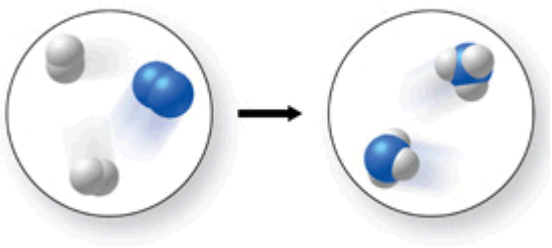
Chapter 2: Atoms, Ions, and the Periodic Table

1. Which of the following were the elements according to the early Greeks?
   A) earth, wind, and fire
   B) earth, air, fire, and water
   C) carbon, hydrogen, and oxygen
   D) sun, sand, and water
   E) none of these
   Ans: B

2. Which of the following statements regarding atoms and atomic theory is **incorrect**?
   A) "Atomos" is a Greek word meaning unbreakable.
   B) Democritus, a Greek philosopher, believed that matter could be broken down into infinitely small pieces.
   C) The ancient Greeks believed that all matter is made of four elements: earth, air, fire, and water.
   D) An element is a substance that cannot be broken down into simpler substances.
   E) By the 1700s, all chemists believed that elements were made of atoms.
   Ans: E

3. Which of the following statements regarding atoms and atomic theory is **incorrect**?
   A) Antoine Lavoisier discovered in the late 1700s that matter is not gained or lost in a chemical reaction.
   B) Joseph Proust showed that when elements combine to form new substances, they do so in specific mass ratios.
   C) According to the law of multiple proportions, when water forms, the mass ratio of hydrogen to oxygen is variable.
   D) John Dalton's atomic theory disagreed with the ancient Greek philosophers' ideas about matter.
   E) The Greek philosophers did not conduct experiments to support their ideas.
   Ans: C

4. The figure shows a molecular-level diagram of the chemical reaction between hydrogen and nitrogen to form ammonia. What is wrong with this diagram?



A) The products contain more nitrogen atoms than the reactants.
B) The products contain more hydrogen atoms than the reactants.
C) The number of reactant molecules should equal the number of product molecules.
D) The products should contain some unreacted hydrogen.
E) The product ammonia molecules should have only two hydrogen atoms attached to nitrogen.

Ans: B

5. Which of the following elements is **not** one of the three most abundant elements in the human body?

A) carbon B) oxygen C) iron D) hydrogen

Ans: C

6. Which of the following statements is **incorrect**?

A) The human body is made up of about 99% carbon, hydrogen, and oxygen.
B) Essential minerals come from the foods we eat and drink.
C) Most of the essential minerals in our diet are classified as metals on the periodic table.
D) Minerals are necessary for the growth and production of bones, teeth, blood, etc.
E) Magnesium is a building-block for hemoglobin, which carries oxygen in our blood.

Ans: E

7. Which of the following observations does **not** relate *specifically* to the law of definite proportions?
   A) Pure water is composed of the elements oxygen and hydrogen in a mass ratio of 8 to 1.
   B) Any sample of a given compound always contains the same proportions by mass of the component elements.
   C) The mass of the products of a chemical reaction is equal to the mass of the starting materials of the reaction.
   D) When a metal reacts with oxygen, the oxygen content of the products is fixed at one or two values.
   E) When water is broken down into its elements by electrolysis, elemental oxygen and hydrogen are formed in an 8 to 1 mass ratio.
   Ans: C

8. Which of the following is **not** part of Dalton's atomic theory?
   A) All matter is composed of small indivisible particles called atoms.
   B) All atoms of a given element have identical mass and chemical properties.
   C) Atoms of one element can be changed to atoms of another element in a chemical reaction.
   D) Atoms combine in whole-number ratios to form chemical compounds.
   E) Chemical reactions involve a rearrangement of the atoms in the starting materials.
   Ans: C

9. Which of the following statements regarding atomic theory is **incorrect**?
   A) John Dalton's experimental results led to the law of conservation of mass.
   B) Antoine Lavoisier's experiments showed that the mass of the products of a chemical reaction equals the mass of the reacting substances.
   C) When wood is burned, the ashes weigh less than the original wood, but this is not a violation of the law of conservation of matter.
   D) Dalton's atomic theory says that a chemical reaction is a rearrangement of atoms into one or more different chemical substances.
   E) Joseph Proust's findings regarding the reactions between metals and oxygen led to the law of definite proportions.
   Ans: A

10. Dalton's atomic theory consisted of all the following postulates **except**
    A) Elements are composed of indivisible particles called atoms.
    B) Atoms of different elements have different properties.
    C) The volumes of gases that combine are in small whole number ratios.
    D) Atoms combine in fixed ratios of whole numbers when they form compounds.
    E) In chemical reactions, atoms are not created or destroyed.
    Ans: C

11. Rutherford's scattering experiment demonstrated
    A) the existence of protons.
    B) the existence of electrons.
    C) the existence of neutrons.
    D) that most of the mass of an atom is in its nucleus.
    E) that the charge-to-mass ratio of an electron is constant.
    Ans: D

12. For the SO_3 molecule, the Law of Definite Proportions requires that the mass ratio of S to O must be
    A) 32:16 B) 32:32 C) 32:48 D) 16:32 E) 16:8
    Ans: C

13. The subatomic particles of interest to chemists, that make up the atom, include all of the following except the:
    A) proton.
    B) alpha particle.
    C) electron.
    D) neutron.
    E) alpha particle and neutron.
    Ans: B

14. In any neutral atom:
    A) the number of electrons equals the number of protons.
    B) the number of electrons is less than the number of protons.
    C) the number of electrons is greater than the number of protons.
    D) the number of electrons is equal to the number of neutrons.
    E) the number of neutrons is always equal to the number of protons.
    Ans: A

15. An atom contains
    A) as many neutrons as electrons.
    B) as many protons as neutrons.
    C) as many nuclei as electrons.
    D) as many electrons as protons.
    E) no protons.
    Ans: D

16. Which of the following statements regarding the nucleus of the atom is **incorrect**?
    A) The nucleus is the central core of the atom.
    B) The nucleus contains the electrons and the protons.
    C) The nucleus contains most of the mass of the atom.
    D) The nucleus contains the neutrons.
    E) The nucleus contains the neutrons and protons **and** most of the mass of the atom.
    Ans: B

17. Which particles are found in the atomic nucleus?
    A) Protons and electrons
    B) Electrons and neutrons
    C) Protons and neutrons
    D) Only electrons
    E) Only neutrons
    Ans: C

18. The number of _____ determines the identity of an element.
    A) electrons
    B) protons
    C) neutrons
    D) neutrons plus protons
    E) protons plus electrons
    Ans: B

19. The atomic number of an element represents
    A) the number of electrons its atom can gain.
    B) the number of neutrons in an atom of the element.
    C) the number of protons in an atom of the element.
    D) the number of protons and neutrons in an atom of the element.
    E) the mass of an atom of the element.
    Ans: C

20. The mass number of an atom represents
    A) the number of electrons in that atom.
    B) the number of isotopes of that atom.
    C) the number of neutrons in that atom.
    D) the number of protons in that atom.
    E) the number of protons and neutrons in that atom.
    Ans: E

21. Which of the following is the same for isotopes of an element?
    A) mass number
    B) mass of an atom
    C) neutron number
    D) atomic number
    E) both atomic number and neutron number
    Ans: D

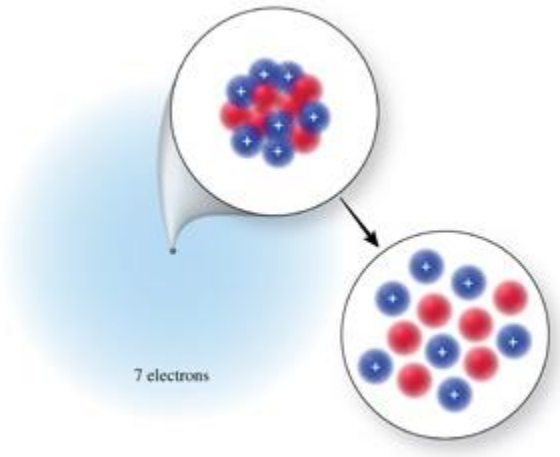
22. Which of the following statements about isotopes is **incorrect**?
    A) The isotopes of an element have the same number of protons, but different numbers of neutrons.
    B) ^{1}H, ^{2}H, and ^{3}H are all isotopes of hydrogen.
    C) Isotopes of an element have similar chemical properties.
    D) The melting point and boiling point of different isotopes of the same element will vary greatly.
    E) The different isotopes of an element have different mass numbers.
    Ans: D

23. What do the following have in common?
$^{17}Cl^{-}$, ^{18}Ar, and $^{19}K^{+}$
A) Number of protons
B) Number of neutrons
C) They are isotopes.
D) Number of electrons
E) They are all ions.
Ans: D

24. Atoms of different isotopes of a given element have the same
A) number of electrons.
B) sum of the number of protons and neutrons.
C) sum of the number of electrons and neutrons.
D) sum of the number of electrons, protons, and neutrons.
E) mass numbers.
Ans: A

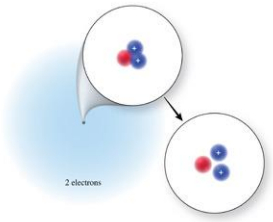
25. The element magnesium, Mg, has three common isotopes: ^{24}Mg, ^{25}Mg, and ^{26}Mg. The difference between these three isotopes is
A) the number of neutrons.
B) the number of electrons.
C) the number of protons.
D) the number of protons and electrons.
E) their physical state.
Ans: A

26. The correct isotope symbol for the isotope in the figure is:



A) $^{14}_{6}C$ B) $^{14}_{7}N$ C) $^{13}_{7}N$ D) $^{20}_{14}Si$ E) $^{15}_{7}N$
Ans: C

27. The correct isotope symbol for the isotope in the figure is:



A) ${}_{2}^{4}\mathrm{He}$ B) ${}_{2}^{3}\mathrm{He}$ C) ${}_{1}^{3}\mathrm{H}$ D) ${}_{2}^{5}\mathrm{He}$ E) ${}_{3}^{5}\mathrm{Li}$
Ans: B

28. The number of neutrons in an atom of I-131 is:
A) 131 B) 78 C) 53 D) 77 E) insufficient information given
Ans: B

29. The number of neutrons in an atom of copper-65 is:
A) 65 B) 29 C) 84 D) 36 E) insufficient information given
Ans: D

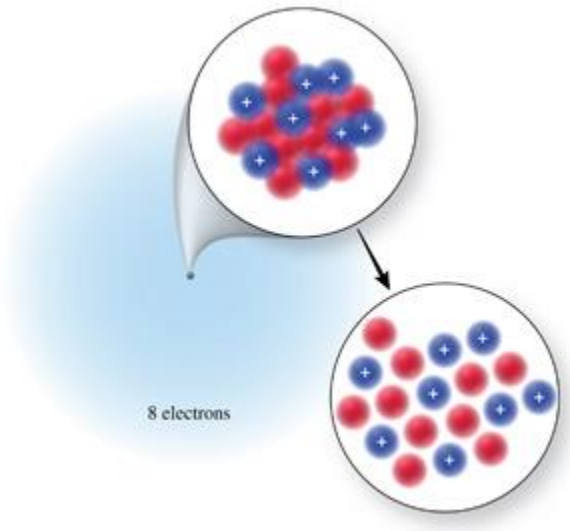
30. The number of neutrons in an atom of uranium-235 is:
A) 235 B) 92 C) 327 D) 143 E) insufficient information given
Ans: D

31. The number of protons and neutrons in an atom of bromine-81 is:
A) 81 protons and 35 neutrons.
B) 35 protons and 81 neutrons.
C) 46 protons and 35 neutrons.
D) 35 protons and 46 neutrons.
Ans: D

32. The number of protons and neutrons in an atom of argon-38 is:
A) 38 protons and 18 neutrons.
B) 18 protons and 20 neutrons.
C) 18 protons and 38 neutrons.
D) 38 protons and 56 neutrons.
E) 18 protons and 56 neutrons.
Ans: B

33. The number of protons and neutrons in an atom of magnesium-25 is:
A) 25 protons and 12 neutrons.
B) 12 protons and 25 neutrons.
C) 25 protons and 37 neutrons.
D) 12 protons and 13 neutrons.
E) 13 protons and 12 neutrons.
Ans: D

34. Identify the element or ion shown in the figure.



A) $^{18}Ne^{2+}$ B) ^{18}O C) ^{18}Ar D) $^{10}O^{2-}$ E) ^{16}O
Ans: B

35. The overall charge of an atom is _____ if the number of electrons is _____ than the number of protons.
A) negative, less B) negative, greater C) positive, greater D) neutral, less
Ans: B

36. The overall charge of an atom is _____ if the number of electrons is _____ than the number of protons.
A) negative, less B) positive, greater C) positive, less D) neutral, less
Ans: C

37. List the number of protons, neutrons, and electrons for $^{40}Ca^{2+}$:
A) 40 protons, 20 neutrons, and 20 electrons
B) 40 protons, 20 neutrons, and 18 electrons
C) 20 protons, 20 neutrons, and 18 electrons
D) 20 protons, 20 neutrons, and 22 electrons
E) 60 protons, 20 neutrons, and 18 electrons
Ans: C

38. List the number of protons, neutrons, and electrons for ^{35}Cl:
A) 35 protons, 18 neutrons, and 18 electrons
B) 18 protons, 17 neutrons, and 17 electrons
C) 17 protons, 18 neutrons, and 18 electrons
D) 17 protons, 18 neutrons, and 17 electrons
E) 52 protons, 18 neutrons, and 18 electrons
Ans: C

39. List the number of protons, neutrons, and electrons for $^{37}Cl^{-}$:
    A) 37 protons, 19 neutrons, and 18 electrons
    B) 20 protons, 17 neutrons, and 17 electrons
    C) 17 protons, 20 neutrons, and 18 electrons
    D) 17 protons, 18 neutrons, and 20 electrons
    E) 54 protons, 17 neutrons, and 18 electrons
    Ans: C

40. Which one of the following has as many electrons as it has neutrons?
    A) ^{1}H B) $^{40}Ca^{2+}$ C) ^{12}C D) ^{19}F E) $^{14}C^{4-}$
    Ans: C

41. Which one of the following has more neutrons than protons?
    A) ^{38}Ca B) ^{15}O C) ^{19}F D) ^{36}Ar E) ^{12}N
    Ans: C

42. Which of the following contains 18 neutrons?
    A) ^{31}P B) $^{34}S^{2-}$ C) ^{36}Cl D) $^{80}Br^{-}$ E) ^{18}O
    Ans: B

43. How many protons, neutrons, and electrons are in an atom of ^{197}Au, the most common isotope of gold?
    A) 197, 79, 118
    B) 118, 79, 79
    C) 79, 197, 79
    D) 79, 118, 118
    E) 79, 118, 79
    Ans: E

44. The isotope symbol for an ion that has 13 protons, 14 neutrons, and 10 electrons is:
    A) $^{14}_{13}Al$ B) $^{13}_{14}Si^{4+}$ C) $^{27}_{13}Al$ D) $^{27}_{13}Al^{3+}$ E) none of these
    Ans: D

45. The isotope symbol for an ion that has 11 protons, 12 neutrons, and 10 electrons is:
    A) $^{12}_{11}Na$ B) $^{12}_{11}Na^{+}$ C) $^{23}_{11}Na^{+}$ D) $^{23}_{11}Na$ E) $^{23}_{12}Mg^{2+}$
    Ans: C

46. The isotope symbol for an ion that has 12 protons, 12 neutrons, and 10 electrons is:
    A) $^{12}_{10}Mg$ B) $^{12}_{12}Ne$ C) $^{24}_{12}Mg^{2+}$ D) $^{24}_{12}Mg^{2-}$ E) none of these
    Ans: C

47. Which of the following statements regarding relative atomic masses is **incorrect**?
    A) Relative atomic mass is one of the numbers that appears on a typical periodic table.
    B) The average mass of the individual isotopes of an element considering the natural abundance of each is the relative atomic mass of that element.
    C) The relative atomic mass of carbon is 12.01 amu because carbon-12 is the most abundant isotope, with smaller amounts of carbon-13 and carbon-14.
    D) The terms "mass number" and "relative atomic mass" can be used interchangeably.
    E) Mass spectrometry is used to find the mass of each isotope of an element, and measure their abundance.
    Ans: D

48. On the planet Melmac, in a galaxy far, far away, argon has three naturally occurring isotopes as follows:

Isotope	Mass (amu)	Natural Abundance (%)
Argon-40	39.962	74.20
Argon-38	37.963	15.15
Argon-36	35.968	10.65

    What is the relative atomic mass of argon on Melmac?
    A) 39.23 amu B) 39.96 amu C) 37.96 amu D) 35.97 amu E) 40.00 amu
    Ans: A

49. On the planet Invertios, boron has two isotopes as follows:

Isotope	Mass (amu)	Natural Abundance (%)
Boron-10	10.0129	80.00
Boron-11	11.0093	20.00

    Estimate the relative atomic mass of boron on Invertios.
    A) 10.0 amu B) 10.2 amu C) 10.5 amu D) 10.8 amu E) 11.0 amu
    Ans: B

50. An element, El, has two isotopes with the following masses and abundances:
    ^{38}El 38.012 amu 75.68%
    ^{46}El 45.974 amu 24.32%
    What is the identity of this element?
    A) Ar B) K C) Ca D) S E) Cl
    Ans: A

51. Naturally occurring copper consists of copper-63 (62.9296 amu), and copper-65 (64.9278 amu). Using the relative atomic mass from the periodic table, which of the following is the best estimate of the percent abundance of the two isotopes of copper?
    A) 50% copper-63 and 50% copper-65
    B) 75% copper-63 and 25% copper-65
    C) 25% copper-63 and 75% copper-65
    D) 90% copper-63 and 10% copper-65
    E) 10% copper-63 and 90% copper-65
    Ans: B

52. Boron has two isotopes: B-10 and B-11, with masses of 10.013 amu and 11.009 amu, respectively. The relative atomic mass of boron is 10.81 amu. Which statement best describes the percent abundance of the isotopes of boron?
    A) It contains more B-10 than B-11.
    B) It contains more B-11 than B-10.
    C) It contains equal amounts of B-10 and B-11.
    D) There must be a third isotope of boron.
    E) A mass spectrum of boron is necessary to answer this question.
    Ans: B

53. Which of the following statements about Mendeleev's periodic table is **incorrect**?
    A) Mendeleev arranged the known elements in order of increasing relative atomic mass.
    B) He grouped elements with similar properties into columns and rows so that their properties varied in a regular pattern.
    C) He arranged the elements so that they were in increasing atomic number order.
    D) He was able to predict the existence and properties of several elements that were unknown at the time.
    E) Mendeleev developed his table before the discovery of protons.
    Ans: C

54. Which of the following statements about the modern periodic table in your text is **incorrect**?
    A) The periodic table is arranged by increasing atomic mass.
    B) The elements are arranged in rows and columns to emphasize periodic properties.
    C) Elements in the same vertical column are called groups or families.
    D) Each group has a Roman numeral and a letter associated with it.
    E) A horizontal row of elements is called a period.
    Ans: A

55. A horizontal row of elements in the periodic table is called a:
    A) group.
    B) family.
    C) period.
    D) both group and family are correct.
    E) both group and period are correct.
    Ans: C

56. A vertical column in the periodic table is called a:
    A) family or group. B) column. C) cohort. D) period. E) covey.
    Ans: A

57. Which of the following terms does **not** apply to the major categories of elements in the periodic table?
    A) metals
    B) antimetals
    C) nonmetals
    D) metalloids
    E) both antimetals and metalloids
    Ans: B

58. Which of the following statements does **not** apply to metalloids?
    A) The physical properties of metalloids resemble those of a metal.
    B) All metalloids are electrical insulators.
    C) Metalloids lie along the stair-step line beginning at boron.
    D) The chemical properties of metalloids are similar to nonmetals.
    E) Metalloids are also known as *semi-metals*.
    Ans: B

59. Which of the following does **not** apply to the main-group elements?
    A) Main-group elements are also known as representative elements.
    B) Main-group elements are in groups labeled with the letter A.
    C) Main-group elements are in groups labeled with the letter B.
    D) Main-group elements include metals.
    E) Main-group elements include nonmetals.
    Ans: C

60. Sodium reacts vigorously with water to form hydrogen gas and a compound containing sodium ions. Which other element is expected to react with water in a similar way?
    A) hydrogen B) aluminum C) nitrogen D) potassium E) silicon
    Ans: D

61. Elements in Group IA (1) (except hydrogen) are called:
    A) alkaline earth metals.
    B) alkali metals.
    C) transition metals.
    D) nonmetals.
    E) halogens.
    Ans: B

62. Elements in Group VIIA (17) are called:
    A) halogens.
    B) chalcogens.
    C) noble gases.
    D) inert gases.
    E) alkali metals.
    Ans: A

63. Elements in Group IIA (2) are called:
    A) halogens.
    B) noble gases.
    C) alkali metals.
    D) alkaline earth metals.
    E) chalcogens.
    Ans: D

64. Elements in Group VIIIA (18) are called:
    A) halogens.
    B) noble gases.
    C) alkali metals.
    D) alkaline earth metals.
    E) chalcogens.
    Ans: B

65. Which of the following statements applies to noble gases?
    A) Noble gases exist as diatomic molecules in their elemental form.
    B) Noble gases are found in Group VIIIA (18) in the periodic table.
    C) Noble gases are very reactive.
    D) Noble gases were discovered in ancient times.
    E) Many compounds are known for each noble gas.
    Ans: B

66. Which of the following statements regarding ion formation is **incorrect**?
    A) Nonmetals usually gain electrons to form ions that have a noble gas electron count.
    B) Main-group metals usually lose electrons to form ions that have a noble gas electron count.
    C) Elements in the same group often form ions of the same charge.
    D) The charge of **any** element's ion can be simply predicted using the periodic table.
    E) All of these statements are correct.
    Ans: D

67. What changes when an ion is formed from an atom?
    A) Neutrons are lost or gained.
    B) Protons are lost or gained.
    C) The nucleus disintegrates.
    D) Electrons are lost or gained.
    E) Either protons or electrons are lost or gained.
    Ans: D

68. Which of the following is the most likely mass for an atom of bromine-81?
    A) 81.000 amu
    B) 80.875 amu
    C) 80.916 amu
    D) 81.331 amu
    E) 81.500 amu
    Ans: C

69. Which of the following is the most likely mass for an atom of silver-107?
    A) 107.000 amu
    B) 107.500 amu
    C) 106.905 amu
    D) 106.500 amu
    E) 107.100 amu
    Ans: C

70. Which of the following is the most likely mass for an atom of silver-109?
    A) 109.000 amu
    B) 108.500 amu
    C) 108.000 amu
    D) 108.905 amu
    E) 109.100 amu
    Ans: D

71. To the correct number of significant figures, the mass of exactly 250 atoms of mercury would be:
    A) 200.6 amu
    B) 250 amu
    C) 5.015×10^4 amu
    D) 5.0100×10^4 amu
    E) 1.246 amu
    Ans: C

72. To the correct number of significant figures, the mass of exactly 200 atoms of carbon is:
    A) 12.01 amu B) 24.02 amu C) 240.2 amu D) 2402 amu E) 16.65 amu
    Ans: D

73. To the correct number of significant figures, the mass of exactly 400 atoms of magnesium is:
    A) 24.31 amu B) 9724 amu C) 97.24 amu D) 16.45 amu E) 0.06078 amu
    Ans: B

74. When comparing 1000 amu of carbon atoms with 1000 amu of helium atoms:
    A) each sample has the same number of atoms.
    B) there are more carbon atoms than helium atoms.
    C) there are more helium atoms than carbon atoms.
    D) it is not possible to tell which sample contains more atoms.
    E) helium is a gas, so it is less dense than the carbon, and therefore there would be fewer atoms.
    Ans: C

75. When comparing 10,000 amu of mercury atoms with 10,000 amu of iron atoms:
    A) each sample has the same number of atoms.
    B) there are more iron atoms than mercury atoms.
    C) there are more mercury atoms than iron atoms.
    D) it is not possible to tell which sample contains more atoms.
    E) mercury is a liquid, so it would be less dense than the iron, and therefore there would be fewer atoms.
    Ans: B

76. When comparing a 10.00 g sample of iron with a 10.00 g sample of lead:
    A) each sample has the same number of atoms.
    B) there are more iron atoms than lead atoms.
    C) there are more lead atoms than iron atoms.
    D) it is not possible to tell which sample contains more atoms.
    E) the lead is heavier than the iron, and therefore there would be more atoms.
    Ans: B

77. Which set of elements below contains, respectively, an alkali metal, a halogen, and a transition metal?
    A) Rb, Br, Ag B) Ca, Kr, Mn C) Sc, Ba, I D) H, F, V E) Li, S, Fe
    Ans: A

78. Which set of elements below contains, respectively, an alkaline earth metal, a noble gas, and a metalloid?
    A) Na, Ar, Si B) Ba, O, As C) Ti, Cl, Pb D) Bi, Kr, B E) Mg, Ne, Ge
    Ans: E

79. Which set of elements below contains, respectively, an alkaline earth metal, a noble gas, and a transition metal?
    A) Ca, Ar, Pb B) Mg, N, Cu C) Sr, He, Ni D) Na, Xe, Fe E) Li, Rn, Cr
    Ans: C

80. Which of the following elements does **not** naturally occur as a diatomic molecule?
    A) oxygen B) nitrogen C) hydrogen D) neon E) bromine
    Ans: D

81. Which of the following elements does **not** occur as a diatomic molecule?
    A) iodine B) fluorine C) nitrogen D) hydrogen E) carbon
    Ans: E

82. Which of the following elements does **not** occur as a diatomic molecule?
    A) oxygen B) fluorine C) nitrogen D) neon E) iodine
    Ans: D

83. To which class does the element chromium belong?
    A) representative (main-group) elements
    B) transition elements
    C) lanthanides
    D) actinides
    E) metalloids
    Ans: B

84. To which class does the element uranium belong?
    A) representative (main-group) elements
    B) transition elements
    C) lanthanides
    D) actinides
    E) metalloids
    Ans: D

85. To which class does the element calcium belong?
    A) representative (main-group) elements
    B) transition elements
    C) lanthanides
    D) actinides
    E) metalloids
    Ans: A

86. Select the element that is an alkali metal in Period 3.
    A) Na B) Mg C) Al D) K E) Ca
    Ans: A

87. Select the element that is a halogen in Period 5.
    A) Br B) Xe C) Te D) I E) N
    Ans: D

88. Select the element that is an alkaline earth metal in Period 4.
    A) Mg B) Sr C) K D) C E) Ca
    Ans: E

89. In which group of the periodic table do the elements **not** form ions?
    A) alkaline earth metals
    B) alkali metals
    C) halogens
    D) noble gases
    E) chalcogens
    Ans: D

90. The ions of most main-group elements have the same number of _____ as the noble gas that is closest to them in the periodic table.
    A) neutrons
    B) protons
    C) electrons
    D) protons and electrons
    E) neutrons and electrons
    Ans: C

91. The correct symbol for the ion formed by nitrogen is:
    A) N^{2-} B) N^{3-} C) N^{3+} D) N^{2+} E) N^{-}
    Ans: B

92. The correct symbol for the ion formed by sodium is:
    A) Na^{+} B) S^{2-} C) Na^{-} D) S^{2+} E) K^{+}
    Ans: A

93. The correct symbol for the ion formed by potassium is:
A) P^{3-} B) P^{3+} C) K^{+} D) K^{-} E) P^{2-}
Ans: C

94. Calcium citrate is a compound found in some calcium supplement medications. The calcium in this compound consists of ions containing 18 electrons. What is the charge of the calcium ions?
A) –2 B) –1 C) +1 D) +2 E) +3
Ans: D

95. Calculate the relative atomic mass of speedium (a fictional element) which has three isotopes with the following masses and abundances:
^{45}Sp 44.99 amu 30.0%
^{47}Sp 46.99 amu 60.0%
^{48}Sp 48.00 amu 10.0%
A) 45.0 amu B) 46.5 amu C) 46.7 amu D) 47.0 amu E) 140 amu
Ans: B

96. Antoine Lavoisier's experiments showed that the mass of the products of a chemical reaction equals the mass of the reacting substances.
Ans: True

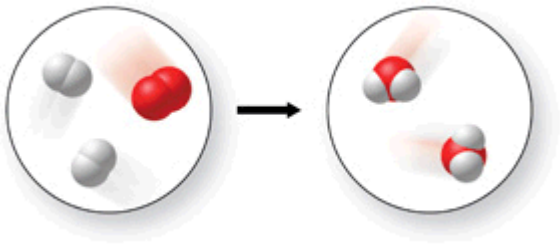
97. John Dalton's experimental results led to the law of conservation of mass.
Ans: False

98. When wood is burned, the ashes weigh less than the original wood, so this is a violation of the law of conservation of mass.
Ans: False

99. Dalton's atomic theory says that a chemical reaction is a rearrangement of atoms into one or more different chemical substances.
Ans: True

100. All of the statements in Dalton's original atomic theory are still considered to be correct today.
Ans: False

101. This figure shows a chemical reaction taking place.



Ans: True

102. An individual atom is made of smaller particles called subatomic particles.
Ans: True

103. Rutherford's alpha-scattering experiment suggested that the atom had a massive positively charged core, which he called the nucleus.
Ans: True

104. The number of neutrons in the nucleus of an atom determines its identity.
Ans: False

105. The number of protons in the nucleus of an atom is the atomic number of that atom.
Ans: True

106. In order for an atom of an element to be neutral, its number of electrons must equal its number of protons.
Ans: True

107. The mass number of an isotope is the sum of the number of protons and neutrons in its nucleus.
Ans: True

108. The properties of metal ions are the same as the properties of pure metal elements.
Ans: False

109. A cation is a positively charged ion that has fewer electrons than protons.
Ans: True

110. An anion is a positively charged ion that has more electrons than protons.
Ans: False

111. One atomic mass unit is equal to the mass of a carbon-12 atom.
Ans: False

112. The relative atomic mass of an element is the average mass of its individual isotopes, considering the relative abundance of each.
Ans: True

113. Lithium is composed of two isotopes: lithium-6 and lithium-7. Lithium-7 is the more abundant of the two isotopes.
Ans: True

114. The mass of exactly 100 carbon atoms is 12.01 amu.
Ans: False

115. The mass of exactly 1000 magnesium atoms is 2.431×10^4 amu.
Ans: True

116. Mendeleev arranged his periodic table in order of increasing atomic number.
Ans: False

117. Mendeleev was able to predict the existence of unknown elements using his periodic table.
Ans: True

118. The modern periodic table is arranged in order of increasing atomic mass.
Ans: False

119. Elements within a vertical column of the periodic table are called a family or group.
Ans: True

120. A horizontal row of the periodic table is called a period.
Ans: True

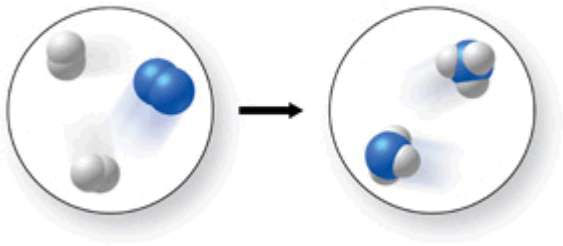
121. A metalloid is an element that has physical properties similar to those of a metal, but chemical reactivity which more closely resembles a nonmetal.
Ans: True

122. Elements in the eight groups labeled “A” are transition elements.
Ans: False

123. Elements in group IIA (2) are called alkali metals.
Ans: False

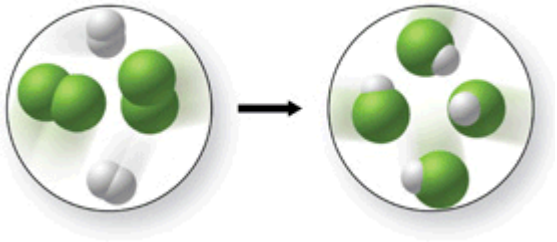
124. There are seven elements that occur naturally as diatomic molecules.
Ans: True

125. Explain what is incorrect, if anything, about the figure shown.



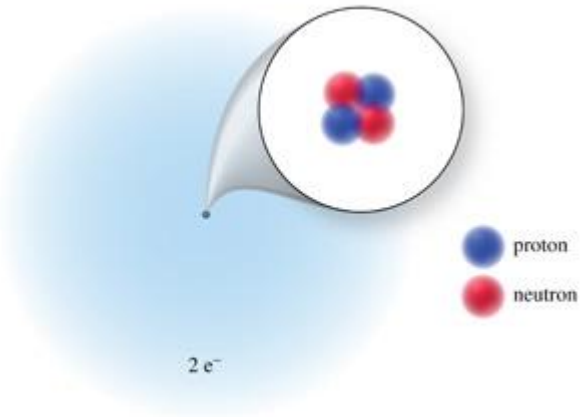
Ans: The reaction violates the law of conservation of mass, since there are not an equal number of hydrogen atoms in the two images.

126. Does the figure shown represent a chemical reaction, or simply a physical change, and does it obey the law of conservation of mass?



Ans: The figure shows a chemical reaction which obeys the law of conservation of mass.

127. Draw a nuclear model of a helium-4 atom. Label the nucleus, protons, neutrons, and electrons, and show the appropriate number of each type of subatomic particle.
Ans:



128. What is the difference between the mass number of an atom, and its mass in amu?
Ans: The mass number is an integer, which is the sum of the protons and the neutrons in the atom, while the mass in amu is an actual measure of the mass of an atom, often to five or more significant figures.

129. The element fluffium (Fl) was discovered on a planet in a galaxy far, far away. Given the information below, calculate the relative atomic mass of fluffium.

Isotope	Mass (amu)	Natural Abundance (%)
^{301}Fl	300.991	67.45
^{303}Fl	302.985	32.55

Ans: 301.6 amu

130. A new element, grubium (Gr), was discovered ground into a child's clothes. Given the information below, calculate the relative atomic mass of grubium.

Isotope	Mass (amu)	Natural Abundance (%)
^{54}Gr	53.992	26.46
^{56}Gr	55.989	73.54

Ans: 55.46 amu

131. List several unique features of the elements in group VIIIA (18) of the periodic table.
Ans: They are all gases, they don't normally combine with other elements or exist as diatomic molecules, and they do not form ions.

132. Describe how you would predict the charge on the ion that would be formed by a representative element.
Ans: Representative metals will lose enough electrons to have the same number of electrons as the noble gas that comes before them in the periodic table, while nonmetals will gain a sufficient quantity of electrons to “catch up” to the noble gas that follows them in the periodic table.

133. When dry ice (solid carbon dioxide) is removed from the freezer, it will sublime, or go directly from the solid phase to the gas phase. Explain why this is not a violation of the law of conservation of mass.
Ans: If you could capture the carbon dioxide gas and weigh it, the mass of the gas would be the same as the mass of the dry ice you started with.

134. Two balloons are filled to equal volumes with the same number of atoms. One balloon is filled with helium, while the other contains xenon. Without breathing in the contents of either balloon, describe how you could tell the difference between the two balloons, and why they would behave differently.
Ans: The helium-filled balloon would float, since helium is less dense than air, due to its low relative atomic mass. The relative atomic mass of xenon is much greater than that of the nitrogen and oxygen that comprise air, so it would be denser than air, and therefore would not float.