AlBr.
C. Al_2Br_3.
D. $AlBr_3$.
E. $AlBr_3$.

110. The chemical formula for iron(III) sulfide is

A. $Fe_3(SO_4)_2$.
B. Fe_2S_3.
C. $Fe_2(SO_3)_3$.
D. $Fe_3(SO_3)_2$.
E. $Fe_2(SO_4)_3$.

111. The formula for aluminum sulfate is

A. $Al_2(SO_3)_3$.
B. Al_2S_3.
C. $Al_2(SO_4)_3$.
D. Al_3S_2.
E. $Al_3(SO_4)_2$.

112. The formula for copper(II) phosphate is

A. $Co_3(PO_4)_2$.
B. $CuPO_4$.
C. $Co_2(PO_4)_3$.
D. $Cu_2(PO_4)_3$.
E. $Cu_3(PO_4)_2$.

113. Choose the name–formula pair that does not match.

A. calcium fluoride, CaF_2
B. iron(III) oxide, Fe_2O_3
C. aluminum oxide, Al_2O_3
D. potassium permanganate, K_2MnO_4
E. sodium sulfite, Na_2SO_3

114. Choose the name–formula pair that does not match.

A. calcium hydride, CaH_2
B. ammonium hydrogen carbonate, NH_4CO_3
C. sodium chlorite, $NaClO_2$
D. calcium hydroxide, $Ca(OH)_2$
E. nitric acid, HNO_3

115. The formula for aluminum fluoride is

A. AlF_3.
B. AlF.
C. Al_2F.
D. AlF_4.
E. AlF_2.

116. The formula for potassium carbonate is

A. P_2C.
B. K_2CO_3.
C. Po_2CO_3.
D. P_2CO_3.
E. K_2C.

117. The formula for magnesium nitride is

A. Mg_2N_3.
B. Mg_3N_2.
C. $MgNO_2$.
D. $Mg(NO_2)_2$.
E. MgN.

118. What is the subscript of potassium in the formula for potassium sulfate?

A. 2
B. 5
C. 3
D. 4
E. 1

119. What is the formula for sodium peroxide?

A. Na_3O_2
B. NaO_2
C. Na_2O
D. NaO_2
E. Na_2O_2

120. What is the formula for the chlorate of gadolinium(III)?

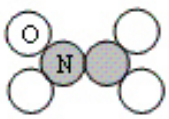
A. $Gd(ClO_4)_2$
B. $GdCl_2$
C. $Gd_2(ClO_3)_3$
D. $GdCl_3$
E. $Gd(ClO_3)_3$

121. What is the formula for the nitride of samarium(III)?

A. SmN
B. Sm_2N_3
C. $Sm(NO_3)_2$
D. $Sm(NO_3)_3$
E. $Sm(NO_2)_3$

122. The correct name for LiCl is

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

123. The chemical name for the model  is

A. dinitrogen tetroxide.
B. nitrogen tetroxide.
C. nitrogen oxide.
D. nitric oxide.
E. nitrogen trioxide

124. The chemical name for the binary, non-ionic molecule with the formula PBr_5 is

A. phosphorus pentabromide.
B. monophosphorus bromide.
C. phosphide pentabromide.
D. phosphorus pentabromine.
E. monophosphorus pentabromine.

125. The formula for chloric acid is

A. $HClO_2$.
B. HClO.
C. HCl.
D. $HClO_4$.
E. $HClO_3$.

126. Which name–formula pair is <u>incorrect</u>?

A. HI, hydroiodic acid
B. H_2SO_3, sulfurous acid
C. H_2SO_4, sulfuric acid
D. $HClO_4$, perchloric acid
E. HNO_3, carbonic acid

127. Which name–formula pair is <u>incorrect</u>?

A. hypochlorous acid, $HClO_2$
B. titanium(IV) carbide, TiC_2
C. strontium nitride, Sr_3N_2
D. magnesium sulfate heptahydrate, $MgSO_4 \cdot 7H_2O$
E. dinitrogen tetroxide, N_2O_4

128. The oxoanion that comes from nitrous acid is

A. $N_2O_3^-$.
B. NO_2^-.
C. HNO_3^-.
D. NO^-.
E. NO_3^-.

129. For the following balanced chemical equation, which substance represents the catalyst?
$2CO(g) + 2NO(g) \xrightarrow{Rh(s)} 2CO_2(g) + N_2(g)$

A. $NO(g)$
B. $CO(g)$
C. $CO_2(g)$
D. $N_2(g)$
E. $Rh(s)$

130. What is the balanced chemical equation that represents the following reaction?

A. $6H + 2N \rightarrow 2NH_3$
B. $6H + 2N \rightarrow 2HN_3$
C. $2N + 2H_3 \rightarrow 2H_3N$
D. $6H + 2N_3 \rightarrow 2N_3H$
E. $3H_2 + N_2 \rightarrow 2NH_3$

131. In the following chemical equation, what is the reactant?
$CuSO_4 \cdot 5H_2O(s) \rightarrow CuO(s) + SO_3(g) + 5H_2O(l)$

A. $CuSO_4 \cdot 5H_2O(s)$
B. $H_2O(l)$
C. $CuO(s)$
D. $SO_3(g)$
E. $CuSO_4(s)$

132. Which is a correct balanced chemical equation corresponding to the following description of a chemical reaction?
Hydrochloric acid reacts with magnesium metal to produce aqueous magnesium chloride and hydrogen gas.

A. $2HCl(aq) + Mg(s) \rightarrow MgCl_2(aq) + 2H(g)$
B. $2HCl(aq) + Mg(s) \rightarrow MgCl_2(aq) + H_2(g)$
C. $2HCl(aq) + Mg(s) \rightarrow MgCl(aq) + H_2(g)$
D. $2HCl(aq) + Mg(aq) \rightarrow MgCl_2(s) + H_2(g)$
E. $HCl(aq) + Mg(s) \rightarrow MgCl(aq) + H(g)$

133. Sulfuric acid reacts with aqueous sodium hydroxide to produce aqueous sodium sulfate and liquid water. Which is the correct balanced chemical equation for this reaction description?

A. $H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2S(aq) + 2H_2O(l) + 2O_2(g)$
B. $H_2S(aq) + 2NaOH(aq) \rightarrow Na_2S(aq) + 2H_2O(l)$
C. $H_2SO_4(aq) + NaOH(aq) \rightarrow NaSO_4(aq) + H_2O(g)$
D. $H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$
E. $H_2SO_4(aq) + (NaOH)_2(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$

134. How many of the following statements are true concerning chemical equations?
I. Coefficients can be fractions.
II. Subscripts can be fractions.
III. Coefficients represent the relative masses of the reactants and/or products.
IV. Changing the subscripts to balance an equation can be done only once.
V. Atoms are conserved when balancing chemical equations.

A. 3
B. 4
C. 2
D. 5
E. 1

135. When the following equation is balanced with lowest whole-number coefficients, what is the coefficient for NO(*g*)?
___$NH_3(g)$ + ___$O_2(g)$ ® ___NO(*g*) + ___$H_2O(g)$

A. 3
B. 2
C. 5
D. 4
E. 1

136. The complete combustion of propane, C_3H_8, yields carbon dioxide and water:
__$C_3H_8 + __O_2 \rightarrow __CO_2 + __H_2O$

The smallest whole-number coefficient of oxygen in the balanced equation is

A. 6.
B. 3.
C. 7.
D. 4.
E. 5.

137. The complete combustion of butane, C_4H_{10}, yields carbon dioxide and water:
__$C_4H_{10} + __O_2 \rightarrow __CO_2 + __H_2O$

The smallest whole-number coefficient of oxygen in the balanced equation is

A. 12.
B. 14.
C. 10.
D. 11.
E. 13.

138. The products of the combustion of acetaldehyde with oxygen are shown in the following equation:
__ CH_3CHO + __ O_2 ® __ CO_2 + __ H_2O
When properly balanced, the equation indicates that ____ molecules of O_2 are required to burn 2 molecules of CH_3CHO.

A. 2
B. 6
C. 4
D. 3
E. 5

139. Energy from the following reaction provided the lift for the moon lander:
__ $(CH_3)_2N_2H_2$ + __ N_2O_4 ® __ N_2 + __ H_2O + __ CO_2
When the equation is balanced, the smallest whole-number coefficient of nitrogen is

A. 5.
B. 4.
C. 1.
D. 3.
E. 2.

140. Treatment of sodium borohydride with sulfuric acid is a convenient method for the preparation of diborane:
__ $NaBH_4$ + __ H_2SO_4 ® __ B_2H_6 + __ H_2 + __Na_2SO_4
When the equation is balanced, the lowest whole number coefficient for hydrogen is

A. 5.
B. 2.
C. 4.
D. 1.
E. 3.

141. All the following may change during a chemical reaction except

A. the total volume of the system.
B. the density of the system.
C. the temperature of the system.
D. the total number of atoms in the system.
E. the total number of molecules in the system.

142. The complete combustion of phenylhydrazine, $C_6H_5NHNH_2$, with the oxidizer dinitrogen tetraoxide is shown in the following equation:
__ $C_6H_5NHNH_2$ + __ N_2O_4 ® __ CO_2 + __ H_2O + __ N_2
When this equation is balanced, the sum of all the coefficients (using smallest whole numbers) is

A. 30.
B. 20.
C. 25.
D. 10.
E. 15.

143. The complete combustion of pentane yields carbon dioxide and water. When the equation
__ $C_5H_{12}(l)$ + __ $O_2(g)$ ® __ $CO_2(g)$ + __ $H_2O(l)$
is balanced, the ratio of the coefficient of CO_2 to the coefficient of O_2 is

A. 8:5.
B. 8:6.
C. 6:5.
D. 5:6.
E. 5:8.

144. A reaction occurs between sodium carbonate and hydrochloric acid, producing sodium chloride, carbon dioxide, and water. Which is the correct set of coefficients, respectively, for the balanced reaction?

A. 3 6 6 3 4
B. 8 6 5 10 5
C. 5 10 10 5 5
D. 1 2 2 1 1
E. none of these

145. When the equation
__ $(CH_3)_2NNH_2$ + __ N_2O_4 ® __ N_2 + __ H_2O + __ CO_2
is balanced, the sum of all the coefficients (simplest whole number) is

A. 13.
B. 12.
C. 9.
D. 10.
E. 11.

146. When the equation
__ $C_5H_6N_2OS(s)$ + __ $O_2(g)$ ® __ $CO_2(g)$ + __ $H_2O(l)$ + __ $N_2(g)$ + __ $SO_2(g)$
is balanced, the sum of all the coefficients (simplest whole number) is

A. 19.
B. 20.
C. 24.
D. 18.
E. 21.

147. Ammonia can be made by reaction of water with magnesium nitride:
__ $Mg_3N_2(s)$ + __ $H_2O(l)$ ® __ $Mg(OH)_2(s)$ + __ $NH_3(g)$
When the equation is properly balanced, the sum of the coefficients is

A. 6.
B. 14.
C. 12.
D. 9.
E. 8.

148. Which one of the following equations is properly balanced?

A. $Sn + 4HNO_3 \rightarrow SnO_2 + 4NO_2 + 2H_2O$
B. $2Na_2SO_4 + 3Bi(NO_3)_3 \rightarrow Bi_2(SO_4)_3 + 9NaNO_3$
C. $CH_3CHO + 3O_2 \rightarrow 2CO_2 + 2H_2O$
D. $NH_4NO_3 \rightarrow 2H_2O + N_2$
E. $Na_2CO_3 + 2H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O + CO_2$

149. Which of the following chemical equations is <u>not</u> balanced?

A. $NH_4NO_3 \rightarrow N_2O + 2H_2O$
B. $C_{12}H_{22}O_{11} \rightarrow 12C + 11H_2O$
C. $2NH_4SCN + Ba(OH)_2 \cdot 8H_2O \rightarrow 2NH_3 + 10H_2O + Ba(SCN)_2$
D. $(NH_4)_2Cr_2O_7 \rightarrow N_2O + Cr_2O_3 + 4H_2O$
E. $2Mg + CO_2 \rightarrow 2MgO + C$

150. Which of the following equations is <u>not</u> balanced?

A. $2Sb_2OS_2 + 10O_2 \rightarrow 2Sb_2O_5 + 4SO_3$
B. $(NH_4)_2Cr_2O_7 \rightarrow N_2 + 4H_2O + Cr_2O_3$
C. $C_{12}H_{22}O_{11} + 12O_2 \rightarrow 12CO_2 + 11H_2O$
D. $2NaCl + Pb(NO_3)_2 \rightarrow PbCl_2 + 2NaNO_3$
E. $Fe_3O_4 + 3CO \rightarrow 3Fe + 3CO_2$