Answers to Selected End-of-Chapter Questions and Problems

Chapter 1

1.1. a. A pure compound in the gas phase.
b. A mixture of blue element atoms and red element atoms: blue atoms are in the gas phase, red spheres are in the liquid phase.
1.3. b
1.5. CH_2O_2
1.7. In both liquid and ice, the water molecules are touching each other. In ice, however, the water molecules arrange themselves in a rigid hexagonal arrangement; in the liquid, the molecules can move around each other and there is no long-range structure to their arrangement.
1.9. At the triple point, the gas's particles have the greatest motion and the solid's particles have the least motion.
1.11. The snow sublimed directly into the gas phase.
1.13. Energy is the ability to do work; work is force times distance; energy makes work possible.
1.15. a, b, c
1.17. 13 times as much
1.19. A Snickers bar (b) and an uncooked hamburger (d)
1.21. Orange juice (with pulp)
1.23. One chemical property of gold is its resistance to corrosion (oxidation). Gold's physical properties include its density, color, melting temperature, and electrical and thermal conductivity.
1.25. We can distinguish between table sugar, water, and oxygen by examining their physical states (sugar is a solid, water is a liquid, and oxygen is a gas) and by their densities, melting points, and boiling points.
1.27. Density, melting point, thermal and electrical conductivity, softness (a–d) are all physical properties, whereas tarnishing and reaction with water (e and f) are both chemical properties.
1.29. Extensive properties will change with the size of the sample and therefore cannot be used to identify a substance.
1.31. To form a hypothesis we need at least one observation, experiment, or idea (from examining nature).
1.33. Yes
1.35. *Theory* in normal conversation is someone's idea or opinion or speculation that can be changed.
1.37. SI units can be easily converted into a larger or smaller unit by multiplying or dividing by multiples of 10. English units are based on other number multiples and thus are more complicated to manipulate.
1.39. 93.2%
1.41. 2.5 mi
1.43. 1330 Cal
1.45. 4.1×10^{13} km
1.47. 2.0 hr
1.49. 4.0 m/s
1.51. 23 g
1.53. 19.0 mL
1.55. 26.5 g; 0.0265 kg

1.57. 58.0 cm^3
1.59. 73.8 mL
1.61. 5.1 g/cm^3
1.63. Yes
1.65. 0.28 cm^3
1.67. Precise: techniques 1 and 3, accurate: techniques 2 and 3, precise and accurate: technique 3; ranges: technique 1, 2 mg; technique 2, 10 mg; technique 3, 2 mg
1.69. a, c, d, f
1.71. a. 17.4
b. 1×10^{-13}
c. 5.70×10^{-23}
d. 3.58×10^{-3}
1.73. Because the Celsius scale is based on the freezing and boiling points of a common liquid—water.
1.75. Zero is the lowest possible temperature.
1.77. −269.0°C
1.79. 285.4 K; 54.1°F
1.81. −89.2°C; 183.9 K
1.83. The T_c for $YBa_2Cu_3O_7$ is already expressed in kelvin, $T_c = 93.0$ K. The T_c of Nb_3Ge converted to K is 23.2 K. The T_c of $HgBa_2CaCu_2O_6$ converted to K is 127.0 K. The superconductor with the highest T_c is $HgBa_2CaCu_2O_6$.
1.85. 0.031 mg/L
1.87. Both mixtures a and b react so that there is neither sodium nor chlorine left over.
1.89. Days 1, 11, and 21
1.91. 5 times more administered than prescribed
1.93. (a) All three; (b) none

Chapter 2

2.1. The elements shaded purple (H, hydrogen) and dark blue (He, helium)
2.3. Purple (H, hydrogen)
2.5. a. Yellow (Cl, chlorine) and red (Ne, neon)
b. Red (Ne, neon)
c. Blue (Na, sodium), green (Au, gold), and orange (Lr, lawrencium)
2.7. Red arrow, alpha; green arrow, beta
2.9. a. Blue (K) and green (Ag)
b. Gray (Mg)
c. Yellow (Sc)
d. Purple (I)
e. Red (O)
2.11. Rutherford concluded that the positive charge in the atom could not be spread out (the pudding) in the atom but must result from a concentration of charge in the center of the atom (the nucleus). Most of the particles were deflected only slightly or passed directly through the gold foil; so he reasoned that the nucleus must be small compared to the size of the entire atom. The negatively charged electrons do not deflect the particles, and Rutherford reasoned that the electrons took up the remainder of the space of the atom outside the nucleus.
2.13. The fact that cathode rays were deflected by a magnetic field indicated that the rays were streams of charged particles.
2.15. Through the alpha decay of the radioactive uranium ore and its products
2.17. Greater than 1
2.19. Hydrogen (^1H)

2.21.

	Atom	Mass Number	Atomic Number = Number of Protons	Number of Neutrons = Mass Number − Atomic Number	Number of Electrons = Number of Protons
(a)	^{14}C	14	6	8	6
(b)	^{59}Fe	59	26	33	26
(c)	^{90}Sr	90	38	52	38
(d)	^{210}Pb	210	82	128	82

2.23.

Symbol	^{23}Na	^{89}Y	^{118}Sn	^{197}Au
Number of Protons	11	39	50	79
Number of Neutrons	12	50	68	118
Number of Electrons	11	39	50	79
Mass Number	23	89	118	197

2.25.

Symbol	$^{37}Cl^-$	$^{23}Na^+$	$^{81}Br^-$	$^{226}Ra^{2+}$
Number of Protons	17	11	35	88
Number of Neutrons	20	12	46	138
Number of Electrons	18	10	36	86
Mass Number	37	23	81	226

2.27. Group 2, RO; group 3, R_2O_3; group 4, RO_2
2.29. Mendeleev based his groups on chemical reactivity. No compounds of the noble gases existed to indicate their presence as a group.
2.31. C, N, and O
2.33. a. Palladium (Pd)
b. Rhodium (Rh)
c. Platinum (Pt)
2.35. Three (Na, Mg, and Al)
2.37. A *weighted average* takes into account the proportion of each value in the group of values to be averaged.
2.39. $(m_X + m_Y)/2$
2.41. ^{51}V
2.43. (a) ^{11}B; (b) ^7Li; (c) ^{14}N
2.45. 63.55 amu
2.47. Yes
2.49. 47.95 amu
2.51. a. CaF_2, 78.074 amu
b. Na_2S, 78.045 amu
c. Cr_2O_3, 151.989 amu
2.53. (a) 1; (b) 3; (c) 6; (d) 6
2.55. (e) CH_4 < (d) NH_3 < (a) CO < (c) CO_2 < (b) Cl_2
2.57. A dozen is too small a unit to express the very large number of atoms, ions, or molecules present in laboratory quantities such as a mole.
2.59. (a) 7.3×10^{-10} mol Ne; (b) 7.0×10^{-11} mol CH_4; (c) 4.2×10^{-12} mol O_3; (d) 8.1×10^{-15} mol NO_2
2.61. (a) 1 mol; (b) 2 mol; (c) 1 mol; (d) 3 mol
2.63. 10.3 g
2.65. a. 7.53×10^{22} atoms
b. 7.53×10^{22} atoms
c. 1.51×10^{23} atoms
d. 2.26×10^{23} atoms