

Reviewing Content

36. a. reactants: sodium and water; products: hydrogen and sodium hydroxide
 b. reactants: carbon dioxide and water; products: oxygen and glucose
37. Dalton said that the atoms of reactants are rearranged to form new substances as products.
38. The arrow separates the reactants from the products and indicates a reaction that progresses in the forward direction. A plus sign separates individual reactants and individual products from one another.
39. a. Gaseous ammonia and oxygen react in the presence of a platinum catalyst to produce nitrogen monoxide gas and water vapor.
 b. Aqueous solutions of sulfuric acid and barium chloride are mixed to produce a precipitate of barium sulfate and aqueous hydrochloric acid.
 c. The gas dinitrogen trioxide reacts with water to produce an aqueous solution of nitrous acid.
40. A catalyst speeds up a chemical reaction.
41. a. $C + 2F + 2G \rightarrow CF_2G_2$
 b. $F + 3W + S + 2P \rightarrow FW_3SP_2$
42. A formula is a unique identifier of a substance. A different formula would indicate a different substance, not the one that is taking part in the reaction you are trying to balance.
43. a. $2PbO_2 \rightarrow 2PbO + O_2$
 b. $2Fe(OH)_3 \rightarrow Fe_2O_3 + 3H_2O$
 c. $(NH_4)_2CO_3 \rightarrow 2NH_3 + H_2O + CO_2$
 d. $2NaCl + H_2SO_4 \rightarrow Na_2SO_4 + 2HCl$
44. a single product
45. a. $2Mg + O_2 \rightarrow 2MgO$
 b. $4P + 5O_2 \rightarrow 2P_2O_5$
 c. $Ca + S \rightarrow CaS$
46. a single reactant
47. a. $2Ag_2O \xrightarrow{\Delta} 4Ag + O_2$
 b. $NH_4NO_3 \xrightarrow{\Delta} N_2O + 2H_2O$
48. a. no reaction
 b. $Zn(s) + 2AgNO_3(aq) \rightarrow Zn(NO_3)_2(aq) + 2Ag(s)$
 c. $2Al(s) + 3H_2SO_4(aq) \rightarrow Al_2(SO_4)_3(aq) + 3H_2(g)$
49. a. $H_2C_2O_4(aq) + 2KOH(aq) \rightarrow K_2C_2O_4(aq) + 2H_2O(l)$
 b. $CdBr_2(aq) + Na_2S(aq) \rightarrow CdS(s) + 2NaBr(aq)$
50. oxygen
51. a. $C_4H_8 + 6O_2 \rightarrow 4CO_2 + 4H_2O$
 b. $C_3H_6O + 4O_2 \rightarrow 3CO_2 + 3H_2O$
52. a. $3Hf + 2N_2 \rightarrow Hf_3N_4$; combination
 b. $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$; single replacement
 c. $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$; combustion
 d. $Pb(NO_3)_2 + 2NaI \rightarrow PbI_2 + 2NaNO_3$;
 e. double replacement
 f. $3Fe + 2O_2 \rightarrow Fe_3O_4$; combination
53. an ion that does not participate in the reaction
54. a. $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
 b. $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$
55. a. $2Al(s) + 6H^+(aq) \rightarrow 2Al^{3+}(aq) + 3H_2(g)$
 b. $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
 c. no reaction

Understanding Concepts

56. a. $Cl_2 + 2NaI \rightarrow 2NaCl + I_2$
 b. $2NH_3 \rightarrow N_2 + 3H_2$
 c. $4Na + O_2 \rightarrow 2Na_2O$
57. a. $Cl_2(g) + 2KI(aq) \rightarrow I_2(aq) + 2KCl(aq)$
 b. $2Fe(s) + 6HCl(aq) \rightarrow 2FeCl_3(aq) + 3H_2(g)$
 c. $P_4O_{10}(s) + 6H_2O(l) \rightarrow 4H_3PO_4(aq)$
58. a. $ZnS(aq) + H_2SO_4(aq) \rightarrow H_2S(g) + ZnSO_4(aq)$
 b. $NaOH(aq) + HNO_3(aq) \rightarrow H_2O(l) + NaNO_3(aq)$
 c. $2KF(aq) + Ca(NO_3)_2(aq) \rightarrow CaF_2(s) + 2KNO_3(aq)$
59. a. $Na_2O(s) + H_2O(l) \rightarrow 2NaOH(aq)$
 b. $H_2(g) + Br_2(g) \rightarrow 2HBr(g)$
 c. $Cl_2O_7(l) + H_2O(l) \rightarrow 2HClO_4(aq)$

60. a. $\text{Fe}(s) + \text{H}_2\text{SO}_4(aq) \rightarrow \text{FeSO}_4(aq) + \text{H}_2(g)$
 b. no reaction
 c. $\text{Br}_2(l) + \text{BaI}_2(aq) \rightarrow \text{BaBr}_2(aq) + \text{I}_2(aq)$
61. a. tube A
 b. $2\text{Na}(s) + 2\text{H}_2\text{O}(l) \rightarrow 2\text{NaOH}(aq) + \text{H}_2(g)$;
 single-replacement
62. a. $2\text{C}_8\text{H}_{18} + 25\text{O}_2 \rightarrow 16\text{CO}_2 + 18\text{H}_2\text{O}$
 b. $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$
 c. $\text{HC}_2\text{H}_3\text{O}_2 + 2\text{O}_2 \rightarrow 2\text{CO}_2 + 2\text{H}_2\text{O}$
63. a. $2\text{Al}_2\text{O}_3 \xrightarrow{\text{energy}} 4\text{Al} + 3\text{O}_2$
 b. $\text{Sn}(\text{OH})_4 \xrightarrow{\Delta} \text{SnO}_2 + 2\text{H}_2\text{O}$
 c. $\text{Ag}_2\text{CO}_3 \xrightarrow{\Delta} \text{Ag}_2\text{O} + \text{CO}_2$
64. a. $\text{H}^+(aq) + \text{OH}^-(aq) \rightarrow \text{H}_2\text{O}(l)$
 b. $\text{S}^{2-}(aq) + \text{H}^+(aq) \rightarrow \text{H}_2\text{S}(g)$
 c. $3\text{OH}^-(aq) + \text{Fe}^{3+}(aq) \rightarrow \text{Fe}(\text{OH})_3(s)$
65. a. $\text{CdS}(s)$
 b. $\text{Na}^+(aq)$ and $\text{NO}_3^-(aq)$
 c. $\text{Cd}^{2+}(aq) + \text{S}^{2-}(aq) \rightarrow \text{CdS}(s)$
66. a. $\text{K}_2\text{O}(s) + \text{H}_2\text{O}(l) \rightarrow 2\text{KOH}(aq)$;
 combination
 b. $\text{C}_{19}\text{H}_{40}(s) + 29\text{O}_2(g) \rightarrow 19\text{CO}_2(g) + 20\text{H}_2\text{O}(l)$;
 combustion
 c. $2\text{Rb}(s) + 2\text{H}_2\text{O}(l) \rightarrow \text{H}_2(g) + 2\text{RbOH}(aq)$;
 single-replacement

Critical Thinking

67. a. $2\text{K}(s) + 2\text{H}_2\text{O}(l) \rightarrow 2\text{KOH}(aq) + \text{H}_2(g)$
 b. $\text{C}_2\text{H}_5\text{OH}(l) + 3\text{O}_2(g) \rightarrow 2\text{CO}_2(g) + 3\text{H}_2\text{O}(g)$
 c. $2\text{Bi}(\text{NO}_2)_3(aq) + 3\text{H}_2\text{S}(g) \rightarrow \text{Bi}_2\text{S}_3(s) + 6\text{HNO}_3(aq)$
 d. $2\text{Al}(s) + 3\text{Br}_2(l) \rightarrow 2\text{AlBr}_3(s)$
 e. $2\text{HNO}_3(aq) + \text{Ba}(\text{OH})_2(aq) \rightarrow \text{Ba}(\text{NO}_3)_2(aq) + 2\text{H}_2\text{O}(l)$
68. Smoking is not permitted near an oxygen source because a fire will burn faster in an area of high oxygen concentration. However, if a match were struck in a room full of oxygen and isolated from combustible material, it would only burn more vigorously.
69. a. $\text{C}_5\text{H}_{12} + 8\text{O}_2 \rightarrow 5\text{CO}_2 + 6\text{H}_2\text{O}$
 $\text{C}_9\text{H}_{20} + 14\text{O}_2 \rightarrow 9\text{CO}_2 + 10\text{H}_2\text{O}$
 b. $2\text{C}_{12}\text{H}_{26} + 37\text{O}_2 \rightarrow 24\text{CO}_2 + 26\text{H}_2\text{O}$
 $\text{C}_{17}\text{H}_{36} + 26\text{O}_2 \rightarrow 17\text{CO}_2 + 18\text{H}_2\text{O}$
 c. $n = \text{CO}_2$; $(n + 1) = \text{H}_2\text{O}$

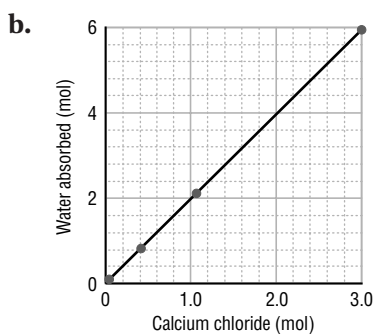
Concept Challenge

70. a. $3\text{NaI} + \text{H}_3\text{PO}_4 \rightarrow 3\text{HI} + \text{Na}_3\text{PO}_4$; double-replacement
 b. $\text{K}_2\text{O} + \text{H}_2\text{O} \rightarrow 2\text{KOH}$; combination
 c. $2\text{H}_2\text{SO}_4 \xrightarrow{\Delta} 2\text{H}_2\text{O} + \text{O}_2 + 2\text{SO}_2$;
 decomposition
 d. $2\text{Al} + 3\text{H}_2\text{SO}_4 \rightarrow 3\text{H}_2 + \text{Al}_2(\text{SO}_4)_3$; single-replacement
 e. $\text{C}_5\text{H}_{12} + 8\text{O}_2 \rightarrow 5\text{CO}_2 + 6\text{H}_2\text{O}$;
 combustion
71. a. (1) combination
 (2) single-replacement
 (3) combustion
 (4) double-replacement
 b. (1) $\text{C}_3\text{H}_8(g) + 5\text{O}_2(g) \rightarrow 3\text{CO}_2(g) + 4\text{H}_2\text{O}(g)$
 (2) $\text{Cu}(s) + 2\text{AgNO}_3(aq) \rightarrow \text{Cu}(\text{NO}_3)_2(aq) + 2\text{Ag}(s)$
 (3) $2\text{Al}(s) + 3\text{Br}_2(l) \rightarrow 2\text{AlBr}_3(s)$
 (4) $\text{Pb}(\text{NO}_3)_2(aq) + 2\text{KI}(aq) \rightarrow \text{PbI}_2(s) + 2\text{KNO}_3(aq)$
72. a. single-replacement
 b. $\text{Cl}_2(g) + 2\text{I}^-(aq) \rightarrow \text{I}_2(aq) + 2\text{Cl}^-(aq)$

Cumulative Review

73. a. water
 b. water vapor in the air
 c. physical change
74. Element: gold; compounds: sodium chloride, ice with water; homogeneous mixtures, salt water, air; heterogeneous mixture: salt and sand; substance: sodium chloride, gold, water with ice
75. 36.6 kg
76. 22 protons, 28 neutrons, and 22 electrons
77. a. $s^2s^22p^63s^23p^64s^23d^{10}4p^6$
 b. $1s^22s^22p^63s^23p^6$
 c. $1s^22s^22p^63s^23p^63d^{10}$
 d. $1s^22s^22p^63s^23p^63d^{10}$
78. Electronegativity is the tendency for an atom to attract bonded electrons to itself. Electronegativity values increase from left to right in a period.
79. a. incorrect; KBr
 b. correct
 c. incorrect; Ca_3N_2
 d. correct

80. a. K_2CrO_4
 b. NaHSO_3
 c. permanganic acid
 d. potassium oxalate
81. a. 2.41 mol
 b. 6.91×10^{-2} mol
 c. 0.934 mol
 d. 7.09 mol
82. a. FeSO_4
 b. FeSO_4 , iron(II) sulfate; $\text{Fe}_3(\text{SO}_4)_3$, iron(III) sulfate
83. $\text{C}_8\text{H}_{10}\text{O}_2\text{N}_4$
84. a. mol CaCl_2 mol H_2O
 0.156 0.312
 0.439 0.878
 1.12 2.24
 3.03 6.06



- c. Two molecules of water.